

Deficits in Verbal Declarative Memory Function in Women With Childhood Sexual Abuse-Related Posttraumatic Stress Disorder

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Abstract: Several studies have shown deficits in verbal declarative memory function in posttraumatic stress disorder (PTSD). Most of these studies have been performed in men with combat-related PTSD compared with healthy subjects; relatively little is known about memory function in women with abuse-related PTSD, or whether these effects are specific to PTSD or are a nonspecific outcome of exposure to early abuse. The purpose of this study was to assess declarative memory function in women with and without a history of early childhood sexual abuse and PTSD. Forty-three women with and without a history of early childhood sexual abuse and PTSD underwent neuropsychological testing with subtests of the Wechsler Memory Scale—Revised for measurement of verbal and visual memory and subtests of the Wechsler Adult Intelligence Scale for measurement of IQ, and behavioral ratings of PTSD and other psychiatric symptoms. Abused women with PTSD had deficits in verbal declarative memory as measured with the subtests of the Wechsler Memory Scale—Revised compared with women with early abuse without PTSD and nonabused women without PTSD. There were no significant differences in IQ. These findings suggest that early abuse with PTSD is associated with deficits in verbal declarative memory, and that these effects are not related to the nonspecific effects of childhood abuse.

Key Words: PTSD, memory, hippocampus, childhood abuse.

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Childhood abuse is an important public health problem that is associated with a range of negative physical and mental health outcomes (MacMillan et al., 1997; McCauley et al., 1997). One important question related to the long-term effects of childhood abuse is the effect on cognitive development. If childhood abuse has negative long-term effects on cognitive development, this could have important implications in a range of areas including public policy, public health, education, and social welfare (Bremner, 2002; Cicchetti and Walker, 2001). In spite of these important public policy concerns, the effects of childhood abuse on long-term cognitive function are not well known.

There has long been an interest in the relationship between exposure to psychological trauma and deficits in memory function (Buckley et al., 2000; Elzinga and Bremner, 2002). Danish survivors of the World War II concentration camps were noted to have subjective complaints of memory problems in a large number of cases (Thygesen et al., 1970). American prisoners of war from the Korean War had deficits in verbal declarative memory function, with a relative preservation of IQ (Sutker et al., 1991). These studies occurred before the development of the diagnostic category of posttraumatic stress disorder (PTSD), leaving unanswered the question of whether verbal declarative memory deficits are specifically associated with stress-related psychiatric disorders including PTSD.

Subsequent studies have demonstrated verbal declarative memory deficits in PTSD (Brewin, 2001; Buckley et al., 2000; Elzinga and Bremner, 2002; Golier and Yehuda, 1998). Several studies using a variety of measures (including the Wechsler Memory Scale, the visual and verbal components of the Selective Reminding Test, the Auditory Verbal Learning Test, the California Verbal New Learning Test, and the Rivermead Behavioral Memory Test) found specific deficits in verbal declarative memory function, with a relative sparing of visual memory and IQ (Barrett et al., 1996; Bremner et al., 1993a, 1995a; Gil et al., 1990; Gilbertson et al., 2001; Golier et al., 1997; Jenkins et al., 1998; Moradi et al., 1999; Roca and Freeman, 2001; Sachinvala et al., 2000; Uddo et al.,

1993; Vasterling et al., 1998, 2002; Yehuda et al., 1995). These studies have been conducted in patients with PTSD related to Vietnam combat (Barrett et al., 1996; Bremner et al., 1993a; Gilbertson et al., 2001; Golier et al., 1997; Roca and Freeman, 2001; Sachinvala et al., 2000; Uddo et al., 1993; Vasterling et al., 1998, 2002; Yehuda et al., 1995), rape (Jenkins et al., 1998), adults with early childhood abuse (Bremner et al., 1995a) and traumatized children (Moradi et al., 1999). One study in adult rape survivors showed that verbal declarative memory are specifically associated with PTSD and are not a nonspecific effect of trauma exposure (Jenkins et al., 1998). Another study of women with early childhood sexual abuse in which some but not all of the patients had PTSD showed no difference between abused and nonabused women (Stein et al., 1999), whereas another study was not able to show a difference between Vietnam veterans with and without PTSD (Zalewski et al., 1994). Other types of memory disturbances studies in PTSD include gaps in memory for everyday events (dissociative amnesia; Bremner et al., 1993b), deficits in autobiographical memory (McNally et al., 1994), an attentional bias for trauma-related material (Beck et al., 2001; Bryant and Harvey, 1995; Cassiday et al., 1992; Foa et al., 1991; McNally et al., 1990, 1993; McNeil et al., 1999; Moradi et al., 2000; Thrasher et al., 1994), and frontal lobe-related impairments (Beckham et al., 1998). These studies suggest that traumas such as early abuse with associated PTSD result in deficits in verbal declarative memory. It is not clear whether cognitive deficits in early abuse survivors are specific to PTSD and are not related to the nonspecific effects of abuse.

The purpose of this study was to compare verbal declarative memory function between women with early childhood sexual abuse and PTSD, with women with early abuse without PTSD, and with nonabused women without PTSD. We hypothesized that verbal declarative memory deficits would be specific to early abuse with associated PTSD.

METHODS

Subjects

Forty-three premenopausal women 18 years or older underwent assessment of memory function. Subjects included women with a history of early childhood (premenarchal) penetrative sexual abuse by self-report with ($N = 18$) and without ($N = 10$) current abuse-related PTSD, and women without abuse or PTSD ($N = 15$). All subjects were recruited by advertisement and gave written informed consent for participation in the study. The consent form was approved by the Human Investigation Committee of Yale University. Women with a history of abuse and PTSD were included with a history of early childhood (premenarchal) penetrative sexual abuse as measured by the Early Trauma Inventory (ETI; Bremner et al., 2000) and the diagnosis of PTSD based on the

Structured Clinical Interview for DSM-IV (SCID; First et al., 1995). PTSD was related in all subjects to early trauma; there were no subjects with PTSD related to adult traumas. Subjects were excluded if they presented with a history of current alcohol or substance abuse or dependence in the past 6 months, schizophrenia, or an eating disorder, as determined by the SCID; serious medical disorder, as determined by laboratory tests and physical examination; organic mental disorder; neurological disorder; or head trauma. All subjects were medication-free 4 weeks or more before the study. The onset of abuse occurred at some time between 4 and 13 years of age (mean, 7 years).

Women with abuse without PTSD met the same inclusion criteria as abused PTSD women with the exception of having a diagnosis of PTSD based on the SCID. Women without abuse or PTSD did not have a history of early childhood sexual abuse or other major traumas as measured by the ETI and did not have a history of psychiatric disorder as measured by the SCID. Psychometric data on the subjects are presented in Table 1. Onset of PTSD was typically in childhood, and in all cases preceded all other psychiatric disorders by at least several years, including affective disorders.

All subjects were evaluated with the SCID for comorbid psychiatric diagnoses. Thirteen of 18 PTSD subjects (72%) fulfilled criteria for a lifetime history of major depression and three (17%) for current major depression. Four subjects (22%) fulfilled criteria for lifetime and current history of panic disorder with agoraphobia, one patient (6%) had a current and lifetime history of generalized anxiety disorder, and one (6%) current and lifetime social phobia. One (6%) subject met criteria for lifetime and current bulimia, and two (12%) for dissociative identity disorder. None of the subjects had current (past 6 months) alcohol or substance abuse or dependence. Four PTSD subjects (22%) fulfilled criteria for a lifetime history of alcohol dependence, three (17%) for lifetime history of alcohol abuse, two (11%) for lifetime history of polysubstance dependence, one (6%) for marijuana abuse, two (12%) for marijuana dependence, one (6%) for cocaine abuse, and one (6%) for cocaine dependence.

Among the abused women without PTSD, six (60%) had lifetime histories of major depression (none had current depression), and one (10%) had a lifetime (not current) history of panic disorder without agoraphobia. One of the women had current and lifetime social phobia (10%). One of the women (10%) had a lifetime (not current) history of bulimia. None of the subjects had current (past 6 months) alcohol or substance abuse or dependence. One of the abused women without PTSD (10%) fulfilled criteria for a lifetime history of alcohol dependence, and one (10%) for a lifetime history of marijuana dependence. None of the nonabused women without PTSD had a history of psychiatric disorder.

TABLE 1. Demographic and Psychometric Data in Women With and Without Abuse and PTSD

	Women with abuse and PTSD (N = 18)	Women with abuse without PTSD (N = 10)	Women without abuse or PTSD (N = 15)	F (2,40) value	p Value
Age	34 (6)	32 (8)	32 (9)	0.43	.66
Years of education	15 (3)	17 (2)	17 (3)	3.76	.03
Years of alcohol abuse	2 (4)	1 (1)	0 (0)	2.86	.07
Age of trauma onset	7.1 (2.9)	9.8 (5.1)	NA	2.96	.10
ETI General Trauma Severity Index	310 (256)	182 (180)	33 (86)	7.62	.0017
ETI Physical Abuse Severity Index	297 (490)	152 (300)	20 (28)	2.40	.11
ETI Emotional Abuse Severity Index	1169 (893)	525 (730)	84 (179)	9.65	.0004
ETI Sexual Abuse Severity Index	244 (485)	155 (299)	4 (7)	1.84	.17
ETI Trauma Severity Index (total)	2021 (1642)	1014 (1197)	142 (200)	9.09	.0006
CAPS (PTSD symptoms) score	60 (26)	12 (12)	N/A	20.95	<.0001
Mississippi Scale (PTSD symptoms) score	119 (25)	80 (11)	70 (10)	28.7	<.0001
CADSS (Dissociative States) score	16 (15)	4 (4)	0 (1)	7.45	.0021
Hamilton Depression Scale score	19 (13)	4 (5)	2 (3)	15.10	<.0001

Neuropsychological Assessments

To assess the intellectual level for each subject, we administered four tests of the Wechsler Adult Intelligence Scale—Revised (WAIS-R): the arithmetic, vocabulary, picture arrangement, and block design tests (Wechsler, 1981).

Two subtests of the Wechsler Memory Scale—Revised (WMS-R; Wechsler, 1987) were administered. The tests included logical memory (free recall of two story narratives, which represents verbal memory) and figural memory (which represents visual memory and involved reproduction of designs after a 6-second presentation). For both subtests, immediate (IMM) and delayed (DEL, 30 minutes) reproduction were tested, and a percentage of retention was computed (DEL/IMM × 100). Earlier versions of the WMS and the WAIS were used to be consistent in administration of test versions across subjects.

Behavioral Assessments

All subjects were assessed with the Clinician Administered PTSD Scale (CAPS; Blake et al., 1995), a reliable and valid measure of PTSD symptom level with subcomponents for the individual symptom clusters. Subjects were also assessed with the Civilian Version of the Mississippi Scale for Combat-Related PTSD, a self-report measure of current PTSD symptom severity that is a continuous measure (Vreven et al., 1995). Severity of childhood abuse was evaluated with the ETI, a reliable and valid instrument for assessment of childhood and adult abuse and trauma (Bremner et al., 2000). The ETI has components for measurement of general childhood trauma (like being in an accident or a natural disaster) and physical, emotional, and sexual abuse. We have developed indexes for measurement of severity of

trauma in each of the subcomponents based on number of endorsed items, duration, and frequency. The ETI Trauma Severity Index is the sum of scores for severity indexes in the subcomponents. The scoring and psychometric properties of the ETI and ETI-based indexes are described in detail elsewhere (Bremner et al., 2000). Baseline dissociative state symptom levels were assessed with the Clinician Administered Dissociative States Scale (CADSS), a reliable and valid instrument (Bremner et al., 1998). Current depressive symptoms were assessed with the Hamilton Depression Scale (Hamilton, 1960). Psychometric data collected with these instruments are presented in Table 1.

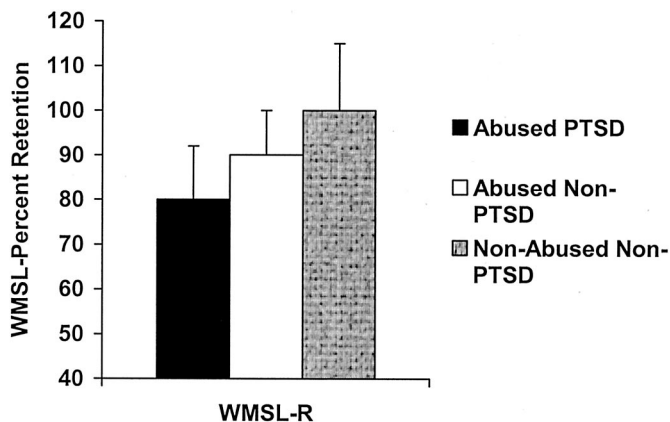


FIGURE 1. Verbal declarative memory function measured with the WMSL-R. Abused women with PTSD (N = 18) had lower scores on the WMSL-R compared with abused (N = 10) and nonabused (N = 15) women without PTSD (F = 7.28; p = .002).

Analysis of variance (ANOVA) was used to compare neuropsychological measures of verbal declarative memory function between patients and controls. We specifically hypothesized lower percent retention on the WMS-R verbal memory (logical) component (WMSL-R), with relative sparing of figural memory and IQ, in PTSD. Pearson correlations were used to compare neuropsychological data and behavioral data. Significance was defined as $p < .05$.

RESULTS

Neuropsychological Measures of Verbal Declarative Memory and IQ

Women with abuse-related PTSD had lower scores on the WMS-R Percent Retention compared with abused women without PTSD and nonabused women without PTSD (Fig. 1; Table 2). There were no significant differences between the groups in visual memory or IQ.

Relationship Between Behavioral Measures and Verbal Declarative Memory

Posttraumatic stress disorder symptom level as measured with the CAPS was significantly negatively correlated with verbal declarative memory function as measured with the WMS—Percent Retention in the group of abused women (including both those with and without PTSD; $r = -0.44$; $df = 26$; $p = .02$; Fig. 2). There were significant correlations within each of the intrusion, avoidance, and hyperarousal domains. There was no relationship between PTSD symptom level and IQ or visual memory. Dissociation as measured by the DES was significantly negatively correlated with verbal declarative memory function as measured with the WMS—Percent Retention in the healthy nonabused women ($r = -0.61$; $df = 11$; $p = .03$), but not the other groups. Dissoci-

ation as measured by the CADSS was negatively correlated with figural memory as measured by immediate ($r = -0.82$; $df = 8$; $p = .007$) and delayed ($r = -0.82$; $df = 8$; $p = .007$) recall on the WMS in the abused group without PTSD, but not the other groups. There were no significant correlations between IQ and dissociative behavioral measures.

Severity of childhood sexual abuse as measured by the ETI was correlated with deficits in verbal declarative memory delayed recall as measured by the WMS in the abused women ($r = -0.48$; $df = 24$; $p = .009$; Fig. 3). There was no relationship between severity of abuse and IQ or visual memory. There was no relationship between age of abuse onset and declarative memory function.

Relationship Between Verbal Declarative Memory and Potentially Confounding Variables

Differences in verbal declarative memory as measured by the WMSL—Percent Retention between the groups continued to be significant after controlling for differences in age, years of education, and years of alcohol abuse by entering these potentially confounding variables in the ANOVA model.

There continued to be significant differences in verbal declarative memory between the groups as measured by the WMSL—Percent Retention after controlling for current and lifetime history of depression by adding these variables in the ANOVA model.

DISCUSSION

Women with abuse-related PTSD had deficits in verbal declarative memory function relative to abused women without PTSD and nonabused women without PTSD as measured

TABLE 2. Neuropsychological Measurements of Verbal Declarative Memory and Other Factors in Women With and Without PTSD and Early Childhood Sexual Abuse

	Women with abuse and PTSD (<i>N</i> = 18)	Women with abuse without PTSD (<i>N</i> = 10)	Women without abuse or PTSD (<i>N</i> = 15)	<i>F</i> (2,40) value	<i>p</i> Value
WMSL-I	25.8 (4.4)	25.4 (6.1)	29.0 (5.4)	2.15	.13
WMSL-D	20.1 (4.4)	22.9 (5.9)	28.1 (6.4)	7.62	.0016 ^b
WMSL-R	80.3 (11.7)	90.4 (11.4)	99.7 (15.0)	7.28	.002 ^a
WMSF-I	25.0 (13.0)	35 (11.9)	27.4 (13.8)	2.70	.08
WMSF-D	22.9 (12.9)	34.7 (12.0)	27.4 (13.8)	2.57	.09
WMSF-R	91.5 (14.0)	98.8 (2.3)	86.0 (26.3)	1.49	.24
Verbal IQ	113.8 (20.0)	116.5 (15.5)	125.9 (16.0)	2.11	.13
Performance IQ	102.1 (12.5)	115.4 (19.5)	105.9 (20.7)	2.06	.14
Full-scale IQ	109.8 (15.2)	117.7 (17.6)	122.3 (17.6)	2.53	.09

^aPTSD group less than abused non-PTSD and nonabused non-PTSD groups by Duncan Multiple Range Test ($p < .05$).

^bPTSD less than nonabused non-PTSD, but not abused PTSD ($p < .05$)

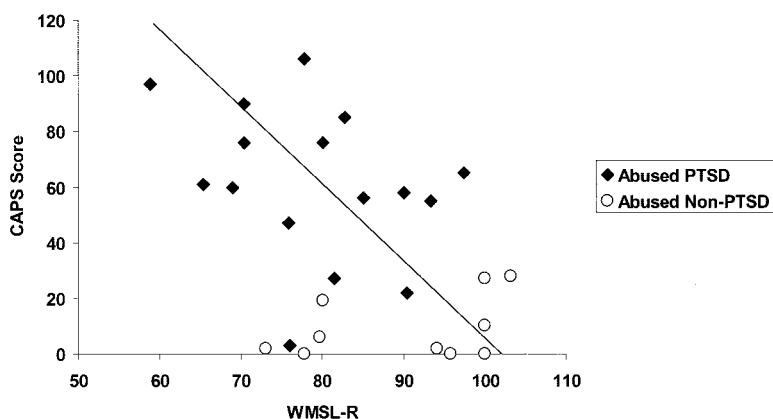


FIGURE 2. Relationship between PTSD symptoms as measured with the CAPS and verbal declarative memory as measured by the WMSL-R in abused women with and without PTSD. Women with PTSD are represented by solid diamonds, and abused women without PTSD are represented by open circles. There was a negative correlation between CAPS scores and WMSL-R scores ($r = -0.44$; $df = 25$; $p = .02$), suggesting that increased PTSD symptoms were associated with greater deficits in verbal declarative memory.

with subtests of the WMS. These subtests are thought to measure consolidation of verbal memory. There were no significant differences in the subtests of visual memory measured with the WMS or IQ. Deficits in verbal declarative memory were correlated with increased PTSD symptoms as measured by the CAPS and severity of childhood sexual abuse as measured by the ETI. There continued to be differences in verbal declarative memory between patients with PTSD and controls after controlling for potentially confounding factors including differences in IQ, years of education, or alcohol abuse.

These findings suggest that early childhood abuse seen in the setting of PTSD is associated with specific deficits in components of verbal declarative memory measured by the subtests of the WMS used in this study that are specific to PTSD and are not a nonspecific outcome of childhood abuse. One previous study in rape survivors demonstrated specificity of memory deficits to PTSD (as opposed to the nonspecific effects of rape in the absence of psychiatric disorder; Jenkins et al., 1998).

There are several possible explanations for the findings of the current study. Stress could lead to alterations in the

hippocampus, which plays a critical role in memory (Arbel et al., 1994; Diamond et al., 1996; Gould et al., 1997, 1998; Luine et al., 1994; McEwen et al., 1992; Sapolsky, 1990, 1996). Consistent with this hypothesis, magnetic resonance imaging studies have found smaller hippocampal volume or other alterations in the hippocampus in PTSD (Bremner et al., 1995b, 1997, 2003; Freeman et al., 1998; Gilbertson et al., 2002; Gurvits et al., 1996; Schuff et al., 2001; Stein et al., 1997; Villareale et al., 2002). Studies in patients with epilepsy found that a loss of neurons in the human hippocampus was correlated with deficits in the WMSL—Percent Retention (Sass et al., 1990, 1995), the primary outcome of the current study. The verbal declarative measures assessed in the present study also most likely involve a neural circuit that connects the hippocampus to the prefrontal cortex, so that deficits in these measures may also involve prefrontal deficits (Selemon and Goldman-Rakic, 1988). It is also possible that inherent deficits in memory function represent a risk factor for PTSD (Gilbertson et al., 2002). Previous studies have found a relationship between premorbid low IQ and the development of PTSD (Macklin et al., 1998; McNally and Shin, 1995).

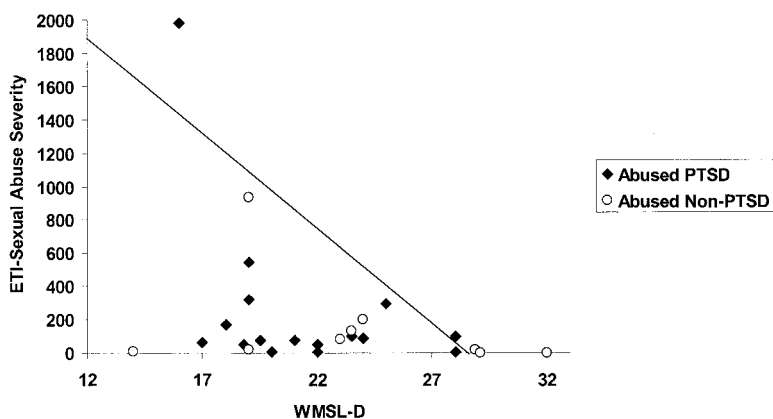


FIGURE 3. Relationship between severity of childhood sexual abuse as measured with the ETI and deficits in verbal memory as measured with the Wechsler Memory Scale Logical Component-Delayed Recall (WMSL-D) in abused women with and without PTSD. Women with PTSD are represented by solid diamonds, and abused women without PTSD are represented by open circles. Sexual abuse severity was correlated with deficits in verbal declarative memory in the abused women ($r = -0.48$; $df = 24$; $p = .009$).

These findings may have public health implications. Early abuse may impair the ability of children to learn and perform academically in school. Studies in animals also support the idea that a deprived environment may affect brain development (Kempermann et al., 1997), a finding which has implications for the possible long-term consequences of childhood neglect and abuse.

There are several limitations of the current study that are worthy of mention. We used subtests of both the WAIS and the WMS. Therefore, this study provided only a limited assessment of memory and IQ. Women with PTSD had fewer years of education than the comparison groups. This was largely a result of few years of education after high school. Years of education is typically used as a proxy for socioeconomic status; however, the PTSD disorder itself may have interfered with the pursuance of higher education. Nevertheless, there continued to be differences in verbal declarative memory between the groups after adjusting statistically for differences in education. Similarly, women with PTSD had higher levels of alcohol abuse than the other groups. Average years of alcohol abuse was much lower (2) than our previous studies of patients with PTSD (6 years or more). Again, there continued to be differences in verbal declarative memory function after controlling for alcohol exposure.

CONCLUSION

Deficits in verbal declarative memory as measured by specific subtests of the WMS-R were found in women with abuse and PTSD relative to women with abuse without PTSD, and nonabused women without PTSD. These deficits were specific to verbal declarative memory. Findings were significant after controlling for years of education, history of alcohol abuse, and differences in IQ. Increased PTSD symptoms and increased severity of abuse correlated with deficits in verbal declarative memory as measured by the subtests of the WMS-R.

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