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EARLY MEMORIES OF CHILDREN AND ADULTS: IMPLICATIONS FOR INFANTILE AMNESIA

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How readily children in grades 2, 5, and 8/9 as well as adults could access early memories was assessed by a memory fluency task: participants recalled as many memories as possible from before starting school in a timed 4-minute task. They also provided their first memory. Although the memory fluency task could be successfully used with all ages, grade 2 children recalled fewer memories than older participants, who did not differ. They also recalled more memories from earlier ages than did adults, and grade 5 children tended to do so too. Grades 2 and 5 children also had earlier first memories. Gender differences were absent for children but were related to methodology for adults. Emotional valence of memories also differed across age. Findings show that infantile amnesia changes with age, with children demonstrating less access to their earliest memories as they get older.

Keywords: memory fluency, infantile amnesia, childhood amnesia, autobiographical memory

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INTRODUCTION

The phenomenon of infantile (or childhood) amnesia is now well established in the literature – i.e., the absence or scarcity of memories about very early life events (see reviews in Bauer, 2007; Peterson, 2002; Rubin, 2000; and Wang, 2003). Extant research has suggested that infantile amnesia does not appear in an all-or-none fashion but involves deviations from delay-related forgetting curves, with the number of memories from the earliest years becoming vanishingly small. Moreover, there may be a two-stage process in which there is a lower boundary (such as 20 – 22 months of age) before which memories cannot be recovered at all, and then a period of slowly accumulating memories during which they are sparse and fragmentary, until children are school-aged (Newcombe, Lloyd, & Ratliff, 2007; Pillemer & White, 1989). As reviewed in Newcombe et al., part of the explanation for infantile amnesia is age-dependent development of the neural network underlying memory in infants.

Two different approaches have typically been taken in the investigation of infantile amnesia in adults: In one of them, adults are asked to provide their very earliest memory. For samples of adults from European backgrounds, their first memory typically dates to when they were age 3.5 years on average, while adults from Asian cultures tend to have a later age of first memory (MacDonald, Uesiliana, & Hayne, 2000; Mullen, 1994; Wang, 2003). In the other method, adults are asked to provide multiple memories, either through an exhaustive search that spans a considerable period of time or by being cued to recall memories related to specific words or target events (see review in Rubin, 2000). The frequency of memories from adults' early years fits an accelerated curve – very few if any memories are retrieved from age 3 or earlier, but by the elementary school years adults can retrieve considerably more. Regardless of method, there is wide individual variation.

Recently, a different variant of the exhaustive search method has been proposed: a memory fluency procedure. In this, researchers assess how readily one can access memories of early life. Wang, Conway, and Hou (2004) asked individuals to recall as many memories from before the age of 5 as they could, and gave them a timed 5 minute period in which to do it. The participants wrote down only a word or short phrase for each memory and focused on recalling as many memories as they could in the limited time available. The participants were from England, the US, and China, and the investigators not only replicated the accelerated memory curve for age at the time of the remembered events that has been found with other procedures, but also found these accelerated memory

curves in all three cultures. The memory fluency procedure was also sensitive to the cultural differences in memory that had been found in prior research with tasks asking participants to provide their single earliest memory (Wang, 2003), shown by a lower rate of acceleration for Chinese adults. As well, the memory fluency procedure has been shown to be sensitive to another variable that has been posited to affect infantile amnesia, namely the nature of parent-child relationships. Peterson, Smorti, and Tani (2008) found that for Italian adult males, warm parent-child relationships were predictive of more memories of early childhood.

Infantile Amnesia in Children

Although considerable research has been devoted to the study of infantile amnesia in *adults*, very little has investigated this phenomenon in *children*. And yet children too seem to experience infantile amnesia, as found by studies asking children for their earliest memory (Peterson, Grant, & Boland, 2005; Tustin & Hayne, 2008) and by studies on the distribution of memories to cue words (Bauer, Burch, Scholin, & Güler, 2007; Fitzgerald, 1991). However, the existence of infantile amnesia in children highlights a puzzling paradox: Even though adults generally cannot recall events from before the age of 3.5 on average, preschoolers clearly can (see reviews in Bauer, 2007; Nelson & Fivush, 2004; Peterson, 2002). In fact, children often exhibit impressive abilities to retain memories of events that occurred when they were 2 or 3 years old over long periods of time (Peterson & Parsons, 2005; Peterson & Whalen, 2001; Quas et al., 1999). More typically, when 2, 3, and 4 year olds were interviewed about their memories of prior events and then re-interviewed about these same previously-recalled early events, investigators find that although some memories are retained several years later, some are also forgotten (Cleveland & Reese, 2008; Fivush & Schwarzmueller, 1998; Van Abbema & Bauer, 2005). Overall, this body of research suggests that memories of one's earliest years become progressively less accessible as children get older.

However, there is still little research that specifically targets the phenomenon of infantile amnesia in children. In the first systematic study in which children of various ages were asked to recall their earliest memory, Peterson et al (2005) found that European Canadian children who were under 10 years of age had an earlier age of first memory than did children who were older. This was replicated by Tustin and Hayne (2008) in a New Zealand sample. In other words, the age of earliest memory seems to increase over childhood.

One of the issues complicating the investigation of infantile amnesia across a range of ages that includes both children and adults is a paucity of common methods that can be appropriately used across a wide age range. Peterson et al (2005) determined that children from 6 to 18 could be asked to recall their earliest memory, although those under 6 years of age had great difficulty with the task and tended to provide recent memories instead of early ones. As well, Bauer et al (2007) found that a word cue method, which has frequently been used with adults, could also be used with 7 – 10 year olds.

A major goal of the present study is to explore whether a memory fluency procedure can be effectively used with children from age 7 to adulthood. Furthermore, are there changes over age in the number of memories that one can retrieve about one's early years, parallel to the increase in the age of one's earliest memory? Answering this is another goal of the current study. As well, how are measures of memory accessibility and measures of the age of one's single earliest memory related? Wang et al (2004) found a parallel pattern of results in adults of different cultures in that Chinese adults had the latest age of earliest memory and simultaneously could retrieve the fewest memories in a timed memory-fluency test. In the current study, we explore how the age of earliest memory and memory fluency are correlated within the same individuals when the samples include both adults and children of different ages.

Episodic Versus Generic Memories

There is another methodological issue that should be considered: the time-scale of the memory. Some memories are episodic, i.e., they are about one-time events that happened at a specific time and place. In comparison, generic memories are about events that were on-going for a period of time in the past or were repeated multiple times. So important are episodic memories in American and Western European cultures that some investigators studying people's memories about earlier life events specifically instruct participants to only recollect episodic memories of one-time events (Conway & Holmes, 2004; Fitzgerald, 1991; Rubin & Schulkind, 1997; Tustin & Hayne, 2008). But investigators studying memory cross-culturally have identified important cultural differences in the sorts of memories that individuals recall. Specifically, the memories recalled by Asians such as Chinese are considerably more likely to be of generic events, rather than the one-time episodic events recalled by Western Europeans (Wang, 2003). Indeed, it is not apparent to us why it is valid for someone to recall stepping on a sharp seashell and cutting her foot one day when

at the beach at age 3, but a memory of repeatedly playing in the waves the same way each day of that same three-week visit to the beach is discounted because it was a repeated event.

In the current study, we investigate whether there are developmental changes in the frequency of episodic versus generic memories, not only over age but in comparisons of children versus adults. Research on children's very early memories has emphasized the importance of memory for generic (or repeated) events since it helps children form scripts or expectations about what will happen in their lives (Nelson, 1986). Furthermore, Nelson has suggested that for very young children, generic memories are most common. An unanswered question is whether early memories become less likely to be generic as children get older, with adults in particular more likely to retrieve episodic memories from early childhood than are children. Fitzgerald (1991) has presented preliminary data suggesting that this is the case; however, since he specifically instructed participants to recall episodic events, his data may instead reflect only poorer compliance with instructions by younger children.

Gender

Gender has also frequently been pointed to in explaining individual differences in early memory. Previous research has shown that adult men and women's autobiographical narratives differ in a number of ways. Women tend to recall memories that are longer, more detailed and vivid than men (de Vries, Blando, & Walker, 1995; Friedman & Pines, 1991; Ross & Holmberg, 1990, Thorne, 1995). They also tend to situate their memories in a social context and place a heavier emphasis on content involving emotion and relationships (Friedman & Pines, 1991; Thorne, 1995). As well, women seem to be able to access their early autobiographical memories more readily than men. When asked to recall as many early memories as possible, women tend to produce a greater number of memories (and at a faster rate) than men when the recalled events are of an emotional nature (Davis, 1999). Furthermore, this female advantage in early autobiographical recall has also been found among school-aged children (Davis, 1999).

Only one study to date has examined gender differences in adults' accessibility of their earliest memories (Wang et al., 2004). When asked to recount as many earliest memories (from before age 5) as possible in a limited time, i.e., a memory fluency task, women provide more memories than men. Interestingly, women's enhanced memory fluency is found cross-culturally,

regardless of whether the women are Chinese, British, or Caucasian-American. While robust gender differences exist among adults' accessibility of their earliest memories, there is currently no research that examines such differences in children. Moreover, given that gender differences have been found among adults recalling early memories, it is important to examine where these differences first appear developmentally. The present study extends memory fluency research by Wang et al. (2004) by providing the first empirical account of memory fluency in children and a preliminary glimpse at where gender differences in earliest autobiographical recall first emerge by comparing children at different points in development.

Emotion

The present research also examines whether there are differences across developmental periods in the emotional content of earliest memories. Specifically, we are interested in whether individuals at different developmental periods recount memories that differ in terms of the proportion of memories that are positive, negative or neutral in content. As Howe (1997) contends, mechanisms such as decay over time and infantile amnesia affect memory for both positive, non-stressful and negative, stressful events in similar ways. Just as traumatic events that occurred to the 2-year-old (and sometimes the 1-year old) can be verbally recalled at 3-4 years of age (Peterson & Parsons, 2005; Peterson & Rideout, 1998), so too may positive and non-stressful events be recalled (for reviews see Bauer, 2007, and Peterson, 2002).

Although some researchers have found stress to be facilitative for children's verbally reported memories in terms of coherence (Fivush, Hazzard, Sales, Sarfati, & Brown, 2003), others have documented deleterious effects (Peterson & Biggs, 1998). However, two reviews of the literature have concluded that at least the central aspects of stressful events are recalled as well or better than non-stressful events (Fivush, 1998; Pezdek & Taylor, 2002) and research has found these memories to be generally accurate and enduring (Fivush, Sales, Goldberg, Bahrick, & Parker, 2001; Peterson & Whalen, 2001). Given these findings, it is predicted that individuals will recall more memories in a memory fluency task that are negative or stressful in content. However, it is unclear whether there are developmental differences between age groups in the types of emotional memories recalled, and if there are such developmental changes, when these differences first emerge.

The current study

A primary purpose of this study was to see if a memory fluency task can be used successfully with children to assess the accessibility of their early memories, so that children of various ages as well as adults can be compared. Children in grades 2, 5, and 8/9 as well as a comparison group of university students were individually interviewed about their memories from before they started school. There was a timed 4-minute session in which participants were asked to recall as many memories as possible (i.e., the memory fluency procedure) while the interviewer took brief notes on each orally-presented memory, and each of those memories was later rated by the participant in terms of their age at the time of the memory and their emotion. Participants were also asked to describe their earliest memory.

It should be noted that the procedure we used deviated from that of Wang et al (2004) because of the limited writing abilities of the younger children. Wang et al administered the memory fluency task to groups of university students, with individuals writing down brief notes on each of their own memories to remind them later. After the timed recall period, participants were instructed to return to each memory and identify their age at the time. We assumed that the difference in methodology was unimportant, but to confirm that, an additional group of adults were included who had group administration of the memory tasks, and wrote down their own notes on each memory recalled.

Hypotheses

There have been no prior studies comparing children with adults using the memory fluency procedure so we did not formulate a hypothesis about age comparisons. However, we did expect adult women to generate more memories than men, as found by Wang et al. (2004) for both US and British participants who are similar in cultural background to the participants in the present sample. In terms of the number of memories retrieved by children, we had no empirical basis for formulating a hypothesis about gender differences based on prior research. Thus, this study is exploratory in terms of the relationship between gender and the ability to access multiple early memories in a timed retrieval task for children of different ages.

In keeping with earlier reports suggesting that older children and adults report a later age for their earliest memory (Peterson et al, 2005; Tustin & Hayne, 2008), it is expected that younger children will have an earlier age of first memory than

will older children or adults. We also expect a gender difference, with adult females having an earlier age of first memory than adult males, in keeping with the results of Wang et al. In terms of gender differences in children, Peterson et al (2005) did not find gender differences in the age of earliest memory. Nor did Tustin and Hayne (2008) find gender differences, but their sample was limited to only seven children of each gender at each age and such a limited sample size may make such differences harder to find. Because of the lack of gender differences in the age of earliest memory in studies of children, we do not anticipate finding such gender differences here. In terms of the relationship between the number of memories retrieved in a memory fluency task and the age at the time of a person's first memory, we expected these two measures to be significantly correlated in the same individuals across all age groups, consistent with Wang et al. (2004).

Since the general consensus in the literature suggests that at least the central aspects of stressful events are recalled as well or better than non-stressful events (Fivush, 1998; Pezdek & Taylor, 2002) and research has found these memories to be generally accurate and enduring (Fivush et al., 2004; Peterson & Whalen, 2001), it is predicted that individuals will recall more memories in a memory fluency task that are negative or stressful in content. Given the exploratory nature of the present investigation, it is unclear whether there are developmental differences between age groups in the types of emotional memories recalled, and if there are such developmental changes, when these differences first emerge.

We also expect the majority of memories from adults and older children to be episodic because our participants are from a Western European Canadian sample. Because Fitzgerald (1991) suggested that there was a developmental change in the proportion of memories that are episodic, with older children having a higher proportion of them than younger children, we predict the same developmental pattern in our data. Finally, we expected the results from the second group of adults (those with group administration of the task) to be comparable to the adults who were administered the task orally and individually.

MATERIALS AND METHODS

Participants

Participants were 225 children (in grades 2, 5, and 8/9) and two groups of 80 adults. All children were recruited from elementary and junior high schools in St. John's, Newfoundland and surrounding areas. In order to recruit children from

their respective schools, after obtaining approval from the school board and individual principals, information packages and consent forms were sent home to the children's primary caregivers. Children from the grade 8/9 age group were also given consent forms to sign whereas the younger children provided oral consent. Participation rates varied between groups and were approximately 25% for the grade 2 group, 22% for the grade 5 group and 7% for the grade 8/9 group. There were 71 children in grade 2 (34 girls, mean age = 8.0, SD = .38 years), 67 in grade 5 (36 girls, mean age = 11.0, SD = .46 years) and 78 in grade 8 or 9 (48 girls, mean age = 14.3 years, SD = .57 years). In addition, two groups of adults (40 females in each group, mean age = 22.0, SD = 2.5 for Group 1 and mean age = 21.8 years, SD = 2.3 years for Group 2) were recruited from undergraduate university classes. Adults in each group were offered a $100 draw as incentive for participation. Participants from all age groups represented a predominantly European-Caucasian sample from mixed socio-economic backgrounds.

Procedure

Children from the school-age groups were interviewed separately by two of six trained female interviewers in small rooms in their schools. At the start of the interview, an interviewer explained that they would be timed for 4 minutes during which time they would be required to recall as many early memories as possible. Children were asked to "think way back to when you were really young, before you started school" and to think of things that happened to them. They were then asked to tell the researcher something about each memory in just a few words, and then to think of another memory. As soon as the child began speaking, the interviewer started the stop watch and the tape recorder. During the 4 minute recollection period the interviewer recorded each memory. Interviewers also provided the children with encouraging responses (e.g., "Think way, way back"; "What else can you remember from before you went to school?") and reminded them that they were to recall as many memories as they could. Once the 4 minute recall period was over, the researcher addressed each memory with the child and asked them to identify their age at the time of the event. They were asked to provide how old they had been in years, and the researcher asked ancillary questions that would help her (in conjunction with knowing the child's date of birth) determine children's age in months as well as years (e.g., Was it summer or winter? Near a special occasion like Christmas, Easter, Halloween or their birthday?). They were also asked how they felt when the event happened. At the end of the interview, children were asked what their earliest childhood memory

was. Adults in Group 1 also individually met with an interviewer in a research room at the university, and the same instructions and procedures were used as for the children. Thus, the interviewer timed the session, wrote down the memories of the adults during the 4-minute recall period, and afterwards went back over the memories to elicit age and emotion at the time of the event for each memory. They then wrote down the memory identified by participants as the earliest. Adults in Group 2 had the same instructions as those in Group 1, except that the tasks were administered in groups during class time. The participants wrote down their own notes on their memories.

Coding

Number of memories and age at first memory. The number of memories each participant recalled was recorded. The memory that was earliest according to the ages given by participants was selected as their first memory. This could be the memory that had been explicitly identified as their first, or if one of their other memories occurred at a younger age, it was selected instead.

Age at the time of each memory. For each memory, participants had been asked how old they had been at the time, and were prompted for ancillary information that would help narrow the age to a particular month, as much as possible. Often the age spanned a range of months. For example, if the event happened in the summer when the participant had been 3 and she was born at the beginning of February, she was between 3 years 4 months and 3 years 7 months at the time of the event. The midpoint for that range was selected as the participant's age. If the participant could only identify her age in years (e.g., "I was 2"), then the midpoint (e.g., 2 years 6 months) was selected as the age.

Affect. Participants had been asked to identify their emotion at the time of each memory, and a research assistant then classified each memory as positive, negative, neutral, or containing a mixture of both positive and negative affect. If a participant said they could not recall any emotion attached to a memory, it was classified as neutral. All memories were classified into one of these four mutually exclusive categories.

Specificity. Memories were classified as episodic if they were about distinct one-time events while memories about repeated events were classified as generic. All memories were classified into one of these mutually exclusive categories.

Reliability. Two trained research assistants, both unaware of the hypotheses, independently coded 20% of the dataset for reliability estimate. Cohen's Kappa was .95 for affect and .93 for memory specificity.

RESULTS

Two different ways of exploring people's earliest memories were used in this study: assessing the accessibility of early memories by means of a memory fluency procedure, and eliciting a participant's earliest memory. The four groups of participants with equivalent methodology (individual task administration) are compared in the same analyses so that age differences can be assessed. Results on the number of memories elicited are presented first, followed by their distribution across age. Then data on the age of participants at the time of their earliest memory are presented, and correlations between the age of earliest memory and the total number of memories retrieved. For analyses of both memory affect and specificity, data were converted to percentages because of differences in the number of memories retrieved by different age groups. Finally, the data from the adults with group administration of the tasks are analyzed separately so that potential effects of methodological differences can be assessed.

Number of Memories

The number of memories produced by children at each grade level is shown in Table 1, and a 4 (grade) x 2 (gender) ANOVA showed that there were differences in the number of memories depending on the grade of the participant, $F(3, 297) = 14.28$, $p < .001$, $\eta^2 = .126$. Tukey-Kramer HSD tests ($ps < .05$) indicated that children in grade 2 recalled fewer memories than did participants in all other age groups, which did not differ from each other. Gender was not significant, either alone or in interaction with any other variable.

Distribution of Early Memories

Each memory produced by participants was categorized by year in terms of the individual's reported age at the time of the event. The mean number of memories identified as having occurred in each of the participants' early years is shown in Table 2. Because there were no gender differences in the number of

memories, for simplicity the data were combined across gender within each age group. The mean age of all of each individual's memories was computed, and this was analyzed in a one-way ANOVA, with grade (4 levels) the between-subjects factor. The mean age of all memories in months was 42.9, 45.4, 48.8, and 46.8 months for participants from grades 2 through adult, respectively, and these differed, $F(3, 301) = 6.04$; $p = .001$, $\eta^2 = .057$. Tukey-Kramer HSD tests ($ps < .05$) indicated that children in grade 2 had a younger mean age of memories than did those in grade 8/9 or adults, while children in grade 5 were intermediate and differed from no one.

Table 1. Means and Standard Deviations for the Number of Memories Recalled

Grade	Female		Male		Both	
	M	*SD*	*M*	*SD*	*M*	*SD*
2	6.03	2.51	6.27	2.66	6.15	2.58
5	9.58	3.79	9.32	3.61	9.46	3.68
8 / 9	9.68	4.67	9.95	4.67	9.80	4.64
Adult-1	10.00	4.56	9.68	4.60	9.84	4.55

Note: 'Adult-1' refers to the university students in group 1.

Participants had been instructed to recall memories from before they started school. As shown in Table 2, there was a sharp drop in the number of memories from age 5, when they were between 60 - 71 months of age.This drop is because most participants began school some time during the year when they were 5. Thus, because of this confound in when different individuals began school, memories from age 5 are excluded from the next set of analyses on the percentage of memories identified as coming from each of the first five years of life (when children were under 1 year of age through age 4). The number of memories from each of the first five years was converted to a percentage; these are depicted in Figure 1. Although memories from before age 1 were included in the percentage calculations, they were not included in ANOVAs because there were so few memories from this age.

Table 2. Distribution of the Mean Number (and SDs) of Memories Identified as Occurring in Each Year of Life

Grade	Age at the Time of the Memory					
	Under 1	1	2	3	4	5
	(0-11 Mo.)	(12-23 Mo.)	(24-35 Mo.)	(36-47 Mo.)	(48-59 Mo.)	(60-71 Mo.)
Grade 2	0.04 (0.20)	0.44 (0.69)	1.24 (1.13)	1.57 (1.35)	2.00 (1.84)	0.86 (1.17)
Grade 5	0.04 (0.21)	0.45 (0.91)	1.19 (1.43)	2.67 (1.96)	3.57 (2.20)	1.54 (2.43)
Grade 8/9	0.14 (1.08)	0.29 (0.71)	0.83 (1.20)	2.26 (1.81)	4.29 (2.85)	1.99 (2.39)
Adult-1	0.02 (0.16)	0.21 (0.44)	0.92 (1.20)	3.54 (2.60)	4.05 (2.88)	1.08 (1.83)
All Ss	0.07 (0.60)	0.33 (0.70)	1.01 (1.25)	2.46 (2.12)	3.51 (2.66)	1.39 (2.07)

Note: 'Adult-1' refers to the university students in group 1.

A mixed model 4 (grade) x 4 (reported age at the time of the memory: age 1-4) multivariate ANOVA was calculated on the percentage of memories provided from each age period. There was a main effect of reported age at the time of memories, Wilks Exact $F(3, 301) = 273.09$, $p < .001$, $\eta^2 = .733$, as well as a significant linear trend for the age at the time of memories, i.e., more memories from later ages, $F(1, 301) = 568.01$, $p < .001$, $\eta^2 = .654$, and a significant quadratic trend, $F(1, 301) = 4.85$, $p = .028$, $\eta^2 = .016$. There was also a significant interaction between grade and reported age at the time of memories, Wilks F(9, 728) = 4.50, $p < .001$, $\eta^2 = .043$. Follow-up ANOVAs were calculated on the percentage of memories reported for each year separately, with grade the between-subjects factor. Significant ANOVAs were followed by Tukey-Kramer HSD tests. There was a difference in the percentage of memories identified as taking place when participants were 1 year old (i.e., 12-23 months of age), $F(3, 301) = 3.65$, $p = .013$, $\eta^2 = .035$. Children in grade 2 provided proportionately more memories from age 1 than did adults, and there was a tendency for grade 5 children to do likewise ($p = .089$). The ANOVA for the percentage of memories from age 2 (24-35 months of age) was also significant, $F(3, 301) = 5.93$, $p = .011$, $\eta^2 = .056$, with grade 2 children providing proportionately more memories from age 2 than did either grade 8/9 or adult participants, and there was also a tendency to provide more than did grade 5 participants (p = .068). For the percentage of memories from age 3 (36-47 months of age), $F(3, 301) = 4.62$, $p = .004$, $\eta^2 = .044$,

children in both grade 2 and grade 8/9 provided more memories from age 3 than did adults. Finally, there was a significant difference in the percentage of memories that came from age 4 (48-59 months of age), $F(3, 301) = 5.81$, $p = .001$, $\eta^2 = .055$. Children in grade 2 provided proportionately fewer memories than did children from grade 8/9, with the latter having fully 54.9% of their memories coming from when they were 4 years old. Participants in grade 5 and adults did not differ from other groups. Thus, overall, grade 2 children provided proportionately more memories from when they had been age 1, 2, and 3 than did adults. And for the most part, children in both grades 5 and 8/9 were similar to adults in the percentage distribution of their memories.

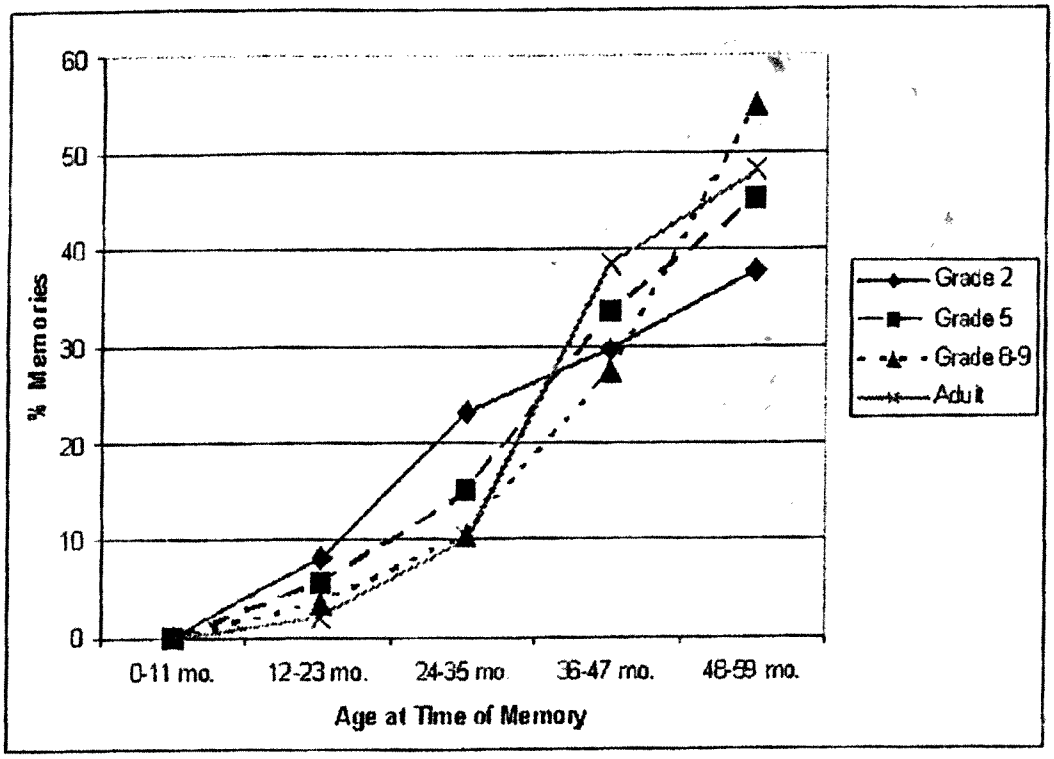

Figure 1. Distribution of Memories Reported to be from Each Year of Life for Each Grade.

Age at Earliest Memory

Data on the age of participants at the time of their earliest memory is presented in Table 3, and was analyzed in a 4 (grade) x 2 (gender) ANOVA. Grade was significant, $F(3, 297) = 3.82$, $p = .010$, $\eta^2 = .037$. Tukey-Kramer HSD

tests ($ps < .05$) indicated that children in grades 2 and 5 did not differ, nor did children in grades 8/9 differ from adults. However, both of the younger groups had earlier ages of first memories than did both of the older groups. There was also a tendency for females ($M = 27.7$) to have earlier first memories than males ($M = 30.1$), $F(1, 297) = 3.41$, $p = .066$, $\eta^2 = .011$. There was no significant interaction.

Table 3. Means and Standard Deviations for Age at Earliest Memory (in Months).

Grade	Female		Male		Both	
	M	*SD*	*M*	*SD*	*M*	*SD*
2	25.04	15.25	27.50	9.65	26.32	12.61
5	24.07	10.21	29.53	9.88	26.64	10.35
8/9	29.93	10.65	32.09	13.34	30.90	11.91
Adult-1	31.13	11.07	31.45	11.59	31.29	11.26

Note: 'Adult-1' refers to the university students in group 1.

Correlations between Age at Earliest Memory and Number of Memories

Pearson correlations were calculated between the age at earliest memory and the number of memories produced in the memory fluency task. Overall, including participants from all grades, there was a significant relationship, $r = -.134$, $p = .019$. To see if this relationship was found for each of the age groups separately, a series of Pearson correlations were calculated on the data from each grade. The age at earliest memory and the total number of memories were significantly associated for children in grades 2 ($r = -.345$, $p = .003$) and 8/9 ($r = -.218$, $p = .043$), although not for those in grade 5 ($r = .063$, *ns*). As well, the correlation was significant for the adult group ($r = -.254$, $p = .023$). Thus, for participants in all groups except in grade 5, the earlier their first memory, the more memories they recalled.

Affect of Memories

The percentages of memories that were positive, negative, or neutral are shown in Table 4. Few memories contained mixtures of both positive and negative affect; thus, they are not considered further, nor included in Table 4. Separate 4 (grade) x 2 (gender) ANOVAs were calculated on the percentage of memories that were positive, negative, or neutral. For the percentage of memories that were positive in affect, there was a significant effect of grade, $F(3, 297) = 4.16$, $p = .007$, $\eta 2 = .040$. Tukey-Kramer HSD tests ($ps < .05$) indicated that children in both grades 2 and 5 had significantly more positive memories, proportionately, than did adults. However, the proportion of positive memories for children in grade 8/9 was intermediate between those of the two younger age groups and the adults, and differed from none of them. There were no significant effects for the percentage of memories that were either negative in affect or neutral. As well, gender was not a significant factor, either alone or in interaction.

Episodic Versus Generic Memories

Each of the memories was classified as episodic or generic, and the percentages of the memories that were episodic were analyzed in a 4 (grade) x 2 (gender) ANOVA. There were no significant effects. Overall, across all age groups and both genders, approximately 58% of all memories were about episodic, specific one-time events. Thus, almost half of the memories retrieved by all participants involved repeated or generic events.

Analyses of Data from the Group-administered Adult Sample

The number of memories provided by women in written form was 8.68 ($SD = 4.03$) and by men was 6.82 ($SD = 3.26$). For comparison, women in the sample for whom the task was administered individually and orally recalled 10.00 memories and men recalled 9.68. (These data are found in Table 1.) A one-way ANOVA (gender the between-subjects factor) found that women recalled significantly more early memories than did men, $F(1, 78) = 5.09$, $p = .027$, $\eta^2 = .061$. In comparison, an ANOVA calculated on the prior sample of adults who gave their memories orally to a researcher found no gender difference, $F(1, 78) = 0.10$, $p = .752$. Thus, the method of administration of the memory fluency task

made a substantial difference in terms of whether or not gender differences were found.

Table 4. Percentages of Memories that are Positive, Negative, or Neutral[1].

Grade	Gender	% Positive		% Negative		% Neutral	
		M	*SD*	*M*	*SD*	*M*	*SD*
2	Female	64.4	26.3	28.6	27.5	4.0	10.3
	Male	63.1	30.1	25.8	23.8	6.3	10.9
	Both	63.7	28.2	27.1	25.5	5.2	10.6
5	Female	62.1	19.9	26.7	19.4	5.4	9.9
	Male	61.9	18.9	28.0	18.8	5.2	7.4
	Both	62.0	19.3	27.3	19.0	5.3	8.8
8 / 9	Female	57.6	22.4	29.6	17.7	6.2	13.0
	Male	57.6	20.5	30.9	17.5	8.8	18.3
	Both	57.6	21.5	30.2	17.5	7.4	15.6
Adult-1	Female	51.8	17.7	36.2	18.6	6.8	8.6
	Male	52.1	21.8	31.5	18.6	9.9	17.2
	Both	51.9	19.7	33.8	18.6	8.3	13.6

[1]The percentages do not add up to 100% because the small number of memories with mixed emotions are not included.

Note: 'Adult-1' refers to the university students in group 1.

DISCUSSION

Investigations of infantile amnesia have mostly been limited to studying adults, which is unfortunate since recent research has suggested that the phenomenon can be found in children too (Bauer et al, 2007; Cleveland & Reese, 2008; Peterson et al, 2005). Particularly scarce is research done simultaneously on both children and adults. A primary purpose of the present study was to see whether a measure assessing the accessibility of early memories that has been found to be effective in adults could be used for children as well, and this purpose was successfully achieved: The memory fluency procedure was a useful instrument for both children and adults, at least when administered individually and orally to children.

We found that children (except those in grade 2) and adults were similar in how many memories from their early lives they could retrieve. This was true across a wide age range, from 10-year-olds in grade 5 to university students. The memory fluency task was also effective with children in grade 2, even though they recalled fewer memories. Although it is possible that grade 2 children have more difficulty retrieving memories from long ago, it is also likely that task difficulty played an important role. Interviewers reported that they had more difficulty staying on-task for four minutes and required more frequent reminders to move on to the next memory.

Interestingly, whether or not gender differences in adults were found was related to task methodology. Wang et al. (2004) found gender differences for both US and British samples, and according to Statistics Canada, 97% of the residents of the geographical area from which we drew participants were of Western European backgrounds, mostly British and Irish. Thus, we predicted gender differences in adults that were similar to those found by Wang et al. Instead, we found that task methodology was critical. If adult university students were interviewed separately and orally, with the interviewer making brief notes on the content of the memories retrieved, there were no gender differences in task performance. However, if they participated in a group setting and were responsible themselves for writing their short notes on their memories, gender differences were robust: women recalled more. This suggests that motivation differences between women and men may be an important but little-explored factor in research on memory for earlier life events.

The few studies that have looked at adults' accessibility for memories from any earlier time (not necessarily their *earliest* memories) have yielded mixed results. Among older adults, women seem to produce more specific and episodic early memories than men. While older women show enhanced recall for gender-stereotyped topics (e.g., relationships, family, etc), they also tend to produce a higher density of specific memories for gender-neutral topics (Pillemer, Wink, DiDonato, & Sanborn, 2003). Conversely, Pillemer and colleagues (2003) did not find any differences between adult men and women in the overall length of narratives produced. Similarly, Rubin, Schulkind, and Rahhal (1999) did not find any gender differences in the distribution of autobiographical memories across the lifespan, the distribution of important memories, the distribution of knowledge for events, or how individuals rated their memories. The fact that gender differences sometimes are found and sometimes are not, and that they can be influenced by minor methodological alterations, suggests that there are many factors influencing the interaction between gender and memory.

In terms of the average age of participants' single earliest memory, this changed across age groups: children in both grades 2 and 5 identified an earlier age of first memory than did children in grades 8/9 or adults. Thus, the key finding of Peterson et al (2005) was replicated: The average age of earliest memory changed across childhood. The two measures used here to explore infantile amnesia, the number of memories in a memory fluency task and the age of earliest memory, were also found to be correlated in all groups except the grade 5 children. Specifically, the earlier the age of one's first memory, the more memories were recalled.

The differences across age in the distribution of memories (with grade 2 children providing more memories from younger years), the mean age of all memories provided by participants, and the age of earliest memory all suggest that younger children are readily accessing memories from a period of their lives that will most likely become shrouded by infantile amnesia as they get older. Furthermore, as suggested in prior research (Bauer et al., 2007; Peterson et al., 2005), age 10 seems to be a watershed age, with children younger than 10 showing greater access to earlier memories than older children. Indeed, the 10-year-olds in grade 5 seemed intermediate: Although their age of earliest memory was similar to that of grade 2 children, the distribution of their memories as well as the mean age of all their memories was intermediate between the grade 2s and the older children as well as adults.

Historically, researchers often explained infantile amnesia by suggesting that younger children did not have the memory skills to be able to recall autobiographical events across several years, but such explanations have been challenged by the large body of research showing that 3 to 5 year olds are able to talk about prior events in their lives, with some of those events occurring a year or more in the past (Bauer, 2007; Peterson, 2002). In fact, events occurring to 2 and 3 year olds have been found to be accurately reported even five years later (e.g., Peterson & Parsons, 2005; Peterson & Whalen, 2001).

Considerable research suggests that the average age of earliest memory for adults of Western European backgrounds has been found to be 3.5 years, and even between that first memory and the age when they had been approximately 7 years old, adults recall fewer memories than one would expect (see review in Bauer, 2007). How does one account for the probable disappearance of many of the memories that were currently retrieved by our grade 2 participants? Bauer et al (2007) looked at the distribution of memories from 7-10 year olds that had been elicited by a cue-word technique, and they found that the distribution did not fit the typical distribution for adult participants. The distribution for adults best fits a power function (Wetzler & Sweeney, 1986; Wixted & Ebbesen, 1991), suggesting

that there is a high rate of forgetting early memories but with age, the rate of forgetting slows down, probably due to consolidation of memory traces. However, the distribution for Bauer et al.'s child participants best fits an exponential function instead, suggesting that their memories are still fragile and interference from later memories still takes a toll (Bauer, 2007).

Other researchers have further suggested that language skills may play a role, too, and specifically that memories formed while children were still young preschoolers may be influenced by the language skills one had at the time the memories were formed (Cleveland & Reese, 2008; Peterson & Rideout, 1996; Simcock Hayne, 2002). These investigators found that children's memories were related to the language skills that the children had at the time the prior events occurred rather than their language skills at the time the memory was elicited. Because Cleveland and Reese (2008) assessed memory and language skills over several years that spanned both preschool and school years, they were able to show that such a relationship between memory and language was not true for memories formed at later ages. It could well be that part of the reason memories from the very early years become increasingly inaccessible is related to more impoverished verbal encoding at the time events occurred or perhaps using vocabulary initially that later comes to have a different meaning. To fully understand what happens to children's early memories as they get older, longitudinal research is essential.

Two other issues were explored in the present research. First, we had expected that younger children would have proportionately more memories that were generic, and that memories would become increasingly episodic over time. This did not occur; rather, the proportion of memories that were episodic remained constant across age. Although robust differences have been found for participants from Asian versus Western European and North American cultures (Wang, 2003), changes across age were not found in this North American sample. Comparisons with children of different ages in other cultures would be informative.

Finally, early memories of younger children were proportionately more affectively positive than those of older children or adults, which suggests that as children develop, the accessibility of positive memories becomes weaker over time. By adulthood, it seems that individuals are more likely to recall memories that are equally positive and negative in content. These findings suggest that there is differential forgetting of positive versus negative memories across development.

Why are positive memories differentially forgotten when individuals reach adulthood? Given that the present study was a cross-sectional design, we were not

able to empirically answer this question and future longitudinal research is needed to clarify this issue. However, this finding is somewhat surprising in light of past research that suggests that at least the central aspects of stressful events are recalled as well or better than non-stressful events (Fivush, 1998; Pezdek & Taylor, 2002) and these memories are generally enduring (Fivush et al., 2004; Peterson & Whalen, 2001). In light of these findings, we expected that individuals would recall more memories in the memory fluency task that were negative in content. However, many of the previous studies on which these predictions were based examined highly stressful and negative events (such as devastating natural disasters and traumatic injuries requiring emergency room care) and may not be comparable to the type of negative events recalled by individuals in the present study. Some researchers argue that it is not the negative or positive nature of an event that affects memory per se, but rather, it is more generally the salience or distinctiveness of the event that affects recall (Howe et al., 2000). In fact, the general distinctiveness of an event has been demonstrated as being a powerful overall predictor of children's event memory and is an important facilitator of their acquisition and retention of information (Howe et al., 2000). It could be that the salience of earliest memories differed across groups such that positive memories were more salient for children in grades 2 and 5 as compared to adults.

It is also possible that positive memories are simply more likely to be forgotten over time. This could be a function of rehearsal. Perhaps, adults are more likely to recount negative experiences as opposed to positive ones in an attempt to understand and cope with the unpleasant events that occurred in the past. Conversely, children may be more likely to rehearse positive experiences with others, which may explain their ability to access a greater number of positive memories. Previous research shows that young adults have enhanced memory for negatively valenced material (Ochsner, 2000) and children tend to produce fewer specific memories in response to negative cues than to positive (Drummond, Dritschel, Astell, O'Carroll, & Dalgleish, 2006). The present findings suggest that enhanced memory for negatively valenced experiences developmentally emerges somewhere between grade 8 and early adulthood.

Another possible explanation for the present findings is methodological. To our knowledge, this is the first study that has assessed the emotional tone of very early memories retrieved in a memory fluency task. Therefore, it is possible that younger children are more likely to recall a greater proportion of positive memories when they are asked to recall as many memories as they can in a constrained amount of time. That is, it may be that the *accessibility* of positive memories is greater in children at younger stages of development, and the accessibility for negative and neutral memories increases over time.

In conclusion, a memory fluency task can be successfully used to study infantile amnesia across a wide age range that includes participants from age 7 to adulthood. Asking individuals for their earliest memory can also be used successfully, as found both here and in prior research (Peterson et al., 2005; Tustin & Hayne, 2008). The existence of common tasks will make it easier to explore the developmental paradox of infantile amnesia, i.e., that young children readily access memories from before they were 3.5 years old but adults' very earliest memory typically only dates to that age. The present study documents changes across age in children's ability to access memories of their earliest years: In comparison to adults, grade 2 children recalled more memories from when they were 1-3 years of age, their mean age of all memories was younger, and their earliest memory dated from a younger age, as did that of grade 5 children. In terms of the age distribution of their memories, grade 5 children were intermediate between younger and older participants. These findings suggest a developmental change in the accessibility of early memories, with memories from their earliest years becoming less available as children get older. However, an important limitation of this research is that it was cross-sectional. Future research needs to be longitudinal in order to document what happens to specific early memories and to elucidate mechanisms of change. Nevertheless, the phenomenon of infantile amnesia seems to undergo developmental changes across childhood.

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