THE EFFECTS OF MISLEADING INFORMATION ON CHILDREN'S MEMORY FOR TRAUMATIC INJURY

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THE EFFECTS OF MISLEADING INFORMATION ON CHILDREN'S MEMORY FOR TRAUMATIC INJURY

by

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Abstract

Children between the ages of 3 and 13 years who had experienced an injury serious enough to warrant Emergency Room treatment were interviewed about their experiences at one-year post-injury. At this time, approximately half the children (the control group) received a standard interview. The remaining children (the experimental group) received a combination of misleading and reinstating information and were also interviewed one week later in the standard format. Children's accuracy of recall did not differ between the control or experimental group children. Implications for children's legal testimony are discussed.

For my grandmother, Rita Parsons, and all those who encourage the pursuit of excellence.

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How reliable are children's memories of traumatic events? The importance of this question becomes more urgent with the increasing number of children participating as witnesses in the legal system. In the early days, canon and British common law asserted that children were impetuous and untrustworthy (Ceci & Bruck, 1993). In fact, it wasn't until the seventeenth century that competency testing of children to give testimony was allowed (Ceci & Bruck, 1993). Today, competency testing is a common practice of the courts as more and more children are subjected to repeated questioning by various authority figures. From a modern legal standpoint, probably the most significant problem with the standard use of repeated questioning to enhance recall is the problem of suggestibility of children (Moston, 1990). Suggestibility is the concern used most frequently as an argument against the use of children as witnesses (e.g. Whipple, 1909; Loftus, 1979).

Suggestibility, broadly defined, refers to the extent to which children's encoding, storage, retrieval, and reporting of events can be affected by a spectrum of

psychological and social factors (Ceci & Bruck, 1993). In comparison, the narrower and more traditional definition of suggestibility asserts that it is "the extent to which individuals come to accept and subsequently incorporate post-event information into their memory recollections" (Gudjunsson, 1986).

A review by Ceci and Bruck (1993) notes that hundreds of studies have examined the degree to which children are able to accurately encode, store, and retrieve different types of information and that most of these studies have examined short-term recollections of objects (as opposed to actions) and of peripneral (as opposed to central) events. Yet, despite these limitations, one salient conclusion can be drawn from these data: memory skills improve with age. This was evident in all the studies cited (Kail, 1989; Ornstein, 1978; Schneider & Pressley, 1989).

This is not to say that younger children have poor memories. Even very young children have good memories, although age may act to developmentally improve memory (Loftus, Miller, & Burns, 1978). For example, young

children's memories have been found to be accurate over long delays provided the materials and procedures are comprehensible to them (Flavell, 1985) or if the information to be remembered has involved a salient action or a personally meaningful event (Cutts & Ceci, 1988; Fivush & Hammond 1990; Jones, Swift & Johnson, 1988; Perris, Myers & Clifton, 1990). In fact, children's recall of action events is highly trustworthy, even in preschoolers (Davies, Taurant & Flin, 1989; Jones et al., 1988) particularly when they are participants in that event (Rudy & Goodman, 1991). However, other studies have found that many factors can affect the accuracy of children's memory. Such factors include central versus peripheral information (Peterson & Bell, in press), age (Baker-Ward, Gordon, Ornstein, Larus & Clubb, 1993; Ceci & Bruck, 1993; Goodman, Quas, Batterman-Faunce, Riddlesberger & Kuhn, 1994; Peterson & Bell, in press), level of stress (Christianson, 1992; Goodman, Bottoms, Schwartz-Kenney & Rudy, 1991; Merritt, Ornstein & Spicker, 1994; Peters, 1987; Peterson & Bell, in press; Vandermaas, Hess & Baker-Ward, 1993; Yuille & Toolestrop, 1992), and

misinformation and/or reinstatement of details surrounding the original event (Ceci, Huffman & Smith, 1994; Fleckenstein & Fagan, 1994; Goodman, Bottoms, Schwartz-Kenney & Rudy, 1991; Goodman, Hirschman, Hepps & Rudy, 1991; Goodman & Clarke-Stewart, 1991; Howe, Courage & Bryant-Brown, 1993; Lepore & Sesco, 1994; Moston, 1990; Rovee-Collier & Shyi, 1992).

The legal community's heightened interest in behavioural science data regarding child witnesses was the primary impetus for stimulating research regarding the suggestibility of children. This issue is particularly important in validating the veracity of uncorroborated statements of child witnesses in law courts (Chadbourn, 1978).

Europe led the world's research in the arena of children's suggestibility during the early 1920's to 1960's using mainly paper-and-pencil tests to measure memory (Ceci & Bruck, 1993). Though the number of published articles on this topic was extensive, only two consistent findings emerged from this era: 1) younger children were more

suggestible than older children and adults (Ceci & Bruck, 1993); 2) there was a negative correlation between suggestibility and IQ, with those possessing lower IQs being less able to resist suggestion (Ceci & Bruck, 1993). However, the correlations with IQ may reflect the fact that the poorer students had more difficulty dealing with written material, or keeping their attention focused during long written tasks, rather than with suggestibility of the experimental manipulations.

More recent studies reflected researchers' concern with another potential confound: the ages of the children included in their sample. In contrast to previous studies, which focused on school-aged children, modern researchers frequently include preschoolers in study designs. This is an important addition since available research data indicates that preschoolers are more likely to be abused and more likely to have their cases come to trial (Doris, 1993). In fact, in a recent analysis of a sample of nearly 800 alleged victims of child sexual abuse in New York, preschoolers (ages 6 and younger) accounted for nearly 40% of the

official sexual abuse cases, and 28% were aged 5 and younger (Doris, 1993). Furthermore, because preschoolers are increasingly being called to testify, the need for a greater understanding of their testimonial accuracy was and still is urgently needed.

To date, the available research on the reliability of children's recollections is both contradictory and uncertain (Baker-Ward et al., 1993; Goodman et al., 1994; Howe, Courage, & Peterson, 1995; Merritt et al., 1994; Ornstein, Gordon, & Larus, 1992; Peters, 1987, 1991; Peterson & Bell, in press; Saywitz, Goodman, Nicholas, & Moan, 1991; Vandermaas et al., 1993). Results vary depending on the time frame and geographical location of the subjects and, perhaps more importantly, depending upon the context in which the research was conducted.

It is obvious that the issue of applying the findings of eyewitness research to real-world settings or context is of paramount importance. The rationale for the use of real-world settings over laboratory settings is that real-world settings approximate more closely the type of trauma

experienced by children in physical or sexual abuse situations. Four real-world settings commonly used by researchers to ethically study children's memory of painful events include experiences with voiding cytourethrograms (VCUG) (Goodman et al. 1994; Merritt et al., 1994), emergency room injuries (Howe, Courage, & Peterson, 1994; Howe et al., 1995; Peterson and Bell, in press), check-ups, including inoculations and/or genital touching (Baker-Ward et al., 1993; Goodman, Bottoms and Schwartz-Kenney, 1991), and dental exams (Peters, 1987; Vandermass et al., 1993).

One medical procedure that has been used is the voiding cytourethrogram (VCUG). This invasive procedure is thought to be similar in many respects to some incidents of sexual abuse. In one such study, Merritt et al. (1994) assessed children's recall of its features immediately and 6 weeks after the VCUG. Results suggested that 88% of the elements of the VCUG experience were recalled by 24 3- to 7- year-olds initially, and 83% of the elements of the VGUC experience were recalled after a 6-week delay. Similar results were found by Goodman, Quas, Batterman-Faunce,

Riddlesberger & Kuhn (1994). They interviewed 46 3- to 10-year-old children who had undergone a VCUG. Age differences were found when comparing young (3- to 4-year olds) children with the older children. Interestingly, memory for the procedure did not reliably vary for children who endured the medical procedure once versus those who did multiple times.

Another medical procedure used by researchers to examine the effects of trauma on memory is emergency room injuries. The injuries and their accompanying treatments often are considered quite traumatic to the child. In one study, Peterson and Bell (in press) examined children's long-term retention of trauma injuries that necessitated hospital room treatment. Results suggested that children of all ages were able to provide considerable information about both the injury and the hospital treatment although the amount of detail increased with age. Furthermore, central information was recalled better than peripheral information. Interviews were conducted initially and at 6- months post-injury.

Other researchers have studied children's recall of physical examinations, some of which included inoculations and/or genital touching. For example, Baker-Ward et al. (1993) studied children at ages 3, 5, and 7 who provided reports of their physical examinations immediately following the checkup and after a delay of either 1, 3, or 6 weeks. Similarly, Goodman, Bottoms, and Schwartz-Kenney (1991) studied the effects of an inoculation at a medical clinic for children at ages 3-7 following 2- and 4- week delays. In both studies, the amount of forgetting in younger children (ages 3 and 5) was significantly greater than in older children (age 7). However, similar to Peterson (1996) and Peterson and Bell (in press), young children did retain considerable memory for the event.

Finally, researchers have studied children's recall of dental examinations. For example, Peters (1987) studied children at ages ranging from 3-8 years for their recall of a dental check-up or cleaning. Similarly, Vandermaas et al. (1993) studied children at ages 4-8 years who visited the dentist for either a teeth-cleaning, check-up or an

operative procedure. Overall, results from both studies suggested that the oldest group was superior to the younger groups (who did not differ from each other).

Taken together these studies suggest that, even after a delay of six months, children as young as 2 years old are capable of remembering details of a personal event that involves their own body and is often painful. However, accuracy of memory does seem to increase with age with central details recalled more often than peripheral details. This last point is important because central information often contains such important information as what happened, who did it, and so on.

Children's stress levels at the time of an event has been cited as a possible confound affecting memory for the event (see Vandermaas et al., 1993, for a review). In a number of the medical/dental studies summarized above, the children were distressed by the procedure and the effect of distress on their memory was investigated. For example, Peters (1987) studied the effects of stress when visiting a dentist for a routine check-up on children ranging in ages

from 3 to 8 years. He found that while children were more anxious at the dentist than at home, a negative effect of stress on recognition memory was significant for only one subject. In contrast, Vandermaas et al., (1993) studied the effects of anxiety on memory for 80 children (ages 4-5 and 7-8) who visited the dentist for either a teeth-cleaning, check-up, or an operative procedure. They found that high anxiety had a debilitative effect on the reports of the older children but not on the reports of the younger children. In fact for younger children higher anxiety scores were associated with slightly higher memory scores. However, they did note that experience with the dental event mediated the influence of age and anxiety on memory. That is, the more experience a child had with the dental procedures studied here, the less likely either stress or age significantly affected memory. This suggests that experience with the procedure is the most important factor affecting memory for that procedure, at least in this study. Otherwise, when experience is held constant, age of the child and their level of stress become important factors.

The effects of distress on memory for various medical procedures has also been investigated. For example, the effects of stress on children's recall of VCUG details was investigated by Merritt et al. (1994). Measures of distress at the time of the procedure were obtained, and higher stress levels were associated with decreased recall. A contrasting effect of stress was found by Goodman, Hirschman, Hepps & Rudy (1991). They studied children's (aged 3- to 7- years old) memory for routine venipuncture or inoculations. Results suggested that the effects of stress were positive. That is, the highest level of stress improved free recall and resistance to suggestion. On the other hand, Peterson and Bell (in press) studied children (aged 2 - 13 years old) who were recruited from an emergency waiting room. Overall conclusions stated that stress played a very little role in children's recall for painful injuries/treatments.

Thus, the effects of anxiety on memory are believed to be more complex than current research with children would suggest. Factors such as prior experience with the event,

age, and level of anxiety are all very important. From these results it is also important to note that, under some conditions, young children can provide accurate and detailed reports of personally experienced distressful events.

Similar conclusions were made in a review of current literature about adults regarding the effects of stress on memory (Christianson, 1992). He stated that there were no real grounds for a simple linear negative relationship between intense emotion and memory. That is, an increase in negative emotions or stress do not necessarily translate into poorer memories for that event. However, Christianson (1992) also concluded that while a linear effect did not exist, there was an interaction between type of information (central or peripheral), stress, and time delay of questioning. Such complexity in assessing the role of stress on memory was also highlighted by Yuille and Tollestrop (1992). They concluded that the way emotion affects eyewitness memory is dependent upon the nature of the event, the response of the witness to the event, and the subsequent factors affecting memory maintenance and retrieval. Which

leads us back to the original question, does stress affect memory? In the available adult literature the answer is "yes". By sheer amount (of the few studies that exist), the current literature on children suggests "probably not very much if at all". The main point to remember is that results are mixed. As well, a number of confounds other than stress play a very important role in the accuracy of memory.

The type of information being recalled (central or peripheral) is often crucial to how memorable a detail was. Even though most adult researchers differentiate between the two types of information, most child researchers do not distinguish between central and peripheral information, but there are exceptions. For example, in a recent review by Christianson (1992) and in studies by Peterson and Bell (in press) and Goodman, Hirschman, Hepps, & Rudy (1991) a distinction was made between central and peripheral information while focusing on the effects of stress on memory accuracy. The amount of detail accurately recalled was found to be different depending upon the detail category

(central details were recalled more often than peripheral details).

Other potential confounds affecting the accuracy of children's recall include the addition of reactivating or misleading information. In general, reinstatement effects (and reactivation) occur when portion of the original event is reexperienced (for a discussion of the distinction to be made between reinstatement and reactivation see Howe et al., 1993). Specifically, reinstatement refers to the presentation of a cue or reminder (Howe et al., 1993). For the purposes of this thesis, reactivation refers to the reinstating (i.e. giving accurate information) of specific details (central or peripheral) to the subject following an experienced event. Recall that misinformation, on the other hand, involves providing inaccurate details (central or peripheral) to the subject following an experienced event. Spear (1973) hypothesized that a reminder or reactivation stimulus primes or recycles the forgotten (or dormant) memory, making it more accessible during the actual retention test. If a memory that had been forgotten can be

retrieved at a later time, then we conclude that it was only inaccessible rather than permanently unavailable for retrieval.

Rovee-Collier and Shyi (1992) trained infants (3 and 6 months-old) to respond to a mobile. A single reminder was presented on either day 13, 27 or 34 following training. Results suggested that the reminder significantly alleviated forgetting after a retention interval of 4 weeks but not after 5. Thus, there is a limit to the effectiveness of a single reactivation treatment, at least with infants this young. They further hypothesized that repeatedly reactivating a memory might strengthen it and progressively flatten its forgetting function such that at some point after a very long retention interval memory will be accessed rapidly.

In a further study of 96 infants (mean age 110.1 days old), Fleckenstein & Fagan (1994) studied the reactivation of infant memory following crying-produced forgetting. In particular, infants learned to move a mobile containing 10 and then 2 objects during four training and one

reactivation session: Sessions 1 and 2 occurred together, Session 3 occurred 24 hours later, the reactivation phase took place six days after Session 3, and finally Session 4 occurred 24 hours after the reactivation phase. The change to a mobile displaying fewer (i.e. two) objects produced crying in several infants. One week later, infants who did not receive the reactivation treatment (exposure to a moving mobile) displayed forgetting. Furthermore, the reactivation treatment alleviated crier's forgetting regardless of which mobile was used. This seems to suggest that not all aspects of the learning context are equally critical in the initiation of the retrieval process.

Similar results were found with preschoolers by Howe, Courage and Bryant-Brown (1993). They studied the effects of reinstatement on 2 1/2 and then 3 1/2 year-olds long-term retention for object-location pairings. Results suggested that regardless of age, reinstatement significantly improved children's long-term retention. They speculated that perhaps reinstatement could lead to the effective restoration of

originally experienced events even after the presentation of misinformation.

The facilitating effect of retrieval on subsequent retention has been reported in studies using verbal materials with adults. McDaniel and Masson (1985) found that initial retrieval experiences facilitate later recall so long as they produce elaboration of an existing memory representation, which, in turn, increases the variability of encoded information. As a result memory can be accessed by more than a single route.

Taken together, these data suggests that reinstatement is affected by how many times the memory has been retrieved, the status of the memory at the time it is accessed, and the context in which the retrieval occurs. Furthermore, very young infants are clearly endowed with neuroanatomical structures that can support the encoding, storage and retrieval of memories over very long intervals. However, to date there have been no studies investigating the role of reinstatement for recall of stressful events. My study addresses this gap in the literature by including

reinstatement as one variable to be explored in children's recall of a traumatic injury and Emergency Room (ER) treatment.

As stated earlier, one of the factors that can potentially affect the accuracy of children's memory is the presentation of misleading details or misinformation. The fact that exposure to misinformation sometimes leads to false reports by children has led to several hypotheses pertaining to underlying mechanisms. The current views regarding underlying mechanisms for children's distorted memory following misinformation can be summarized as age per se. Some researchers suggest that there is a developmental trend (Loftus et al., 1978) while others suggest that nothing can be generalized across all ages (Zaragoza, 1987). More specifically, one side of the argument maintains that certain ages, due to their lack of cognitive development, are more susceptible to the presentation of misinformation and are therefore more likely to confuse it with reality (Loftus et al., 1978). The flip side of this argument suggests that there is no consistent developmental trend

evident across studies: therefore cognitive development is not the most important factor contributing to the variation in results (Zaragoza, 1987). Regardless of the mechanism, factors such as context (Goodman, Bottoms, Schwartz-Kenney, & Rudy, 1991; Moston, 1990), age (Ceci, Huffman, & Smith, 1994; Goodman, Bottoms, Schwartz-Kenney & Rudy, 1991; Goodman, Hirschman, Hepps, & Rudy, 1991; Loftus et al., 1978), type of misinformation (Zaragoza, 1987), saliency of the event (Bruck, Ceci, Francoeur, & Barr, 1995), and perceived authority of the interviewer (Goodman, 1984; Lepore & Sesco, 1994) may all affect suggestibility.

According to the memory impairment hypothesis (Loftus et al., 1978), when children are exposed to misleading suggestions about an event they have witnessed, these suggestions impair their ability to remember the events they saw. The memory impairment hypothesis further assumes that as a consequence of this impaired memory for original details, younger children are more likely than older children to remember the misleading suggestions instead of the events they actually witnessed. Supporting the idea that

children's memories are subject to distortion was Goodman (1984). She simply suggested that young children may be especially subject to suggestion because so many people (older children and adults) are generally authoritative in relation to them.

In contrast to the memory impairment hypothesis predictions and Goodman's (1984) speculation, lies research conducted by Zaragoza (1987). She compared children's and adults' memory performance as affected by suggestive or misleading postevent factors and concluded that there was no clear-cut developmental trend in children's eyewitness memory performance. According to Zaragoza, children are more suggestible than adults in some ways, and less so in others. Furthermore, suggestibility was not consistent for any age group and varied according to the extent to which the dynamic factors interacted in each situation. That is, any variation shown in the results cannot be attributed only to age-related cognitive development. Rather, there are other factors such as the type of misinformation presented that also significantly contributes to the variation.

More recently, Moston (1990) stated that suggestibility of children can be accounted for in part by the methodological failings of interviewers. It follows then, that a review of the most current methodological trends in recent studies on suggestibility in children might illuminate important methodological considerations to make when performing research in this area. First, consider the research that has found children to be resistant to suggestive questioning.

Goodman, Bottoms, Schwartz-Kenney, and Rudy (1991) videotaped 3- to 7- year olds while they were receiving inoculations at a medical clinic. Children were interviewed either once after a 4-week delay or twice, following 2- and 4- week delays. Similar to Moston (1990), these authors suggest that their findings highlight the importance of maintaining a warm, supportive interviewing style so that children feel comfortable enough to counter an adult's false suggestion and recount events accurately. Moreover, repeated interviewing was not associated with increased suggestibility. Likewise, Goodman and Clarke-Stewart (1991)

found children (4- to 7 years old) who were interviewed in a warm, supportive environment were able to resist strongly worded suggestions about actions associated with sexual abuse. Children were interviewed 10 - 12 days later.

Very recently, Pezdek and Roe (1994) reported that children's (ages 4- and 10- years old) memory for a more frequently occurring event was more resistant to suggestion than memory for an event experienced only once. They conclude that children who have been repeatedly abused by the same perpetrator are more likely to have reliable memory for the abuse than those abused only once, regardless of whether other potential sources of suggestibility intervened.

In contrast to the above studies that showed children were resistant to suggestion are other studies that show they are very suggestible under certain conditions. For example, Lepore and Sesco (1994) found that 4- to 6- year-olds would produce misleading reports about their interactions with either familiar or unfamiliar adults when they were prompted to do so by an opinionated adult

interviewer. Similarly, Bruck et al. (1995) found that 6-year-olds who were given misleading information about the actions of an assistant and a pediatrician made more false allegations about their actions than did children who were not given this information. They conclude that their results which involved children's reports about salient actions involving their own bodies in stressful situations challenge the view that suggestibility effects are confined to peripheral, nonaction events.

Extrapolating from these studies we can conclude that children are especially likely to accept an interviewer's suggestions when they are younger and when the interviewer's suggestions are strongly stated. However, whether children would misconstrue events to the point that an allegation of abuse would result is still debatable.

In their major review on suggestibility in children, Ceci and Bruck (1993) admit that earlier literature had been criticized for lack of methodological sophistication and poor ecological validity. Furthermore, they maintain that current literature is full of contradictory interpretations

of results. Overall, Ceci and Bruck (1993) concluded that there were reliable age differences in suggestibility but that even very young children were capable of recalling information that would be forensically relevant.

Taken together, these data suggest that to conduct research on the suggestibility of children's memory one must include very young children in the sample, the children must be interviewed more than once, and the interview must be done in a caring environment and manner, by a trained interviewer. My study addresses these important methodological considerations by including children from 3-12 years old, by interviewing them initially, at 6-months and then at 1-year post injury, and finally by using only trained interviewers who conduct the interviews in the child's own home.

The focus has thus shifted from simply examining whether children are suggestible to determining what circumstances and factors influence their suggestibility. As stated earlier, factors such as the age of the child, their level of stress, central versus peripheral details and the

presentation of reinstating or misleading information all contribute to the accuracy of children's memory. My study addresses these important issues while extending the previous research in the area of suggestibility. My study is similar to other studies in this area (Ceci et al., 1995; Goodman et al., 1986; Goodman, Hirschman, Hepps & Rudy, 1991; Pezdek and Roe, 1994; Saywitz and Moan-Hardie, 1994) in that misleading questions are asked. However, my study, unlike Goodman et al. (1986), does not involve games performed by a confederate in an artificial setting; instead misleading questions in my study are asked about traumatic events that children have personally experienced in a real world setting. My study (like Merritt et al., 1994 and Vandermaas et al., 1993), involves children who have suffered high stress traumas (i.e., broken bones, cuts requiring sutures, burns, dog bites, or temporary loss of vision following a bump to the head). Such high stress levels are also more likely to reflect the stress encountered in actual physical/sexual abuse cases.

The type of information assessed is also included. Other research has suggested that the questions (both misleading and reinstating) must reflect both central and peripheral information (Christianson, 1992; and Peterson & Bell, in press). This study addresses these criteria.

This study involved sources of trauma which occur naturally in a child's life. Subjects are children who were taken to a children's hospital for Emergency Room services, and their parents. Initial (within about one week of the event), and 6- month standard interviews were conducted on all subjects. At 1 -year post-injury, control subjects were interviewed with the standard procedure. However, experimental subjects were interviewed with a combination of reinstatement and misleading questions which were subdivided into central and peripheral information based on their personal traumatic experience. One week later, experimental subjects also received a standard interview. The timing of the interview, at one year post-injury, was selected because in real life forensic situations, there is often a lag of many months or a year between when something happens to a

child and the time of the court appearance where misleading questions are presented (Ceci and Bruck, 1993). Therefore, the timing in this study reflects real life time constraints.

The hypotheses are as follows: (1) children will not be easily misled, as indicated by accurate responses in the follow-up interview; (2) older children will recall more accurate information than younger children; (3) the reinstated information will be recalled more often than information than is not reinstated; and (4) stress will not have an effect on the accuracy of information recalled. No specific hypothesis on central versus peripheral information was formulated because there is a lack of sufficient information available at this time to make any speculations.

Method

Subjects

Children were recruited from the Charles A. Janeway Children's Hospital in St.John's, Newfoundland. Parents of

all children were approached in the Emergency Room where they were seen by medical staff on an outpatient basis due to a trauma injury.

Children included in this particular study had lacerations requiring suturing (N=58), broken bones requiring casting (N=43), dog bites (N=1), burns (N=1), or temporary loss of vision following a bump to the head (N=1).

In terms of age, 26 3-4 year-olds (8 girls and 18 boys, mean age=3.8 years), 30 5-6 year-olds (13 girls and 17 boys, mean age=5.6 years), and 48 8-13 year-olds (22 girls and 26 boys, mean age=9.11 years) were included (total = 104). All children were White and were from mixed Socioeconomic backgrounds.

Procedure

Parents were approached in the Emergency room and asked to fill out a consent form if they elected to participate in the study. Details of the study were described on the consent form.

Initial interviews took place in the child's home soon after consent forms were signed (mean delay = 3.38 days, range = 1 to 10 days). Questions were based on a prototype interview developed by Peterson (1995) and covered incidents surrounding injury and hospital visit (see Appendix 1 for a list of sample responses made by children, adapted from Peterson & Bell, in press). Parents were subsequently interviewed and provided the information against which the children's information was compared for accuracy. Parents also verbally completed a stress rating scale (1-6), with a scale of 1 referring to "almost no stress" and 6 referring to "very upset, highly distressed". They did this for each of two episodes that were potentially distressing to the children, namely the injury and the hospital treatment.

If parents were not the primary eyewitness to the child's injury, other people were subsequently interviewed (e.g. babysitters, teachers, etc.). The basic criterion for interviewing people other than the child was that they had be present to witness the injury and/or hospital treatment experienced by the child. Although it is possible that the

adult primary eyewitness to the child's injury could be in error, these reports were the best available standard against which the child's report could be compared.

Rapport was established with the child, followed by interviews (see Appendix 3 for the prototype interview) which consisted of free-recall (no specific questions asked) and then cued recall (specific questions asked). Questions covered central and peripheral information (see Appendix 1 for examples). Interviews typically lasted 20 - 30 minutes.

Children were re-interviewed at about six months (mean = 6.1 months, range = 5.1 to 9.0 months) post-injury using the standard free-recall and cued recall questions that were used during the initial interview. Parents were asked not to rehearse the injury/hospital visit with the child prior to this visit.

At approximately one year (mean = 12.2 months, range = 11.0 to 14.2 months) following their initial interview children were assigned to either an experimental or control group. In the experimental group all of the children received a series of misleading (for example, You hurt your

arm, who was with you while you were getting a needle?) and reinstatement questions (**Aunt Jane** waited at the hospital with you, where were you when you hurt yourself?) which were based on statements made by the child in earlier transcribed interviews (see Appendix 2 for more examples). All the questions (both misleading and reinstating) were subdivided into either central or peripheral information. Central and peripheral details came from earlier transcripts (either initially or at six months), and then was randomly assigned to be misleading or reinstatement information. If a particular type of detail was misled for one child (for example, "Who got to them first") then this particular detail ("Who got to them first") was reinstated for the next child. In general, we tried to balance the number of central and peripheral, misleading and reinstatement questions (see Table 1). However, recall that children had to have provided the information in earlier interviews so that we could be confident that they had actually known the information. Thus, differences in the number of questions asked to various children can be explained by the fact that younger

children recall less information than older children in earlier interviews.

Insert Table 1 about here

The misleading or reinstated items of information always occurred at the first part of the sentence, which allowed the child to focus on answering the second part of the question. Once rapport was established through general conversation, the games were brought out. Thus, the appropriate number of counterbalanced questions were asked to the child (see Table 1) while the child performed one of two possible distracter tasks: 3-6 year-olds colored pictures of "Barney" the dinosaur and 8-13 year-olds played the game "Tetris" on "Gameboy". Children were encouraged to concentrate on the task throughout the interview. If at any time the child corrected the interviewer by saying, for example, "that's not what happened!", the interviewer would

remain neutral and continue on with the next question. All experimental subjects were reinterviewed one week later using the standard interview questions that had been asked during both prior interviews. Control subjects were interviewed only once using the standard interview questions. All experimental interviews were counterbalanced such that half the children were interviewed by the same interviewer twice (at one year and one week later) and half the children were interviewed by a different interviewer both times (at one year and one week later). Similarly control interviews were also counterbalanced so that the same interviewer did not conduct all the interviews (at one year).

Approximately 12% of the scored interviews were checked against another trained scorer for reliability. The reliability score (97.98%) was calculated by dividing the number of agreements between the scorers by the number of agreements plus the number of disagreements between the scorers.

Results

The issue of suggestibility is the primary concern of this paper. So the initial analysis examined the accuracy of the misled and reinstated item scores for the misled and reinstated groups at each age. This accuracy score was created by adding up all the correct responses and dividing by the number of correct responses plus the number of incorrect responses (#correct/#correct + #incorrect x 100%). These percentages of correct responses can be seen in Table 2 and Figure 1.

Insert Table 2 and Figure 1 about here

Because the data were not normally distributed (100% category was the most frequent category, thus, the most frequent category was the highest score which creates a violation of the variability assumption for ANOVA), a rank

transformation was applied (Judd and McClelland, 1989; Conover and Iman, 1981). In this transformation each datum is replaced by its ordinal rank or in the case of tied ranks by the average of the ordinal ranks and then the usual parametric tests are applied. All analyses in this study were run on SPSS. An ANOVA with Age (3 levels) as the between-subjects factor and Truth (mislead vs. reinstate) as the within-subjects factor was conducted on the experimental subjects. There were no significant main effects but there was an Age by Truth interaction, that approached significance F (2,41) = 3.19 $p < .052$. Inspection of Figure 1 shows there was a tendency for the youngest and oldest age groups to accurately recall more reinstated information whereas the middle age group tended to accurately recall more misled information, perhaps this is something future research could address.

The above analysis was performed on the sum of all relevant information recalled by the child; the next one differentiates the type of information recalled into central versus peripheral information. Because the data were not

normally distributed (100% was the most frequent category) a rank transformation was applied (Judd and McClelland, 1989; Conover and Iman, 1981). An ANOVA with Age (3 levels) as the between-subjects factor and Truth (mislead vs. reinstate) and Information (central vs. peripheral) as the within-subjects factors was conducted on the transformed data of the experimental subjects. There were no significant main effects nor interactions. That is, in all three age groups children are correctly recalling about the same amount of information regardless of whether the information relates to central or peripheral events.

To summarize, in the first analysis there was an Age x Truth interaction that approached significance. In the second analysis there were no significant effects.

Since all experimental subjects had been reminded of the target events during the reinstatement/misleading session that had taken place the week before their recall interview (even though some details provided by the researcher were incorrect), they eventually had the whole episode reinstated (see Howe et al., 1993, for a discussion

of the tendency toward the spread of reactivation). Thus it was important to compare the experimental group with a control group which had not had such reinstatement. To determine children's overall accuracy, the percentage of times the experimental and control children were correct in the information they provided in response to the standard interview was examined (see Table 3).

Insert Table 3 about here

Inspection showed the data to have a distribution such that central values of the scores were more frequent than either of the tails. Following Hays (1994) and Bradley (1968) an ANOVA was applied to the original data although the assumption of normally distributed error was somewhat violated. An ANOVA, with Age (3 levels) and Condition (control vs. experimental) as between-subjects factors was calculated. Age groups differed significantly in accuracy of response, F (2,196) = 4.66 $p < .001$. Planned comparisons

were performed to see where the differences lay. The only significant difference was between age 3-4 yrs and 8-13 yrs and not ages 3-4 yrs and 5-6 yrs or ages 5-6 yrs and 8-13 yrs. F (2,196) = 4.52 $p < .01$. Condition (experimental or control) had no effect and there was no significant interaction effect (See Figure 2). This suggests that control subjects, who had no reinstatement of their experience a week prior to the interview, recalled just as much correct information as the experimental group, who did have such reinstatement. Further, in both groups the amount correctly recalled increased with age.

Insert Figure 2 about here

The proportion of information accurately recalled by experimental and control subjects was determined for central and peripheral information categories across three age categories (see Figure 3).

Insert Figure 3 about here

Because the data were not normally distributed (100% was the most frequent category) a rank transformation was applied. To determine if there was a difference between the amount of central and peripheral information accurately recalled by experimental and control children as they got older, an ANOVA with Age (3 levels) and Condition (control vs. experimental) as between-subjects factors and Information (central vs. peripheral) as the within-subjects factor was calculated. The age effect approached significance, F (2,98) = 2.95 $p < .057$. Planned comparisons were done to see where the differences lay. As in the previous analyses, the only significant differences were between ages 3-4 yrs and 8-13 yrs, F (2,98) = 3.15 $p < .04$, and not ages 3-4 yrs and 5-6 yrs or ages 5-6 yrs and 8-13 yrs. In addition, there was a significant Condition (experimental vs. control) by Information (central vs.

peripheral) interaction, F (1,98) = 6.91 p < .01 (see Figure 4), a post hoc analysis of this interaction showed, that when analyzed for differences in central information, there was no significant difference of Condition (experimental vs. control). However, when analyzed for differences in peripheral information, there was a significant difference of Condition (experimental vs. control). That is, the experimental and control groups recalled similar amounts of central information, but experimental group subjects recalled significantly more peripheral information than control group subjects F (2,98) = 4.10 p < .04. The Age (3 levels) by Condition (experimental vs. control) by Information (central vs. peripheral) interaction was not significant.

Insert Figure 4 about here

To summarize, it appears that even when children have not been reinstated they still recall a considerable amount of information that increases with age and is comparable to a group where the information has been reinstated.

Recall that other factors such as stress have been cited as influencing the amount of correct information recalled by children. To explore this, the impact of stress on children's accuracy, including accuracy on the misled and reinstated items, was analyzed by calculating correlations between stress and the accuracy scores of the children that were included in the above factorial analyses. Stress ratings were used from both the injury and the hospital treatment(s). See Table 4.

Insert Table 4 about here

Because the central and peripheral data that was misled, reinstated or controlled were not normally

distributed (100% was the most frequent category) a rank transformation was applied (Judd & McClelland, 1989; Conover & Iman, 1981). The only significant correlation for the above analysis was between stress at time of injury and stress at time of hospital visit (r = .289, $p < .05$). This suggests that children who are stressed at the time of initial injury are also likely to be stressed during the hospital treatment. However, it appears that stress is not associated with how accurately either the experimental or control children remember the details of events that were experienced a year previously. Nor does stress impact children's accuracy on information that had been either misled or reinstated the week before.

Discussion

From a modern legal standpoint, the most significant problem with the use of repeated questioning to enhance recall is the suggestibility of children (Moston, 1990). The

degree to which children are able to accurately report what they have personally experienced is an issue that becomes increasingly more important as the number of children called to testify within the legal system increases (Ceci & Bruck, 1993). Overall, in our study the accuracy of children's memory (ages 3-13 years-old) was not influenced by variables such as misleading or reinstating information, stress at time of injury, or stress at time of hospital visit.

Interestingly, reinstating information had little effect on the accuracy of children's memory. This is a different finding than the results of other studies on reactivation (Rovee-Collier & Shyi, 1992; Fleckenstein & Fagan, 1994; Howe, Courage, & Bryant-Brown, 1993). For example, Rovee-Collier and Shyi (1992) found that a reminder significantly alleviated forgetting after a retention of 4 weeks but not after 5. Similarly, Fleckenstein and Fagan (1994) also found that reactivation alleviated forgetting of infants. However, both of these studies involved infants (instead of children 3-13 years old), and a different delay than our study (one to five weeks instead of one year).

Howe, Courage, & Bryant-Brown (1993) found that reinstatement increased long-term retention in 2 1/2 and 3 1/2 year olds for object-location pairings. While these ages are similar to this study, the task is not. Howe and colleagues' (1993) task (object-location pairing) is quite different from personal injury. Moreover, normally reactivation is supposed to, in theory, follow forgetting (Rovee-Collier and Shyi, 1992). The children in this study did not forget very much; rather, the subjects (regardless of age) recalled a considerable amount of information even after a delay of one year.

Loftus, Miller and Burns (1978) suggested that there was a developmental trend regarding children's vulnerability to misleading information, with younger children more suggestible than older children. In contrast, our results are more supportive of Zaragoza (1987) who asserted that reports made by younger children indicated that they were not more easily misled than older children. In our study, older children were significantly more accurate than younger children when we compared control and experimental children:

however, when we just looked at experimental children, the only ones who were misled or reinstated, the differences between younger and older children were not significant. The reason age was a significant factor in one analysis and not in the other may be because when we looked at the experimental children alone we were only concerned with correct recall of the bits and pieces of information that had been misled or reinstated at one year. However, when we added the control children we were looking at all the possible information recalled correctly across the whole interview; not just bits and pieces of information as with the experimental group. Thus, while age is important in terms of accuracy, we found no evidence that age contributed to greater vulnerability to misleading or reinstated information. As well, for the misleading treatment, our findings were not consistent with others in this area (Goodman, Bottoms, Schwartz-Kenney, & Rudy, 1991; Goodman, Hirschman, Hepps, & Rudy, 1991; Ceci, Huffman, Smith, & Loftus, 1994; Lepore & Sesco, 1994; Goodman, & Rudy, 1991). For example, Goodman, Bottoms, Schwartz-Kenney & Rudy (1991)

and Goodman, Hirschman, Hepps & Rudy (1991) found older children to be less suggestible than younger children in answers to misleading questions. Similarly, Ceci, Huffman, Smith & Loftus (1994) found young children to be disproportionately vulnerable to making errors and claiming they actually experienced events when they really only thought about them and Lepore & Sesco (1994) found that young children (4- to 6- year-olds) would produce misleading reports about their interactions with either familiar or unfamiliar adults when they were prompted to do so by an opinionated adult interviewer. In contrast to these studies, our study found that young children were not more likely to be misled than older children. Perhaps one possible explanation is that in our study it was absolutely necessary that a good rapport was established with the child before the interview procedure was started. As well, the interview was conducted in the child's own home which provided a very comfortable environment in which they could talk. On the other hand, the comfort of home also gave children the opportunity to correct any information that was misleading.

If in fact the child indicated that the information was incorrect the interviewer remained neutral. Another possible explanation may be that in some of the other studies children were asked questions regarding events that were either made up (fantasy) or not salient to them personally (Lepore & Sesco, 1994). In contrast, in our study children were asked questions regarding a personally salient event, that is, injury and hospital treatment.

Comparisons between our methodology and other studies in this area is important to consider. A number of investigators have interviewed children about scheduled medical or dental procedures (for example, Baker-Ward, Gordon, Ornstein, Larus, & Clubb, 1993; Goodman, Hirschman, Hepps & Rudy, 1991). As Peterson (1996) has pointed out, these events were expected and well-rehearsed. In contrast, this study involves injuries that are not expected or rehearsed. Further, there is a vast difference in the cases where children are interviewed following a routine doctor check-up and this study. Namely, the children in this study are often highly stressed (even though stress was not a

significant factor affecting recall accuracy), while the children getting a routine medical or dental check-up seldom are. In fact, medical staff are well known for explaining in great detail the specifics of an examination, especially when dealing with very young children.

Stress at time of injury and stress at time of hospital treatment did not affect the children's ability to accurately recall information. This is similar to the results of Peterson and Bell (in press) whose overall conclusions stated that stress played very little role in children's (aged 2-13 years old) recall for painful injuries/treatments. In contrast, other studies have found stress to be an important variable influencing some children's recall of a personally experienced event. For example, Vandermaas, Hess, and Baker-Ward (1993) found that stress during a dental cleaning, check-up or operative procedure had a debilitative effect on the reports of children 7-8 yrs old whereas Goodman, Hirschman, Hepps, & Rudy (1991) found the effects of stress to be positive. That is, the highest level of stress improved children's (aged 3-

to 7- years old) resistance to suggestion. Perhaps differences between Vandermaas and colleagues (1993) findings and ours is due to the levels of stress in the Vandermaas and colleagues (1993) study, it was lower than the levels of stress experienced by children in our study. Differences between the results of Goodman and colleagues (1991) and ours could be attributed to subject number. They had only one child who was highly stressed and only three more children who were moderately stressed, whereas we had 60 children who were highly distressed during injury, treatment, or both. Furthermore, how stress is measured methodologically is often very important. Some researchers have used physiological recordings of stress (specifically the release of adrenaline that accompanies stress, e.g., Gold, 1987, McGaugh, 1989) whereas others (including this study) have used questionnaires/Likert scales to record stress (Peters, 1987, 1991, Goodman, Bottoms, Schwartz-Kenney & Rudy, 1991). Perhaps a stress effect on children's memory would be noticeable if physiological measures were used rather than a ratings scale.

Accuracy rate for the experimental and control children in our study depending on whether the information was central or peripheral was interesting. When the significant Condition by Information interaction was analyzed, it was worth noting that both experimental and control group children accurately recalled similar amounts of central information but experimental group children accurately recalled more peripheral information than control group children. This is different from Peterson and Bell's (in press) finding that for all the children sampled in their study central information was recalled more accurately than peripheral information. Though they used similar aged children, these children were only interviewed initially and six months post-injury, not one year post-injury like our subjects. Moreover, perhaps the reactivation treatment is increasing the amount of peripheral information accurately recalled by our experimental group children. Whereas, our control group children who never received reactivation, tended to recall more accurate central information, similar to subjects in the Peterson and Bell (in press) study.

Notwithstanding potential problems with the methodology, our results are good news for people interested in children's memory for personal injury. Children are not easily mislead when interviewed appropriately and their memories are in fact quite reliable even after a delay of one year. Even the youngest children in our group are impressive. Despite repeated interviewing the children are not making many mistakes, and errors of omission were more likely than errors of incorrect information.

Future studies need to follow up the children after longer delays after the experimental treatment to allow possible forgetting to occur, and as always researchers need to remind the parents not to rehearse the incident with their child. For as the number of children called to testify in legal settings increases so too does the urgency for more research on this topic increase.

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Appendices

Appendix 1. Standard Interview: Table of possible types of information and sample responses given by children divided into central and peripheral information. Adapted from Peterson and Bell, (in press).

Appendix 2. Examples of misleading and reinstating questions.

Appendix 3. Prototype Interview (Adapted from Peterson, 1996)

Appendix 1

Prototype of Injury and Hospital Treatment With Examples of Items and Classification Category as Central (C) or Peripheral (P) Detail (Adapted from Peterson & Bell, in press).

Item	Example	Category
	THE INJURY	
Time of day	"Right after lunch"	P
Place	"In my backyard"	P
Who was with you	"Mom and my brother Joe"	P
Who else was around	"My friend Anna was playing there too"	P
Actions prior to injury	"I was running"	P
The injury	"I got a big cut on my leg"	C
How it occurred	"I was tripped"	C
Who did it	"By my brother"	C
What objects involved	"I hit a piece of the porch that was sticking up"	C
Cry	"I had to just scream"	C
Blood	"It was bleeding all down my leg"	C
Who first responded	"Mommy heard me cry"	C
Where you went before hosp.	"She took me into the kitchen"	P
Actions to treat injury	"She wiped my knee"	C
Objects of home treatment	"And put a cloth on my knee to soak up blood"	C
Anyone else look/help?	"My brother was watching"	P
Went to hospital	"Then I went to the hospital"	C
Who took you to hospital	"Mom drove me there"	P
Who else went along	"My brother had to come too"	P
Time of hospital trip	"We got to the hospital half an hour later"	P

THE HOSPITAL TREATMENT

Registration	"A nurse checked me in"	P
Vitals measured	"I got my blood pressure taken"	P
Waiting period	"I had to wait a long time"	P
Actions while waiting	"I watched the TV"	P
Initial exam	"Finally somebody looked at my cut"	C
Hospital personnel	"It was a girl doctor"	C
X-rays	"I got an X-ray because they thought something was still in my knee"	C
Cast	(not relevant)	C
Needles	"I got 4 needles to put my knee asleep"	C
Stitches	"And then I got 14 stitches"	C
Bandage	"I got a big bandage all down my leg"	C
Procedural details	"The doctor washed out my cut first"	P
Other treatment objects	"With soap"	P
Cry	"That made me cry"	C
Popsicle	"The nurse gave me a yellow popsicle"	P
Family in treatment room	"My Mom was in there with me"	P
Went home	"We went home"	P
Stopped somewhere on way	"On the way we stopped at McDonald's"	P
Post-hospital treat	"Mom got me some fries"	P
Who you told/showed	"I called my Dad and my Nana and told them"	P

APPENDIX 2. Examples of misleading and reinstating questions

Misleading (The incorrect information is in bold and always occurs at the first part of the sentence).

Central Information:

You hurt yourself on **glass**, what did the doctor do to make you feel better?

A **bandage** was put on your cut, what time was it when you hurt yourself?

Peripheral Information:

Your **mom** was with you when you hurt yourself, what did the hospital give you for a treat?

You stopped at **McDonald's** on the way home from the hospital, where did you go when you first hurt yourself?

Reinstatement (the first part of the sentence is correct information)

Central Information

Your mom and dad were at home when you hurt yourself, what did you do when you came home from the hospital?

You cut your hand, who called your mom from the school?

Peripheral Information:

You were riding your bike when you hurt yourself, how long did you wait at the hospital before seeing the doctor?

Your mom was in the room when you got stitches, who was there when you first hurt yourself?

APPENDIX 3. Prototype Interview (Adapted from Peterson, 1996).

Questionnaire for Injuries

Free Recall of injury and treatment, use standard elicting techniques for narratives.

"Tell me what happened when you hurt yourself", "Help me remember what happened when you were hurt"

Probed Recall:

I'm going to ask some questions to make sure I understand what happened:

How did it happen?

Who was there?

Who did it, (if relevant)?

What objects were involved?

Where?

When?

What did you do when it happened?

How much did it hurt?

How much did you cry, how long did you cry?

How much did it bleed, how long did it bleed?

Who got help?

Who came and got you?

What did they do?

How long did you wait before going to the hospital?

How did you get to the hospital?

Who else came with you?

What happened when you got there?

What did you do while waiting?

How long did you wait before you saw the doctor?

When you did see the doctor was it a boy/girl?

Did you have a needle, tell me where (on body).

How many needles did you get?

How much did that hurt?

How much did you cry?

Who was in the room with you?

if broken bone:

Tell me what happened when you got x-rays?

How much did the x-rays hurt?

How long did you cry?

Did you have to get a cast?

Who put the cast on?

How did they put it on?

Who was in the room with you?

if cut:

Did someone give you stitches?

How many?

Did you get a bandage?

How much did it hurt?

How long did you cry?

Who was in the room with you?

Did the doctors give you anything special?

What happened when you went home?

Tell me about anything special that happened later that day.

Who did you tell?

Table 1. Average number of misled and reinstated questions divided into central and peripheral categories asked to children across three age groups.

	Age Groups (in years)			
	3-4	5-6	8-13	Total
Misled				
Central				
Mean	2.1	2.41	2.63	2.45
S.D.	(1.05)	(0.66)	(0.78)	(0.80)
Peripheral				
Mean	2.2	3.08	3.5	3.09
S.D.	(0.70)	(1.08)	(1.05)	(1.03)
Total	4.3	5.5	6.13	5.54
	(0.87)	(0.94)	(1.02)	(0.96)
Reinstate				
Central				
Mean	1.9	2.3	2.27	2.20
S.D.	(1.06)	(1.03)	(0.76)	(0.87)
Peripheral				
Mean	2.4	2.91	3.54	3.11
S.D.	(1.30)	(1.16)	(1.01)	(1.14)
Total	4.3	5.25	5.81	5.31
	(1.19)	(1.09)	(1.09)	(1.10)

Table 2. Means and Standard deviations for accurate recall of Misled and Reinstated information divided into central and peripheral information categorized across three age groups.

Means and standard deviations for misled and reinstated information divided into central and peripheral information categories	Age Groups (in years) 3-4	5-6	8-13	Total
Misled Central				
Mean	92.50	90.90	90.90	91.27
S.D.	(16.87)	(30.15)	(23.83)	(23.20)
Peripheral				
Mean	85.00	95.45	96.13	93.32
S.D.	(24.15)	(15.07)	(12.71)	(16.78)
Total	88.75	93.18	93.52	92.32
	(20.63)	(23.37)	(19.06)	(20.44)
Reinstate Central				
Mean	96.50	90.90	100.00	96.86
S.D.	(11.06)	(30.15)	(0)	(16.00)
Peripheral				
Mean	89.50	89.09	96.81	93.14
S.D.	(25.65)	(24.68)	(11.29)	(19.08)
Total	91.66	90.00	98.40	95.00
	(20.02)	(26.90)	(8.05)	(17.62)

Table 3. Means and standard deviations for experimental and control group's accurate recall of central and peripheral information across three age groups.

Means and standard deviations for experimental and control groups accurate recall of central and peripheral information	Age Groups (in years)			Total
	3-4	5-6	8-13	
Experimental				
Central				
Mean	90.50	94.17	93.86	93.18
S.D.	(7.61)	(12.93)	(7.22)	(9.09)
Peripheral				
Mean	86.00	89.17	96.36	92.05
S.D.	(17.91)	(12.21)	(4.67)	(11.67)
Total	88.25	91.67	95.11	92.61
	(5.98)	(9.61)	(4.05)	(10.42)
Control				
Central				
Mean	92.19	96.94	96.54	95.50
S.D.	(9.48)	(21.14)	(4.64)	(6.68)
Peripheral				
Mean	83.44	84.44	88.85	86.08
S.D.	(16.43)	(15.03)	(10.79)	(13.84)
Total	87.81	90.69	92.69	90.79
	(10.14)	(8.02)	(6.66)	(11.83)

Table 4. Correlations between age, misleading central, peripheral and total, reinstated central, peripheral and total, control central, peripheral and total, stress at time of injury and stress at time of hospital treatment.

	Injury Stress	Hospital Stress
Age	-.1227	-.2890
Misleading Central	-.0993	-.1372
Misleading Peripheral	-.2362	-.1035
Misleading Total	-.2951	-.2625
Reinstated Central	-.1887	-.1977
Reinstated Peripheral	-.2780	-.1704
Reinstated Total	-.2535	-.2291
Control Central	-.1529	-.2058
Control Peripheral	-.0809	-.0629
Control Total	-.0863	-.1124
Stress at Injury	1.0	.2892*
Stress at Hospital	.2892*	1.0

*p<.05

Figure 1. Total amount of misled and reinstated information recalled correctly by experimental group children across three age groups.

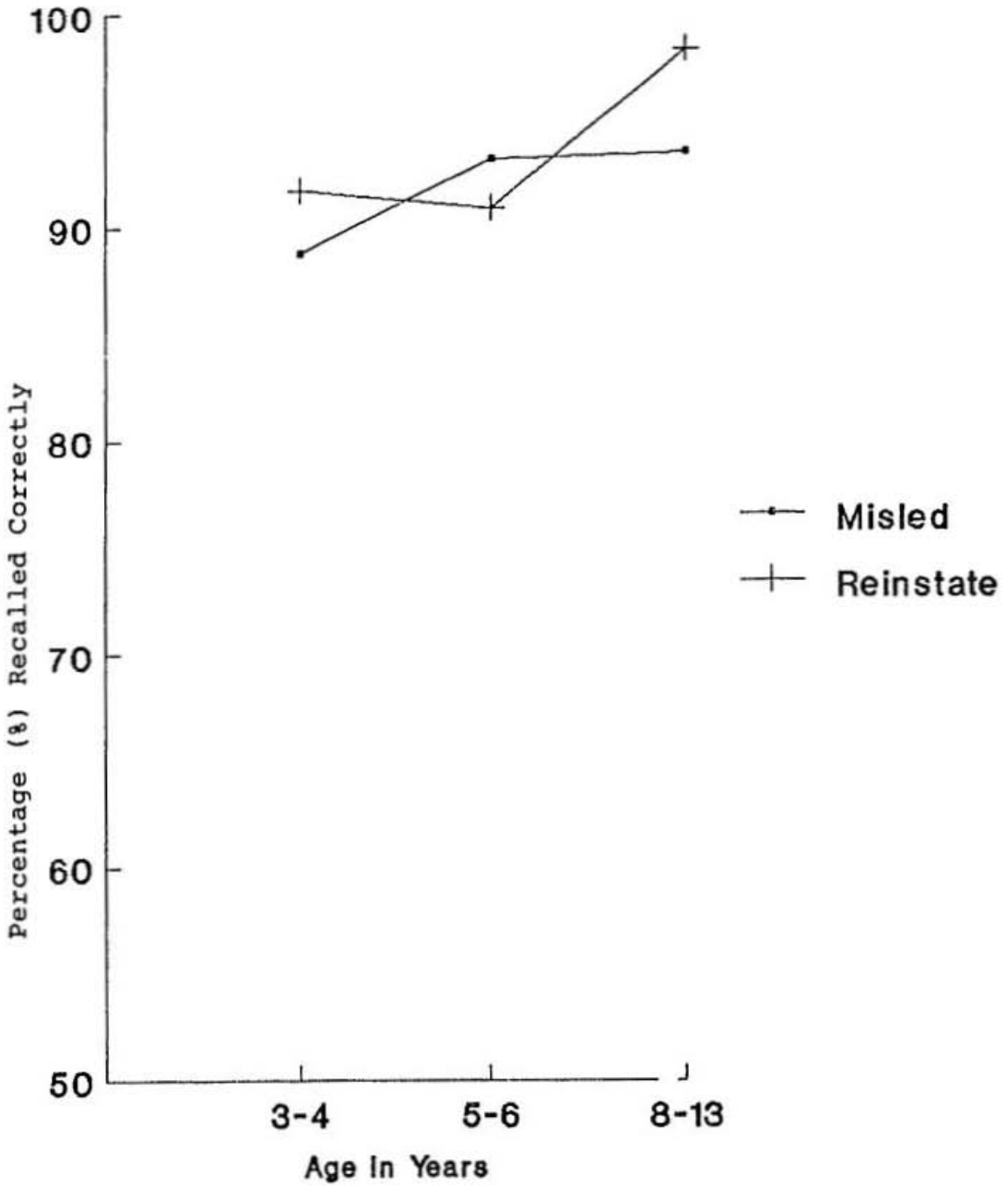

Figure 2. Total amount of information recalled correctly by control and experimental children across three age groups.

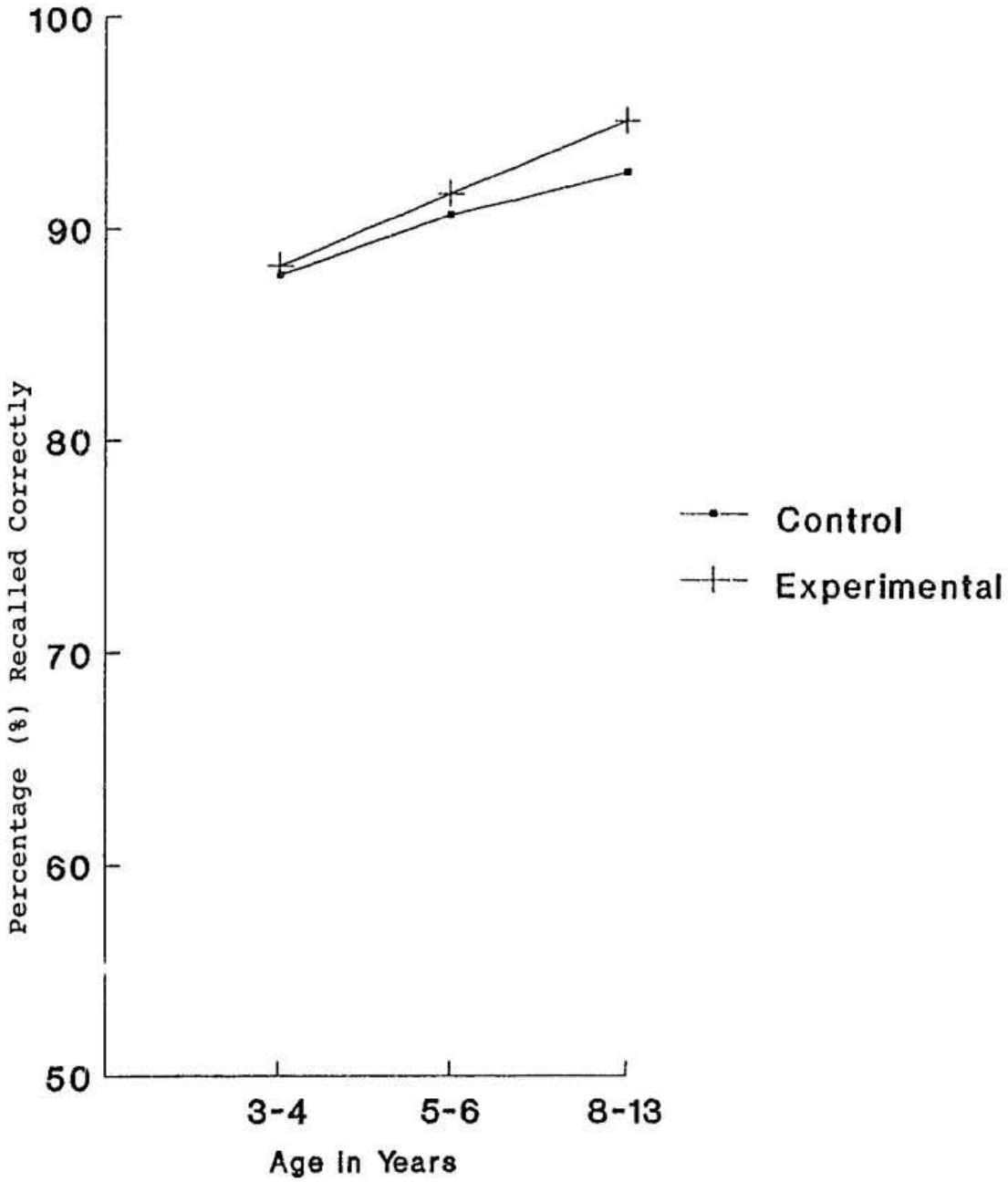

Figure 3. Percentage of central and peripheral information recalled correctly by experimental and control children across three age groups.

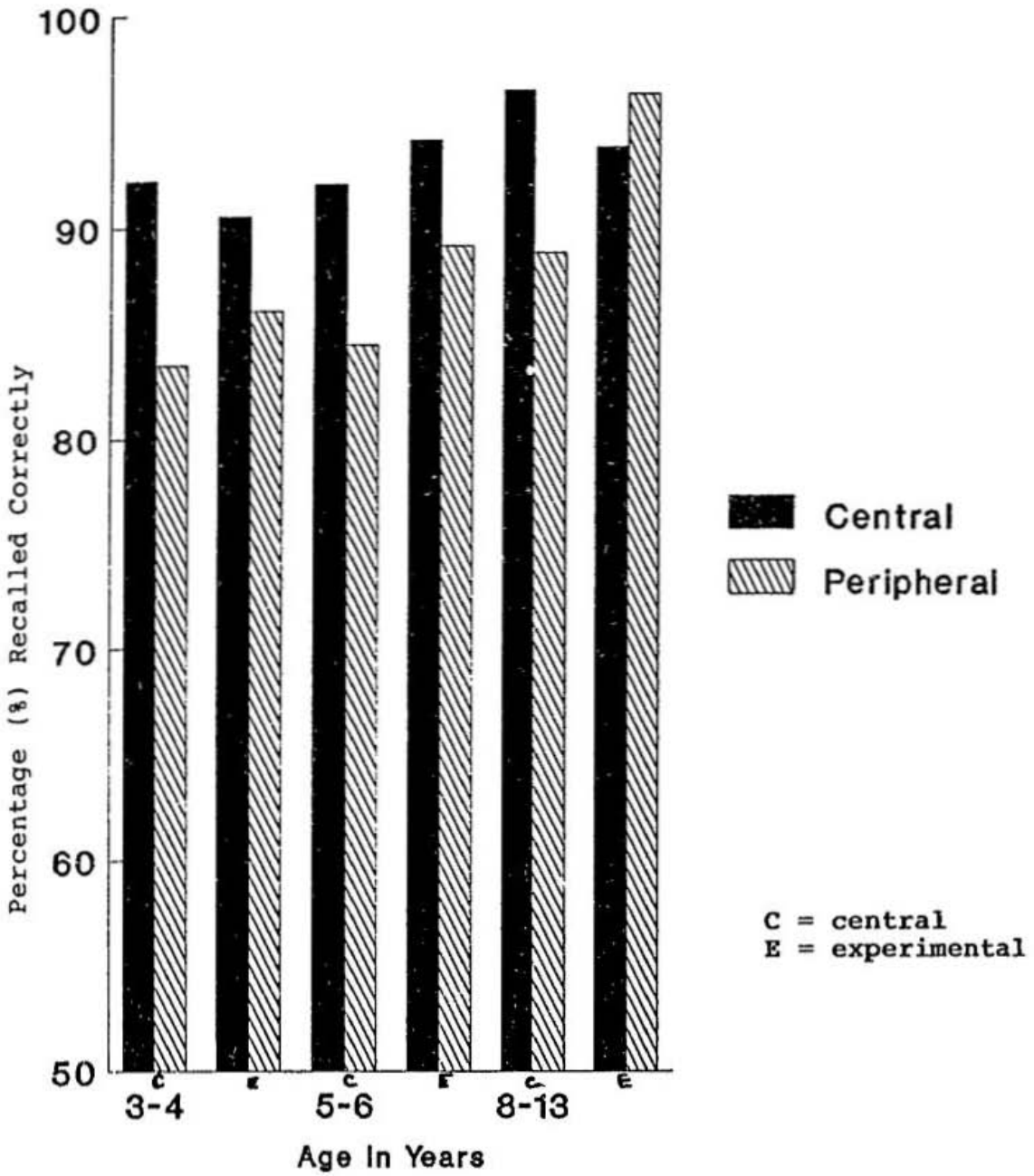

Figure 4. Interaction between amount of central and peripheral information recalled correctly for control and experimental groups.