

# Maltreated Children's Memory: Accuracy, Suggestibility, and Psychopathology

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Memory, suggestibility, stress arousal, and trauma-related psychopathology were examined in 328 3- to 16-year-olds involved in forensic investigations of abuse and neglect. Children's memory and suggestibility were assessed for a medical examination and venipuncture. Being older and scoring higher in cognitive functioning were related to fewer inaccuracies. In addition, cortisol level and trauma symptoms in children who reported more dissociative tendencies were associated with increased memory error, whereas cortisol level and trauma symptoms were not associated with increased error for children who reported fewer dissociative tendencies. Sexual and/or physical abuse predicted greater accuracy. The study contributes important new information to scientific understanding of maltreatment, psychopathology, and eyewitness memory in children.

*Keywords:* children, maltreatment, memory, suggestibility, trauma

There is much scientific interest in the effects of childhood trauma on memory development. Research suggests that adults who self-report a history of childhood maltreatment are more likely than adults who report no such history to evince memory deficits (e.g., Edwards, Fivush, Anda, Felitti, & Nordenberg, 2001; Hunter & Andrews, 2002). Yet little is known developmentally about the effects of trauma, such as maltreatment, on children's memory. Such knowledge is essential to constrain theories about trauma and memory and to ensure proper application of memory research (e.g., to legal cases).

When considering memory reports of maltreated children, clinically significant factors are of special interest. Child maltreatment

places individuals at increased risk of trauma-related psychopathology, including posttraumatic stress disorder (PTSD) and dissociation, which are associated in adults with certain memory problems and increased suggestibility (e.g., Bremner, Shobe, & Kihlstrom, 2000; Hyman & Billings, 1998), although perhaps also with some memory advantages (e.g., Alexander et al., 2005). These clinically relevant factors may affect children's neurophysiology (e.g., Carrion, Weems, & Reis, 2007) as well as event memory and suggestibility (for reviews, see Eisen & Goodman, 1998; Eisen & Lynn, 2001; Howe, Goodman, & Cicchetti, in press). Further, maltreated children, on average, often display language and intellectual delays (Culp et al., 1991; Egeland, 1991; Eigsti & Cicchetti, 2004; McFadyen & Kitson, 1996), which have been identified as potential influences on children's event memory and suggestibility (e.g., Alexander et al., 2002; Dent, 1992; Quas et al., 1999). As we explain later, it is possible that some of these clinically significant factors, especially trauma-related psychopathology, particularly affect memory for stressful experiences.

Therefore, our study concerned maltreated children's memory and suggestibility for a stressful (medical) event. On-line measures of stress arousal (e.g., cortisol levels) were obtained. The questioning took place in a context particularly high in ecological validity, specifically, that of active maltreatment investigations. Before detailing the study, we review relevant literature.

## Memory in Maltreated Children

Adults with maltreatment histories, especially if they develop trauma-related psychopathology, may evince memory functioning

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that differs in potentially important ways from that in nonmaltreated adults. A history of maltreatment is associated in adults with gaps in and less specific autobiographical memory (Edwards et al., 2001; Hunter & Andrews, 2002; Kuyken & Brewin, 1995) and error on semantic-associate "false memory" tasks (Bremner et al., 2000). Such deficits have been variously attributed to problems in such basic memory processes as encoding, memory monitoring, and/or retrieval (e.g., McNally, 1997; Williams & Broadbent, 1986). Also, Windmann and Krueger (1998) proposed that traumatized individuals overinterpret neutral information as trauma related and thus are more prone to false alarms on certain memory tasks.

However, adults with maltreatment histories, especially those with greater traumatization, often keenly attend to and evince better memory for trauma-related information than do nontraumatized individuals (Alexander et al., 2005; Vrana, Roodman, & Beckham, 1995). Factors such as abuse severity, dissociative tendencies, and PTSD have been identified in adults as possibly contributing to maltreated individuals' memory performance (see Bremner et al., 2000; Eisen & Lynn, 2001; Goodman et al., 2003).

Although relatively few published studies of memory accuracy in abused children exist (e.g., Beers & DeBellis, 2002; Howe, Cicchetti, Toth, & Cerrito, 2004; Katz, Schonfeld, Carter, Leventhal, & Cicchetti, 1995; Moradi, Doost, Taghavi, Yule, & Dalglish, 1999; Porter, Lawson, & Bigler, 2005), the extant research has largely failed to reveal—or has left unstudied—the same predictors of memory performance in abused versus nonabused children as found for adults. Moreover, only a small handful of studies has examined abused versus nonabused children's eyewitness memory. In one such study, Goodman, Bottoms, Rudy, Davis, and Schwartz-Kenney (2001) reported that abused and nonabused children's memory for a social interaction did not significantly differ on measures of free recall or suggestibility (e.g., to questions relevant to abusive actions). However, nonabused children were more accurate than abused children in answering specific questions and made fewer photo identification (ID) errors, even with differences in IQ and behavioral symptomology statistically controlled. Typical age patterns in memory emerged (i.e., more accurate memory with age). Katz et al. (1995) found that alleged child sexual abuse (CSA) victims with substantiated cases showed greater memory accuracy about an anogenital examination than did alleged CSA victims involved in unsubstantiated cases. Children with known neglect histories, but no known CSA or child physical abuse (CPA), were not included in these studies. Neglected children might be particularly prone to error given their backgrounds of inattention by parents and/or absence of basic needs, which might jeopardize their cognitive functioning (Gaudin, 1999).

Of particular relevance is our own previous study on memory and suggestibility in maltreated children (Eisen, Qin, Goodman, & Davis, 2002). As in the present research, the children were questioned about anogenital examinations received in the context of a 5-day inpatient abuse assessment program. Eisen, Qin, et al. (2002) found that intelligence and general psychopathology were significantly related to children's memory accuracy. However, few abuse-related differences in memory were found: In most respects, children with substantiated abuse performed comparably to each other (e.g., CSA compared to CPA victims) and to control children with no known history of child maltreatment. Typical age patterns

were obtained, with older children outperforming younger children. Errors to abuse-related questions (e.g., that the doctor undressed the child when in fact the doctor had not) were infrequent, although they were more common in younger than older children. The relatively low error rates may reflect children's greater resistance to suggestions involving negative (e.g., embarrassing, taboo) than neutral or positive acts (Ceci, Loftus, Leichtman, & Bruck, 1994; Saywitz, Goodman, Nicholas, & Moan, 1991; Schaaf, Alexander, & Goodman, in press; but see Candel, 2006). The present study represents an expansion and refinement of this previous work.

### Stress and Children's Memory

In the present study, we examined maltreated children's memory and suggestibility about a stressful event. It is therefore important to consider how stress may affect children's memory. For adults, studies largely converge on the notion that information relevant to the main stressor, as opposed to more peripheral information, is retained particularly well (Christianson, 1992; Reisberg & Hertel, 2004). However, for children, findings are more mixed. Some studies lead to the conclusion that stressful events are clearly impressed upon children's minds, resulting in particularly accurate memory reports (e.g., Goodman, Hirschman, Hepps, & Rudy, 1991; Peterson & Bell, 1996; see Howe et al., in press, for review), although the memories are still subject to normal memory processes such as forgetting. Other studies suggest that stress and trauma result in poorer memory for the details of the event and increased susceptibility to suggestive questions (e.g., Fivush, McDermott Sales, Goldberg, Bahrick, & Parker, 2004; Merritt, Ornstein, & Spicker, 1994; see Eisen & Lynn, 2001, for review).

Across studies of children's and adults' memory for stressful experiences, measures of distress have varied widely (e.g., self-report, observer report, physiological indicators). Moreover, the various indices are typically uncorrelated (e.g., Brigham, Maass, Martinez, & Wittenberger, 1983). However, hypothalamic-pituitary-adrenal responsivity (e.g., cortisol release) is an indicator of physiological distress of special interest given its relation to later memory functioning (e.g., see Li et al., 2006). Based on the putative neurotoxic effects of elevated cortisol on such brain structures as the hippocampus (e.g., Bremner et al., 1997; Carrion et al., 2007; Sapolsky, 1996), increased cortisol shortly after a stressful event could be negatively correlated with accurate and complete memory, and therefore possibly positively correlated with increased suggestibility. Heart rate acceleration is another potential indicator of distress. To the extent that heart rate acceleration indicates a defense response that might block encoding of information (Sokolov, 1963; Turpin, 1986), elevated heart rate relative to baseline heart rate might also be associated with greater memory error and suggestibility.

However, like adults, children do not all respond in the same way to highly stressful or traumatic experiences (e.g., Steward et al., 1996). These differential responses to stress and trauma are likely moderated by a host of individual-difference factors, for instance in psychopathology (e.g., dissociation, PTSD) and intellectual functioning (e.g., language ability, intelligence, short-term memory [STM] capacity), that can influence children's memory for highly stressful events, perhaps more so than they do for many nonstressful experiences (Alexander, Goodman, Schaaf, Shaver, &

Quas, 2002; Eisen & Goodman, 1998). We discuss such factors next.

### Individual-Difference Factors Related to Memory

#### *Dissociation and Memory*

Dissociation is frequently cited as a common response to trauma in maltreated children (Macfie, Cicchetti, & Toth, 2001a, 2001b; see Putnam, 1996, for a review). Theoretically, the child dissociates as a defensive response to psychologically remove her or himself from the traumatic situation. This results in a form of cognitive avoidance (Carlson, Armstrong, & Loewenstein, 1997) designed to protect the child from overwhelming stressors. It is believed that such responses of, in effect, "zoning out," may become enduring personality or coping tendencies in times of stress (Koopman, Classen, & Spiegel, 1994; Lynn & Rue, 1994).

In recent years, theorists have adopted a taxonomic view of dissociation (e.g., Waller, Putnam, & Carlson, 1996). In line with this approach, high scores on dissociation scales are thought to reflect a pathological form of dissociation that is distinct from nonpathological dissociative traits, the latter of which are more akin to fantasy proneness. Moreover, this particularly pathological form of dissociation is thought to be linked to a history of trauma in childhood. To the extent that maltreated children who remain high in dissociative tendencies may become more dissociative during a (nonabusive) stressful event, they may evince worse memory and greater suggestibility than would maltreated children who show less elevated dissociative tendencies.

In adults, dissociation is associated with various forms of memory impairment. For instance, a positive relation exists between dissociation and adults' suggestibility, including false-memory formation (Eisen & Carlson, 1998; Hyman & Billings, 1998; Paddock et al., 1999; Winograd, Peluso, & Glover, 1998; but see Eisen, Morgan, & Mickes, 2002). Dissociation in adults is also related to lost memory or lack of disclosure of CSA experiences (Goodman et al., 2003). One of the only published studies to investigate dissociation and suggestibility in children failed to find significant relations (Eisen, Qin, et al., 2002). The present study was designed to improve on the methods used by Eisen, Qin, et al. (2002) in an effort to examine possible relations between dissociation and memory/suggestibility for stressful and nonstressful events in a more comprehensive manner.

#### *PTSD and Memory*

It has been proposed that dissociation is related to the development of PTSD, which is one of the most common diagnoses given to traumatized children (Browne & Finkelhor, 1986). Although PTSD is associated with adults' memory performance (e.g., Alexander et al., 2005; Bremner et al., 2000; Zoellner, Foa, Brigidi, & Przeworski, 2000), and has been defined as a disorder of memory (Sullivan & Gorman, 2002), there is a paucity of research addressing the effects of PTSD on children's memory. Consistent with findings in the adult literature, Moradi et al. (1999) reported that children and adolescents with PTSD showed poorer overall memory performance when compared to children with no evidence of psychopathology (see also Porter et al., 2005). However, Beers and DeBellis (2002) failed to uncover differences in memory ability

between a sample of maltreated children with PTSD and a matched sample of children without psychopathology, although differences in attention and abstract reasoning were revealed. The paucity of research examining memory deficits in children with PTSD clearly needs to be redressed.

As alluded to earlier, in adults, PTSD is associated with gaps in autobiographical memory and greater error on the Deese/Roediger McDermitt task (Bremner et al., 2000; Zoellner et al., 2000) but also with an overfocus on trauma-related information (McNally, 2003), which can result in better memory for such information (Vrana, Roodman, & Beckham, 1995). Similarly, it is possible that in childhood, PTSD is associated with particularly accurate memory for stressful events, especially if trauma-related, as well as with deficits in memory for nonstressful events. Concerning the former possibility, symptoms of hyperarousal are commonly experienced by children with PTSD, and such symptoms have important implications for memory. Hyperarousal symptoms may be the result of a preparatory response to a generalized expectation of danger and a hypervigilance to details of threatening situations (e.g., Rieder & Cicchetti, 1989). Therefore, some traumatized children may show enhanced processing and recall for stressful or trauma-related experiences by virtue of their being hypervigilant in times of increased threat. However, PTSD is often comorbid with depression, which could adversely affect memory performance (Hertel, 2004). The present study addressed these questions by examining relations between symptoms of PTSD and children's memory and suggestibility for stressful events.

#### *General Psychopathology*

Eisen, Qin, et al. (2002) uncovered a significant relation between general psychopathology (global adaptive functioning [GAF]) and maltreated children's errors on misleading questions about a stressful medical procedure. Eisen, Goodman, et al. (1998) noted that general psychopathology could affect children's memory in a variety of ways (e.g., attention deficits, depression, and/or anxiety associated with general psychopathology could result in poor encoding of event details, perhaps especially during highly stressful and/or traumatic events; disturbed children might have more problems handling lengthy, challenging memory interviews, perhaps especially ones in which they are asked to recount the details of difficult, embarrassing, and/or traumatic experiences). In the present study, we attempted to replicate Eisen et al.'s findings by examining the relation between GAF scores and memory for stressful events.

#### *Language Ability*

In the forensic context, language ability plays a key role in determining a young child's ability to understand questions and to respond in a coherent manner. Several investigators failed to find a relation between children's language ability and event memory (Greenhoot, Ornstein, Gordon, & Baker-Ward, 1999; Gross & Hayne, 1999). Pipe and Salmon (2002) speculated that the lack of relation between Peabody Picture Vocabulary Test (PPVT) scores and errors on misleading questions may reflect the overshadowing of the importance of receptive language by social factors known to affect children's responses to misleading questions (Greenstock & Pipe, 1996). However, Quas et al. (1999) reported that PPVT

scores were related to children's performance on specific questions, and Carter, Bottoms, and Levine (1996) uncovered significant relations between language complexity and suggestibility (see also Saywitz, Goodman, Nicholas, & Moan, 1991). Given the fact that child maltreatment is often associated with language delays (e.g., Culp et al., 1991), it was important to investigate the relation between language abilities and memory/suggestibility in a child maltreatment sample. Of note, child neglect is often related to particularly severe language delays, and thus might be expected to be especially detrimental to eyewitness memory performance (Eigsti & Cicchetti, 2004; Gaudin, 1999).

### *Intelligence and STM*

Maltreatment is associated with lower scores on intelligence tests (e.g., Gowan, 1993). Again, children who suffer neglect may be especially at risk of lower intelligence scores and delays in cognitive ability generally (Gaudin, 1999). Because intelligence and cognitive abilities may influence memory skill, it is important to examine relations between intelligence and memory in maltreated samples. In studies of intelligence and eyewitness memory, significant relations emerge when nonmaltreated individuals are included who have intelligence test (IQ) scores indicative of retardation (e.g., Dent, 1992; Henry & Gudjonsson, 2003). Moreover, STM capacities are typically tapped on IQ tests, and such capacities could in theory be related to memory performance more generally (e.g., as an indication of general memory capacity). In the current study, we included three indices of STM.

### The Present Study

The present study extended Eisen, Qin, et al.'s (2002) research in several important ways. First, we assessed hypothalamic-pituitary-adrenal responsivity (i.e., cortisol), as well as heart rate and observer- and self-rated stress, regarding an even more stressful medical procedure: an anogenital examination plus venipuncture (i.e., blood draw). Second, we expanded the range of measures to include the assessment of depression, and we added an additional measure of dissociation. Third, we included a more comprehensive assessment of STM and intellectual ability. Finally, we increased the sample size and significantly improved the methodological approach to assessing memory and suggestibility.

Several hypotheses were tested: (1) Overall, children with histories of neglect, due to their deprived environments, would have the least accurate memories, whereas nonabused children would have the most accurate memories. (2) Children with particularly high levels of dissociation, greater general psychopathology, and lower cognitive functioning would evince poorer memory and

greater suggestibility when experiencing high stress. (3) Stress, as evidenced by an increase in cortisol levels from baseline to post-exam measurement, would be related to poorer event memory and increased suggestibility for the anogenital exam/venipuncture, as would be an analogous increase in heart rate. (4) As found in previous studies, older children would show better memory and greater resistance to misleading information when compared to their younger counterparts. (5) Memory and resistance to suggestion would be better for central than peripheral information regarding the anogenital exam/venipuncture.

In addition, we were interested in examining how well children resisted suggestions of inappropriate behavior on the part of the hospital staff. Based on previous data (Eisen, Qin, et al., 2002), we expected that most children would not confuse the physician's conduct in the anogenital exam with inappropriate fondling or sexual misconduct even when suggested through leading and misleading questions, perhaps because the suggested acts are taboo and personally relevant (Goodman, Rudy, Bottoms, & Aman, 1990). However, (6) because of their greater susceptibility to false suggestion—likely due to heightened effects of social influence or limitation on cognitive development—younger children were expected to make more such errors than were older children.

Finally, it could be argued that the anogenital examination is particularly relevant to CSA cases. Thus (7), to the extent that trauma-relevant information is remembered especially well (e.g., Alexander et al., 2005; McNally, 2003), the CSA victims should be particularly resistant to such suggestions. Similarly, (8) we also tested the hypothesis that PTSD would be associated with better memory for a stressful event.

### Method

#### *Participants*

Participants were referred to the Under the Rainbow (UTR) program at Mt. Sinai Hospital in Chicago, an inpatient unit specializing in the assessment of child abuse and neglect. Referrals typically came from such sources as the Department of Child and Family Services, family physicians, and school counselors. A total of 328 children (179 girls, 149 boys) participated (see Table 1). The sample included all children who could be tested (e.g., timely consent from Department of Child and Family Services). They were from predominantly low-socioeconomic-status families in urban areas of Chicago. Among the children, 70.4% were African-American, with 15.2% Latino, 13.7% Anglo, and 0.6% "other" ethnic origin. The children were stratified into three age groups: 3–5 years ( $M = 4.1$  years), 6–10 years ( $M = 7.8$  years), and 11–16 years ( $M = 12.3$  years).

Table 1  
*Age Group and Abuse Status (n) of the Participating Children*

Abuse status	3- to 5-year-olds	6- to 10-year-olds	11- to 16-year-olds	Total
Sexually abused	19	21	18	58
Physically abused	17	41	17	75
Sexually and physically abused	6	18	5	29
Neglected	48	66	16	130
Nonabused/control	19	10	7	36
Total	109	156	63	328



Based on case history from the Department of Child and Family Services and the results of the current UTR investigation, children were categorized into one of five abuse status groups (see Table 1). If either of the two sources indicated that a child had been sexually or physically abused, the child was classified as sexually or physically abused, respectively. If the Department of Child and Family Services records or the current UTR investigation indicated that a child had been both sexually and physically abused (SPA), the child was classified into the SPA group. A child was classified as neglected if information from the two sources revealed that the child had an indicated history of neglect but no indicated abuse (CSA or CPA). The nonabused control group consisted of children who had no known past or current CSA, CPA, or neglect. These children typically had been in contact with an alleged abuser and, for that reason, an evaluation was being conducted. The Department of Child and Family Services case records were missing for 38 children, and the UTR investigation reports were missing for 3 children (both sources of information were missing for 1 child). For these children, abuse status was determined by considering information available from either the Department of Child and Family Services or the UTR investigation, information obtained from the state's abuse telephone hotline, and medical evidence from the children's UTR physical examination. Although it was impossible to know the children's histories with certainty, our groupings reflect those typical within the child protective service system.

### Materials

#### Cognitive Functioning Measures

*Short Form of the Wechsler Intelligence Scale for Children—Third Edition (WISC-III) and Wechsler Preschool and Primary Scale of Intelligence (WPPSI).* The WISC-III short form for children 7 years of age and older included block design and vocabulary subtests. Their combined scores highly correlate with the WISC-III full-scale scores. For children under 7 years old, the block design and vocabulary subtests from the WPPSI (Wechsler, 1991) were used.

*Peabody Picture Vocabulary Test, Revised (PPVT-R).* For the PPVT-R (Dunn & Dunn, 1981), a measure of receptive vocabulary, children identify pictures of target words from among distractor pictures.

*STM.* Three STM subtests (Sentences, Objects, Digits) from the Stanford Binet, 4th Edition (SB-4) assessed for children's STM abilities. Scores were combined to make an overall STM factor (Thorndike, Hagen, & Sattler, 1986). The Memory for Sentences subtest is for 2- to 20-year-olds, but the Memory for Objects and Digit subtests are for 7-year-olds and older. The tests were administered accordingly.

#### General Psychological Functioning

*Global Adaptive Functioning (GAF).* This measure of adaptive functioning is based on criteria prescribed in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; American Psychiatric Association, 1994). GAF ratings are made by considering a child's psychological, social, and educational functioning on a continuum of mental health and illness. GAF is among the

most useful instruments for measuring overall psychosocial functioning (Endicott, Spitzer, Fleiss, & Cohen, 1976; Sohlberg, 1989). Ratings are made on a 100-point scale with higher ratings indicating higher levels of adaptive functioning.

#### Dissociation Measures

*Children's Perceptual Alteration Scale (CPAS).* The 28-item CPAS (Evers-Szostak & Sanders, 1992) is a self-report measure of dissociative experiences. Children, 6 years and older, indicate on a 4-point scale (1 = *never happens to me* to 4 = *always happens to me*) how often they have experiences such as, "When I'm awake, I feel like I'm dreaming." CPAS discriminates between normal and clinical samples.

*Dissociative Experiences Scale for Adolescents (A-DES).* The 30-item A-DES (Armstrong, Putnam, Carlson, Libero, & Smith, 1997), for 11-year-olds and older, contains 30 items that describe dissociative experiences such as "When I am somewhere that I don't want to be, I can go away in my mind." Children rate on a 10-point scale (0 = *never* to 10 = *always*) how often each experience happens to them.

*Child Dissociative Checklist (CDC).* The CDC (Putnam, 1985) is an observer-report measure of dissociative behavior in children as young as 4 years. Parents/caretakers indicate on a 3-point scale (0 = *not at all true* to 2 = *very true*) whether behaviors such as, "Child frequently talks to him or herself, may use a different voice or argue with self at times" are characteristic of the child. The CDC was administered only to adults who had cared for the child for 2 months or longer. The CDC discriminates among normal, sexually abused, and dissociative-disordered children.

#### Other Trauma-Related Measures

*Child Depression Inventory (CDI-S).* The CDI-S (Kovacs, 1992) is a widely used 10-item self-report measure of depression for 8- to 15-year-olds. For each item, children are asked to indicate which of three statements best represents how they have felt in the past 2 weeks, for example, "I feel sad: once in a while (0), many times (1), or all the time (2)." Higher numbers indicate elevated depression.

*Trauma Symptom Checklist-Child Version (TSC-C).* The TSC-C (Briere, 1989) is a 54-item questionnaire designed to assess posttraumatic stress, dissociation, anxiety, anger, sexual concerns, and depression in 8- to 15-year-olds who have been abused and/or otherwise traumatized. Children are asked to circle how often experiences such as "Scary ideas or pictures just pop into my head" happens to them on a 4-point scale (0 = *never* to 3 = *almost all of the time*).

#### Event Memory Measure

An anogenital exam/venipuncture memory questionnaire was designed for this study. It included 1 free-recall question, 2 open-ended questions (1 central, 1 peripheral), 39 specific questions (22 central, 17 peripheral), 29 misleading questions (11 central, 18

peripheral), and 2 photo identification questions.<sup>1</sup> The questionnaire started with a free-recall question (e.g., "Tell me everything you can remember about that doctor exam. What happened?"), followed by a prompt for additional information ("What else happened? I need to know everything that happened"). The free-recall questions were followed by a mix of open-ended questions (e.g., "What did the nurse look like?" "What did the doctor do when she examined your bottom?"); specific yes/no questions (e.g., "Was there a sink in there?" "Did the doctor check your throat?"); misleading yes/no questions that suggested an incorrect response (e.g., "The nurse didn't put something tight on your arm, did she?" "The doctor didn't have his/her shirt on, did s/he?"). Specific and misleading questions were roughly balanced for equal numbers of "yes" and "no" correct answers to control for possible response bias.

The open-ended, specific, and misleading questions were also classified into central questions (e.g., "Who took your clothes off for that doctor exam?" "How many times did she stick you with the needle?"), and peripheral questions (e.g., "What was the nurse wearing?" "There wasn't a mirror in there, was there?"). Eleven independent adults naive to the hypotheses watched a representative videotape of a child undergoing the anogenital exam/venipuncture and then rated each of the open-ended, specific, and misleading questions on a scale of 1 (*very peripheral*) to 4 (*very central*). Questions with ratings of 2.5 or above were classified as central, whereas questions with ratings below 2.5 were classified as peripheral.

In addition, two photo identification questions (one for the doctor and one for the nurse) were included in the anogenital exam/venipuncture questionnaire. The photo identification questions required children to examine a five-person photo lineup and indicate if any photo was of the target person (i.e., doctor, nurse) who had been present during the event. The lineups were either target present (i.e., the correct photo was in the lineup) or target absent (i.e., the correct photo was not in the lineup), which varied between subjects. Each target-present lineup consisted of a target photo and four distracter photos (i.e., photos of people who were similar in age, race, and gender to the target person). Each target-absent lineup consisted of five photos of people who were of similar age, race, and gender as the target person. Pretesting was conducted to assure lineup fairness. Specifically, 30 racially diverse 3- to 16-year-olds (not otherwise in the study) were asked to select the person who "looked the most like a doctor/nurse." Results of this pilot testing indicated that none of the photos was more likely to be chosen than the others,  $\chi^2(4, N = 30), p > .05$ . Presentation of target-present or target-absent lineups and arrangements of photos within each lineup were systematically counter-balanced based on the child's age, gender, and abuse status.

### Procedure

#### Informed Consent

Some children were in their parent's/legal guardian's custody ( $n = 101$ ), but the majority of children were in the custody of the Department of Child and Family Services ( $n = 226$ ). Informed consent was obtained from the appropriate source (e.g., for the latter children, the Department of Child and Family Services provided informed consent).

#### The Anogenital Exam/Venipuncture Stress Measures

On the second day of each child's hospitalization, a standard physical examination was conducted by a staff physician and a nurse. The examination, which was a routine part of the UTR protocol, was conducted to gather medical evidence of CSA, CPA, or neglect. During the check-up, the doctor examined the child's body (e.g., looked in ears, eyes, mouth; checked patella reflex) and performed a genital and anal exam (for older girls, a full gynecological exam). During this portion of the exam, the doctor took swab samples from the child's genitals and anus and digitally penetrated the anus. Finally, children's blood was drawn (i.e., venipuncture performed) by the nurse, at which time, some children had to be physically restrained. During the entire procedure, a research assistant recorded details of the exam using a standard checklist in lieu of videotaping. Children's stress during the exam was measured in several ways, as described next.

*Observer stress ratings.* The doctor, nurse, and research assistant rated each child's medical-exam distress level on two scales. One scale (1 = *very happy* to 6 = *very unhappy*) assessed children's general affect during the exam. The second scale (1 = *not crying* to 6 = *hysterical*) assessed children's level of crying. All ratings, made at the end of the exam, concerned the child's distress at three points: toward the beginning (i.e., patella reflex testing), during the anogenital exam, and during the venipuncture.

*Child stress ratings.* Thirty min after the exam, children were asked to rate how they felt at three separate time points—the beginning of the exam, during the anogenital exam, and during the venipuncture—using 4-point scales (1 = *very happy* to 4 = *very unhappy*). Scales were presented to children as a series of faces depicting smiles and frowns (e.g., the very happy option was accompanied by a smiling face; the very unhappy option by a frowning face). Children were given practice using these response options before the critical questions were asked.

*Physiological measures of stress: heart rate.* Prior to the exam, the research assistant attached leads to the child for measuring heart rate, which was recorded from a standard chest array of electrocardiogram leads connecting to an Industrial and Biomedical Sensors Heart Rate Monitor (model 4600; Waltham, MA) and a Coulbourn High Gain Bio-Amplifier (S75-01; Allentown, PA). All physiologic analogue signals were digitized by a Coulbourn Labline Analog to Digital Converter (L25-12; Allentown, PA). The Coulbourn instruments were interfaced with an IBM-AT-compatible computer through a Coulbourn Labline Computer Interface (L18-16; Allentown, PA).

Baseline measures of heart rate were also obtained, using the same procedures and the same equipment as just described but between 1 and 3 days later, at a matched time of day (within 90 min of the time the previous readings were taken during the exam). This baseline reading was taken in a resting state, just after the child had spent 4 min watching a relaxing video. Heart rate data were screened for movement artifact.

*Physiological measures of stress: Salivary cortisol.* Children's hypothalamic-pituitary-adrenal responsivity during the exam was assessed via children's salivary cortisol. Two saliva-cortisol sam-

<sup>1</sup> One memory question was excluded from the analyses ("She didn't wear gloves on her hands, did she?") because the action was inconsistently documented.

ples were taken from each child. The postexam sample was taken approximately 20 min after the exam. The second was a baseline sample taken between 1 and 3 days later, at approximately the same time as the baseline heart rate readings were taken, just after the child spent several minutes watching the relaxing video. These baseline readings were taken at a time of day matched to the exam time (within 90 min of the time) to control for diurnal patterns of arousal. The samples were obtained by using salivette tubes (Sarsedt; Newton, NC) as described by Tunn, Mollmann, Barth, Derendorf, and Krieg (1992). Cortisol levels were measured in nmol/L units by radioimmunoassay using a commercially available kit, also as described by Tunn et al. (1992).<sup>2</sup>

### *The Memory Interviews*

On the 5th day of each child's stay, children were administered the anogenital exam/venipuncture memory questionnaire by a research assistant who had not been present during the anogenital exam/venipuncture. After the interview, children were debriefed about the purpose of the memory questions. All memory interviews were videotaped.<sup>3</sup>

### *Other Measures*

The intelligence and vocabulary measures (WISC-III, WPPSI, PPVT-R), STM measures (Sentences, Objects, Digits), dissociation measures (CPAS, A-DES, CDC), trauma measures (TSC-C, the Post-traumatic Stress Inventory for Children [Eisen & Carlson, 1997]), and the CDI-S were administered by a research assistant at some point during each child's 5-day hospitalization. Because children were involved in multiple activities during their stay, the timing of these measures could not be standardized across children.

## Results

The study conformed to a 3 (age: 3- to 5-year-olds vs. 6- to 10-year-olds vs. 11- to 16-year-olds)  $\times$  5 (abuse status: CSA vs. CPA vs. SPA vs. neglect vs. nonabused/control) between-subject design. Preliminary analyses of variance (ANOVAs) revealed that, although girls ( $M = 1.60$ ) provided more correct units of information than did boys ( $M = 1.34$ ) about the anogenital exam/venipuncture in response to open-ended questions,  $F(1, 326) = 4.08, p < .05$ , no other significant gender differences in memory, psychopathology, or intelligence emerged. Therefore, gender was generally not considered further. Given the realities of a hospital environment, some missing data was inevitable. We report the fullest number of participants possible per each analysis. The number of participants in the smallest cell of the ANOVAs was never less than 5. All significant effects are reported.

### *Children's Event Memory*

Children's responses to free recall and open-ended questions were coded into units of correct and incorrect information. For example, the statement, "The nurse took my clothes off and looked in my mouth," would receive one correct point each for "nurse," "took off," "my," "clothes," and one incorrect point each for "looked in," "my," "mouth." Responses to specific and misleading questions were coded into correct responses, commission errors, omission errors, and "don't know" answers. Three coders scored

interviews from 36 (11%) randomly selected participants. Proportion of agreement was .81 for units of information for free-recall and open-ended questions and .96 for responses to specific and misleading questions. Disagreements were resolved through discussion. Two of the coders then scored the rest of the interviews.

Due to the large number of variables involved in this study, we limited most analyses to the examination of errors. Important exceptions were the analyses of free recall and open-ended questions. Because units of correct information in free recall and open-ended questions are not the simple inverse of errors (as in the case for most yes/no type questions, given the low "don't know" rate), correct units of information for free recall and open-ended questions were also analyzed in addition to analyses of errors. For the specific and misleading questions, we typically collapsed over commission and omission errors and report proportion total error, because the significant trends were identical in either case, although when important, error types are reported separately. However, in main tables, to be maximally informative, we present separate means for proportion commission and omission errors, as well as proportion total errors.

*Effects of age, abuse, and centrality on memory.* For the anogenital exam, a series of separate 3 (age)  $\times$  5 (abuse status)  $\times$  2 (centrality: central vs. peripheral) ANOVAs, with centrality as a within-subject factor, was performed. This was not possible for free recall because centrality was not specified for that measure; thus, a 3 (age)  $\times$  5 (abuse status) ANOVA was performed. The expected significant age effects emerged for units of correct information to free recall and open-ended questions,  $F_s(2, 313) \geq 43.38$ , and proportion errors to specific and misleading questions,  $F_s(2, 313) \geq 77.50, p_s < .001$ , with older children providing more correct information and fewer errors, respectively (see Table 2). Planned comparisons further indicated that the differences among all three age groups were significant. Overall, there were no significant age differences for units of incorrect information for free recall and open-ended questions.

In addition, the Age  $\times$  Abuse Status interaction was significant (even with cognitive ability measures covaried) for units of correct information to open-ended questions,  $F(8, 313) = 2.13, p < .05$ . Simple effects analyses revealed that performance significantly differed only for the 6- to 11-year-olds,  $F(4, 151) = 2.92, p < .05$  (CSA:  $M = 1.85, SD = .71$ ; CPA:  $M = 1.80, SD = 1.10$ ; SPA:  $M = 1.26, SD = .77$ ; neglect:  $M = 1.33, SD = .82$ ; nonabused/controls:  $M = 1.68, SD = .89$ ). Because we predicted that neglected and control children's performance would differ from that of the other groups, planned comparisons were conducted. Al-

<sup>2</sup> An ELISA assay was used. The intra-assay coefficient of variation for the assay is in the range of 6.6–7.8%. The inter-assay coefficient of variation is in the range of 7.3–8.3%. Note that the regimented nature of the busy hospital unit interfered at times with our ability to obtain cortisol samples, especially those that had to be matched in time to the postexam measure. There were no known systematic differences (e.g., in age, gender, race/ethnicity, psychopathology) between participants for whom we did versus did not obtain a complete set of cortisol data.

<sup>3</sup> Memory for a neutral event was also tested, and findings are reported in a separate paper (Chae, Eisen, Goodman, & Qin, 2006). The order of questionnaires (memory for the anogenital exam/venipuncture vs. neutral event) was counterbalanced, and analyses indicated that order did not significantly affect memory performance.

Table 2  
Memory for the Anogenital Examination and Venipuncture

Question	Age group			Abuse-status group					Total, N = 328
	3-5, n = 109	6-10, n = 156	11-16, n = 63	CSA, n = 58	CPA, n = 75	SPA, n = 29	NEG, n = 130	CTRL, n = 36	
Free-recall questions									
Correct units	6.10 <sup>a</sup> (6.55)	16.99 <sup>b</sup> (15.05)	33.29 <sup>c</sup> (25.58)	20.76 (21.07)	20.49 (16.78)	16.66 (24.82)	13.35 (16.44)	12.58 (14.72)	16.50 (18.33)
Incorrect units	.69 (1.91)	1.17 (2.66)	.54 (1.13)	.47 (.10)	.91 (1.87)	1.45 (3.25)	1.10 (2.68)	.31 (.86)	.89 (2.21)
Open-ended questions									
Correct units	.71 <sup>a</sup> (.55)	1.54 <sup>b</sup> (.91)	2.66 <sup>c</sup> (1.41)	1.77 (1.19)	1.71 (1.25)	1.58 (1.42)	1.27 (1.04)	1.24 (.95)	1.48 (1.56)
Central	.79 (.72)	1.57 (1.14)	2.81 (1.96)	1.74 (1.30)	1.79 (1.57)	1.83 (1.73)	1.33 (1.36)	1.32 (1.06)	1.55 (1.42)
Peripheral	.62 (.64)	1.49 (1.16)	2.48 (1.35)	1.82 (1.43)	1.60 (1.35)	1.23 (1.29)	1.18 (1.04)	1.13 (1.16)	1.39 (1.25)
Incorrect units	.31 (.36)	.25 (.34)	.22 (.23)	.21 (.25)	.28 (.30)	.28 (.39)	.28 (.37)	.23 (.31)	.26 (.33)
Central	.33 (.54)	.17 (.45)	.21 (.32)	.18 (.32)	.21 (.34)	.26 (.57)	.28 (.55)	.19 (.46)	.23 (.47)
Peripheral	.28 (.37)	.34 (.45)	.24 (.34)	.25 (.40)	.38 (.45)	.31 (.46)	.28 (.38)	.27 (.29)	.30 (.40)
Specific questions proportion incorrect									
Overall error	.35 <sup>a</sup> (.10)	.22 <sup>b</sup> (.10)	.14 <sup>c</sup> (.06)	.22 (.12)	.23 (.12)	.27 (.09)	.27 (.13)	.25 (.10)	.25 (.12)
Commission	.15 (.10)	.07 (.06)	.04 (.03)	.08 (.08)	.07 (.06)	.12 (.10)	.10 (.09)	.10 (.09)	.09 (.09)
Omission	.20 (.11)	.15 (.08)	.11 (.06)	.15 (.09)	.17 (.10)	.15 (.07)	.17 (.09)	.14 (.08)	.16 (.09)
Central	.36 (.13)	.20 (.13)	.11 (.08)	.20 (.16)	.22 (.13)	.25 (.13)	.26 (.17)	.25 (.13)	.24 (.15)
Peripheral	.34 (.13)	.24 (.11)	.19 (.10)	.25 (.12)	.25 (.14)	.30 (.12)	.28 (.12)	.24 (.13)	.26 (.13)
Misleading questions proportion incorrect									
Overall error	.36 <sup>a</sup> (.15)	.16 <sup>b</sup> (.12)	.09 <sup>c</sup> (.06)	.18 (.14)	.18 (.14)	.24 (.18)	.24 (.17)	.22 (.16)	.21 (.16)
Commission	.18 (.13)	.07 (.10)	.02 (.04)	.08 (.10)	.07 (.09)	.12 (.16)	.12 (.14)	.10 (.10)	.10 (.12)
Omission	.17 (.09)	.09 (.05)	.07 (.05)	.10 (.08)	.11 (.08)	.11 (.06)	.13 (.08)	.11 (.08)	.12 (.08)
Central	.31 (.17)	.11 (.12)	.04 (.06)	.13 (.18)	.13 (.14)	.18 (.18)	.20 (.18)	.16 (.16)	.16 (.17)
Peripheral	.38 (.18)	.19 (.14)	.12 (.07)	.21 (.14)	.20 (.15)	.27 (.19)	.27 (.19)	.25 (.18)	.24 (.18)
Sexual-abuse related									
Commission	.07 <sup>a</sup> (.09)	.03 <sup>b</sup> (.07)	.01 <sup>c</sup> (.04)	.03 (.06)	.03 (.07)	.05 (.09)	.05 (.08)	.05 (.09)	.04 (.08)
Omission	.36 <sup>a</sup> (.23)	.21 <sup>b</sup> (.21)	.11 <sup>c</sup> (.16)	.15 (.22)	.28 (.25)	.20 (.20)	.26 (.23)	.23 (.19)	.24 (.23)

Note. Values are means, with standard deviations in parentheses. For age comparisons, different superscripts within a row indicate significant differences,  $F_s(1, \geq 170) \geq 4.56, p_s < .05$  (planned comparisons). CSA = sexual abuse. CPA = physical abuse. SPA = sexual and physical abuse. NEG = neglect. CTRL = nonabused controls.

though none of the groups' means differed from that of the nonabused/control group, CSA and CPA victims provided more units of correct information to open-ended questions than did neglected children,  $p_s < .05$ .

Moreover, the main effect of abuse status was significant for errors to misleading questions,  $F(4, 313) = 2.43, p < .05$ . Planned comparisons revealed that, although the maltreated children's performance did not significantly differ from that of nonabused controls, CSA victims and CPA victims were significantly less suggestible than neglected children,  $p_s < .01$ .<sup>4</sup>

Significant main effects of centrality emerged for units of correct information for the open-ended questions and proportion errors to specific and misleading questions,  $F_s(1, 313) \geq 6.98, p_s < .01$ : Children provided more correct information and fewer errors to central than peripheral questions. For errors to specific questions, the main effect of centrality was qualified by a significant Age  $\times$  Centrality interaction,  $F(2, 313) = 6.32, p < .01$ , and a significant Age  $\times$  Abuse Status  $\times$  Centrality interaction,  $F(8, 313) = 1.99, p < .05$ . Analysis of simple effects for the significant

Age  $\times$  Centrality interaction indicated that the effects of age were significant for both central and peripheral specific question errors,  $F_s(2, 313) \geq 30.23, p_s < .001$ . Further analysis of simple effects revealed that children in the two older age groups were less likely to make errors on central specific questions than peripheral specific questions,  $F_s(1, \geq 62) \geq 8.86, p_s < .01$ , whereas this was not true for the younger age group. The three-way interaction was uninterpretable.

Thus, overall, the most consistent findings were the expected age and centrality differences, with some potentially important exceptions (e.g., younger children's performance did not differ for errors to specific central vs. peripheral questions). Of interest, CSA and CPA victims provided more units of correct information and

<sup>4</sup> Note that the mean for the SPA children is equivalent to that of neglected children, but the more limited sample size for the former group reduced our statistical power to detect a significant difference between the SPA group and CPA + CSA groups.



were more resistant to false suggestion than were neglected children.

*Sexual-abuse related questions.* Among the specific and misleading questions, we were particularly interested in six questions (e.g., “When you were in the doctor room the time the red balloons were in there too, did the doctor touch you on the vagina/penis?” “The doctor took off your shirt, didn’t s/he?”) that concerned acts of potential interest in an actual CSA investigation. Children in the two older age groups were less likely than younger children to make commission and omission errors,  $F_s(2, 313) \geq 20.01, p_s \leq .001$  (see Table 2). The differences between all age groups were significant (planned comparisons).

Moreover, the abuse status main effect was significant for proportion of omission errors,  $F(4, 313) = 3.18, p < .05$ . Because it was predicted that CSA victims would have better memory for the anogenital exam/venipuncture questions that specifically related to CSA issues, planned comparisons contrasted the combined mean for the CSA plus SPA groups ( $M = .17$ ) in comparison to the combined mean for the remaining groups ( $M = .26$ ). The planned comparison indicated that children with a history of CSA made fewer omission errors than did children with no such history,  $F(1, 326) = 11.52, p = .001$ .

Note that regardless of their past history of abuse or neglect, children made few commission errors to the CSA-related questions (4%). Even for children in the youngest age group, the proportion of commission errors to these questions was only 7%. In contrast, the omission rate was more substantial.

### Photo Identifications

Because small cell *ns* rendered 3 (age)  $\times$  5 (abuse status) ANOVAs invalid, children who were sexually and/or physically abused formed an abused group, which was compared to the remaining two groups (neglected vs. controls). Moreover, because the oldest age group’s error rate was at times zero for commission errors, the two older age groups were combined for relevant comparisons, resulting in 2 (age)  $\times$  3 (abuse) ANOVAs. In one case (doctor lineup, target-present commission errors), there were too few children in the control group for meaningful analyses, so that the neglected and control children were combined to form one group.<sup>5</sup> In that case, a series of 3 (age)  $\times$  2 (abused vs. nonabused) ANOVAs was conducted on the error scores. For the two lineup types (doctor, nurse), there were no significant effects or interactions involving the abuse status variable (see Table 3). However, pervasive age differences were evident in photo lineup performance, especially for the target-absent conditions. Specifically, for both target-absent photo arrays, age main effects were significant,  $F_s(2, 112) > 7.62, p_s < .001$ . In all cases, 3- to 5-year-olds made significantly more errors than did children in the two older age groups; for the nurse lineup, all three age groups significantly differed. On target-present lineups, for the doctor, the age main effect was significant for both commission and omission errors,  $F_s(1 \text{ or } 2, 127) \geq 5.03, p_s < .05$ . In both analyses, 3- to 5-year-olds made significantly more errors than older children. For the nurse target-present photo array, the age main effect was significant for commission errors,  $F(1, 152) = 12.96, p < .001$ : Again, 3- to 5-year-olds were more likely than older children to make false identifications.

Thus, across two photo lineups, 3- to 5-year-olds performed poorly when faced with target-absent lineups. Over half of the time, these children misidentified a foil as the target. Even when the target was present, the 3- to 5-year-olds still had a tendency to make more commission errors. However, once children reached 6 years, their photo identification performance was not much different from that of older children.

### Individual Differences in Memory Performance

We next examined relations between individual differences in cognitive functioning, trauma symptoms, and children’s memory, with age partialled. Means for individual-difference measures per age group are shown in Table 4. Note that 49.81% of the sample reached the clinical cutoff for GAF (i.e., 70 and below), and 26% of the sample fell at or above the clinical cutoff of 12 on the CDC. The clinical cutoff for most TSC-C subscales is  $T = 65$ : 9% of the sample reached the TSC-C clinical cutoff for the PTSD symptoms subscale and 12% reached the clinical cutoff for dissociation. For the CDI-S, a  $T$  score of 65 or above is considered clinically significant in a high-risk sample; 12% of the children had a  $T$  score in the clinical range on the CDI-S.

Given our interests in psychopathology and memory, we examined developmental and abuse status differences in psychopathology for children who were sexually and/or physically abused compared to children in the neglected and control groups. A series of 3 (age group)  $\times$  3 (abuse status) ANOVAs were conducted. For CDC scores, the main effects of age and abuse type were significant,  $F_s(2, 186) > 3.31, p_s < .05$ . Posthoc Tukey tests indicated that the sexual and/or physical abuse group ( $M = 9.09, SD = 6.98$ ) had significantly higher CDC scores than did the neglected group ( $M = 5.97, SD = 5.17$ ),  $p < .01$ . The CDC mean for the control group ( $M = 8.22, SD = 6.92$ ) did not significantly differ from that of the other two groups. In addition, the 6- to 10-year-olds’ mean CDC score ( $M = 6.76, SD = 6.20$ ) was significantly lower than that of the 3- to 5-year-olds ( $M = 9.82, SD = 7.00$ )  $p < .05$ . For GAF ratings, no significant main effects or interactions emerged from the ANOVA (sexually and/or physically abused:  $M = 67.27, SD = 11.52$ ; neglected:  $M = 70.66, SD = 12.50$ ; control:  $M = 69.76, SD = 12.52$ ). In contrast, PTSD diagnosis was significantly related to abuse status,  $\chi^2(2, N = 325) = 14.76, p < .001$ : The sexually and/or physically abused group ( $M = .19, SD = .39$ ) were the most likely to obtain a PTSD diagnosis compared to the neglected children ( $M = .05, SD = .23$ ) or the control group ( $M = .03, SD = .17$ ).

*Composite individual-difference measures.* To reduce the number of variables, we conducted a series of principal component analyses and created composite scores for individual-difference measures and memory measures when factors had sufficient reliability. Regression analyses were then performed with the composite scores.

Three aspects of cognitive functioning were examined: STM, receptive language comprehension, and intelligence. A principal component analysis with Varimax rotation revealed one factor,

<sup>5</sup> The control and neglected group did not significantly differ on photo identification commission errors for the doctor, target-present photo lineup.

Table 3  
Mean Photo Identification Errors

Lineup type	Age group			Abuse group			Total
	3-5	6-10	11-16	Abused	NEG	CTRL	
Photo identification of doctor							
Target present	<i>n</i> = 49	<i>n</i> = 56	<i>n</i> = 28	<i>n</i> = 67	<i>n</i> = 53	<i>n</i> = 13	<i>n</i> = 133
Commission	.37 (.49) <sup>a</sup>	.07 (.26) <sup>b</sup>	.00 (.00) <sup>b</sup>	.18 (.39)	.15 (.36)	.15 (.38)	.17 (.37)
Omission	.06 (.24) <sup>a</sup>	.30 (.46) <sup>b</sup>	.29 (.46) <sup>b</sup>	.18 (.39)	.26 (.45)	.15 (.38)	.21 (.41)
Target absent	<i>n</i> = 54	<i>n</i> = 87	<i>n</i> = 28	<i>n</i> = 81	<i>n</i> = 70	<i>n</i> = 18	<i>n</i> = 169
Commission	.54 (.50) <sup>a</sup>	.25 (.44) <sup>b</sup>	.07 (.26) <sup>b</sup>	.30 (.46)	.36 (.48)	.22 (.43)	.31 (.47)
Photo identification of nurse							
Target present	<i>n</i> = 49	<i>n</i> = 82	<i>n</i> = 27	<i>n</i> = 76	<i>n</i> = 63	<i>n</i> = 19	<i>n</i> = 158
Commission	.29 (.46) <sup>a</sup>	.05 (.22) <sup>b</sup>	.00 (.00) <sup>b</sup>	.09 (.29)	.13 (.34)	.16 (.37)	.11 (.32)
Omission	.08 (.28)	.16 (.37)	.11 (.32)	.13 (.34)	.11 (.32)	.16 (.37)	.13 (.33)
Target absent	<i>n</i> = 46	<i>n</i> = 57	<i>n</i> = 24	<i>n</i> = 62	<i>n</i> = 51	<i>n</i> = 14	<i>n</i> = 127
Commission	.59 (.50) <sup>a</sup>	.35 (.48) <sup>b</sup>	.04 (.20) <sup>c</sup>	.39 (.49)	.39 (.49)	.29 (.47)	.38 (.49)

Note. Numbers in parentheses are standard deviations. Superscripts that differ indicate significant mean differences. Abused = sexual abuse and/or physical abuse. NEG = neglect. CTRL = nonabused controls.

with an eigenvalue = 2.02. This single factor accounted for 67.2% of the variance. All three measures loaded heavily on this factor (factor loadings ≥ .78). A composite score, which measured general level of cognitive functioning, was created by averaging *z* transformation of the scores on the three measures (Cronbach's α = .76).

A number of measures assessed dissociation and other aspects of trauma symptoms. These included four self-report measures (A-DES, CPAS, TSC-C, and CDI-S) and three observer ratings (CDC, PTSD diagnosis, and GAF ratings). A principal component analysis with Varimax rotation was conducted, which generated two factors. All four self-report measures loaded heavily on the first factor (eigenvalue = 3.01, factor loadings ≥ .50). The three observer measures loaded on the second factor (eigenvalue = 1.10, factor loadings ≥ .57). Combined, these two factors accounted for 58.7% of the variance. A composite score that measured self-

report trauma symptoms was created by averaging *z* transformation of scores on the four self-report measures (Cronbach's α = .87). Note that this composite score was not possible for the 3- to 5-year-old group due to lack of self-reported measures. However, the three observer measures did not have sufficient reliability to form a valid scale. Scores on these three measures were used individually in further analyses.

Correlations among potential predictors of memory are shown in Table 5. Because abuse status with five levels does not form a continuous measure, we created an "abuse status" variable: (a) sexually and/or physically abused versus (b) neglected children plus nonabused controls. Using one-way group analysis of covariance with age as the covariate, there were no significant differences when the neglected and control children were compared on cognitive functioning, self-report of trauma symptoms, CDC, GAF, and the various memory measures (the latter lack of signif-

Table 4  
Means for Individual-Difference Variables for Each Age Group

Measure	3- to 5-year-olds		6- to 10-year-olds		11- to 16-year-olds	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Short-term memory	95.75	11.65	93.01	13.44	87.13	13.73
PPVT (standard score)	69.47	17.24	67.92	17.18	70.66	16.97
WPPSI	14.62	3.98	12.48	4.88		
WISC			11.65	4.43	11.37	4.79
GAF	68.86	12.01	69.38	12.90	67.27	9.89
CDC	9.82	7.00	6.76	6.20	8.03	6.00
CPAS			56.70	13.65	52.50	12.75
A-DES					2.56	1.92
TSC-C ( <i>T</i> score)			37.22	21.31	37.85	22.71
CDI-S (Total score)			3.92	3.61	3.13	2.94
CDI-S ( <i>T</i> score)			52.80	11.28	49.89	9.51
PTSD diagnosis (%)	4.59		13.07		20.63	

Note. GAF = Global Adaptive Functioning ratings. CDC = Child Dissociative Checklist total scores. CPAS = Children's Perceptual Alteration Scale. A-DES = Dissociative Experiences Scale for Adolescents. TSC-C = Trauma Symptom Checklist for Children. CDI-S = Child Depression Inventory for Children. PTSD = posttraumatic stress disorder diagnosis (0 = no PTSD, 1 = PTSD).

Table 5  
Correlations Among Individual-Difference Measures

Measure	1	2	3	4	5	6	7	8	9
1. Age	—								
2. Gender <sup>a</sup>	-.03	—							
3. Maltreatment <sup>b</sup>	.10	-.19*	—						
4. Abuse <sup>c</sup>	.17**	-.08	.35***	—					
5. Cognitive	.10	.03	-.19*	-.01	—				
6. Trauma	-.17*	.03	.10	.05	-.07	—			
7. GAF	-.05	-.06	-.05	-.13*	.13*	-.20**	—		
8. CDC	-.11	-.06	-.06	.19**	-.16*	.28**	-.21**	—	
9. PTSD	.19**	-.12*	.10	.21**	.07	.17*	-.21**	.17*	—

Note.  $n \geq 144$ . Cognitive = cognitive functioning composite score. Trauma = self-report of trauma symptoms composite score. GAF = Global Adaptive Functioning ratings. CDC = Child Dissociative Checklist total scores. PTSD = posttraumatic stress disorder diagnosis (0 = no PTSD, 1 = PTSD).

<sup>a</sup> 1 = female, 2 = male. <sup>b</sup> 0 = control, 1 = sexually and/or physically abused or neglected. <sup>c</sup> 0 = neglected or control, 1 = sexually and/or physically abused.

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

icant difference was counter to our prediction),  $F_s(1, \geq 95) \leq 3.03, p > .05$ , thus justifying the combined neglect-control group. We also created a "maltreatment" variable: (a) nonabused controls versus (b) sexually and/or physically abused plus neglected children. Consistent with our prediction, being abused (sexually and/or physically) was positively correlated with CDC scores and PTSD diagnosis and negatively with GAF ratings. Also, children with higher GAF ratings or lower CDC scores scored higher on measures of cognitive functioning. Self-report of trauma symptoms was significantly correlated with GAF ratings, CDC scores, and PTSD diagnosis. Finally, children diagnosed with PTSD scored as more dissociative. Other significant correlations are shown in Table 5.

**Composite memory performance.** Memory measures, including units of correct and incorrect information to free recall and open-ended questions, and proportion of commission and omission errors to specific and misleading questions, were entered into a principal component analysis with Varimax rotation.<sup>6</sup> Three factors emerged: commission errors to specific and misleading questions (eigenvalue = 7.40), correct answers to free recall and open-ended questions (eigenvalue = 2.64), and omission errors to specific and misleading questions (eigenvalue = 1.53). Combined, they accounted for 48.2% of the variance. Three composite memory scores were created by averaging  $z$  transformation of the individual memory measures with factor loading of .50 or above: commission errors to specific and misleading questions (Cronbach's  $\alpha = .94$ ), correct information to free recall and open-ended questions (Cronbach's  $\alpha = .85$ ), and omission errors to specific and misleading questions (Cronbach's  $\alpha = .75$ ).

**Predicting memory performance.** Partial correlations between the individual-difference measures and composite scores of memory performance were calculated with age statistically controlled. The abuse and maltreatment variables did not predict memory performance,  $r_s \leq .131, n_s = 116$ . However, cognitive functioning (with correct information,  $r = .26$ ; with commission errors,  $r = -.19$ ;  $n = 116, p_s < .05$ ), self-report trauma symptoms (with commission errors,  $r = .37, n = 116, p < .001$ ), and GAF (with commission errors,  $r = -.20, n = 116, p < .05$ ) predicted memory. The predictors were then entered into a series of separate standard regression analyses simultaneously to assess the unique

contribution of each predictor to the three composite memory scores. Age and cognitive functioning significantly predicted correct information to free recall and open-ended questions (see Table 6); the regression equation accounted for 30.1% of the variance. Age, cognitive functioning, and self-report of trauma symptoms significantly predicted commission errors to specific and misleading questions; the regression equation accounted for 33.6% of the variance. Finally, age alone significantly predicted omission errors to specific and misleading questions, and the regression equation accounted for 21.2% of the variance. Thus, older children and children with better cognitive functioning were more accurate. Of interest, children who reported more trauma symptoms made more commission errors to the specific and misleading questions.

#### Individual Differences in Photo Identifications

Each child saw only one photo lineup (either target present or target absent) for the doctor and nurse. In addition, because the target-present and absent condition varied randomly across the two lineups (i.e., a child might have seen a target-present lineup of the doctor but a target-absent lineup of the nurse), it was not meaningful to calculate correlations among the commission and omission errors across the two lineups. No composite score of the errors to the photo identification questions was created.

Partial correlations were calculated between the individual-difference measures, on the one hand, and commission and omission errors to the photo lineups for target-present and target-absent conditions separately, on the other hand, with children's age partialled. Only one significant partial correlation emerged: CDC scores were negatively correlated with omission errors to doctor photo identification in the target-present condition, partial  $r = -.29, p < .05$ . Of interest, it suggested that children with higher scores on the trauma measures were more accurate, consistent with

<sup>6</sup> We also tested memory for a neutral event and for a clinical interview (see Chae et al., 2006). Children who made memory errors about one event tended to make memory errors about the other events (e.g., with age partialled: specific questions,  $r_s \geq .23, p_s < .05$ ; misleading questions,  $r_s \geq .53, p_s < .001$ ). Data from those memory tests are included in the composite memory indices to provide a more robust measure.

Table 6  
Summary of Linear Regression Analyses for Factors Predicting Event Memory (Method = Unique)

Variable	B	SE	β	p
Predicting correct information to free recall and open-ended questions (multiple R = .55, n = 326, p < .001)				
Age	.15	.03	.50	<.001
Cognitive functioning	.23	.07	.27	<.01
Predicting commission errors to specific and misleading questions (multiple R = .58, n = 215, p < .001)				
Age	-.08	.02	-.38	<.001
Cognitive functioning	-.10	.05	-.17	<.05
Self-report of trauma symptoms	.16	.05	.31	<.001
Predicting omission errors to specific and misleading questions (multiple R = .46, n = 328, p < .001)				
Age	-.08	.02	-.46	<.001

Note. B = unstandardized coefficient. β = standardized coefficient.

the idea of greater hypervigilance during stressful or trauma-related events in traumatized children. No other individual-difference measure was significantly correlated with the measures of photo identification, with age partialled. Regression analyses were therefore not conducted.

Stress and Memory for the Examination

Children’s stress during the anogenital exam/venipuncture was assessed by observers’ (doctor’s, nurse’s, research assistant’s) ratings of the children during the beginning of the checkup, the anogenital exam, and the venipuncture, and by physiological measures (heart rate, cortisol levels) before, during, and after the anogenital exam/venipuncture. For each stress measure, we first examined possible gender differences and relations between age, abuse status, trauma symptoms, and stress levels. We then examined relations between stress, memory for the anogenital exam/venipuncture, and psychopathology.

Observer ratings. The observer (doctor, nurse, research assistant) ratings of distress were entered into a principal component analysis. Three factors emerged that collectively accounted for 78.8% of the variance. The three factors corresponded to ratings of stress at the beginning of the exam (factor loadings ≥ .78), stress during the anogenital exam (factor loadings ≥ .72), and stress during the venipuncture (factor loadings ≥ .77). Three composite average rating scores (doctor, nurse, research assistant) were created (Cronbach’s α > .85).

With the composite observer stress rating as the dependent variable, preliminary analysis indicated that girls were rated as significantly more distressed during the anogenital exam (M = 2.76) than were boys (M = 2.24), F(1, 205) = 15.15, p < .001. A 3 (age) × 5 (abuse status) × 3 (composite stress rating: beginning vs. anogenital exam vs. venipuncture) mixed ANOVA revealed a significant main effect of the within-subject factor of stress, F(2, 187) = 30.78, p < .001, and a significant main effect of age, F(2, 188) = 5.04, p < .01. The main effects were qualified by a significant Age × Stress interaction, F(4, 374) = 4.20, p < .01. Simple effects indicated that for all age groups, the observers’ ratings of the children’s stress at the three stages of the exam were significantly different; that is, the observed stress level significantly increased from the exam’s beginning to the venipuncture, F<sub>s</sub>(2, ≥ 43) ≥ 6.95, p<sub>s</sub> < .01, except that observed stress of the older children did not significantly increase from the anogenital exam to the venipuncture (see Table 7). In addition, age differences in observed stress were significant at the beginning of the exam, F(2, 202) = 7.24, p < .001, and during the venipuncture, F(2, 202) = 12.28, p < .001: The 3- to 5-year-olds were rated as significantly more distressed than the two older age groups. There were no significant main effects or interactions involving abuse status on observed stress.

Children’s self-ratings. After the exam, children rated their own distress for the three time periods. Self-ratings from 24 children were excluded because of lack of understanding or lack of seriousness. Children whose self-ratings were excluded were significantly younger (M = 4.58 years) than those whose self-ratings were not excluded (M = 8.52 years), F(1, 190) = 39.93, p < .001. Preliminary analyses suggested no significant gender differences in self-ratings of distress. A 3 (age) × 3 (abuse status: abused vs. neglected vs. control) × 3 (stress rating: beginning vs. anogenital

Table 7  
Stress Measures: Observers’ Ratings

Exam stage	Age group			Abuse-status group					Total
	3–5	6–10	11–16	CSA	CPA	SPA	NEG	CTRL	
Beginning	n = 60	n = 100	n = 45	n = 31	n = 53	n = 24	n = 75	n = 22	n = 205
M	2.37	2.03	2.10	2.06	2.09	2.23	2.14	2.31	2.15
SD	.92	.29	.29	.41	.34	.70	.60	.88	.57
Anogenital exam	n = 62	n = 100	n = 45	n = 31	n = 54	n = 24	n = 76	n = 22	n = 207
M	2.67	2.48	2.42	2.67	2.31	2.68	2.48	2.80	2.52
SD	1.09	.99	.83	1.00	.81	1.00	.95	1.37	.99
Venipuncture	n = 61	n = 99	n = 45	n = 31	n = 53	n = 24	n = 75	n = 22	n = 205
M	3.52	2.78	2.51	2.80	2.73	2.92	3.08	3.17	2.94
SD	1.29	1.21	.88	.91	1.13	1.19	1.27	1.35	1.19

Note. CSA = sexual abuse. CPA = physical abuse. SPA = sexual and physical abuse. NEG = neglect. CTRL = nonabused controls.



exam vs. venipuncture) mixed ANOVA revealed a significant stress main effect,  $F(2, 154) = 14.74, p < .001$ : Self-rating of distress increased significantly from the beginning of the exam to the anogenital exam and the venipuncture. Although the age main effect was not significant, there was a significant Age  $\times$  Stress interaction,  $F(4, 308) = 2.82, p < .05$ . Analysis of simple effects indicated that self-rated stress increased significantly from the exam beginning to the anogenital exam,  $F_s(2, \geq 37) \geq 15.36, p_s < .001$ , for children in the two older age groups (6- to 10-year-olds:  $M_s = 2.00, 3.10, 2.66$ ;  $SD_s = .99, .91, 1.20$ ;  $n = 89$ ; 11- to 16-year-olds:  $M_s = 2.44, 3.15, 3.13$ ;  $SD_s = .85, .78, .89$ ;  $n = 39$ ) but not for children in the 3- to 5-year-old group ( $M_s = 2.47, 2.50, 2.61$ ;  $SD_s = 1.21, 1.25, 1.20$ ;  $n = 36$ ). In addition, self-rated stress at the exam beginning and at the anogenital exam was lower for the youngest children than for those in the two other age groups,  $F(2, 164) = 5.55, p < .01$ . Self-rated stress during the venipuncture was not significantly different across age groups. The main effect of abuse status was not significant.

*Physiological measures: Cortisol levels.* The sample for whom we have cortisol data did not significantly differ from those without cortisol data in age,  $F(1, 326) < 1.00$ , gender,  $\chi^2(1, N = 328) = .41$ , PTSD diagnosis,  $\chi^2(1, N = 325) = .45$ , or other psychopathology measures,  $F_s < 1.00$ . They did, however, significantly differ in abuse status,  $\chi^2(2) = 9.30, p = .01$ . Whereas we had cortisol measures on 50–54% of the neglected and control children, we had cortisol data on only 36% of the sexually and/or physically abused children. A 2 (age: 3- to 5-year-olds vs. 6- to 16-year-olds)  $\times$  3 (abuse status: abused vs. neglected vs. control)  $\times$  2 (cortisol level: baseline vs. postexam) mixed ANOVA indicated a significant increase from baseline in cortisol level after the exam,  $F(1, 140) = 9.03, p < .001$  (see Table 8).

A 2 (gender)  $\times$  2 (exam: baseline vs. postexam) mixed factorial ANOVA revealed a significant gender difference in cortisol levels,  $F(1, 144) = 6.18, p < .05$  (girls:  $M = 5.41$ ; boys:  $M = 6.81$ ). In

addition, the within-subject main effect of exam was also significant,  $F(1, 144) = 13.69, p < .001$  (baseline:  $M = 5.07, SD = 3.43$ ; postexam:  $M = 6.96, SD = 5.78$ ). The Gender  $\times$  Exam interaction was not significant,  $F(1, 144) = 3.33, p > .05$ .

*Physiological measures: Heart rate.* Gender differences in heart rate were not significant. In addition, a 3 (age)  $\times$  2 (abuse status: abused vs. nonabused)  $\times$  3 (heart rate phase: baseline vs. anogenital exam vs. venipuncture) mixed ANOVA revealed no significant main effects of age, abuse status, or heart rate phase. The pattern, however, was consistent with an increase from baseline ( $M = 94.62, SD = 17.52$ ) to the anogenital exam ( $M = 98.8, SD = 18.10$ ) to the venipuncture ( $M = 99.95, SD = 20.70$ ;  $n = 91$ ).

*Relations among stress measures.* Observers' ratings of stress were significantly correlated with children's self-ratings of stress: for the anogenital exam,  $r = .26, n = 167, p < .001$ ; for the venipuncture,  $r = .24, n = 163, p < .01$ . However, none of the stress ratings significantly correlated with either the cortisol or heart rate difference scores, and no significant correlation emerged between the two physiological measures of stress, as is often found in similar research (e.g., Brigham et al., 1983).

Thus, the behavioral and subjective ratings seemed to tap a similar phenomenon, but the physiological measures did not. Nevertheless, virtually all stress indicators revealed an increase in stress from the beginning of the medical exam to the parts concerning the anogenital and/or venipuncture.

*Relations between stress and individual-difference measures.* Did children with greater psychopathology evince more distress during the anogenital exam than did children with less psychopathology? Observers' ratings of the children's distress during the anogenital exam were modestly but significantly correlated with GAF ratings,  $r = -.16, n = 162, p < .05$ ; CDC scores,  $r = .18, n = 122, p < .05$ ; and PTSD diagnosis,  $r = .17, n = 206, p < .05$ . That is, children who had lower levels of psychological function-

Table 8  
*Physiological Measures of Stress*

Measure	Age group			Abuse group		Total
	3–5	6–10	11–16	Abused	Nonabused	
Cortisol (nmol/L units)						
Baseline	$n = 52$	$n = 87$	$n = 31$	$n = 76$	$n = 94$	$n = 170$
<i>M</i>	5.53	5.14	3.88	4.63	5.35	5.03
<i>SD</i>	3.90	3.54	1.78	3.56	3.33	3.44
Postexam	$n = 55$	$n = 83$	$n = 27$	$n = 69$	$n = 96$	$n = 165$
<i>M</i>	7.26	6.87	6.55	6.63	7.18	6.95
<i>SD</i>	5.53	5.94	4.33	5.74	5.42	5.55
Heart rate						
Baseline	$n = 45$	$n = 62$	$n = 25$	$n = 62$	$n = 70$	$n = 132$
<i>M</i>	101.84	95.53	86.84	98.29	94.04	96.04
<i>SD</i>	16.34	16.65	16.92	15.56	18.26	17.12
Anogenital exam	$n = 41$	$n = 51$	$n = 24$	$n = 52$	$n = 64$	$n = 116$
<i>M</i>	106.76	97.41	94.13	100.63	99.55	100.03
<i>SD</i>	17.60	17.53	18.14	18.88	17.89	18.27
Venipuncture	$n = 35$	$n = 51$	$n = 23$	$n = 46$	$n = 63$	$n = 109$
<i>M</i>	105.83	100.49	89.70	98.70	100.83	99.93
<i>SD</i>	18.81	21.30	21.24	19.77	22.21	21.15

ing, higher CDC scores, or a PTSD diagnosis tended to be rated as more distressed during the anogenital exam by the doctor, nurse, and research assistant (all of whom were blind to the psychopathology scores/diagnoses). In addition, changes in cortisol levels were negatively correlated with GAF ratings,  $r = -.19$ ,  $n = 116$ ,  $p < .05$ , so that children with lower levels of psychological functioning tended to have greater change in cortisol levels following the exam. These correlations remained significant with age and gender partialled.

*Relations between stress, anogenital exam/venipuncture memory, and dissociation.* With effects of age and gender statistically controlled, overall, children rated (by doctor, nurse, research assistant; composite observer rating) as more distressed during the venipuncture, which came at the end of the exam, also tended to make more errors to central misleading questions, partial  $r = .16$ ,  $n = 201$ ,  $p < .05$ ; that is, they tended to be more suggestible, although the correlation was of low magnitude. Similarly, overall, children who had greater change in cortisol level following the anogenital exam/venipuncture tended to make more errors to central misleading questions related to the anogenital exam/venipuncture, partial  $r = .20$ ,  $n = 142$ ,  $p < .05$ . No correlations between the stress measures and photo identification performance were significant after the effects of age and gender were partialled. However, the pattern of results changed in important ways when dissociation was considered.

It was predicted that dissociation would influence children's memory for a stressful event. In particular, high levels of dissociation, which are believed to reflect a pathological form of dissociation (Waller et al., 1996), were predicted to be associated with especially poor memory and increased suggestibility. The CPAS was selected for establishing high and low dissociative groups because it was the self-report measure with the broadest age range, 6–16 years. (The results are essentially the same when the CDC is used.) Children with CPAS scores greater than the mean ( $M = 1.98$ ) were classified as high dissociators ( $M = 2.41$ ,  $SD = .35$ ,  $n = 97$ ), and those with CPAS scores below the mean were classified as low dissociators ( $M = 1.62$ ,  $SD = .20$ ,  $n = 116$ ). The high dissociators had significantly higher CPAS scores than did the low dissociators,  $F(1, 211) = 419.31$ ,  $p < .001$ . The two groups did not significantly differ on measures of stress,  $F_s(1, \geq 65) < 1.00$ , and they also did not significantly differ in abuse status,  $\chi^2(4, N = 213) = .77$ .

Partial correlations were calculated between memory for the anogenital exam/venipuncture and measures of stress, with effects of age partialled, for high and low dissociators separately. The measures of stress used in the correlational analyses were cortisol levels, defined as the difference between postexam cortisol and baseline cortisol level; heart rate, defined as the difference between the average heart rate during the anogenital exam/venipuncture and baseline heart rate; and observer ratings, defined as the difference between the composite score of average distress levels during the anogenital exam/venipuncture as rated by the doctor, nurse, and research assistant, and the composite score of average stress ratings at the beginning of the exam. There were no significant correlations for heart rate or observer ratings with the memory measures. However, the pattern of correlations for cortisol fit the prediction. For low dissociators, higher levels of cortisol were associated with fewer omission errors to specific questions,  $r = -.28$ ,  $n = 44$ ,  $p < .05$ , and fewer commission errors to misleading

questions,  $r = -.28$ ,  $n = 44$ ,  $p < .05$  (one-tailed). Thus, the greater the stress, the better was the low dissociators' memory. However, for children high in self-reported dissociation, the opposite pattern emerged: For these children, higher cortisol was associated with more errors of omission to specific questions,  $r = .25$ ,  $n = 50$ ,  $p < .05$ , and more commission errors to misleading questions,  $r = .28$ ,  $n = 50$ ,  $p < .025$ . For these children, there was also a significant correlation between higher stress and less correct information to open-ended questions,  $r = .25$ ,  $n = 50$ ,  $p < .05$  (one-tailed).

To control for possibly confounding variables, regression analyses were performed separately for high and low dissociators to predict omission and commission errors regarding the anogenital exam/venipuncture (see Table 9). Note that the age range in these analyses is restricted because the CPAS was administered to children 6 years and older. Thus, 3- to 5-year-olds could not be included in these regression analyses. In the regressions, age was entered first, followed by the cognitive functioning composite score, self-report of trauma composite score, GAF rating, and cortisol difference score. For high dissociators, age, self-reported trauma symptoms, and cortisol difference score predicted omission errors; self-reported trauma symptoms and cortisol difference score, but not age, predicted commission errors. Thus, for high

Table 9  
Summary of Linear Regression Analyses for Factors Predicting Anogenital Exam/Venipuncture Memory Errors

Variable	B	SE	$\beta$	p
Low dissociators				
Predicting omission errors to specific and misleading questions (Multiple $R = .55$ , $F(1, 38) = 15.71$ , $p < .001$ )				
Age	-.01	.004	-.55	<.001
Predicting commission errors to specific and misleading questions (Multiple $R = .29$ , $F(1, 38) = 3.51$ , $p = .07$ )				
Age	-.003	.002	-.29	.07
High dissociators				
Predicting omission errors to specific and misleading questions (Multiple $R = .50$ , $F(3, 41) = 4.61$ , $p < .01$ )				
Age	-.01	.01	-.33	<.05
Self-report trauma symptoms	-.03	.01	-.31	<.05
Cortisol difference score	.003	.001	.284	<.05
Predicting commission errors to specific and misleading questions (Multiple $R = .56$ , $F(3, 41) = 6.19$ , $p < .001$ )				
Age	-.01	.01	-.13	>.05
Self-report trauma symptoms	.05	.02	.39	<.01
Cortisol difference score	.01	.002	.35	<.05

Note. B = unstandardized coefficient.  $\beta$  = standardized coefficient.

dissociative children who were 6 years or older, higher cortisol difference scores predicted more commission and omission errors. Also, for these highly dissociative children, self-reported trauma symptoms predicted more commission errors but fewer omission errors. Because CPAS was used to classify the children into high and low dissociative groups, but was also included in the self-reported trauma variable, the appropriate interpretation of these findings is that, among highly dissociative children, more self-reported trauma symptoms (including more dissociation) was associated with greater commission but fewer omission errors. For children low in dissociation, only age significantly predicted omission errors, and none of the variables independently predicted commission errors.<sup>7</sup>

### Discussion

This study was designed to examine memory and suggestibility in children with substantiated maltreatment histories, as well as in children without known histories of abuse or neglect. It was also designed to investigate individual-difference factors hypothesized to be related to children's memory. Specifically, we examined memory for a stressful event and sought to determine if individual differences in cognitive measures (intellectual ability, language comprehension, STM) and psychopathology (dissociation, depression, PTSD, general psychological functioning) were related to various memory indices (answers to free recall, open-ended, specific, and misleading questions; photo identification) for 3- to 16-year-olds.

#### *Age and Memory*

As predicted, older children showed better memory and less suggestibility than did their younger counterparts. However, age differences were not consistently apparent for incorrect answers to free recall and open-ended questions. These findings are similar to those of other studies on maltreated children's (Eisen, Qin, et al., 2002; Goodman et al., 2001) and nonmaltreated children's (Cassel & Bjorklund, 1995; Poole & Lindsay, 2002) memory.

Of special interest was the children's performance in response to misleading questions. The increase in accuracy and resistance to suggestion from preschool to elementary years has been well documented (e.g., Goodman & Reed, 1986), including on maltreated samples (e.g., Eisen, Qin, et al., 2002): Young children have more problems handling suggestive questions. Less well documented is the decrease in inaccuracy when 6- to 10-year-olds are compared to adolescents. Few child eyewitness studies have included adolescents, yet they are often involved in maltreatment cases (U.S. Department of Health and Human Services, 2006).

#### *Central Versus Peripheral Information*

As predicted, children generally demonstrated better memory and greater resistance to misleading information on questions related to central rather than peripheral elements of the stressful event. For example, children regardless of age provided more units of correct information in response to central than peripheral open-ended questions. However, the present study also revealed different age trends in memory for central versus peripheral information. The two older age groups but not the youngest age group showed

better memory for central than for peripheral information in response to specific questions about the anogenital exam. What is central about certain events for older children and adults may not be central to young children. Reliance on adult centrality ratings is standard as well as meaningful from a forensic perspective. The trends we uncovered are similar to those for nonabused children (e.g., Goodman, Bottoms, et al., 1991).

Thus, overall, the pattern of results fits with the expectation that, at least by 6 years of age, individuals better remember central than peripheral information about highly stressful events (Christianson, 1992). However, this was not consistently the case for younger children.

#### *Abuse Status*

It was predicted that children with histories of neglect would perform more poorly on the memory tasks than would children with abuse histories. Although pervasive effects of abuse status on memory were not uncovered, several interesting findings emerged. CSA and CPA victims tended to be more accurate than neglected children. For example, abused children were significantly less suggestible than neglected children when confronted with misleading questions about the anogenital exam; children who had experienced CSA or SPA made fewer omission errors to abuse-related questions; and, at least for the 6- to 11-year-olds, children with abuse histories provided more correct answers to open-ended questions about the anogenital exam/venipuncture than did children with neglect histories. These patterns may reflect better eyewitness memory abilities in abused than neglected children. However, it is also possible that the abused children's advantage was due to the greater trauma relevance of the anogenital exam/venipuncture to abused compared to neglected children. Such findings would be consistent with those of studies demonstrating elevated memory in traumatized adults for trauma-related material (e.g., Vrana et al., 1995). It will be important in future studies to vary, systematically, trauma relevancy in relation to abuse experiences when examining eyewitness memory in maltreated populations.

#### *Errors on the Abuse-Related Questions*

Errors to the abuse-related questions are of particular forensic concern. These questions were designed to be relevant to the types of questions asked in actual CSA investigations, and they generally involved memory for genital touch and undressing. They were also phrased in the most suggestive way possible given the Department of Child and Family Services and UTR restrictions. Asking suggestive abuse-related questions about the anogenital exam becomes a particularly good analogue to certain actual forensic interviews, especially given the study's context within an ongoing

<sup>7</sup> The main cortisol analyses were reconducted with time of day the postexam cortisol measure was taken statistically controlled. Despite a loss of statistical power, the main patterns were maintained (e.g., higher post-exam cortisol compared to baseline; cortisol difference score and self-reported trauma symptoms predicting memory errors). Moreover, the main cortisol analyses were conducted with the subset of participants for whom cortisol was tested, on average after a 25-min delay, and the results were also entirely consistent with those reported.

abuse investigation. By the time we interviewed the children about their memory for the anogenital exam, the children had been repeatedly questioned over an extended period of time, being asked whether friends, family members, or strangers touched them inappropriately or attempted to hurt them in any way. Therefore, this mode of inquiry had been essentially normalized for these children. Asking them about possible transgressions by the doctor and/or nurse was arguably not outside reasonable expectations. In addition, the genital touch and digital penetration that occurred during the anogenital exam combined with the often confusing and highly stressful circumstances (e.g., removal from home) created an even more ecologically valid framework. Within this context, we attempted to determine if children would falsely acknowledge inappropriate behavior on the part of the doctor or nurse when asked in a suggestive manner. Our findings replicate those of Eisen, Qin, et al. (2002), who showed that most children in similar circumstances did not readily accept these suggestions. Although the youngest children in the present study made significantly more errors on these questions than did children in the two older groups, the preschoolers made commission errors at a rate of only 7%, on average (and thus a 93% rate of resistance to the abuse questions). Across all ages, commission errors to the abuse-related questions occurred at low rates (4%). Considering that many of the children showed developmental delays and poor language skills, this small number of errors on complex, tricky, albeit at times blatantly misleading, questions was impressive.

### *Photo Identification Tasks*

In general, children in the youngest age group made significantly more errors than did children in the two older age groups on both target-present and target-absent lineups. Performance on the target-absent display was concerning, especially for the younger children. On the target-absent photo array of the doctor, 54% of the 3- to 5-year-olds made a false identification compared to only 25% of the school-age children and 7% of the oldest group. Similar patterns of results emerged when children were presented with a target-absent lineup for the nurse. Previous studies have documented children's poor performance on target-absent lineups (Parker & Carranza, 1989), but much less is known about the performance of adolescents on such tasks.

It is important to note that the false identification rates of children, averaged across age groups, in the target-absent conditions (e.g., doctor = 32%, nurse = 38%) are comparable to false identification rates with target-absent lineups found in published field studies with adults (38% on average; see Cutler & Penrod, 1995, for a review). However, children in the present study were likely to see the nurse in the unit before and after the exam. This should have resulted in greater accuracy in picking the nurse from the display. Thus, despite repeated exposures to the nurse, the young children's performance was still concerning.

Overall, these data indicate that young children (3 to 5 years) were more prone to make false identifications than were their older counterparts, even on target-present lineups. By the time the children reached about 6 years of age, their performance became more comparable to that of adolescents. Techniques to aid young children in correct identification are clearly needed (Goodman, Bottoms, Schwartz-Kenney, & Rudy, 1991).

### *Individual Differences in Cognitive Functioning*

Children were administered measures of STM, intelligence, and language ability, which, when combined, formed our cognitive functioning factor. As a group, the sample scored rather low on each of these measures relative to published norms. It is likely that this poor performance was due to a lack of appropriate intellectual stimulation at home, as the majority of the sample came from neglectful and/or traumatizing environments. Cognitive functioning (with age statistically controlled) predicted correct responses to free recall and open-ended questions and commission errors to specific and misleading questions. Given that the memory interviews involved nearly an hour of complex and often purposely tricky and difficult questions, it was expected that children with better language, STM, and intellectual skills would demonstrate better memory and less suggestibility. For example, STM ability may help children keep track of the content of misleading questions relative to the children's true experiences. Also, low intelligence may make children more gullible or less confident of their memories. Our findings are consistent with theory in this area (Gudjonsson & Clark, 1986; Schooler & Loftus, 1993) that would predict a relation between cognitive ability and errors in this type of suggestibility paradigm in which misleading questions are asked on a single occasion.

However, that cognitive ability was not significantly related to omission errors or photo identification was also of interest. To the extent that our cognitive functioning factor heavily reflected verbal skills, it may be understandable that it did not predict photo identification ability, which is arguably a more visual and less verbal task. Omission errors may largely reflect lack of encoding, rather than use of verbal, STM, or intellectual skills.

### *Psychopathology, Stress, and Memory*

*Abuse and trauma-related psychopathology.* CSA and/or CPA victims were more likely than the other children to obtain a PTSD diagnosis, higher CDC (dissociation) scores, and lower GAF (psychological adjustment) scores. These findings are consistent with those of past research on effects of CSA and CPA (e.g., Browne & Finkelhor, 1986). However, abused children compared to non-abused and neglected children were not more likely to rate themselves as having more trauma symptoms.

It should be noted that GAF ratings and PTSD diagnoses were not made independently. Moreover, the clinicians making the PTSD and GAF assessments knew the child's abuse history when they made their judgments. It is possible that clinicians rated abused children as more disturbed in part because of the children's histories. The CDC was completed independently of other standardized measures, however.

*Psychopathology and memory.* A major intent of the study was to examine possible associations between trauma-related psychopathology and memory performance in maltreated children. It was predicted that children with greater psychopathology would perform more poorly on memory tasks. Indeed, children with higher self-reported trauma symptoms produced more commission errors to specific and misleading questions.

There are several possible explanations as to why elevated levels of trauma-related psychopathology would be associated with poorer memory and increased suggestibility. More disturbed



children may be more distracted and/or less organized at encoding. More disturbed children may also have a more difficult time with lengthy and complex interviews and be more confused by tricky and misleading questions. In adults, trauma-related psychopathology has been linked to memory monitoring difficulties (e.g., Bremner et al., 2000). Perhaps our study tapped early stages of such monitoring problems.

However, in contrast to the findings of more errors in children with greater trauma-related psychopathology, we also found that more self-reported trauma symptoms and more dissociative tendencies (higher CDC scores) predicted fewer errors on the identification task. This finding may reflect greater hypervigilance to people involved in activities that relate to children's trauma experiences. Note that Goodman et al. (2001) reported poorer photo identification accuracy in child victims of CSA and/or CPA compared to matched controls in memory for a benign social interaction. Thus, the pattern of findings across the two studies fits with an interpretation of trauma-related psychopathology leading to heightened attention and memory to trauma-related cues but less attention and worse memory to nontrauma-related cues, at least for photo identification.

*Dissociation and memory for stressful events.* It is widely believed that dissociative tendencies are related to memory difficulties. We were especially interested in testing the hypothesis that highly dissociative children would perform more poorly than less dissociative children on tasks assessing memory for stressful events, for example, because highly dissociative children might dissociate when stress is elevated, leading to impaired cognitive processing at encoding and more difficulty retrieving information related to the stressful event. We found that children with greater dissociative tendencies (higher CDC scores), as well as with lower psychological functioning (GAF score) and/or a PTSD diagnosis, evinced greater distress than others during the anogenital exam/venipuncture as indexed by observer ratings and/or changes in cortisol levels. These children's emotional problems, likely linked to past traumatic experiences, may predispose children to greater distress when confronting potentially hurtful or threatening situations.

Also, and as predicted, dissociation was significantly related to children's memory for the anogenital exam/venipuncture. Specifically, for children who were highly dissociative, commission errors regarding the anogenital exam/venipuncture were predicted by cortisol response and self-reported trauma symptoms. Thus, being a child who was highly dissociative and who mounted a stronger physiological (cortisol) response, presumably indicating greater distress, was associated with greater memory errors and suggestibility later. At the same time, more trauma symptoms predicted fewer omission errors for the highly dissociative children.

These associations did not emerge for children low in dissociative tendencies. Thus, negative effects of stress on memory were restricted to children who were more dissociative. It is possible that the highly dissociative children became more dissociative during the stressful anogenital exam/venipuncture and that this reaction interfered with accurate memory later. However, for highly dissociative children, self-reported trauma symptoms also predicted greater commission errors (e.g., greater suggestibility) for a neutral event and a clinical interview, whereas this was not

the case for children who were lower in dissociative tendencies (see Chae et al., 2006).

Thus, several interpretations of these relations must be considered. First, the pattern of responding for highly dissociative children may reflect an affirmative response bias. A child with a response bias to say "yes" would produce fewer omission errors to such questions as "The doctor didn't touch your private parts, did she?" but more commission errors to questions such as "The doctor took your clothes off, didn't she?" Thus, an affirmation bias might exist for the highly dissociative children who have more trauma symptoms but not for the children low in dissociation. However, second, it is also possible that highly dissociative children who have greater trauma symptoms have more trouble with memory monitoring generally, a trend that is consistent with a subset of findings for adults (e.g., dissociation predicts greater tendency toward false memory: Hyman & Billings, 1998). Third, these children may have more difficulty encoding or retaining event information. Fourth, such children may find the interview situation intimidating or otherwise anxiety provoking, leading to greater suggestibility and error. Finally, it is possible that these factors in confluence adversely affected the children's accuracy.

Note that in a related study, Eisen, Qin, et al. (2002) did not detect significant relations between dissociation and memory in a maltreated sample. One reason for the inability of Eisen and colleagues to detect significant relations between dissociation and memory in the previous effort may be related to statistical power. The sample size in the current study was larger than that reported by Eisen, Qin, et al. (2002). Also, cortisol measures, arguably a particularly sensitive measure of distress, were unavailable in the previous study.

*PTSD and memory.* We were also interested in testing the notion, derived from the adult literature, that children with PTSD would be more attentive in threatening situations and possibly show improved memory and greater resistance to misleading information related to these stressful events (e.g., McNally, 2003; Vrana et al., 1995) versus the notion that children with PTSD would have worse memory functioning (e.g., Bremner et al., 2000). However, in our study, PTSD diagnosis was unrelated to memory performance or suggestibility. The lack of relations might reflect the need to have a continuous measure of PTSD symptoms as opposed to a dichotomous measure, such as PTSD diagnosis, to detect PTSD-memory associations (Alexander et al., 2005). Alternatively, clinicians' diagnoses of PTSD in children may have been unreliable. Finally, it is possible that relations between PTSD and memory emerge in adulthood but are not evident in childhood.

### *Caveats*

The present study offers important new insight into memory and suggestibility in maltreated children, but caveats should be mentioned. First, because of the number of variables of interest, it would have been ideal to test an even larger sample. Second, in this complex and unique study, we conducted a large number of statistical tests to explore issues of theoretical and/or applied importance, some of which have never been scientifically examined before. However, due to the number of tests, some of our findings may reflect chance factors. Third, given the realities of a hospital setting, we suffered missing data for some children on

some measures (e.g., cortisol). Replication of the present study is needed.

Fourth, inclusion of a control group of children who were not in the UTR unit was not feasible, given that our study mainly concerned memory for the UTR events. Fortunately, we included nonabused children who were inpatients in the UTR unit. However, it should be kept in mind that the nonabused controls were also likely to have backgrounds that involved exposure to trauma in their homes or community, even though maltreatment had not been substantiated. Relatedly, although the classification of children as maltreated followed the strict standards set by child protective services and hospital staff, it is possible that some children in our maltreatment groups had not in fact suffered abuse or neglect. To the extent that children were misclassified, the study provides a conservative test of our hypotheses.

Fifth, we collected cortisol approximately 20 min after the main stressor. On inspecting the cortisol response curves to various stressors reported in the literature, the "peak" cortisol response may have occurred 5 to 10 min later than our collection time. Consequently, our sampling may have missed the peak cortisol response. Nevertheless, as the 20-min time period was standard for all groups and, based on published curves, would have captured the majority of the response, it seems reasonable to have compared cortisol responses across the groups. Moreover, the adequacy of our baseline measure could be questioned, for example, because of interindividual variability related to cortisol circadian cycles. However, given the relatively large number of children involved in our study, interindividual differences in baseline cortisol are strongly attenuated. Moreover, it should be noted that the cortisol levels, both before and after the exam, were well within the "normal" range and that the mean changes from before to after were rather small. Thus, it is likely the stressor in our study was not a major one for the children as a whole. Our stressor and cortisol procedures therefore may have provided a conservative test. Finally, a salivary sample taken immediately before the anogenital exam/venipuncture would have resulted in better differentiation of elevated cortisol due to the children's general circumstances versus reactivity to the medical procedures. Future studies should take these issues into consideration.

Sixth, we could not include children who did not have the anogenital exam/venipuncture, and thus we could not examine effects of specific and misleading questions on such children, as has been accomplished in other studies (e.g., Saywitz et al., 1991). Seventh, we could not randomly assign children to abuse or stress groups. Although we attempted to statistically control for possibly confounding factors, causal inferences should be made cautiously.

Finally, the ecological validity of our study was relatively high in terms of the setting and circumstances and some actions involved (e.g., anogenital touch), but there are still important differences between the experiences of children in our study and those of many children involved in forensic cases (e.g., children were questioned only once about each event, the doctor's actions were socially acceptable).

### Conclusion

In conclusion, we examined memory and suggestibility in maltreated 3- to 16-year-olds and nonabused controls in relation to potentially important individual-difference factors. Typical age

patterns emerged in the children's eyewitness memory performance. Children 6 years and older were more accurate concerning central information about a stressful event, whereas this pattern was not consistently found for younger children. Trauma-related psychopathology and poor cognitive functioning were significant predictors of memory inaccuracy. For example, regarding trauma-related psychopathology, being highly dissociative and mounting a greater stress response as well as self-reporting more trauma symptoms were associated with increased memory error for stressful medical procedures. Children in substantiated CSA and/or CPA cases were more accurate than were children in substantiated neglect cases when questioned about stressful events. To date, the present study is one of the few that exists on individual differences in memory accuracy and suggestibility for children with substantiated maltreatment.

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