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## Attention and Memory in School-Age Children Surviving the Terrorist Attack in Beslan, Russia

Sara Scrimin, Ughetta Moscardino, Fabia Capello, and Giovanna Axia

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Little is known about the impact of terrorism on children's cognitive functioning and school learning. The primary purpose of this study was to report on cognitive functioning among school-age children 20 months after a terrorist attack against their school. Participants included 203 directly and indirectly exposed children from Beslan and 100 nonexposed children from another town of the Russian Federation. All children were tested using nonverbal neuropsychological measures of attention, memory, and visual-spatial performance. Predisaster traumatic events and terrorism-related exposure factors were evaluated. Findings revealed that overall, directly and indirectly exposed children performed significantly less well than controls in all domains. In addition, direct exposure and loss of a family member were associated with poor memory performance.

On September 1, 2004, a group of terrorists attacked School Number 1 in Beslan, Russia, where 1,300 children and adults were attending a party for the opening school year. The terrorists took children and parents hostage for 3 days. Amassed in the school gymnasium, people were denied water, food, and medication; some children died of dehydration, and others were killed together with adults. The Beslan community stood nearby the school, heard the shooting, and witnessed corpses being thrown out of the school building. The ordeal ended when widely dispersed mines exploded, destroying part of the school and prompting the army to intervene. Of 330 people killed, 186 were children.

As Parfitt (2004) noted, the school massacre in Beslan is one of the worst atrocities enacted on a civilian population in Europe in recent history. Yet in recent years terror attacks have become a worldwide reality. Following the latest experiences with terrorism,

increased attention has been devoted to the behavioral and psychological effects of mass violence and terror attacks on individuals and communities.

Research on terrorism-related trauma has mainly focused on adults (Fremont, 2004). However, the impact of terrorism on children covers a range of violent acts that include isolated events in countries not at war, such as the Oklahoma City bombing (Pfefferbaum, Nixon, & Krug, 1999), the 9/11 terrorist attacks (Beauchesne, Kelly, Patsdaughter, & Pickard, 2002; Schuster et al., 2001), and bombings of towns in Israel (Laor, Wolmer, & Cohen, 2001). These and other studies examined the effects of diverse kinds and severity of exposure on children and adolescents and focused on the protective and risk factors moderating children's psychological reactions (Salmon & Bryant, 2002) as well as on those aspects that may lead to the development of post traumatic stress disorder (Nemeroff et al., 2006). Nonetheless, empirical data regarding the neuropsychological outcomes of terrorism in children are still scarce (Scrimin et al., 2006).

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### CHILDHOOD REACTIONS TO TERRORISM

Empirical evidence indicates that children exposed to terror acts are greatly affected by the experience. Recent studies report that the rates of posttraumatic stress

disorder (PTSD) in children exposed to terrorist activities range from 28% to 50% (e.g., Pfefferbaum et al., 1999). Even after a short event and even if they are not directly exposed, school-age children can develop negative reactions (Phillips, Prince, & Schiebelhut, 2004) and high rates of PTSD (Pfefferbaum et al., 1999). Negative reactions may include several psychological and psychiatric problems such as depression, anxiety, separation problems, mood changes, sleep difficulties, behavioral problems, and regressive symptoms (e.g., Hoge & Pavlin, 2002; Joshi & O'Donnell, 2003; Trappier & Friedman, 1996).

The literature on children's psychological functioning after terrorism primarily has focused on the development of posttraumatic symptomatology and behavioral problems. Specifically, scholars have identified (a) factors exerting a direct adverse effect (i.e., risk factors) on psychological functioning and (b) variables serving as moderators that interact with the risk factors, such that the adverse effect of the risk factor is exacerbated (i.e., vulnerability factors) or mitigated (i.e., protective factors) in the presence of the moderator variable (Chmura Kraemer, Kiernan, Essex, & Kupfer, 2008; MacKinnon & Luecken, 2008).

There are various characteristics of children themselves (e.g., gender, age), their environment (e.g., predisaster traumatic experience, such as domestic violence), and their traumatic exposure that may increase the probability of developing psychological symptoms after terrorist events (La Greca, 2000; Laor & Wolmer 2000, Udwin, Boyle, Yule, & O'Ryan, 2000). Other characteristics (e.g., social support and family functioning) may play a protective role facilitating positive adaptation and recovery in response to the traumatic event (Laor et al., 2006). The most important factor that may contribute to adverse psychological outcomes is level of exposure, as it predicts the risk of developing symptoms both in the short and in the long term (Almqvist & Brandell-Forsberg, 1997; Bat-Zion & Levy-Shiff, 1993; Pfefferbaum et al., 1999; Pfefferbaum et al., 2000). Specifically, the degree of exposure in terms of physical proximity to the event (Pfefferbaum, 1997) explains different degrees of distress and functional impairment, whereas temporal proximity explains a general decrease in distress over time. Moreover, personal loss of relatives and friends (Laor et al., 2006; Nader, Pynoos, Fairbanks, & Frederik, 1990) or multiple exposure to traumatogenic elements within the same event (e.g., being injured, seeing blood, being exposed to disturbing scenes, witnessing death and level of life threat; Green et al., 1991; Nader et al., 1990; Pynoos, Federik, & Nader, 1987) predict more severe traumatic symptoms. These associations have been observed for several types of trauma, including exposure to a sniper attack (Nader et al., 1990) and exposure to various

war-related traumas (Laor et al., 1996; Smith, Perin, Yule, & Rabe-Hesketh, 2001).

In addition, across a range of studies, various indicators of social support moderate the effect of risk factors on psychological outcomes in children exposed to trauma. For example, the direct exposure of the community has been identified as a major vulnerability factor (Laor et al., 2006), whereas support from parents, teachers, and classmates serves as protective factor against development of symptoms (Laor & Wolmer, 2000; Vernberg, La Greca, Silverman, & Prinstein, 1996).

Beyond these factors, characteristics of the individual also predict outcomes in psychological symptoms, although such characteristics have been examined with less consistency. Pretrauma psychopathology may serve as a vulnerability factor for developing psychopathology following subsequent trauma exposure. This association has been demonstrated by using historical data on pretrauma functioning (Udwin et al., 2000). Gender and young age also seem to predict risk for later symptoms, in that girls, as well as younger children, tend to show higher rates of later mood or anxiety symptoms following traumatic stress (Pynoos, 1993).

Despite the fact that the psychological implications following terror events are well documented (see Fremont, 2004, and Hagan, 2005, for recent reviews), surprisingly little is known about the association between exposure to terrorism and children's neuropsychological functioning.<sup>1</sup> In the present study, we aimed to address this gap by investigating the relations between risk factors related to terrorism exposure and children's cognitive functioning. In particular, we assessed whether objective risk factors related to the degree of exposure to the event (i.e., physical proximity to the event, personal loss of relatives and friends, and multiple exposure to traumatogenic elements within the same event; Laor et al., 2006; Nader et al., 1990; Pfefferbaum, 1997; Salmon & Bryant, 2002) influence children's neuropsychological functioning after controlling for predisaster vulnerability.

## NEUROPSYCHOLOGICAL FUNCTIONING AND ACADEMIC PERFORMANCE AFTER TRAUMA IN CHILDREN

Brain development, with the associated progression of cortical myelinization, starts prior to birth but continues well into adolescence and adulthood (e.g., Sowell, Thompson, Tessner, & Toga, 2001). During late childhood and preadolescence, cognitive development mostly

<sup>1</sup>In this article the term *neuropsychological functioning* refers to attention and memory functioning and performance measured by test scores.

occurs in the school context. Hence, school learning and cognitive functioning related to academic performance are paramount for subsequent development (Bornstein & Krasnegor, 1989; Johnson, 1997). During school activities, attention and memory abilities are needed to improve learning and knowledge. Attention involves the ability to select what we perceive and focus on and to ignore other stimuli, whereas memory allows storage and retrieval of information. Both of these cognitive abilities have been widely studied in relation to PTSD in adults, as patients often complain about difficulties concentrating and remembering things in everyday life. Recent studies report that many patients with PTSD exhibit learning and memory deficits, mainly for verbal material (Vasterling & Brailey, 2005). It also has been documented that lower scores on intelligence tests are associated with increased severity of PTSD symptoms, even when controlling for the extent of trauma exposure (McNally & Shin, 1995).

Nonetheless, virtually no information is available on attention, memory, and learning skills among terrorism-exposed children. Research findings concerning traumatized children exposed to violence indicate that children are likely to show deficits in neuropsychological standardized test scores in addition to low school grades. For example, community violence exposure was associated with a decrease in school attendance and grades in a large sample of middle school students (Bowen & Bowen, 1999) as well as with a substantial decrease in IQ and reading achievement in young children (Delane-Black et al., 2002). Similar results were found in a study of Lebanese adolescents, whose PTSD was associated with lower scores on standardized achievement tests (Saigh, Mroueh, & Bremner, 1997). Perez and Widom (1994) assessed a cohort of abused children, observing that formerly abused and neglected individuals had significantly lower IQ scores compared to the control group. Child maltreatment also has been associated with lower scores on standardized tests of academic achievement (Eckenrode, Laird, & Doris, 1993; Leiter & Johnsen, 1994). These findings highlight the presence of poor academic functioning in children following what are usually chronic traumatic events. The cognitive issues that arise following these types of trauma are associated with children's psychological symptoms. For example, children who experience anxiety or PTSD symptoms following trauma may have difficulties concentrating (Toren et al., 2000). Yet it is not clear whether lower academic and cognitive performances are the result of the exposure to traumatic events or of the psychological symptoms, particularly the PTSD symptoms associated with it. Very few studies have addressed the issue of trauma, PTSD, and cognitive performance, and they are mainly related to the effect of chronic trauma. Only two studies have explored

neuropsychological functioning associated with PTSD in children (Beers & De Bellis, 2002; Moradi, Doost, Taghavi, Yule, & Dalgleish, 1999). Beers and De Bellis conducted an extensive neuropsychological evaluation of children who developed PTSD following exposure to a variety of traumatic experiences (e.g., sexual abuse, physical abuse, and witnessing domestic violence). When compared with the performance of healthy controls, children with PTSD demonstrated significant deficits within the domains of attention and abstract reasoning. These children were more susceptible to distraction and demonstrated greater impulsivity, as they made more errors on a task of sustained attention. In contrast, maltreated children with related PTSD did not perform differently from comparison children on measures of language, memory and learning, visuo-spatial abilities, and psychomotor skills. Moradi and colleagues administered the River-Mead and Behavioral Memory Test to children and adolescents with PTSD and to a non-traumatized control group. Children with PTSD had significantly lower scores on the Immediate Story, Delayed Story and Total profiles. However, both studies did not assess a trauma-exposed non-PTSD comparison sample, thus limiting the interpretability of the results.

Given the inconsistency of findings in the adult literature as well as the limited and preliminary information available on cognitive functioning among trauma-exposed youth, more research is needed to examine attention, memory, and learning performance in children exposed to traumatic events. School-age children are still undergoing cortical maturation. As a result, trauma exposure may have important developmental consequences. In addition, very little is known about cognitive functioning among children surviving terrorism (Scrimin et al., 2006), and there are no studies focusing on these aspects in children who are facing the long-term effects of terrorism-induced trauma. Our previous study of school-age children surviving the 3-day siege in Beslan's school revealed significant difficulties in sustaining attention and in short-term memory as well as high rates of severe posttraumatic stress reactions 3 months after the attack (Scrimin et al., 2006).

## CURRENT STUDY

Building on our previous work with Beslan children and their families, this study aimed to evaluate attention, memory, and visual-spatial performance, as well as academic performance, in a large sample of children using a dose-of-exposure design. We assessed children attending the new school in Beslan who had been both directly and indirectly exposed to the terrorist attack and compared them with a sociodemographically similar group of

nonexposed children (i.e., same-age, same-sex children from a different town of the North Ossetian Republic). The rationale for assessing attention, memory and visual-spatial abilities lies in the relevance of these neuropsychological skills for school learning and performance. These skills are paramount during the school years for knowledge acquisition. In fact, the relationship between attention and memory skills and academic performance is well documented (e.g., Alloway et al., 2005; Swanson, 2006).

School grades were also collected from teachers, yet a direct assessment of cognitive functioning through the use of nonspecific academic tasks (e.g., detecting a small bell figure on a sheet containing several small figures of objects; copying a figure) was also deemed important. In particular, we selected nonverbal tasks to assess children's attention (i.e., rapidity and accuracy) and memory (i.e., immediate and delayed recall) for a number of reasons. First, Beslan children experienced the extremely severe trauma at school, and thus the use of academic tasks related to school learning practices (e.g., reading, writing, remembering specific words or subjects) may have resulted in a poor performance due to school avoiding behaviors. Because the terrorist attack occurred in school, the building itself as well as the use of school-related tasks may function as trauma reminders eliciting avoidance behaviors and poor task performances. Second, there were no standardized verbal tests available for this particular population. Third, nonverbal tests reduce linguistic bias, as they do not require oral responses, reading, writing, or object manipulation.

Children's performance on these tasks was studied in relation to level of exposure to the terrorist attack. We addressed children's physical proximity to the event by using a dose-exposure design (i.e., comparing three groups with different levels of proximity to the terrorist attack: directly, indirectly, and nonexposed children) and additional trauma-related exposure as measured by the number of personal losses as well as multiple exposure to traumatogenic elements. Because teachers and the school psychologist were concerned about the possible arousing effects related to the administration of a measure assessing PTSD symptoms, we used children's level of exposure as an indicator of the amount of trauma experienced by each child. The effects of predisaster traumatic events, age, and gender were also controlled.

The degree of exposure in terms of physical proximity to the event (Pfefferbaum, 1997), personal loss of relatives and friends (Laor et al., 2006), and multiple exposure to traumatogenic elements within the same event (e.g., being injured, seeing blood, exposure to disturbing scenes, witnessing death and level of life threat; Green et al., 1991) predict more severe psychological

symptoms. Hence, we expected that directly exposed, indirectly exposed, and control children would show different levels of performance on measures of attention, memory, visual-spatial ability, and overall school academic performance. We expected that directly exposed children would show the worst performance, whereas control children would perform better than the other two groups. In addition, we expected that within the Beslan group of directly exposed children, the experience of personal losses and multiple exposure to traumatogenic elements would be associated with lower levels of cognitive performance.

## METHOD

### Participants

A total of 303 children participated in the study. Two-hundred three of these children were attending fifth, sixth, and seventh grades at the new School Number 1 in the North Ossetian town of Beslan, whereas 100 children were from a different town of Ossetia (located 30 km from Beslan). Children were grouped on the basis of their level of exposure to the traumatic event: 101 Beslan children (60 boys, 41 girls) who were in the school during the terrorist attack (directly exposed group), 102 Beslan children (45 boys, 57 girls) who were not in the school during the terrorist attack (indirectly exposed group) because they were late/absent that day, and 100 children (50 boys, 50 girls) from another town of the North Ossetian Republic located 20 km from Beslan (control group). Children's mean age was 11.9 years ( $SD = 1.08$ , range = 8–16). No significant differences between the three groups in mean age and gender were found. In addition, there was no significant difference in family socioeconomic status,  $F(1, 302) = 0.69$ ,  $p = .147$ . All families lived in rural areas that were low in socioeconomic status, and 80% reported a medium income on a 3-point scale measure ranging from 1 (*low*) to 3 (*high*). Participants from all groups spoke both Ossetian and Russian.

### Procedure

Directly and indirectly exposed children were recruited 20 months after the traumatic event in the Ossetian town of Beslan during a 1-month data collection. Children were assessed at school, during school hours, by trained certified psychologists with the help of two professional interpreters as well as the collaboration of school teachers and the school psychologist. Prior to data collection, written permission was obtained from the Ministry of Education together with informed consent by the school principal and psychologist. In addition,

verbal consent was obtained from all parents during a meeting during in which the purposes and methods of the study were explained. Before the beginning of each session, children were informed about how it would take place and were told that they could chose not to participate or leave the session at any time. No child refused to participate or left the classroom before the end of the session. The majority (92%) of parents provided informed consent, yielding a sample size of 203 for children in the “exposed” conditions. The control group included 100 randomly selected children of fifth, sixth, and seventh grades balanced for age and gender. Informed consent was obtained from all parents of control children. Procedures and measures were identical for the two groups (Beslan children and controls).

## Measures

**Predisaster traumatic events and terrorism-related exposure scale scores.** Predisaster traumatic events and terrorism-related exposure were evaluated by teachers, who were asked to report on each child from a list of possible traumatic events. Each teacher was asked to report on those children who were attending the class she was responsible for, hence she knew the children and families reasonably well and also had access to the school psychologist’s reports. On average, each teacher reported on 18 students. A checklist containing a number of traumatic events was given to teachers. The list included predisaster traumatic events (i.e., loss of a family member, domestic violence, severe illness) and terrorism-related exposure (i.e., being inside or outside the school during the attack, loss of a family member during the attack, being severely injured, having seen dead bodies, having seen killings). Teachers could also add additional sources of child stress that were not mentioned in the list, if they believed them to be relevant. It is important to specify that although teachers completed the list, the psychologist was present and available to answer questions or discuss the relevance of events. Later, an overall score of predisaster traumatic events was created by summing all factors related to this domain. Terrorism-related exposure was composed of loss of significant others and multiple exposure to traumatogenic elements. Factors pertaining to each of these categories were summed to yield two separate scores: loss of a family member scale score and multiple exposure to traumatogenic elements scale score.

**Attention.** Attention rapidity and accuracy were assessed using the Attention Bell Test (Biancardi & Stoppa, 1997). This is a paper-and-pencil, nonverbal test composed of four sheets of paper, each containing one-dimensional scattered figures of several objects

(e.g., bell, apple, tree). The child is asked to find as many bells as he or she can in a fixed time for each sheet (30 sec, 60 sec, 90 sec, 120 sec). A score of attention rapidity is given on the basis of the number of bells marked by the child on the 30-sec sheet, whereas a score of attention accuracy is given based on the number of bells marked by the participant on the 120-sec sheet. This test was originally developed to assess levels of attention in school-age children but it has also been used with clinical populations (e.g., children with dyslexia and attention deficit hyperactivity disorder; Biancardi & Stoppa, 1997) and has proven good concurrent and predictive validity in several Italian samples (Biancardi & Stoppa, 1997). Because no Russian or Ossetian validation of this test is currently available, in further analyses we used raw scores controlling for age.

**Memory and visual-spatial functioning.** Nonverbal visual-constructional ability and immediate as well as delayed memory were measured with the Rey Complex Figure Test (Meyers & Meyers, 1995). The child is asked to copy a complex figure (“Rey-Copy”) and then, without being told in advance, to reproduce it from memory (immediate and delayed recall; “Rey-Immediate” and “Rey-Delay,” respectively). To code the test, we used the Meyers and Meyers scoring system (Meyers & Meyers, 1995), which allowed us to assess each child’s accuracy in copying and memory of the figure both immediately and after 30 min, during which a distracting task was administered (delayed recall). This test has proven concurrent and predictive validity (Meyers & Meyers, 1995). Construct validity was also evaluated, and high intercorrelations among the Rey Complex Figure Test and the Wechsler Adult Intelligence Scale–Revised subtests were found. In addition, this test has been validated in clinical populations (Sodic, Anticevic, Britvic, & Ivkovic, 2007) and in different cultures (e.g., United States, Croatia, Finland, Italy, Cambodia; Henry, 2001; Rosselli & Ardila, 2003). Good interrater reliability was demonstrated with this scoring system. In the present study, intercoder agreement between two independent raters on 20% of the sample was good (Pearson’s  $r = .87$ ). Raters were blind in relation to which group they were coding. Given the lack of Russian/Ossetian versions of this test, raw scores were used in all analyses controlling for age.

**Academic performance.** School performance of each child was accounted for by recording the overall grade received in his or her report card at the end of the school year provided by the teacher 20 months after the terrorist attack. This grade is expressed on a 5-point scale ranging from 1 (*very low*) to 5 (*excellent*).

## Statistical Analyses

Data were first graphically examined for skewness, kurtosis, and outliers. The Kolmogorov–Smirnov test confirmed normalcy (all  $ps > .05$ ) for all variables; hence, no transformations were necessary. Next, descriptive statistics were performed. Chi-square statistics were used to assess differences in the frequencies of predisaster traumatic events among directly exposed, indirectly exposed and control children, as well as differences in the frequencies of terrorism-related exposure between the two groups of Beslan children. Multivariate analyses of covariance on measures of attention (rapidity and accuracy scores), memory (Rey Figure Immediate and Delayed recall), visual-spatial performance (Rey Figure Copy), and school grade were performed. Group (directly exposed, indirectly exposed, and control children) and gender were used as between factors, and age and predisaster traumatic events served as covariates. In addition, differences between paired measurements in the Rey Complex Figure test (Copy vs. Immediate recall and Immediate Recall vs. Delayed Recall) were analyzed via a multivariate analysis of variance with group as a between-subjects factor and Copy versus Immediate and Delay recall as a within-subject factor, followed by dependent samples  $t$  post hoc tests. Finally, intra-group analyses were performed, in which we assessed partial correlations (age corrected) between predisaster traumatic events, terrorism-related exposure factors, and children's neuropsychological performance.

## RESULTS

## Predisaster Traumatic Events and Terrorism-Related Exposure

Table 1 shows the frequencies of endorsement of predisaster traumatic events and terrorism-related exposure factors by group. Predisaster traumatic events were fairly homogeneous across the directly exposed, indirectly exposed, and control groups. The overall average scores of pre-disaster traumatic events in the three groups were .22 ( $SD = .50$ , range = 0–2), .28 ( $SD = .47$ , range = 0–2), and .23 ( $SD = .45$ , range = 0–2), respectively. Frequencies of endorsement of terrorism-related exposure factors are reported only for the directly and indirectly exposed children, as the control group had not been exposed to the event.

Group comparisons were significant for all factors related to levels of trauma exposure, providing evidence that the objective features of exposure were intrinsically related to the grouping variable of having directly or indirectly experienced the terrorist attack. In the directly exposed children, noteworthy was the rate of loss of a family member (61.4%), especially of a sibling (33.7%). All children who were in the school during the attack had seen dead bodies, and more than half of them (57.4%) had witnessed killings and were seriously hurt. Hence, the level of multiple exposure to traumatogenic elements was very high among the directly exposed group compared to the indirectly exposed one.

TABLE 1  
Frequencies of Predisaster Traumatic Events and Terrorism-Related Exposure Among Directly Exposed, Indirectly Exposed, and Control Children

	<i>Direct Exposure Group<sup>a</sup></i>		<i>Indirect Exposure Group<sup>b</sup></i>		<i>Control Group<sup>c</sup></i>		$\chi^2(2)$
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
Predisaster Traumatic Events							
Loss of Family Member	10	9.9	13	17.7	9	9	0.82
Domestic Violence	8	7.9	8	7.8	7	7	0.075
Severe Illness	4	4.0	8	7.8	5	5	1.51
Terrorism-Related Exposure							
Loss of Family Member							
Parent	20	19.8	4	3.9	—	—	12.28**
Sibling	34	33.7	3	2.9	—	—	32.14**
Grandparent	8	7.9	0	0.0	—	—	8.41*
Multiple Exposure							
Seriously Hurt	51	50.5	0	0.0	—	—	68.79**
Having Seen Dead Bodies	101	100.0	18	17.6	—	—	141.88**
Having Seen Killings	58	57.4	0	0.0	—	—	82.04**

<sup>a</sup> $n = 101$ , <sup>b</sup> $n = 102$ , <sup>c</sup> $n = 100$ .

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

TABLE 2  
Attention Performance, Memory, and Visual-Spatial Functioning, and School Grades by Exposure Group and Gender

Measure	Group		Gender		Effect			
	Indirect Exposure ( <i>n</i> = 102)		Control Group ( <i>n</i> = 100)		Boys ( <i>n</i> = 155)		Girls ( <i>n</i> = 148)	
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )
Attention	Direct Exposure ( <i>n</i> = 101)		Indirect Exposure ( <i>n</i> = 102)		Control Group ( <i>n</i> = 100)		Boys ( <i>n</i> = 155)	
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )
Rapidity	12.74 (4.06) <sup>a</sup>	12.99 (3.64) <sup>b</sup>	14.10 (1.55) <sup>a,b</sup>	12.84 (3.22)	13.73 (3.15)	5.41 (2, 302)	.035	.005
Accuracy	30.44 (3.31) <sup>a</sup>	30.24 (4.31) <sup>b</sup>	33.66 (1.31) <sup>a,b</sup>	30.76 (4.22)	32.15 (2.37)	43.0 (2, 302)	.226	.0001
Memory and Visual Spatial Functioning	Direct Exposure ( <i>n</i> = 101)		Indirect Exposure ( <i>n</i> = 102)		Control Group ( <i>n</i> = 100)		Boys ( <i>n</i> = 155)	
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )
Immediate Recall	20.26 (6.81) <sup>a</sup>	20.68 (6.58)	22.52 (1.56) <sup>a</sup>	20.61 (6.01)	21.72 (5.01)	9.05 (2, 285)	.061	.0001
Delay Recall	20.32 (6.76) <sup>a</sup>	20.91 (6.64)	22.32 (1.45) <sup>a</sup>	20.79 (5.84)	21.66 (4.99)	7.14 (2, 285)	.049	.001
Copy	27.44 (3.31) <sup>a</sup>	27.51 (3.36) <sup>b</sup>	34.14 (1.19) <sup>a,b</sup>	29.27 (3.00)	30.11 (3.10)	62.14 (2, 285)	.310	.0001
School Grade (range = 1–5)	3.09 (0.76) <sup>a</sup>	3.01 (1.02) <sup>b</sup>	3.55 (1.07) <sup>a,b</sup>	3.01 (0.54)	3.11 (0.83)	8.71 (2, 302)	.143	.001

Note: Groups with the same letter are significantly different according to Bonferroni test (critical  $\alpha = .05/3 = .01$ ).



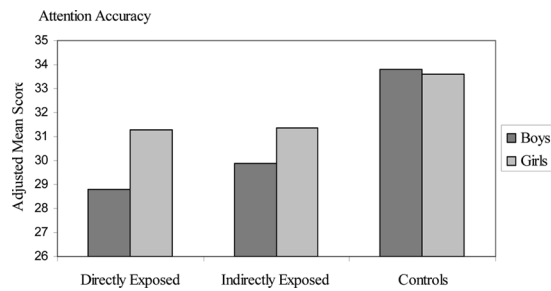


FIGURE 1 Interaction effect of group and gender on attention accuracy among school-age children. *Note:* Means are adjusted for age.

### Neuropsychological Variables and School Grades

Descriptive statistics on neuropsychological test performance of directly and indirectly exposed children and controls are reported in Table 2 together with main group comparisons. Overall, children from Beslan (directly and indirectly exposed groups) performed less well on all measures compared to controls. In the domain of attention, directly and indirectly exposed children did not differ from each other, whereas both performed significantly worse than controls in attention rapidity and in attention accuracy, after controlling for age and predisaster traumatic events. In addition, boys obtained significantly lower scores than girls in both attention rapidity and accuracy. A significant interaction effect of group and gender on attention accuracy was also found (Figure 1), with boys in the direct and indirect exposure groups showing a decrease, disproportionate to girls, in attention accuracy performance compared to those in the control group.

In the memory domain of the Rey Figure Test, directly and indirectly exposed children performed significantly worse than controls. It is noteworthy that scores on immediate and delayed recall tasks had much higher standard deviations in the directly and indirectly exposed children compared to controls, thus indicating a wider variation in the performance related to these memory tasks. Yet Bonferroni post hoc test (with a critical  $\alpha = .05/3 = .01$ ) revealed that only directly exposed children significantly differed from controls,

reporting lower scores in both tasks (immediate and delayed recall). These group differences were statistically significant after controlling for child age and predisaster traumatic events. In this domain, there were no significant gender differences.

In the visual-spatial ability domain of the Rey figure Copy accuracy task, directly and indirectly exposed children did not differ from each other, whereas both performed significantly worse than controls. Specifically, Beslan children made significantly more accuracy and placement errors and thus produced a poorer copy of the figure compared to control children. Group differences were statistically significant after adjusting for child age and predisaster traumatic events. No significant gender differences emerged in children's copy performance.

Across all groups, children scored significantly lower on the immediate recall step than on the copy step of the Rey Complex Figure test ( $\Lambda = .688$ ),  $F(4, 562) = 19.261$ ,  $p < .0001$ . That is, they made significantly more errors when they had to draw the figure from memory than when they had to copy it,  $t(1, 201) = 12.51$ ,  $p < .0001$ , for directly exposed children;  $t(1, 202) = 17.91$ ,  $p < .0001$ , for indirectly exposed children; and  $t(1, 99) = 93.61$ ,  $p < .0001$ , for controls. Children from the directly exposed group made almost twice as many errors compared to control participants; mean scores (and standard deviations) for paired differences were 7.85 (.56) and 11.62 (.39), respectively.

Finally, correlations were performed between neuropsychological measures and school performance as derived from the overall grade received by children on their report cards. No significant associations were found. In addition, in relation to school performance, directly and indirectly exposed children did not differ from each other, whereas both had significant lower grades compared to controls.

### Terrorism-Related Exposure and Neuropsychological Variables

Table 3 presents age-corrected correlations between predisaster traumatic events, levels of trauma exposure,

TABLE 3  
Partial Correlations for Directly Exposed Children Between Predisaster Traumatic Events, Terrorism-Related Exposure, and Neuropsychological Variables

	Attention		Memory		Visual-Spatial Functioning
	Rapidity	Accuracy	Immediate Recall	Delayed Recall	Figure Copy
PreDisaster Traumatic Events	.18	.10	.18	.16	.11
Terrorism-Related Exposure					
Loss of Family Member Scale Score	-.02	.01	-.33**	-.27*	-.33**
Multiple Exposure Scale Score	-.21*	.06	.04	-.25*	-.16

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

and neuropsychological variables for children directly exposed to the attack. Predisaster traumatic events were not associated with neuropsychological performance, but there were significant correlations for the terrorism-related exposure variables. Specifically, loss of a family member was negatively associated with children's performances in the three tasks of the Complex Rey Figure Test. The multiple exposure to traumatogenic elements scale score was significantly and negatively correlated with attention rapidity and the delayed recall task. The same set of correlations was performed for the indirectly exposed group, but no significant associations emerged.

## DISCUSSION

The main goals of this study were to report on cognitive functioning in school-age children 20 months after a terrorist attack in their school and to identify terrorism-exposure risk factors that may influence neuropsychological performance after controlling for predisaster traumatic events. Group comparisons between directly and indirectly exposed children in relation to these variables indicated a significant difference in dose of exposure: children of the directly exposed group were not only physically closer to the event, as they were in the school during the 3-day-siege, but they also experienced more personal losses and multiple exposure to traumatogenic elements. Children who went to school that day to celebrate with family and friends were trapped in the building together with siblings, parents, or even grandparents who had brought them to the party. These same children had seen an large number of dead bodies, some of them were killed during the siege, whereas others died after the explosions, fire and the collapse of the school roof on the 3rd day. In contrast, children outside the school were protected from directly experiencing these situations by parents and other community members, whereas children from the control group did not experience the attack at all.

Using a dose of exposure design, we found that directly and indirectly exposed children from Beslan performed significantly less well within the domains of attention, memory, visual-spatial functions and overall school functioning compared with same-age, socio-demographically similar, healthy children who had not been exposed to the terrorist attack. After controlling for potential confounds, both exposed and non-exposed children were less rapid and accurate in the attention tasks, thus demonstrating to be more susceptible to distraction and less able to sustain attention compared to controls. This finding was particularly evident for boys of the directly and indirectly exposed groups. In the memory domain, directly and indirectly exposed

children performed worse than controls, yet only the directly exposed group significantly differed from the control group. In addition, both directly and indirectly exposed children were less accurate and precise compared to controls when copying the Rey Complex figure, demonstrating poorer visual-spatial performance.

Hence, neuropsychological functioning of children who were directly and indirectly exposed to terrorism was poorer than that of controls. In addition, directly exposed children performed significantly less well than controls in the immediate and delayed recall tasks, showing an association between memory functioning and level of exposure in terms of physical proximity to the event. Within the same group of exposed children, a poorer memory performance was associated with loss of a family member during the attack, thus suggesting a relation between memory functioning and level of exposure to the attack in terms of losses.

These findings lend support to the idea that the degree of exposure to terrorist actions is related not only to the prevalence of psychological symptoms (e.g., Fremont, 2004; Pfefferbaum et al., 1999) but also to children's cognitive functioning. Even if further research is needed to replicate and expand these results, we must take into account that high doses of terrorism-related exposure in terms of physical proximity, personal losses, and multiple exposure to traumatogenic elements may impact on school-age children's visual-spatial memory performance (immediate and delay recall) 20 months after the attack. Our previous study revealed neuropsychological impairment of basic attention and memory processes in a group of Beslan children three months after the attack (Scrimin et al., 2006). This result is now supported by the present study conducted on a larger sample of children more than one year after the violent event occurred. Whereas our previous findings may have been explained by temporal proximity to the attack and the association with children's psychological state of arousal, the present results indicate significant long-term problems in learning-related abilities.

One may hypothesize that a single terrorism-related traumatic event, together with a number of exposure factors, impacts on the long-term functioning of children's developing brain. In this regard, terrorism exposure in school-age children appears to be similar to child maltreatment and other traumas in its associations with cognitive outcomes (e.g., Beers & DeBellis, 2002; Danley-Black, 2002; Moradi et al., 1999). The reason for such a poor neuropsychological performance in children exposed to terrorism may lay in the nature of such events. Because terrorists can strike at any time and anywhere, the threat of terrorism is enduring and omnipresent. As a result, it has been documented that many children exposed to terrorism display long-term psychological and behavioral problems (e.g., Joshi &

O'Donnell, 2003), as well as anxious preoccupation with personal and family safety (Fremont, 2004) and concentration difficulties (Dodge, 1993; Maslow, 1954). Similarly, direct and high-dose exposure terrorism may have long-term effects on children's memory and academic performance. More studies are needed to investigate if trauma exposure is the only direct culprit for producing such low cognitive performances, or if the presence of psychological problems (e.g., PTSD symptoms) arising as a consequence of trauma exposure also impacts on children's cognitive functioning. Still, our results suggest that terrorism-related exposure is a risk factor for developing memory impairments and low school performance and thus should be taken into account when working with students affected by terrorism.

In particular, it is worth noting the significant association between personal loss of a family member and memory performance among directly exposed children. This association highlights the important role of experiencing the death of a loved one in children's cognitive functioning. Previous literature on youths exposed to terrorism with and without associated deaths provides evidence of how bereaved trauma survivors report higher levels of PTSD symptoms, arousal, worry, depression, and complaints about physical health both immediately and years following the traumatic death (Goenjian et al., 2001; Pfefferbaum et al., 1999; Pfefferbaum et al., 2000). In addition, youths who experience the loss of a person to whom they were emotionally closer (e.g., parent or sibling) tend to be even more symptomatic (Pfefferbaum et al., 2000) than others. Our findings indicate that the loss of a family member not only impacts children's psychological functioning, but also can result in poor memory performance. This pattern may be linked to the definition of grief, which implies emotional, psychological, behavioral as well as cognitive reactions to the death of someone deemed significant. Future research should address whether childhood traumatic grief following terrorism affects cognitive functioning and development.

One final consideration concerning the degree of exposure to terrorism-related factors is related to the lack of significant differences between directly and indirectly exposed children in attention, visual-spatial abilities, and school performance. A possible interpretation of this result may be the wide-ranging impact of this terrorist attack, which occurred in a small, traditional society where almost every member suffered the loss and/or injury of a relative or a friend (Parfitt, 2004). As a result, it is likely that the event exerted a profound effect on the entire community. Direct and indirect exposure of the community, as well as parental and family distress have been identified as major risk factors for children's psychological distress (Laor & Wolmer

2000; Laor et al., 2006; Vernberg, et al., 1996). In our previous study among caregivers of children who survived the Beslan school siege, parents reported a sense of helplessness and of "living in constant fear" due to the perceived lack of protection by institutional forces and the general sociopolitical situation of the Northern Caucasus (Moscardino, Axia, Scrimin, & Capello, 2007). The absence of a significant difference between directly and indirectly exposed children's attention and visuo-spatial performance may be because children are highly susceptible to secondary exposure (i.e., exposure through the reaction of the community or through the fearful reactions of parents and teachers). Indeed, Moscardino, Scrimin, Capello, Altoè, and Axia (2008) found similar levels of psychological distress among directly and indirectly exposed adolescents of the same community. An additional explanation is that in response to the event, the number of lessons taking place at the new Beslan school decreased, and the school personnel's attitude was to deal with classes generally more softly and in a less demanding way, especially with those students who were in the school during the attack. Hence, even if these kids were academically performing worse, the school psychologist told us that teachers would not give them lower grades as a means to increase their learning motivation and protect them from experiencing frustration.

Cognitive performance also differed according to gender, particularly in relation to attention tasks. However, our finding is in contrast with the literature on psychological problems and posttraumatic symptoms (Solomon, Gelkopf, & Bleich, 2005; Wadsworth et al., 2004), which indicates that girls are more vulnerable to psychological distress and report more emotional and behavioral problems than boys. A possible explanation of girls' better neuropsychological performance might be an overall higher learning motivation in school activities displayed by girls compared to boys at this age (for a recent review, see Meece, Glienke, & Burg, 2006) together with cultural factors that may encourage girls more than boys to devote themselves to school work (e.g., all teachers in school are women).

There are several limitations of this study that should be noted. First, as previously reported, we could not obtain information regarding children's posttraumatic stress symptoms and thus did not assess their effect on neuropsychological functioning. Ethical reasons prevented us from administering a measure of PTSD, as the psychologist and the school principal were extremely concerned about its possible distressing effects on children, including excessive emotional arousal and re-experiencing of the event. A further limitation is the absence of a set of additional measures, such as parent-report measures of predisaster traumatic events, parental distress, family functioning, and social support.

Future research should include these measures to better understand the role of the larger ecology on children's neuropsychological and academic functioning in response to terrorism.

### Implications for Research, Policy, and Practice

The present findings add to the literature by reporting on attention, memory, and visual-spatial performance in school-age children more than 1 year after a terrorist attack and by linking children's performance in immediate and delayed recall tasks to a high degree of exposure to terrorism. Following a terrorist attack, school constitutes a major part of the recovery environment over time; being able to get back to learning and school activities is relevant not only for long-term development but also to foster recovery and "healthy" daily routines (Pfefferbaum, 1997; Wolmer, Laor, & Yazgan, 2003). Understanding the domains of cognitive functioning in which children perform worse and the factors that may affect them the most may help to plan better intervention programs in school to improve the performance of these children. Much can be learned from our results. Terrorism may be a risk for children's school failure due to significant attention and memory problems more than 1 year after a terrorist attack. Health professionals and clinicians working with school-age children survivors of terrorism should promote school activities that are appealing to students. In addition, teachers should consider organizing lessons and tests that require short periods of concentration, because directly and indirectly exposed children are not able to sustain attention as much as nonexposed children. Special attention should be paid to those children who have been more exposed to the attack in terms of physical proximity to the event and number of personal losses. These children in particular may have difficulties in tasks requiring memory abilities. Teachers should keep this in mind during school lessons and tests and may promote simple activities to improve children's memory skills. A useful approach may be to monitor children's performances very frequently with the use of short tests or other brief assessment measures. Finally, it could be helpful to increase children's motivation through the use of more interesting and appealing tasks to improve cognitive performance and learning. However, further research is needed to address the effectiveness of different interventions.

### REFERENCES

- Alloway, T. P., Gathercole, S. E., Adams, A. M., Willis, C., Eaglen, R., & Lamont, E. (2005). Working memory and phonological awareness as predictors of progress towards early learning goals at school entry. *British Journal of Developmental Psychology*, 23, 417–426.
- Almqvist, K., & Brandell-Forsberg, M. (1997). Refugee children in Sweden: Post-traumatic stress disorder in Iranian preschool children exposed to organized violence. *Child Abuse & Neglect*, 21, 351–366.
- Bat-Zion, N., & Levy-Shiff, R. (1993). Children in war: Stress and coping reactions under the threat of the Scud missile attacks and the effect of proximity. In L. Lewis & N. Fox (Eds.), *The psychological effects of war and violence in children* (pp. 143–161). Hillsdale, NJ: Erlbaum.
- Beauchesne, M. A., Kelly, B. R., Patsdaughter, C. A., & Pickard, J. (2002). Attack on America: Children's reactions and parents' responses. *Journal of Pediatric Health Care*, 16, 213–221.
- Beers, S. R., & De Bellis, M. D. (2002). Neuropsychological function in children with maltreatment-related posttraumatic stress disorder. *American Journal of Psychiatry*, 159, 483–486.
- Biancardi, A., & Stoppa, E. (1997). Il test delle campanelle modificato: Una proposta per lo studio dell'attenzione in età evolutiva (The Attention Bell Test). *Psichiatria dell'Infanzia e dell'Adolescenza*, 64, 73–84.
- Bornstein, M. H., & Krasnegor, N. A. (Eds.). (1989). *Stability and continuity in mental development. Behavioral and biological perspectives*. Hillsdale, NJ: Erlbaum.
- Bowen, N. K., & Bowen, G. L. (1999). Effects of crime and violence in neighborhoods and schools on the school behavior and performances of adolescents. *Journal of Adolescent Research*, 14, 319–342.
- Chmura Kraemer, H., Kiernan, M., Essex, M., & Kupfer, D. J. (2008). How and why criteria defining moderators and mediators differ between the Baron & Kenny and MacArthur approaches. *Health Psychology*, 27, 101–108.
- Danley-Black, V., Covington, C., Ondersama, S. J., Nordstrom-Klee, B., Templin, T., Ager, J., et al. (2002). Violence exposure, trauma and IQ and or reading deficits among urban children. *Archives of Pediatric Adolescent Medicine*, 156, 280–285.
- Dodge, K. A. (1993). Social cognitive mechanisms in development of conduct disorder or depression. *Annual Review of Psychology*, 44, 559–584.
- Eckenrode, J., Laird, M., & Doris, J. (1993). School performance and disciplinary problems among abused and neglected children. *Developmental Psychology*, 29, 43–62.
- Fremont, W. P. (2004). Childhood reactions to terrorism-induced trauma: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry*, 43, 381–392.
- Goenjian, A. K., Molina, L., Steinberg, A. M., Fairbanks, L. A., Alvarez, M. L., & Goenjian, H. A. (2001). Posttraumatic stress and depressive reactions among Nicaraguan adolescents after Hurricane Mitch. *American Journal of Psychiatry*, 158, 788–798.
- Green, B. L., Korol, M., Grace, M. C., Vary, M. G., Leonard, A. C., Gleser, G. C., et al. (1991). Children and disaster: Age, gender, and parental effects on PTSD symptoms. *Journal of the American Academy of Child and Adolescent Psychiatry*, 30, 945–951.
- Hagan, J. F., Jr. (2005). American Academy of Pediatrics Committee on Psychosocial Aspects of Child and Family Health; Task Force on Terrorism. Psychosocial implications of disaster or terrorism on children: A guide for the pediatrician. *Pediatrics*, 116, 787–795.
- Henry, G. K. (2001). The Rey Figure in Amazonia: Effects of jungle living on children's copy performance. *Developmental Neuropsychology*, 19, 33–39.
- Hoge, C. H., & Pavlin, J. A. (2002). Psychological sequelae of September 11. *New England Journal of Medicine*, 347, 443–445.
- Johnson, M. H. (1997). *Developmental cognitive neuroscience*. Cambridge, MA: Blackwell.

- Joshi, P. T., & O'Donnell, D. A. (2003). Consequences of child exposure to war and terrorism. *Clinical Child and Family Psychological Review*, 6, 275–292.
- La Greca, A. M. (2000). PTSD in children. In G. Fink (Ed.), *Encyclopedia of stress* (Vol. 3, pp. 181–186). San Diego (CA): Academic Press.
- Laor, N., & Wolmer, L. (2000). Children exposed to disaster: The role of the mental health professionals. In M. Lewis (Ed.), *Child and adolescent psychiatry: A comprehensive textbook* (pp. 925–937). Philadelphia: Lippincott Williams & Wilkins.
- Laor, N., Wolmer, L., Alon, M., Siev, J., Samuel, E., & Toren, P. (2006). Risk and protective factors mediating psychological symptoms and ideological commitment of adolescents facing continuous terrorism. *The Journal of Nervous and Mental Disease*, 194, 279–286.
- Laor, N., Wolmer, L., & Cohen, D. J. (2001). Mothers' functioning and children's symptoms 5 years after a SCUD missile attack. *American Journal of Psychiatry*, 158, 1020–1026.
- Laor, N., Wolmer, L., Mayes, L., Golomb, A., Silverberg, D. S., Weizman, R., et al. (1996). Israeli preschoolers under Scud missile attacks: A developmental perspective on risk-modifying factors. *Archives of General Psychiatry*, 53, 416–423.
- Leiter, J., & Johnsen, M. C. (1994). Child maltreatment and school performance. *American Journal of Education*, 102, 154–189.
- MacKinnon, D. P., & Luecken, L. J. (2008). How and for whom? Mediation and moderation in health psychology. *Health Psychology*, 27, 99–100.
- Maslow, A. (1954). *Motivation and personality*. New York: Harper & Row.
- McNally, R. J., & Shin, L. M. (1995). Association of intelligence with severity of post traumatic stress disorder symptoms in Vietnam combat veterans. *American Journal of Psychiatry*, 152, 936–938.
- Meece, J., Glienke, B. B., & Burg, S. (2006). Gender and motivation. *Journal of School Psychology*, 44, 315–373.
- Meyers, J. E., & Meyers, K. R. (1995). Rey Complex Figure test under four different administration procedures. *The Clinical Neuropsychologist*, 9, 63–67.
- Moradi, A. R., Doost, H. T., Taghavi, M. R., Yule, W., & Dalgleish, T. (1999). Everyday memory deficits in children and adolescents with PTSD: Performance on the Rivermead Behavioural Memory Test. *Journal of Child Psychology and Psychiatry*, 40, 357–361.
- Moscardino, U., Axia, G., Scrimin, S., & Capello, F. (2007). Narratives from caregivers of children surviving the terrorist attack in Beslan: Issues of health, culture, and resilience. *Social Science and Medicine*, 64, 1776–1787.
- Moscardino, U., Scrimin, S., Capello, F., Altoè, G., & Axia, G. (2008). Psychological adjustment of adolescents 18 months after the terrorist attack in Beslan, Russia: A cross sectional study. *Journal of Clinical Psychiatry*, 69, 854–859.
- Nader, K., Pynoos, R., Fairbanks, L., & Frederik, C. (1990). Children's PTSD reactions one year after a sniper attack in their school. *American Journal of Psychiatry*, 147, 1526–1530.
- Nemeroff, C. B., Bremner, J. D., Foa, E. B., Mayberg, H. S., North, C. S., & Stein, M. B. (2006). Posttraumatic stress disorder: A state-of-the-science review. *Journal of Psychiatry Research*, 40, 1–21.
- Parfitt, T. (2004). How Beslan's children are learning to cope. *The Lancet*, 364, 2009–2010.
- Perez, C. M., & Widom, C. S. (1994). Childhood victimization and long-term intellectual outcomes. *Child Abuse & Neglect*, 18, 617–624.
- Pfefferbaum, B. (1997). Post traumatic stress disorder in children: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry*, 36, 1503–1511.
- Pfefferbaum, B., Nixon, S. J., & Krug, R. S. (1999). Clinical needs assessment of middle and high school students following the Oklahoma city bombing. *American Journal of Psychiatry*, 156, 1069–1074.
- Pfefferbaum, B., Seale, T. W., McDonald, N. B., Brandt, E. N., Rainwater, S. M., & Maynard, B. T. (2000). Posttraumatic stress two years after the Oklahoma city bombing in youths geographically distant from the explosion. *Psychiatry*, 63, 358–370.
- Phillips, D., Prince, S., & Schiebelhut, L. (2004). Elementary school children's responses 3 months after the September 11 terrorist attacks: A study in Washington, DC. *American Journal of Orthopsychiatry*, 74, 509–528.
- Pynoos, R. S. (1993). Traumatic stress and developmental psychopathology in children and adolescents. In J. M. Oldham, M. B. Riba, & A. Tasman (Eds.), *American psychiatric press review of psychiatry* (Vol. 12, pp. 205–238). Washington, DC: American Psychiatric Press.
- Pynoos, R. S., Frederik, C., & Nader, K. (1987). Life threat and post-traumatic stress in school-age children. *Archives of General Psychiatry*, 44, 1057–1063.
- Rosselli, M., & Ardila, A. (2003). The impact of culture and education on non verbal neuropsychological measurements: A critical review. *Brain and Cognition*, 52, 326–333.
- Saigh, P. A., Mroueh, M., & Bremner, J. D. (1997). Scholastic impairments among traumatized adolescents. *Behavioral Research Therapy*, 35, 429–436.
- Salmon, K., & Bryant, R. A. (2002). Posttraumatic stress disorder in children. The influence of developmental factors. *Clinical Psychology Review*, 22, 163–188.
- Schuster, M. A., Stein, B. D., Jaycox, L. H., Collins, R. L., Marshall, G. N., & Elliott, M. N. (2001). A national survey of stress reactions to September 11, 2001 terrorist attacks. *National English Journal of Medicine*, 345, 1507–1512.
- Scrimin, S., Axia, G., Capello, F., Moscardino, U., Steinberg, A. M., & Pynoos, R. S. (2006). Posttraumatic reactions among injured children and their caregivers 3-months after the terrorist attack in Beslan. *Psychiatry Research*, 141, 333–336.
- Smith, P., Perin, S., Yule, W., & Rabe-Hesketh, S. (2001). War exposure and maternal reactions in the psychological adjustment of children from Bosnia-Herzegovina. *Journal of Child Psychology and Psychiatry*, 42, 395–404.
- Sodic, L., Anticevic, V., Britvic, D., & Ivkovic, N. (2007). Short term memory in Croatian war veterans with post traumatic stress disorder. *Croatian Medical Journal*, 48, 140–145.
- Solomon, Z., Gelkopf, M., & Bleich, A. (2005). Is terror gender-blind? Gender differences in reaction to terror events. *Social Psychiatry and Epidemiology*, 40, 947–954.
- Sowell, E. R., Thompson, P. M., Tessner, K. D., & Toga, A. W. (2001). Mapping continued brain growth and gray matter density reduction in dorsal frontal cortex: Inverse relationships during postadolescent brain maturation. *Journal of Neuroscience*, 21, 8819–8829.
- Swanson, H. L. (2006). Cognitive processes that underlie mathematical precociousness in young children. *Journal of Experimental Child Psychology*, 93, 293–364.
- Toren, P., Sadeh, M., Wolmer, L., Eldar, S., Koren, S., Weizman, R., et al. (2000). Neurocognitive correlates of anxiety disorders in children: A preliminary report. *Journal of Anxiety Disorders*, 3, 239–247.
- Trappler, B., & Friedman, S. (1996). Posttraumatic stress disorder in survivors of the Brooklyn Bridge shooting. *American Journal of Psychiatry*, 153, 705–707.
- Udwin, O., Boyle, S., Yule, W., & O'Ryan, D. (2000). Risk factors for long-term psychological effects of a disaster experienced in adolescence: Predictors of post traumatic stress disorder. *Journal of Child Psychology and Psychiatry*, 41, 969–979.
- Vasterling, J. J., & Brailey, K. (2005). Neuropsychological findings in adults with PTSD. In J. J. Vasterling & C. R. Brewin (Eds.),

- Neuropsychology of PTSD: Biological, cognitive, and clinical perspectives* (pp. 178–207). New York: Guilford.
- Vernberg, E. M., La Greca, A. M., Silverman, W. K., & Prinstein, M. J. (1996). Prediction of post traumatic stress symptoms in children after hurricane Andrew. *Journal of Abnormal Psychology, 105*, 237–248.
- Wadsworth, M. E., Gudmundsen, G. R., Raviv, T., Ahlqvist, J. A., McIntosh, D. N., & Kline, G. H. (2004). Coping with terrorism: age and gender differences in effortful and involuntary responses to September 11th. *Applied Developmental Science, 8*, 143–157.
- Wolmer, L., Laor, N., & Yazgan, Y. (2003). School reactivation programs after disaster: Could teachers serve as clinical mediators? *Child and Adolescent Psychiatric Clinics of North America, 12*, 363–381.