Journal of Traumatic Stress
February 2012, *25,* 1–4

ISTSS International Society for Traumatic Stress Studies

BRIEF REPORT

Recollection of Negative Information in Posttraumatic Stress Disorder

Géraldine Tapia,[1] David Clarys,[2] Aurélia Bugaiska,[3] and Wissam El-Hage[4]
[1]Department of Psychology, Health, and Quality of Life, Université Bordeaux, Segalen, France
[2]Research Center for Cognition and Learning, Université de Poitiers, Poitiers, France
[3]Laboratory for the Study of Learning and Development, Université de Dijon, Dijon, France
[4]Inserm U930 ERL CNRS 3106, Université François Rabelais de Tours, France

The purpose of the present study was to investigate the effects of posttraumatic stress disorder (PTSD) associated with the effects of emotional valence on recall processes in recognition memory. Patients suffering from PTSD ($n = 15$) were compared with 15 nontraumatized patients with anxious and depressive symptoms and with 15 nontraumatized controls on the remember/know paradigm using negative, positive, and neutral words. The PTSD group remembered more negative words than the nontraumatized controls, $F(1, 42) = 7.20$, $p = .01$, but there was no difference between those with PTSD and those with anxiety or depression, $F(1, 42) = 2.93$, $p = .09$, or between the latter and controls, $F(1, 42) < 1$. This study did not allow us to determine whether this recollection bias for negative information was specific to the PTSD status or was triggered by the greater level of anxiety displayed in this group.

Posttraumatic stress disorder (PTSD) has been linked to selective memory of emotional stimuli: PTSD patients recall more trauma-related words than either nontraumatized or trauma-exposed controls (Coles & Heimberg, 2002). Cognitively, this effect is thought to be mediated by increased allocation of processing resources to self-referent negative material (Williams, Watts, MacLeod, & Mathews, 1997). Evidence suggests that this process may have an impact on item memory and source monitoring.

Many researchers associate source-monitoring processes with recollective processes, as in remembering versus knowing (e.g., Cook, Hicks, & Marsh, 2007). The source-memory-as-recollection stance predicts that source monitoring will be better for valenced than for neutral words, valenced material being associated with greater recollection (Kensinger & Corkin, 2003).

A previous study found that PTSD patients are more likely to know than to remember nontrauma-related information, suggesting that source monitoring in general might be impaired in PTSD (Tapia, Clarys, El-Hage, Belzung, & Isingrini, 2007). A more recent study investigated whether trauma-related source monitoring might be specifically impaired in PTSD (Brennen, Dybdahl, & Kapidžić, 2007), using the Deese–Roediger–McDermott paradigm to induce false memories and the remember/know paradigm to examine the phenomenological quality of recall. As expected, more war-related lures were mistakenly recalled by the PTSD group than by controls, but these false memories were not associated with more remember responses.

The aim of the present study was to investigate the effects of PTSD on source monitoring for valenced material using the remember/know paradigm, but without first eliciting false memories. We tested first whether negative information is more likely to be remembered in PTSD patients than in controls, and second whether this PTSD-related recollection bias for negative information produces more remembered false memories for such information.

Method

Participants

There were three groups of 15 participants (18–45 years): a PTSD group, a nontraumatized psychiatric group suffering from anxiety/depression to examine the confounding effect of self-relevance, and a nontraumatized control group. Antidepressant medication, but not benzodiazepine, was accepted in the clinical subjects. Interviews with the PTSD outpatients (14 women) were conducted using the Clinician-Administered PTSD Scale (CAPS; Blake et al., 1995; $M = 62.8$, $SD = 20.2$). PTSD followed sexual abuse during childhood ($n = 3$), rape ($n = 6$), road traffic accidents ($n = 1$), or intimate partner violence ($n = 5$). Patients with a history of major depressive disorder were excluded from this group. The

Correspondence concerning this article should be addressed to Géraldine Tapia, EA4139, Laboratoire Psychologie, Santé et Qualité de Vie, Université Bordeaux Segalen, France. E-mail: geraldine.tapia@u-bordeaux2.fr

DOI: 10.1002/jts.21659

anxiety/depression outpatients (eight women) had no history of trauma.

Before inclusion, psychiatric status and comorbidities were assessed using the Mini International Neuropsychiatric Interview (Duburcq et al., 1999). The psychiatric comorbidities associated with PTSD/anxiety-depression groups were PTSD (15/0), major depressive episode (8/15), suicidal risk (5/9), agoraphobia (3/5), and addiction (0/0). Neither PTSD nor anxiety/depression patients had any history of bipolarity, psychosis, obsessive–compulsive disorder, addiction, or organic mental disorder. The control participants (11 women) had no history of psychiatric disorder and were medication-free. History of trauma was an exclusion criterion for this group. All participants gave their informed written consent.

Procedure and Measures

Anxiety, depression, and dissociation symptoms were assessed using the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), the short form of the Beck Depression Inventory (BDI-SF; Beck, Rial, & Rickels, 1974), and the Dissociative Experiences Scale (DES; Bernstein & Putnam, 1986). The descriptive data and group contrasts are presented in Table 1.

The experimental stimuli in the remember/know paradigm comprised 90 words (30 negative, 30 positive, and 30 neutral words; see Appendix) selected from a French database (Messina, Morais, & Cantraine, 1989). This list comprises 904 nouns rated on a 5-point scale from pleasant to unpleasant. We selected 30 negative words rated lower than 2, 30 positive words rated higher than 4, and 30 neutral words rated between 2.5 and 3.5. Statistical testing ensured that the three sets were emotionally significantly different (all $p < .001$). The negative words were not selected as being specifically trauma-relevant, although some could be. Frequency (CELEX lexical database; Baayen, Piepenbrock, & Gulikers, 1995) and number of letters were matched across emotions (all $p = ns$). The words were divided into two sets of 45 words (15 negative, 15 positive, 15 neutral). One set was presented at encoding and its words were used as target items in the following recognition test; the other set provided the lures (sets counterbalanced across participants).

Participants were instructed to read the words aloud and to remember them for a subsequent test. Ten minutes later, in the recognition phase, each word appeared on the screen until the participant pressed the Yes button if the word was recognized as having appeared in the study list, or the No button if not. If the response was yes, the subject had to indicate if recognition was based on remembering (the word evoked a specific recollection of the learning sequence), knowing (the word did not evoke any specific recollection of the learning sequence), or guessing (uncertain if the item was seen during the learning task or not). Gardiner, Java, and Richardson-Klavehn (1996) showed that including the guess category avoids responses that are really guesses being identified as know responses.

Data Analyses

As recommended (Perfect, Williams, & Anderton-Brown, 1995), different separate analyses of variance (ANOVAs) were carried out on the mean proportion of remember and know hits and false alarms, with group as between-subjects factor and word type as within-subjects factor. When necessary, contrast analyses with a Bonferroni corrected p value were conducted to control for family-wise error rates. Because the three groups were comparable on age and education level, but not gender, $\chi^2(1, N = 45) = 6{,}14$, $p = .013$, between PTSD and anxiety/depression groups, the analyses included gender in the model.

Results

Table 1 presents descriptive data. The results of remember, know, and guess hits and false alarms are displayed in Table 2. The repeated measures levels met the assumption of sphericity for remember hits, $\chi^2(2, N = 45) = .915$, *ns*, know hits, $\chi^2(2, N = 45) = .903$, *ns*, remember false

Table 1
Descriptive Data and Group Contrasts

	PTSD		AD		C		Group differences					
	$N = 15$		$N = 15$		$N = 15$		PTSD vs. AD		PTSD vs. C		AD vs. C	
Measures	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	η_p^2	*F*	η_p^2	*F*	η_p^2
Age	24.6	8.3	30.6	9.6	26.9	9.5	3.34		<1		1.10	
Ed level	10.9	2.4	11.1	2.6	11.5	2.4	<1		<1		<1	
STAI-S	55.5	15.0	45.7	14.3	28.5	7.3	3.38	.11	39.2***	.58	17***	.38
STAI-T	62.5	10	54.6	9.8	38.3	9.2	4.66*	.14	48.1***	.63	22.5***	.45
BDI-SF	20.0	9.1	15.5	7.4	2.5	3	2.18		50.2***	.64	40.6***	.59
DES	22.8	16.3	18.6	12.7	10	8.1	<1		7.36**	.21	4.90*	.15

Note. $F(1, 28)$ except $\chi^2(1)$ for gender. PTSD = Posttraumatic stress disorder; AD = anxiety-depression; C = control; Ed level = education level; STAI-S = State-Trait Anxiety Inventory-State; STAI-T = State-Trait Anxiety Inventory-Trait; BDI-SF = Beck Depression Inventory-Short Form; DES = Dissociative Experience Scale, MINI = Mini International Neuropsychiatric Interview; MDD = major depressive disorder.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 2
Means and Standard Deviations by Valence of R, K, and G Hits and False Alarms

		PTSD $N = 15$				AD $N = 15$				C $N = 15$			
		Hits		FA		Hits		FA		Hits		FA	
	Valence	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
R	Negative	0.76	0.21	0.04	0.06	0.58	0.33	0.06	0.08	0.48	0.31	0.06	0.08
	Positive	0.64	0.24	0.03	0.04	0.61	0.33	0.04	0.07	0.57	0.32	0.03	0.06
	Neutral	0.31	13.1	0.05	0.07	0.49	0.30	0.01	0.04	0.47	0.32	0.02	0.05
K	Negative	0.22	0.2	0.05	0.09	0.34	0.31	0.04	0.07	0.47	0.28	0.08	0.09
	Positive	0.34	0.24	0.07	0.09	0.35	0.28	0.06	0.09	0.41	0.31	0.08	0.08
	Neutral	0.62	0.16	0.07	0.08	0.42	0.27	0.06	0.08	0.46	0.29	0.04	0.05
G	Negative	0.01	0.03	0.01	0.02	0.08	0.15	0.03	0.04	0.05	0.06	0.05	0.08
	Positive	0.02	0.04	0.01	0.02	0.04	0.15	0.01	0.02	0.02	0.03	0.25	0.22
	Neutral	0.06	0.13	0.02	0.03	0.09	0.17	0.01	0.03	0.06	0.13	0.04	0.05

Note. PTSD = Posttraumatic stress disorder; AD = anxiety-depression; C = control; FA = false alarms; R = remember; K = know; G = guess.

alarms, $\chi^2(2, N = 45) = .956$, *ns*, and know false alarms, $\chi^2(2, N = 45) = .972$, *ns*. For remember hits, the 3 × 3 ANOVA mixed-model showed a significant main effect of word type, $F(2, 84) = 31.7$, $p < .001$, $\eta_p^2 = .43$, and a significant interaction between group and word type, $F(4, 84) = 13.3$, $p < .001$, $\eta_p^2 = .39$. The main effect of group was not significant, $F(2, 42) < 1$. The ANOVA indicated a significant group effect for negative words, $F(2, 42) = 3.69$, $p = .03$, $\eta_p^2 = .15$. Contrast analyses with a Bonferroni corrected p value of .05/3 ($p = .017$) indicated that the PTSD group "remembered" more negative words than the control group, $F(1, 42) = 7.20$, $p = .01$, $\eta_p^2 = .15$. No significant difference was found between PTSD and anxiety/depression groups, $F(1, 42) = 2.93$, $p = .09$, nor between control and anxiety/depression groups, $F(1, 42) < 1$. There was no significant effect of group for positive and neutral words, $F(2, 42) < 1$ and $F(2, 42) = 2.09$, *ns*, respectively.

For know hits, the ANOVA showed a significant main effect of word type, $F(2, 84) = 17.4$, $p < .001$, $\eta_p^2 = .29$, and a significant interaction between group and word type, $F(4, 84) = 9.60$, $p < .001$, $\eta_p^2 = .31$. The main effect of group was not significant, $F(2, 42) < 1$. There was a significant group effect for negative words, $F(2, 42) = 3.24$, $p = .05$, $\eta_p^2 = .13$. Contrast analyses with a Bonferroni corrected p value of .05/3 ($p = .017$) indicated that the PTSD group produced fewer know responses for negative words than the control group, $F(1, 42) = 6.46$, $p = .014$, $\eta_p^2 = .87$. No significant difference was found between PTSD and anxiety/depression groups, $F(1, 42) = 1.31$, *ns*, nor between control and anxiety/depression groups, $F(1, 42) = 1.95$, *ns*. The ANOVA indicated no significant effect of group for positive and neutral words, $F(2, 42) < 1$ and $F(2, 42) = 2.89$, $p = .07$, respectively.

For remember false alarms, the 3 × 3 ANOVA mixed-model showed a significant main effect of word type, $F(2, 84) = 4.58$, $p = .01$, $\eta_p^2 = .10$; the main effect of group, $F(2, 42) < 1$, and the interaction between group and word type were not significant, $F(4, 84) = 2.16$, $p = .08$. The main effect of word type, however, no longer appeared after adjusting for gender. The analysis of covariance was $F(2, 84) < 1$. For know false alarms, the ANOVA revealed no significant effects.

Discussion

The present study compared the effects of emotional valence of stimulus material on recall processes in subjects suffering from PTSD, patients with anxiety and depression without PTSD, and nontraumatized controls. Results showed that the PTSD group displayed a different pattern of memory bias than controls, but there was no difference between the PTSD and anxiety/depression groups, or between the anxiety/depression and control groups. The PTSD participants did not differ from the control group in overall recognition rate of negative words, but they were more likely to remember a negative word than to know it. These results suggest that PTSD patients pay greater attention to processing negative information, and the resulting cognitive processing might not be beneficial for item memory but only for source memory.

Our study failed to demonstrate any group effect on remember false alarms for negative words, confirming Brennen et al.'s results (2007). Posttraumatic stress disorder may enhance source monitoring for negative valenced words without eliciting false memories. Finally, although some authors argue that heightened attention toward valenced material reduces source monitoring (e.g., Cook, et al., 2007), our study suggests that valenced words can enhance source memory without affecting recognition hit rates.

This study has a few methodological limitations. First, our results may be a consequence of inadequate statistical power and may not reflect real life. In addition, as we did not include a trauma-exposed group without PTSD we cannot rule out the possibility that the recollection

enhancement for negative words may be trauma-related rather than an effect of PTSD. Second, the psychiatric groups did not differ in remembering negative words. Consequently, it is not clear whether the results are driven specifically by PTSD or by anxiety or depression. Furthermore, the level of anxiety of the anxiety/depression group was between those of the PTSD and control groups; their rate of remember judgments for negative words was also between those of the other two groups. The pattern of memory bias may thus reflect an effect of anxiety level, suggesting that anxiety triggers enhanced recollection of negative words. Third, our control samples were not strictly matched, notably the male to female ratio in the psychiatric groups. Finally, the negative words did not include specific self-reference trauma-related words, mainly because of the heterogeneity of the traumatic experiences. However, this suggests that the PTSD-related recollection bias is based more on emotionality than on the relevance of the stimuli.

Overall, this study supports the argument that PTSD enhances the available resources for binding the context of negative valenced information into a memory trace without causing any mnemonic disadvantage. Further studies need to examine whether this cognitive profile is specific to PTSD.

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Appendix

Word Lists

Negative words	Positive words	Neutral words
Accident	Joy	Shirt
Panic	Beauty	Building
Weapon	Poetry	Box
Hole	Sweetness	Corner
Smoke	Balance	Gallery
Destruction	Spring	Team
Demon	Star	Leaf
Delusion	Bouquet	Clock
Hospital	Cake	Engine
Disease	Ocean	Material
Captive	Health	Smell
Tomb	Travel	Roof
Trouble	Butterfly	Cylinder
Death	Couple	Square
Drama	Cinema	Paper
Shock	Cheerful	Suit
Anxiety	Charm	Block
Gun	Melody	Angle
Cage	Kindness	Corridor
Cinder	Harmony	Group
Disaster	Summer	Page
Devil	Diamond	Watch
Delirium	Flower	Industry
Psychiatry	Gift	Metal
Tiredness	Beach	Team
Prison	Rest	Steam
Funeral	Holidays	Arc
Sadness	Meadow	Pipe
Victim	Fidelity	Circle
Tragedy	Show	Ink