IQ and Posttraumatic Stress Symptoms in Children Exposed to Interpersonal Violence

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ABSTRACT: Background: The literature is mixed as to the relationship between intelligence quotient (IQ) and Posttraumatic Stress Disorder (PTSD) symptomatology in adult populations. Even less is known about the relationship in children who have been traumatized. *Methods:* Fifty-nine children and adolescents (mean age = 10.6) with a history of interpersonal violence were evaluated with respect to PTSD symptomatology, number of traumas, and estimated Verbal, Performance and Full scale IQ scores. PTSD symptomatology included symptom levels for cluster B (re-experiencing), cluster C (avoidance and numbing), and cluster D (Hypervigilance) and criterion F, functional impairment. *Results:* Results indicated that Full scale and Verbal IQ were significantly associated with the number of traumas, re-experiencing symptoms, and impairment. Performance IQ was only associated with impairment. Regression analyses suggested that together PTSD symptomatology predicted Full scale and Verbal IQ but nor Performance IQ and impairment was the single best predictor of IQ generally. *Conclusions:* Findings provide support for an association between PTSD symptoms and IQ, particularly verbal IQ. Two possible reasons for this relationship are that higher levels of Verbal IQ may serve as a premorbid protective factor against the development of re-experiencing symptoms, or performance on post-trauma Verbal IQ measures may be negatively impacted by expression of PTSD symptoms. Longitudinal studies are needed to clarify which of these two possibilities explains the association.

KEY WORDS: posttraumatic stress disorder; intelligence quotient; children; trauma.

Cognitive processes associated with traumatic events commonly include intrusive thoughts and the inability to remember aspects

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of the traumatic experience.[1] However, there is growing evidence that cognitive difficulties may not only occur in the context of memory for the traumatic event, but also in other domains of executive function. Traumatized adults exhibit deficits in sustained attention,[2,3,4] mental manipulation,[5] and strategic and declarative memory abilities.[6,2,4]

There are conflicting reports on the extent to which the Intelligence Quotient (IQ), a hypothesized fixed cognitive attribute, is influenced by traumatic experiences. Some researchers have linked posttraumatic stress disorder (PTSD) symptom severity to IQ scores,[2,7,8] with increased PTSD symptomatology in Vietnam combat veterans associated with lower scores on standardized IQ tests. While most studies are cross-sectional, examination of veteran service records for pre-trauma IQ scores has allowed some researchers to posit directionality for the association. The authors of one such study[7] stated that "lower IQ represents a pre-combat vulnerability factor for PTSD" (p. 185), echoing similar conclusions of Macklin and colleagues.[9] Overall, correlational findings suggest that full scale IQ may have a significant relationship with post-trauma symptoms.

Examining verbal and performance IQ scores, the two components that make up the full scale IQ score, has provided further information about whether specific domains of intellectual functioning are differentially related to trauma symptoms. After demonstrating that African American and Hispanic Persian Gulf combat veterans with PTSD performed more poorly on WAIS-R verbal subtests than did their PTSD negative peers, Vasterling and colleagues concluded that higher verbal IQ might serve as a pre-morbid protective factor against symptom development post-trauma.[10] Acknowledging their cross-sectional design limitation, these authors later investigated a larger sample of Vietnam-era veterans' service records. Supporting their original idea, they found that those veterans with a diagnosis of PTSD had lower estimated pre-combat verbal IQ scores.[4]

Not all studies have reported support for a relationship, either as risk factor or as a substrate between IQ and either trauma or PTSD. Studies comparing Vietnam veterans to non-veterans, former prisoners of war to combat veterans, and Vietnam combat veterans with PTSD to those without PTSD found no differences between the groups on verbal, performance, and full scale IQ scores.[11,12,13] In addition, others report a lack of association between trauma symptoms and performance on IQ measures with non-Veteran populations. For example, female adult survivors of

childhood abuse demonstrated no differences from non-abused adult women on WAIS subtests of Arithmetic, Vocabulary, Picture Arrangement, Block Design[14] and Vocabulary, Similarities, Picture Completion, and Digit Symbol.[15] These studies are more in line with the view that IQ is a fixed construct, and thus not associated with trauma symptoms.

Although more limited, research on traumatized children and IQ reflects the same mixed findings found in adult studies. For example, Samet and colleagues examined WISC-III scores in traumatized adolescents, and found no differences between those who met diagnostic criteria for PTSD and those who did not meet criteria.[16] In contrast, in a study comparing sexually abused children to controls, full scale and verbal IQ scores were similar, but traumatized children exhibited lower performance IQ than their peers.[17] Others have noted poorer performance on individual subtests of IQ measures, but not full scale, verbal or performance IQ scores. Beers and De Bellis reported that maltreated children performed worse than control subjects on the WISC-III Similarities subtest, but performed similarly on the Vocabulary, Digit Span, Block Design, Object Assembly, and Coding subtests.[18]

Overall, mixed findings in both children and adults may reflect an even more complicated relationship between IQ and trauma than previously hypothesized. Examining the three clusters of the PTSD diagnostic criteria separately, as well as the individual verbal and performance IQ subtests that make up full scale IQ, may allow detection of more precise relationships; in fact, each of the PTSD clusters may have different degrees of relationships to the indices of IQ. For example, Diamond and colleagues found that cluster B (re-experiencing), a component of the DSM-IV diagnostic criteria for PTSD, was negatively associated with both verbal IQ and full scale IQ in adult survivors of childhood sexual abuse.[19] The current study was designed to examine the components of IQ, PTSD total symptomatology, and individual cluster symptomatology, and PTSD-related impairment in functioning in traumatized children and adolescents. Based on the theory that trauma can affect acquisition of key developmental milestones, we believe that it may also affect ability to either optimally develop or use the skills tapped by an IQ test. Thus, it was hypothesized that PTSD symptoms and IQ would be negatively correlated in traumatized adolescents. Analyses sought to explore which aspects of PTSD symptomatology and IQ were related in an effort to clarify past inconsistent findings.

Method

Participants

The sample was recruited from local social service departments and mental health clinics. They were referred to this study because they fulfilled the criteria below. In an attempt to decrease the effect of the heterogeneity of traumatization, only children who experienced a criterion A stressor involving interpersonal trauma (i.e., physical abuse, sexual abuse, and/or witnessing violence) were examined. We recruited children who (1) had at least one episode of exposure to trauma, as defined by DSM-IV criterion A1; (2) exposure to trauma occurred more than six months prior to the evaluation; (3) had no known history of alcohol or drug abuse/dependence and (4) had a currently safe, stable home environment with an adult caretaker willing to participate in the study.

Fifty-nine children and adolescents ($n = 59$) participated in the current study. Consent was obtained from the participating counties' courts for those subjects in foster placement (46%). Most cases had prior child protective services involvement (71%). A procedure was in place to report any suspected ongoing maltreatment, yet no cases were suspected. The investigators presented all subjects and their caretakers, regardless of prior court consent, with a written IRB approved informed consent. In addition to caretaker consent, all participants gave active assent to participate in the study. The final sample consisted of 34 boys and 25 girls for a total sample of 59 children and adolescents. The mean age of participants was 10.7 years (SD = 1.9) with a range of 7.1–14.1 years. Most children (55%) experienced multiple traumatic events, including separation and loss (55%), witnessing violence (40%), physical abuse (37%), sexual abuse (20%), physical neglect (12%), and emotional abuse (7%).

Measures and Procedures

Clinician-Administered PTSD Scale for Children and Adolescents. To assess re-experiencing, avoidance/numbing, and hyperarousal symptoms, the Clinician-Administered PTSD Scale for Children and Adolescents (CAPS-CA) was used.[20] The CAPS-CA is the child version of a well-validated assessment tool for assessment of PTSD in adults.[21] It is a structured clinical interview consisting of standardized prompt questions, supplementary follow-up (probe) questions, and behaviorally anchored 5 point rating scales (0 to 4) corresponding to the frequency and intensity of each symptom assessed. The CAPS-CA assesses all DSM-IV criteria for PTSD. Specifically, it assesses exposure to criterion A1 events and the individuals' experience of these events (i.e., criterion A2), the 17 symptoms for PTSD clustered in DSM-IV (i.e., criteria B, C, and D), the 1-month duration requirement (criterion E), and impairment in social, scholastic, and developmental domains (criterion F). The CAPS-CA has adequate internal consistency estimates for the ratings and has shown concurrent validity with the Child PTSD Checklist.[20] A board-certified child psychiatrist (VC) was trained on the administration of instrument and conducted all CAPS-CA interviews. An intra-class correlation coefficient of 0.97 was

established with one of the originators of the CAPS-CA (Dr. Elana Newman), who rated videotaped recordings of 10 of the interviews. Internal consistency (coefficient alpha) for the symptom scales was 0.82 for the total symptom score, 0.75 for cluster B re-experiencing, 0.71 for cluster C avoidance and 0.52 for Cluster D hyperarousal.

The Wechsler Abbreviated Scales of Intelligence (WASI). The WASI was used to estimate intelligence.[22] The WASI is a nationally standardized ($n = 2245$) test of intelligence that yields Verbal, Performance, and Full Scale IQ scores that correlate with subscales of the Wechsler Intelligence Scale for Children-Third Edition (WISC-III) and the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III). Its standardization sample was stratified on sex, race/ethnicity, and educational and geographic level parameters. Consistent with the WISC-III, the WASI provides the test-age equivalents of subtest raw scores for school-aged children and young adults. The WASI was developed for persons 6 to 89-years-old and is a reliable measure of intelligence in clinical, psychoeducational, and research settings. The WASI consists of four subtests-Vocabulary, Block Design, Similarities, and Matrix Reasoning. These four subtests compose the Full Scale, Vocabulary and Similarities compose the Verbal Scale, and the Block Design and Matrix Reasoning compose the Performance Scale.

Results

Preliminary analysis indicated that gender was significantly associated with Full scale IQ ($r = -0.27$, $p = 0.035$) and Performance IQ ($r = -0.26$, $p = 0.048$) (i.e., boys tending to score higher than girls). Age and gender were not significantly correlated with any of the other variables. Ranges, means and standard deviations for the IQ and PTSD measures as well as the correlations among the measures are presented in Table 1. Results indicated that the total number or traumas, cluster B re-experiencing symptoms, and impairment scores were significantly negatively correlated with verbal and full scale IQ. Impairment was also significantly negatively correlated with performance IQ. Significant difference (r to z test) tests for dependent correlations were conducted to compare the correlation between Performance IQ and PTSD symptoms and between Verbal IQ and PTSD symptoms. Only the difference in the correlation for total number of traumas could be considered significantly different. The difference was 0.20 (95% confidence interval for the difference 0.00 to 0.40, $p = 0.05$).

In order to explore the pattern of associations more fully three hierarchical regression analyses were conducted. In the first regression analysis Verbal IQ scores were used as the criterion variable and age and gender were added into the model in the first step and

Table 1
Ranges, Means, Standard Deviations and Correlations Between the Measures

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. Total Traumas									
2. Re-experiencing	0.19								
3. Avoidance/numbing	0.01	0.62**							
4. Hyperarousal	0.05	0.37**	0.46**						
5. Total Symptoms	0.09	0.81**	0.89**	0.72**					
6. Impairment	0.29*	0.55**	0.55**	0.43**	0.64**				
7. WASI VIQ	−0.36**	−0.31*	0.01	−0.12	−0.15	−0.40**			
8. WASI PIQ	−0.16	−0.22	0.02	−0.13	−0.12	−0.29*	0.68**		
9. WASI FSIQ	−0.29*	−0.28*	0.03	−0.13	−0.15	−0.37**	0.92**	0.92**	
Range	1–4	0–29	0–47	0–29	6–89	0–13	64–137	62–138	62–142
Mean	1.88	10.19	15.86	11.34	37.39	5.55	92.31	94.62	92.88
SD	0.91	7.66	10.19	7.28	20.39	3.57	16.55	18.43	17.61

Note: *$p < 0.05$, **$p < 0.01$, two-tailed tests, WASI = Wechsler Abbreviated Scales of Intelligence.

Table 2
Summary of Regression Analyses

Step		R^2	*Change in* R^2	*t*	*p*	β	*VIF*
Model 1-Predicting WASI Verbal							
1	Age	0.08	0.08	−0.6	0.570	−0.07	1.2
	Gender			−1.5	0.130	−0.18	1.1
2	Total Traumas**	0.38	0.30*	−1.6	0.109	−0.40	1.2
	Re-experiencing**			−1.6	0.123	−0.25	1.9
	Avoidance/numbing			1.9	0.060	0.33	2.1
	Hyperarousal			−0.3	0.781	−0.04	1.4
	Impairment			−2.4	0.024	−0.38	2.0
Model 2-Predicting Total WASI IQ							
1	Age	0.08	0.08	−0.4	0.711	−0.05	1.2
	Gender			−1.7	0.101	−0.21	1.1
2	Total Traumas	0.34	0.26*	−1.0	0.314	−0.14	1.2
	Re-experiencing**			−1.5	0.154	−0.24	1.9
	Avoidance/numbing			2.1	0.044	0.36	2.1
	Hyperarousal			−0.5	0.634	−0.07	1.4
	Impairment			−2.3	0.024	−0.39	2.0

Note: F all full models $p < 0.01$, WASI = Wechsler Abbreviated Scales of Intelligence, VIF = Variance inflation factors, *Significant change in R^2, **Significant predictor when impairment is not in the model.

and then each of the PTSD symptom measures were entered in the second step. Results are summarized in Table 2 and indicated that the second step produced a significant change in R^2 suggesting that together the PTSD symptoms measures accounted for an additional 30% of the variance in verbal IQ scores beyond age and gender. Significance tests for the standardized betas indicated that only impairment was a significant predictor. However, to further explore findings given the sample size and the strong intercorrelation between impairment and cluster B, C, & D symptoms, the regression analysis was re-run excluding impairment from the model. This model indicated that the total number of traumas and cluster B re-experiencing symptoms were significant predictors.

In the second regression analysis performance IQ scores were used as the criterion variable and age and gender were added into the model in the first step and then each of the PTSD symptom measures were entered in the second step. Results indicated that the overall model was not significant (Model $R^2 = 0.21$, $p = 0.131$).[a]

[a]A regression model with just age, gender and criterion F impairment indicated that impairment was a significant predictor of Performance IQ.

In the final regression analysis full-scale IQ scores were used as the criterion variable and age and gender were added in to the model in the first step and then each of the PTSD symptom measures were entered in the second step. Results are summarized in Table 2 and indicated that the second step produced a significant change in R^2 suggesting that together the PTSD symptoms measures accounted for an additional 26% of the variance in full-scale IQ scores beyond age and gender. Significance tests for the standardized betas indicated that impairment and cluster C avoidance and numbing were significant predictors. Again, to further explore findings given the sample size and the strong intercorrelation between impairment and symptoms, the regression analysis was re-run excluding impairment from the model. This model indicated that only the cluster B re-experiencing symptoms were significant.

Discussion

Consistent with hypotheses, links were found between IQ and PTSD symptomatology. Verbal IQ was significantly associated with the number of traumas, cluster B (re-experiencing) symptomatology and impairment, with higher Verbal IQ associated with fewer symptoms and fewer traumas. Our findings are consistent with adult studies showing an inverse correlation between Verbal IQ and PTSD symptoms[4] and more specifically with re-experiencing symptoms.[19] They differ, however, with a study of hospitalized children that found no difference in Verbal IQ between children with trauma and PTSD and children with trauma and no PTSD.[16] In another child study that separated Verbal IQ components, a difference was found for Similarities, but not for Vocabulary subtests.[18] These differences may stem from different methodological approaches. Our study design differed in that it examined individual IQ subscales associations with each of the PTSD symptom clusters. Taken together, our findings provide converging evidence for an association between verbal intelligence and specific PTSD symptoms. Combining all cluster scores together to generate a total PTSD score may obscure actual correlational relationships (this may help account for the series of mixed findings in the literature).

Potential explanations for the association are dependent on whether Verbal IQ is viewed as a premorbid risk factor or as a result of the expression of re-experiencing symptoms. If lower Verbal IQ is indeed a risk factor, the re-experiencing cluster of symptoms may be

differentially affected by several mechanisms. For example, higher levels of Verbal IQ may result in an increased ability to consolidate traumatic memories via a personal narrative, such as a verbal method of combating re-experiencing symptoms. Alternatively, premorbid higher levels of Verbal IQ could lead to better success at making accurate appraisals of the trauma and post-trauma experience, or predispose trauma victims to be relatively more facile at increasing self-efficacy and identifying and implementing successful coping strategies. However, it is also possible that lower performance on a Verbal IQ measure is a marker of PTSD, and best attributed to the development of re-experiencing symptoms subsequent to a traumatic event. Re-experiencing symptoms are by definition intrusive and distracting, and may divert attentional resources, impairing Verbal IQ test performance and thus underestimating true cognitive aptitude. Interestingly, our results suggest that age and gender did not influence our findings. Hence, this may suggest that if a temporal relationship exists between verbal IQ and PTSD symptoms, it is not limited to the age range being studied here. In addition, our limited sample size may not be large enough to detect developmental differences between boys and girls. Larger studies are needed to investigate any developmental factors influencing the association between verbal IQ and specific PTSD symptoms.

Potential limitations to this study include the small sample size ($n = 59$) and its cross-sectional design which does not allow inferences in directionality. For example, potential associations between Performance IQ and PTSD symptom measures may have been lessened by the small sample size. Our results, however, are consistent with some other authors not finding an association between Performance IQ and PTSD symptoms. In addition, we supplemented our findings with a regression approach to investigate Performance IQ more directly, and we found no significant differences. Although, the bulk of the literature on PTSD and IQ scores is cross-sectional, or has utilized a retrospective design, longitudinal designs have been used to develop cognitive models of PTSD. Our results are consistent with one such study. For example, cognitive variables that may be influenced by verbal abilities (such as, appraisal of sequelae of trauma or cognitive processing style during trauma) have been shown to predict development of PTSD severity in a prospective study.[23]

Only by documenting pre-morbid (pre-trauma) IQ levels, then re-evaluating them prospectively at set intervals after trauma exposure, can definitive statements be made about directionality. One

way to address this issue would be to isolate and measure specific cognitive skills differentially impacted by the cluster B re-experiencing symptoms (i.e., intrusive recollections, distressing dreams, acting or feeling as if the event were recurring, psychological distress at exposure to cues, and physiological reactivity on exposure to cues). These cognitive skills may mediate the relationship between PTSD symptoms and IQ level, accounting for the lower IQ scores demonstrated by those with more symptomatology. Another option is to examine other aspects of cognition in concert with IQ. For example, measures of cognitive ability (the complex product of such variables as aptitude, motivation, experience, education and practice) and academic achievement (the measure of one's ability to successfully apply aptitude and ability) can be added to research cognitive batteries. Measures of ability and achievement have the benefit of inherent increased variability, as children and adolescents are expected to improve in both domains merely as a function of time; thus, subtle deficits may become more readily apparent.

Independent of directionality, the relationship between re-experiencing PTSD symptoms and cognitive functioning has significant clinical implications. While screening is important for all children and adolescents who have experienced interpersonal trauma, particular prevention efforts may need to be focused on those who have lower IQ scores. Identification of those at higher relative risk could inform intervention intensity choices and optimize clinical care.

Our study results also suggest that there may be differentially effective treatment approaches based on degree of re-experiencing symptoms. Addressing cluster B symptoms in treatment may bolster development or recruitment of beneficial cognitive processes disrupted by distracting, intrusive and distressing re-experiencing symptoms. For example, an increased focus on developing a cohesive traumatic narrative, linked to reduction of re-experiencing symptoms, may be warranted. Regardless of directionality, the negative association between symptoms and Verbal IQ suggest that those who have the most severe re-experiencing symptoms may unfortunately be those least equipped to effectively manage these symptoms.

Summary

Most current treatments of PTSD include cognitive strategies to manage symptoms, especially those of intrusive nature (Cluster B re-experiencing symptoms). Research in children who experience

trauma and develop posttraumatic stress symptoms necessitates the study of IQ and its individual verbal and performance components. In this study we have demonstrated that symptoms of PTSD, particularly re-experiencing symptoms and total number of traumas correlate negatively with Verbal IQ. Preventive and intervention efforts should include identifying children with this potential risk factor or marker of PTSD. Attention must also be given to the development of strategies to assist youth who have experienced trauma and have low Verbal IQ.

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