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Reminiscence and hypermnesia in children's eyewitness memory

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Abstract

Three experiments examined reminiscence and hypermnesia in 5- and 6-year-olds' memory for an event across repeated interviews that occurred either immediately afterward (Experiment 1) or after a 6-month delay (Experiments 2 and 3). Reminiscence (recall of new information) was reliably obtained in all of the experiments, although the numbers of new items recalled were fewer after a delay than when the interviews occurred immediately afterward. Hypermnesia (increasing total recall over repeated recall attempts) was obtained only in Experiment 1 when interviews occurred immediately and 24 h after the event.

Keywords: Memory; Eyewitness testimony; Reminiscence; Hypermnesia; Repeated interviewing

Introduction

Both laboratory-based studies and applied eyewitness memory studies indicate that repeated retrieval attempts can lead to reminiscence (the elicitation of new information) and the related phenomenon of hypermnesia (increases in recall across

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several recall attempts) under certain conditions. Hypermnesia depends on reminiscence, but it also depends on the recall of previously recalled information. Insofar as repeated recall attempts usually contain omissions of previously recalled information (forgetting) as well as reminiscence, for hypermnesia to be observed, the reminiscence of new information must also exceed forgetting. Despite their potential to enhance eyewitness accounts, there has been no research that directly examined the phenomena of reminiscence and hypermnesia in children's eyewitness memory. This may be due in part to the controversy surrounding repeated interviews in real-world contexts. In particular, some researchers have argued that repeated interviews could be used as a means of introducing suggestive information and that inconsistencies across repeated tellings of the same event may reduce the credibility of a child's testimony. Insofar as interviews composed of open-ended questions typically yield accurate information from young children (e.g., Fivush, 1994; Jones & Pipe, 2002; Peterson & Bell, 1996; Pipe, Sutherland, Webster, Jones, & La Rooy, 2004), repeated open-ended interviews may lead to increased recall in children's eyewitness memory as measured by reminiscence and hypermnesia. In the current study, we examined repeated open-ended interviews following both short and long delays with children recalling a witnessed event.

Reminiscence and hypermnesia both have typically been found with adults following a procedure originally developed by Erdelyi and Becker (1974). In a typical reminiscence and hypermnesia experiment, the participants view a set of to-be-remembered items presented as either pictures or words. After all of the items have been presented, the participants are instructed to recall as many of the items as they can remember. The participants then receive two further tests, again recalling as many of the items as they can remember. In each test, the participants are usually required to make a fixed number of responses even if doing so means guessing. The results of studies using this procedure have shown that the correct recall of pictures (Erdelyi & Becker, 1974; Roediger, Payne, Gillespie, & Lean, 1982; Shapiro & Erdelyi, 1974), and of words if visualized (Erdelyi, Finkelstein, Herrell, Miller, & Thomas, 1976; Henkel, 2004), increases across trials, whereas errors do not systematically increase. More recently, Kern, Libkuman, and Otani (2002) found that a greater amount of hypermnesia was obtained when negatively arousing pictures were used as stimuli than when nonarousing pictures were used.

However, there may be minor trade-offs against the increases in recall. Henkel (2004) found that across repeated recall trials, the participants made more source-monitoring errors in deciding whether the to-be-remembered stimuli were originally presented as pictures or words, especially when they were unaware that they would be later tested on memory for source. Shaw, Bjork, and Handal (1995) found retrieval-induced forgetting; that is, across repeated tests, the probability of recalling additional related information was less than that of recalling unrelated information. Kelley and Nairne (2003) showed that memory for the order in which words from a list are recalled decreases across repeated testing. Of particular interest to eyewitness memory research is how the costs and benefits observed for repeated testing in laboratory studies translate into applied contexts.

A few applied studies have used realistic events and provided direct evidence confirming the predictions of the laboratory research. One of these applied studies of hypermnesia focused on the events of the widely televised O. J. Simpson verdict (Bluck, Levine, & Laulhere, 1999). Eight months after the verdict announcement, the adult participants were asked to recall the events surrounding the verdict three times in response to open-ended free recall cues during a 1-h recall session. Bluck and colleagues (1999) found that the recall of correct information increased between the first and third trials. There were no simultaneous increases observed for errors across the recall attempts. Dunning and Stern (1992) investigated hypermnesia in undergraduate students' memory for a 4-min video of a violent crime. As in Bluck and colleagues' (1999) study, the participants were asked for three free recall accounts. The results were clear in that recall increased monotonically as the number of recall attempts increased, indicative of hypermnesia; errors did not increase significantly across the successive recall attempts. Scrivner and Safer (1988) also examined recall across repeated interviews of a violent 2-min video. Their results showed that the number of details that the participants wrote down increased across each recall attempt. Although there was a significant increase in the number of errors, it was small; the mean number of errors increased by only a half error from the first trial to the fourth trial. Scrivner and Safer concluded that just because initial memory reports are incomplete does not mean that the omitted information has decayed permanently from memory. Bornstein, Liebel, and Scarberry (1998) examined hypermnesia for an emotionally arousing event compared with a nonemotionally arousing event. Although they did find hypermnesia, they did not find evidence of a greater amount of hypermnesia for the emotionally arousing event. Errors increased over trials, but although this increase was significant, it was only a 1% increase between the first and third recall tests.

Turtle and Yuille (1994), in contrast, found no evidence of hypermnesia for memory of a $4\frac{1}{2}$-min video of a crime. The absence of hypermnesia in their Experiment 1 might be due to the more stringent criterion that Turtle and Yuille used; whereas hypermnesia is typically measured simply as an increase in correct recall, they subtracted the amount of information forgotten from the previous recall attempt. The absolute amount recalled is, in effect, reduced by the amount that is forgotten from the preceding trial. Using this unusual measure, hypermnesia as defined in other studies might not have been detected.

With respect to children's memory, there are only a handful of studies that have examined hypermnesia directly, whether in the laboratory or in real-world analogs. Early research conducted by Ballard (1913) and Ammons and Irion (1954) investigated hypermnesia in 12-year-olds. The children in their studies were asked to memorize poetry during a short period of time and then to recall it. Their results demonstrated that the average number of lines of poetry recalled increased between an immediate recall test and a recall test repeated 2 days later. As in the adult studies, these authors demonstrated that there was more information in memory than was elicited in any single recall attempt. Paris (1978), using a laboratory procedure, demonstrated that 8- and 12-year-olds' memory for a list of words increased between three recall attempts that were separated by delays of minutes. Howe, Kelland, Bry-

ant-Brown, and Clark (1992) also examined memory for word lists in $7\frac{1}{2}$- and 10-year-olds. They observed hypermnesia across four consecutive recall trials separated by delays of minutes, and they noted that there was no difference in the magnitude of the hypermnesia effect for the two age groups studied. However, the effect was stronger when children were tested at a delay of 2 days than when they were tested at longer delays of 16 and 30 days.

Dent and Stephenson (1979) provided some evidence that hypermnesia may occur in children's eyewitness memory across repeated interviews. In their study, 10- and 11-year-olds recalled more details about a film during an interview conducted after 24 h than during an interview conducted immediately after seeing the film, without an increase in errors. However, recall did not increase further in repeated interviews conducted at 2-week and 2-month delays. In a second experiment, Dent and Stephenson obtained a similar finding when children were tested in immediate, 24-h, and 48-h interviews. This increase in recall was observed only when children responded to free recall requests for information or to general questions about what had happened. Children who were interviewed with specific questions did not show any increase in recall. Henry and Gudjonsson (2003) examined hypermnesia in the eyewitness memory of 11- and 12-year-olds with and without intellectual disabilities. The eyewitness event was performed in the children's classrooms and consisted of a performance by an actor about school life 100 years ago. After the event, the children were interviewed about what they could remember with an open-ended interview protocol immediately and 2 weeks later. The results showed an increase in free recall across the two interviews but not in response to specific questions.

Even when children do not demonstrate hypermnesia, they may nonetheless recall new information across repeated recall attempts. When the level of recall remains the same or decreases over time, it does not necessarily follow that the same information is simply repeated from interview to interview. Reminiscence (without hypermnesia) has been observed in children's reports about past events in many studies specifically examining the individual pieces of information reported across interviews to see whether they are new or repeated from previous interviews (e.g., Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993; Fivush & Hamond, 1989; Hudson & Fivush, 1991; Peterson, Moores, & White, 2001; Pipe, Gee, Wilson, & Egerton, 1999; Salmon & Pipe, 1997, 2000). These studies have generally found that new information can be recovered in later interviews and added to children's accounts. However, a primary issue surrounding the introduction of newly reminisced information is the accuracy of the new information (Salmon & Pipe, 1997). A consistent finding has been that new information is less accurate than information consistently reported across interviews. Salmon and Pipe (1997, 2000) found that new information added after a 6-month delay was approximately 50% as accurate as information reported within a week. Peterson and colleagues (2001) similarly found that new information recalled about an injury and subsequent hospital treatment became progressively less accurate at delays of 6 months, 1 year, and 2 years. By the 1- and 2-year delays, the accuracy of new information ranged between 44 and 63% on average for children between 2 and 12 years of age (see also Steward et al., 1996). However,

these studies examined new information added to accounts after a 6-month or 1-year delay between interviews. Relatively little is known about the accuracy of new information added to children's accounts when there are short delays between interviews.

The three experiments that we present here are unique in that they are the first to examine systematically how the concepts of both reminiscence and hypermnesia can help in our understanding of children's eyewitness memory. We used an event originally devised by Murachver, Pipe, Gordon, Owens, and Fivush (1996) called "visiting the pirate" and delays of 1 day and 6 months for the interviews. This design permitted us to examine reminiscence and hypermnesia both when little forgetting had occurred immediately after the event and when a significant amount of forgetting had occurred 6 months after the event (Jones & Pipe, 2002). The children's recall was elicited through open-ended verbal recall interviews.

In the analyses, we evaluated the costs and benefits of repeated interviewing by comparing the number of correct details with the number of errors that were made in the interviews. Evidence of hypermnesia was measured as an increase in the number of accurate details recalled across successive interviews. Reminiscence was measured as the cumulative recall of *new* details across repeated interviews, that is, the number of correct details from the first interview plus new details from the subsequent interview(s) (Bluck et al., 1999). These two measures allowed us to separately assess whether the absolute amount of information reported across interviews increased (hypermnesia) as well as whether multiple interviews, taken together, provided an increasing amount of new information (reminiscence).

Experiment 1

Experiment 1 examined reminiscence and hypermnesia in children's eyewitness memory immediately and 24 h after an event when little forgetting had taken place and recall was expected to be at its greatest. An additional variable considered was whether being forewarned of an upcoming interview would affect hypermnesia. Knowing that an interviewer will return to ask for more information may result in witnesses thinking about further items of information in between interviews, thereby resulting in a greater amount of hypermnesia. Thus, half of the children were forewarned that there would be a repeated interview and half were not.

Method

Participants

The participants were 40 children of European extraction (20 boys and 20 girls) recruited from local primary schools in Dunedin, New Zealand. The mean age of the children at the time of the event was 6 years 1 month ($SD = 4\frac{3}{4}$ months). The caregivers of the children agreed in writing to their children's participation, and all children were willing participants.

Materials

Four panels (120 cm wide by 180 cm high) were arranged with a large painting of a pirate setting comprising the backdrop. Set out in front of these were a sail, a drum and sticks, a name book, a skeleton pen, a brown box, a waistcoat, a table and cloth, a water jug, a jar for dye, an eyedropper, a bowl, a paintbrush, map paper, a red box, a poem, a parrot in a cage, birdseed and a scoop, a telescope, a steering wheel, a key, a treasure map, a spade, a barrel of polystyrene chips, a treasure chest, a padlock, gold bars and coins, and a wooden cutout of a boat.

Procedure

A researcher escorted the children individually from their class and introduced them to the "friendly pirate" who was dressed in blue and white striped pants, a blue top, a purple waistcoat, and a red sash. After the introductions, the pirate and each child performed the 20 event-activities together. The event ended when the child found a treasure chest, inside of which was an inexpensive gift that the child kept as a token of the pirate's appreciation of his or her assistance. During the event, the pirate did not specifically name the objects and actions used in the activities but used empty language such as "Okay, now that we are done with that, let's have a go with this." The entire event lasted between 10 and 15 min.

Children were individually interviewed immediately after the visit to the pirate (Interview 1) and again 24 h later (Interview 2). Before the first interview, half of the children received instructions that forewarned them that they would be interviewed again the following day about what they could remember. The remaining children received interview instructions that did not indicate that they would be interviewed again. Aside from these instructions, the children received the same interview protocol in each interview. Each interview began with the child being asked, "Tell me everything you can remember about when you visited the pirate." After the child had recalled all that he or she could, the interviewer introduced four open-ended cues in an attempt to elicit further information:

1. "I heard that the first thing you have to do is to become a real pirate. I bet you had to do lots of fun things for that. Tell me what they are.
2. "It sounds like you had to do some special things to get the map ready. Tell me what they were.
3. "What about winning the pirate key? What sorts of things do you have to do for that?
4. "I heard that the last thing you have to do is find the treasure. How did you do that?"

The interviewer encouraged the child to keep saying what he or she could remember by using statements such as "What else happened?," "Tell me some more things that happened," and "That sounds like fun." There were two interviewers (1 man and 1 woman), and the same interviewer conducted both interviews for each child.

The participants were randomly assigned to each condition within the constraint that there were equal numbers of boys and girls across conditions. Each interviewer interviewed the same number of boys and girls.

Transcripts of the audiotapes and videotapes of the interviews were coded so that a child received credit for a correct item by mentioning any of the 55 actions and objects that were part of the 20 prescribed pirate and child activities. For example, the statement "I looked through the telescope" received credit for the mention of the action "look" and of the object "telescope." Additional credit was not given if the child mentioned the same detail(s) again later in the interview. Mentions of the actions and objects that had been provided in the interview cues (e.g., map, chest, key, unlock) were not credited. Errors were coded as intrusions (mentions of actions or objects that the child reported as occurring or being present during the event when in fact they had not occurred or been present) or as distortions (incorrect descriptions of items that had been present). Intrusions and distortions were combined to form a single category of errors for the purpose of analysis. Two independent raters coded one third of the transcripts, and interrater reliability was calculated as the number of coding agreements divided by the total number of agreements and disagreements for each transcript following Tinsley and Weiss (2000). One of the raters was aware of the conditions in which the children were grouped, whereas the other rater was not. Interrater reliability was 88.4%.

Results and discussion

Preliminary analyses showed that there was no effect of interviewer on the amount of correct information or on the number of errors. For clarity, only significant results that exceed an alpha of .05 are reported in what follows.

To examine hypermnesia (an increase in the number of correct details recalled in Interview 2), a mixed-model analysis of variance (ANOVA) was performed with the number of details reported (correct details or errors) and interview (Interview 1 or Interview 2) as within-subjects factors and with interview instructions (children forewarned of second interview or children not forewarned of second interview) as a between-subjects factor. The results of this analysis showed that children reported a greater number of correct details than of errors, $F(1,38) = 339.66$, $p < .001$, and that there was a difference in the number of details reported across interviews, $F(1,38) = 8.24$, $p < .01$. There was also a significant interaction between these factors, $F(1,38) = 5.79$, $p < .05$ (Table 1). Further analysis of the interaction showed that although correct recall increased between the immediate interview ($M = 14.65$, $SD = 5.21$) and the interview 24 h later ($M = 16.60$, $SD = 6.15$), $F(1,38) = 7.07$, $p < .05$, total errors remained constant between the immediate interview ($M = 0.68$, $SD = 1.14$) and the interview 24 h later ($M = 0.78$, $SD = 1.05$). These findings indicate that the effect of repeated interviewing across a delay of 24 h can be characterized as a growth in the amount of correct information reported in the interviews but not in the amount of errors. The size of the hypermnesia effect was an additional 1.95 correct details recalled in the second interview. There was no main effect or interactions involving the factor of interview instructions.

Table 1
Mean numbers of details reported in Experiment 1

Condition	Immediate interview	24-h interview	Cumulative recall[a]
Correct			
Forewarned	15.75 (6.07)	17.45 (6.09)	22.00 (6.71)
Not forewarned	13.55 (4.76)	15.75 (6.26)	19.95 (5.72)
Overall	14.65 (5.21)	16.60 (6.15)	20.97 (6.24)
Errors			
Forewarned	0.65 (1.13)	0.65 (0.93)	1.05 (1.46)
Not forewarned	0.70 (1.17)	0.90 (1.16)	1.45 (2.11)
Overall	0.68 (1.14)	0.78 (1.05)	1.25 (1.80)

Note. Standard deviations are in parentheses.
[a] Cumulative recall is the number of details from the immediate interview plus new details from the 24-h interview.

To examine reminiscence (the cumulative recall of new details across Interviews 1 and 2), a mixed-model ANOVA was performed with the cumulative recall of details reported (correct details or errors) and interview (Interview 1 or Interview 2) as within-subjects factors and with interview instructions (children forewarned of second interview or children not forewarned of second interview) as a between-subjects factor. The cumulative recall of details across the two interviews was significant, $F(1,38) = 171.85$, $p < .001$, and overall there were more correct details than errors, $F(1,38) = 393.09$, $p < .001$. There was also an interaction between the cumulative recall of correct information and errors across the two interviews, $F(1,38) = 103.59$, $p < .001$ (Table 1). Two further analyses of the interaction showed that cumulative recall of correct details increased between the immediate interview ($M = 14.65$, $SD = 5.21$) and the interview 24 h later ($M = 20.97$, $SD = 6.24$), $F(1,38) = 143.91$, $p < .001$, and that the cumulative recall of errors increased between the immediate interview ($M = 0.68$, $SD = 1.14$) and the interview 24 h later ($M = 1.25$, $SD = 1.80$), $F(1,38) = 16.45$, $p < .01$. The magnitude of reminiscence was 6.32 new correct details in the second interview. The cumulative recall in the amount of correct details was greater in magnitude than the cumulative recall of errors, which amounted to less than 1 error on average; fully 92% of the new information reported in the second interview was correct. It seems that reminiscence and hypermnesia can occur after short delays due to repeated interviewing, as suggested by both laboratory and applied studies (e.g., Bluck et al., 1999; Erdelyi, 1996; Howe et al., 1992). The current study extends the findings of previous research to children's recall of an experienced event.

There was no effect of interview instructions in any analyses. Regardless of whether the children knew that they would be asked again about what they could remember, reminiscence and hypermnesia occurred. Thus, an explanation that reminiscence and hypermnesia depend on the participants deliberately trying to remember relevant information between interviews can be tentatively set aside. However, it remains possible that because the children were recruited from the same school, those who were not forewarned of the second interview may have nonetheless

suspected that they would be reinterviewed through conversations with their classmates (e.g., see Principe & Ceci, 2002).

Experiment 2

Experiment 2 examined hypermnesia in children's reports of an event after a delay of 6 months. We followed a procedure similar to that of Bluck and colleagues (1999), who found hypermnesia after an 8-month delay in adults' free recall of a realistic event when there were multiple interviews over a short time period. In the current experiment, children who had previously participated in Experiment 1 were followed up 6 months later and participated in three interviews separated by 5-min intervals. The interview protocol also differed from that used in the previous experiment; to be consistent with Bluck and colleagues, we used only a single free recall instruction, omitting the four open-ended cues referring to different aspects of the event. During the 5-min intervals, the children either drew a picture of what they could remember about their visit to the pirate (event-related drawing interval) or drew a picture about an unrelated activity (unrelated drawing interval).

The drawing manipulation was predicted to enhance both reminiscence and hypermnesia. Instructing participants to focus their thinking on the to-be-remembered material between recall attempts has been found to increase the amount of hypermnesia in laboratory studies with adults (Erdelyi & Becker, 1974) and has been used in applied studies to facilitate hypermnesia (Bluck et al., 1999; Bornstein et al., 1998). Laboratory research has also shown that there is greater hypermnesia for the recall of pictures than for the recall of words (Erdelyi & Becker, 1974) and that recall of words that are visualized produce hypermnesia (Erdelyi et al., 1976). Furthermore, with respect to children's recall, drawing has been shown to benefit recall by serving as a unique and individual retrieval cue (Butler, Gross, & Hayne, 1995; Gross & Hayne, 1999). We anticipated that asking the children to draw a picture of what they could remember about their pirate visit would help them to both *think about and visualize* information that they could remember from the event—information that would then be available for reporting in a subsequent interview. In the unrelated drawing condition, drawing served as a distracter that prevented the children from thinking about and visualizing what had happened between recall attempts.

Method

Participants

In Experiment 2, 35 children (19 boys and 16 girls) of the 40 children who originally participated in Experiment 1 were available for testing and were randomly assigned into the two drawing conditions (event-related drawing and unrelated drawing) with the constraints that there were approximately equal numbers of boys and girls in each drawing condition and that there were equal numbers of children from each condition in Experiment 1 in each of the drawing conditions in Experi-

ment 2. The mean age of the participants available at follow-up was 6 years 1 month ($SD = 4\frac{1}{2}$ months) at the time of the event. Caregivers gave written consent for their children to participate, and all children assented to participate in the interviews when they were called on to do so.

Materials and procedure

The children were interviewed about the event they had experienced as part of Experiment 1. After a 6-month delay, the children were interviewed three times about what they could remember about their visit to the pirate. Each interview consisted of a single open-ended request for the children to recall all that they could (e.g., Bluck et al., 1999). Although the children did not receive the four open-ended cues as they had in Experiment 1, general encouragers such as "Tell me some more things that happened" were used. Each interview ended when the child stopped responding. There was a 5-min interval between each interview. There were two interviewers, and each interviewer interviewed approximately equal numbers of boys and girls in each condition.

After the first interview, the children in the event-related drawing condition were given 5 min to draw a picture about what they could remember from when they had visited the pirate. After the second interview, the children were again given 5 min to draw another picture of what they could remember about the friendly pirate. The children who participated in the unrelated drawing condition drew pictures about what they did during their holidays. During the first 5-min interval, they drew a picture about what they did during their Christmas holiday. During the second 5-min interval, they drew a picture about what they did during their midyear school holiday. The children drew their pictures on white sheets of paper (210 by 297 mm) with crayons. While the children were drawing, the interviewer sat at a nearby table attending to "paperwork" that he or she needed to do. If a child spoke, the interviewer told him or her to continue drawing and that he or she (the interviewer) would be ready to continue shortly. The interviews were taped, transcribed, and coded as in Experiment 1. Two independent raters coded one third of the transcripts, and interrater reliability was 86.4%. One of the raters was aware of the conditions the children were in and one was not.

Results and discussion

Preliminary one-way ANOVAs performed on the number of correct details and errors in the first, second, and third interviews revealed that there was no effect of interviewer. A second set of analyses showed that there were no unpredicted effects of the manipulation in Experiment 1 (forewarned or not forewarned) on the first, second, and third interviews for correct information or for errors. Only significant results that exceed an alpha of .05 are reported in what follows.

To examine hypermnesia (an increase in the number of details recalled across interviews), a mixed-model ANOVA was performed with the number of details reported (correct details or errors) and interview (first, second, or third) as within-sub-

jects factors and with drawing condition (event-related drawing or unrelated drawing) as a between-subjects factor. The only significant effect was that children reported more correct details than errors, $F(1,66) = 90.93$, $p < .001$ (Table 2).

To examine reminiscence (the cumulative recall of new details across the three interviews), a mixed-model ANOVA was performed with the cumulative recall of details reported (correct details or errors) and interview (first, second, or third) as within-subjects factors and with drawing condition (event-related drawing or unrelated drawing) as a between-subjects factor. Children reported more correct details than errors, $F(1,66) = 86.16$, $p < .001$, and cumulative recall of details differed as a function of interview, $F(1,66) = 80.74$, $p < .001$. The interaction between these factors was also significant, $F(1,66) = 10.96$, $p < .001$ (Table 3). Further analysis revealed that the cumulative recall increased monotonically across the first interview ($M = 8.11$, $SD = 5.31$), second interview ($M = 11.40$, $SD = 5.80$), and third interview ($M = 12.89$, $SD = 5.97$) for correct details, $F(1,66) = 61.29$, $p < .001$, and across the

Table 2
Mean numbers of details reported at the 6-month follow-up in Experiment 2

Condition	Interview 1	Interview 2	Interview 3
Correct			
Pirate drawing	7.81 (6.46)	8.94 (4.09)	7.44 (4.60)
Unrelated drawing	8.37 (4.28)	8.47 (5.54)	9.05 (5.04)
Overall	8.11 (5.31)	8.69 (4.28)	8.31 (4.84)
Errors			
Pirate drawing	0.88 (1.20)	1.63 (2.47)	2.25 (2.59)
Unrelated drawing	0.37 (0.60)	1.05 (1.13)	1.53 (1.39)
Overall	0.60 (0.95)	1.31 (1.86)	1.86 (2.03)

Note. Standard deviations are in parentheses.

Table 3
Mean cumulative recall of details reported at the 6-month follow-up in Experiment 2

Condition	Interview 1	Cumulative recall at Interview 2[a]	Cumulative recall at Interview 3[b]
Cumulative correct			
Pirate drawing	7.81 (6.46)	11.75 (5.85)	12.75 (5.83)
Unrelated drawing	8.37 (4.28)	11.11 (5.90)	13.00 (6.25)
Overall	8.11 (5.31)	11.40 (5.80)	12.89 (5.97)
Cumulative errors			
Pirate drawing	0.88 (1.20)	2.19 (2.99)	3.87 (4.78)
Unrelated drawing	0.37 (0.60)	1.21 (1.03)	2.16 (1.80)
Overall	0.60 (0.95)	1.66 (2.18)	2.94 (3.54)

Note. Standard deviations are in parentheses.

[a] Cumulative recall at Interview 2 is the number of details from Interview 1 plus new details from Interview 2.

[b] Cumulative recall at Interview 3 is the number of details from Interview 1 plus new details from Interviews 2 and 3.

first interview ($M = 0.60$, $SD = 0.95$), second interview ($M = 1.66$, $SD = 2.18$), and third interview ($M = 2.94$, $SD = 3.54$) for errors, $F(1, 66) = 20.33$, $p < .001$. The increase in the cumulative recall of correct details was greater than that for errors. For correct details, the increase amounted to an extra 4.78 pieces of information and was twice that of the cumulative recall of errors (2.34). Of the new information reported by the third interview, 67% was correct.

There was no evidence of hypermnesia within the three testing periods at the 6-month follow-up, and there was no effect of the interpolated event-related drawing activity. These results are inconsistent with the findings of Bluck and colleagues (1999), who found hypermnesia after a delay of 8 months in adults. Clearly, from the analysis of the cumulative recall, new details were added to children's accounts in the subsequent interviews, although the amount of reminiscence was less than that observed in Experiment 1 due to forgetting. A practical consideration is that the absence of a hypermnesia effect might be because children did not repeat enough information from the previous interviews. It is possible that the children thought that because they had already provided details a few minutes earlier, there was little need to repeat them and so instead they focused on recalling new details. In addition, children were not prompted in any recall session. Experiment 2 used only free recall instructions, whereas Experiment 1 (in which hypermnesia was found) used four open-ended prompts after free recall to further elicit more complete narratives. It is possible that additional prompting facilitated the reporting of previously recalled details in additional interviews. This possibility was investigated in Experiment 3.

Experiment 3

Experiment 3 examined forgetting, reminiscence, and hypermnesia in children's eyewitness memory after a 6-month delay, following the interview protocol used in Experiment 1, in which hypermnesia was observed. Unfortunately, it was not possible to compare recall at 6 months in Experiment 2 with that soon after the event in Experiment 1 due to the different interviews used and the different intervals between the interviews. Therefore, in Experiment 3, all of the interviews were identical. The participants received a baseline interview immediately after their participation and were interviewed twice at the 6-month delay, with 24 h separating these two interviews. This design allowed us to examine forgetting and reminiscence between the immediate baseline interview and the 6-month initial interview and to examine reminiscence and hypermnesia across the 6-month initial and repeated interviews.

Method

Participants

The participants were 21 children (10 boys and 11 girls) recruited from local primary schools. The mean age of the children at the time of the event was 6 years $2\frac{1}{2}$ months ($SD = 5$ months). Caregivers gave written consent for their children's

participation, and all children assented to participate in the interviews when they were called on to do so.

Materials and procedure

The materials and the "visiting the pirate" event were identical to those used in Experiments 1 and 2. The children were interviewed immediately after their participation in the event, and two further interviews were conducted after a 6-month delay. At the 6-month delay, the interviews were 24 h apart. The interviews were identical in format to those in Experiment 1. At the 6-month delay, the children were forewarned that the interviewer would be returning and that they would be reinterviewed. All interviews were audiotaped and then transcribed.

Two interviewers conducted the immediate interviews. At the 6-month delay, one of the interviewers who had conducted the immediate interviews and one new interviewer were used. In the 6-month delay interviews, the interviewer who had previously interviewed children in the immediate interviews now interviewed children who he or she had not interviewed previously. Two independent raters coded one third of the transcripts, and interrater agreement was 88.3%.

Results and discussion

Preliminary analyses showed that there was no effect of interviewer on the amount of correct information recalled or on the number of errors.

Forgetting and reminiscence across the 6-month delay

To establish whether significant forgetting had occurred and whether the effect of delay was consistent with previous research (e.g., Jones & Pipe, 2002), a within-subjects ANOVA was performed with the number of details reported (correct details or errors) and interview (immediate interview or 6-month initial interview) as factors. The analysis showed that children reported more correct details than errors, $F(1,20) = 67.63$, $p < .001$, and that the total number of details reported overall decreased across the 6-month delay, $F(1,20) = 13.70$, $p < .001$. There was also an interaction between the number of details reported and the interview, $F(1,20) = 43.92$, $p < .001$. Two further analyses confirmed that the interaction could be characterized as a decrease in total amount of correct information between the immediate interview ($M = 15.66$, $SD = 6.68$) and the 6-month initial interview ($M = 9.72$, $SD = 6.94$), $F(1,20) = 33.75$, $p < .01$, and as an increase in errors between the immediate interview ($M = 0.57$, $SD = 0.68$) and the 6-month initial interview ($M = 2.00$, $SD = 2.70$), $F(1,20) = 6.44$, $p < .05$ (Table 4).

To examine reminiscence across the 6-month delay (the cumulative recall of new details across the immediate interview and the 6-month initial interview), a within-subjects ANOVA was performed with the number of details (correct details or errors) and interview (immediate interview or 6-month initial interview) as factors. This analysis showed that children reported more correct information than errors,

Table 4
Mean numbers of details reported in the immediate interview and the 6-month initial interview in Experiment 3

Condition	Immediate interview	6-month initial interview	Cumulative recall at the 6-month initial interview[a]
Correct	15.66 (6.68)	9.72 (6.94)	18.14 (7.22)
Errors	0.57 (0.68)	2.00 (2.70)	2.52 (2.99)

Note. Standard deviations are in parentheses.
[a] Cumulative recall at the 6-month initial interview is the number of details from the immediate interview plus new details from the 6-month initial interview.

$F(1,20) = 35.03$, $p < .001$, and that the cumulative recall of details increased across the 6-month delay, $F(1,20) = 105.36$, $p < .001$. However, there was no interaction between these factors indicating a similar increase in the cumulative recall of new errors and correct information (Table 4) across the 6-month delay. The magnitude of the increase was 2.48 correct details and 1.95 errors; just over half (56%) of the new information reported after the 6-month delay was correct.

Reminiscence and hypermnesia across the 6-month interviews

To examine hypermnesia after a 6-month delay (an increase in the number of details recalled in the 6-month repeated interviews), a within-subjects ANOVA was performed with the number of details (correct details or errors) and 6-month interview (6-month initial interview or 6-month repeated interview) as factors. The analysis showed only that children reported more correct details than errors, $F(1,20) = 31.22$, $p < .001$ (Table 5).

To examine reminiscence (the cumulative recall of new details across the 6-month initial and 6-month repeated interviews), a within-subjects ANOVA with the number of details (correct details or errors) and 6-month interview (6-month initial interview or 6-month repeated interview) as factors showed that children reported more correct details than errors, $F(1,20) = 28.57$, $p < .001$, and that there was an increase in the cumulative recall of details across the interviews, $F(1,20) = 30.86$, $p < .001$. The interaction between these variables was also significant, $F(1,20) = 5.98$, $p < .05$ (Table 5). Two further analyses showed that the cumulative recall of correct

Table 5
Mean numbers of details reported in the 6-month initial and 6-month repeated interview in Experiment 3

Condition	6-month initial interview	6-month repeated interview	Cumulative recall at the 6-month repeated interview[a]
Correct	9.72 (6.94)	10.57 (6.73)	12.62 (7.05)
Errors	2.00 (2.70)	1.81 (1.72)	3.14 (3.52)

Note. Standard deviations are in parentheses.
[a] Cumulative recall at the 6-month repeated interview is the number of details from the 6-month initial interview plus new details from the 6-month repeated interview.

information increased between the 6-month initial interview ($M = 9.72$, $SD = 6.94$) and the 6-month repeated interview ($M = 12.62$, $SD = 7.05$), $F(1,20) = 19.07$, $p < .001$, and that the cumulative recall of errors increased between the 6-month initial interview ($M = 2.00$, $SD = 2.70$) and the 6-month repeated interview ($M = 3.14$, $SD = 3.52$), $F(1,20) = 15.87$, $p < .001$. The magnitude of the cumulative recall of correct information was 2.90 pieces of information, which was twice that of the increase in errors (1.14) across the same interviews; nearly three quarters (72%) of the new information provided in the 6-month repeated interview was correct.

General discussion

In these experiments, we examined reminiscence and hypermnesia in 5- and 6-year-olds' verbal recall of an event when repeated interviews occurred soon after the event or following a long delay. Reminiscence (the recall of new information) proved to be reliable across all three experiments. In each experiment, open-ended recall instructions were sufficient to elicit the new information. However, repeated interviewing did not consistently produce hypermnesia. Hypermnesia occurred only in Experiment 1, with the total amount of correct information recalled increasing by 13% across the two interviews conducted immediately and 24 h after the event, respectively. In Experiments 2 and 3, when the repeated interviews took place following a 6-month delay, hypermnesia was not observed. The total number of errors that was reported within an interview did not increase across repeated interviews separated by 5 min or 24 h in any of the experiments, whereas the cumulative recall of new errors did increase.

Although there was forgetting, it is interesting that from the perspective of eyewitness memory, a second interview at the 6-month delay elicited new information. New details were added regardless of whether the interviews were separated by a 5-min interval (following the procedure used by Bluck et al., 1999), a 24-h delay, or a 6-month delay. Previous research has shown that children also report new information when there are long delays between repeated interviews, for example, the first interview conducted soon after the event and the second interview conducted 6 months after the event (e.g., Pipe et al., 1999; Salmon & Pipe, 1997, 2000). Together with these past studies, the current findings suggest that reminiscence is a reliable and robust phenomenon in children's eyewitness recall of past events over both short and long delays. However, delay duration does exert an influence. The number of new details reported when the interviews occurred after a 6-month delay was fewer than that reported when the interviews occurred soon after the event.

An inconsistency of our findings compared with those in applied adult hypermnesia research is that children's reports included increasing numbers of new errors across interviews in all three experiments. In Experiment 1, when the interviews occurred immediately and 24 h after the event, the magnitude of the increase was less than a single error and accounted for approximately 8% of all the new information. Compared with the much larger increase in the recall of correct details, this relatively minor increase in errors would not appear to compromise the accuracy of new

information elicited. However, at the 6-month delay, when interviews were conducted 5 min or 24 h apart, errors represented approximately 30% of all the new information recalled. In Experiment 3, errors represented 44% of the new information reported between the immediate baseline interview and the 6-month initial interview. However, the higher percentage of errors should be considered in the context of an overall decrease in the amount of new information reported after the 6-month delay.

The finding of hypermnesia in Experiment 1, coupled with the greatest amount of reminiscence, is consistent with the recommendation that eyewitness interviews with young children should be conducted as soon as possible before too much forgetting has occurred (Jones & Pipe, 2002; Pipe et al., 1999; Pipe & Wilson, 1994; Salmon & Pipe, 2000) and suggests additional advantages. After short delays between experiencing an event and recalling it, children's accounts are generally more accurate and contain few errors when open-ended cues are used. The current research suggests that if children receive multiple interviews while their memories are "fresh" immediately after the event of interest, hypermnesia occurs without an increase in the total amount of errors across interviews. The hypermnesia finding is consistent with that of Dent and Stephenson (1979) and extends their findings to encompass increases in recall for younger children used in our study. The improvement in recall across repeated interviewing in Experiment 1 also did not depend on whether or not the children had been forewarned that they would be reinterviewed. In a real-life situation, interviewers might not want to set up the expectation that there will be a second interview before the first one has begun. In particular, interviewers might not know whether a second interview will be required until the first one has been completed.

We had expected that, based on previous research, repeated interviewing would result in both reminiscence and hypermnesia in all three experiments. The trace integrity theory (Brainerd, Reyna, Howe, & Kingma, 1990; Howe et al., 1992), however, does provide a partial explanation for why we observed a reduction in the amount of reminiscence over time and, hence, the absence of hypermnesia. Brainerd and his collaborators (1990) argued that reminiscence and hypermnesia can occur due to retrieval relearning (a process in which recall cues become increasingly effective) or as a result of reintegration of the memory trace (a process in which the memory is restored). In the current study, when children were interviewed immediately after the event, little forgetting had occurred and retrieval relearning might have facilitated reminiscence and hypermnesia. Because no forgetting had taken place, repeated retrieval attempts during the interviews were highly effective at accessing additional information to the point where increasing amounts of information could be recalled. In contrast, by 6 months, the children had forgotten a significant amount of what they had originally encoded about the event. Before correct details can be retrieved, the memory trace must be reintegrated from related information, and this may be a more effortful and time-consuming mental process. However, even if it were more difficult to reminisce new information after forgetting has occurred, the trace integrity theory does not help us to understand why we did not obtain hypermnesia. What remains to be explained is why, after a 6-month delay, there appears to be trial-to-trial forgetting of correct information that is similar in magnitude to the

reminiscence of new information, with the end result being neither an increase nor a decrease of correct details reported across repeated interviews.

The event used in this study, although realistic and enjoyable for the children, did not carry with it the personal significance of events that are known to be well remembered, and it is possible that hypermnesia might be observed and reminiscence might be enhanced when the event is of personal significance. For example, Peterson and her colleagues examined memory for a personal injury and subsequent hospital treatment of children between 2 and 13 years of age in interviews consisting largely of free and cued recall. After an initial interview, interviews were repeated at delays of 1 week, 6 months, 1 year, 2 years (Peterson, 1999; Peterson & Bell, 1996), and 5 years (Peterson & Whalen, 2001). Peterson and Bell (1996) found that the percentage of relevant information reported by the children decreased up to the 6-month interview. At a 2-year delay, Peterson (1999) observed an effect of delay only on details about the visit to the hospital. When these children were followed up and given a final interview 5 years later, effects of delay were once again found. At this long 5-year delay, the memory decrements were now confined to recall of peripheral information about the injury and memory for the visit to the hospital (Peterson & Whalen, 2001). Peterson also reported that new information added to the children's accounts about the salient aspects of the events was generally accurate. Thus, at the longest delays (2 years and 5 years), memory for the injury was maintained; therefore, there may have been new details that could be reported across multiple interviews.

Fivush, McDermott Sales, Goldberg, Bahrick, and Parker (2004) interviewed 3- and 4-year-olds about what they could remember about Hurricane Andrew between 2 and 6 months after the hurricane and again 6 years later. The interviews consisted of open-ended requests for children to tell all they could remember about the stressful event. The results showed that across the 6-year delay, the amount of information that the children reported doubled and that what was reported in the 6-year interview contained very few details that had been reported earlier. Fivush and colleagues suggested that the children reconstructed what they had remembered about the events over the course of time and that the stories they told changed in accordance with what was relevant to their own lives. It would have been interesting to see what would have happened to the level of reminiscence if the children had been interviewed 2 days in a row at the 6-year delay. Given that they were able to report so much new information about the event, a second interview may have resulted in hypermnesia.

Repeated interviewing may also be a sufficient way of maintaining memory across long delays. Pipe and colleagues (2004) followed up children who were originally interviewed immediately or after a delay of 1 day, 1 week, 1 month, and 6 months as part of an earlier study. Pipe and colleagues reinterviewed these children 1 and 2 years after the event and included a control group whose members were interviewed only at the 1- and 2-year delays. The results suggested benefits to long-term recall when an intervening interview occurred at the 6-month delay rather than shortly after the event. It appeared that the single interview at the 6-month delay attenuated further forgetting. In Pipe and colleagues' study, children received only a single interview at each delay, and it is unknown whether repeated

interviewing across short delays would have been of even greater benefit for long-term memory.

Clearly, there is a need for future research to further explore the effects of repeating open-ended interviews on children's reports of past events. Relatively few studies have explored the effects of repeating open-ended interviews as a means of enhancing accurate recall in children. Our study has shown that there are advantages to repeating interviews with young children, with the greatest benefits occurring when the interviews take place soon after the event (Experiment 1). However, although our interview protocol was open-ended, it remains to be discovered whether free recall instructions alone would have been enough to obtain hypermnesia. When hypermnesia was obtained, the children also received four open-ended cues targeting specific aspects of the event, and it is possible that it was these cues that facilitated hypermnesia. Therefore, a short delay might be necessary, but whether it is sufficient remains to be determined. Moreover, children are not always interviewed soon after alleged events have occurred, and our results also show that new errors are likely to be reported after a delay of 6 months. It is also important to be mindful that the experiments reported here examined children's memory for an event under conditions that facilitate accurate recall. When children are interviewed in real-world contexts, they are not necessarily asked exclusively open-ended questions, and the effects of repeating specific and leading questions may differ from those observed here. What is clear is that children have more to tell than simply what they report in a single interview and that there may be advantages to repeating open-ended interviews designed to elicit accurate recall.

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