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The Intellectual Performance of Traumatized Children and Adolescents With or Without Posttraumatic Stress Disorder

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Abstract

This study compared the Wechsler Intelligence Scale for Children–III (WISC–III) scores of traumatized youth with posttraumatic stress disorder (PTSD) to the scores of trauma-exposed and nonexposed comparison groups without PTSD. All groups were free of additional major childhood psychiatric disorders. The PTSD group scored significantly lower than the comparison groups on verbal subtests, but not on performance subtests. The scores of the trauma-exposed PTSD negatives and nontrauma exposed controls were not significantly different. Accordingly, PTSD and not a history of trauma exposure in the absence of PTSD was associated with lower verbal IQ.

Keywords

PTSD; IQ; assessment; urban; stress

A number of investigations have examined the association between trauma exposure, posttraumatic stress disorder (PTSD; American Psychiatric Association, 1994), and measured intelligence. Several studies have reported that PTSD is associated with lower performance on intelligence tests. For example, Vasterling, Brailey, Constans, Borges, and Sutker (1997) reported that Gulf War veterans with PTSD had significantly lower Wechsler Adult Intelligence Scale–Revised (WAIS–R; Wechsler, 1981) Verbal and Full Scale IQs relative to comparable veterans without PTSD. In a similar vein, McNally and Shin (1995) reported that the PTSD symptom severity scores of Vietnam combat veterans with PTSD

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were negatively correlated with general intellectual performance on the Shipley Institute of Living Scale (Zachary, 1991) after controlling for the extent of combat exposure. Likewise, Silva and colleagues (2000) reported that higher Wechsler Intelligence Scale for Children–Revised (WISC–R; Wechsler, 1974) IQ, as measured by the Information, Vocabulary, and Digit Span subtests (Silva, personal communication, 2005), was associated with lower PTSD prevalence among treatment-seeking urban youth. Jenkins, Lang-lais, Delis, and Cohen (2000) also observed that the WAIS–R Digit Span and Digit Symbol scores of rape victims with PTSD were significantly lower than the scores of victims that did not develop the disorder.

In contrast, investigations have also reported that PTSD is not associated with lower performance on intelligence tests. Sutker, Bugg, and Allain (1991) reported that the WAIS–R Full Scale IQs of World War II and Korean Conflict former prisoners of war did not significantly predict PTSD status. Likewise, Zalewski, Thompson, and Gottesman (1994) also reported nonsignificant differences between the WAIS–R Information and Block Design scores of Vietnam veterans with PTSD, a generalized anxiety disorder group, and a nonclinical comparison group.

In a significant departure from all of the cross-sectional studies that explored the relation between PTSD and IQ, Macklin and colleagues (1998) examined the relation between precombat intellectual functioning and intellectual functioning following the development of combat-related PTSD. Macklin and colleagues administered a short form of the WAIS–R or the Shipley Institute of Living Scale to Vietnam veterans with or without PTSD. The authors also obtained an index of participants' precombat intellectual functioning as reflected by their scores on the Armed Forces Qualification Test (AFQT; Maier, 1993). After controlling for the effects of precombat IQ, the authors determined that the relation between postcombat IQ and PTSD was nonsignificant and concluded that IQ may act as a risk or protective factor for PTSD. It was also evident that the presence of chronic PTSD did not lower estimated intellectual potential inasmuch as variations in IQ over time were not related to diagnostic status. In a similar vein, Kaplan and colleagues (2002) administered modified versions of the Otis-Lennon Mental Ability Scale (Otis & Lennon, 1986), the WISC–R Similarities and Arithmetic subtests, and the Raven Progressive Matrices (Raven, 1992) to Israeli high school adolescents before they were inducted into the military and reported that below average intellectual functioning prior to enlistment was predictive of subsequent PTSD.

Examined comprehensively, it is evident that these studies are marked by discordant outcomes. It may also be said that few studies employed research designs that compared the intellectual functioning of participants with PTSD to traumatized PTSD negatives and nontraumatized controls. Only one of the aforementioned investigations made these comparisons (i.e., Jenkins et al., 2000) and this report only measured performance on the WAIS–R Digit Span and Digit Symbol subtests. Clearly, comparative information involving traumatized individuals with and without PTSD relative to nontraumatized controls on a wider range of intellectual indices could provide significant insights about the relation between trauma exposure, PTSD, and intellectual functioning.

This study sought to determine if lower intelligence scores are associated with PTSD and if trauma exposure in the absence of PTSD is associated with lower scores. In addressing these questions, the Wechsler Intelligence Scale for Children–III (WISC–III; Wechsler, 1991) scores of traumatized youth with or without PTSD were compared to the scores of a nontraumatized comparison group. As lower intellectual performance has been associated with major depressive disorder (MDD), attention deficit hyperactivity disorder (ADHD), conduct disorder, substance dependence, and psychotic disorders (Brown, Tapert, Granholm, & Delis, 2000; Hodges & Plow, 1990; Kalska, Punamaki, Makinen-Pelli, &

Saarinen, 1999; Nelson & Israel, 2003), participants with these disorders were excluded from the study. In the absence of major comorbid disorders, it was hypothesized that youth with PTSD would evidence lower WISC–III scores relative to traumatized PTSD negatives and nonclinical controls for three reasons. First, the only study in the literature that employed all of the standard Wechsler subtests and excluded a number of comorbid disorders that could influence intellectual performance (Vasterling et al., 1997) determined that veterans with PTSD had significantly lower WAIS–R IQs relative to war-zone veterans without psychiatric morbidity. Second, an investigation by Saigh, Mroueh, and Bremner (1997) determined that the Metropolitan Achievement Test (MAT; Prescott, Balow, Hogan, & Farr, 1988) scores of adolescents with PTSD were significantly lower than the scores of traumatized PTSD negatives and a nonclinical control group. Although the MAT is an index of academic achievement, it has been moderately correlated with measures of intellectual functioning (Prescott et al., 1988). Third, single-case treatment studies reported that the WISC–R Digit Span and Coding subtest scores of children and adolescents with PTSD significantly increased following *in vitro* flooding (Saigh, 1987a, 1987b).

It was also hypothesized that the WISC–III scores of the traumatized PTSD negatives and nontraumatized controls would not significantly differ because Saigh and colleagues (1997) observed nonsignificant differences between the achievement scores of traumatized PTSD negatives and nonclinical controls. Additional support for this hypothesis is provided by child–adolescent investigations that observed nonsignificant differences between the anxiety, depression, and misconduct ratings of traumatized PTSD negatives and nontraumatized controls (McLeer, Callaghan, Henry, & Wallen, 1994; Saigh, 1989, 1991; Saigh, Yasik, Oberfield, Halamandaris, & McHugh, 2002).

Method

Participants and Procedure

Recruitment process—The staff at Bellevue Hospital clinics were informed about the purpose of the study and asked to refer youth who reportedly experienced, witnessed, or were confronted with an event or events (e.g., sexual assaults, physical assaults, or accidents) that involved actual or threatened death or serious injury, or a threat to their personal physical integrity or the physical integrity of others. A control group consisting of children and adolescents without a reported history involving trauma exposure was recruited from clinics that provide routine medical services to children and adolescents between the ages of 1 to 18 years. Child assent and the written consent of one of the parents or legal guardians were obtained prior to participation.

A multifaceted evaluation process was used to select youth who met criteria for PTSD, youth who were exposed to traumatic events as indicated by PTSD Criterion A1 who did not develop PTSD, and nontraumatized youth. Multiple examiners and assessment methods were used to formulate PTSD diagnoses inasmuch as this approach reduces information variance that is associated with psychiatric evaluations (Nelson & Israel, 2003; Spitzer, Endicott, & Robins, 1978). Accordingly, all of the participating children and adolescents received two independent clinical interviews and two independent administrations of the Children's PTSD Inventory (Saigh, 2003a, 2003b).

Exclusionary criteria—Inasmuch as youth with a history of abuse or neglect may experience ongoing distress through court proceedings and/or foster care placements (McLeer et al., 1994; Merry & Andrews, 1994), participants with a history of abuse or neglect were not examined. The New York State Family Court Act (Article 10, Section 1012, 1970) was used to define sexual or physical abuse. Accordingly, youth that had been abused by a parent or guardian were excluded and youth that had been sexually or physically

assaulted by a person other than a parent or guardian were included. Participants with WISC–III Full Scale IQs in the deficient range (70 or less) were excluded as earlier research with the Children's PTSD Inventory determined that similar cases experienced difficulty in understanding test questions and verbalized inconsistent answers (Saigh, 2003b). In addition, youth that were not able to speak or understand English were excluded from the study. Youth with MDD, ADHD, conduct disorder, substance dependence, or psychotic symptoms as determined through administrations of the DICA–R were also excluded. Youth who were receiving medication that could influence functioning on an IQ test were excluded, as were youth with a history of head trauma.

Participant sample—Bellevue Hospital practitioners referred 228 cases that presented following traumatic experiences to the investigators. Parental or guardian consent and child assent was obtained for 157 (69%) cases. Of this number, 52 (33%) were excluded due to head injury (n = 24), limited English proficiency (n = 10), positive history of child abuse or neglect (n = 2), and WISC–III Full Scale IQs in the deficient range (n = 16). Of the remaining 105 cases, 39 (36.14%) met criteria for PTSD and 66 (62.86%) did not. Nine of these traumatized youths (3 PTSD and 6 PTSD negatives) exceeded the upper age limit (16 years, 11 months, 30 days) of the WISC–III and were excluded. Six youths were excluded because they did not complete the research protocol. Among the PTSD group, eight cases were excluded because they met criteria for MDD and one was excluded because he met criteria for substance dependence. Among the traumatized PTSD negative group, two met criteria for MDD, one had ADHD, and two had conduct disorder. These cases were also excluded.

With reference to the control group, the parents or guardians of 276 youths without reported history of trauma exposure were invited to enroll their children in the study. Parent or guardian consent and child assent was provided by 74 (27%) of these cases. Thirty-two (43%) were excluded due to head injury (n = 2), limited English proficiency (n = 15), current psychopharmacological treatment that could affect functioning on an intelligence test or psychotherapy (n = 8), and WISC–III Full Scale IQs in the deficient range (n = 7). Five cases reported that they experienced traumatic incidents that were consistent with the *DSM–IV* PTSD Criterion A1 definition and these cases were assigned to the traumatized participant pool. None of the nontraumatized youths had a DICA–R diagnosis for MDD, ADHD, conduct disorder, substance dependence, psychotic symptoms, or had experienced a life-threatening illness.

The recruitment process led to the identification of 26 PTSD, 52 traumatized PTSD negatives, and 37 nontraumatized controls. Exploratory data analysis was conducted to investigate the distribution of the WISC–III Verbal, Performance, and Full Scale IQs within the experimental groups. Based on this analysis, four cases (1 PTSD, 2 traumatized PTSD negatives, and 1 nontraumatized control) evidenced extreme WISC–III scores and were excluded from the data analysis. As such, the final sample consisted of 25 PTSD, 50 traumatized PTSD negatives, and 36 controls. The age range for participants was 7.25 to 16.99 years (M = 13.12, SD = 2.57). Overall, there were 64 male and 47 female participants. The parents or guardians of the participants completed the Hollingshead (1975) Four-Factor Index of Social Status questionnaire. The demographic characteristics of the selected sample are presented in Table 1.

Table 2 lists the types of PTSD Criterion A1 traumatic events that were reported by the PTSD and traumatized PTSD negative groups. Among the PTSD group, 44.0% reported exposure to a single traumatic event, 40.0% reported exposure to two traumatic events, and 16.0% reported exposure to more than two traumatic events. With reference to the traumatized PTSD negatives, 72.0% reported exposure to a single traumatic event, 22.0%

reported exposure to two traumatic events, and 6.0% reported exposure to more than two traumatic events. The types of secondary traumas that were reported by the PTSD and traumatized PTSD negative groups is also reported in Table 2.

Diagnostic Measures

Children's PTSD Inventory—The Children's PTSD Inventory (Saigh, 2003a, 2003b) is a child–adolescent structured clinical interview that reflects the *DSM–IV* criteria for PTSD. In terms of internal consistency, Saigh (2003b) reported an alpha of .95 at the diagnostic level. With reference to interrater reliability, 98.0% agreement was evident at the diagnostic level. An interrater intraclass correlation coefficient (ICC) of .98 and an interrater reliability kappa of .96 were evident at the diagnostic level. In terms of test–retest reliability, 97.6% agreement was evident at the diagnostic level. A test–retest kappa of .91 and an ICC of .90 were observed at the diagnostic level. In terms of validity, the Children's PTSD Inventory diagnoses were compared to clinician-derived diagnoses as well as diagnoses obtained via administrations of the Structured Clinical Interview for the *DSM–IV* (SCID; First, Gibbon, Williams, & Spitzer, 1996) and the Diagnostic Interview for Children and Adolescents–Revised (DICA– R; Reich, Leacock, & Shanfeld, 1995) PTSD modules. Moderate to high levels of sensitivity (.84 –.92), specificity (.93–.98), positive (.63–.93) and negative (.95–.99) predictive power, and diagnostic efficiency (.93– .95) were reported.

Diagnostic Interview for Children and Adolescents–Revised (DICA–R)—The DICA–R (Reich et al., 1995) is a semistructured interview that consists of modules that reflect the *DSM–IV* criteria for different disorders. Each participant received administrations of the MDD, ADHD, conduct disorder, substance dependence (i.e., alcohol, tobacco, glue sniffing, marijuana, and street drugs), and psychotic symptoms modules by a trained examiner. Reich (2000) reported test–retest kappa coefficients that ranged from .32 to .59 for the ADHD module. Reich (2000) also reported kappa coefficients that ranged from .55 to .80 for the MDD module and a coefficient of .92 for the CD module. Test–retest kappas for the substance dependence module ranged from .66 to 1.00 and a coefficient of .76 was reported for the psychotic symptoms module (Reich, personal communication, April 6, 2000). Reich (personal communication, February 5, 2001) also reported sensitivity coefficients of 82, .85, .92, .1.00, and 1.00 for the MDD, ADHD, conduct disorder, substance dependence, and psychotic symptoms modules. Specificity coefficients of .72, .73, .71, .80, and .72 were reported for the respective DICA–R modules.

Clinical interviews—All participants received two clinical interviews by one of two board-certified child psychiatrists and/or a licensed psychologist. The two psychiatrists had 21 and 9 years of postresidency experience and the psychologist had 23 years of postdoctoral experience. The clinicians independently interviewed the participants and determined if they had been exposed to traumatic incidents that were commensurate with the *DSM–IV* PTSD Criterion A 1 definition and if their symptoms met criteria for PTSD. The examiners used the *DSM–IV* PTSD criteria to guide their efforts.

Diagnostic agreement—In terms of diagnostic agreement for the unstructured clinical interviews, the clinicians agreed on the diagnostic status of 108 of 111 cases ($\kappa = .93$). Agreement between clinician-derived diagnoses and the diagnoses generated through administrations of the Children's PTSD Inventory was evident among 105 of the 111 cases ($\kappa = .86$) that were examined. For the six cases wherein diagnostic disagreement occurred, case conferences were conducted to discuss the diagnostic symptoms of the cases and final diagnostic decisions were reached through a consensual process.

Stressor Severity Measure

Severity of Psychosocial Stress Scale: Children and Adolescents (SPSS-CA)—The SPSS-CA (American Psychiatric Association, 1987) scale is a 6-point Likert-type index that is intended to assist clinicians in formulating stressor severity ratings. The scale presents specific examples to facilitate the rating process. Taken in this context, the "death of both parents" is listed as a catastrophic stressor and accorded a rating of 6 and "breaking up with a boyfriend or girlfriend" is listed as a mild stressor and accorded a rating of 2. The absence of a significant stressor is rated as 1 for *none*. Accordingly, a board-certified child psychiatrist with 21 years of postresidency experience and a psychologist with 23 years of postdoctoral experience read all of the recorded responses to the Children's PTSD Inventory stress exposure items and independently rated the statements according to the SPSS-CA criteria. A Pearson Product Moment correlation of .98 ($p < .001$) was observed between the independently derived stressor severity ratings. As stressor severity has been associated with increased psychiatric morbidity in children and adolescents (Pynoos et al., 1993), SPSS-CA ratings were used to test for potential differences between traumatized youth with or without PTSD.

Dependent Measure

Wechsler Intelligence Scale for Children–Third Edition (WISC–III)—The WISC–III (Wechsler, 1991) is a standardized measure of intellectual functioning appropriate for individual administration to children ages 6 to 16 years. The WISC–III was standardized on a nationally representative sample of 2,200 children. The WISC–III consists of 10 standard subtests that are used in the calculation of Verbal, Performance, and Full Scale IQs as well as Index scores for Verbal Comprehension, Perceptual Organization, Freedom from Distractibility, and Processing Speed. The reported IQ, Index, and subtest scaled scores are based on normative comparisons to the ages of the examinees. Licensed psychologists or doctoral school psychology students who successfully completed courses and practicum involving the intellectual assessment of children and adolescents administered the WISC–III.

Results

Demographics

As noted in Table 1, significant differences between the comparison groups were evident for gender, ethnicity, age, and socioeconomic status. Furthermore, the mean number of index traumas reported by the PTSD group ($M = 1.84$, $SD = 1.03$) significantly exceeded the mean number of index traumas that were reported by the traumatized PTSD negatives ($M = 1.34$, $SD = 0.59$), $F(1, 74) = 7.14$, $p < .01$. The mean number of index traumas was not significantly related to the WISC–III Verbal ($r = -.22$, $p > .05$), Performance ($r = .08$, $p > .05$), or Full Scale ($r = -.10$, $p > .05$) IQs. The amount of time that had passed since trauma exposure for the PTSD group ($M = 3.5$ months, $SD = 4.2$ months) was significantly less than the time interval for the traumatized PTSD negatives ($M = 7.4$ months, $SD = 10$ months), $F(1, 73) = 5.71$, $p = .02$. Time since trauma exposure was not significantly related to the WISC–III Verbal ($r = -.08$, $p > .05$), Performance ($r = -.15$, $p > .05$), or Full Scale ($r = -.13$, $p > .05$) IQs. The mean age at the time of trauma exposure for the PTSD group was 13.7 years ($SD = 2.7$ years) and 12.71 years ($SD = 2.7$) for the traumatized PTSD negatives. The mean age at trauma exposure for the trauma exposed groups was not significantly different, $F(1, 73) = 2.36$, $p > .05$. Age at the time of trauma exposure was also not significantly related to the WISC–III Verbal ($r = -.08$, $p > .05$), Performance ($r = .01$, $p > .05$), or Full Scale ($r = -.05$, $p > .05$) IQs. Based on these results, gender, ethnicity, and socioeconomic status were included as covariates in the data analysis. As the WISC–III standard scores are based on age norms (Wechsler, 1991), age was not included as a covariate.

Stressor Severity

The mean SPSS-CA ratings for the PTSD, traumatized PTSD negatives, and nontraumatized controls were 5.89 (*SD* = 0.25), 5.72 (*SD* = 0.41), and 1.25 (*SD* = 0.54). The mean ratings of the PTSD and traumatized PTSD negatives were not significantly different, $F(1, 73) = 3.67$, $p > .05$. Among the traumatized cases, male participants had a mean stressor severity rating of 5.74 (*SD* = 0.38) and female participants had a mean rating of 5.84 (*SD* = 0.34). A nonsignificant difference was observed relative to the stressor severity ratings of the trauma exposed male and female participants, $F(1, 73) = 1.05$, $p > .05$.

Multivariate & Univariate Analyses of WISC–III Scores

Three ANCOVAs were conducted to test for group differences on the WISC–III Verbal, Performance, and Full Scale IQs using gender, socioeconomic status, and ethnicity as covariates. Bonferonni comparisons were conducted to identify significant group comparisons. Analogously, three separate ANCOVAs followed by Bonferronni comparisons were conducted to identify significant group differences on the Verbal Comprehension, Perceptual Organization, and Freedom from Distractibility Index scores. Two separate MANCOVAs controlling for gender, socioeconomic status, and ethnicity followed by univariate *F* tests and Bonferonni comparisons were performed to test for group differences on the WISC–III Verbal and Performance subtests.

Table 3 presents the WISC–III IQ, Index, and subscale scores (means and standard deviations) for the comparison groups as well as the outcomes of the group comparisons. Significant group differences were evident on the WISC–III Verbal and Full Scale IQs. As may be seen, Bonferronni comparisons revealed that the mean WISC–III Verbal and Full Scale IQs of the PTSD group were significantly lower than the means of the traumatized PTSD negatives and controls. In contrast, the means of the traumatized PTSD negatives and controls were not significantly different. Similarly, an ANCOVA indicated nonsignificant differences on the Performance IQ. With regard to the Index scores, a series of ANCOVAs identified significant group differences for Verbal Comprehension and nonsignificant differences for Perceptual Organization and Freedom from Distractibility. The mean Verbal Comprehension score of the PTSD group was significantly lower than the mean scores of the PTSD negatives and controls. All other group comparisons were nonsignificant.

A MANCOVA identified significant group differences on the WISC–III verbal subtests, Wilks's Λ, $F(12, 200) = 1.92$, $p < .05$. Univariate *F* tests denoted significant group differences on the Similarities, Arithmetic, Vocabulary, and Comprehension subtests. Nonsignificant differences were noted on the Information and Digit Span subtests. As may be noted from Table 3, the mean Arithmetic, Vocabulary, and Comprehension subtest scores of the PTSD group were significantly lower than the scores of the controls. The mean Vocabulary, Comprehension, and Similarities scores of the PTSD group were significantly lower than the mean scores of the traumatized PTSD negatives. No statistically significant differences were evident when the means of the traumatized PTSD negatives and controls were compared on all of the dependent variables. A MANCOVA determined that there were nonsignificant group differences across the Performance subtests, Wilks's Λ, $F(10, 202) = 1.74$, $p > .05$.

Discussion

After controlling for a number of potentially confounding psychiatric disorders and conditions, this study determined that youth with PTSD had significantly lower scores on discrete measures of verbal intelligence relative to traumatized PTSD negatives and nontraumatized controls. Trauma exposure in the absence of PTSD was not associated with

lower estimates of intelligence as the performance of the traumatized PTSD negatives and controls did not significantly vary across measures.

As hypothesized, participants with PTSD performed less proficiently relative to the traumatized PTSD negatives and controls. Although children and adolescents with PTSD had significantly lower Full Scale IQs, this difference may be largely attributed to the contribution of the Verbal Comprehension Index as indicated by significantly lower performance on the Vocabulary, Similarities, and Comprehension subtests. Conversely, significant differences were not found on any of the Performance subtests, Perceptual Organization Index, or the Performance IQ. Interestingly, the only other study that employed the standard battery of WAIS–R subtests and excluded many forms of comorbid disorders that could influence intellectual performance (Vasterling et al., 1997) reported very similar results. The Vasterling report determined that war-zone exposed veterans with PTSD evidenced lower estimates of verbal intelligence relative to war-zone exposed veterans without PTSD. Vasterling and her coauthors also failed to find significant differences on the WAIS–R Performance subtests. The current observations suggest that in the absence of major comorbid disorders, PTSD is associated with deficits on specific indices of verbal intelligence. The combined evidence also suggests that these deficits may be evident across developmental levels. Given that many of the tests that differentiated the comparison groups are based on the accumulation of school-based knowledge (Andreou & Karapetsas, 2004; Kamphaus, 2001; Kelly, Madden, Gardner, & Rudman, 2002; Wechsler, 1991), PTSD-related interruption of education should be considered as a potential explanation for the results.

As predicted, trauma exposure in the absence of PTSD was not associated with lower estimates of intelligence as the WISC–III scores of the traumatized PTSD negatives and the nontraumatized controls did not significantly vary. This finding is congruent with the results of earlier case-control investigations that reported that the academic achievement (Saigh et al., 1997), anxiety, depression, misconduct (Saigh, 1989, 1991), and introversion–extraversion (Saigh et al., 2002) scores of traumatized PTSD negatives and nonclinical controls were not significantly different. As such, trauma exposure in the absence of PTSD and major comorbid disorders does not appear to represent a significant risk factor for intellectual deficits in children and adolescents.

Several explanations may apply to these findings. Biological investigators have reported that verbal functions are associated with the left hippocampus (Sass, Westerveld, & Lencz, 1992; Scoville & Milner, 1957), and MRI studies have reported smaller left hippocampal volume among adults with PTSD (Bremner et al., 2003; Gilbertson et al., 2002; Gurvits et al., 1996; Villareale et al., 2002). In view of this and because comparable deficits were not observed among adult childhood abuse victims without PTSD (Bremner, Vermetten, Afzal, & Vythilingam, 2004), it may be argued that PTSD-induced hippocampal changes may be linked to the observed deficits. An alternative explanation involves the possibility that reduced hippocampal volume may have existed prior to trauma exposure. Gilbertson and colleagues (2002) reported that the hippocampal volume of noncombat-exposed monozygotic twins without PTSD was comparable to the volume of their identical twins with severe combat-related PTSD. These authors also reported that the hippocampal volume of the noncombat-exposed twins whose brothers had PTSD were significantly smaller than the volumes of combat veterans without PTSD and their noncombat-exposed siblings. Gilbertson and colleagues (2002) concluded that “smaller hipocampi in PTSD represent a preexisting, familial vulnerability rather than the neurotoxic product of trauma exposure per se” (p. 1245). Research demonstrating a relationship between low premorbid IQ and the development of PTSD (e.g., Macklin et al., 1998) is consistent with this hypothesis. Although it is not possible to empirically substantiate these hypotheses in the absence of

premorbid data, these explanations are commensurate with etiological formulations that emphasize the role of verbal skills relative to the expression, prevention, and treatment of PTSD (cf. Brewin, 2001; Brewin & Smart, 2005; Bryant & Harvey, 1995; Litz, Kaloupek, Orsillo, & Weathers, 2000).

Since the Wechsler scores of the participants with PTSD were significantly lower on subtests that correlate with measures of academic achievement and social understanding (Andreou & Karapetsas, 2004; Kamphaus, 2001; Kelly et al., 2002; Wechsler, 1991), and PTSD is a treatable disorder (Foa et al., 1999, Foa & Rauch, 2004; March, Amaya-Jackson, Murray, & Schulte, 1998; Saigh, 1987a; Saigh, Yasik, Oberfield, & Inamdar, 1999), the significance of early case identification is apparent. This recommendation is particularly relevant as future school-based achievement is influenced by existing skills (Anderson, 1995; Geary, 1994; Rayner, Foorman, Perfett, Pesetsky, & Seidenberg, 2001) and because 40% of the PTSD group reported that they experienced academic problems after trauma exposure relative to 10% of the traumatized PTSD negatives.

Patterns of intellectual performance also should be recognized as a factor to consider in the development of individual treatment plans. Youth with verbal deficits and average or above average strengths on performance tasks that measure attention to visual details may be more responsive to interventions that rely on visual imagery of traumatic material such as *in vitro* flooding. The outcomes of the current investigation coupled with the successful outcomes of child (Saigh, 1987a; Saigh et al., 1999) and adult (Foa et al., 1999, Foa & Rauch, 2004) exposure-based PTSD treatment studies provide an empirical basis for this recommendation.

These observations must be tempered with the understanding that additional comorbid disorders (e.g., phobias, learning disabilities, and dysthymia) were not identified and the results should be viewed accordingly. These observations also should be viewed with the realization that the use of ANCOVA in nonrandomized designs has been the topic of some debate (Maxwell & Delaney, 1990; Miller & Chapman, 2001; Wildt &, 1978), and that different outcomes may have been apparent if gender, socioeconomic status, and ethnicity were not employed as covariates. The relation between trauma severity and PTSD may also warrant consideration in future research as the difference between the trauma severity ratings of the PTSD and traumatized PTSD negative groups approached significance.

Inasmuch as 68.86% of the traumatized cases and 26.81% of the potential controls participated, a form of selection bias may have occurred. Since the consent form indicated that trauma exposure is a risk factor for psychological morbidity and as this document indicated that participants and their families would receive free psychological evaluations, feedback, and referrals for treatment on an as-needed basis, the traumatized participants and their parents may have valued these benefits more than the nontraumatized cases that declined to participate. It also may be argued that the nontraumatized participants were more altruistic than the nontraumatized cases that declined to participate. The possibility that the nontraumatized participants may have been more intelligent than their nontraumatized peers should also be considered because altruism has been positively correlated with performance on intelligence tests (Bar-Tal, Korenfeld, & Raviv, 1985; Lourenco, 1993; Zahn-Waxler, Iannotti, & Chapman, 1982).

A follow-up study that compares the Wechsler performance of traumatized participants with and without PTSD and with and without comorbidity may be associated with more external validity as youth with PTSD frequently present with comorbid disorders (Saigh, Yasik, Sack, & Koplewicz, 1999). These findings must also be considered with the understanding that premorbid estimates of intelligence and academic achievement were not available. Future research should attempt to include these variables as covariates because estimates of

premorbid functioning would contribute to our understanding of the relationship between traumatic events and the intellectual resources of youth.

It also should be recognized that these findings might not generalize to different measures of intelligence and/or neuropsychological functioning. Clearly, additional research should explore the relation between trauma exposure, diagnostic status, and cognitive performance across a range of neuropsychological indices. Future research should also examine the role of moderator variables such as maternal education and mother– child interactions as developmental psychologists have reported that these variables are partially predictive of child intelligence (Sameroff, Seifer, Baldwin, & Baldwin, 1993). Finally, investigators may wish conduct a similar study with a younger sample because preschool children may encode and react to stressful information in a way that is different from that of older children (Howe, 2000).

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Table 1

Demographic Variables

Variable	PTSD	Traumatized PTSD negative	Nontraumatized control	Group comparisons
		Age (years)		
M	14.35	13.00	12.44	$F(2, 108) = 4.44$, $p < .05$
SD	2.49	2.58	2.35	$1 < 2^{*}, 3^{*}$
		Socioeconomic rating[a]		
M	34.87	24.81	33.83	$F(2, 108) = 6.76$, $p < .01$
SD	10.89	12.89	11.62	$3 < 1^{**}$
		Gender (%)		
Male	56.0	70.0	41.7	$\chi^2 (N = 111) = 6.92$, $p < .05$
Female	44.0	30.0	58.3	
		Race/ethnicity (%)		
African American	8.0	32.0	16.7	$\chi^2 (N = 111) = 15.91$, $p < .05$
Asian	4.0	10.0	0.0	
Caucasian	8.0	14.0	5.6	
Hispanic	80.0	44.0	77.8	

Note. 1 = PTSD; 2 = PTSD negative; 3 = control.

[a] Hollingshead (1975).

$^{*}p < .05$.

$^{**}p < .01$.

Table 2

Types of Traumas Reported by PTSD and Traumatized PTSD Negative Groups

Variable	PTSD		Traumatized PTSD negative	
	Primary traumas (Criterion A1)			
	N[a]	%	*N*[b]	%
Sexual assault	5	20.0	0	0.0
Physical assault	9	36.0	13	26.0
Shot	4	16.0	2	4.0
Dog attack	1	4.0	6	12.0
Motor vehicle accident	4	16.0	12	24.0
Hand injury	0	0.0	12	24.0
Smoke inhalation	2	8.0	2	4.0
Other	0	0.0	3	6.0
	Secondary traumas[c] (Criterion A1)			
	N[d]	%	*N*[e]	%
Sexual assault	4	19.1	0	0.0
Physical assault	6	28.6	2	11.8
Dog attack	0	0.0	1	5.9
Motor vehicle accident	1	4.8	2	11.8
Hand injury	0	0.0	1	5.9
Other	1	4.8	0	0.0
Witnessed trauma	9	42.8	11	64.7

[a] $n = 25$.

[b] $n = 50$.

[c] Number of secondary traumas reported by 14 PTSD positives and 14 PTSD negatives. All other PTSD positives and PTSD negatives reported only one trauma.

[d] $n = 21$.

[e] $n = 17$.

Table 3

Descriptive Data and Statistics for Group Comparisons on WISC–III IQs, Index Scores, and Verbal Subtest Scaled Scores

	PTSD[a]		Traumatized PTSD negative[b]		Control[c]		Univariate results		
Scale	***M***	***SD***	***M***	***SD***	***M***	***SD***	***F*[d]**	***p***	**Group comparisons**
IQ scores									
Full scale IQ (FSIQ)	87.96	7.20	96.31	12.78	96.86	10.71	4.18	.018	1 < 2*, 3*
Verbal IQ (VIQ)	88.20	7.56	99.60	12.81	99.67	11.71	6.40	.002	1 < 2**, 3**
Performance IQ (PIQ)	90.08	11.38	94.66	12.71	94.75	11.31	1.00	.370	NA
Index scores									
Verbal comprehension	89.04	8.49	98.78	11.41	97.81	11.31	4.79	.010	1 < 2*, 3*
Perceptual organization	91.00	11.25	96.50	13.50	94.11	10.65	1.38	.256	NA
Freedom from distractibility	91.76	10.76	99.80	14.79	100.53	15.22	2.05	.134	NA
Verbal subtests									
Information	8.96	2.35	9.62	3.02	9.31	2.79	0.04	.959	NA
Similarities	8.04	1.95	10.06	3.03	9.75	2.55	3.42	.036	1 < 2*
Arithmetic	7.68	1.89	9.46	3.23	9.86	2.71	3.09	.050	1 < 3*
Vocabulary	7.44	2.10	9.58	2.35	9.56	2.43	6.37	.002	1 < 2**, 3**
Comprehension	7.28	2.73	9.62	2.73	9.75	3.17	4.85	.010	1 < 2*, 3*
Digit span	9.04	2.59	10.24	3.05	10.00	3.60	0.68	.506	NA
Performance subtests									
Picture completion	8.92	2.27	10.04	2.50	9.33	2.61	NA	NA	NA
Coding	8.44	2.87	8.60	2.78	10.61	3.05	NA	NA	NA
Picture arrangement	8.88	2.42	8.78	3.39	8.33	2.80	NA	NA	NA
Block design	7.56	2.83	9.46	3.23	9.17	2.82	NA	NA	NA
Object assembly	8.08	3.20	8.64	2.77	8.31	2.61	NA	NA	NA

Note. Means and standard deviations represent WISC–III IQ, Index, and subtest age-scaled standard scores. NA = not applicable.

[a] $n = 25$.

[b] $n = 50$.

[c] $n = 36$.

[d] $df = (2, 105)$.

* $p < .05$.

** $p < .01$.