# EXAMINING THE RELATIONSHIP BETWEEN POSTTRAUMATIC STRESS DISORDER SYMPTOMS AND ATTENTION DEFICITS IN CHILDREN

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Abstract

Posttraumatic stress disorder (PTSD) is a debilitating illness that affects children. Symptoms of the disorder involve negative behavioral and emotional changes that are associated with biological and cognitive alterations. Research with adult populations reveals impaired cognitive functioning in individuals with PTSD, particularly in the areas of working memory and sustained attention. Some research utilizing subjective parent and teacher reports of children's attention-related behavior suggests that children may also experience impairment in these areas; however, only a few studies have attempted to use objective and direct tasks to measure attention in youth. Within the existing literature, there is evidence of deficits in sustained attention in children with PTSD, but findings have been inconclusive regarding working memory deficits. The current study examined attention deficits in youth using measures of sustained attention and working memory. Results support the existing literature that shows sustained attention deficits in youth with clinically significant PTSD symptoms, and echo findings of a lack of working memory deficits. The current study expanded the existing literature by examining symptom-level effects on sustained attention and working memory, demonstrating that children with clinical levels of hyperarousal and avoidance symptoms performed worse on tasks of sustained attention when compared to children without clinical levels of symptoms. Findings may help improve the field's understanding of the cognitive correlates of PTSD, which may have an impact on school performance and approaches to assessing and treating the disorder.

## Introduction

Examining the Relationship between

Posttraumatic Stress Disorder Symptoms and Attention Deficits in Children

Posttraumatic Stress Disorder (PTSD) manifests in both adults and children as a direct result of exposure to traumatic events or stressors. Childhood PTSD has been researched after exposure to natural disasters (Polusny et al., 2011; Salloum & Overstreet, 2008), the loss of a loved one (McClatchy, Vonk, & Palardy, 2009), and witnessing violence (Graham-Bermann, Castor, Miller, & Howell, 2012), among other traumatic events. Symptoms of PTSD are categorized into clusters broadly described as involuntarily reexperiencing the trauma, avoiding stimuli associated with the event, an increase in arousal, and negative changes in cognition and mood (American Psychiatric Association [APA], 2013).

Over the past decade, research has turned towards exploring the functional implications of PTSD by exploring how symptoms may disrupt individuals' daily lives. Importantly, symptoms inherent to the disorder indicate cognitive impairments in information processing that result in behavioral and emotional changes. One cognitive area that has recently been of interest to researchers is attention, a set of abilities that allows one to focus and concentrate on stimuli. Research in adults provides empirical evidence that individuals who experience PTSD symptoms perform poorly on discrete tasks of attention (Gil, Calev, Greenberg, Kugelmass, & Lerer, 1990; Vasterling, Brailey, Constans, & Sutker, 1998). Less research has been devoted to younger populations, despite the fact that attention carries vital importance for children, particularly in the context of school. Attention is required for engaging in goal-directed tasks that require concentration, like focusing on instruction or concentrating on an academic assignment.

Unfortunately, empirical evidence of attention deficits in children with PTSD is lacking. Some research provides subjective reports of behavior affected by impaired attention (e.g., Saigh, Yasik, Oberfield, Halamandaris, & McHugh, 2002); however, few studies have used an objective approach to examining attention deficits. Research using an objective approach to explore attention in children may help the field clarify whether attention deficits in children with PTSD are similar to those found in adults, and inform treatment decisions impacting children's daily functioning. The proposed study empirically examined attention deficits in children with PTSD using direct and objective measures. The following literature review includes an overview of PTSD, a brief review of biological research explaining how symptoms may interfere with cognitive processes, and finally, a summary of existing evidence of attention deficits in youth experiencing PTSD symptoms.

## Posttraumatic Stress Disorder

PTSD is a severe anxiety disorder that can develop after exposure to death or serious injury of the self or another (APA, 2013). Four clusters of symptoms characterize PTSD, including intrusion, avoidance, negative alterations in cognitions and mood, and alterations in arousal and reactivity (APA, 2013). The current diagnostic criteria for PTSD include exposure to a traumatic event (Criterion A) followed by at least one intrusion (Criterion B) and avoidance (Criterion C) symptom in addition to two negative cognition (Criterion D) and arousal (Criterion E) symptoms that interfere with adaptive functioning for at least one month following the traumatic event (APA, 2013). Several studies have found that some children exposed to trauma display symptoms of posttraumatic stress (Norris, Friedman, & Watson, 2002; Cuffe, Addy, & Garison, 1998; Horowitz, Weine, & Jekel, 1995), and a minority develop clinically significant

PTSD (Berman, Kurtines, Silverman, & Sarafini, 1996; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995).

According to APA, intrusion or reexperiencing symptoms include frightening dreams or nightmares, "reliving" parts of the trauma, and intrusive thoughts. Individuals may relive the trauma through flashbacks in which they feel as if the event were recurring. Cognitive theorists have posited that reexperiencing symptoms are maintained via classical conditioning. In the moment of the trauma, individuals associate sensory and physiological aspects of the trauma with intense fear. As a result, the same anxiety arises in later situations when no actual threat exists. Reactions are triggered by trauma-related cues to reexperience the traumatic event as if it were occurring in the present (Brewin et al., 1996). The DSM-V (APA, 2013) has specified ways in which reexperiencing symptoms may be uniquely experienced in children, noting that children may reenact trauma-specific events or engage in play where traumatic themes are expressed or experience dreams with unrecognizable content (APA, 2000).

The most recent version of the DSM (APA, 2013) has divided the avoidance/emotional numbing cluster from the DSM-IV-TR (APA, 2000) into two parts. Criterion C, avoidance, includes individuals attempting to stay away from feelings, thoughts, and exposure to stimuli associated with the trauma. This behavior is reflective of an individual's efforts to minimize distress through the avoidance of trauma reminders, or triggers (APA, 2013). As triggers generalize, individuals may avoid an increasing number of thoughts, feelings, and places, which leads to withdrawal from people and activities. Individuals may be unable to recall important aspects of the trauma and may avoid talking about the event or stressor. Avoiding feelings associated with the trauma may lead to an individual to display a restricted range of affect. Like reexperiencing symptoms, avoidance symptoms may manifest differently in children than in

adults. For example, children may express a sense of a foreshortened future. Many traumatized children do not expect to marry, have children, or have a normal life span (Saigh, 1992).

Criterion D, negative alterations in cognitions and mood, includes negative beliefs and expectations about oneself, developing a sense of blame or guilt related to the event, diminished interest in activities, alienation, and constricted affect. Steil and Ehlers (2000) found that distress suffered by adult victims of motor vehicle accidents was related to meaning the victims ascribed to the symptoms (e.g., believing the intrusive thoughts were a sign of "going mad"). The unproductive meaning attached to trauma reactions was found to be associated with avoiding reminders of the traumatic event, seeking distraction from the trauma memory, and actively trying to rid one's mind of cognitions about the trauma.

Hyperarousal symptoms represent the final symptom cluster (E) of PTSD, and include increased physiological or psychological arousal that can involve an increased startle reaction, irritability or angry outbursts, hypervigilance, difficulty falling or staying asleep, and difficulty concentrating (APA, 2013). Hyperarousal includes the same physiological responses that occurred during the original traumatic event, such as increased heart rate, muscle tone, and respiration (Rothschild, 2000; Schore, 1994). Research suggests that similar to intrusion symptoms, hyperarousal symptoms are also maintained in an associative process through the formation of fear networks that form after exposure to trauma and store information about sources of threat (Foa, Steketee, & Rothbaum, 1989). This concept is based on Lang's (1977) proposal that emotions are stored in memory networks that link responses and meaning to emotional events. Foa et al. (1989) suggested that networks built around mental representations of fear are readily activated by general internal and external cues. Individuals with PTSD regularly interpret a broad range of stimuli as threatening, due to the generalization of cues.

Cognitive theory suggests that symptoms of posttraumatic stress disorder are inter-related. Symptoms of avoidance and a poor evaluation of one's reactions are largely maintained by negative cognitions and mood (Steil & Ehlers, 2000). Further, negative thoughts about the event and attempts to suppress thoughts about the trauma may act as a trigger for intrusive reexperiencing symptoms (Ehlers & Clark, 2000). These symptoms also surface when non-threatening sensory and physiological stimuli unintentionally trigger reexperiencing a traumatic event due to their conditioned association with the trauma. Reexperiencing the event may include increased physiological and psychological excitement in the moment; however, a longer lasting state of hyperarousal is a hallmark symptom of PTSD due to the individual remaining steadily on edge.

Behaviors that occur as a result of PTSD symptoms can cause cognitive interference with basic information processing. In fact, research shows increasing evidence that compared to healthy individuals, adults with PTSD possess multiple cognitive deficits, including those of attention (e.g., Gil, Calev, Greenberg, Kugelmass, & Lerer, 1990; Vasterling, Brailey, Constans, & Sutker, 1998). Some work has been devoted to the link between specific symptom clusters and cognitive debilitation (see Vasterling et al., 1998). In particular, reexperiencing and hyperarousal symptom clusters have garnered interest because of their associations with alterations in the fear response due to hypersensitivity to both trauma-related cues and general threat. Biological research helps explain physiological vulnerabilities that underlie these particular symptoms, and how they may affect cognitive processing.

## Neurobiological Explanations of PTSD Symptoms

Reexperiencing and hyperarousal symptoms are associated with consistent activation of the fear response, which may impair brain functioning needed for certain cognitive activities

(DeBellis et al., 1999; Kimble, Ruddy, Deldin, & Kaufman, 2004). Exposure to a stressor initiates a biological response wherein threat is assessed and an appropriate behavioral response is organized via biological systems. This response is organized through the effects of catecholamines and other chemicals that contribute to the alteration of behavior and the neuroendocrine response involved in the hypothalamic-pituitary-adrenal (HPA) axis, both of which have structural and functional implications for specific brain areas. The following section briefly describes biological reactions to stress, links to reexperiencing and hyperarousal symptoms, and implications for cognitive functioning.

The amygdala is a structure in the brain that signals immediate biological responses in the face of a stressor—any event perceived as threatening, frightening, or otherwise harmful. The amygdala projects to the lateral hypothalamus and rostral ventral medulla to initiate activation of the sympathetic nervous system (Armony, 2013) in response to perceived threat. The amygdala is responsible for the initial release of catecholamines that play a large role in the behavioral and emotional responses to stress. Norepinephrine (NE) and epinephrine are released from the adrenal medulla and induce blood flow and glucose to the skeletal muscles in order to mobilize the body appropriately. NE also plays a key role in the encoding of emotional memories via interaction with corticotropin-releasing hormone (CRH), which increases fear conditioning by heightening arousal and vigilance (Vermetten & Bremner, 2002). Gamma-Aminobutyric acid, or GABA, dampens behavioral and physiological responses by inhibiting the circuits involving NE and CRH. Thus, decreases in GABA remove an anxiolytic effect, leading to hyperarousal. In sum, the release of catecholamines allows for a hyperaroused state in direct response to stressors.

The central amygdala also projects to the bed nucleus of the stria terminalis to initiate the neuroendocrine HPA response (Armony, 2013). This reaction is initiated after neurons in the

hypothalamic paraventricular nucleus (PVN) release corticotropin -releasing hormone (CRH) in order to stimulate the production and release of adrenocorticotropin (ACTH) from the anterior pituitary gland. This in turn signals the adrenal gland to release cortisol. Several brain pathways modulate HPA axis activity - the hippocampus and prefrontal cortex (PFC) inhibit CRH neurons in the PVN, while the amygdala stimulates them. However, cortisol is largely responsible for regulating the stress response by providing negative feedback to the HPA axis, eventually terminating the body's response to stress when threat has subsided (Southwick et al., 2005). Cortisol binds with receptors on the pituitary, hypothalamus, hippocampus, and amygdala and signal the halting of stress-activated biological reactions. These processes lessen cortisol levels and further suppress the release of cortisol itself.

Over time, prolonged or chronic stress and continued activation of the HPA axis leads to an altered stress response that can place the individual at risk for a predisposition for severe mental health conditions, particularly PTSD. Studies show that cortisol plays a part in the development of the disorder, as low levels indicate an altered stress response that has shown to predict development of PTSD (Resnick, Yehuda, Pitman, & Foy, 1995; Yehuda, McFarlane, & Shalev, 1998). In fact, research reveals that hydrocortisone or corticosterone administered shortly after trauma exposure can prevent PTSD (Schelling, Kilger, & Roozendaal, 2004), and that a normal circadian cortisol rhythm mimicked by the induction of hydrocortisone can be effective in the treatment of PTSD (Aerni, Traber, & Hock, 2004). Research has not yet revealed the exact nature of HPA dysfunction in individuals with PTSD; however, it appears to be related to a failure to adequately regulate SNS activity, which may partially explain symptoms of hyperarousal (APA, 2000). Research has also associated catecholamines with PTSD. Studies have shown that individuals with PTSD exhibit decreases in receptors that enable GABA's

inhibitory effects (Vermetten & Bremner, 2002). A number of studies have demonstrated that a summation of catecholamine levels over a period of one day are higher in both children and adults with PTSD (e.g., DeBellis, Lefter, Trickett, & Putnam, 1994; see Southwick et al., 2005 for a review).

The changes in key brain structures involved with the stress response have important functional effects that may eventually contribute to the maintenance of PTSD. The amygdala serves as the interface between the sensory experience of threat and the body's response, as it activates the SNS and signals the HPA axis (Shin et al., 2005). The amygdala plays an important role in emotional response, fear conditioning, and importantly, creating and storing emotional memories (Davis & Whalen, 2001; Mitra et al., 2005). In humans, although studies examining structural volume have been mixed (See Woon & Hedges, 2008; Karl, Schaefer, Malta, Dorfel, Rohleder, & Werner, 2006), imaging studies have revealed hyper-responsiveness in the amygdala in individuals with PTSD during the presentation of stressful material (Shin, Rauch, & Pitman, 2006; Rauch, Whalen, & Shin, 2000).

Research has shown that the hyper-responsiveness of the amygdala is associated with hypo-responsiveness of the hippocampus, another brain structure implicated the stress response. While the amygdala is responsible for the emotional component of memories, the hippocampus serves in the processing of explicit memories. The hippocampus contextualizes events in the moment, orienting individuals to time and place. Research has shown that hippocampal functioning is compromised during exposure to stressors (Rothschild, 2000; Yehuda, 2002). At the time of trauma exposure, compromised hippocampal functioning may be attributed to heightened cortisol levels and increased amygdala activity, which blunt the contextualizing functions of the hippocampus.

In addition to functioning in the face of trauma exposure, the hypoactivity of the hippocampus and hyperactivity of the amygdala help explain the occurrence of PTSD symptoms. Due to some aspects of traumatic experiences being contextually obscured, threat cues like sights, sounds, and smells associated with the trauma become generalized (Rothschild, 2000). Threat cues trigger a sensitive and hyperreactive amygdala in the absence of threat, resulting in physical hyperarousal and reexperiencing symptoms.

One final brain structure discussed in the literature describing the fear response is the prefrontal cortex (PFC), which is associated with higher-order processes involved in planning and organizing behavior. The PFC controls the limbic system, as lesion studies show that the medial PFC modulates emotional responses through inhibiting the amygdala (Bremner, 2007). Research has been conducted on hyporeactivity of this region of the brain in individuals with PTSD. Specifically, some researchers suggest that along with the hippocampus, the ventromedial prefrontal cortex (vmPFC) and associated areas (i.e., anterior cingulate cortex [ACC], subcallosal cortex, and orbitofrontal cortex) undergo decreased activity (See Rauch, Shin, & Phelps, 2006; Rauch, Shin, & Pitman, 1998) when processing stressful events. The vmPFC may fail to adaptively maintain extinction of conditioned emotional responses signaled by the amygdala after perceived threat has subsided. Thus, after the fear response has been initiated, the vmPFC may not be able to extinguish responses in order to return the body to its original, non-threatened state.

Biological evidence helps explain the manifestation of PTSD, particularly for intrusive and hyperarousal symptoms. The release of catecholamines, irregular levels of cortisol, and altered reactivity and function of brain structures involved in the stress response show how these particular symptoms manifest and are maintained. The effects of reexperiencing and

hyperarousal symptoms may extend to cognitive areas, which ultimately have functional implications for individuals. For example, research has shown an association between reexperiencing symptoms and a general pattern of cognitive difficulty restraining unwanted or non-relevant thoughts (See Vasterling et al., 1998; and Shimamura, 1996). Individuals undergoing reexperiencing symptoms must devote cognitive resources to thought suppression and controlling arousal, and as a result, may experience consistent difficulty focusing on goal-directed behavior. Regarding hyperarousal symptoms, the persistent activation of the fear response due to generalized association of threat cues leads to a hyperaroused state, which is not ideal for cognitive processing.

Given these ideas about the cognitive effects of PTSD symptoms, recent research has turned towards exploring the relationship between PTSD symptoms and the cognitive construct of attention. Deficits of attention have been noted in adults and children with PTSD in various lines of research (e.g., Vasterling et al., 2002; Beers & DeBellis, 2002). Attention represents an important area of research in youth because it is necessary for academic and behavioral success in the context of school. Evidence of attention deficits has been observed in school-age children with PTSD through the use of subjective behavior rating scales completed by parents and teachers (Husain et al., 2008). Other research has employed a more objective approach to attention using direct measures that require individuals to complete discrete tasks; however, this research has largely been conducted with adult populations. A few studies within this particular line of research have been conducted with children (Beers & DeBellis, 2002; DePrince, Weinzierl, & Combs, 2009), but results have not mirrored findings in adults (Samuelson et al., 2006; Vasterling et al., 1998; Vasterling et al., 2002).

## PTSD and Attention

Attention is a cognitive process of selectively concentrating on one aspect of the environment while ignoring other aspects. Attention has also been referred to as the allocation of visual, auditory, and tactile processing resources (Anderson, 2004). Attention is vital to performing goal-directed tasks, lies at the basis for all information processing, and is highly relevant in real world contexts. Stein, Kennedy, and Twamley (2002) state that mild or even subtle attention impairments can result in clinically significant difficulties in daily tasks, especially since these contexts involve more complex processing demands due to distractions in the environment.

Attention is certainly relevant to real world contexts for children, such as the school environment. For example, attention is necessary to read fluently, as children must visually process and decode words while simultaneously "holding" text in their minds to comprehend meaning (Samuelson et al., 2006). On a more global level, children need to focus their attention to follow teachers' directions during instructional lessons (e.g., when solving complex math problems requiring several steps) or behavioral tasks (e.g., following the proper sequence for cleaning up or finishing work in one area of the classroom before moving to another). With respect to the importance of attention in schools, researchers and clinicians have included measures of the construct in rating scales that are used in schools to assess children's behavior. Studies using these rating scales represent one avenue through which research has linked PTSD symptoms to attention in children (Husain et al., 2008; Matthews & Overstreet, 2006).

### Assessment of Attention through Behavior Rating Scales

Subjective measures of attention-related behavior have allowed researchers to explore attention deficits in children experiencing PTSD symptoms. Behavior rating forms are typically

norm-referenced and completed by caregivers, teachers, or self-reported by older children using a Likert scale to measure the frequency and/or severity of specific problems. Studies assessing attention deficits using rating scales such as the Child Behavior Checklist (CBCL; Achenbach, 1991) provide support for attention problems in PTSD-diagnosed children.

The CBCL (Achenbach, 1991) provides two broadband scales of children's internalizing and externalizing behaviors as well as a number of content-specific scales. The 11-item Attention Problems scale measures the inability to attend to tasks (e.g., "can't concentrate"). Saigh, Yasik, Oberfield, Halamandaris, and McHugh (2002) used the CBCL to examine attention in 104 urban adolescents aged 7 to 18 ($M$ = 13.30, $SD$ = 2.8) exposed to a variety of traumatic experiences. Results indicated that adolescents diagnosed with PTSD were rated by their parents as having significantly more symptoms on the Attention Problems subscale than were trauma-exposed adolescents without PTSD as well as non-trauma exposed controls.

Teachers have also reported attention deficits in children experiencing PTSD symptoms. The CBCL-Teacher Report Form (TRF; Achenbach, 1991) parallels the structure of the parent report form and includes a 22-item Attention Problems scale. Husain and his colleagues (2008) conducted a study with 791 Sarajevan children ($M$ age = 10.9 years) exposed to the Bosnian war. Children provided a self-report of PTSD symptoms using the PTSD Reaction Index (RI; Pynoos, Frederick, Nader, Arroyo, Steinberg, & Eth, 1987) and were divided into two groups according to clinical cutoffs provided by the RI. The researchers found that teachers were more likely to report some level of attention problems among children who self-reported clinically significant PTSD symptoms (8%) than among children who did not self-report clinically significant PTSD symptoms (2.5%). Of the 5.2% with significant attention problems, 68.6% self-reported significant levels of PTSD. Similarly, in another study, researchers examined teachers' reports

of school-aged children who were exposed to high rates of community violence, and found that self-reported PTSD symptomotology was significantly related to measures of attention as reported by teachers ($r = .30$, $p < .01$; Matthews & Overstreet, 2006).

The attention scales on the CBCL and TRF (Achenbach, 1991) provide evidence of attention deficits in children who meet symptom criteria for PTSD as well as children actually diagnosed with the disorder. This evidence is subjective and indirect, as the measures solicit others' perceptions regarding children's attention. Recent research seeks to provide a direct assessment of attention that requires children to complete a discrete task while measuring their performance. This research attempts to operationalize attention to provide an estimate of how well individuals can mentally maintain and manipulate information, directly capturing performance.

**Assessment of Attention through Objective Measures**

Much of the research using direct measures to gauge attention in individuals experiencing PTSD symptoms has been conducted in adult populations; however, some studies have been conducted with younger populations. Interestingly, while findings regarding the domain of sustained attention and PTSD symptoms in children are similar to findings in adults, studies have reported somewhat inconsistent results between adults and children with regard to working memory. The following section reviews the measurement of the two different areas of attention and possible explanations for discrepancies between findings in adults and children.

**Sustained attention.** Sustained attention involves continuous maintenance of alertness and receptivity for a particular set of stimuli or stimulus changes over time (Davies, Jones, & Taylor, 1984). Tasks measuring sustained attention typically require attending to a target, organizing appropriate responses to signals for the target, and inhibiting inappropriate responses

to non-targets. Sustained attention has been measured using continuous performance tasks, where individuals focus on auditory or visual stimuli and respond (e.g., via button press) when presented with a target stimulus. The nontarget stimuli outnumber the target signals, so subjects with attention deficits tend to miss target signals (committing acts of omission, or inattention) and/or impulsively react to non-target signals (committing acts of commission, or impulsivity).

Individuals experiencing hyperarousal symptoms may display difficulties inhibiting the impulse to respond, thereby reacting to non-targets. Vasterling et al. (1998) used the Conners Continuous Performance test (CPT; see Conners, 1992) to compare sustained attention in 19 Persian Gulf War veterans diagnosed with PTSD to a sample of 24 veterans without PTSD. Vasterling et al. (1998) found that those in the PTSD group made an average of four times as many commission errors than those without PTSD, impulsively misidentifying a target stimulus significantly more often. No differences in omission errors were observed between groups. Other studies assessing sustained attention (e.g., Shucard, McCabe, & Szymanski, 2008) have reported similarly large differences regarding increased errors of commission to distracter stimuli in adult populations with a PTSD diagnosis using the CPT.

Interestingly, in a later study comparing the CPT performance of 26 Vietnam War veterans with PTSD diagnoses to a sample of 21 veterans without a mental disorder, Vasterling et al. (2002) reported more acts of omission by individuals with PTSD, versus acts of commission in her earlier study. This later study revealed that veterans with PTSD identified the target stimulus at a significantly poorer rate compared to those without PTSD, as shown by a significantly lower hit rate *T*-score. According to cognitive theory, intrusive thoughts that occur as a result of reexperiencing symptoms may interrupt goal-directed processes involved in sustained attention tasks. Thus, individuals who make more omission errors, missing target

stimuli in tasks of vigilance, may do so as a result of a cognitive pattern that includes problems focusing attention and general heightened distractibility.

The same pattern of findings was observed by Gil and colleagues (1990). In their study, the researchers assessed cognitive functioning in 12 PTSD-diagnosed patients and 12 psychiatric patients matched for severe psychopathology from an outpatient clinic in Jerusalem. Twelve normal control participants were also assessed. Like Vasterling et al. (2002), Gil et al. (1990) reported that individuals with PTSD tended to commit more omission errors by displaying a deficit in hit rate on a continuous performance task. On a task that required participants to listen to a tape recording and identify target stimuli, the 12 participants with PTSD identified targets with 25% less accuracy than the 12 participants in the healthy control group.

The tendency to make more commission and omission errors has also been observed in children. Matthews (2009) observed poorer performance on tasks of sustained attention using the CPT-II (Conners, 2000) in eight children who met diagnostic criteria for PTSD compared to eight control group children similar in age and gender. The children in her study were between the ages of 8 and 14 ($M$ = 11.54, $SD$ = 2.25) and 56% were ethnic minorities. Results for group differences were significant in terms of acts of commission, but not omission. Matthews (2009) found that children with a diagnosis of PTSD earned *T*-scores 14 points higher than matched controls, indicating significantly worse performance. Though statistically non-significant, Matthews also reported evidence of more omission errors among the PTSD group. Children who qualified for a diagnosis of PTSD earned *T*-scores higher than matched controls by six points, suggesting a trend toward worse performance on the CPT-II (Conners, 2000).

Finally, Beers and De Bellis (2002) reported evidence of significant omission errors committed by children diagnosed with PTSD. In their study, the researchers compared different

domains of executive functioning in 14 children diagnosed with PTSD (*M* = 11.38 years, *SD* = 2.6 years) to a group of 15 healthy children without a history of maltreatment (*M* = 12.17, *SD* = 1.75) but similar in age, race, socioeconomic status, and IQ. The researchers used the Digital Vigilance Test (Kellen & Lewis, 1996) to assess sustained attention, which requires participants to maintain vigilance and identify target stimuli. Participants were required to find and cross out "6s and 9s" that appeared within rows of single digits. Though groups did not differ in speed to complete the task, PTSD participants missed three times as many target digits, committing more omission errors than participants without a PTSD diagnosis.

Research investigating sustained attention in individuals with PTSD reveals fairly consistent deficits in both adults and children. Although deficits in children are more subtle, effects in studies with adults are medium to large in magnitude in acts of both omission and commission when comparing PTSD-diagnosed individuals to those without the disorder. According to cognitive theory, the propensity for individuals to miss target stimuli may be indicative of a distractible cognitive pattern marked by difficulty maintaining attention (Vasterling et al., 1998; Shimamura, 1996), which results from PTSD symptoms. Specifically, individuals with PTSD may have difficulty on tasks of sustained attention due to the cognitive effects of hyperarousal and reexperiencing symptoms.

Biological evidence provided by brain imaging studies of individuals diagnosed with PTSD or otherwise exposed to trauma helps explain sustained attention deficits across development. Imaging studies on both adults and children show an association between PTSD and structural alterations of the prefrontal cortex (PFC), the neural substrate of sustained attention. The PFC is involved with higher-order information processing. Shimamura (2000) describes the PFC as a gate that controls and manipulates information through processes of

selection, maintenance, updating, and rerouting. Researchers suggest that during goal-directed activities that require focus and concentration, the PFC orchestrates thoughts and actions in order to reach goals (Miller & Cohen, 2001). Studies have shown that the medial PFC and associated areas, including the anterior cingulated cortex (ACC), is activated in tasks of sustained attention (Kirino, Belger, Goldman-Rakic, & McCarthy, 2000; Fichtenholtz et al., 2004).

As discussed in a previous section, the PFC is also involved in the modulation of emotional responses during stress through inhibiting the amygdala (Bremner, 2007). Frequent activation of the stress response occurring in individuals with PTSD symptoms may eventually take a structural toll on the PFC, thus explaining sustained attention deficits. Indeed, research shows that the PFC is structurally altered in individuals with PTSD. Specifically, individuals with PTSD have decreased volumes of the frontal cortex. For example, Andersen et al., (2008) reported decreased overall frontal cortex in adults, and van Harmelen et al., (2010) showed an association between maltreatment and a volume reduction in the left dorsal medial prefrontal cortex. Reduced volume in the ACC has also been noted in adults; in fact, this reduction has been correlated with PTSD symptom severity in some adult studies (Woodward et al., 2006).

Similarly, in PTSD-diagnosed child populations, evidence for neuronal loss specific to the ACC has been found (DeBellis, Keshavan, Spencer, & Hall, 2000). Studies also report a decrease in overall volume of the PFC (Felmingham et al., 2007) and the orbitofrontal cortex (Hanson et al., 2010). Further, researchers have documented an abnormally high density of gray matter in prefrontal regions among children with PTSD relative to controls (Carrion et al., 2009; Richert, Carrion, Karchemskiy, & Reiss, 2006). Research suggests that increased gray matter volume is indicative of dysfunctional frontal lobe pathways resulting from faulty regulation of key structures involved in emotional and fearful responses (Carrion et al., 2009). Thus, as in

adult populations, structural abnormalities observed in the PFC and associated areas are in line with research that demonstrates sustained attention deficits in children with PTSD.

In summary, research has shown that a key area of the brain responsible for sustained attention is structurally compromised in volume and in children, also different in gray matter density. Abnormalities noted in the PFC for both adults and children with PTSD are in accord with research revealing sustained attention deficits across age groups. Sustained attention deficits appear to be especially pronounced in adults, as studies have shown moderate to large effects in magnitude comparing performance between individuals with PTSD versus those without the disorder. Interestingly, objective measures of another attentional process, working memory, have revealed inconsistencies in performance between adults and children with PTSD. Varying findings of structural abnormalities found in the hippocampus, a brain structure implicated in working memory processes, helps explain differences found between performance of adults and children on tasks in this area of attention.

**Working memory.** Working memory is the ability to hold information in mind that is no longer present in the environment (Finn, Sheridan, Kam, Hinshaw, & D'Esposito, 2010). The working memory system is viewed as a part of the larger constellation of memory, where information is perceived, attended to, and retrieved. Tasks that assess working memory require individuals to focus attention on stimuli, such as digits, words, or spatial locations, "hold" the information in their mind, and verbally or physically supply information back to complete the task.

Deficits in working memory have been found in veterans with PTSD. For example, Samuelson et al. (2006) compared working memory in 67 male and female veterans who met criteria for PTSD to 30 veterans who did not meet criteria for PTSD using tasks from the

Wechsler Memory Scale (WMS: Wechsler, 1997a) and Wechsler Adult Intelligence Scale, Third Edition (WAIS-III; Wechsler, 1997b). Working memory was assessed using a task that required participants to listen to sequences of numbers and letters and repeat back the numbers first in ascending order followed by the letters in alphabetical order (Letter-Number Sequencing; Wechsler, 1997). Raw score results showed significantly worse performance by individuals with a diagnosis of PTSD, as these participants recalled an average of two sequences less than individuals without the disorder after controlling for alcohol use, education level, vocabulary abilities, and depression scores. Working memory was also assessed using a task in which participants were read a series of digits and were asked to repeat them in sequence forwards and backwards (Digit Span; Wechsler, 1997). Similarly poorer performance in PTSD-diagnosed individuals was observed, as these individuals earned raw scores an average of four points less than those without the disorder.

These findings echo the results of other studies reporting deficits in attention and working memory in civilian and veteran adults with PTSD. Poorer Digit Span performance by veterans with PTSD has been observed when compared to psychiatric controls and healthy participants (Gil, Calev, Greenberg, & Kugelmass, 1990) as well as veterans without PTSD (Vasterling et al., 2002). Similar results have also been found in non-veteran populations. For example, Brandes, Ben-Schachar, Gilboa, Bonne, Freedman, and Shalev (2002) assessed working memory in 48 adult survivors of various traumatic events (including motor vehicle accidents, terror attacks, and assault) in Jerusalem. Subjects were divided into two groups: those with low and those with high levels of PTSD symptoms. Survivors with high levels of symptoms demonstrated poorer performance, recalling an average of two number sequences less on the Digit Span Backward

task of the Weschler Memory Scale (WMS III; Weschsler, 1997) compared to those with low levels of symptoms.

Few studies have measured working memory in children with PTSD symptoms. Beers and De Bellis (2002) compared different domains of executive functioning in 14 children diagnosed with PTSD following maltreatment ($M$ = 11.38 years, $SD$ = 2.6 years) and to a group of 15 healthy children without a history of maltreatment ($M$ = 12.17, $SD$ = 1.75) similar in age, race, socioeconomic status, and IQ. Interestingly, no differences were found between groups on scaled scores of the Digit Span subtest (WISC-III; Wechsler, 1991; PTSD group, $M$ = 9.08, $SD$ = 1.93 and $M$ = 10.38, $SD$ = 2.81), which is inconsistent with evidence of impairments in working memory in adult samples but consistent with another study conducted with children.

Samuelson, Krueger, Burnett, and Wilson (2010) also used Digit Span (WISC-IV; Wechsler, 2003) in addition to Letter-Number Sequencing to assess working memory in children who had witnessed intimate partner violence between their mother and a partner. Their sample was mostly comprised of African American children (73%), and included 27 children with PTSD according to the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) and 35 children without PTSD. Samuelson et al. (2010) also did not observe differences in age-corrected scaled scores when comparing the PTSD group to children without the disorder in performance for either task (Digit Span, PTSD group, $M$ = 9.8, $SD$ = 3.4 and No-PTSD group, $M$ = 9.1, $SD$ = 3.0; Letter-Number Sequencing, PTSD group, $M$ = 9.2, $SD$ = 2.7 and No-PTSD group, $M$ = 8.6, $SD$ = 3.5, respectively).

Matthews (2009) examined working memory in her study of children with PTSD. In contrast to the findings of Beers and De Bellis (2002) and Samuelson et al. (2010), Matthews (2009) observed that children who met clinical criteria for PTSD performed significantly worse

on a task of working memory. Matthews (2009) used age-corrected scaled scores from the Digits Backward task (Wechsler, 2003) and showed that children with PTSD earned scores an average of four points lower than children in the comparison group who had also been exposed to trauma but did not have a diagnosis of PTSD. Interestingly, Matthews did not observe significant differences in performance on another task of working memory, Letter-Number Sequencing (Wechsler, 2003).

Research reveals relatively consistent deficits in PTSD-diagnosed adults on tasks of working memory, but existing findings with children are less clear. Children with PTSD in Matthews' (2009) study performed poorly compared to their matched counterparts on the Digits Backward task (Wechsler, 2003); however, children in her sample did not perform significantly worse on the Letter-Number Sequencing task (Wechsler, 2003), and other studies have failed to demonstrate a significant deficit in working memory in children with PTSD (Beers & De Bellis, 2002; Samuelson et al., 2010). Although measurement factors may partially explain differing findings in children compared to adults, as researchers vary in their decision to separate the forwards and backwards components of working memory tasks, biological findings point to the possibility that deficits in working memory may not exist in youth with PTSD. Specifically, research on the neural substrates supporting working memory in children, which include the PFC and the hippocampus, helps explain the lack of evidence for working memory deficits in children (Finn et al., 2010).

In addition to the PFC's involvement in sustained attention, studies have established the structure's association with working memory (Finn et al., 2010, Goldman-Rakic, 1987). The PFC undergoes development throughout adolescence (Lenroot & Giedd, 2006), and despite the structure's immaturity, few performance differences have been observed between adolescents

and adults on simple working memory tasks. This fact suggests that another brain structure may be recruited throughout childhood and adolescence that supports working memory performance. Finn et al. (2010) conducted a study to examine the extent to which the PFC and the hippocampus, another brain region associated with working memory (Blumenfeld & Ranganath, 2006), are involved in tasks of working memory throughout adolescence. Using fMRI scans in a longitudinal study, the researchers administered a delayed match-to-sample task (Sternberg, 1969; Rypma & D'Esposito, 2000) that presented uppercase letters in groups of either two (e.g., P and Q) or six (e.g., L, F, N, R, H, and K). After a delay, participants were required to indicate if a lowercase letter (e.g., n) matched an uppercase letter previously presented.

Finn et al. (2010) reported that both the PFC and hippocampus were active during the task at scan 1, when participants were in early adolescence (*M* age = 15.1, *SD* = 1.55). During scan 2 approximately three years later (*M* age = 18.3, *SD* = 1.45), only the PFC was activated, showing that neural recruitment during working memory function shifts throughout development. The researchers suggest that the involvement of the hippocampus earlier in adolescence may be a compensatory function enacted due to the immaturity of the PFC, and that hippocampal involvement fades across development. Finn et al.'s (2010) study indicates that adults may solely rely on the PFC for both sustained attention and working memory processes, but children and early adolescents rely on both the PFC and the hippocampus.

This finding has important implications for the lack of working memory deficits observed in children with PTSD. For children, structural damage to the PFC caused by prolonged activation of the stress response may not be as impactful for engaging in tasks of working memory due to the hippocampus helping to "drive" performance. This argument is bolstered by the fact that research indicates structural integrity in the hippocampi of children with PTSD.

Specifically, one longitudinal study did not note smaller volume in children diagnosed with PTSD over a two year time period (De Bellis, Hall, Boring, Frustaci, & Moritz, 2001), and the majority of studies reporting on hippocampi in children with PTSD generally fail to reveal volumetric changes (De Bellis, Hooper, Wooley, & Shenk, 2010; Carrion et al., 2001; Mehta et al., 2009; De Bellis et al., 2002). Thus, intact hippocampal structure and functioning, despite prolonged activation of the stress response and its affect on the PFC, may help explain why working memory deficits are not observed in children. Prolonged exposure to stress and eventual structural damage to the PFC may explain working memory deficits in adults with PTSD, but because younger individuals also call upon the hippocampus to perform tasks of working memory, they do not demonstrate apparent deficits in this area of attention. These findings demonstrate the important role development plays in conceptualizing the effect of trauma in children, and how development may impact the effect of trauma on attention.

## Current Study and Hypotheses

PTSD is a debilitating disorder that has the power to alter cognitive processes. Cognitive impairments may include deficits in attention, a worthy functional area to examine in children since attention is necessary for applied tasks in school. Some researchers have demonstrated evidence of attention-related problems in children experiencing PTSD symptoms using parent and teacher reports of behavior (Husain et al., 2008; Matthews & Overstreet, 2006), while others have attempted to directly measure deficits (DePrince, Weinzierl, & Combs, 2009; Beers & DeBellis, 2002; Matthews, 2009). The current study used objective direct measures to assess attention in children experiencing PTSD symptoms, expanding work that has been done to date.

The current study utilized measures of sustained attention and working memory to determine how PTSD symptoms affect these specific aspects of attention in children. Research

revealing the compromised structure of the PFC provides the basis for sustained attention deficits that manifest across development in youth with PTSD. Conversely, the structural integrity of the hippocampus in childhood and early adolescence appears to protect working memory processes in youth with PTSD in this period of development. Therefore, it was hypothesized that children with clinically significant PTSD symptoms would perform more poorly on tasks of sustained attention when compared to children without significant symptoms, but the two groups would not differ on tasks of working memory.

Beyond overall impact of PTSD symptoms, theories suggest that symptom clusters, specifically reexperiencing and hyperarousal, may differentially affect cognitive functioning. These clusters are different from the avoidance cluster due to their direct interference with the ability to concentrate and the exhaustion of cognitive resources directed at controlling arousal (Vasterling et al., 1998); however, no studies have directly explored the potential impact of PTSD on attention at the symptom cluster level. It was hypothesized that youth who meet criteria for the reexperiencing and hyperarousal symptom clusters would display poorer performance on tasks of sustained attention than youth who do not meet criteria. No differences were anticipated between any groups regarding tasks of working memory.

Because research has revealed that specific factors correlate with PTSD, these factors were measured within the present study due to their potential impact on attention. Specifically, symptoms of depression are among the most common type of symptoms in traumatized youth with and without PTSD (Mazza & Reynolds, 1999). Evidence shows that depressive symptoms have been associated with both working memory dysfunction (Zakzanis, Leach, & Kaplan, 1998) and reduced sustained attention (Favre, Hughes, Emslie, Stavinoha, Kennard, & Carmody,

2009). Thus, in the current study, symptoms of depression were measured as a potential control variable.

Further, studies have shown that greater cumulative trauma exposure has been associated with higher levels of stress. For example, within their national study, Finkelhor, Ormrod, and Turner (2009) reported an association between children with high cumulative levels of victimization and higher levels of psychological distress. Due to the relationship between trauma exposure and psychological distress, it stands to reason that attention may also be negatively impacted. The current study aims to examine the effects of PTSD, not solely trauma exposure, on attention. Thus, levels of exposure to trauma were measured by two potential control variables. First, participants were asked whether or not they were exposed to various forms of community violence, such as hearing gunshots in their neighborhood or witnessing violence. Additionally, the number of loved ones lost by study participants was also measured. Among children with PTSD, loss is the most common traumatic experience reported (Goodman et al., 2004). Together, exposure to community violence and number of loved ones lost measured participants' experience of multiple traumas and served as potential control variables.

## Methods

### Participants

In consideration of study hypotheses that sustained attention but not working memory deficits may be observed in children and early adolescents, the current study targeted participants within this age range. Participants included 44 children between the ages of 8 and 14 in the 3rd through 8th grade. The mean age of participants was 12.24 (*SD* = 1.20). Thirty-three participants (75%) were female. One hundred percent of the current sample identified as African American. Participants were recruited from six schools, including three Knowledge is

Power Program (KIPP) Schools (*N* = 25), McDonogh City Park Academy (*N* = 7), McDonogh 32 Literacy Charter School (*N* = 7), and Cohen College Prep (*N* = 6). Socioeconomic information for individual participants was unavailable; however, approximately 91% of the student population across all six schools qualified for free or reduced lunch (National Center for Education Statistics, 2012).

Participants were divided into PTSD groups based on a score of 38 on the PTSD-RI. The developers of the PTSD-RI (Pynoos et al., 1998) assert that a cutoff score of 38 has the greatest specificity and sensitivity for detecting an actual diagnosis of PTSD (Rodriguez, Steinberg, Saltzman, & Pynoos, 2001a; 2000b). Twelve participants (27%) exceeded a cutoff equal to or higher than 38 on the PTSD-RI (*M* = 47.92; *SD* = 7.04) and made up the PTSD group. The remaining 32 participants comprised the No-PTSD group (*M* = 16.50; *SD* = 8.39; [*F* (1.42) = 132.57, *p* <. 00]).

Table 1 presents demographic information, number of losses, exposure to community violence, and mental health symptoms in PTSD vs. No-PTSD groups. Not surprisingly, children in the PTSD group were exposed to more violence (*M* = 3.00; *SD* = 1.21) than children in the No-PTSD group (*M* = 2.06*; SD* = 1.05; [*F* (1.42) = 6.46, *p* <. 05) and children in the PTSD group also reported greater losses (*M* = 2.83*; SD* = 2.66*)* than children in the No-PTSD group (*M* = 1.66*; SD* =1.00*;* [*F* (1.42) = 4.66, *p* <. 05]. The PTSD group reported more symptoms of depression (*M* = 33.17, *SD* = 14.11) than the No-PTSD group (*M* = 13.59 (*SD* = 9.60; *F* (1.42) = 27.81, *p* <.00]).

**Procedures**

Data were collected in the spring of 2014 in partnership with a local community mental health agency that provides services to children and their families in New Orleans. The agency

conducts semiannual school-based screenings that focus on assessment of trauma exposure and traumatic stress reactions to identify students in need of therapeutic services. The current study involved the administration of attention measures along with the agency's screening procedures. Of the ten schools where the agency conducted screenings for the spring of 2014, six schools fit the study's age range and all agreed to participate in the research. At each of the six schools, a parent notification packet was sent home with students. The packet included two sections: one that detailed services that students might be eligible to receive as a result of the mental health screening and one that included a description of the current study and the informed consent. Five hundred and sixteen packets were sent out and 110 families (21%) consented to participating in the community agency's mental health screening. This participation rate is consistent with prior screenings (Smith, personal communication, July 22, 2013). Of these families, 46 (42%) also consented to participating in the current research study.

Two members of the research team accompanied staff from the community agency to partnering schools and data collection took place in private rooms located on school campuses. Mental health screening measures were conducted by staff from the community mental health agency as part of their standard procedures. Screening measures are described below and included a trauma symptom index, depression index, and trauma exposure survey, all of which lasted approximately 20 minutes.

Research personnel attained assent to participate in the study from children who had parental consent to participate in research. The RAs explained all aspects and procedures of the study to the child by outlining each point on the assent form, which included limits of confidentiality and the freedom to stop study procedures at any time. Two students declined to participate despite parent consent, thus 44 participants were included in the study. Attention

measures were given by research team members trained in standardized administration procedures and lasted approximately 20 minutes. Attention measures were completed either before or after the mental health screening measures, according to students' availability. Students allowed to miss greater than 20 minutes from a class period received mental health screening measures first, followed immediately by attention tasks; otherwise, researchers returned to schools within the following week to administer study measures. The order of measures (e.g., working memory tasks followed by sustained attention tasks and vice versa) was systematically counterbalanced across participants. Participants were compensated with a light snack for their participation in the study.

**Measures**

***Trauma Exposure.*** Exposure to trauma was assessed using two surveys that served to identify an event or loss that may have resulted in experiencing posttraumatic symptoms. First, the Experience Survey (Salloum, 2006), included in Appendix A, was administered as an interview to assess participants' experience with loss. Participants were asked whether they had ever lost a loved one. Follow-up questions assessed the nature of death (e.g., homicide, suicide, AIDS, drowning, drowning in Hurricane Katrina, natural causes [like old age], an accident, heart attack, cancer, and other), the approximate month and year the death occurred, the child's relationship with the deceased, and whether or not the participant witnessed the death. Second, the Violence Exposure Survey (adapted from Richters & Martinez, 1990; see Appendix B) was used to assess degree of exposure to various acts of community violence. The survey asks participants to indicate whether they have heard or seen: guns being shot, individuals getting shot, stabbed, or beaten up, or viewed dead bodies in and around their home. Participants

indicated their exposure to any of these events from "0 times" to "Many Times" on a scale of 0 – 5.

Information from the trauma exposure assessment was used in two ways. First, the information was used to identify an event that met PTSD criteria for trauma to be used in the subsequent assessment for PTSD. The DSM-V (APA, 2013) describes trauma as direct or indirect exposure to actual or threatened death, serious injury, or violence. Upon completion of these two measures in which exposure to death and violence were assessed, children were asked which loss or violent event "bothers you the most," "makes you feel the saddest," and is "the hardest for you to talk about." The trauma that children identified as the hardest for them to talk about was used as a reference for assessing PTSD (Pynoos et al., 2001). Second, the two surveys yielded two variables that reflected degree of trauma exposure. The number of loved ones lost was summed for each participant. Any exposure to the six violent events was summed to generate a total that could range from 0 – 6.

***PTSD Symptomatology.*** Part III of the UCLA assesses PTSD symptoms. Participants were asked to identify the events of loss or exposure to violence they identified as "the hardest to talk about". The UCLA PTSD Reaction Index for DSM-IV, Child Version (PTSD-RI; Pynoos, Rodriguez, Steinberg, Stuber, & Frederick, 2001), found in Appendix C, was administered to gauge the severity of PTSD symptoms in participants. Although the PTSD-RI is intended to be a self-report measure, it was administered as an interview. The current study utilized the DSM-IV version of the PTSD-RI because at the time of the study, an index based on DSM-V criteria was relatively new and little psychometric data was available. The PTSD-RI for DSM-IV is known to have strong reliability and validity (Steinberg, Brymer, Decker, & Pynoos, 2004). Roussos et al., (2005) reported an internal consistency coefficient reaching $\alpha = .90$ and Goenjian et al., 2001

reported excellent one-week test-retest reliability (α = .93) within their sample. For the current study, the internal reliability was similarly strong, α = .92. Internal reliability within symptom clusters was also acceptable.

The PTSD-RI based on the DSM-IV measures symptom criteria according to three clusters: reexperiencing, hyperarousal, and avoidance. As recommended by the scale authors, the 20-item version was administered to all youth (Steinberg et al., 2004). Each item describes a symptom of PTSD (e.g., "I watch out for danger or things that I am afraid of") and participants indicated the frequency with which they experienced the symptom during the past month on a Likert scale from 0 (none of the time) to 4 (most of the time).

Based on the total score of 17 items that correspond with the DSM–IV PTSD symptom criteria, a clinical cutoff score of 38 was used to estimate whether children presented with clinically significant PTSD symptoms (Steinberg et al., 2004). The clinical cut-point of 38 was used to create PTSD and no-PTSD groups. Participants with summed scores greater than or equal to 38 were considered to have clinically significant levels of posttraumatic symptoms and made up the PTSD group ($N$ = 12). Children with scores less than 38 made up the No-PTSD group ($N$ =32).

In addition to the clinical cutoff score, symptom cluster scores were calculated. The five items that correspond to reexperiencing symptoms demonstrated good internal consistency (α = .89). The nine items that correspond to avoidance symptoms demonstrated an alpha of .79, and the six items corresponding to hyperarousal demonstrated an alpha of .72, both of which are considered adequate levels of consistency (George & Mallory, 2003). Participants were also separated into three additional groups according to clinical levels of individual symptoms. According to the UCLA-RI (Pynoos et al., 2001), a diagnosis of PTSD includes the endorsement

of one reexperiencing, three avoidance, and two hyperarousal symptoms rated in frequency as 3 (much of the time) or 4 (most of the time) within the past month. Thus, three additional variables were created for each symptom cluster and participants were coded according to whether or not they met the criteria for symptom clusters separately. The reexperiencing group comprised of 18 participants, including all 12 members of the PTSD group and six participants who uniquely met symptom cluster criteria but not disorder criteria. The avoidance group was made up of 14 participants, 11 of whom also belonged to the PTSD group and three participants who uniquely met criteria for avoidance. Finally, the hyperarousal group comprised of 24 participants, which included all 12 members of the PTSD group in addition to 12 participants who independently met criteria for hyperarousal.

***Attention measures.*** The study utilized four subtests that represent the Broad Attention Cluster of the third edition of the Woodcock Johnson Test of Cognitive Abilities (WJ-III; Woodcock & McGrew, 2001). Developers of the WJ-III maintain that these four tasks encompass specific cognitive aspects of attention: the abilities to divide attention, attend to speech sounds, sustain attention, maintain interference control, and demonstrate attentional capacity. Research has endorsed the Broad Attention Cluster as a good indicator of attentional abilities (Gregg, Coleman, & Knight, 2003). Further, studies have used the processing tasks of Auditory Attention (Lerner & Yasutake, 2001; Ford, 2003), Pair Cancellation (Ford, 2003), Numbers Reversed, and Auditory Working Memory (Vesley, 2001; Ford, 2003) to assess attention deficits. For the current study, these subtests were further subdivided to examine Sustained Attention and Working Memory.

*Sustained attention.* Auditory Attention and Pair Cancellation were administered as per standardized administration instructions in order to assess sustained attention. The Auditory

Attention task requires both selective and sustained attention to auditory stimuli, as the participant must overcome the effects of auditory distractions to discriminate oral language. Participants are required to listen to words presented in an audio recording in the context of background noise and to point to pictures that represent the words presented. The items increase in difficulty by both sound discrimination and background noise intensity, and the task can last up to five minutes. A standard score ($M$ = 100, $SD$ = 15) was computed according to age norms and was used in analyses to indicate sustained attention abilities.

The Pair Cancellation subtest from the WJ-III was also used to assess sustained attention. The test provides information about interference control and sustained attention, as the participant is required to stay on task in a vigilant manner. The timed task requires participants to scan a paper protocol and circle each instance in which one particular item (a ball) follows another (a dog). The paper protocol consists of a continuous sequence of over 200 balls, dogs, and cups with the targeted sequence (ball, then dog) appearing sporadically, and the participant is given three minutes to complete the task. Performance is scored by subtracting the number of missed sequences or erroneously marked sequences from the number of correctly marked sequences. A standard score ($M$ = 100, $SD$ = 15) that took into account completion times was generated according to age and sex norms.

***Working Memory***. Two tasks from the WJ-III were administered according to standardized directions in order to measure working memory. Numbers Reversed and Auditory Working Memory comprise the Short Term Memory (*Gsm*) factor on the WJ-III and measure the narrow ability of working memory (Woodcock & McGrew, 2001). Numbers Reversed requires participants to hold a series of numbers in memory while performing the mental operation of reversing the number sequence. The task increases in difficulty by requiring participants to

listen, hold, and manipulate increasingly longer series of digits. Age and sex-normed standard scores ($M$ = 100, $SD$ = 15) were computed based on the number of series of digits accurately repeated backward.

The Auditory Working Memory subtest required participants to listen to an audio recording dictating a string of numbers and words (e.g., 4…orange…1…bear…7) and orally recite the words first, followed by the numbers, in the order that they were dictated (e.g., orange, bear, 4, 1, 7). Like Numbers Reversed, this task measured the ability to mentally hold and manipulate information that is no longer present in the environment. Raw scores on this task were computed based on the number of series recited accurately, which yielded standard scores ($M$ = 100, $SD$ = 15) according to age and sex.

***Depressive Symptoms***. The Mood and Feelings Questionnaire (MFQ; Angold, Costello, Messer, & Pickles, 1995) is one of the most widely used assessment tools for the screening of depression in children (Sattler, 2002) and is known to have strong reliability and validity (Angold, Costello, Messer, Pickles, Winder, & Silver, 1995). Internal consistency within the current sample was excellent ($\alpha$ = .93). Like the PTSD-RI, the MFQ was administered in an interview style. The MFQ includes 33 items that consist of descriptive phrases regarding how the subject has been feeling or acting recently. Coding reflects whether the phrase was descriptive of the subject most of the time (coded as 2), sometimes (1), or not at all (0) in the past two weeks. The 33 items were summed to create a depressive symptomotology score, with possible scores ranging from 0 to 66. A recent study suggests a clinical cutoff score of 29 or higher to indicate clinically significant depressive symptoms (Daviss et al., 2006). The mean depression score for the current study sample was 18.93 ($SD$ = 13.97). The MFQ can be found in Appendix D.

# Results

## Data Screening

Data screening techniques were conducted prior to hypothesis testing (Tabachnick & Fidell, 2001). First, the dataset was verified to ensure the accuracy of the data entry. RAs reviewed all protocols to ensure correct scoring and data entry. For one participant, Numbers Reversed and Auditory Working Memory were discontinued prematurely, and both of these subtest scores were removed from the data set. In another instance, a participant requested to stop a task of working memory, and that score was also excluded. Further, RA notes revealed three instances of significant disruption during testing. Specifically, the RA reported that noise from a nearby classroom was audible throughout one subtest, an administrator walked in during another session and distracted a participant from a task requiring sustained attention, and students walked into the testing room during a working memory task for a third participant. These three subtest scores were excluded from analyses.

Variability within participants' performance was notable in this sample. Upon examining individuals' scores on all four tasks, two participants appeared to perform significantly differently on one task compared to the other three. Developers of tests of cognitive abilities report that score discrepancies between subtest scores greater than two standard deviations have a base rate of less than 4% within the population (Wechsler, 2003). Thus, scores that were greater than two standard deviations (i.e., 30 standard score points) from the next lowest score were adjusted according to the winsorizing procedure (Kline, 2011). These scores were changed to the value of the next most extreme score among participants.

Assumptions of univariate normality were tested for the study sample of 44 participants. Skew and kurtosis for the four attention variables were within normal limits indicating that

assumptions of normality were met. The final data set included standard scores for Pair Cancellation ($N$ = 44), Auditory Attention ($N$ = 42), Numbers Reversed ($N$ = 42), and Auditory Working Memory ($N$ = 42).

Among remaining study variables, two univariate outliers on the loss variable were identified with a *z*-score greater than 3 standard deviations from the mean (Tabachnic & Fidell, 1996). These univariate outlier scores were converted to the value of the next most extreme score, according to the winsorizing procedure (Kline, 2011). Skew and kurtosis for the distribution of the loss variable was within normal limits after the winsorizing procedure. Skew and kurtosis for all other study variables were within normal limits indicating that assumptions of normality were met. Maholonobis Distances were calculated for study variables and no multivariate outliers were detected.

Finally, order effects were explored. A variable was created to indicate whether participants underwent the mental health screening or attention tasks first. Due to students' limited availability for screening and research procedures during the school day, only three participants underwent the mental health screening immediately before attention variables. A series of Fisher's exact tests revealed no differences among study variables between this group when compared to the rest of the sample. Within attention measures, a variable was created to reflect whether working memory or sustained attention measures were administered first. ANOVAs revealed no significant differences between groups among study variables.

**Descriptive Information and Intercorrelations among Study Variables**

All participants indicated some history of trauma exposure and loss. Specifically, 41 participants (93%) indicated having lost someone close to them, with a mean of 1.98 reported losses. The most frequent type of loss was related to illness or death by natural causes, which

participants also most frequently indicated as their identified trauma (45%). Thirty-one participants (71%) reported exposure to violence in their neighborhoods and homes at least three times. Table 1 highlights differences in these variables between the PTSD and No-PTSD groups.

Bivariate Pearson and point biserial correlations among study variables were computed and are presented in Table 2. Correlation coefficients revealed many moderate to strong relations between variables. PTSD and depression were significantly related to each other ($r$ = .77, $p$ < .01), as well as to children's exposure to community violence and loss. Specifically, exposure was significantly related with both depression ($r$ =.53) and PTSD ($r$ = .38*)* at the .01 level. Loss was significantly related to depression ($r$ = .49) and PTSD ($r$ = .37) at the .01 level. Loss was also related to exposure at the .05 level ($r$ = .35).

Tasks of attention varied in their relationship to one other. In the standardization sample, correlations among these four subtests ranged from .19 to .39. In the current sample, correlations among subtests ranged from .03 to .45 (McGrew & Woodcock, 2001). Although the magnitude of correlations was generally the same, the small sample size of the current study limited the ability to demonstrate statistically significant associations. Participants' performance on Pair Cancellation was significantly related to Numbers Reversed ($r$ = .45, p < .01) and to Auditory Working Memory ($r$ = .30, p < .05). Numbers Reversed was marginally related to Auditory Working Memory ($r$ = .26, p < .10).

Bivariate correlations also revealed relationships between demographic and mental health variables and attention variables, particularly the task of Pair Cancellation. Specifically, males ($r$ = -.33) and younger children ($r$ = -.36) performed significantly better on the task of sustained attention. Exposure to community violence (r = -.36) and depressive symptoms (r = -.34) were both significantly negatively associated with performance on Pair Cancellation at the .05 level.

PTSD symptoms also trended negatively with performance on the sustained attention task ($r$ =-.27) at the .10 trend level.

**Tests of Hypotheses**

**Hypothesis one.** To test whether children with clinically significant symptoms of PTSD performed differently than children without PTSD on tasks of sustained attention and working memory, two one-way (PTSD vs. No-PTSD) multivariate analyses of variance (MANOVAs) were conducted. First, the two indices of sustained attention were entered as dependent variables and PTSD group served as the independent variable. Results revealed that children with clinical levels of PTSD performed significantly worse on tasks of sustained attention than children without the disorder ($F$ 1,40) = 3.41, $p$ <. 05). Univariate ANOVAs revealed that the sustained attention task of Pair Cancellation ($\eta_p^2$ = .12) drove the effect *(M PTSD group* = 89.92, *SD* = 10.64 vs. *M no-PTSD group* = 96.97, *SD* = 8.19). A series of MANCOVAs were conducted to examine whether this finding could be maintained after controlling for important covariates. When controlling for loss, results remain significant, as children with clinical levels of PTSD performed significantly worse on tasks of sustained attention than children without the disorder ($F$ 2, 39) = 3.18, $p$ <. 05). Results held at the trend level when controlling for sex ($F$ 2, 39) = 2.60, $p$ <. 10), age ($F$ 2, 39) = 2.77, $p$ <. 10), and for exposure to community violence ($F$ 2, 39) = 2.00, $p$ <. 10). The group difference was no longer significant, even at the trend level, when controlling for depressive symptoms. However, group means remained in the same direction as the findings reported above for Pair Cancellation *(M PTSD group* = 91.90 vs. *M no-PTSD group* =96.14).

In the second MANOVA, the two indices of working memory were entered as dependent variables and PTSD group was entered as the independent variable. The results of the working

memory MANOVA were not significant. Table 3 displays means and standard deviations for each task, divided by PTSD group.

**Hypothesis two.** To examine whether children with clinically significant symptoms at each cluster level performed differently than children without significant symptoms on tasks of sustained attention and working memory, a series of multivariate analyses of variance (MANOVAs) were conducted. First, the two sustained attention tasks served as the dependent variables for three separate MANOVA analyses, one for each symptom cluster. Next, the two working memory tasks served as the dependent variables for each symptom cluster analysis. Results are displayed in Tables 4, 5, and 6.

Regarding sustained attention, no statistically significant relationships were observed between groups of participants who met criteria for the reexperiencing symptom cluster and participants who did not; however, a trend-level effect was observed between groups of participants who met criteria for the avoidance symptom cluster and those who did not. Participants with clinical levels of avoidance symptoms tended to perform more poorly than those without clinical levels of symptoms on tasks of sustained attention [$F(1, 40) = 2.59$, $p < .10$; $\eta_p^2 = .12$). Another trend-level effect was observed between groups of participants who met criteria for the hyperarousal symptom cluster and those that did not. Participants with clinical levels of hyperarousal symptoms tended to perform more poorly than those without clinical levels of symptoms on tasks of sustained attention [$F(1, 40) = 2.56$, $p < .10$; $\eta_p^2 = .12$). No statistically significant relationships were observed between either of the working memory tasks and any of the symptom clusters.

## Discussion

The current study expands the limited literature examining attention deficits in children with PTSD symptoms. As hypothesized, children with PTSD symptoms generally demonstrated impairments in sustained attention but not in working memory. The findings from the current study appear to suggest that development plays a critical role in different areas of attention; however, a critical examination and interpretation of the results warrant more research within the area of PTSD and attention in children, particularly in the realm of working memory function.

### *Sustained Attention in Children with PTSD Symptoms*

Sustained attention involves continuous maintenance of alertness over time (Davies, Jones, & Taylor, 1984). Results revealed some support for sustained attention deficits when comparing children with clinically significant symptoms of PTSD to children without significant symptoms of the disorder. Analyses revealed a large effect size ($\eta_p^2 = .15$; Cohen, 1988; Miles & Shevlin, 2001) between PTSD and no-PTSD groups when considering performance on both tasks. Further, on Pair Cancellation, the specific task that drove the effect, group membership explained approximately 12% of variance in performance. These findings indicate that participants with clinically significant symptoms experienced more difficulty completing a paper-and-pencil visual task under time constraints ($M = 89.92$) when compared to performance of participants without clinically significant PTSD symptoms ($M = 96.97$). Results suggest that individuals who meet symptom criteria for PTSD experience difficulty remaining vigilant while performing the attention task for an extended period of time. Notably, on both tasks of sustained attention, the average performance of participants with PTSD fell within the Low Average range as compared to participants without clinically significant symptoms, whose performance fell in the Average range (McGrew & Woodcock, 2001).

The observed group differences in sustained attention appear to be driven by specific symptom clusters. Specifically, participants with significant hyperarousal and avoidance symptoms tended to perform worse on sustained attention tasks compared to those without clinical symptoms in these clusters. Further, although results were not statistically significant, means on the task of Auditory Attention were very discrepant when comparing participants with clinically significant reexperiencing symptoms.

Although results were only trend-level, the association between the hyperarousal symptom cluster and tasks of sustained attention was anticipated. Symptoms of hyperarousal have been associated with generally heightened SNS activity and a hyper-responsive amygdala (Southwick et al., 2005). Over time, the vmPFC, which is tasked with extinguishing emotional responses signaled by the amygdala, may fail to adaptively maintain control. The failure of this structure to regulate the amygdala may eventually lead to persistent hyperarousal that may be detrimental to attention. Individuals who are chronically hyperaroused may have trouble managing their heightened state and concentrating on stimuli for several minutes at a time, akin to the demands of sustained attention tasks.

The association between the avoidance symptom cluster and sustained attention was not hypothesized. As previously discussed, researchers suggest that the vmPFC and associated areas (i.e., anterior cingulate cortex [ACC], subcallosal cortex, and orbitofrontal cortex) undergo decreased activity when processing stressful events, resulting in chronic dysfunction (See Rauch, Shin, & Phelps, 2006; Rauch, Shin, & Pitman, 1998; Carrion et al., 2009; Rauch et al., 2006). Researchers further assert that this dysfunction may contribute to the avoidance cluster of symptoms, particularly in the area of emotional numbing (Leskin & White, 2007). Drawing from research on adults exposed to traumatic stress and animal models of inescapable shock, Litz

et al. (1997, 2000) theorizes that emotional numbing may result from exhaustion due to prolonged periods of arousal, and that numbing symptoms are caused by the depletion of cognitive and emotional resources. Litz and his colleagues propose that individuals with PTSD expend considerable cognitive, behavioral, and emotional energy managing hyperarousal symptoms. The cognitive load from managing symptoms may reduce individuals' affective capacity, resulting in emotional numbing. Research on adults (Flack, Litz, Hsieh, Kaloupok, & Keane, 2000) and children (Weems, Saltzman, Reiss, and Carrion, 2003) support this theory. Specifically, in his sample of forty-two children between the ages of 7 and 14, Weems et al. (2003) collected PTSD symptom data at two time points and found that emotional numbing was related to hyperarousal symptoms, and that Time 1 hyperarousal predicted Time 2 emotional numbing, even when controlling for other symptoms of PTSD. Weems et al.'s (2003) study demonstrates the link between hyperarousal and avoidance symptoms. Results from the current study, showing associations between tasks of sustained attention and both hyperarousal and avoidance symptom clusters, supports this research.

Results from the current study did not reveal a statistically significant association between reexperiencing symptoms and sustained attention. However, an examination of means shows that on average, participants with clinically significant reexperiencing symptoms ($M$ = 88.35; $SD$ =12.50) performed worse when compared to participants without clinically significant symptoms ($M$ = 95.52; 11.66). In fact, analyses revealed a medium to large effect size ($\eta_p^2$ = .09; Cohen, 1988; Miles & Shevlin, 2001). Due to a relatively low $N$ and accompanying low power, the medium to large effect remained statistically undetected. Still, the large discrepancy in means between groups in regards to reexperiencing is notable. The general pattern of cognitive difficulty restraining unwanted or non-relevant thoughts caused by reexperiencing

symptoms (See Vasterling et al., 1998; and Shimamura, 1996) may partially explain participants' difficulty focusing goal-directed behavior within the task of Auditory Attention.

Although the possibility exists that children with reexperiencing symptoms struggle with tasks that require sustained attention, it is also possible that the cognitive difficulty associated with this cluster is apparent during actual intrusive thoughts, but not during the time when reexperiencing symptoms are inactive. Individuals actively undergoing reexperiencing symptoms must devote cognitive resources to thought suppression and controlling arousal, which may lead to difficulty focusing on goal-directed behavior (See Vasterling et al., 1998; and Shimamura, 1996); however, during times when individuals are not undergoing intrusive thoughts and do not necessitate the devotion of cognitive resources, the ability to sustain attention may remain intact. Thus, more research exploring the symptom-specific effects on attention is necessary.

### *Working Memory in Children with PTSD Symptoms*

No statistically significant group differences of working memory were found between children with or without clinical levels of PTSD within the current sample. Further, no significant differences were found at the symptom-level, between participants who experienced clinical levels of reexperiencing, hyperarousal, and avoidance symptoms and those who did not. Effect sizes for group differences in working memory were small to medium in regards to reexperiencing (Miles & Shevlin, 2001; $\eta_p^2 = .06$), hyperarousal ($\eta_p^2 = .02$), and avoidance symptom clusters ($\eta_p^2 = .07$), and consistently lower than effect sizes for group differences in sustained attention (see tables 4, 5, and 6). where. Results from the current study align with previous research that did not demonstrate a significant deficit in working memory in children with PTSD (Beers & De Bellis, 2002; Samuelson et al., 2010) and support the idea that working

memory impairments related to PTSD emerge later in development. However, closer examination of performance on each of the working memory tasks reveals inconsistency, rendering findings difficult to interpret.

Current findings revealed no differences in performance between participants on the task of Numbers Reversed, as average performance fell within the Low Average range (Woodcock, Mather, & McGrew, 2001) for both groups. The similarity in performance between groups is unique among the four tasks in the current study, as participants without clinically significant levels of PTSD performed within the Average range on the other three tasks. Participants' performance on Numbers Reversed may suggest that working memory deficits are not yet apparent in children and early adolescents. These results align with previous research that failed to demonstrate a significant deficit in working memory in children with PTSD (Beers & De Bellis, 2002; Samuelson et al., 2010), and support the theory that while working memory deficits in individuals may be related to PTSD, impairments are not evident in childhood due to a biological process that protects working memory in children. Specifically, research suggests that the hippocampus is activated in children during tasks of working memory (Finn et al., 2010). For children, structural damage to the PFC caused by prolonged activation of the stress response may not be impactful for engaging in tasks of working memory due to the hippocampus helping to "drive" performance. This process does not hold throughout adulthood, as research shows that reliance on the hippocampus during tasks of working memory fades (Finn et al., 2010). Adults rely solely on frontal lobe structures, mainly the PFC, to complete tasks of working memory. Because frontal lobe structures are impacted by stress, working memory functioning is vulnerable in adults with PTSD (Samuelson et al., 2006; Gil et al., 1990; Brandes et al., 2002).

Findings within Auditory Working Memory, the other working memory task employed in the current study, contrast results within the Numbers Reversed task. Participants performed similarly on the task of Auditory Working Memory as they did on both tasks of sustained attention; that is, participants with clinically significant levels of PTSD performed worse, within the Low Average range according to scale developers (Woodcock, Mather, & McGrew, 2001), than participants without clinical levels of the disorder, who performed within the Average range. Also, more variability was observed within participants without PTSD symptoms on Auditory Working Memory when compared to performance on both tasks of sustained attention. It is notable that though both tasks of working memory in the current study required individuals to hold and rearrange information in their mind, items presented within the Auditory Working Memory task are more conducive to visualization strategies (e.g., imagining a bear or an orange, versus numbers only). The use of visualization strategies may help explain some variability within the task. Regardless, differing performance between groups on tasks of Auditory Working Memory may suggest that working memory deficits begin to emerge within this stage of development. Further, at the symptom-level, a discussion of effect size is warranted. Within the task of Auditory Working Memory, a medium effect ( $\eta_p^2 = .09$; Cohen, 1988; Miles & Shevlin, 2001) was statistically undetected, once again due to low power. This suggests the possibility that a larger sample may bring to light significant differences between groups regarding the Auditory Working Memory task.

On the surface, findings from the present study support that working memory deficits related to PTSD emerge later in development. However, closer examination of performance on tasks, particularly Auditory Working Memory, reveals a contrast between tasks that make it difficult to determine whether or not deficits have emerged. Accordingly, further research is

needed within the area of working memory and PTSD among children. This line of research is better established in adults (Samuelson et al., 2006; Gil et al., 1990; Brandes et al., 2002), and future research should expand towards younger populations.

### *Implications of Study Findings*

Results of the current study have important implications for children with PTSD. School represents a context in which children's ability to focus and pay attention is critical. Sustained attention skills are necessary to perform academically, as students must be able to attend to lessons for several minutes at a time. Sustained attention is also a critical skill for completing behavioral tasks in the school environment. For example, a degree of sustained attention is necessary at all grade levels to attend to classroom lectures, complete class and home assignments, and maintain focus on school-related tasks for extended periods of time. Persistent difficulty with any of these tasks may result in poor academic performance and behavioral problems; in fact, recent research has linked PTSD symptoms to failing a class or grade, problematic relationships with peers and teachers, school suspensions, and even arrest (Lipschitz, Rasmusson, Anyan, Cromwell, & Southwick, 2000; Bolton, Hill, & O'Ryan, 2004; McLean, Rosenbach, Capaldi, & Foa, 2013). Results of two studies suggest that attention problems at least partially explain this phenomenon (Husain et al., 2008; Matthews & Overstreet, 2006).

The failure to find deficits in working memory performance have different implications for the school setting, as working memory corresponds to other classroom skills. Specifically, working memory is important in the development of early reading skills, as children must visually process and decode words, "holding" text in their minds (Samuelson et al., 2006). In fact, research shows that children with reading problems also experience difficulties in working memory (Swanson & Ashbaker, 2000; Wang & Gathercole, 2013). On a more global level,

children employ working memory skills to follow teachers' step-wise directions, during some instructional lessons (e.g., when solving complex math problems requiring several steps) and to perform certain behavioral tasks (e.g., following the proper sequence for cleaning up or finishing work in one area of the classroom before moving to another). Results from the current study do not clearly indicate working memory deficits in children with PTSD; however, there is limited research that explores this area. Because working memory functions are essential for an array of educational activities, more research in this area is called for.

The current study is unique in having utilized an auditory sustained attention task. Most studies that evaluate sustained attention solely use visual tasks similar to Pair Cancellation, where participants attend to visual stimuli. The Auditory Attention task used in the current study required individuals to employ auditory ability to discriminate target stimuli. The ability to attend to stimuli in an auditory modality is important in the context of school, as lessons involve verbal explanations and instruction, requiring sustained auditory attention. Results suggesting that children with moderate PTSD symptoms may have difficulty sustaining auditory attention task has implications for supportive school interventions. For example, children with PTSD may require verbal directions to be repeated several times, beyond what is necessary for children without mental health symptoms.

Results of the current study also have implications for the evaluation and treatment of PTSD in children. Evidence from research and clinical experience highlights significant advances in the assessment and treatment of the disorder (Cohen, 2010), which include recommendations to determine the severity of symptoms and degree of functional impairment. As sustained attention deficits in children may impact academic performance, employing test batteries that specifically evaluate children's cognitive strengths and weaknesses addresses the

need for evaluating functional impairments. This type of information can inform the design of school interventions for students with the disorder.

Careful diagnosis of PTSD is especially important given the potential misdiagnosis of attention deficit hyperactivity disorder (ADHD) among school-age children. Researchers have identified and illustrated how symptoms of both disorders, such as inattention and hyperactivity, may be inappropriately attributed to one disorder over the other (Cuffe, McCullough, & Pumariega, 1994; Weinstein, Staffelbach, & Biaggo, 2000; Wozniak et al., 1999). Although research has recently attended to the symptom overlap and problem of misdiagnosis of the two disorders, it is unclear whether teachers and administrators understand the extent to which PTSD can affect attention. Results from the current study add to the literature underlining the importance for assessing inattentive behavior to make accurate diagnoses.

Further, the relationship between sustained attention deficits related to PTSD may potentially impact mental health programming in schools. Given the connection between mental health and academic success, the movement towards trauma informed care (TIC) is gaining traction in school and community mental health research and practice (Ko et al., 2008; Brown, Baker, & Wilcox, 2012). TIC is grounded in the idea that treatment systems and practices should ameliorate the negative effects of trauma (Elliott, Bjelacjac, Fallot, Markoff, & Reed, 2005). Trauma-informed care in the school environment involves a deeper understanding of how trauma affects child development and the incorporation of effective evidence-based interventions to address traumatic reactions (Walkley & Cox, 2013). School-based clinicians may use study findings to advocate for services that address PTSD symptoms, which in turn may have a positive effect on mental health.

In terms of specific mental health programming in schools, research shows that cognitive behavioral therapy (CBT) is the most effective type of intervention in reducing symptoms of PTSD in children (Cohen & Mannarino, 2008; Cohen et al., 2002). The psychoeducation and coping strategies that are taught during treatment sessions are akin to an academic lesson, as they require focus and application, and higher-order cognitive skills are required to connect thoughts, emotions, and behavior (Cohen & Mannarino, 2008; Kendall, 2000). Children who experience difficulty sustaining attention may be unable to process the skills and strategies involved in treatment and will ultimately be unable to implement coping strategies outside of therapy. Thus, clinicians implementing CBT with PTSD-affected children should be mindful of attention problems that could serve as a barrier against treatment effectiveness. Clinicians should be prepared to modify lessons (e.g., move at a slower pace, encourage participation to verify children's understanding of concepts) or find other treatment modalities for children with more severe or apparent attention problems.

### *Study Limitations and Areas for Future Research*

Recruiting participants was a challenge in the current study, and several reasons may have contributed to the low participation rate. First, the parent notification packet containing the research consent was one of many packages delivered by students to their families for review throughout the school year. Stein and his colleagues (2007) report that rates for participation in research conducted in schools may be substantially higher when the consent form and accompanying materials are provided directly to parents rather than distributed in the classroom to be sent home with students. Second, of the families that consented to participating in the community agency's mental health screening, less than half (42%) consented to participating in the current research study. The parent notification packet that was sent home with students may

have been overwhelming to families reviewing the contents. The packet contained a lengthy consent for treatment from the community agency. Parents and students may have neglected to read about the research study and provide consent, having already reviewed the most pertinent items. As a result, considerably less consents were sent home to families and returned by students than anticipated.

Although recruitment procedures limited the sample size, a reasonably representative sample of urban youth was achieved, in that all participants in the study underwent at least some exposure to trauma and loss and over a quarter of participants experienced clinical levels of PTSD, which is consistent with previous research on trauma-exposed children (Fletcher, 1996). In order to increase participation rates in the future, researchers may consider which modality is best in contacting and presenting research to families. For example, researchers may consider attending an open house or parent night and speak directly to families, explaining the research study and purpose, and gaining investment from families. Greater participation rates might also be achieved through clinical settings, where consent can be obtained from parents more easily. However, recruiting in clinical settings may result in enrolling more participants with clinically significant symptoms of PTSD and a dearth of exposed participants without the disorder, which would pose a barrier in comparing attention performance between groups of participants.

The current study sample size was small, which precluded a meaningful examination of control variables. The small sample limited power in analyses, and the addition of control variables further reduced power. Because the recruitment of youth participants with PTSD is generally challenging and studies in this area tend to use small samples, some researchers have used different approaches to control for variables. For example, De Bellis et al. (2009) included three groups in their study: a non-exposed control group, an exposed depression group without

clinically significant symptoms of PTSD, and a clinically significant PTSD group. This design allowed for closer examination of the unique effects of clinically significant PTSD symptoms.

Including a third exposed group without clinical levels of PTSD allows researchers to compare performance to individuals with PTSD and examine specific effects of the disorder. Some researchers argue that studies including PTSD samples with comorbid disorders limit specificity, as attention deficits cannot be attributed solely to PTSD, but also by symptoms of other conditions (Meewisse et al., 200). Thus, some researchers have excluded participants who meet criteria for other mental health conditions from both PTSD and comparison groups (e.g., Jenkins et al., 2000; Saigh et al., 2002). Other researchers (e.g., Vasterling et al., 1998, 2002) have chosen to include PTSD participants who suffer from common comorbid conditions. Studies that allow for common comorbidities may yield results that are more ecologically valid, given the high rates of comorbidity of a range of other disorders in youth with PTSD (Carrion, Weems, Ray et al., 2002; Cuffe et al., 1994; Famularo et al., 1996; Mazza & Reynolds, 1999; McLeer et al., 1994; Merry & Andrews, 1994). In fact, McFarland and Yehuda (1995) stated that the presence of PTSD and the absence of another psychiatric disorder is the exception rather than the rule.

Studies that include participants who suffer from PTSD and other comorbid disorders may be more representative of PTSD populations than samples without comorbid conditions. The current study included individuals with depressive symptoms, but controlling for these symptoms resulted in the failure to conduct meaningful analyses due to a small sample size. In order for researchers to more thoroughly examine the effects of PTSD, future studies should consider designs that include multiple groups in order to maximize the specificity of PTSD symptom effects. Specifically, given the high correlation between symptom levels of depression

and PTSD within the current sample and in children exposed to trauma generally, specificity of PTSD symptom effects may be best examined when comparing four groups: a non-exposed control group, an exposed depression-only group, a group with clinically significant depression and PTSD symptoms, and a group with clinically significant PTSD symptoms only. A research study structured in this way would help better confirm conclusions that group differences are specific to PTSD.

The current study measured PTSD using an index that adhered to the DSM-IV criteria for the disorder. Since the inception of the study design, new measures have become available based on the DSM-V criteria for PTSD. For example, similar to the UCLA-RI for DSM-IV, the UCLA PTSD Reaction Index for DSM-V (Pynoos & Steinberg, 2014), includes a trauma exposure history profile and a symptom overview with a frequency scale. The newer version includes four questions regarding dissociative symptoms to aid in the diagnosis of a Dissociative Subtype. Most relevant to the present study, the scale divides the original 9 questions of the DSM-IV avoidance symptom cluster into two separate clusters. Specifically, two questions represent the avoidance cluster, and 13 questions address negative cognitions and mood. According to theory regarding avoidance symptoms (Litz et al., 1997, 2000), emotional numbing may be the result of attempts to manage hyperarousal symptoms. Studies that utilize PTSD rating scales such as the UCLA-RI for DSM-IV (Pynoos & Steinberg, 2013), which include emotional numbing symptoms with the Negative Cognitions and Mood cluster, may continue to demonstrate a relationship between this cluster and sustained attention performance. However, given the reduced questions for the avoidance cluster in some measures based on the DSM-V, and the general difficulty that researchers have experienced in child self-reports of this symptom

(See Scheeringa, 2006), it is possible that a relationship between this cluster and tasks of attention will not be detected.

Finally, attention deficits were not assessed in conjunction with behavioral rating scales or behavioral observations of real world task performance. As a result, the effects of findings on daily functioning are an approximation. Given research that has revealed findings of attention-related problems observed in children with PTSD using behavior rating scales (Saigh et al., 2002), future work may incorporate rating scales from multiple reporters in the assessment of attention deficits. Future studies may also consider incorporating behavioral observations in the natural environment to examine how deficits in specific areas of attention relate to specific real-world tasks. For example, children with PTSD may be observed during a lesson or task that requires continuous attention for several minutes.

Table 1. *Descriptive Statistics for PTSD and No-PTSD Groups*

| | PTSD ($n$ = 12) | | | | No-PTSD ($n$ = 32) | | |
|---|---|---|---|---|---|---|---|
| | *Mean* | *SD* | Range | | *Mean* | *SD* | Range |
| Sex | 92% Female | | | | 68% Female | | |
| Age (years) | 12.59 | 1.29 | 10.46 – 14.48 | | 12.11 | 1.16 | 8.98 – 14.11 |
| Grade | 6.17 | 1.11 | 4 - 8 | | 5.94 | .91 | 3 - 7 |
| Exposure to Violence[1] | 3.00 | 1.21 | 2 - 6 | ** | 2.06 | 1.05 | 0 – 4 |
| Number of Losses[2] | 2.83 | 2.66 | 0 – 8 | ** | 1.66 | 1.00 | 0 – 4 |
| PTSD Symptomatology[3] | 47.92 | 7.04 | 38 – 59 | + | 16.50 | 8.39 | 1 - 31 |
| Depressive Symptomatology[4] | 33.17 | 14.11 | 5 - 50 | + | 13.59 | 9.60 | 1 - 41 |

*Note.* [1] $F$ (1,42) = 6.46, $p$ <. 05; **
[2] $F$ (1,42) = 4.66, $p$ <. 05 **
[3] By UCLA PTSD Reaction Index, $F$ (1,42) = 132.57, $p$ <. 00 +
[4] By Mood and Feelings Questionnaire, $F$ (1,42) = 27.81, $p$ <. 00 +

Table 2. *Intercorrelations among Study Variables*

| Variable | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Sex | .28* | .28* | .12 | -.01 | .13 | .15 | -.11 | -.33** | -.27 | -.17 |
| 2. Age | | .85+ | .18 | -.19 | -.05 | .01 | .03 | .36** | -.09 - | -.16 |
| 3. Grade | | | .13 | -.24 | -.17 | -.05 | .22 | -.18 | -.07 | -.05 |
| 4. Exposure to Violence | | | | .35** | .53+ | .38+ | -.08 | -.36** | -.05 | -.15 |
| 5. Losses | | | | | .49+ | .37+ | -.14 | -.20 | .01 | -.10 |
| 6. Depressive Symptomatology | | | | | | .77+ | -.18 | -.34** | -.08 | -.27* |
| 7. PTSD (PTSD-RI | | | | | | | -.20 | -.27* | .03 | -.21 |
| 8. Auditory Attention | | | | | | | | .23 | .04 | .14 |
| 9. Pair Cancellation | | | | | | | | | .45+ | .30** |
| 10. Numbers Reversed | | | | | | | | | | .26* |
| 11. Auditory Working Memory | | | | | | | | | | |

*Note*. Sex is coded 0 (Male), 1 (Female); Loss indicated number of people close to participant who have died; Exposure to CV indicates score on exposure to community violence scale; PTSD-RI (PTSD Reaction Index); Higher scores indicate better task performance.

* $p$<.10; **$p$ < .05; + $p$ < .01

Table 3. *Analyses of Variance between PTSD and No-PTSD Groups*

| Attention Type and Task | PTSD | | | No-PTSD | | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *SD* | *N* | *Mean* | *SD* |
| **Sustained Attention** | | | | | | |
| Auditory Attention | 12 | 87.83 | 13.73 | 30 | 94.53 | 11.48 |
| Pair Cancellation | 12 | 89.92 | 10.64 | 32 | 96.97 | 8.19 |
| **Working Memory** | | | | | | |
| Numbers Reversed | 11 | 88.18 | 16.40 | 31 | 88.13 | 12.30 |
| Auditory Working Memory | 11 | 89.63 | 9.97 | 31 | 97.55 | 14.34 |

*Note*. Standard scores; higher scores indicate better performance ($M = 100$, $SD = 15$)
* $p<.10$; ** $p < .05$; + $p < .01$

Table 4. *Re-Experiencing Cluster Analyses*

| | df (Group, Error) | *F* | $\eta_p^2$ | Re-Experiencing | | | No Re-Experiencing | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *N* | *Mean* | *SD* | *N* | *Mean* | *SD* |
| **Sustained Attention** | **1, 40** | **1.82** | **.09** | | | | | | |
| Auditory Attention | | | | 17 | 88.35 | 12.50 | 25 | 95.52 | 11.66 |
| Pair Cancellation | | | | 17 | 93.65 | 11.55 | 25 | 95.80 | 7.59 |
| **Working Memory** | **1, 39** | **1.29** | **.06** | | | | | | |
| Numbers Reversed | | | | 16 | 91.56 | 14.54 | 25 | 86.36 | 12.40 |
| Auditory Working Memory | | | | 19 | 93.94 | 10.76 | 25 | 96.88 | 15.46 |

* $p<.10$; ** $p < .05$; + $p < .01$

Table 5. *Hyperarousal Cluster Analyses*

| | df (Group, Error) | *F* | $\eta_p^2$ | Hyperarousal | | | No Hyperarousal | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *N* | *Mean* | *SD* | *N* | *Mean* | *SD* |
| **Sustained Attention** | **1, 40** | **2.56*** | **.12** | | | | | | |
| Auditory Attention | | | | 24 | 89.29 | 12.56 | 18 | 97.06 | 10.93 |
| Pair Cancellation | | | | 24 | 93.33 | 10.29 | 18 | 97.06 | 7.63 |
| **Working Memory** | **1, 39** | **.32** | **.02** | | | | | | |
| Numbers Reversed | | | | 22 | 89.32 | 14.32 | 19 | 87.32 | 12.43 |
| Auditory Working Memory | | | | 22 | 94.72 | 10.50 | 19 | 96.89 | 16.99 |

* $p<.10$; ** $p < .05$; + $p < .01$

Table 6. *Avoidance Cluster Analyses*

| | df (Group, Error) | *F* | $\eta_p^2$ | Avoidance | | | No Avoidance | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *N* | *Mean* | *SD* | *N* | *Mean* | *SD* |
| **Sustained Attention** | **1, 40** | **2.59*** | **.12** | | | | | | |
| Auditory Attention | | | | 14 | 90.07 | 13.53 | 28 | 93.89 | 11.81 |
| Pair Cancellation | | | | 14 | 90.57 | 9.85 | 28 | 97.11 | 8.40 |
| **Working Memory** | **1, 39** | **1.44** | **.07** | | | | | | |
| Numbers Reversed | | | | 13 | 88.62 | 16.35 | 28 | 88.29 | 12.05 |
| Auditory Working Memory | | | | 13 | 90.69 | 10.24 | 28 | 98.07 | 14.68 |

* $p<.10$; ** $p < .05$; + $p < .01$

## Appendix A

### Experience Survey (Salloum, 2006: revised 6/2008)

**SAY:** First I am going to ask you whether you have had someone close to you die.

1. Have you had a family member or someone close to you die? **Circle:** Yes or No

If you circled yes…

2. About how many people close to you have died? _____
   (If more than 5, ask them to tell you about the 5 people they were closest to)

**SAY:** Now I would like you to tell me more about each person who has died. [For each person indicated, ask the child who the person was, how s/he died, when s/he died, and whether the child witnessed the death. NOTE…you may need to help the child identify time of death by providing anchors, like asking them how old they were or what grade they were in when it happened, etc.]

| | YEAR/MONTH | WHO/RELATIONSHIP | WITNESSED | |
|---|---|---|---|---|
| Homicide (was killed by someone else) | _____ | _____ | yes | no |
| Suicide (they killed themselves) | _____ | _____ | yes | no |
| AIDS | _____ | _____ | yes | no |
| Drowning | _____ | _____ | yes | no |
| Drowning/Katrina | _____ | _____ | yes | no |
| Died/Katrina | _____ | _____ | yes | no |
| Natural Causes (like old age) | _____ | _____ | yes | no |
| Accident | _____ | _____ | yes | no |

| | | | | |
|---|---|---|---|---|
| Heart Attack | _____ | _____ | yes | no |
| Cancer | _____ | _____ | yes | no |
| Other | _____ | _____ | yes | no |

Please make notes about each death the child identifies along with any important details mentioned about the funeral or aftermath:

_____

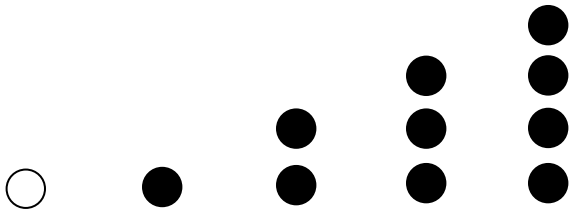
_____

_____

## Appendix B

**Violence Exposure Survey**
(adapted from Richters and Martinez, 1990)

USE LAMINATED RATING SHEET SCALE TO TEACH CHILD RESPONSE FORMAT
**SAY**: Answer the statements based on things you have seen in REAL LIFE only, NOT what you have seen on TV, in movies, or in video games. Tell me the number of times you have seen the following.



| How Often: | 0 Times | 1 Time | 2 Times | 3 Times | Many Times |
|---|---|---|---|---|---|
| 1. I have heard guns being shot | 0 | 1 | 2 | 3 | 4 |
| 2. have seen somebody get stabbed | 0 | 1 | 2 | 3 | 4 |
| 3. I have seen somebody get shot | 0 | 1 | 2 | 3 | 4 |
| 4. I have seen a dead body outside or in my home | 0 | 1 | 2 | 3 | 4 |
| 5. I have seen someone being beat up | 0 | 1 | 2 | 3 | 4 |
| 6. I have seen somebody in my home get shot or stabbed | 0 | 1 | 2 | 3 | 4 |

Notes (After going through the survey, please ask child to tell you about each item they have experienced and write info obtained her in notes):

_____

_____

_____

## Appendix C

### Posttraumatic Stress Disorder Reaction Index (PTSD-RI)

**Write the trauma/loss that the child identified as the *hardest to talk about***:

_____

_____

**SAY**: Please **THINK** about [***name the hardest to talk about event***]. Then, **TELL ME** how often the problem has happened to you ***in the past two weeks***. Use the **Rating Sheet** to help you decide how often the problem has happened in the past two weeks.

Give the child the **Rating Sheet**.

**SAY**: Lets try one for practice. How often or how much of the time during the past two weeks have you had purple teeth? [You may need to help the child with an anchor in time. For the pre-screen, its likely been about two weeks since school has started, so you could say…like since school has started).

**EXPLAIN**: Each of these calendars is two weeks. The one that says None/Never doesn't have any X's in it because the problem hasn't happened at all in the past two weeks. The one that says Little/One Time Each Week as two X's in it because the problem has happened a little bit, or a couple of times. The ones that say Some and Much have a few more X's in them because the problem has happened more often. And the one that says Most/Almost Everyday has an X for most days because the problem happens so much.

**SAY:** So how often or how much of the time during the past two weeks have you had purple teeth? [If the child is having a hard time understanding the time concept, try another couple of examples until they are able to get the hang of it].

**SAY**: Now, **THINK** about [***name the hardest to talk about event***]. Then, **TELL ME** how often each of these problem has happened to you ***in the past two weeks***. Use the **Rating Sheet** to help you decide how often the problem has happened in the past two weeks.

**PLEASE BE SURE TO ANSWER ALL THE QUESTIONS**

| **Before each item, SAY: *HOW MUCH OF THE TIME DURING THE PAST TWO WEEKS…*** | **None** | **Little** | **Some** | **Much** | **Most** |
|---|---|---|---|---|---|
| 1 D4 Have you watched out for danger or things that you are afraid of? | 0 | 1 | 2 | 3 | 4 |
| 2 B4 When something reminded you of [***identified trauma***], did you get very upset, afraid or sad? | 0 | 1 | 2 | 3 | 4 |
| 3 B1 Have you have upsetting thoughts, pictures, or sounds of [***identified trauma***] come into your mind when you did not want them to? | 0 | 1 | 2 | 3 | 4 |
| 4 D2 Did you feel grouchy, angry or mad? | 0 | 1 | 2 | 3 | 4 |

| **Before each item, SAY: *HOW MUCH OF THE TIME DURING THE PAST TWO WEEKS…*** | **None** | **Little** | **Some** | **Much** | **Most** |
|---|---|---|---|---|---|
| 5 B2 Have you had dreams about [***identified trauma***] or other bad dreams? | 0 | 1 | 2 | 3 | 4 |
| 6 B3 Did you feel like you were back in time when the [***identified trauma***] happened, living through it again? | 0 | 1 | 2 | 3 | 4 |
| 7 C4 Did you feel like staying by yourself and not being with your friends? | 0 | 1 | 2 | 3 | 4 |
| 8 C5 Did you feel alone inside and not close to other people? | 0 | 1 | 2 | 3 | 4 |
| 9 C1 Did you try not to talk about, think about, or have feelings the [***identified trauma***]? | 0 | 1 | 2 | 3 | 4 |
| 10 C6 Did you have trouble feeling happiness or love?<br>**PROMPT:** Do you understand that question?<br>**IF NEEDED**: How much of the time during the past two weeks has it been hard to feel happy? | 0 | 1 | 2 | 3 | 4 |
| 11 C6 Do you have trouble feeling sadness or anger?<br>**PROMPT:** Do you understand that question?<br>**IF NEEDED**: How much of the time during the past two weeks has it been hard to feel sad or angry? | 0 | 1 | 2 | 3 | 4 |
| 12 D5 Did you feel jumpy or startle easily, like when you heard a loud noise or when something surprised you? | 0 | 1 | 2 | 3 | 4 |
| 13 D1 Did you have trouble going to sleep or wake up often during the night? | 0 | 1 | 2 | 3 | 4 |
| 14 AF Did you think that some part of the [***identified trauma***] is your fault? | 0 | 1 | 2 | 3 | 4 |
| 15 C3 Did you have trouble remembering important parts of the [***identified trauma***]? | 0 | 1 | 2 | 3 | 4 |
| 16 D3 Did you have trouble concentrating or paying attention? | 0 | 1 | 2 | 3 | 4 |
| 17 C2 Did you try to stay away from people, places, or things that make you remember the [***identified trauma***]? | 0 | 1 | 2 | 3 | 4 |
| 18 B5 When something reminded you of [***identified trauma***], did you have strong feelings in your body, like your heart beats fast, your head aches, or your stomach aches? | 0 | 1 | 2 | 3 | 4 |
| 19 C7 Did you think that you will not live a long life? | 0 | 1 | 2 | 3 | 4 |
| 20 D2 Did you have arguments or physical fights? | 0 | 1 | 2 | 3 | 4 |
| 21 C7 Did you feel pessimistic or negative about your future?<br>**PROMPT**: Do you understand that question?<br>**IF NEEDED:** Pessimistic means negative. | 0 | 1 | 2 | 3 | 4 |
| 22 AF Have you been afraid that [***something like the identified trauma***] will happen again? | 0 | 1 | 2 | 3 | 4 |

## Appendix D

## Mood and Feelings Questionnaire

**SAY:** Now I'm going to ask you some questions about how you might have been feeling or acting recently. For each question, please tell me how much you have felt or acted this way ***in the past two weeks***. If a sentence was true about you most of the time, say **TRUE.** If it was only sometimes true, say **SOMETIMES**. If a sentence was not true about you, say **NOT TRUE**.

**GIVE**: Practice questions on the RATING SHEET to teach the child response format and administer the survey once the child understands. For each item say, "In the past two weeks …." Prior to reading the item to the child so that they are cued in to use the rating sheet.

**ITEM #7:** If child does not understand what restless means, say "restless means you have a hard time sitting still."

| **Before each item, SAY:** ***HOW MUCH OF THE TIME DURING THE PAST TWO WEEKS DOES THIS STATEMENT DESCRIBE YOU:*** | **0 Not True** | **1 Sometimes** | **2 True** |
|---|---|---|---|
| 1 I felt awful or unhappy | 0 | 1 | 2 |
| 2 I didn't enjoy anything at all. | 0 | 1 | 2 |
| 3 I was less hungry than usual. | 0 | 1 | 2 |
| 4 I ate more than usual. | 0 | 1 | 2 |
| 5 I felt too tired I just sat around and did nothing. | 0 | 1 | 2 |
| 6 I was moving and walking more slowly than usual. | 0 | 1 | 2 |
| 7 I was very restless. | 0 | 1 | 2 |
| 8 I felt I was no good anymore. | 0 | 1 | 2 |
| 9 I blamed myself for things that weren't my fault. | 0 | 1 | 2 |
| 10 It was hard for me to make up my mind. | 0 | 1 | 2 |
| 11 I felt grumpy and upset with my parents. | 0 | 1 | 2 |
| 12 I felt like talking less than usual. | 0 | 1 | 2 |

| **Before each item, SAY:** ***HOW MUCH OF THE TIME DURING THE PAST TWO WEEKS DOES THIS STATEMENT DESCRIBE YOU:*** | **0 Not True** | **1 Sometimes** | **2 True** |
|---|---|---|---|
| 13 I was talking more slowly than usual. | 0 | 1 | 2 |
| 14 I cried a lot. | 0 | 1 | 2 |
| 15 I thought there was nothing good for me in the future. | 0 | 1 | 2 |
| 16 I thought that life wasn't worth living. | 0 | 1 | 2 |
| 17 I thought about death or dying. | 0 | 1 | 2 |
| 18 I thought my family would be better off without me. | 0 | 1 | 2 |
| 19 I thought about killing myself. | 0 | 1 | 2 |
| 20 I didn't want to see my friends. | 0 | 1 | 2 |
| 21 I found It hard to pay attention or concentrate. | 0 | 1 | 2 |
| 22 I thought bad things would happen to me. | 0 | 1 | 2 |
| 23 I hated myself. | 0 | 1 | 2 |
| 24 I felt I was a bad person. | 0 | 1 | 2 |
| 25 I thought I looked ugly. | 0 | 1 | 2 |
| 26 I worried about aches and pains. | 0 | 1 | 2 |
| 27 I felt lonely. | 0 | 1 | 2 |
| 28 I thought nobody really loved me. | 0 | 1 | 2 |
| 29 I didn't have any fun at school. | 0 | 1 | 2 |
| 30 I thought I could never be as good as other kids. | 0 | 1 | 2 |
| 31 I felt I did everything wrong. | 0 | 1 | 2 |
| 32 I didn't sleep as well as I usually sleep. | 0 | 1 | 2 |
| 33 I slept a lot more than usual. | 0 | 1 | 2 |

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# Biography

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