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Cognitive Interference for Trauma Cues in Sexually Abused Adolescent Girls With Posttraumatic Stress Disorder

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Investigated cognitive processing of fear-relevant information in sexually abused adolescent girls with posttraumatic stress disorder (PTSD) using a modified Stroop procedure (MSP). Participants were 20 sexually abused girls with PTSD, 13 sexually abused girls without PTSD, and 20 nonvictimized girls who served as controls, 11 to 17 years old. Word conditions included abuse-related threat, developmentally relevant (related to the experience of sexual abuse, e.g., trust, secrecy, and intimacy), general threat, positive, and neutral. Girls with PTSD were expected to show cognitive interference for trauma-related words as well as for developmentally relevant words, relative to adolescents without PTSD. Overall color naming was significantly slower in the PTSD group than in the nonabused controls. Contrary to expectation, all participants demonstrated cognitive interference for trauma-related words. Relevant theoretical and methodological issues are highlighted.

Although research on child and adolescent victims of trauma has increased significantly in recent years, understanding of the key features and symptom presentation of posttraumatic stress disorder (PTSD) in children and adolescents lags behind comparable research on adults (McNally, 1991, 1993). This is particularly true of the cognitive aspects of PTSD (e.g., reexperiencing or intrusive symptoms) that are considered a hallmark of the disorder and are difficult to assess via self-report. Studies on the information processing aspects of PTSD in adults have shown that reexperiencing symptoms can be assessed in nonintrospective ways using the modified Stroop color naming procedure (MSP; Williams, Watts, MacLeod, & Matthews, 1988). In the MSP, participants are asked to name the colors of words relevant to specific facets of psychopathology as well as neutral or positive words. Delays in color naming are thought to occur when the meaning of the word attracts the participant's attention despite an effort to concentrate on the color of the word, resulting in longer reaction times (Williams, Mathews, & MacLeod, 1996; Williams et al., 1988).

Using variations on the MSP procedure, a number of studies have shown increased color naming latencies specific to trauma-related information in adult rape victims, combat veterans, and disaster victims with PTSD (e.g., Cassiday, McNally, & Zeitlin, 1992; Foa, Feske, Murdock, Kozak, & McCarthy, 1991; Kaspi, McNally, & Amir, 1995; Litz et al., 1996; McNally, Kaspi, Riemann, & Zeitlin, 1990; Thrasher, Dalgleish, & Yule, 1994; Vrana, Roodman, & Beckham, 1995). It is suggested that the ease of activation of trauma-related memories results in longer color naming latencies for fear-relevant words relative to neutral or positive words (Litz & Keane, 1989; Litz et al., 1996). As a result, cognitive interference for threat-related information on the MSP has been interpreted as a quantitative measure of the intrusive symptoms of PTSD.

The MSP has many methodological variations that are germane to understanding these results. The investigation reported here was modeled after two MSP studies with adult PTSD participants (Cassiday et al., 1992; Foa et al., 1991). Both studies utilized a computerized single-trial version of the MSP and included rape victims with current PTSD, rape victims without current PTSD (the majority of whom had past diagnoses of PTSD), and a nontraumatized control group. Foa et al. used four types of words in their study: rape-relevant threat, general threat (e.g., death), neutral, and nonwords. Computer (as opposed to card) presentation ensured consistency in the timing of word presentation. Specific threat words produced cognitive interference but general threat, neutral, and nonwords did not, in the current PTSD

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group alone. Although nonwords were included to control for semantic content, this has not been replicated in more recent studies (Foa et al., 1991).

Cassiday et al. (1992) also used four word types: high threat (rape-related), moderate threat (rape-related), positive, and neutral. Both high threat and moderate threat words produced Stroop interference, relative to positive and neutral words, but only in the current PTSD sample. This study also examined whether performance would differ if stimuli were presented in random order versus a blocked format (wherein words are grouped by category). The results suggested that the blocked format produced less interference for positive and neutral words (but not the threat words), perhaps reflecting semantic habituation (Cassiday et al., 1992). The authors also correlated MSP interference with PTSD symptomatology and noted that increased MSP interference in individuals with PTSD is related to the presence of intrusive symptoms but not avoidance symptoms (Cassiday et al., 1992). In both studies, rape victims with PTSD showed significantly longer latencies for rape-related words, albeit also showing longer latencies for all word types. Response latencies of control participants did not differ across word types. Given the inclusion of rape victims without current PTSD, the findings suggest that the color naming interference is attributable to current PTSD rather than prior exposure to rape.

Notably, there is little cognitive experimental research with younger victims with PTSD. However, the role that information processing factors play in the etiology and maintenance of generalized fear and anxiety in younger populations has received considerable attention (Kendall & Ingram, 1987; Kendall & Ronan, 1990; Vasey, 1993; Vasey & Daleiden, 1996). Recent studies have used the MSP and other performance-based paradigms to assess cognitive processing in anxious children and adolescents. The majority of these studies examined cognitive interference in nonclinical samples of fearful children, inhibited children, or both (not adolescents) and demonstrated mixed results (Kindt, Bierman, & Brosschot, 1997, Kindt, Brosschot, & Everaerd, 1997; Martin, Horder, & Jones, 1992; Martin & Jones, 1995; Schwartz, Snidman, & Kagan, 1996; Vasey, Elhag, & Daleiden, 1996). Consistent with the adult literature, Martin et al., using the card format of the MSP, found that nonclinical spider-fearful children (6 to 13 years old) were slower to color name spider-related words than neutral words, but nonfearful children showed no performance decrement. Martin and Jones (1995) replicated this finding using a pictorial version of the MSP to extend testing to children who could not read (4 to 9 years old). Vasey et al. (1996), using a dot probe detection task that measures visual attention toward threatening versus neutral words, found that high-test-anxious girls and boys (11 to 14 years old) showed an attentional bias toward threat-related words.

However, a number of studies report more unexpected findings. Schwartz et al. (1996) used a computerized single-trial MSP with adolescents (12 to 13 years old) classified 11 years earlier by temperament status (inhibited or uninhibited). These authors found that color naming latencies were longer for threat and positive as compared to neutral words but found no group differences. Two additional computerized single-trial MSP studies (Kindt, Bierman, & Brosschot, 1997; Kindt, Brosschot, & Everaerd, 1997) noted that both high- and low-anxious children demonstrate cognitive interference that was specific to threat-related information. Kindt, Bierman, and Brosschot also compared the computerized and card MSP formats and found similar results.[1] Kindt and colleagues interpreted these data to suggest that fear-related memories in the younger children who were studied may not have been sufficiently developed and that control children, in contrast to control adults, may be less able to inhibit the processing of threatening information during the MSP. However, each of these studies is limited by the use of nonclinically anxious samples and the absence of older adolescent participants.

Only one study to date has examined attentional biases in children and adolescents with diagnosed anxiety disorders (Vasey, Daleiden, Williams, & Brown, 1995). This study included participants (9 to 14 years old) who met criteria for at least one *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., rev. [*DSM–III–R*]; American Psychiatric Association, 1987) anxiety disorder, as well as nonclinical controls. Using the dot probe task, the authors found that clinically anxious children showed an attentional bias toward threat-related words relative to controls. This study is the first to demonstrate the existence of an attentional bias toward threat-related information in a clinically diagnosed anxious sample of children and adolescents. However, there are some methodological concerns. First, the anxious sample was comprised of children representing seven different primary diagnoses. Although anxious children (and adults) generally show high rates of comorbidity among the anxiety disorders (Barlow, DiNardo, Vermilyea, Vermilyea, & Blanchard, 1986), grouping participants with seven primary diagnoses makes interpretation of the findings less clear. Additionally, the emotionally threatening words may have had differing effects depending on the particular anxiety disorder. Although the literature on content-specific biases is mixed, the adult literature suggests that cognitive interference for threat cues may

[1]Interestingly, however, the authors found that the processing biases assessed by the two formats did not correlate and therefore, these two formats may measure different or perhaps unstable mechanisms.

be disorder specific.[2] Finally, other types of emotional words (e.g., positive words) were not included in this study.

If we are to understand better the fundamental features of PTSD in younger populations, cognitive models and paradigms designed to investigate processing biases seem appropriate. Research to date suggests that examination of cognitive interference is relevant to the study of adult PTSD, as well as child and adolescent anxiety disorders. This study was designed to examine cognitive interference for threat cues in adolescent girls who had been sexually abused and reported current PTSD. Given that this is the first study to examine a clinical sample of adolescents with primary diagnoses of PTSD, consideration of the most appropriate paradigm (i.e., computerized MSP, card MSP, dot probe task) was important. Concerns with the MSP include ambiguity about the source of interference, uncontrolled timing of stimulus presentation (with the card format), and failure to find anxiety-related group differences in nonclinical samples of young children (with the computerized version). Concerns with the dot probe task include greater impact of age differences in reading ability when the task is used with younger children, inconsistent effects in upper and lower probe positions, and the fact that the paradigm has not been used to compare multiple word conditions. The computerized, single-trial MSP was selected for this study given its documented success in clinical samples of adult PTSD participants, particularly those who had experienced sexual trauma (Cassiday et al., 1992; Foa et al., 1991).

Additionally, it is important to consider that adult models of information processing in PTSD have not been applied to more chronic and developmentally inappropriate types of trauma (e.g., child sexual abuse). Childhood sexual abuse frequently involves more than one incident of abuse. Even in cases in which abuse occurs on only one occasion, the developmental inappropriateness of child sexual abuse may lead to broader effects. As a result, the types of threat stimuli, responses, and meanings that are relevant to the child or adolescent may expand beyond the specific external cues associated with an abuse event and include more internally pertinent reminders (e.g., confusion about trust, identity, abandonment, secrets and silence, differentiation from family; Smucker, Dancu, Foa, & Niederee, 1995). If this is the case, one could expect that cognitive interference would be noted to words reflecting developmentally relevant issues such as trust, secrecy, and intimacy, as well as to more externally relevant trauma words.

This study seeks to replicate the studies of cognitive interference in adult rape-related PTSD (Cassiday et al., 1992; Foa et al., 1991) with an adolescent sample of sexually abused girls diagnosed with PTSD. It is predicted that sexually abused girls with PTSD will show delays in color naming abuse-related threat words, relative to general threat, positive, and neutral words. This hypothesized effect is not expected in girls who have been sexually abused but do not currently meet diagnostic criteria for PTSD or in girls who have not been sexually abused. Additionally, this study examines the exploratory hypothesis that sexual abuse during childhood and adolescence will have a broader developmental effect (relative to abuse occurring in adulthood). Thus, a group of developmentally relevant words representing internal issues that may also cause cognitive interference is included in the MSP.

Method

Participants

Three groups of participants (11 to 17 years old)[3] were included in the study (seeTable 1):

1. 20 sexually abused adolescent girls with a current, primary *Diagnostic and Statistical Manual of Mental Disorders* (4th ed. [*DSM–IV*]; American Psychiatric Association 1994) diagnosis of PTSD, recruited from a local community mental health agency (PTSD group).
2. 13 sexually abused adolescent girls with no current diagnosis of PTSD recruited from the same agency (abuse group)
3. 20 adolescent girls with no history of sexual abuse who were free of any psychiatric diagnoses, recruited from the community (control group).

Adolescents in both sexually abused groups had been referred for mental health services most often because of the abuse, but in some cases for other concerns (e.g., anxiety, depression, behavior problems). Therapists at this agency were contacted by Jennifer B. Freeman and asked to discuss the study with girls meeting inclusion criteria. For the majority of adolescents in the two clinical groups, sexual abuse had been substantiated by Child Protective Services. In some cases, the investigation was ongoing.

[2]For example, McNally et al. (1990) found that combat-related PTSD patients do not show interference for Obsessive Compulsive Disorder threat cues and Hope, Rapee, Heimberg, and Dombeck (1990) reported that panic patients showed interference to physical threat cues, not to social threat words, but social phobics did the opposite.

[3]Although the study was originally limited to girls between the ages of 12 and 17, the decision was made to include five 11-year-olds (all of whom were within 6 months of their 12th birthday) due to difficulty in recruitment.

Table 1. *Sample Characteristics*

	Group					
	PTSD[a]		Abuse[b]		Control[a]	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age (in Years) of Participant	14.1	1.7	13.8	2.0	14.6	1.7
Number of Persons in Household	4.7	1.5	4.3	1.4	4.9	1.3
Race or Ethnicity of Participant						
African American	30%		15%		15%	
Caucasian	60%		77%		85%	
Other	10%		8%		0%	
Parent Educational Level						
High School or Below	42%		16%		30%	
Some College	48%		46%		20%	
College or Higher	10%		38%		50%	
Family Income[c,d]						
$10,000 or Under	53%		46%		0%	
$10,001–$30,000	26%		31%		15%	
$30,001–$50,000	21%		16%		35%	
$50,001 and Over	0%		7%		50%	
Kaufman Brief Intelligence Test						
Verbal IQ[c]	95	11	97	8	102	8
Performance IQ	101	13	105	11	106	10
Overall IQ	98	12	101	8	105	10
Woodcock–Johnson Tests of Achievement, Revised						
Letter Word ID (Total Score)[c,d]	48	4	47	3	50	3
Passage Comprehension (Total Score)	28	3	28	4	29	4

Note: PTSD = posttraumatic stress disorder.
[a]$n = 20$. [b]$n = 13$. [c]PTSD < Control, $p < .05$. [d]Abuse < Control, $p < .05$.

Adolescent girls were included in the PTSD group if they (a) had been seriously sexually abused (defined as involving at least direct genital touching of any sort) by a male perpetrator and (b) met criteria for a current primary diagnosis of PTSD on the basis of the PTSD module of the Schedule for Affective Disorders and Schizophrenia for School Age Children (K–SADS; Orvaschel, 1995; both child and parent forms). Participants were excluded if they (a) met criteria for a psychotic disorder, attention deficit hyperactivity disorder, or conduct disorder (moderate or severe subtype; also diagnosed by the K–SADS);[4] (b) reported a history of severe physical abuse requiring medical attention; (c) read below the fifth-grade level; (d) if their estimated intelligence quotient was below 70; or (e) if parental consent was not obtained. The PTSD sample included 20 adolescents with an average age of 14.1 years (*SD* = 1.7). In addition to PTSD, secondary diagnoses were prevalent in this group (see Table 2).

Adolescent girls were included in the abuse group if they (a) had been seriously sexually abused (as previously defined) and (b) met threshold criteria in no more than one of the three PTSD symptom clusters on the basis of the K–SADS, where threshold symptoms are as follows: reexperiencing symptoms (one or more), avoidance symptoms (three or more), and arousal symptoms (two or more). Exclusion criteria for the abuse group were identical to the PTSD group. The final abuse sample included 13 adolescents with an average age of 13.8 years (*SD* = 2.0). Psychiatric diagnoses also were prevalent in this group (see Table 2). Eight participants in the abuse group met criteria for a past diagnosis of PTSD for which they had received at least some treatment.[5] Only 2 girls in the abuse group had no current PTSD symptoms.

Adolescent girls were included in the control group if they (a) reported no history of sexual abuse and (b) did not meet criteria for any current *DSM–IV* Axis I disorder on the K–SADS. Participants were excluded if

[4]Participants with attention deficit hyperactivity disorder, conduct disorder (moderate or severe subtype), and psychosis were excluded from the study given the possibility of interference with the attentional nature of the task and the length and demands of the procedure.

[5]Although it is notable that many of the participants in the ABUSE group had past diagnoses of PTSD, this group is comparable to other studies in the literature. For example, Cassiday et al. (1992) and Foa et al. (1991) included control groups of assault victims without current PTSD who met criteria for past PTSD, yet did not demonstrate the same levels of cognitive interference as participants with current PTSD. From a theoretical standpoint, cognitive interference is associated with the activation of fear networks representative of current episodes of psychopathology. Although trauma-related memories, "expertise" with PTSD-related information, and current concerns about victimization clearly still exist for adolescents with past PTSD, theoretical models predict that cognitive interference would be present, yet attenuated for abused adolescents with a past diagnosis of PTSD (Williams et al., 1996).

they (a) reported a history of severe physical abuse requiring medical attention, (2) read below the fifth-grade level, (c) if their estimated IQ was below 70, or (d) if parental consent was not obtained. The control sample included 20 adolescents with an average age of 14.6 years (*SD* = 1.7).

All K–SADS diagnostic interviews were audiotaped, with 25% (*n* = 13) randomly selected for evaluation by a second clinician to estimate interrater reliability. One hundred percent agreement was noted for PTSD, dysthymia, and major depression. Diagnostic reliability was low only for oppositional defiant disorder (κ = .33).[6]

Stimulus Materials

The word conditions for the MSP included abuse-related threat words, developmentally relevant words, general threat words, positive words, and neutral words (see Table 3). The words were adapted from previous research (Cassiday et al., 1992; Foa et al., 1991; Vasey et al., 1995) and pilot tested in a separate group of sexually abused adolescent girls and nonabused adolescent girls. Using a list of approximately 20 words in each category, participants involved in pilot testing rated the words on the degree of threat and their estimate of how commonly they used the word in everyday conversation, using a scale of 1 (*no threat/never used*) to 5 (*extremely high threat/used very frequently*). Ten words that were high in threat for the abused group and low in threat for the control group, but similar in frequency for both groups, were selected for both the abuse-related and developmentally relevant word categories. The general threat, positive, and neutral words had similar ratings of threat and frequency in both groups. In the MSP, 10 words from each of the five conditions were presented three times, for a total of 150 randomized presentations. Word lists were equal on the average number of syllables, and reading difficulty was no higher than fifth-grade level.

Apparatus

The study was conducted with a Dataworld 386 computer. Each word was centrally presented on a NEC MultiSync 3D color monitor in uppercase letters about 2 cm high. The words were presented for 1.5 sec with a 5-sec interstimulus interval. The participant's reaction time for each trial was computer recorded (in msec) through the use of a voice-activated microphone with adjustable sensitivity.

[6]It should be noted that diagnoses other than those listed did not occur at sufficient frequency in the reliability sample to allow computation of kappa.

Measures

Intelligence and Achievement Measures

The following two measures were administered for the purposes of study inclusion. Group differences on these measures also were examined to assess their potential impact on primary analyses.

Kaufman Brief Intelligence Test (K–BIT). The K–BIT (Kaufman & Kaufman, 1990) is a brief, individually administered measure of verbal and nonverbal intelligence designed to be used with individuals 4 to 90 years old. The K–BIT yields an overall composite IQ, as well as Vocabulary and Matrices scores. Results are based on age-based standard scores (*M* = 100, *SD* = 15). Split-half reliability coefficients are excellent for Vocabulary (*r* = .92) and Matrices (*r* = .87). A composite internal consistency reliability mean of .92 is also excellent. Research with the K–BIT has demonstrated concurrent validity with other measures of intelligence (Kaufman & Kaufman, 1990).

Table 2. *Psychiatric Diagnoses and Posttraumatic Stress Disorder (PTSD) Symptoms in PTSD and Abuse Groups*

	Group	
Diagnoses[a] and Symptoms	**PTSD[b]**	**Abuse[c]**
Major Depression	5	1
Dysthymia	7	5
Adjustment Disorder With Depressed Mood	1	0
Depression, Not Otherwise Specified	1	0
Panic Disorder With Agoraphobia	1	0
Social Phobia	1	1
Specific Phobia	2	1
Generalized Anxiety Disorder	6	1
Conduct Disorder (Mild Subtype)	1	0
Oppositional Defiant Disorder	7	6
PTSD (Past)	—	8
Total Number of Psychiatric Diagnoses[d]		
M	3.0	1.30
SD	1.4	0.90
Total Number of PTSD Symptoms[d]		
M	11.3	3.40
SD	2.5	1.70
Total Number of Reexperiencing Symptoms[d]		
M	2.8	0.23
SD	1.1	0.44
Total Number of Avoidance Symptoms[d]		
M	4.8	1.70
SD	1.2	1.50
Total Number of Arousal Symptoms[d]		
M	3.6	1.40
SD	1.0	0.96

[a]Totals exceed total *n* because of presence of multiple comorbid diagnoses in some participants. [b]*n* = 20. [c]*n* = 13. [d]Groups differ significantly at $p < .001$.

Woodcock–Johnson Tests of Achievement–Revised (WJ–R ACH) Broad Reading Cluster subtests. The WJ–R (Woodcock & Johnson, 1989) is an individually administered educational battery designed to estimate the level at which a child has acquired the skills and knowledge taught in school. The standard battery of the WJ–R ACH consists of nine subtests. The two subtests that measure basic reading skills were administered: Letter-Word Identification and Passage Comprehension. Internal consistency reliability coefficients are excellent for each subtest (Letter-Word Identification, r = .92; Passage Comprehension, r = .91). The median reliability for the Broad Reading cluster is .95.

Psychopathology and Abuse Measures

Two diagnostic interviews were administered for the purposes of study inclusion. Standardized self-report measures were given to describe the three samples. Group differences on self-report measures were also examined post hoc to assess their impact on primary analyses.

K–SADS–Epidemiologic Version (K–SADS–E). The K–SADS–E (Orvaschel, 1995) is a semistructured diagnostic interview designed to assess past and current episodes of psychopathology in children and adolescents (6 to 17 years old). The current version assesses signs and symptoms of Axis I disorders using *DSM–IV* criteria. The K–SADS–E involves both a parent and a child or adolescent interview and the results of these interviews are used in combination to determine diagnoses. Recent data on the current version indicate that kappas range from .49 to .75 across all diagnoses (H. Orvaschel, personal communication, October 24, 1996) with a kappa of .63 for PTSD.

Child sexual abuse characteristics. A clinical interview, modeled after the Child Sexual Abuse Initial Interview (McLeer, 1993), was conducted with each adolescent. The interview was designed for this study to collect data about the following characteristics relating to abuse events: severity and frequency of abuse, coercion, family dysfunction, loss of social contacts, out-of-home placement, and legal involvement (Spaccarelli, 1994). It also served to screen out physical abuse.

PTSD Reaction Index (PTSD–RI). The PTSD–RI (Frederick, 1985) is a 20-item index designed to assess the presence and severity of PTSD symptoms. The PTSD–RI correlates .91 with confirmed cases of childhood and adolescent PTSD (Frederick, 1985). Test–retest reliability (over 1 week) has been shown to be .94 (Pynoos & Nader, 1989). The total raw score ranges from 0 to 80 and scores over 40 are considered clinically significant.

Impact of Event Scale (IES). The IES (Horowitz, Wilner, & Alvarez, 1979) is a 15-item self-report questionnaire that measures two elements of PTSD: event-related intrusion and event-related avoidance for any specific trauma. Split-half reliability for the total scale is .86; internal consistency (Cronbach's α) is .78 for intrusion and .80 for avoidance. Test–retest reliability (over 1 week) is .87. Raw scores above 26 on either the Intrusion or Avoidance scales are considered clinically significant.

Children's Depression Inventory (CDI). The CDI (Kovacs & Beck, 1977) is a 27-item self-report measure that assesses affective, cognitive, and behavioral symptoms of depression in children and adolescents 8 to 17 years old. Internal consistency reliability

Table 3. *Stimulus Words*

Abuse-Related Threat				
hold	force	penis	kissing	naked
undress	suck	trapped	stuck	penetrate
Developmentally-Relevant				
secret	abandoned	lonely	dumb	reject
shame	ugly	imperfect	slut	withdrawn
General Threat				
cancer	knife	explosion	sick	war
funeral	coffin	gun	fire	weapon
Positive				
happy	smile	nice	laughing	enjoy
joy	lucky	terrific	super	brilliant
Neutral				
table	window	lamp	carpet	bookshelf
curtain	sofa	desk	chair	cabinet

coefficients range from .71 to .89 indicating good internal consistency of the instrument (Kovacs, 1992). Test–retest reliability data indicate a range from as low as .38 to .94 (Saylor, Finch, Spirito, & Bennett, 1984). However, low reliabilities appear to be associated with long periods of time between testing (where one would not expect stability of symptoms), and most studies indicate an acceptable level of stability. Validity data are similarly varied, but overall, they support the predictive power of the measure (Kovacs, 1992; Saylor et al., 1984). For the purposes of this study, only the total *T* score was examined where *T* scores greater than 60 are considered to be clinically significant.

Revised Children's Manifest Anxiety Scale (RCMAS). The RCMAS (Reynolds & Richmond, 1978) is a 37-item self-report measure designed to assess the level and nature of anxiety in children and adolescents ages 6 through 19. The measure yields four subscales: Worry/Oversensitivity, Physiological Symptoms, Concentration Anxiety, and Lying. Both internal consistency and test–retest reliabilities are greater than .80, and the RCMAS correlates highly with other child and adolescent measures of anxiety (Eisen & Kearney, 1995). For the purposes of this study, only the total *T* score was examined where *T* scores greater than 60 are considered to be clinically significant.

In addition, demographic information (e.g., parental education, family size, family income) was collected from parents at the time of the parent K–SADS interview.

Dependent Measures

Color naming latency. The time elapsed between presentation of the stimulus and color naming response of the participant (accurate to ±1 msec) was recorded for each target word. These response latencies were averaged across 30 presentations of each of the five word conditions, yielding five scores for each participant. As in previous studies using the MSP, outliers of ±2 *SD* were removed for each participant in each word condition given the high likelihood that these were artifacts. Also, latencies shorter than 350 msec (e.g., participants activating the voice-response relay prematurely) and other errors (e.g., naming the wrong color, reading the word aloud rather than naming the color) were removed. Approximately 3% of responses in the PTSD group, 2% of responses in the abuse group, and 2% of responses in the control group were excluded.

Procedure

Prior to participation, the study was explained, and informed assent and consent were obtained. After completion of the screening and self-report measures, each participant was seated approximately 0.6 m from the computer screen for the MSP task. The microphone was attached to the participant's collar, and the voice-activated mechanism was adjusted to the participant's voice tone. Next, she was presented with five color patches (red, white, yellow, green, blue) and asked to name them by giving a distinct label to each color. Instructions were given to name the color of each word or patch being presented as quickly and as accurately as possible, ignoring the meaning of the word. Participants were told to avoid anticipating any particular color given that colors were randomly assigned to various words and could appear in any order.

Twenty practice trials using number words (*one, two, three, four, five;* Cassiday et al., 1992) were introduced. Practice continued until at least 80% of the colors were named correctly. The participant then was presented with 150 experimental trials of the MSP. The presentation of each stimulus initiated a timing cycle that was stopped by the participant's verbal response. Because of the 5-sec interstimulus interval, a maximum response latency of 4 sec was allowed. Following completion, the participant was debriefed and paid $20.

Results

Preliminary Analyses

Demographic characteristics of the three samples were similar (see Table 1). The groups did not differ in age, number of persons living in the household, ethnicity, or parental educational level, but there was a significant difference in family income, $\chi^2(10, N = 52) = 30.21$, $p = .001$, with the control group reporting significantly higher family income relative to the other two groups. Additionally, significant differences were noted between groups on IQ and reading achievement. Specifically, there was a marginal difference between groups on Verbal IQ, $F(2, 50) = 3.14$, $p = .052$, with girls in the PTSD group scoring lower than those in the control group, $t(38) = 2.34$, $p = .02$. Additionally, there was a marginal difference between groups on Letter-Word Identification, $F(2, 50) = 3.12$, $p = .053$, with adolescents in the abuse group scoring lower than adolescents in the control group, $t(23) = 2.34$, $p = .03$. However, overall means for all groups fell in the average range on each measure (see Table 1).

The PTSD group had significantly more total psychiatric diagnoses, total PTSD symptoms, total intrusive symptoms, total avoidance symptoms, and total arousal symptoms than the abuse group (see Table 2). Only two significant differences were noted between the PTSD and abuse groups on characteristics relating to sexual abuse and public disclosure. Participants in the PTSD group were more likely to report that they had

Table 4. *Self-Report Measures of Psychopathology*

Measure	Group					
	PTSD[a]		Abuse[b]		Control[a]	
	M	*SD*	*M*	*SD*	*M*	*SD*
Children's Depression Inventory						
Total *T* Score[c,d]	56.7	12.6	46.8	9.8	40.8	6.3
Revised Children's Manifest Anxiety Scale						
Total *T* Score[c,d]	58.5	14.8	40.0	10.9	36.7	12.3
Impact of Events Scale						
Intrusion Subscale[d]	16.2	10.4	3.4	4.0		
Avoidance Subscale[d]	23.8	8.0	12.8	10.0		
Posttraumatic Stress Disorder Reaction Index						
Total Score[d]	42.3	15.6	14.8	10.0		

Note: PTSD = posttraumatic stress disorder.
[a]$n = 20$. [b]$n = 13$. [c]PTSD > Control, $p < .05$. [d]PTSD > Abuse, $p < .05$.

been offered something special by the perpetrator (PTSD $n = 11$; abuse $n = 2$), $\chi^2(1, N = 33) = 4.47$, $p = .034$, and that they had lost friends following disclosure of the sexual abuse (PTSD $n = 8$; abuse $n = 1$), $\chi^2(1, N = 33) = 4.15$, $p = .042$.

Information was gathered on standardized questionnaire measures (CDI, RCMAS, PTSD–RI, IES) to describe the sample (see Table 4). It should be noted that nonvictimized controls were not given the IES or the PTSD–RI because both measures pertain to having experienced a traumatic event (i.e., sexual abuse). As expected, victims with PTSD scored highest on all of the measures, followed by the abuse group, and then the control group.

Primary Analyses

Modified Stroop task. Due to the group differences on Verbal IQ and Letter-Word Identification, these variables were used as covariates in the primary analysis. Mean response latencies were submitted to a 3 (group) × 5 (word type) multivariate analysis of covariance with repeated measures on the second factor. Because of concerns about violation of homogeneity of variance–covariance matrices due to unequal sample size and significance of Box's M test at $p < .001$, Pillai's Trace was used to evaluate multivariate significance of within-subjects effects (Tabachnick & Fidell, 1989). Effect sizes (ES) were determined based on a measure of percent of variance accounted for, termed partial η^2 (Cohen, 1988).[7]

Examination of color naming latencies revealed a significant main effect of group, $F(2, 48) = 3.60$, $p = .04$, ES = 13% of variance, and of word type, $F(4, 47) = 8.59$, $p < .001$, ES = 42% of variance (see Table 5). Follow-up tests with Bonferroni correction indicated that the PTSD group had significantly longer overall color naming latencies than the control group, $t(38) = –2.68$, $p < .05$, but did not differ from the abuse group, $t(31) = .96$, $p = .34$. The abuse and control groups did not differ significantly from each other, $t(38) = –1.46$, $p = .15$. Additionally, participants took more time to color name abuse-related words relative to the four other word types: versus developmentally relevant, $F(1, 50) = 14.87$, $p = .000$; general threat, $F(1, 50) = 29.18$, $p = .000$; positive, $F(1, 50) = 27.15$, $p = .000$; neutral, $F(1, 50) = 28.96$, $p = .000$. Participants also took longer to color name the developmentally relevant words relative to the neutral and positive words: versus neutral, $F(1, 50) = 4.10$, $p = .05$; positive, $F(1, 50) = 16.86$, $p = .000$. Finally, participants took longer to color name the general threat words than the positive words, $F(1, 50) = 7.09$, $p = .010$.

Secondary Analyses

Correlational analyses. To test whether color naming delays were correlated with self-report measures of intrusive symptoms in traumatized adolescents (PTSD and abuse groups), scores on the Intrusion scale of the IES (IES–I) and the total number of intrusion symptoms on the PTSD–RI were correlated with color naming latencies for the different word types (using Bonferroni correction to control for alpha inflation). Contrary to the expectation that scores on these self-report measures would be significantly related to response latencies, scores on the IES–I and the total number of intrusion symptoms on the PTSD–RI were not significantly correlated with mean response latencies for any of the word types (all rs < .17).

[7]This measure facilitated interpretation of ES with small effects ranging from 2% to 12% of variance, medium effects between 13% and 44%, and large effects where 45% or more of variance was accounted for by the effect (Cohen, 1988). Examination of ES in conjunction with traditional inferential statistics allows consideration of the magnitude of effects, which is particularly relevant when small sample sizes may influence the results of significance testing.

Table 5. *Modified Stroop Response Latencies in Milliseconds*

	Group							
	PTSD[a]		Abuse[b]		Control[a]		ME Word[c]	
Condition	M	SD	M	SD	M	SD	M	SD
Abuse-Related Words	1,028.4	296.1	988.8	173.3	809.3	126.9	936.1	234.5
Developmentally Relevant Words	960.2	263.7	903.0	130.1	771.1	97.4	874.8	199.8
General Threat Words	936.0	228.2	924.5	140.8	775.0	119.6	872.4	186.3
Neutral Words	931.3	235.6	901.8	119.8	738.0	101.2	851.1	188.0
Positive Words	913.4	185.5	882.5	108.9	745.7	88.9	842.5	155.4
Main Effect Group	953.9	241.8	920.1	134.6	767.8	106.8		

Note: PTSD = posttraumatic stress disorder; ME = main effect.
[a]$n = 20$. [b]$n = 13$. [c]$n = 63$.

Identification of potential suppressor variables. Given the significant group differences on the self-report measures of anxiety (RCMAS) and depression (CDI), the data were examined with each of these variables used as a covariate to test for suppression of the predicted Group × Word Type interaction. As in the earlier analyses, Pillai's Trace was again used to evaluate multivariate significance. Using CDI total *T* score as a covariate, there continued to be significant main effects of both group, $F(2, 49) = 5.26$, $p = .009$, ES = 18% of variance, and word type, $F(4, 47) = 8.59$, $p < .001$, ES = 42% of variance. The PTSD and abuse groups had significantly longer overall color naming latencies than the control group, $t(38) = 3.00$, $p = .004$; $t(31) = 2.52$, $p = .014$, when controlling for depression. There were no differences between the abuse group and the PTSD group, $t(31) = -.63$, $p = .528$. The results of pairwise comparisons examining the main effect of word type were identical to those reported in the primary analyses.

Using RCMAS total *T* score as a covariate, there continued to be significant main effects of both group, $F(2, 49) = 5.22$, $p = .009$, ES = 18% of variance, and Word Type, $F(4, 47) = 8.59$, $p < .001$, ES = 42% of variance. As seen in the primary analyses, the PTSD and abuse groups had significantly longer overall color naming latencies than the control group, $t(38) = 2.87$, $p = .005$; $t(31) = 2.52$, $p = .014$, when controlling for total levels of anxiety. There were no differences between the abuse group and the PTSD group, $t(31) = -.56$, $p = .574$. The results of pairwise comparisons examining the main effect of word type were identical to those reported in the primary analyses.

Discussion

This study was designed to examine cognitive interference for trauma cues in sexually abused adolescent girls with PTSD using the MSP. Due to group differences, primary analyses were conducted while controlling for Verbal IQ and reading achievement. The results indicate that overall color naming was significantly slower in the PTSD group than in the control group. Contrary to expectation, the abuse group did not differ significantly from either the PTSD group or the control group. Also unexpectedly, all participants demonstrated cognitive interference toward threat-related stimuli. Although significant differences between groups and within stimulus conditions were noted, the absence of the predicted interaction between group and word type remained puzzling. Thus, additional analyses were completed to identify potential suppressor variables. Interestingly, statistically controlling for depression and anxiety did not negate the group differences on the MSP.

Overall, there were three central findings. First, sexually abused adolescent girls with PTSD show more overall color naming interference (for all word types) than nonclinical controls. Second, cognitive interference toward trauma-related words seems to exist in both abused and nonabused adolescents. Third, a more generalized response to abuse-related negative emotion in all participants may best account for cognitive interference in these three groups of adolescents. Some potential explanations and implications of these findings are addressed in what follows.

As in comparable studies of adults with PTSD, adolescents with PTSD showed more overall color naming interference regardless of content. Unlike the adult literature, however, adolescents with PTSD did not show greater interference for abuse-related words. Given the absence of this predicted interaction, it is possible that the group differences found in the investigation may have been a function of the considerable diagnostic comorbidity in the PTSD group. However, it is difficult to test this hypothesis, as the majority of comparable adult PTSD studies have not reported on diagnostic comorbidity (Cassiday et al., 1992; Foa et al., 1991; Thrasher et al., 1994). Litz et al. (1996) is the only study to report data on comorbid diagnoses, finding that despite significant psychiatric comorbidity in veterans with and without PTSD, those with current PTSD still showed greater cognitive interference toward high threat material than those without PTSD. Notably, however, when overall depression and anxiety scores

were used as covariates in the study reported here, group differences remained significant. Clearly, future studies of cognitive interference with children and adolescents diagnosed with PTSD need to assess the full spectrum of comorbid psychiatric disorders.

The fact that the two sexually abused groups did not demonstrate differences in overall color naming interference is counter to results seen in the adult PTSD literature. Of particular concern is the fact that many adolescents in the abuse group met criteria for past diagnoses of PTSD. However, many adult rape victims without current PTSD also met criteria for past diagnoses of PTSD in comparable adult studies (Cassiday et al., 1992; Foa et al., 1991). It is possible that the adults in these studies had received more effective types of treatment or reported less current PTSD symptomatology than the adolescents in the abuse group. However, as noted earlier, it makes theoretical sense to predict that cognitive interference would be present, yet attenuated for adolescents without a current PTSD diagnosis. In the end, it seems that past PTSD diagnoses in the abuse group would be a more problematic confound had threat-related biases been noted only in the PTSD and abuse groups. Because all three samples showed delays in naming the abuse and developmentally relevant words, one cannot attribute this finding to a history of abuse or the presence of past PTSD.

The unexpected finding that all participants demonstrated cognitive interference for abuse-related material is counterintuitive, yet important. Perhaps a generalized response to abuse-related negative emotion in all participants may best account for cognitive interference.[8] It is possible the abuse-related threat words (e.g., *penis*) may have caused more interference than expected for all adolescents, even those in the control group, given the likelihood that they have had less exposure to such "taboo" words and may have felt somewhat uncomfortable. An alternative explanation is that nonabused adolescents showed cognitive interference for abuse-related words because their sexuality is, in fact, of current emotional relevance. Williams et al. (1996) wrote that "relatedness to current concern is necessary to explain Stroop interference in nonclinical participants" (p. 19). Perhaps our findings would have differed had the threat-relevant material been less emotionally relevant to all adolescents (e.g., relating to some other type of trauma or a different diagnostic group). Another possibility is that adolescents are less able than adults to inhibit the processing of threat-related stimuli, as suggested by Kindt, Bierman, and Brosschot (1997). However, nonvictimized adolescents did not rate abuse-related words as threatening during pilot testing. This in turn suggests that the cognitive interference seen in the control group did not necessarily represent a bias toward threatening information.

Clearly, methodological limitations must be considered in interpreting these findings. First, the study was limited to adolescent girls and therefore is not generalizable to all adolescents. Next, it is necessary to examine the quality of the stimuli (i.e., words used in the MSP). A primary concern is that the abuse-related and developmentally relevant threat words were not specific enough. Given variations in each girl's abuse situation, it is possible that idiosyncratic abuse words (e.g., words that were specific to each girl's abuse) may have been more salient and that the PTSD group would have shown greater interference than both other groups as expected (e.g., Riemann & McNally, 1995). Additionally, it would have been useful for all participants to rate each word used in the MSP on its level of threat and frequency in everyday language.

It also is possible that the order of word presentation may have attenuated group differences. Two previous studies using the card format of the MSP (in which the stimuli are blocked by category) with nonclinically anxious children have found an anxiety-related bias (Martin et al., 1992; Martin & Jones, 1995). However, as noted earlier, Kindt, Bierman, and Brosschot (1997) in a study of nonclinically anxious young children and Cassiday et al. (1992) in a study of adult rape victims with PTSD did not find meaningful differences between single-word and blocked conditions. Additionally, all participants were administered the clinical interviews (diagnostic interview and abuse interview) prior to completing the MSP. As a result, it is possible that all of the adolescents were primed to think about abuse or negative affect more generally. This could explain in part the source of interference in the control participants.

Finally, the ecological validity of the MSP task itself must be considered, given potential ambiguity about mechanisms behind threat-related interference (Thorpe & Salkovskis, 1997; Vasey, 1996). Indeed, this is the fourth attempt to use a single-trial, computerized MSP with anxious youngsters and the fourth to show that all participants demonstrate cognitive interference for anxiety-related stimuli. Notably in this study, however, cognitive interference for all adolescents was specific to abuse-related words rather than all emotionally negative words (i.e., abuse-related threat words produced more interference than the general threat and developmentally relevant conditions). Clearly, it is worth considering the use of a less ambiguous and potentially more sensitive paradigm (e.g., the dot probe task). However, it is important to underscore how little we know about the performance of anxious, older adoles-

[8]This is also supported by examining correlations between color naming interference and the following variables: PTSD reexperiencing symptoms, PTSD avoidance symptoms, PTSD arousal symptoms, and total number of diagnoses. Looking only at the two sexually abused groups, all correlations were nonsignificant ($r < .10$).

cents on any performance-based paradigm, particularly those with PTSD. Based on the current state of the PTSD literature, it seems premature to abandon the MSP completely in trying to understand further the potential differences in children, adolescents, and adults with PTSD.

This study is the first of its kind to examine cognitive interference in adolescent victims of trauma with PTSD. However, additional research is necessary to clarify these results. The inclusion of a nonclinically referred group of sexually abused children and adolescents without current psychiatric diagnoses would be particularly informative, although possibly difficult to obtain.[9] By examining attentional biases in such a sample, it might be possible to further elucidate the nature of anxiety in sexually abused children without current PTSD and the relation of cognitive interference to overall psychiatric impairment. Another important sample to consider would be children and adolescents with and without PTSD who have experienced more acute types of traumatic events (e.g., school shootings) to examine differences in attentional biases across varied traumatic events. The inclusion of a psychiatric control group with no history of sexual abuse or PTSD also would serve as an important comparison. Finally, similar studies should be done to examine information processing biases in other child and adolescent anxiety disorders. Only one study (Vasey et al., 1995) has examined attentional biases in a clinical group of anxious children and this study, as reviewed earlier, included children with a variety of anxiety disorder diagnoses. Such research would help to advance further the child anxiety literature by expanding our current models.

Overall, this investigation provides an important preliminary step toward understanding cognitive interference in adolescent girls with PTSD. Unfortunately, information processing models of child and adolescent anxiety remain in the early stages of development. We must continue to investigate specific child and adolescent anxiety disorders to move beyond general models of anxiety and fear-related attentional processing. This area of research has significant clinical relevance as well. Attentional biases are implicated in the development of further cognitive biases and distortions, emotional regulation and dysregulation, the development of maladaptive behavior, and most likely, the development of adult anxiety disorders (Daleiden & Vasey, 1997). As a result, identifying maladaptive forms of cognitive processing has important implications for childhood and adolescent PTSD and anxiety disorders as well as developmental psychopathology more broadly.

[9]Such a sample potentially could be recruited by working in conjunction with a child protective services agency that sees children solely on the basis of having been abused and not based on referral for specific psychiatric problems.

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