

## The Offset of Childhood Amnesia: Memory for Events That Occurred Before Age 3

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Adult memory for the events surrounding the birth of a sibling was examined in 69 adults. The authors identified a steep offset for childhood amnesia for this event before the child reaches age 2½ years. The authors also examined the accuracy of information recalled. Although the majority of the answers were accurate, false memories were a consistent feature of the data. Alternative explanations of the authors' data were considered by examining the amount of information an additional 57 adults had about a family birth for which they could have no memory. The pattern of results did not support the view that participants might be unable to differentiate between memories and knowledge about the event.

The failure to remember autobiographical events that occurred in earliest childhood is a puzzling paradox. Despite the acknowledged importance of the first 3 years of life in forming human adults, almost no reportable memories are retained from this period. This phenomenon has been repeatedly demonstrated (e.g., Dudycha & Dudycha, 1941; Sheingold & Tenney, 1982; Usher & Neisser, 1993; Waldvogel, 1948) and was termed by Freud (1916/1963) infantile amnesia, although the term childhood amnesia may be preferable. Although some people report memories from the age of 3 onwards, it is not unusual to have no memory of events that occurred before the age of 6 or 7, and for some the amnesia can extend even further than this. The interpretation one places on this paradoxical amnesia has important implications for the way in which one understands the memory processes and the development of these processes across time. However, a consensus on the correct interpretation of the phenomenon has been hard to find, the suggested explanations ranging from the lack of a self-concept in infancy (Howe & Courage, 1993) to the lack of a fully functioning hippocampal system (Nadel & Zola-Morgan, 1984).

Hypothesized causes of childhood amnesia are many, but finding evidence to verify any of them has proved more problematic. This difficulty is magnified by the difficulty in obtaining reliable data about the nature of the phenomenon

itself. Simply asking people for their earliest memory and its age are unreliable means, as people may find it difficult to isolate their earliest memory. As it is notoriously difficult to accurately date our memories (N. R. Brown, Ripps, & Shevel, 1985), the method of probing memory for a specific and clearly datable target event has been used with effect. Events such as the birth of a sibling or the hospitalization of the child are useful because the date of their occurrence is usually known and is verifiable (Sheingold & Tenney, 1982; Usher & Neisser, 1993). Moreover, as these events are also experienced and usually remembered by the parents, the accuracy of the memory can often be checked against the memory of the parent. Despite the danger that the parental memory itself may sometimes be inaccurate (Robbins, 1963), this method has been of use.

This method was used in a recent study by Usher and Neisser (1993, also reported in part and cited as Usher, 1989a, 1989b; and Usher & Neisser, 1991), which has become widely cited and influential (e.g., Bauer, 1996; Berliner & Williams, 1994; Drummey & Newcombe, 1995; Fivush, Haden, & Adam, 1995; Howe & Courage, 1993; Lindsay & Read, 1994; Meltzoff, 1995; Morton et al., 1995; Nelson, 1993; Newcombe & Fox, 1994; Pillemer, Picariello, & Pruett, 1994). The study asked students about their memories for four early childhood events (the birth of a sibling, the death of a family member, moving to another house, and hospitalization of the child) and found some participants had memories for events that occurred when they were under the age of 3. Most memories from this early period were of the birth of a sibling, although there were also many concerning hospitalization. This result has been cited as showing evidence for adult memory for events that occurred at age 2 (e.g., Drummey & Newcombe, 1995; Fivush et al., 1995; Howe & Courage, 1993; Morton et al., 1995), although the report of Usher and Neisser (1993, pp. 163–164) makes clear that the relevant groups were, in fact, between 2 and 3 years in age when their sibling was born. Thus it is quite possible that those participants reporting memories of the birth of their sibling may have been those in the latter part of the age range (i.e., approaching 3 years old).

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However, even if these citations have exaggerated the available evidence, the report of Usher and Neisser nevertheless contains new and important evidence of memories for events that occurred when the child was under the age of 3 years, substantially earlier than previous reports: Sheingold and Tenney (1982), for example, found no reliable evidence for memories of events that occurred before the child had reached age 3.

However, there are some problems with the wholesale acceptance of the evidence presented by Usher and Neisser (1993). The strongest and most widely cited evidence of memory for events that occurred before age 3 comes from those participants who were asked about the events surrounding the birth of their sibling. However, despite the impressively large number of students questioned overall in this study ( $N = 222$ ), careful reading of the data makes it clear that there were only 12 participants in the critical group who were asked about their memories of a sibling birth that occurred when they were between 2 and 3 years old. Four of these participants had no memory at all for the event, 1 participant could answer only one question, and 7 participants could answer three or more questions about the events surrounding their sibling's birth. These figures, however, refer to those who gave an answer to the questions asked of them and gives no indication of the accuracy of the answer given. If the participant gave his or her permission, the mother of each participant was contacted and asked to verify the answers. Although Usher and Neisser do not give a breakdown of response rates in different groups, among all groups and ages, 60% of the participants gave permission for their mother to be contacted, and 67% of those mothers returned the questionnaire. Thus 40% of the mothers of participants were successfully contacted. When this figure is applied to the 8 participants who claimed to recall something about the birth of a sibling that occurred when they were between 2 and 3 years old, it suggests that no more than three or four mothers from this critical group returned the questionnaire. Overall, 61% of the mothers' responses definitely confirmed their child's answer, but 12% stated that they believed that their child's response was inaccurate. The mothers could not definitely confirm or deny the remainder of the answers given. Thus, this very important and much cited result of memory of events before age 3 is based on the responses of very few participants, many of whose answers were not verified, and some of which were specifically denied by their mothers. Therefore, there is little evidence that the participants' memories were accurate.

Moreover, Loftus (1993) has pointed out that the questions used by Usher and Neisser (1993) were such that it would not be surprising if the answers were accurate, even if the participants did not have true memories of the events themselves. For example, if asked what was the baby doing when you first saw him or her, Loftus has suggested that the range of possible answers is somewhat limited (sleeping, crying, feeding?) and therefore a correct answer is not implausible from a participant who has no genuine memory. In addition to these general questions to which any intelligent adult might make a reasonable guess, there are other questions that may be answered using family-specific knowl-

edge. For example, a participant who knows that his or her grandparents lived nearby and played an important role in their childhood is likely to be able to guess accurately if asked "Who looked after you when your mother was in hospital?" We call this type of knowledge that enables participants to correctly answer questions for which they have no genuine autobiographical memory *family knowledge*, although no attempt is made here to distinguish between knowledge that is likely to be shared by all families (e.g., that the behavioral repertoire of a newborn infant is limited) and family-specific knowledge (e.g., that a maternal grandmother lived locally). Usher and Neisser, of course, carefully instructed their participants not to guess or to use information from sources other than memory, but asked them to report only what they truly remembered. However, the difficulty of distinguishing between sources of memories or information is well documented (for recent examples using student populations similar to that of Usher & Neisser (1993), see Crombag, Wagenaar, & van Koppen, 1996; Hyman, Husband, & Billings, 1995). Thus, the participants may have had difficulty distinguishing between true autobiographical memories and family knowledge in long-term memory.

For these reasons, we felt it important to replicate the critical result of Usher and Neisser (1993) with certain additional controls. First, we looked more closely at a larger group of participants who were between 2 and 3 years old at the time of their sibling's birth. This would allow us to determine whether those who are reporting memories are, in fact, nearer the end of the age range and approaching 3 years old at the time of their sibling's birth. Equally importantly, we also examined the suggestion of Loftus (1993) that knowledge gleaned from sources other than a true autobiographical memory may be contributing to the reports by these participants. To this end, we questioned participants who could have no autobiographical memory for the events surrounding the birth of a child within their family but who nevertheless are likely to have equal access to family knowledge about the events. We asked participants about the events surrounding their own birth, particularly from the viewpoint of the elder brother or sister. Thus all participants (all of whom came from families with only two children) were asked about the events surrounding the birth of the younger child in their family. However, the elder child in a family might be expected to have autobiographical memories of the events, supplemented by family knowledge. The younger child of a family relies entirely on family knowledge. For example, participants who were the elder child were asked, "Who looked after *you* when your mother was in hospital [giving birth to the younger sibling]?" whereas the participants who were the younger child in their family were asked, "Who looked after *your older sibling* when your mother was in hospital [giving birth to our participant]?" By comparing the answers of the two groups, we can assess the contribution that family knowledge is playing in these reports. By doing so, we do not wish to claim that there is a simple dichotomy between knowledge and autobiographical memory, but we are looking at the relative contribution of each in the reports of the two groups.

In summary, the following study examines two groups of participants. To avoid possible interference between memories of other family births occurring during their childhood, we selected only participants who came from two-child families. Therefore, all had only one sibling birth within their immediately family, and all were asked about the events surrounding the birth of the younger child within their family. Thus, the participants who were the elder child in their families were recalling the events surrounding the birth of their sibling, exactly as in the Usher and Neisser (1993) study. Those participants who were the younger sibling in their family were asked to report any information they had about the events surrounding their own birth. The questions asked of the younger-child participants were modeled on the questions asked to the elder siblings, and covered identical content.

## Method

### Participants

In order to identify suitable potential participants from two-child families, a contact questionnaire was distributed to students in a variety of disciplines at the University of Durham, Durham, United Kingdom, and Sunderland University, Sunderland, United Kingdom. The questionnaire invited students and staff to indicate their general willingness to participate in unspecified psychological research in the university. Participants were asked to provide the following information: their name, program of study, date of birth, gender, and contact details along with the date of birth of any children and the name, gender, and date of birth of all full siblings.

From this contact questionnaire, participants were identified who had only one sibling and no children of their own. In addition, the age difference between siblings had to be between 2:0 and 3:3 years if the participant was the elder child in their family and 3:3 or less if they were the younger. (Throughout this article we refer to ages in years and months: 3:3 means 3 years, 3 months.) There was no constraint on the current age of our participants, although the necessity of excluding participants who had children of their own served to exclude many older prospective participants. Participants who were suitable by the above criteria were contacted by electronic mail, letter, or personal invitation to take part in what was described as a study of early memory, for which they would be paid £3 (British pounds sterling).

### Questionnaires

Those who responded to our invitation were given a questionnaire, which they completed individually or in small groups in the laboratory. There were two questionnaires: one for those who were the elder child and one for those who were the younger child in their family. We refer to the group of elder children recalling the birth of their sibling as the *recall group*, and they completed the recall questionnaire. The younger children are referred to as the *report group*, who completed the report questionnaire. We were able to establish in which group the participant fell, and therefore the appropriate questionnaire, on the basis of the information provided in the contact questionnaire. At this point, however, we verbally checked this information and established whether the relevant birth took place in the hospital or at home (see the following sections).

*The recall questionnaire.* The recall questionnaire asked about the events surrounding the birth of a younger sibling and was

closely based on that used by Usher (1989b; Usher & Neisser, 1993). The instructions given to the recall participants were in written form and included the following sentences:

It is very important that you only report information that you actually remember. If you think you remember something, report it; however, if you only know about certain information because you have seen photos or heard family stories about it, do not include it.

Later they were told, "... So again, please report only those things that you actually remember." Moreover, the instructions included the following:

No one is expected to recall details about every question. In fact, you may be able to recall very little or nothing about parts of the event. What you don't recall is as important to this investigation as what you do recall.

Thus participants in the recall group were instructed to include only those things for which they had an autobiographical memory.

The recall questionnaire included some biographical questions (i.e., name, participant's age when a sister or brother was born [in years and months], date of birth, and gender). Question one was an introductory question and was not subsequently scored. The body of the questionnaire is shown in the Appendix and consisted of the 17 universal and 14 contingent questions used by Usher (1989b; Usher & Neisser, 1993). *Universal questions* concerned aspects of the event, which it was assumed would have been experienced by all participants and therefore could potentially be answered by them all. *Contingent questions* concerned aspects that may or may not have been experienced by a participant (e.g., a set of 7 questions concerning events taking place on a visit to the mother and baby in the hospital that could only be answered if such a visit had occurred). In addition, participants were asked to add any additional information that they could recall. The universal questions are marked with an asterisk in the Appendix. Participants were also asked to rate the recency and frequency with which they had thought about, talked about, or heard others discuss the events surrounding the birth of their sibling on a 4-point scale. They were also asked whether photos, videos or films, family stories, or other external sources had helped to keep the event preserved for them and, if so, to rate the frequency with which they had experienced this source on a 5-point scale (from *less than once a year* to *more than once a month*). The questionnaire ended with a request to provide their mother's name and address in order that she might be contacted to complete a similar questionnaire. Participants were asked not to discuss their answers to the questions with her before she had completed the questionnaire.

Thus, in summary, the recall questionnaire we used was identical to that used by Usher and Neisser (1993) except that the questions they used to assess the emotional content of the memories were excluded from our questionnaire and minor changes in the wording were used to accommodate British English.

*The report questionnaire.* Participants who were the younger sibling were given the report questionnaire. The report questionnaire was closely similar to the recall questionnaire described previously. It differed only in asking about the events surrounding the participant's own birth, particularly as experienced by their elder sibling. For example, whereas elder children were asked, "Who told *you* that your mother was leaving for hospital [to give birth to your younger sibling]?" the younger children were asked, "Who told *your older brother/sister* that your mother was leaving for hospital [to give birth to you]?" The written instructions given to report participants were similar to those given to the recall participants, except the first two excerpts quoted previously were excluded from the report instructions and replaced by the follow-

ing: "We don't expect that you will remember the events, but you may know a great deal of information from other sources e.g. family stories or photographs." The report questionnaire also included the statement,

No one is expected to report details about every question. In fact, you may be able to report very little or nothing about parts of the event. What you don't report is as important to this investigation as what you do report.

This is the same as that given to the recall participants.

For both recall and report questionnaires, equivalent questionnaires were constructed for participants for whom the relevant birth took place at home rather than in the hospital. These were slightly shorter than the hospital questionnaires (24 questions rather than 36), as it was not possible to include the contingent questions about the possible hospital visit or the universal questions about the arrival home of mother and baby from hospital.

*Scoring of participants' questionnaires.* We scored the questionnaires. Credit was given for all informative answers, with the exception of Questions 7 and 22. For example, to the question, "Did you receive any presents?" credit was given for the informative answer "toys" or "a teddy bear," but not for the answer, "I think I did, but I don't know what." As a result of poor wording, a simple answer of "No" to Question 7 or 22 in the recall questionnaire was ambiguous and therefore not given credit, although unambiguously negative answers were given credit (e.g., "No, we didn't"). For consistency, simple answers of "No" to these questions from participants in the report group were also not credited. Where exactly the same information was used in more than one question, it was only credited once under the more appropriate question. However, it was still possible for different aspects of one incident to be given credit in answer to two or more questions. For example, a participant reported receiving the gift of an apple under Question 31 and also reported eating it under Question 21. These seemed to us to be separable memories, and therefore credit was given for both. However, a participant who reported that they were in bed sleeping under both Questions 9 and 11 was given credit for this information only once.

*Mothers' questionnaires.* For those who had given permission for us to contact their mother, we sent to the mother a questionnaire about the events surrounding the birth of their younger child. The questionnaire contained all the questions that the participants had been asked (e.g., "Who told your child that you were leaving to go to hospital?"), but the questions that their child had answered were marked, and mothers were asked only to answer those questions that their child had answered. When they had given their own independent answer to these questions, they were asked to open a sealed envelope that contained a copy of their child's answers to the same questions. The mothers were then asked to assign to each question one of the following:

1. My child's memory/report matches my own memory.
2. I believe my child was inaccurate.
3. Our memories involve different aspects of the event, we may both be right.
4. Although I recalled this differently, s/he may be right.
5. Other (please comment).

As an incentive for returning the completed questionnaire, £1.00 (British pound sterling) for every returned questionnaire was promised to a local neonatal care hospital.

*Scoring of mothers' questionnaires.* The mothers' questionnaires were used to verify the information given by their children, our participants. The participants' answers were assessed by an independent person as to whether they were verified by the mother, denied by the mother, or neither verified nor denied by the mother.

We took a strict definition of *verified* and included only those answers that the mother unambiguously claimed were correct. Included in the category of neither verified nor denied were many answers that the mother had judged to be in Category 3 or 4 from the alternatives listed previously and therefore that she admitted could be correct. Those answers that the mother had rated as 5 (*other, please comment*) were rescored by the independent rater according to the comments of the mother. The most common reason for scoring an answer as 5 (*other*) was the mother's acknowledgment that she could not recall the answer to our question. In these cases the participant's response was rated as neither verified nor denied. Another illustrative case is a participant's report of events that the mother confirmed had occurred, not on the occasion of the birth but on some other occasion (in which case it was rated as denied). It was relatively common for participants to report partially correct information. For example, a participant reported being cared for during her mother's absence by her grandmother, but the mother reported that both grandparents had played a role. In these cases the participant's response was rated as verified, as the response itself is correct, although incomplete. However, where the response was overinclusive, for example, claiming that both grandparents were present when the mother reports that the grandfather was absent, the response was rated as neither verified nor denied, as it has elements that are both verified and denied. Under our strict definitions, therefore, such a response cannot be said to be either unambiguously verified or denied.

## Results

Approximately 700 contact questionnaires were completed and returned. Of these, 69 elder and 61 younger children were judged to be suitable according to our criteria, responded to the invitation, and completed the questionnaire. Four of these completed questionnaires were discarded because the dates of birth of the siblings reported on the contact questionnaire did not correspond with age gap between siblings given on the main questionnaire. For 4 of those in the recall group and 2 of those in the report group, the relevant birth took place at home, rather than in the hospital, and the home-birth versions of the questionnaires were used for these participants. The mean age of participants in the recall group was 20:11, whereas the mean age of those in the report group was 19:10. This difference in the current age of our participants was not significant,  $t(124) = 1.47, p > .05$ .

### The Recall Group

*Comparison with data of Usher and Neisser (1993).* Usher and Neisser (1993) had 12 participants who were between ages 2:0 and 2:11 at the time of their sibling's birth. We had 57 such participants in total. Usher and Neisser primarily analyzed the results on the basis of answers to the universal questions, and for ease of comparison, we have also done so. The mean number of universal questions answered by these participants in the Usher and Neisser study was 5.3 (calculated from Usher & Neisser, 1993, Table 2), whereas our participants answered an average of 5.1 universal questions. This figure is not significantly different from that obtained by Usher and Neisser (1993),  $t(67) = 0.09, p > .05$ , which suggests that the minor differences

between the studies in methods of recruiting participants or variations in questionnaire wording has not significantly changed the level of responding. Moreover, Usher and Neisser had 12 participants who were between ages 3:0 and 3:11 in their study. We had 12 who were in the slightly more limited age range of 3:0–3:3. Those who were aged 3:0–3:11 in Usher and Neisser's study answered an average of 6.6 universal questions (calculated from Usher & Neisser, 1993, Table 2), whereas our group answered 6.8. Again, this figure is not significantly different from that obtained by Usher and Neisser (1993),  $t(22) = 0.02, p > .05$ , once again suggesting that the base rate of responding did not differ between the two studies.

*Analyses by age at time of sibling's birth.* Our larger sample size allowed us to break the data down further by age. We divided the recall group into four groups according to their age at the time of their sibling's birth. Thus the four groups consisted of participants aged 2:0–2:3, 2:4–2:7, 2:8–2:11, and 3:0–3:3 and contained 21, 19, 17, and 12 participants, respectively. Again, we concentrate our analyses on the universal questions that can, in principle, be answered by all participants. In contrast, contingent questions refer to events that may not have been experienced by all participants, and it is possible that experience, rather than recall, varied with age. For example, the decision of the parents on whether to take an elder sibling to visit the mother and newborn baby in the hospital could plausibly depend on the age of the child. For this reason, only universal questions are included in this analysis.

Usher and Neisser (1993) set a lenient criterion for remembering an event as having answered at least one universal question about it. In addition, they set a rather more strict, although still arbitrary, criterion as having answered three or more universal questions. Like Usher and Neisser, we determined the proportions of participants who answered at least one question and those who answered three or more questions for each group. This is shown in Figure 1, alongside Usher and Neisser's data for comparison. Using the strict criterion of recall of being able to answer three or more universal questions, we found that the age groups differed in the number of participants who recalled the birth event,  $\chi^2(3, N = 69) = 8.64, p < .05$ . From the figure it would appear that it is the youngest group, those aged 2:0–2:3 at the time of their sibling's birth, who were less often able to recall the events. To test this suggestion further, the number of universal questions answered by each participant was transformed by a logarithmic transformation in order to ensure homogeneity of variance as measured by Cochran's  $C$ ,  $C(16, 4) = 0.34, p = .52$ , and Bartlett-Box  $F$ ,  $F(3, 6826) = 0.41, p = .74$ , and the data analyzed using a one-way analysis of variance (ANOVA). This analysis revealed a significant effect of age group,  $F(3, 65) = 3.29, p < .05$ . A Newman-Keuls test revealed that the youngest group (ages 2:0–2:3) differed significantly from all the other groups ( $p < .05$ ), which in turn did not differ significantly from each other ( $p > .05$ ). Thus, whether analyzed as the number of participants who reach a criterion of recall or on the number of universal questions answered, the data suggest that the age groups are not equivalent in the amount

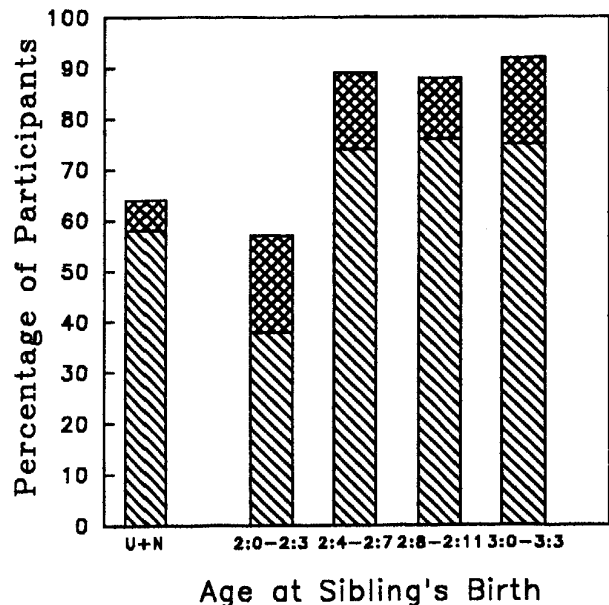


Figure 1. The percentage of participants in the recall group who answered at least one universal question (cross-hatched) or answered three or more universal questions (diagonal slashes) according to their age at the time of their sibling's birth. Equivalent data from participants in the study of Usher and Neisser (1993; U+N) who were between ages 2:0 and 2:11 are shown to the left for comparison. Ages are given as years:months.

they recall. Those participants who were younger than 2:4 at the time of their sibling's birth are recalling significantly less than those who were older.

*Recall of information by gender.* Our recall group consisted of 25 men and 44 women. The mean number of universal questions answered by male and female participants in each age group is shown in Figure 2, which suggests that the men in the youngest age group (2:0–2:3) may be answering fewer questions than the similarly aged women. However, an Age Group  $\times$  Gender ANOVA on the number of universal questions answered (logarithmically transformed as before) revealed no effect of gender,  $F(1, 61) = 0.29, p > .05$ , nor any interaction of gender with age,  $F(3, 61) = 0.24, p > .05$ , although a main effect of age group was apparent,  $F(3, 61) = 2.94, p < .05$ , as before.

*The effects of rehearsal–review.* Each participant reported the frequency and recency with which they had thought about, talked about, or heard others discuss the birth event. The frequency was rated on a 4-point scale that ranged from *never* to *many times in my life*. The most common responses were *a few times* (37 responses) and *several times* (23 responses), although 3 participants reported that the events had never been discussed, and 5 had discussed it many times. The recency was rated on a 5-point scale (*within the last six months, since I left school, during the years when I was aged 14–18, before the age of 14, or never*). Responses to this question were more evenly distributed, the number of participants responding to each of the

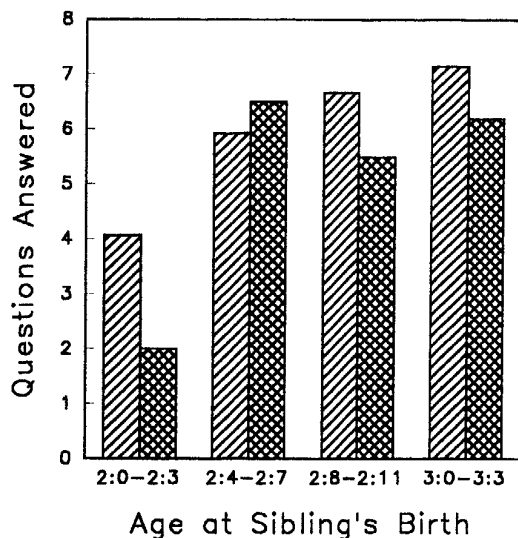


Figure 2. The number of universal questions answered by male (cross-hatched) and female participants (diagonal slashes) in the recall group according to their age at the time of their sibling's birth. Ages are given as years:months.

alternatives was 12, 19, 16, 18, and 4 respectively. However, the number of universal questions answered by those in the recall group was not significantly correlated with either the recency,  $r = .22$ ,  $t(67) = 1.85$ ,  $p > .05$ , or frequency,  $r = .22$ ,  $t(67) = 1.85$ ,  $p > .05$ , of this rehearsal-review. Perhaps unsurprisingly, however, the frequency and recency ratings were significantly correlated with each other,  $r = .52$ ,  $t(67) = 4.98$ ,  $p < .01$ , because participants who reviewed the events relatively frequently had also reviewed them relatively recently.

The participants were also asked to report any external sources that had helped preserve the events for them (e.g., photographs, family stories, etc.). These were commonly available, with only 6 from 69 recall participants reporting that there were no external sources available to them. Usher and Neisser (1993) have suggested that presence of family stories interacts with recall for those who were younger than 4 years old at the time of their sibling's birth, such that those with access to family stories recall less than those without such stories. To test this suggestion, we calculated the number of universal questions answered by those who reported family stories and those who did not. However, in contrast to the study of Usher and Neisser (1993) there was no suggestion that those without family stories recalled more than those of the same age with family stories (without family stories: mean number of universal questions answered = 2.5,  $N = 14$ ; with family stories: mean number of universal questions answered = 5.95,  $N = 55$ ). Indeed, the converse was true, with those reporting the presence of family stories answered significantly more universal questions than those reporting none,  $t(67) = 2.81$ ,  $p < .01$ . Thus, our results point towards the more intuitively appealing conclusion that those who have family stories available are

able to answer more questions about an event than those who do not.

Photographs were also a commonly reported source of external information. Fifty of our 69 recall participants reported the presence of relevant photographs. There was a difference between the number of universal questions answered by those who reported the presence of relevant family photographs and those who did not. Those who had photographs answered an average of 6.0 universal questions, whereas those reporting no photographs answered significantly fewer,  $M = 3.5$ ,  $t(68) = 2.12$ ,  $p < .05$ . Thus, as presented earlier, the presence of an external source that could aid memory was associated with better recall.

#### Comparison of Recall and Report Groups

There were 57 participants who were the younger child in the family and who were asked to report the events surrounding their own birth. These participants answered an average of 6.9 universal questions compared with an average of 5.4 by all the participants in the recall group. This difference between the groups is significant,  $t(124) = 2.00$ ,  $p < .05$ . Thus, the report group answered more universal questions than the recall group.

As described previously, a simple answer of "No" to Questions 7 and 22 was not given credit because, in the recall questionnaire, it is ambiguous as to whether the participant means that they have no memory of that event or that they have a memory that the event did not take place. The total number of such ambiguous, and therefore uncredited, answers was 48 for the report group and 13 for the recall group.

*Analyses by age of sibling at time of birth.* The report group were split into five age groups. Four of these corresponded to those used with the recall group (2:0-2:3, 2:4-2:7, 2:8-2:11, and 3:0-3:3), but we included an additional group of those whose sibling had been younger than 2:0 years at the time of their own birth. Figure 3 shows the proportion of report participants in each age group who reported information, using the same strict and lenient criterion of knowing something about the events that was used with the recall group. It is apparent from this figure that almost all participants are able to answer at least three universal questions about events for which they could be expected to have no memory. Moreover a chi-square analysis revealed that the proportions answering three or more questions did not differ between the age groups,  $\chi^2(4, N = 57) = 4.67$ ,  $p > .25$ . An ANOVA on the logarithmically transformed number of universal questions answered confirmed that there is no effect of age group on the number of universal questions answered in the report group,  $F(4, 52) = 1.80$ ,  $p > .05$ . Thus, as one might predict, the age of one's sibling at the time of one's own birth has no effect on the amount of information one can report about the event.

*Verification of information produced.* Eighty-three percent (105) of participants gave us permission to contact their mother (57 from the recall group and 48 from the report group). Ninety-four mothers were sent the mothers' questionnaire (the discrepancy between this and the previous figure

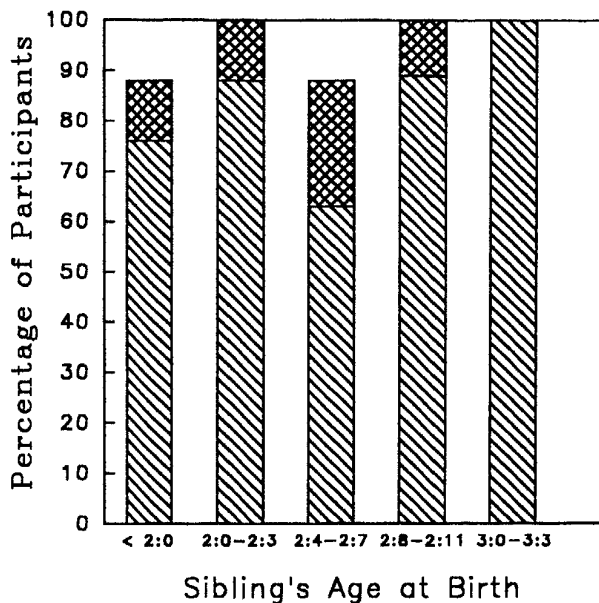


Figure 3. The percentage of participants in the report group who answered at least one universal question (cross-hatched) or answered three or more universal questions (diagonal slashes) according to the age of their sibling at the time of the participant's birth. Ages are given as years:months.

is due to the fact that the mothers of those participants who recalled or reported nothing at all were not contacted). Eighty-five percent of those mothers we attempted to contact returned the questionnaire (40 from the recall group and 40 from the report group), although 1 mother of a recall participant and 3 mothers of report participants failed to follow the instructions properly, and the mothers' responses had to be discarded. Thus we successfully contacted the mothers of 60% of our participants. This represents 66% of those we wished to contact (i.e., those who had given at least one answer that needed verification) and also 66% of those we wished to contact in both the recall and report group (cf. Usher & Neisser (1993), who reported 60% of their participants giving contact permission and 67% of questionnaires returned by mothers giving a successful contact rate of 40%).

Table 1 shows for the recall and report groups the proportion of all questions answered by participants for whom we had a mother's response that were verified, denied, or neither verified nor denied by the participant's mother. From these data it is apparent that the answers of those in the report group were more frequently denied by their mothers than the answers of those in the recall group. This effect is significant,  $\chi^2(1, N = 878) = 4.79, p < .05$ . However, there was no difference between the number of answers specifically verified by the mothers of participants in the two groups,  $\chi^2(1, N = 878) = 1.00, p > .05$ . We were also able to break down this verification data by the age gap between our participants and their siblings. These data are also shown in Table 1. From these data, it is clear that those

recall participants who were aged 2:0-2:3 at the time of their sibling's birth did not have a greater proportion of their answers denied by their mothers than those who were older at the time of the sibling birth,  $\chi^2(1, N = 488) = 0.42, p > .05$ . Therefore, despite the fact that this group answered significantly fewer questions than those who were older at the time of their sibling's birth, there is no evidence that the responses they do give are any less accurate.

Loftus (1993) suggested that mothers may be loath to deny the answers given by their children, and thus the mothers' verifications must be viewed with caution. However, there was no indication in our data that mothers were unwilling to state that their child's answer was wrong. We had responses from 39 mothers of participants in the recall group, of which 11 (28%) denied none of their child's answers. The vast majority of mothers, therefore, denied at least one answer. Moreover, participants whose mothers denied at least one of their child's answers answered an average of 14.9 questions (median = 14), whereas those whose mothers denied none of their answers answered only a mean of 6.6 (median = 6). Thus, those who denied none of their child's answers simply had many fewer answers to verify, and presumably less opportunity to deny answers, rather than a general unwillingness to do so.

**Errors produced.** We also investigated the types of errors produced by each group. Each answer that had been denied by the mother was categorized according to the type of error, on the basis of the mother's independent answer to the same question and any comments given by the mother. Errors were put into one of the following seven categories: (a) source error (the event did occur, not at the time of the sibling birth, but on some other occasion); (b) error of time (the time of day reported for the occurrence of the event is incorrect); (c) error of place (the event occurred much as described but not where it is said to have taken place); (d) error of person (mistaken over the person or people involved

Table 1  
Percentage of Answers Verified by Mother According to Group and Intersibling Birth Interval

Group/interval	Mother's categorization		
	Verified	Neither verified nor denied	Denied
Recall			
2:0-2:3	65	24	11
2:4-2:7	74	14	12
2:8-2:11	54	28	18
3:0-3:3	62	26	12
Overall	63.5	23.2	13.3
Report			
<2:0	57	26	17
2:0-2:3	57	16	27
2:4-2:7	81	5	14
2:8-2:11	56	25	19
3:0-3:3	61	24	14
Overall	60	21	19

Note. Interval represents years:months.



or present at an event); (e) minor error of commission (other minor error in an otherwise correctly described event); (f) major error of commission (major error, particularly reporting events that did not occur); and (g) error of omission (reporting that something did not occur when it did). The proportion of errors produced by each group that fell in each of these categories is shown in Table 2.

**Pattern of information produced.** We also looked at the pattern of information produced. Figure 4 shows the percentage of answers from the recall and report groups respectively that were supplied to each question. This allows us to compare the pattern of questions answered by the two groups, irrespective of the total number of questions answered. It is clear from this figure that some questions are answered far more frequently than others. For example, compare Question 4 ("What were you doing when told [that your mother was to have a baby]?") and Question 12 ("Who took care of you while your mother was in hospital?"). Interestingly, Loftus (1993) picked out 4 questions as examples of questions that she claimed are easily answered on the basis of family knowledge alone. Indeed, for members of the report group, who are relying solely on family knowledge, these 4 questions rank 1, 4, 6, and 17 (out of a total of 32 questions) in a scale of the most often answered questions. However, the respective ranks for these same questions as answered by the participants in the recall group are 1, 2, 11.5, and 4. Moreover, there is a significant correlation between the number of answers the report and recall groups produced for each question,  $r = .68$ ,  $t(30) = 5.08$ ,  $p < .01$ . However, despite this high overall correlation, there are some significant differences in the way the two groups answered the questions. For example, Questions 10 ("Who went with her [to hospital]?") and 30 ("What presents did the baby get?") are significantly more often answered by those in the report group than those in the recall group,  $\chi^2(1, N = 1,281) = 8.74$ ,  $p < .005$ , and  $\chi^2(1, N = 1,281) = 4.44$ ,  $p < .05$ , respectively. In contrast, Question 18 ("What did you do [when visiting your mother in hospital]?") and Question 25 ("What was the baby doing [when you first saw baby]?") were significantly more often answered by those in the recall group,  $\chi^2(1, N = 1,281) = 4.52$ ,  $p < .05$ , and  $\chi^2(1, N = 1,281) = 3.92$ ,  $p < .05$ , respectively.

Table 2  
*Type of Error as a Percentage of Total Errors Produced by Each Group*

Type of error	Group	
	Recall	Report
Occasion	4.7	9.5
Time	12.5	6.8
Place	9.4	5.4
Person	26.6	29.7
Minor error of commission	10.9	5.4
Major error of commission	29.7	35.1
Omission	6.3	8.1
	100.0	100.0

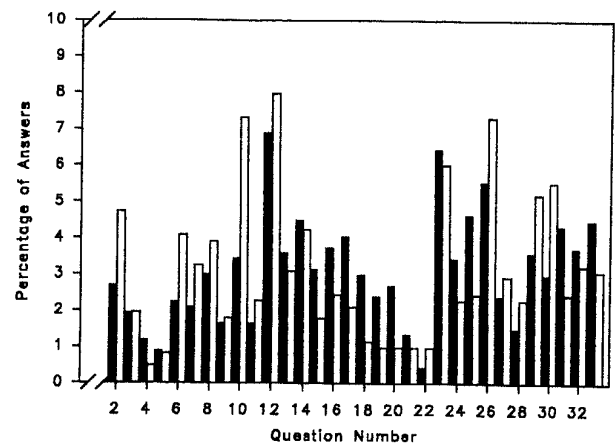


Figure 4. The percentage of all answers given by a group that were in response to the question shown. Black bars show the percentage of answers for the recall group; white bars show the percentage for the report group.

## Discussion

This study has two major findings. The first is that 75% of participants who were between 2;4 and 2;11 at the time are able to recall something about the events surrounding their sibling's birth (as measured by our strict, though necessarily arbitrary, criterion of answering at least three questions about it). Thus, Usher and Neisser's (1993) report of memory for events that occurred when the child is younger than 3 years old is replicated using a much larger sample size. Moreover, those who experienced a sibling birth when they were aged between 2;0 and 2;3 remember significantly less than those who were between 2;4 and 3;3 years of age, so we are able to further narrow the critical age of the earliest memories to the first half of the 3rd year of life. The implications of this finding are discussed further in a later section.

However, an alternative explanation of Usher and Neisser's (1993) results was proposed by Loftus (1993) and may be extended to our own data. She correctly pointed out that a participant may have sufficient information from sources other than memory to answer the questions asked by Usher and Neisser and by us. Our data confirm this view. Participants in the report group, who can be expected to have no memory of events (some of which occurred before their own birth, others in their 1st weeks of life), were able to answer many of the questions that we and Usher and Neisser had asked of participants. Should this finding cause us to reject the evidence we have collected of memory for events that occurred in the later two thirds of the 3rd year (i.e., after 2 years and 3 months)? We argue that the pattern of data we collected is not consistent with this argument. First, our report participants, relying only on family knowledge, actually answered significantly more questions than the recall participants, who were able to draw on both family knowledge and autobiographical memory. Thus, it is unlikely that our recall participants were simply reporting to us



all the information they knew, being unable to discriminate between sources of knowledge. If that were the case, our recall participants would be expected to relate the same amount of information as our report participants or perhaps even more, as they could supplement family knowledge with true autobiographical memories. However, this was not the case. Thus the recall participants filtered their knowledge about the events and reported only a subset of this knowledge. Of course, we cannot know from our data whether they filtered the information accurately into those items they knew on the basis of autobiographical memory and those that they knew from other sources. However, a further aspect of our data suggests that they may have done so. We found a significant difference between the amount of information reported by those who were between 2:0 and 2:3 and those who were older than this at the time of the sibling birth. Yet our results from the report group suggest no age-related differences in the amount of family knowledge available to participants. This difference between the youngest and oldest recall participants can therefore only reasonably come from differences in the number of memories available to the groups. Thus the conclusion from this discussion is that although participants have a great deal of information available to them about their sibling's birth from a variety of sources, they are not reporting all this information as though it were autobiographical memory.

However, a counterargument to the above is the fact that the pattern of answers given by the report and recall groups was similar, suggesting that they had similar types of information available. This may suggest that the recall group confused memories and family knowledge. Indeed, the questions that Loftus (1993) picked out as being easily answered on the basis of family knowledge alone were more frequently answered by those in the recall group than those in the report group. However, one should bear in mind that an overall correlation is not unexpected as some of the questions clearly asked about events that are less salient than others (e.g., the time of day of the homecoming) and are likely to be incorporated in few family stories or memories. Other events, such as the first meeting of baby and elder sibling, are highly salient events that are likely to figure in both autobiographical memories and in family lore. The very fact that a story is retold within a family suggests that it resides in the autobiographical memory of a member of the family and is likely to be salient to all members of the family. More important, perhaps, is the fact that there are some questions about which the two groups appear to have very different amounts of information. Most notably, many participants in the report group knew who cared for their sibling during their mother's stay in the hospital. This is just the sort of information that is likely to be retained in family knowledge. However, relatively few of the participants actually recalled this information, perhaps because care had been taken to ensure that the temporary caregiver was well-known to the child (grandparents figured strongly in answers to this question) and therefore the incident was not particularly memorable.

Within the recall group, the presence of external sources of information about the sibling birth, such as family stories

and photographs, was associated with better recall, suggesting that external information sources may have been used by our recall group. This finding is directly counter to the finding of Usher and Neisser (1993). However, Usher and Neisser's data must be regarded with some doubt on this point because of the small sample size. They included only 12 participants in each age group for each event and then went on to divide this group according to the presence or absence of various external sources of information concerning the events. For example, for the sibling birth they questioned a total of 60 participants across five age groups, 49 of whom reported the presence of family stories. Thus, their conclusions about the amount of information recalled by those without family stories was based on a total of only 11 participants across five age groups. In contrast, our own data were based on a considerably larger sample, and the conclusions are therefore more likely to be reliable. However, there is a danger raised by our conclusions: Those who have external sources of information about the birth were also able to answer more questions, suggesting that they may be reporting knowledge gleaned from the external information sources and not from their own memories. However, although this is possible, we can offer alternative explanations of this link between memory and external memory sources. First, the presence of external sources may have helped preserve memories that might otherwise have faded. Second, a good memory for the birth event may actually reinforce memory for the external sources (e.g., a photograph is more meaningful and perhaps therefore more memorable for a participant who recalls the original event). At present, we cannot discern between these possible explanations of the link between the presence of external memory sources and memory.

Perhaps the most important aspect of these data is the finding that those who were aged 2:4–2:7 and older at the time of their sibling's birth have significantly more memories of the event than those who were aged 2:0–2:3. Of course, we are not claiming that there is a sudden and reliable change in abilities in all children at age 2 years and 4 months, but that the ability to recall is much more common after this point than before. We have no evidence that the age of this change depends on gender, although if such a gender difference existed it would be expected to be relatively small and may be hidden by the fact that we grouped ages in 4-month age bands. This grouping may be too coarse to pick up subtle gender differences in age of first recall. Interestingly, this change in mnemonic abilities in the early part of the 3rd year corresponds to several changes in the cognitive abilities of children. Not only is there an explosion of language around this age (R. Brown, 1973) but also impressive changes in the representational abilities of children (see Howe & Courage, 1993, for a discussion of some of these as they relate to the issue of childhood amnesia).

Our own study is not dissimilar to that of Sheingold and Tenney (1982), who, using a similar questionnaire, also found a steep offset to childhood amnesia. However, the offset suggested by their data was around 3½ years, whereas our own data suggest an offset more than a year before this. It is perhaps important that Sheingold and Tenney ques-

tioned participants, all of whom had a sibling born when they were age 3 or older. Thus, those who were questioned about births that took place when they were between ages 2:0 and 2:11 (and who recalled very little) had also been asked about a more recent sibling birth that may have caused interference in memory. Usher and Neisser (1993) took some account of this by asking participants about only one sibling birth, and in all cases this was the participant's "*most recent pre-school-age*" experience of a sibling birth (p. 157). In our study, we questioned only those who had only one sibling and no children of their own, such that the sibling birth about which we asked was the only birth within their immediate family experience. We hoped that this would limit interference, and it may explain our earlier estimates. Our participants, like those of Usher and Neisser and college students in Sheingold and Tenney's study, were graduates or on university undergraduate programs and thus are also not a random selection of participants. They were undoubtedly of above average intelligence, and two thirds of our sample were women. Although gender did not have a significant effect on recall, some or all of these factors may have influenced our early estimate of the offset of childhood amnesia, and later estimates may be found using other participant populations.

Another potentially important difference between the study of Sheingold and Tenney (1982) and our study is that Sheingold and Tenney accepted as memories only answers that were more specific than those that we accepted. For example, to the question, "Were you given any presents?" Sheingold and Tenney did not give credit for the answers "toys" or "clothes" but would accept "a teddy bear" or "a dress." Whereas Usher and Neisser (1993) did not report their procedure, we presume they followed that reported in Usher (1989b), giving credit for all informative answers, which we interpret as being similar to our own practice. The result of this difference between Sheingold and Tenney and our study is probably to decrease the number of memories accepted as such in the report of Sheingold and Tenney and may be the cause of their relatively late estimate for the offset of childhood amnesia. However, we believe that our relatively lax criterion for accepting an answer is to be preferred for the following reason. For the vast majority of our participants, the most common response to our questions was to reply that they did not know the answer. Indeed we encouraged this, as the instructions given to both groups included the words

No one is expected to recall/report details about every question. In fact, you may be able to report/recall very little or nothing about parts of the event. What you don't report/recall is as important to this investigation as what you do report/recall.

Thus, when participants did give an answer to a question, we must assume that it represented some specific knowledge or memory. We did not have the opportunity to follow up with participants and ask them to provide us with further details to their answer ("What sort of toy?/What clothes?"), but we presume that many would have been able to do so. Thus to discount this information, as Sheingold and Tenney

(1982) did, seems to us to be unjustified. However, some answers that we credited on this basis did appear to us to be somewhat problematic, particularly in the case of negative answers. For example, to the question, "Was there anything unusual about the room?" the answer "No" was scored in just the same way as an answer containing more content, such as, "Yes, it was very light and airy." Again the justification of our procedure is that the vast majority of our participants reported that they did not know if there was anything unusual about the room. Although it is possible that some of our participants reinterpreted our question as, "Can you recall anything unusual about the room?" one would not expect this effect to differentially affect participants, particularly not according to their age at the time of their sibling's birth. Therefore we believe that there is no danger that such effects could be influencing the outcome of this study. However, we did discount answers of "No" to Questions 7 and 22 that were ambiguous as the result of poor wording in the recall questionnaire. Thirty-five percent (48 answers) of possible answers to these questions were negative answers that were not credited, whereas the equivalent figure for the report group is only 11% (13 answers). This is consistent with our view that the majority of these participants meant that they could not remember, rather than that they recalled that the event had not taken place, and that it is appropriate to discount all such answers. The alternative explanation is an astonishingly high rate of participants recalling that room preparation and telephone contact had not taken place. These two questions should certainly be reworded in any future studies.

The mothers of our participants were also asked to verify their child's answers. From these data we were able to determine that the majority of the answers given by our participants were verified by their mother. We took a very strict definition of verified and did not include those occasions where the mother herself could not recall the information we asked for or where, although she recalled the answer differently, she said that her child's answer could be correct. Thus our figure for verified answers is almost certainly an underestimation of the true accuracy as judged against the mother's memory. Although one must also bear in mind the distinct possibility that mothers themselves do not have an accurate memory of all events (Robbins, 1963), it is clear that many early memories are essentially accurate. However, it is of note that more than 13% of memories from the recall group are judged by their mothers to be inaccurate; in the report group this figure rises to nearly 20%. Thus, those who are relying on reconstructions from family knowledge are, not unexpectedly, likely to introduce inaccuracies into their reports. Of particular interest here is the finding that those between ages 2 years and 2 years, 3 months at the time of their sibling's birth, although recalling relatively less than those who were older at the time, do not show this increase in false memories. Although this finding undoubtedly needs further study, it suggests that these participants did genuinely have memories from this period, rather than relying entirely on reconstructions from family knowledge that they mistake as memories. Thus their memories are fewer in number, but equally accurate.

Some caution must be exercised over the data on the type of error produced. Of particular interest is the occurrence of source monitoring errors, that is, errors where the participant reports a memory that is correct in its content but that did not occur at the time of the sibling's birth. For example, one participant reported that the elder sibling had been given an orange to play with and had, unobserved, succeeded in eating portions of it. The mother confirms this event occurred, but on another occasion. Another participant recalled receiving a mug as a gift. The mother reports that this gift was a later Christmas present. However, such errors are relatively rare. The largest category of errors was major errors of commission. This includes answers that describe events that the mother reports are significantly inaccurate. For example, a participant reported that she was at nursery school when her mother left for the hospital, whereas her mother reports that at that time she had not yet begun nursery school and was playing at home. Another participant recalls that when they visited the hospital, she ignored her mother and the baby and played with other children present. The mother denies this account and recalls that the child sat with her, holding and talking to the baby. Of course, although these examples give some indication of the type of errors seen, the appropriate categorization was not always straightforward. For example, the case of the child reporting that she was at nursery school when her mother left for the hospital did, according to her mother, later attend nursery school. This could then be categorized as a source error in which the child is misplacing a real memory of nursery school. Equally, although source errors appear to be relatively rare, they were detected only when the participant's mother spontaneously reported them in written comments, as we did not specifically allow for their occurrence. It is possible that some of the events that the mother judged to be incorrect in the context asked, did in fact occur on some other occasion, which she failed to report. In addition, the second largest category for the recall group are errors of person, in which the events include incorrect people. Many of these errors involved who had told the child significant information, including that the mother was leaving for the hospital or the gender of the baby, but also included relatively minor errors such as who was present when the baby arrived home. Although these errors were relatively common, this in part reflects the type of questions we asked that gave greater scope for errors of this type than some other error types. Thus not all the errors described are major errors, and some are relatively minor.

In conclusion, we are able to fully confirm the claim of Usher and Neisser (1993) that an event that occurs when a participant is younger than 3 years old may be recalled in adulthood. Moreover, many participants are able to show substantial recall of events that took place when they were age 2½, but recall of events that took place in the first quarter of this year are much more rare. However, in situations where memories from this earliest period are recalled, we have no evidence that they are less accurate than memories from the later period. Thus, we are able to point to a steep

offset of childhood amnesia during the first half of the 3rd year of life. Our study makes no claims to explain the phenomenon of childhood amnesia, but any such explanations should be based on the increasingly reliable data about the nature of the phenomenon itself.

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## Appendix

### Study Questions

The 33 questions asked in the study. The 17 universal questions are marked with an asterisk.

1. Do you remember being told that your mother was going to have a baby?
  - \*2. Who told you?
  - \*3. Where were you?
  - \*4. What were you doing when this happened?
  - \*5. What time of day was it?
  6. Were there any special purchases made in preparing for the baby's birth? If so, what were they?
  7. Do you recall your parents doing any kind of room preparation for the baby? If so, what?
  - \*8. Who told you that your mother was leaving to go to the hospital?
  - \*9. What were you doing when she left?
  - \*10. Who went with her?
  - \*11. What did you do right after your mother left?
  - \*12. Who took care of you while your mother was in hospital?
  13. Did you do anything special with this person while your mother was away?
  - \*14. How did you find out that the baby was a boy or a girl?
- If you visited your mother while she was in hospital, please answer questions 15–21, otherwise go to question 22.*
15. What time of day was it when you visited her?
  16. Were there other patients besides your mother in the room?
  17. Were there other visitors in the room while you were there?

18. What did you do there?
19. Do you remember how the room was arranged or what specific items of furniture were in the room?
20. Was there anything unusual about the room?
21. Did you eat anything while you were in the hospital? If so, what?
22. Did you talk with your mother on the telephone while she was in the hospital? Do you remember anything specific from the conversation(s)?
- \*23. Where were you the first time you saw the baby?
- \*24. What was the baby wearing the first time you saw him/her?
- \*25. What was the baby doing?
- \*26. Who picked your mother up from hospital?
- \*27. What time of day was it when they came home?
- \*28. What did you do when they arrived home?
- \*29. Was anyone else at home when they arrived? If so, who?
30. What presents did the baby get?
31. Did you get any presents at that time? What were they?
32. Who gave them to you?
33. If you recall anything else about the events surrounding the birth of your sister/brother, please add it here.

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