# 3

# Injuries, Emergency Rooms, and Children's Memory

## Factors Contributing to Individual Differences

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The relationship between children's emotional reactions to stressful events and their subsequent memory of those events is an important one, playing a role in both clinical and forensic situations. Considerable research has shown that children's emotional reactions during an event are major contributors to how well it is later remembered. In a review of children's recall for autobiographical events, whether or not there was robust long-term recall of these events was highly related to emotionality, and highly negative events seem to be particularly well-remembered (Peterson, 2002). As contrasting examples, pre-schoolers recalled approximately 20–30% of the features of a living-room camping trip when interviewed one day or three weeks later (Boland, Haden, & Ornstein, 2003; Haden, Ornstein, Eckerman, & Didow, 2001; Ornstein, Haden, & Hedrick, 2004), but 75% of the features of facial surgery events (caused by injuries) when they were interviewed a full year later (Burgwyn-Bailes, Baker-Ward, Gordon, & Ornstein, 2001). It should be noted, however, that the latter events involved acute stress; one cannot assume that similar relationships between stress and memory hold when stress is chronic versus acute. This issue is explored by Greenhoot, Johnson, Legerski, and McCloskey (this volume).

In this chapter, we will first present some recent theoretical discussion of the relationship between stress and memory, and then summarize a body

of research conducted in our laboratory that has explored children's recall of naturally occurring stressful events, specifically injuries serious enough to require hospital emergency-room treatment. In particular, we will focus on potential sources of individual variation in children's recall of real-life stressful events, both in research conducted in our laboratory and in related research conducted by other investigators. Finally, we will discuss the practical significance of this work for clinical and legal contexts.

## Theoretical Considerations

There has been considerable debate about the relationship between acute stress and memory in children with various studies differing in empirical findings. According to a recent meta-analytic review of this research, part of this variation may be attributable to the nature of the distressing events (Deffenbacher, Bornstein, Penrod, & McGorty, 2004). Deffenbacher et al. (2004) distinguish between events that elicit an arousal mode of attention control (i.e., an orienting response, or high level of attention focused on the event) and ones that elicit an activation mode of attention control (i.e., a defensive response such as the well-known fight or flight response). A defensive response is elicited by events that threaten bodily integrity or self-esteem, and thus involve considerably higher degrees of distress than events that elicit an orienting response. Deffenbacher et al. argue that some studies investigating the relationship between stress and memory had procedures that elicited an orienting response while others elicited a defensive response. Thus, it may be difficult to compare the effects of stress on memory when there is such variation in what constitutes the "high stress" category in different research studies. As an example of this variation, Peters (1997) exposed children to an unexpected fire alarm. Although children in his highest stress group had elevated blood pressure and pulse rates, none of the children cried or showed hysterical distress. In contrast, in a series of studies of children who suffered an unexpected and very painful injury (such as a broken bone, crushed fingers, or deep laceration), the high stress group was composed of children who suddenly began to scream in pain and were typically described by their parents as extremely upset or hysterical (Peterson, 1999; Peterson & Bell, 1996; Peterson & Whalen, 2001).

In their review, Deffenbacher et al. (2004) propose a theoretical model of how stress affects memory; they suggest that as stress increases, memory for those details that are the focus of participants' attention are increasingly recalled. However, when stress levels become very high, there is a catastrophic drop in memory performance. This model fits the data from extant studies of how accurately adults can recall event

details when the target events meet the authors' criteria for eliciting a defensive response. Surprisingly, in the smaller number of studies that involved children, they found no relationship between stress and recall accuracy in children.

The other outcome measure Deffenbacher et al. assessed was how accurately children and adults could identify faces from line-ups. Parallel to their findings on accuracy of event detail recall, they found that adults showed increases in recall as stress increased, until high levels of stress occurred. At that point, there was a similar sharp drop in the accuracy of face line-up identification. And, again, parallel to their findings for accuracy of event detail recall, there was no relationship between stress and how well children could identify faces from line-ups.

However, Deffenbacher et al. did not assess the amount of information recalled about target events. The focus of this chapter is on children, and although (as those authors suggest) the *accuracy* of what children recall may not be compromised under high stress conditions, it is possible that *how much* they recall is. Overall, their model may fit data from adult studies but the relationship between stress and memory in children is still very unclear. In the next sections, we review research from our laboratory on children's recall of high-stress events.

## Children's Recall of Injuries Requiring Emergency-Room Treatment

Over the past decade, I and my colleagues have been exploring children's recall of naturally-occurring events that are highly salient to children and that elicit a lot of distress, namely personal injuries such as bone fractures and lacerations that are serious enough to require hospital emergency-room treatment. In this research, children and their families are recruited during their emergency-room visit and, over the years, around 80% have agreed to participate. Because this research has been conducted in Canada, where medical care is paid for by the government and all children receive equivalent treatment regardless of their socioeconomic circumstances, the children represent a cross-section of their community. Although we could recruit families from the emergency room, ethically we could not interview them until they had had time to read our information and consider it at their leisure, so all child and parent interviews took place approximately a week later. And in order to get cooperation from most families, we had to go to them, in their homes, which is where all interviews have taken place.

In this entire body of research on emergency-room injuries, it is clear that many of the children were extremely upset. Many were described by parents as hysterical. In the words of one child, "I never cried—I

just *screamed.*" A parent describing a three-year-old said, "He was screaming! Bawling! Lots of blood!" Many children also perceived their bodies to be threatened. To quote another child, "The blood was just flying everywhere." So we were confident that we had an event that was highly distressing for at least some children, and as well, other children were not so upset. According to the differentiation made by Deffenbacher et al. (2004), between distressing events that elicit an orienting versus a defensive response, we are confident that for some of our children, the defensive response was elicited, on the basis of both parental and child self-descriptions of how distressed the children were.

How to capture the child's recall has been a perennial issue. The problem is that there was not a standardized event that all children experienced. Rather, each bone fracture, laceration, dog bite, or crushed finger differed in details. Probably the one that was most divergent was a four-year-old who had a wasp fly up her nose and got thoroughly lodged in the upper nasal passage. The wasp of course stung her painfully from the inside, and was sufficiently stuck that it had to be removed with forceps at the hospital. The child, not surprisingly, was hysterical the whole time. So, how to capture this variation and allow comparison across children? We devised a standardized prototype of typical injury and hospital treatment events, and children were scored on the proportion of these prototype components that they recalled with parental witnesses determining which components of the prototype were applicable. Examples of prototype components include where and when the injury took place, who was there, what led to the injury, how the child reacted, who first got to them, what that person did, and so on. Children were scored on whether or not they provided information relevant to each applicable prototype component. Thus, we could assess the *completeness* or exhaustiveness of children's recall, in terms of the proportion of the relevant prototype components that they actually recalled. We could also assess the *accuracy* of their recall, again by comparing their recall with witness reports. Others who have studied children's recall of naturally occurring stressful events (such as hurricanes) have looked at the absolute *amount of information* that children have recalled by counting the number of new or unique units of information (Bahrick, Parker, Fivush, & Levitt, 1998; Fivush, Sales, Goldberg, Bahrick, & Parker, 2004), and so in some studies we used this measure too. This has a different focus than the completeness measure described above. In assessments of completeness, each component of a prototypical experience is scored as present or not, regardless or how much detail the child provides about that component. In contrast, when the amount of new information is assessed, each new detail is separately counted. Compare "we were in the backyard" with "we were in the backyard down by that hole in the fence

where the mud is." These are equivalent under the prototype complete-ness scoring (they both specify where events took place), but the latter contains considerably more new units of information.

There are two things we should qualify. First, we have often checked to see if the nature of the injury, whether a bone fracture, laceration requiring sutures, or other injury, makes a difference, and it does not. The second qualification, however, does turn out to be important: in every study, children recalled significantly more about the details of their injury experience than about their hospital treatment, even though paren-tal ratings showed that children were often as upset in the hospital as they were at the time of injury. There could be several potential expla-nations for this difference in how well these two events are recalled. For one thing, the injury is a unique event, whereas these children have visited this emergency room numerous times (see Peterson & Bell, 1996, for relevant data) since it serves as the after-hours clinic for all phy-sicians in the region. As well, it is likely that children have a better understanding of the temporal and causal connections between successive injury than hospital components, since many probably do not understand
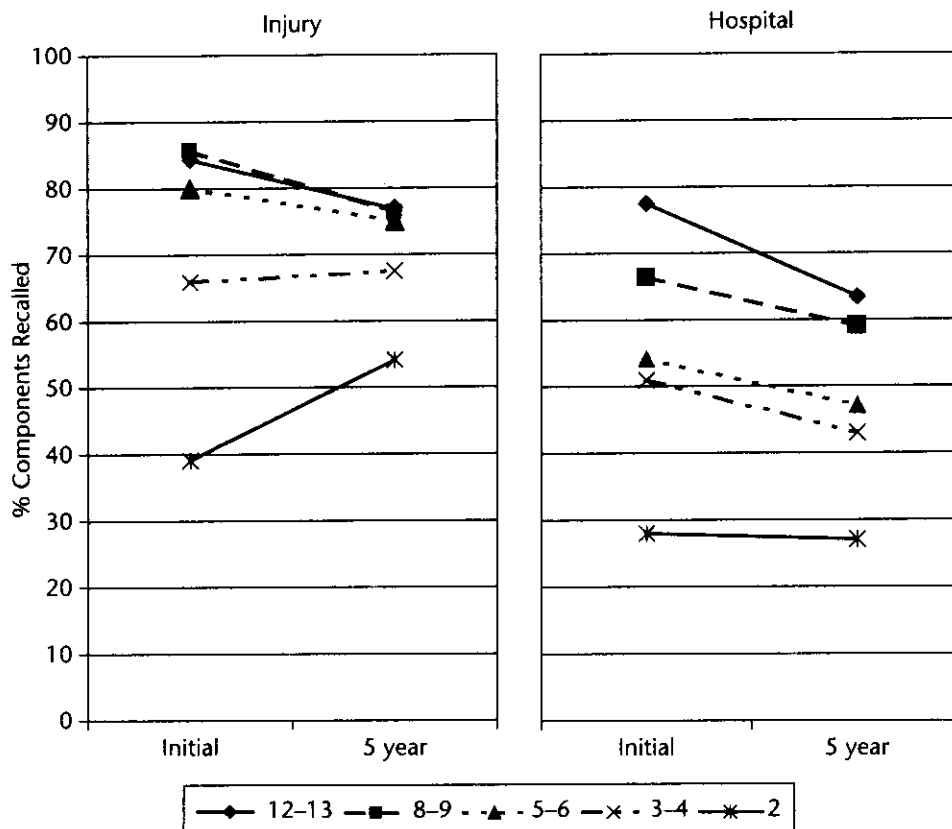


Figure 3-1. Percentage of relevant prototype components recalled by chil-dren initially and five years later about their injury and hospital treatment.

why they go to one place in the hospital and wait, talk to someone there, and then get taken to another place (e.g., x-rays) and wait, then get taken somewhere else for another treatment component. In the next section, we will review the results of this series of studies, focusing on potential sources of individual variation.

## Stressful Events are Well-Remembered Events

A host of research demonstrates the robust nature of children's recall for stressful events. For example, investigators who have studied children's memory for highly stressful experiences that included painful medical procedures such as voiding cystourethrograms (VCUG) (Goodman, Quas, Batterman-Faunce, Riddlesberger, & Kuhn, 1994, 1997; Merritt, Ornstein, & Spicker, 1994; Quas et al., 1999; Salmon, Price, & Pereira, 2002) and natural disasters such as hurricanes (Bahrick et al., 1998; Fivush et al., 2004), have repeatedly shown that children have extensive memory for these stressful, highly salient events.

Injuries serious enough to require hospital emergency room treatment are also well-recalled events. We have found, for completeness of recall, that children recalled on average (across all age groups) 75% of the prototype components of their injuries when interviewed a week after they occur, and 73% of those components a full five years later (Peterson & Whalen, 2001). They did not recall as many prototype components of their hospital treatment (57% initially and 50% five years later, see Figure 3–1), but recollection is still considerably better than for more mundane events that are often not recalled at all, or require considerable cuing (Peterson, 2002). For accuracy, children's recall is quite accurate shortly after the target events occurred (averaging 94% accuracy for both events), and although accuracy deteriorates over time, accuracy of injury and hospital recall still averages 86% and 78%, respectively, five years later (see Figure 3–2).

Although decreases were found five years later in the completeness and accuracy of recall, a different pattern was found for the amount of new information children provide, which increased over time. Children provided on average 52 new units of information initially about their injury and 46 new units about hospital treatment, and five years later they averaged 71 and 54 units of new information for their injury and hospital treatment, respectively (see Figure 3–3). This increase over time in the number of new units of information has been found by others as well (Fivush et al., 2004), and may reflect children's improved vocabularies and narrative skills. As they get older, they provide more descriptive detail about the components of their experiences.

In summary, stressful events are typically well-remembered events. Nevertheless, the relationship between stress and memory is more
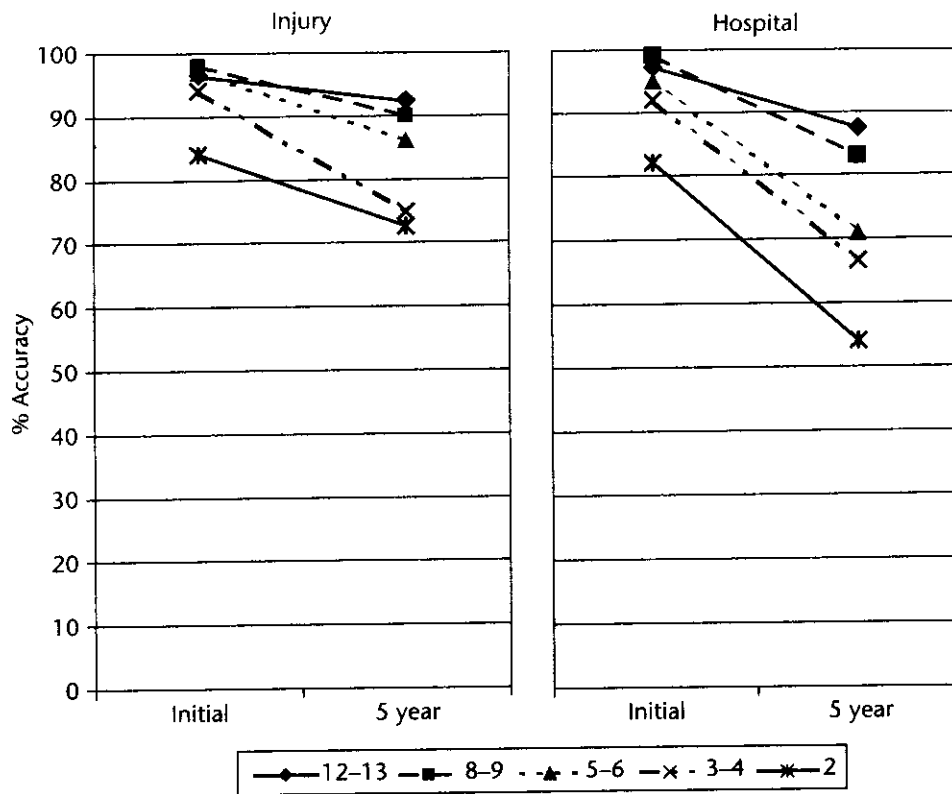
Figure 3–2. Percentage of children's recall about their injury and hospital treatment that is accurate, both initially and five years later.

complex than this because researchers have documented considerable individual variation between children's recall of identical events. Because this relationship is complex, it is necessary to use a range of perspectives, from neurobiological (see Carver & Cluver, this volume, and Wiik & Gunnar, this volume) to physiological (see Wallin, Quas, & Yim, this volume, and Alexander & O'Hara, this volume), to children's cognitive understanding (see Baker-Ward, Ornstein, & Starnes, this volume, Compas, Campbell, Robinson, & Rodriguez, this volume, and Laible & Panfile, this volume), to socioemotional perspectives (see Chae, Ogle, & Goodman, this volume, McDermott-Sales, this volume, Laible & Panfile, this volume, and Oppenheim & Koren-Karie, this volume, as well as research presented here). Below, we show via our data the well-known importance of the child's age for how well events are recalled; we then discuss a number of other individual difference variables that have been investigated in our laboratory.

## Importance of Children's Age

One factor that must be taken into account is the child's age. Even when the target events being recalled seem equivalent, how old the child

is at the time of event occurrence makes a difference (Peterson, 2002; Quas et al., 1999; Salmon et al., 2002). Children less than two years of age when the events happened typically recall little or nothing of even highly stressful events, and what little they may recall tends to be fragmentary (Peterson & Rideout, 1998; Terr, 1988; see review in Peterson, 2002). Importantly, it is children's age at the time of event occurrence rather than age at the time of event recall that is key; older children seem to retain only fragments of target events that occurred when they were very young, although some of them may weave these fragments together with memories from other related events to provide coherent narratives, even though these narrative accounts may be amalgamations of a number of separate events. We found this in our five-year follow-up interviews of injured former one- and two-year-olds (Peterson & Parsons, 2005).

By the time children are three years of age, their recall of stressful events can be quite extensive and robust. However, it still becomes better with age, as researchers who have investigated a range of target events have found (Burgwyn-Bailes et al., 2001; Goodman et al., 1997; Peterson, 1999; Peterson & Bell, 1996; Peterson & Whalen, 2001; Salmon et al., 2002; Shrimpton, Oates, & Hayes, 1998). Figures 3–1 to 3–3 demonstrate age differences in how complete, accurate, and informative children's recall of emergency-room injuries is across a wide age variation. The figures also show how recall changes over five years. For older children, it becomes less complete with age. However, this is not necessarily the case for younger children, particularly two-year-olds, who recall a greater proportion of injury components five years later. This increase is probably an artifact of how difficult it is to interview two-year-olds. As anyone who has tried to interview children this young knows, they are much more interested in playing than sitting and talking, but five years later, they are cooperative seven-year-olds. These data on the completeness and accuracy of recall have been presented elsewhere (Peterson, 2002; Peterson & Whalen, 2001) and are reprinted here for comparison with data on the informativeness of children's recall.

As is apparent in Figure 3–3, children of all ages provide more descriptive detail five years later, particularly about injury components, even if they recall fewer of those prototype components. This increase in informativeness after delays spanning years has been found by others as well. For example, Fivush et al. (2004) found that children provided more new units of information about a destructive hurricane six years later than they had initially. These findings are consistent with the notion that memory and language are different although interacting skills. Although language can be used to encode as well as communicate aspects of memory, it is unlikely to capture the entirety of any given
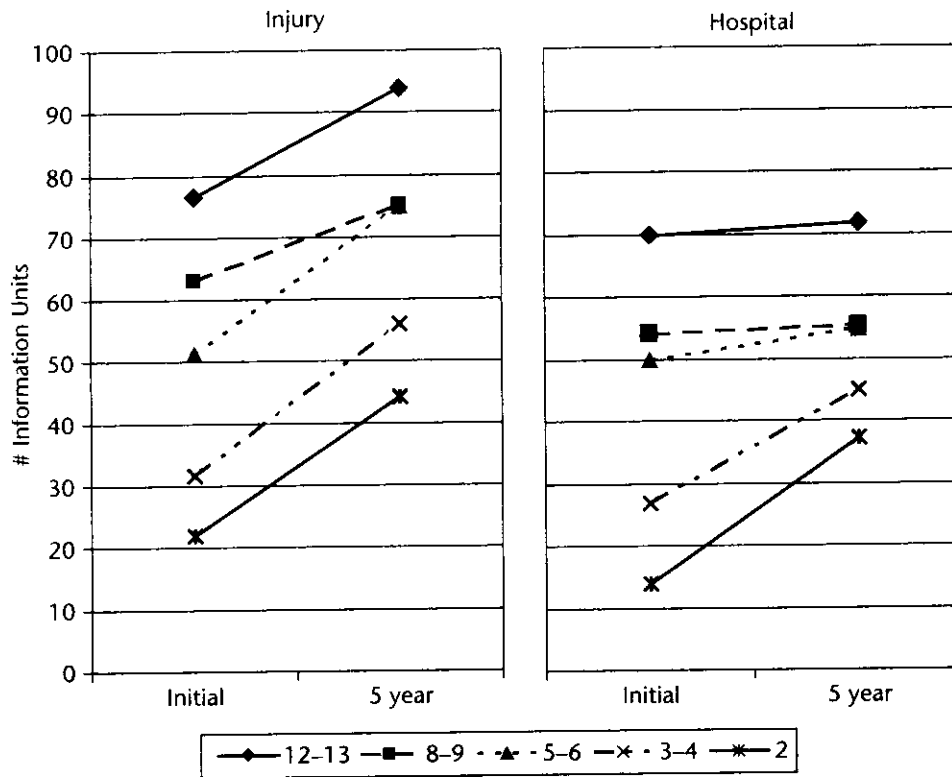
Figure 3–3. Number of new units of information provided initially and five years later.

memory. As children's linguistic ability increases, the same memory may become verbally conveyed with more linguistic complexity, more descriptive detail, and so on. Thus, even though long-term recall may become less complete and less accurate, it nevertheless may contain more information.

## Variation in Stress

How to measure the degree of distress experienced by a child during stressful events has been a contentious issue. Some investigators advocate using only physiological measures (Peters, 1997), but these are not practical for naturally occurring events. Others have used externally validated measures such as the amount of damage done to one's home by a destructive hurricane (Bahrick et al., 1998; Fivush et al., 2004). However, it is not clear that this is a good measure of the amount of distress experienced by an individual child. One child whose house's damage is classified as moderate may have been terrified while another whose house fell into the same category of damage may have been much less upset.

In our research with children recruited from the emergency room we have asked parents (who were witnesses to the child's experience)

to rate their child's distress on a Likert scale ranging from not at all distressed to extremely distressed. This rating was completed not only for the time of injury but also while the child was being treated at the hospital. Although the number of choices on the distress scale varied slightly, essentially we classified children's level of stress as low, moderate, or high.

But what about the child's own version of how distressed he or she was? Steward et al., in their 1996 monograph concerning interviewing children about body touch during medical exams, stress the importance of looking at children's own feelings about what happened to them. Unfortunately, with the exception of one study, we did not ask children for their own estimates of distress. However, all of them were asked about whether or not (and how much) they had cried. A child who stated that she had been "very very crying," or another who replied to the question "What happened in the hospital?" with "Well, I was screeching a *lot*" are communicating considerable information about their emotional state at the time of event occurrence, as are children who stated that they didn't cry. (By the way, we had parental confirmation on crying.) We classified children's level of distress on the basis of their self-descriptions of crying as low, moderate, or high, and the correlations between children's self-descriptions of crying and their parents' ratings of children's distress were quite high: for the injury, Pearson's $r = .58$ and for hospital treatment, $r = .72$ (both $ps < .001$). Furthermore, we did regression analyses (see below) on the relationship between recall and our stress measures (both parental ratings and children's self-descriptions of crying, independently), and the results were the same, regardless of which measure of stress we used.

There was, however, one study in which Rees, Fivush, Sales and I used the Faces Pain Scale that was used by Steward and her colleagues (1996) to get children's self-ratings of distress. There were 62 children between two and six years of age who provided this scale, and the correlations between their self-ratings of distress on the Faces Pain Scale and parental ratings of how distressed their children were, on a verbal Likert scale, were $r = .24$ ($p < .05$) for distress during the injury event and $r = .30$ ($p < .01$) for distress during hospital treatment. Although these are statistically significant, the correlations are nevertheless rather low. Furthermore, correlation and regression analyses found little relationship between children's Faces Pain Scale judgments and their recall, while there were such relationships for both parental ratings and children's self-descriptions of crying. Thus, having children make judgments on the basis of line drawings of faces may not be a particularly good way of measuring children's distress, at least when children are this young. On the other hand, looking at children's self-

descriptions of their emotional reactions, such as how much they cried, does seem to hold promise as a measure of children's distress about real-world events that are stressful enough to elicit what Deffenbacher et al. (2004) term a defensive mode of response, when there are no research investigators around who could collect other measures.

In the research in which we collected parental Likert ratings of child distress as well as children's self-descriptions of crying, we looked at the relationship between children's degree of distress and their recall. We had 201 children between two and 13 years of age who had both an initial and one-year follow-up interview, as well as 145 with a two-year follow-up. Overall, for the injury, approximately 50% of the children were rated as highly upset and 40% moderately upset, with 10% in the low stress category. For hospital treatment, approximately 30% of the children were classified as highly stressed and about the same for moderately stressed, while about 40% were classified in the low stress category. Repeatedly we have found that there is no correlation between children's distress at the time of injury and their age—older children were as likely to be highly distressed as younger children. However, stress ratings were correlated with age for hospital stress in that younger children were more likely to be highly distressed during hospital treatment than were older children.

Both partial correlations (age partialled out) and stepwise regressions were calculated between children's distress and their recall, using both children's self-descriptions and parental ratings separately. For the accuracy of children's recall, stress played no significant role in either their initial or follow-up interviews. This agrees with the conclusions derived by Deffenbacher and his colleagues in their review of the effects on stress on memory. In that review, they found that, although the accuracy of *adults'* recall was compromised by high degrees of distress, *children's* accuracy was unimpaired. In contrast, Salmon et al. (2002) found that children who cried during a voiding cystourethrogram had less accurate recall.

Our findings for both the completeness of children's recall and the amount of new information provided were quite different than for accuracy, however. During their initial interview, as stress increased, children became less complete in their accounts. For the number of new units of information, children who were least distressed consistently provided more information in their initial interview than did those who were most distressed. (See Table 3–1.) Salmon et al. (2002) also found crying associated with less information recalled by children.

In contrast to the results described above, children who recalled a destructive hurricane recalled more new units of information if they were placed in the moderately distressed group rather than either the

Table 3–1. Percentage Completeness of Recall in Initial Interview as a Function of Distress (Child Self-Descriptions and Parent Ratings Averaged)

| | Degree of Stress | | | | | |
| | Low | | Moderate | | High | |
| Event | Mean | SD | Mean | SD | Mean | SD |
|---|---|---|---|---|---|---|
| Recall Completeness (percentage) | | | | | | |
| Injury | 75.0% | 17.4 | 72.6% | 18.5 | 71.5% | 15.7 |
| Hospital | 63.6% | 23.2 | 57.3% | 19.2 | 48.6% | 21.2 |
| Number of New Units of Information | | | | | | |
| Injury | 56.9 | 29.3 | 46.5 | 23.6 | 48.3 | 21.4 |
| Hospital | 48.8 | 29.9 | 49.2 | 24.4 | 39.9 | 24.4 |

low- or high-stress groups (Bahrick et al., 1998). However, there are numerous differences between that study and ours: not only did they differ in terms of the nature of the event and the delay before an initial interview took place (several months in the hurricane study), but classification of stress level was done on the basis of damage to the children's houses rather than how the children themselves emotionally reacted. Furthermore, children in the moderate stress group lived with house renovations and repairs caused by hurricane damage, while other children either had to move out or had little house damage. Thus, children in the moderate-stress category may have had more extended reminders of the event or may have included more information on the aftermath of the hurricane.

To summarize the results of our emergency-room injury studies, children who were highly distressed had worse recall during their initial interview, both in terms of recall completeness and the amount of information provided. Thus, children's recall seems to be compromised under conditions of high stress. This relationship is consistent with what Deffenbacher et al. (2004) found with adults, who also had poorer recall when they experienced high degrees of distress. However, what the children in our study did recall remained just as accurate regardless of how distressed they were, unlike what Deffenbacher et al. found for adults.

## Variation in Language Competence

Some investigators have suggested that children's language competence may play a role in how well children recall events. As suggested by Boland et al. (2003), children with better language skills at the time of an event might be better at verbally encoding the details, which in turn might help them remember it later. Although better verbal skills have

sometimes been shown to help children recall the details of nonstressful events (Boland et al., 2003; Gordon et al., 1993; Simcock & Hayne, 2002), little research has looked at this variable when target events were stressful. An exception is Burgwyn-Bailes et al., (2001) who assessed three- to seven-year-olds' recall of details surrounding facial surgery for lacerations. They found that children's receptive vocabulary (as measured by the Peabody Picture Vocabulary Test) was predictive of younger children's recall, although not that of older children.

We also investigated variation in language competence using the Peabody Picture Vocabulary Test. This work involved 95 children (46 girls and 49 boys) between two and six years of age, and was done in collaboration with Rees, Fivush, and Sales. In contrast to the findings of Burgwyn-Bailes et al. (2001), this same measure of receptive language was unrelated to how complete, how informative, or how accurate children's recall of their injury or subsequent hospital treatment was.

## Variation in Temperament

It has also been suggested that children's behavioral style, or temperament, may influence how they recall a stressful event. For example, Merritt et al. (1994) found that children who had higher adaptability and were higher on the approach/withdrawal dimension had better open-ended as well as total recall about a VCUG procedure. In contrast, Burgwyn-Bailes et al. (2001) and Greenhoot, Ornstein, Gordon, & Baker-Ward (1999) found little or no relationship between children's recall of details of their treatment of facial lacerations or of pediatric examinations and the temperament dimensions measured by the Temperament Assessment Battery for Children.

In the same study of two- to six-year-olds mentioned above, in collaborative work with Rees, Sales, and Fivush, we assessed child temperament using the Emotionality, Activity, and Sociability Temperament Survey. We found no relationship between children's recall of injury and emergency room treatment and any of the measured dimensions of temperament.

## Parental Conversational Style

A socioemotional factor that is beginning to receive attention is the way that parents habitually discuss past events with their children. Considerable research has shown that parents differ in the way they talk with their children about past experiences (e.g., Fivush, 1991; Fivush & Fromhoff, 1988; Haden, Haine, & Fivush, 1997; Harley & Reese, 1999; McCabe & Peterson, 1991; Peterson & McCabe, 2004; Reese & Fivush, 1993—see Fivush, Haden, & Reese, 2006, for a review). Some parents

engage in much more of this "memory talk" than others (McCabe & Peterson, 1991), and the structure of these conversational exchanges differs in systematic ways. A dimension of conversational exchange differences that has been frequently studied is that of parental elaboration. When parents use an elaborative conversational style while discussing past events with their children, they elaborate on what their children say as well as encourage their children to provide more elaboration about target events in their own turns at talk. Specifically, elaborative parents (compared to nonelaborative) provide more information in their turns at talk and encourage and support their children's contributions. They ask open-ended questions and encourage extended, dyadic discussion of target events. Other parents, in contrast, ask a few formulaic questions and engage in little of this elaborative exchange. In short, parents differ in the frequency as well as structure of conversations about events in their children's past.

These parental differences in reminiscing style have repeatedly been shown to be related to how much information children later provide in their open-ended memory conversations with both parents and researchers (see reviews in Fivush et al., 2006; Nelson & Fivush, 2004; Peterson & McCabe, 2004; and Reese, 2002). However, the increased contribution to memory conversations by children of elaborative parents may reflect only an increased willingness to keep on talking. It is another matter to suggest that memory itself for past events may be better for children whose parents engage in this elaborative style of interaction. Recently, this is exactly what some investigators are suggesting. They have found that mothers who engaged in elaborative talk while a target event was ongoing, such as museum visits, video viewings, or living-room camping trips, had children who recalled more about those experiences later (Boland et al., 2003; Low & Durkin, 2001; Tessler & Nelson, 1994). Importantly, such talk can even have a facilitative effect on children's memory when it takes place after the event is over (Conroy & Salmon, 2006; Leichtman, Pillemer, Wang, Koreishi & Han, 2000; McGuigan & Salmon, 2004). For example, Leichtman et al. (2000) recorded the visit of a former preschool teacher who visited her class after her baby was born and engaged in a series of activities with the children. Later that day, mothers (who were not present and did not know the details of the visit) talked with their children about their former teacher's visit. Mothers who were elaborative in these memory conversations had children who recalled more about the visit three weeks later. In summary, mothers who engage in elaborative memory conversations with their children about both everyday and distinctive *nonstressful* events, not only during the event but also later, have children who in turn seem to recall more detail about those events. But to our knowledge, there

has been little investigation of whether parental reminiscing style affects children's memory for highly *stressful* events which by their nature have high memorability.

To explore the question of whether parents' styles of talking to their children about past experiences is related to children's recall of a stressful event, 67 parents of two- to six-year olds were provided with a tape recorder and asked to talk with their children about the target injury/hospital treatment events in as natural a manner as possible, while the researcher left the room (Peterson, Sales, Rees, & Fivush, 2007). The elaborativeness of the parents' talk was coded by breaking parental utterances into propositional units and then coding each unit as one of the following: (a) memory question elaborations, in which a question tried to elicit new information from the child as well as incorporated new information within the question; (b) memory question repetitions, in which a question tried to elicit new information from the child but did not itself contain any new information; (c) yes-no question elaborations, in which the child was required to confirm or negate the new information provided by the parent; (d) yes-no question repetitions, in which the child was required to confirm or negate previously mentioned information; or (e) evaluations, which were statements that confirmed or negated the child's previous utterance. After this, we created a composite score for each parent. This composite score was derived as follows: the number of elaborations plus evaluations was divided by the number of all utterance types to provide an elaboration ratio. This ratio was then entered in statistical analyses to assess the relationship between an elaborative parental style and their children's memory. As seen in Table 3–2, the relationship between age and all of the memory measures except accuracy of injury recall was highly significant. For the relationship between the elaboration ratio and the memory measures (with age partialled out), virtually all partial correlations were significant for the initial interview. For the two-year follow-up interview, the completeness of both injury and hospital recall as well as the accuracy of hospital recall were still significantly related to the parental elaboration ratio calculated from parent-child talk two years previously.

Next, we did a series of hierarchical regression analyses, one on each of our recall outcome measures: amount of information, completeness, and accuracy, separately for the injury and hospital events. We removed the variance attributable to age, gender, the elaboration ratio, and the age *x* elaboration interaction, in that order. For the two-year follow-up data, we did the same, except that variance attributable to the child's prior recall during the initial interview was removed first. Our results are displayed in Figure 3–4.

Table 3-2. Correlations between Children's Memory Measures and Age, and Partial Correlations (Age Partialled Out) between Memory Measures and Parental Elaboration Ratio

| Measure | Event | Age | Elaboration |
|---|---|---|---|
| Initial Interview | | | |
| Information | Injury | .59*** | .25* |
| | Hospital | .54*** | .34** |
| Completeness | Injury | .70*** | .25* |
| | Hospital | .59*** | .36** |
| Accuracy | Injury | .21 | -.11 |
| | Hospital | .43*** | .38*** |
| 2-Year Interview | | | |
| Information | Injury | .57*** | .24 |
| | Hospital | .54*** | .21 |
| Completeness | Injury | .48** | .32* |
| | Hospital | .52*** | .39* |
| Accuracy | Injury | .16 | .12 |
| | Hospital | .38* | .38* |

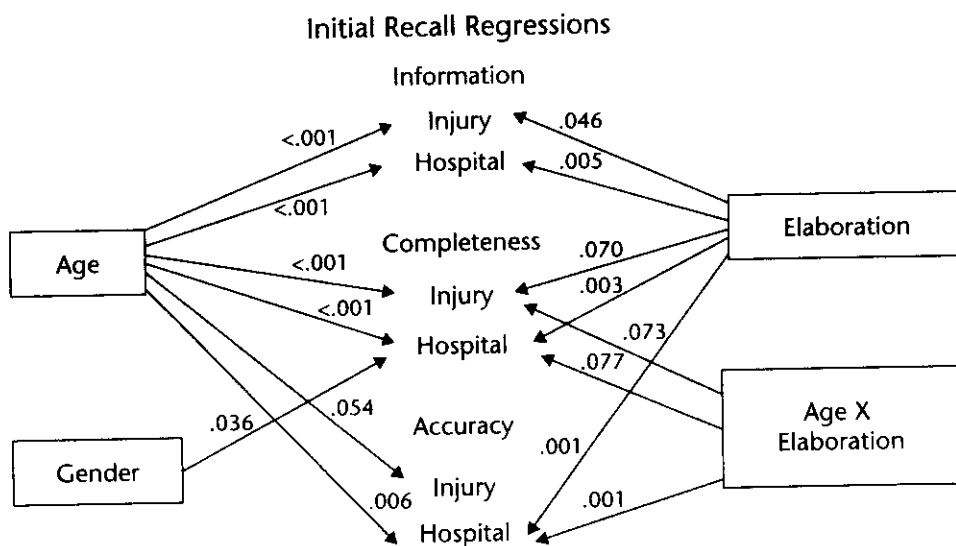$*p < .05$ $**p < .01$ $***p < .001.$



Figure 3-4. Factors significant in hierarchical regression analyses (initial interview).

Age of course was a powerful predictor, and gender was only significant for the completeness of children's recall of the hospital (girls had more complete recall of hospital treatment). But parental elaboration also played a significant role, for all three outcome measures and for both events. The elaboration ratio predicted the amount of information and the recall completeness of injury events as well as the amount

of information, recall completeness, and accuracy of the hospital event. Means during their initial interview for children of low versus high elaborators (using a median split) are shown in Table 3-3.

The age $x$ elaboration interaction (for the accuracy of children's hospital recall and recall completeness of both events) showed that it was the younger preschoolers for whom parental elaboration made the most difference. That is, when there is an age $x$ elaboration interaction, it is the recall of the youngest children that is helped most by having a parent with an elaborative conversational style. In the two-year follow-up data, regression analyses showed that the children's prior recall was the critical variable that removed most of the variance for all data sets, and other variables played little additional role.

In summary, children of parents who used a highly elaborative style of conversing with them about past events had more informative, complete, and accurate recall during their initial interview. This was true even when all variance attributable to age was removed first. With the exception of children's accuracy about injury details, having elaborative parents was helpful for children's recall of both their injury and hospital experiences.

Parental elaborative style played much less of a role in children's two-year recollections over and above the variance accounted for by previous recall. Instead, parental conversational style may help the child create a more elaborated representation initially, which is reflected by their better recall during their first interview. This more elaborated representation is then better recalled over time. Such an explanation, that earlier conversations mediate recall by affecting children's representations, would account for why parental elaborative style is correlated with better recall in both children's initial and two-year interview, but largely drops out of the regression analyses at two years since the variance related to prior recollection has already been removed.

Why might a topic-extending, elaborative parental style of reminiscing facilitate children's memory? First, as documented in prior research (McCabe & Peterson, 1991; Snow & Dickinson, 1990), such

Table 3-3. Means for Children of Low vs. High Elaborators (Initial Interview)

| Type of Data | Event | Low Elab. Ratio | High Elab. Ratio |
|---|---|---|---|
| Amount of info | Injury | 16.5 units | 23.1 units |
| | Hospital | 10.9 units | 21.3 units |
| Completeness | Injury | 63.5% | 72.8% |
| | Hospital | 44.8% | 61.1% |
| Accuracy | Hospital | 81.5% | 89.3% |

parents more frequently carry on memory conversations in everyday life. Secondly the memory conversations of parents with an elaborative style are more extensive than those of nonelaborative parents (Fivush & Fromhoff, 1988; Haden et al., 1997; Harley & Reese, 1999; McCabe & Peterson, 1991; Reese & Fivush, 1993). The former parents ask more questions that require memory responses, and flesh out the details with contributions from their own memory. In other words, children are given more opportunity to rehearse more aspects of the experiences and are reminded about various components of it, and such reinstatement has frequently been shown to assist long-term retention (Pressley & Schneider, 1997). As well, such conversations seem to help children organize their recollections, and also provide a scaffold that guides children in terms of what sorts of information they should remember and report about an event (Peterson & McCabe, 2004). In addition, daughters in particular have been shown to mirror their mothers in terms of how they construct accounts of prior events (Peterson & Roberts, 2003). In the present study, we were unable to assess how frequently parents talked with their children about these target events, but we could assess how elaboratively they did so when given a tape recorder and asked to discuss them. And elaborated parent-child memory conversations were related to better child recall, even for the kind of stressful events that are likely to be recalled anyway, such as personal injury.

## Summary of Individual Difference Factors

A summary of the various factors we have looked at is shown in Table 3–4. These included children's age, amount of distress (rated by parents and self-descriptions of emotional response by children), parents' style of reminiscing with their children (elaborativeness of conversational style), receptive language ability (Peabody Picture Vocabulary Test-Revised), and temperament (Emotionality, Activity, and Sociability Temperament Survey—the EAS). It is also possible that the socioeconomic status of the family may be correlated with memory since it has been shown to be a predictor of the richness of children's linguistic home environment (Hart & Risley, 1995). Because parental education attainment provides some indication of socioeconomic status, we evaluated that too. In addition, the number of siblings in the home was assessed, since the number of children among whom parents need to spread verbal attention may also be predictive of child memory. The outcome variables that we looked at included measures of completeness, accuracy, and informativeness of children's memory accounts.

Age of course was an important variable, but so was the way that parents talked with their children and how distressed their children

Table 3–4. Summary of Analyses between Memory Measures and Various Factors

| Factor | Initial Interview | 2-Year Interview |
|---|---|---|
| Age | Sig. effect | Sig. effect |
| Stress | Sig. effect | No effect |
| Parental elaboration | Sig. effect | Mediated effect |
| Language (PPVT) | No effect | No effect |
| Temperament (EAS Scale) | No effect | No effect |
| Maternal education | No effect | No effect |
| Paternal education | No effect | No effect |
| # siblings in home | No effect | No effect |

were. In contrast, receptive language ability, temperament, and a couple of measures of socioeconomic status seemed to have little effect on recall. Others have highlighted different individual difference factors that seem to play an important role, and, in particular, the attachment relationship between parent and child (see Chae, Ogle, & Goodman, this volume). Both attachment and parental conversational style represent different aspects of the dyadic relationship between parents and children, and these socioemotional factors seem to influence children's ability to recall stressful events.

## Implications

There are a number of forensic and clinical implications of this work. First, it is clear that children do have substantial memory for distressing events. Furthermore, this memory is robust and long-lasting. In addition, it retains remarkable accuracy after the passage of several years. When you consider how young some of the children in our studies were when they were injured, it is impressive that recall is so accurate after such a long period of time. After the passage of five years (a substantial proportion of their lifetimes!), three-quarters of the injury-event information provided by children who were less than five years of age at the time of injury was still accurate. Older children had even higher accuracy rates. Although the big picture painted by children's recall after five years was the most provided information that was correct, not all details were. For example, a few children claimed in their five-year follow-up interviews that among the onlookers to their injury were siblings who were not yet born.

Although children did not provide as much information or remain as accurate about the hospital treatment event, there are some reasonable explanations about why this may be so. Foremost among them is the fact that visits to this hospital emergency room were not unique events,

unlike the injury experiences. Because this emergency room serves as the after-hours clinic for virtually all physicians in the region, children are taken there for the flu, for bad colds, for infections, and for anything else that occurs in the evenings or on weekends. Children had been there an average of a dozen times for various reasons by the time they were injured (Peterson & Bell, 1996), and undoubtedly were there multiple times during the subsequent five years. Children's most common memory errors about the hospital event involved mixing up different visits. This of course has serious implications for children who experience repeated stressful events, such as repeated abuse. Our research participants had a harder time keeping straight the events of the target hospital visit that was precipitated by their injury, but found it much easier to retain accurate recall about the unique injury event. Another possible contributor to their poorer recall of hospital details is that that event is less logically ordered—at least to a young child.

Another implication of this research is that stress is not devastating to children's recall. Some of the children in our research were completely hysterical with pain and fear, with considerable screaming. Nevertheless, the accuracy of their recall was not compromised. Although children in our highest stress category did have less complete recall and provided fewer units of new information, the decrement was remarkably little, given the amount of emotional distress these children were experiencing. Furthermore, this decrement associated with high levels of distress mostly characterized their initial but not their later interviews.

Although it is a truism to say that the age of the children makes a difference, nevertheless these age differences provide a difficult challenge. Children who are barely two years of age or younger at the time of event occurrence seem to have very problematic recall, if they remember anything at all. Recall that unknowing amalgamates of multiple experiences is forensically useless (or worse). For preschoolers, although they may recall a lot of detail about stressful events, they often require considerable prompting to provide relevant information (Ceci & Bruck, 1995). In contrast, older children are likely to provide much more information after open-ended prompts. This has important implications for forensic and clinical situations: in order to get a lot of information from preschoolers one often has to ask a lot of questions, which may increase the possibility of tainted recall.

The finding that elaborative parent-child conversations help children's long-term recall of event details is both intriguing and promising. Furthermore, these elaborative conversations seem to especially help younger children—who are the ones most likely to have abbreviated responses to questions and for whom more prompting is generally required. In other words, elaborative conversations are most helpful for

the children who need it most. As a clinical therapist who is regularly seeing a child client, one might adopt the role of an elaborative conversational partner, or one might train parents to be more elaborative in their conversational interactions with their children. Researchers have found that one can train parents to be more elaborative in their memory conversations with their children, with resultant improvements in children's recall (e.g., Boland et al., 2003; Peterson, Jesso, & McCabe, 1999).

Even more encouraging is the fact that an elaborative conversational style may make a difference even when that conversation takes place after a period of time has elapsed. For example, Leichtman et al. (2000) found that mothers who used an elaborative style when talking with their children about the visit of a former preschool teacher, even though that conversation took place later and even though the mothers had no detailed knowledge of the events being discussed, had children who recalled more information three weeks later. Not only mothers, but elaborative experimenters too can have a facilitative effect on children's recall. For example, elaborative researcher-child conversations that took place after a staged event was over helped children's recollection of event details (Conroy & Salmon, 2006; McGuigan & Salmon, 2004).

But even a detailed, chronologically and logically organized interview may help. In other research in our laboratory, we delayed some children's initial interview about emergency room injuries for a year, and we found that children who had been three to four years old at the time of injury had poorer recall in their one-year follow-up interview than did their age-mates who had a detailed interview shortly after their injury (Tizzard-Drover & Peterson, 2004). However, the presence of an early interview made no difference for older school-aged children. We interpreted these findings as showing that detailed and organized interviews can help preschoolers organize the details of the event in their minds. The interriews may also remind children of the minutia of the experience. Interestingly, when these former preschoolers were interviewed again two years after injury, their recall was equivalent to that of other children who had been interviewed initially as well as after a year (Peterson, Pardy, Tizzard-Drover, & Warren, 2005). In other words, having that detailed interview delayed for a year did not seem to compromise their long-term recall. The earlier interview was equally helpful, whether it took place within a few days or after a year. What all of this suggests is that having a supportive, elaborative interviewer who engages in a chronologically and logically organized interview can help younger children's long-term recall.

Overall, it is clear that children's recall of stressful events is impressive, but it is also clear that it is influenced by a number of factors.

Some of these are inherent to the child (for example, age at the time), but others can be manipulated (for example, a partner's elaborative conversational style). There are undoubtedly other factors that play important roles in influencing children's recall besides the ones investigated here, and many of these are discussed in other chapters in this volume. It is apparent that any attempt to understand the relationship between stress and memory needs to be a multi-factor, complex one.

There remain a number of questions that need to be answered, however. First, it is not clear how the nature of the event to be remembered influences children's recall. The events that we studied are public events. Although they cause distress at the time, they are ones that may confer a lot of positive attention later. Everyone, from Aunt Bessie to neighbors and friends, tends to be told about these events, and many children bear bandages, casts, or sutures that elicit widespread comment and concern. Such is not the case with private events such as abuse. Here, children are forbidden to talk about the events rather than verbally rehearse them with everyone.

As well, the injury event was a unique event rather than a repeated event. This has important implications for memory. Although we did not explicitly investigate the issue of repeated versus unique events, it is probable that some of the difficulty children had recollecting their hospital experience is that it could be mixed up with other hospital visits. Indeed, such confusions were identified by parents as the source of many of children's errors. Because we did not have documentation on other visits, we could not explicitly investigate how frequently children made these source errors, and so this too is beyond the scope of this chapter.

There are also important differences between what we can do as researchers and what police interviewers can do, and some of the work described above on the role of an elaborative conversational style may not be applicable to forensic situations. Interviewers are constrained in terms of how they can question children, and they certainly cannot do the sort of elaborative additions to conversations that elaborative parents (or researchers) typically do. Elaborative conversational partners typically embellish children's recollections with additions of their own, and this would be problematic for forensic interviewers since what they say may be seen as suggestive or incorporated into children's later recall. However, the interviews conducted by Tizzard-Drover and her colleagues (Tizzard-Drover & Peterson, 2004; Peterson et al., 2005) did not add new information to the children's accounts. However, they were systematic, organized, chronological, and logical. So even without the additions that elaborative conversational partners typically make, these interviews helped younger children's long-term recall a year later.

In summary, children who are over two years of age have robust and long-term recall about injuries they have sustained that require hospital emergency room treatment. Even if these events were highly stressful, causing enormous emotional distress at the time, children could recall a lot, and this recall was primarily accurate. Nevertheless, individual difference variables play a role, and it seems that some variables may be able to be deliberately altered to help children's recall. In particular, the socioemotional context of parent-child and experimenter-child conversations seems to play an important role. In other words, one cannot forget that children are embedded in a socially and emotionally complex and important world, and this world even implications for memory.

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