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A Decade Later: Adolescents' Memory for Medical Emergencies

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Summary: Approximately a decade earlier, 39 adolescents (3–5 years old at the time of event occurrence) were interviewed about stressful injuries serious enough to require hospital emergency room treatment. Parent and/or other witnesses were also interviewed to provide a record against which children's recall was compared. Prior to the current follow-up, the adolescents had varying numbers of interviews (2–5), and half had been interviewed 5 years previously, whereas the remainder had not been interviewed for 8 or more years. In spite of the long delay since injury and the young age of the adolescents at the time, their recall of their injury was still excellent in terms of completeness, unique narrative detail, and accuracy, although there was a small decrease in accuracy. However, recall of hospital treatment was poorer and showed significant deterioration over time. In addition, the presence of an interview after 5 years (halfway through the 10-year delay) as well as the number of interviews had no significant effect on 10-year recall of either event, although more interviews tended to make free recall of the injury more detailed.

The present study explores adolescents' recall of a highly salient emotional event approximately a decade after it occurred, focusing on whether discussion through formal interviews influences that recall. Adolescents were asked to recall injury events they had experienced when they were between 3 and 5 years of age, which were serious enough to require hospital emergency room treatment. The children themselves as well as independently interviewed adult eyewitnesses provided accounts of those events shortly after they had transpired, providing records against which later recall could be compared. Over the subsequent decade, adolescents were re-interviewed although as detailed in the succeeding paragraphs, different adolescents were re-interviewed a different number of times.

The theoretical concepts of consolidation and reinstatement can help explain how interviews may help maintain memories. Consolidation refers to the processing that takes place when sensory input is transformed into more durable memory representations (Bayliss, Bogdanovs, & Jarrold, 2015), and talking about an event soon after it occurred can help a child to consolidate memory of the event (Fivush, 2011). Reinstatement refers to the provision of cues or reminders of an event at a later point in time (Hudson & Grysman, 2013). Successful reminders can take various forms, and considerable research shows that memory conversations with parents or other adults remind and reinforce event memories (Fivush, 2011; Larkina & Bauer, 2012). Importantly, repeated interviews can also provide effective reinstatement because they foster systematic and detailed recall of a target event (La Rooy, Pipe, & Murray, 2005).

A number of researchers have explored the effects of reinstating interviews on subsequent recall (see review in Hudson & Grysman, 2013). In some studies, interim interviews prior to a final interview have had beneficial reinstating effects. For example, Hudson (1990) found that 4- to 5-year-olds who were interviewed immediately after a workshop had better memory after 4 weeks than did other children. Likewise, Pipe, Sutherland, Webster, Jones, and La Rooy (2004) found that interim interviews helped 5- to 7-year-olds recall a pirate event at both 1 and 2 years. More pertinent to the present study is the research by Peterson and her colleagues: Tizzard-Drover and Peterson (2004) interviewed 3- to 9-year-olds about injuries resulting in emergency room treatment after 1 year, with some children having had prior reinstating interviews and others not, and these children were followed up after 2 years by Peterson, Pardy, Tizzard-Drover, and Warren (2005). For 3- to 4-year-olds, having an early reinstating interview fostered better recall at 1 year, and after 2 years, recall for the hospital event (although not their injury) was still poorer if they had not had early reminders of the event through early interviews.

In all the aforementioned studies, accuracy of the children's information could be assessed by independent means. However, in some cases, repeated interviews have had beneficial effects in forensic field situations. For example, La Rooy, Katz, Malloy, and Lamb (2010) discuss cases in which repeated interviewing of child abuse victims led to new and forensically crucial data.

Although some research has documented beneficial reinstatement effects of repeated interviews, others have shown no measurable effect. For example, reinstating interviews had little effect on 6-year-old children's recall of a magic lesson (Gee & Pipe, 1995), even a year later (Pipe, Gee, Wilson, & Egerton, 1999), or on young children's recall of a pediatric checkup (Ornstein et al., 2006), or on 3- to 5-year-olds' memory of playing in a lab (Quas et al., 2007). However, it is important to emphasize that in these studies, there was little suggestive questioning or misinformation introduced, and so these issues are not considered here.

Summarizing the aforementioned literature, earlier reinstating interviews sometimes were found to help children's subsequent recall of target events, but in other research they had little effect. Three potential contributors to this variation are explored in the present investigation. These include content of the event, number of interviews, and timing of those interviews.

In terms of content, the events explored here are not mundane, everyday events—and mundane events are typically more poorly recalled (Peterson, 2002) and thus reminders may be more important for them. Rather, the target events

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were painful, distressing, and highly salient, and were also talked about frequently at the time they occurred by the children themselves as well as their families. However, there were two target events: the children's injury experience and the subsequent treatment at the hospital. Prior research has found that even over a 5-year delay, the injury event is extremely well recalled, with no deterioration in completeness of recall in terms of the components of that experience, only a relatively small decrease in accuracy and an increase in the number of details they provide (see summaries of this body of research in Peterson, 2011, 2012). In contrast, the hospital event, although equally stressful (Peterson & Bell, 1996), is not as well recalled. Potential explanations for this discrepancy are that the hospital was less likely to be the focus of extensive family discussions at the time of injury, and the hospital event was less coherent in children's understanding. Thus, reinstating interviews may be more helpful for children's 10-year recall of their hospital experience compared with their injury.

A second potential factor is the timing of interviews, and research suggests that timing can play a role in long-term recall. For example, Roberts and Powell (2007) found that the timing of misinformation sessions was a significant influence on children's recall, with early sessions most beneficial for later accurate recall. An advantage for early interviews was also found by Pipe et al. (2004), who assessed 5- to 7-year-olds' memory for a pirate event at both 1 and 2 years. Some children had early interim interviews immediately or at delays of 1 day, 1 week, 1 month, or 6 months. Those with early interviews (within the first week) had more accurate recall after 1 year, suggesting that an early opportunity to talk about the event through an organized and systematic interview helped their recall a year later. This beneficial effect of an immediate interview was also found by Tizzard-Drover and Peterson (2004): 3- to 4-year-olds (although not older children) had greater recall and accuracy about their injury and hospital treatment that had occurred a year earlier if they had an interview shortly after the event. However, these beneficial effects were no longer discernible after a delay of 2 years in interviews about the pirate event (Pipe et al., 2004) or injury (Peterson et al., 2005). In contrast, an early interview still fostered more accurate recall about the hospital as well as more extensive free recall about the hospital (Peterson et al., 2005).

Other researchers have explored the effects of late initial interviews on subsequent recall. The theoretical construct of reactivation predicts that an initial interview that is delayed (such that recall is more effortful) will be more effective at maintaining long-term memory than an early initial interview (Hayne & Rovee-Collier, 1995). Some research supports this. Powell and Thomson (1997) as well as Hudson and Sheffield (1998) found that children who were initially interviewed after some weeks had gone by after an event tended to recall more at a long-term interview than did children who had been initially interviewed after 1 week. Similarly, Pipe et al. (2004) found that children whose initial interviews were 1 or 6 months after a target event had better open-ended recall at 1 year than did children who had been interviewed within a week of the event. These studies suggest that when an interview occurs after some forgetting has occurred and thus requires more effortful retrieval, long-term maintenance of the memory is enhanced.

In the present study, all adolescents had an initial interview shortly after injury, and thus the predicted effects of initial interviews do not differ between individuals. However, although different adolescents had variable numbers of interviews within the first 2 years, only half had interviews 5 years after injury. Thus, half of the adolescents had extensive verbal reminders of the events after 5 years, whereas the remainder had not had a reinstating interview for 8–10 years.

The third factor explored here is the number of interviews. In a review of studies that incorporated repeated interviewing (La Rooy, Lamb, & Pipe, 2009), the authors concluded that the effects of repeated interviewing are not clear. Of the 50 reviewed studies, two-thirds showed decreases in the amount of accurate recall, although for the 14 studies classified as stressful, only half demonstrated such decreases. Furthermore, decreases in the amount of accurate recall were more characteristic of those studies that had only two interviews. Those with four interviews were likely to have no change in recall, whereas the rare studies with five or more interviews tended to show increases not only in the amount of accurate recall, but also increases in errors. As argued by Peterson (2011), whether one finds increases or decreases or no change in memory performance over time can also partly depend upon what property of memory one is measuring. In her assessment of children's recall of an injury over a 5-year delay, the relative completeness of accurate recall was unchanged, percentage accuracy of the children's accounts decreased, and the number of information details they provided increased. (She did not assess recall of hospital treatment, so trends for this event are unknown.). In their assessment of repeated interviews, Goodman and Quas (2008) stress that 'it is more than just how many' (p. 386), with other properties of the interviews, such as their timing and nature, also being important factors.

In the review of La Rooy et al., almost all of the studies spanned a relatively short delay. Very few measured recall over several years. In those studies that do have long-term follow-ups, children's recall after long periods of time can at times be detailed and accurate. For example, Fivush, Sales, Goldberg, Bahrick, and Parker (2004) found that former 3- to 4-year-olds could recall extensive information about a devastating hurricane when re-interviewed 6 years later. And as described earlier, children who experienced injuries requiring emergency room treatment still had excellent recall of their injury 5 years later (Peterson & Whalen, 2001). In terms of more mundane events, although many (or even most) events initially experienced by preschoolers are subsequently forgotten, some children can provide considerable accurate detail several years later about the events that they do recall, although significant prompting may be required (Hudson & Fivush, 1991). However, little research has investigated delays that span a decade or more when the target events had occurred while children were preschool-aged.

In the present study, I took advantage of the existence of a unique sample of adolescents who had documented stressful injuries approximately a decade earlier. Former 3-to 5-year-olds at the time of injury who could be traced were re-contacted. Half had been interviewed 5 years previously, whereas the

rest had not been interviewed for at least 8 years. Furthermore, the number of prior interviews they had experienced varied between 2 and 5. The investigation explored memory for two types of events, their injury and the hospital visit. According to parental reports, the injury event was highly discussed with children at the time it occurred, whereas conversation was much less detailed about what happened in the hospital. When the families were visited at each successive interview, they were asked about how much the target events had been discussed since our last visit, and on all those after 6 months had passed the parents claimed that the events either had not been talked about at all or there had occasionally been only brief allusions to them since the events were 'old news'. Similar patterns of event discussion have been found by others (e.g., Fivush & Schwarzmueller, 1995).

In terms of event content, it was expected that the injury event would be considerably more memorable than the hospital one because this had been true in prior similar research (see review in Peterson, 2012). Although there had been little deterioration in memory completeness or accuracy for the injury event after 5 years (Peterson & Whalen, 2001), and the amount of narrative unique detail about the injury even increased over time (Peterson, 2011), there is no clear prediction about how well the adolescents' memory of the injury will be maintained over a decade except that a deterioration in accuracy is expected. However, deterioration of memory for the hospital event in completeness, accuracy, and amount of narrative detail is predicted.

In terms of interview timing, only half of the adolescents had a detailed reinstatement of their injury and hospital treatment 5 years after their injury, and it is hypothesized that those adolescents would have better recall, particularly about the harder-to-remember hospital event.

In terms of the number of interviews, prior research has been inconsistent (La Rooy et al., 2009), although there seems to be a tendency for more interviews to be associated with better recall, presumably because of reinstatement effects. However, none of the studies incorporated as lengthy a delay between interviews as is found here. Thus, no a priori hypothesis is proposed.

METHOD

Participants

Approximately a decade earlier, participants had been recruited from the emergency room of the only children's hospital in Newfoundland, Canada, where they had been taken because of an injury requiring outpatient treatment (e.g., broken bones or lacerations requiring suturing). The current sample includes 39 adolescents (19 girls) who were able to be contacted after such a long time delay (mean delay = 10.8 years, $SD = 2.1$ years, range = 8.5 to 15.6 years), which constitutes 41.9% of the 93 children of target ages who had initially participated. An additional four adolescents declined to be interviewed. Preliminary analyses showed no differences in initial recall between participants and the other 54 children. The sample included 12 adolescents who had been 3-year-olds at the time of injury, 13 former 4-year-olds, and 14 former 5-year-olds (current ages 12.1–19.7 years). All were White and because medical care is free in Canada, they represent a cross-section of the community in terms of socio-economic status.

The interview history of the adolescents differed. Nineteen had been interviewed at 5 years post-injury, whereas 20 had not. The total number of interviews varied between 2 (initial and one other) and 5 (initially and after 6 months, 1 year, 2 years, and 5 years). Overall, 15 adolescents had been interviewed twice before, 11 had been interviewed three times, 10 had been interviewed four times, and 3 had been interviewed five times prior to the present interview.

Procedure

At the time of original recruitment, families had been approached in the emergency room and interested families were contacted a few days later to set up home visits. Both children and adult witnesses to their injury (usually parents) were individually interviewed (Peterson & Bell, 1996). The initial witness interviews were the 'gold standard' against which all later child interviews were compared. For the present study, traceable families of former 3- to 5-year-olds at the time of injury were contacted and asked if we could interview the adolescents again about their prior injury. Parents were asked to not discuss the target event with their adolescents prior to the interview. Written or oral consent (for parents) or assent (for adolescents) was obtained. Although all prior interviews had taken place in the children's homes, six of the final interviews were conducted there and the remainder conducted by telephone. Preliminary analyses showed no differences because of the location of the interview.

The interview was the same as used in all earlier studies. Adolescents were reminded about their injury when they had been taken to the hospital a long time ago ('Remember that time a long time ago that you broke your arm? Tell me everything you can remember about it. What happened?') Interviews always began with free recall, followed by a series of question probes in mostly Wh- question format ('Where were you when it happened? Who was with you? What did you do when you first got hurt?'). A complete list of probes can be found elsewhere (Peterson & Bell, 1996; Peterson & Whalen, 2001). All interviews were transcribed verbatim, and scoring was performed from transcripts. All aspects of this study were approved by the university's human investigation committee for ethical treatment of human participants.

Data coding

The same coding procedures were used here as in Peterson (2011). However, unlike in Peterson (2011), information about both the injury event and the hospital event are included, although injury and hospital data are analyzed separately. Four types of data were coded, as described in the succeeding sections. Both total and free recall were scored; free recall included information provided after the initial open-ended prompt ('Tell me everything you remember about …'), whereas total recall included all information provided by adolescents, whether in free or prompted recall.

Recall completeness

In earlier research, idealized prototypes of typical injury and hospital treatment events had been developed (Peterson & Bell, 1996). Although each child's injury and treatment were unique, it conformed to most components of this prototype, albeit some elements may have been omitted for a particular child (e.g., a child who broke a bone did not obtain sutures). Through initial witness interviews, we had determined which elements of the prototype applied to each child. The same individuated prototype used in previous assessments of each child's recall was used here. Because there were different numbers of relevant prototype components for different adolescents, their completeness scores are presented as percentages: the number of components of the injury or hospital prototype that they had recalled divided by the total number of relevant components that they could have included, according to adult witness report. For example, if a parental report at the time of injury identified 14 components of the injury prototype as relevant to her child's injury but the adolescent a decade later only recalled 10 of them, she was given a percentage recall score of 71.4%. Only components that were accurately recalled are presented here; errors in recalling prototype components are presented in the succeeding sections.

Accuracy of completeness components

Only commission errors were counted, that is, instances in which an adolescent stated information that was explicitly contradicted by the adult witness report. Instead of using the *possible* components that adolescents potentially could have remembered as the denominator in calculations (as in the completeness measure earlier), this measure used the *actual* number of components that adolescents provided, and then the percentage of those components that was accurate was derived. For example, if an adolescent provided nine correct components and one incorrect one, her percentage accuracy score was 90.0%.

Unique narrative detail

Each unique unit of information introduced by the adolescent was identified, for both the injury and hospital events. These included details pertaining to person (e.g., 'Mom was there'), location (e.g., 'We were at my Nan's'), action (e.g., 'Then I fell'), object (e.g., 'Out of the tree'), and attribute (e.g., 'It was a big tree'). The data presented here are frequency counts of how many unique narrative details were provided by the adolescents.

Accuracy of unique narrative detail

Adult witness transcripts were searched to assess the accuracy of each unique unit of information provided by the adolescents. Accuracy proportions were calculated by dividing the number of details confirmed as accurate by the number of details confirmed as accurate plus inaccurate. However, approximately 8% of the unique details provided by adolescents were unable to be confirmed as either accurate or inaccurate. These were excluded from calculations of accuracy.

Reliability of scoring

Two raters scored 13% of the transcripts and the rest were coded by one coder. Agreement for completeness was 95%, for accuracy of components was 90%, for the number of unique narrative details was 90%, and for the accuracy of those details was 85%.

RESULTS

Data for recall of the injury event are presented first, followed by data for hospital treatment. For both types of events, data for total recall (free plus prompted) are presented before data for free recall. All 39 adolescents provided recall about their injury experience when the entirety of their interview was considered (i.e., total recall), but four adolescents provided no information about their hospital experience in their 10-year interview even when prompted extensively. Data from these adolescents are included in analyses of the injury event as well as the analyses of hospital completeness and number of unique details (because all adolescents could have potentially provided relevant information but did not). However, they are excluded from analyses of hospital accuracy percentages because these are calculated by dividing the number of correct details adolescents provide by the total of accurate plus inaccurate details.

In terms of injury free recall, all of the adolescents provided free recall about their injury in the 10-year interview, although two of them provided no free recall during their initial interview. These adolescents are deleted in analyses of accuracy when initial and 10-year recalls are compared. However, because all adolescents provided free recall about the injury event in their final interview, all are included in the analyses that only consider 10-year interview data. In terms of hospital free recall, a number of adolescents did not provide free recall about the hospital event. Four adolescents did not provide hospital free recall initially although they did in their 10-year interview, seven adolescents did not provide free recall in either visit, and four adolescents provided no hospital free recall in their final interview although they had obtained so initially. Analyses of completeness and number of unique details include all 39 adolescents because data relevant to these categories could have been provided. However, for analyses of accuracy, those that compare initial and final recall only include 24 adolescents, whereas the analyses that use only the 10-year data include 28 adolescents.

In addition, analyses of the accuracy of unique details exclude those details that were unable to be confirmed either as correct or as errors. For injury recall, 10.3% of adolescents' unique details in their initial interview and 7.6% in the final interview were unable to be confirmed, and for hospital recall, 9.0% in the initial interview and 6.4% in the final interview could not be confirmed. Preliminary analyses of variance (ANOVAs) were calculated on unconfirmed details with Time (initial versus last interview) a repeated variable, and it was not significant for either event. Therefore, unconfirmed details are not considered further.

Below, adolescents' recall at their final interview is first compared with their initial recall through repeated measures

ANOVAs. Next, initial ages of the children (i.e., their age in months at the time of injury) were centered around zero, and the repeated measures analyses were re-calculated with age as a covariate. Subsequently, potential factors that might affect their 10-year recall were explored through regression analyses, namely, timing of interviews (specifically, whether or not they had a 5-year interview) and number of interviews. Because the sample is relatively small and there are a relatively large number of analyses, a more rigorous p-value is used ($p \leq .01$).

Injury total recall (free plus prompted recall)

Comparing initial and 10-year recall

A series of repeated measures ANOVAs was calculated with time (initial versus last interview), the only variable. The data are presented in Table 1. Subsequently, the analyses were re-run with age at the time of injury (centered), the covariate. This allowed assessment of not only age but the time × age interaction.

In terms of completeness of recall, there was no significant main effect for time. When age was entered as a covariate, age was significant, $F(1, 37) = 11.18$, $p = .002$, $\eta^2 = .232$—adolescents who had been older at the time of injury were more complete than those who had been younger. There was also a significant time × age interaction, $F(1, 37) = 10.61$, $p = .002$, $\eta^2 = .223$. Although younger children initially recalled proportionately fewer prototype components than did older ones, 10 years later the completeness scores were similar across age. For the accuracy of completeness components, there were no significant differences over time although there was a tendency for adolescents to be less accurate 10 years later than initially, ($p = .035$). When age was added as a covariate, there were no significant effects.

For the number of unique details, adolescents tended to provide more correct details in their 10-year interview than initially ($p = .047$), and those who had been older at the time of injury tended to provide more unique details than did their younger peers ($p = .017$). In terms of the accuracy of unique details, these details became less accurate with time, $F(1, 38) = 13.87$, $p = .001$, $\eta^2 = .267$. Accuracy decreased from 91.6% to 84.6%. The addition of age had no effect.

Table 1. Comparisons of total recall (free + prompted recall) of initial and 10-year follow-up interviews: means and *SD*s for completeness, completeness accuracy, number of unique details, and accuracy of unique details

		Initial interview		10-year interview	
Measure	*N*	*M*	*SD*	*M*	*SD*
Injury event					
% Completeness	39	72.2	13.9	70.2	15.3
% Completeness accuracy	39	90.5	8.7	86.6	8.4
Number of unique details	39	37.6	14.7	44.6	18.6
% Unique detail accuracy	39	91.6	8.3	84.6	9.6
Hospital event					
% Completeness	39	58.2	18.3	31.5	19.1
% Completeness accuracy	35	92.6	10.2	81.5	19.9
Number of unique details	39	34.2	17.6	21.1	17.1
% Unique detail accuracy	35	92.8	8.7	87.2	14.6

Potential factors influencing 10-year recall

A series of hierarchical regression models were built to predict adolescents' 10-year recall performance in terms of completeness, accuracy of that completeness, number of unique details, and accuracy of those details. Three variables were entered: (1) age at the time of injury, measured in months; (2) timing of interviews, assessed by presence of a 5-year interview (yes versus no); and (3) number of interviews (varying between 2 and 5). In the hierarchical regressions, age was entered in step 1. In step 2, either presence of a 5-year interview or number of interviews was entered. In step 3, the interaction between that variable and age was entered. The dependent variables were the adolescents' recall performance in their 10-year interview, with separate regressions conducted for each of the four types of recall: completeness, completeness accuracy, number of unique details, and accuracy of those details. Because age as a separate variable has already been presented earlier as a covariate in the ANOVAs, only findings related to timing and number of interviews are presented for all regression analyses, here and and in the succeeding sections. None of the regression models were significant for either predictor variable. That is, neither the presence of a 5-year interview nor the number of prior interviews was predictive of adolescents' recall about their injury in their 10-year interview.

Injury free recall

Comparing initial and 10-year recall

A parallel series of repeated-measure ANOVAs were calculated with time (initial versus last interview), the repeated measure and means are presented in Table 2. Subsequently, the analyses were re-run with age as the covariate. Results for free recall are quite different from total recall.

For completeness of recall, adolescents provided considerably more prototype components in their last interview ($M = 39.1\%$) than they had as young children ($M = 22.2\%$), $F(1,38) = 33.04$, $p < .001$, $\eta^2 = .465$. When age was added as a covariate, there were no significant effects. The accuracy of completeness components did not differ over time, and the addition of age as a covariate had no effect. The number of unique details significantly increased over time (from 7.6 to 21.2 details), $F(1, 38) = 35.66$, $p < .01$, $\eta^2 = .484$, and there

Table 2. Comparisons of free recall of initial and 10-year follow-up interviews: means and *SD*s for completeness, completeness accuracy, number of unique details, and accuracy of unique details

		Initial interview		10-year interview	
Measure	*N*	*M*	*SD*	*M*	*SD*
Injury event					
% Completeness	39	22.2	11.6	39.1	15.2
% Completeness accuracy	37	94.8	14.0	93.1	12.7
Number of unique details	39	7.6	4.8	21.2	14.3
% Unique detail accuracy	37	98.5	5.5	91.0	13.5
Hospital event					
% Completeness	39	12.1	12.0	9.6	9.1
% Completeness accuracy	24	95.8	20.4	85.8	23.7
Number of unique details	39	6.49	6.36	6.46	7.90
% Unique detail accuracy	24	93.1	16.1	88.8	18.5

was a tendency for those who had been older at the time of injury to provide more details than did those who had been younger ($p = .045$). However, the accuracy of unique details decreased, $F(1,36) = 9.97$, $p = .003$, $\eta^2 = .217$.

Potential factors influencing 10-year recall

Parallel to analysis of adolescents' total recall, a series of hierarchical regression models was built to predict adolescents' 10-year free recall in terms of completeness, number of unique details, and accuracy of both. As before, age at time of injury was entered in step 1, either the presence of a 5-year interview or the number of prior interviews was entered in step 2, and in step 3 the interaction between these factors and age was entered. None of the regressions was significant, although there was a tendency for more interviews to be associated with more unique details ($p = .039$). Those with two interviews (N = 15) provided a mean of 16.6 unique details, those with three interviews ($N = 11$) provided 23.5 details, those with four interviews ($N = 10$) provided 20.2 details, while those with five interviews ($N = 3$) provided a mean of 38.7 details.

Summary

In terms of injury total recall, a delay of approximately a decade had relatively little effect on recall, except that the accuracy of unique details decreased and there was a tendency for the accuracy of completeness components to decrease too. There was a tendency for more unique details to be provided in the 10-year interview than initially as well. Furthermore, those adolescents who had been older at the time of injury provided more complete accounts; this interacted with time such that children who were younger recalled fewer completeness components in their initial interview, but as adolescents, the recall of younger and older participants converged. In addition, those adolescents who had been older when injured tended to provide more unique details.

In terms of injury free recall, the completeness as well as the number of unique details in adolescents' free recall about their injury increased over time, although the accuracy of unique details decreased. There was also a tendency for those adolescents who had been older at the time of injury to provide more details than did those who had been younger.

In terms of regression analyses, neither the presence of an interview 5 years after injury nor the number of interviews had a significant effect on recall 10 years later, although there was a tendency for more interviews to be associated with more unique details.

Hospital total recall (free plus prompted recall)

Comparing initial and 10-year recall

Another series of repeated-measure ANOVAs was calculated with time (initial versus last interview) the repeated measure (see Table 1 for means and *SD*s), and these were followed up by re-analyses with age as a covariate.

In terms of completeness of recall, adolescents were much less complete 10 years later than initially (*M*s = 31.5% vs 58.2%), $F(1, 38) = 48.85$, $p < .001$, $\eta^2 = .562$. This substantially differs from their performance over time when recalling the components of their injury. When age was added as a covariate, younger participants at the time of injury tended to be less complete than older ($p = .040$). The accuracy of completeness components also decreased over time, from 92.6% to 81.5%, $F(1, 34) = 8.20$, $p = .007$, $\eta^2 = .194$. The addition of age as a covariate had no effect. Unlike for adolescents' recall of their injury experience, the number of unique details decreased over time, from 34.2 to 21.1 details 10 years later, $F(1, 38) = 12.01$, $p = .001$, $\eta^2 = .241$. In addition, those who had been younger at the time of injury tended to provide even fewer details than did those who had been older ($p = .026$). In terms of the accuracy of unique details, there was no change over time.

Potential factors influencing 10-year recall

The same regression models were built to assess adolescents' recall about their hospital experience (completeness, number of unique details, and accuracy of both) 10 years after the experience had occurred. None were significant.

Hospital free recall

Comparing initial and 10-year recall

Again, a series of repeated-measure ANOVAs was calculated with time (initial versus last interview), the repeated measure (Table 2), and analyses were re-run with age the covariate.

Unlike the decreases over 10 years in completeness, accuracy of completeness components, and number of unique details for total recall, there were no differences over time in free recall for any of these measures, although when the covariate of age was added, those adolescents who had been younger at the time of injury were less complete ($F(1,37) = 7.27$, $p = .010$, $\eta^2 = .164$) and provided fewer details ($F(1,37) = 7.36$, $p = .010$, $\eta^2 = .166$) than did those who had been older. There were no significant effects for the accuracy of unique details, except that those who had been younger tended to be less accurate ($p = .023$).

Potential factors influencing 10-year recall

Another series of hierarchical regression models was built to predict adolescents' hospital free recall in their 10-year interview, parallel to those described earlier. None of the regression models were significant.

Summary

In terms of hospital total recall, the quantity and quality of hospital recall decreased over the 10 years of the study. This decrease was true for completeness, the number of unique details, and the accuracy of both (although the factor of time was of only borderline significance for unique details). In addition, those adolescents who had been younger at the time of injury tended to be less complete and provide fewer details than did those who had been older when injured. Four adolescents were unable to provide any recollection of the hospital visit as well.

In terms of hospital free recall, many adolescents, especially younger ones, provided no free recall about their hospital experience. There were no differences over time in the completeness of their recall or the accuracy of their

completeness components, nor in the number of unique details they provided. In terms of age, those adolescents who had been younger at the time of injury were less complete and provided fewer unique details, as well as tended to have less accurate details, than did those adolescents who had been older when injured.

For recall of the hospital, regression analyses were all nonsignificant. Neither the presence of a 5-year interview nor the number of interviews influenced adolescents' recall after a decade.

DISCUSSION

The most striking finding is how little adolescents' recall of a stressful and highly salient injury decreased over the subsequent decade (and for a couple of adolescents, almost a decade and a half). To keep this in perspective, these adolescents had been between 3 and 5 years of age at the time. For most adults, their very earliest memory dates from 3.5 years old on average (Rubin, 2000), and memories from this time period are not only typically sparse but the memories themselves are often fragmentary (Peterson, 2002). Nevertheless, these adolescents still recalled the injury they had experienced so many years ago in considerable detail. Approximately 70% of the components of their injury event were still accurately recalled, and they provided about 45 accurate unique details about that long-ago event—even more than initially. Although accuracy had deteriorated somewhat, adolescents' recall of both completeness components and unique details was still quite high (about 85%). This is a remarkable achievement.

Such excellent recall of long-ago events is not unique. For example, when Fivush et al. (2004) interviewed 9- and 10-year-olds about a destructive hurricane 6 years earlier, the authors stated that 'all children were able to recall this event in vivid detail 6 years later' (Fivush et al., 2004: 104). In terms of more mundane events, Hudson and Fivush (1991) reported that if children were appropriately cued (e.g., with photographs), the recall of a museum trip 6 years before by some children was quite extensive and accurate. Likewise, when Van Abbema and Bauer (2005) re-interviewed former 3-year-olds after a delay of 6 years about everyday events they had previously discussed with their mothers, those events that they did recall (about 40%) 'were recounted in an accurate, detailed manner' (Van Abbema & Bauer, 2005: 829).

When one looks at free recall about their injury experience, all adolescents produced detailed reports. In fact, their free recall was more complete and considerably more detailed 10 years later than initially. Furthermore, the completeness components in their free recall did not become less accurate over time, and although the unique details they provided became less accurate, accuracy still remained over 90%. Teenagers are considerably more linguistically adept than preschoolers, more cooperative, and have a better understanding of what interviewers want. So it is not surprising that they volunteer more information after a general prompt. Importantly, every teenager was able to do so, even though the event was from their preschool years.

Adolescents' excellent recall of the injury event contrasts to their poorer recall of the hospital treatment event that immediately followed. As hypothesized, the content of the event mattered. First, four adolescents were unable to recall anything even with extensive prompting. Seven additional adolescents provided no free recall whatsoever about the hospital. In terms of total recall, they recalled only 31% of the completeness components of this event, and less than 10% of those in free recall. Adolescents also recalled fewer unique details than originally, in contrast to the increased amount of detail in their reports about their injury experience. In other words, the hospital event was more forgettable.

Why was the injury remembered so well, and the hospital event not? Stress has often been identified as an important factor, with stressful events typically well recalled by children (Pezdek & Taylor, 2002). However, the hospital event investigated here was just as stressful and painful as the injury event (Peterson & Bell, 1996). Part of the explanation may be that the hospital event was less comprehensible in the child's view, and indeed, coherence has been shown to be a factor that contributes to better long-term recall (Morris, Baker-Ward, & Bauer, 2010; Peterson, Morris, Baker-Ward, & Flynn, 2014). Aspects of the hospital visit were also less distinctive, which also contributes to long-term memory (Howe, Courage, Vernescu, & Hunt, 2000). Even though the sutures, cast, or other treatment outcome were distinctive, much of the hospital visit was not. Indeed, as reported in Peterson and Bell (1996), this cohort of adolescents had been to that particular hospital emergency room for a host of other reasons across childhood.

However, a key factor differentiating the two events may be the way the events were talked about. The injury event was big news in the families and everyone had to be told—from relatives to friends of both parents and children. Several researchers have suggested that elaborative or detailed reminiscing after an event has occurred helps children consolidate their memories, which in turn helps them provide detailed and coherent reports in later interviews (Fivush, 2011). In contrast, the hospital event may have had a more abbreviated discussion. Unfortunately, this cannot be directly tested in this sample. However, other research has suggested that family discussion may help keep memories more accessible, and certainly laboratory research has supported the helpful role that verbal rehearsal and reminders may play in remembering something (Larkina & Bauer, 2012). Conroy and Salmon (2006) found that discussion even helped 5-to 6-year-olds recall arbitrarily connected scenes of a staged event. However, the efficacy of such rehearsal and reminders with non-laboratory research has been more mixed. In earlier work investigating recall of their injury/hospital experiences with the same cohort of children as in the current study, if parents were elaborative when talking with their children about these events, this helped younger children recall more about the hospital event even though it had little impact on the well-remembered injury event (Peterson, Sales, Rees, & Fivush, 2007).

This is not to say that the only reason the injury event was so well-remembered is that it was highly discussed, or in other words, that it would not have been well-remembered if not for family discussion. For salient real-life events, some

researchers have found that recall amount and accuracy were not related to how frequently the events were talked about, according to parental reports (Fivush et al., 2004; Fivush & Schwarzmueller, 1995). Larkina and Bauer (2012) experimentally manipulated the amount of parent-child talk about target events by instructing parents to treat some randomly selected events as 'family stories' and talk about them with their 4-year-olds at least monthly for a year, while other selected events were seldom discussed. A year later, they found that the events that comprised the non-family stories were less accessible in free recall, but when probed, the amount that children recalled about both types of events was equivalent. The authors conclude that 'repeated conversations about a past event help to maintain accessibility of the memory but may not substantially impact the integrity of the memory trace itself' (Larkina & Bauer, 2012: 473). However, it should be noted that their follow-up was only a year later. This decreased accessibility may well have had substantial impact on the children's memory after much greater lengths of time have passed.

It is important to note not only what we found (especially the excellent long-term recall about their injury by adolescents a decade later) but also what we did not find. In several analyses, we found that the number of interviews had no significant impact, although there was a tendency for more interviews to foster an increase in the number of unique units of information adolescents provided in their free recall about their injury. Likewise, the presence of an interview midway through this 10-year delay did not have an impact. Earlier research with this cohort of children had come to the same conclusions (Peterson et al., 2005), but that earlier research had been based on much shorter delays between the event and final interview. Because the delay here was considerably longer (and 10 years is especially long when you consider the fact that the children were no more than 5 years of age at the time of the event), I expected that a reinstating interview half-way through this delay would be helpful, especially for the hospital event. However, this expectation was not confirmed.

Although forgetting of events that occur in the preschool years is typical, the injury events explored here are not typical events in children's lives. These events were embedded in countless family discussions between children and others as well as between those others in the child's presence. Children also had physical reminders for some days or weeks afterwards (casts, sutures, scars, etc.) as well as return visits to medical personnel for additional treatment in many cases (removal of casts or sutures). Thus, the memory traces of these injury events were robust. After a decade or more had elapsed, these events continued to be remembered in accurate detail.

In terms of forensic implications, the fact that these events were so well-remembered after such long periods of time can be reassuring because there are often considerable delays between event occurrences and children's testimony about them. Nevertheless, there still was a deterioration in accuracy, and although the decreases in accuracy were modest, they still occurred. These inaccuracies can at times have significant deleterious effects within the context of the forensic system. It should also be noted that this research does not directly address the sorts of forensic events that are not the subject of family discussion—such as sexual or physical abuse, where events may be wrapped in cloaks of secrecy. In these cases, the child's own self-reminders through rumination may result in the events being equally memorable. What is clear from this research is that some events are remembered extremely well for many years.

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