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Memory and executive dysfunctions associated with acute posttraumatic stress disorder

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ABSTRACT

Posttraumatic stress disorder (PTSD) in its chronic form has been associated with a number of neurocognitive impairments involving emotionally neutral stimuli. It remains unknown whether such impairments also characterize acute PTSD. In the present investigation, neurocognitive functions were examined in trauma exposed individuals with ($n=21$) and without ($n=16$) acute PTSD, as well as in a group of individuals never exposed to trauma ($n=17$) using specific and standardized tasks such as the Rey Auditory Verbal Learning Test, the Aggie's Figure Learning Test, the Autobiographical Memory Interview, the D2 test, the Stroop task, the digit and visual span tasks of the Wechsler Memory Scale-III, the Trail Making Test, the Tower of London and the vocabulary subtest of the Wechsler Adult Intelligence Scale-III. A number of deficits in the cognitive domains of memory, high-level attentional resources, executive function and working memory were found in the group with a diagnosis of acute PTSD only and not among the other groups. The findings, which point to the possibility of disturbed fronto-temporal system function in trauma-exposed individuals with acute PTSD, are particularly relevant for the early clinical management of this disorder.

1. Introduction

Two well-established facts have emerged from the literature on neuropsychological characteristics of individuals with posttraumatic stress disorder (PTSD). Firstly, information-processing biases have been repeatedly observed, the most robust finding being attentional deficits while processing emotional stimuli (e.g. McNally et al., 1990; Paunovic et al., 2002; Vasterling and Brewin, 2005). Secondly, despite the fact that their magnitude and nature tend to vary across studies, cognitive abnormalities have also been found on neuropsychological tests involving neutral stimuli (for a review see Vasterling and Brewin, 2005). Yet, in our view, the literature would be enhanced by bringing new information on an issue of great relevance: it remains unknown whether such impairments are present at the onset of the disorder. Indeed, since most of the data comes from retrospective studies including participants who have been symptomatic for years or even decades, such as war veterans or adults survivors of child abuse, it is not yet possible to conclude whether the neuropsychological profile associated with *chronic* PTSD also relates to *acute* PTSD.

Findings related to cognitive abnormalities in individuals with chronic PTSD, as measured on standard neuropsychological tasks, are undeniable. Researchers have rather consistently observed verbal (e.g. Bremner et al., 1995; Yehuda et al., 1995; Jenkins et al., 1998; Gilbertson et al., 2001; Golier and Yehuda, 2002) or visual (Bremner et al., 1993) episodic memory dysfunctions. While others have also found dysfunctions in more complex attentional and executive resources (e.g. Vasterling et al., 1998; Koenen et al., 2001; David et al., 2002; Stein et al., 2002; Vasterling et al., 2002), it seems that basic attentional capacities tend to be preserved in individuals with chronic PTSD (Vasterling and Brewin, 2005). Another type of cognitive dysfunctions often seen in patients with chronic PTSD is the reduced specificity of autobiographical memories (Wessel et al., 2002; Dalgleish et al., 2008).

However, only three studies have focused on cognitive functioning in the early posttraumatic phase. A first study, by Harvey et al. (1998), examined the specificity of autobiographical memories in survivors of motor vehicle accidents within the week following their accident. The results showed that altered accessibility of personal memories in the acute posttraumatic phase was associated with poorer outcome 6 months later. A second investigation, by Brandes et al. (2002), found that survivors with initially high levels of PTSD symptoms had impaired attention and immediate recall of visual information, as well as lower IQ compared to those with low initial symptoms. Finally, a

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third study obtained neuropsychological measures within days following traumatic exposure and 6 weeks later (Bustamante et al., 2001). Negative correlations were found between baseline delayed recall, as well as retroactive interference, and PTSD at follow-up. Accordingly, the authors concluded that deficits in areas of verbal memory days after trauma exposure may represent a risk factor for PTSD.

Exploring cognitive functioning of recently traumatized individuals is relevant because the factors linked to the persistence of PTSD may differ from those related to the initial development of the disorder, from which many remit. Yet, while those three studies suggest that neuropsychological deficits associated with chronic PTSD may be present in the early stages following traumatic exposure, considering that the patients were assessed within days of trauma exposure, their findings more likely relate to acute stress disorder (ASD) rather than to acute PTSD. Indeed, an important temporal distinction exists between ASD, acute and chronic PTSD. Symptoms of ASD, which must include dissociation, are experienced during or immediately after the traumatic event, last for at least 2 days and resolve within the following 4 weeks. If the disturbance persists for more than one month after the traumatic exposure, the diagnosis should be changed for acute PTSD. Finally, if the duration of symptoms persists for more than 3 months, chronic PTSD is specified. Whereas most of the previous findings related to either chronic PTSD or acute stress disorder, the nature of neuropsychological impairments linked to acute PTSD remains unclear.

The current investigation was thus designed to further our understanding of the neuropsychological concomitants of acute PTSD. To do so, the present investigation assessed neurocognitive functioning in two groups of individuals (one with and one without PTSD) who had been exposed to a single trauma in the previous month as well as in a third group of individuals never exposed to a traumatic event. Importantly, this study design was selected because it allows for the discrimination between the effects of trauma exposure and the effects related to having acute PTSD.

We hypothesized that the trauma-exposed group with acute PTSD would display a similar pattern of neuropsychological disturbances (in cognitive areas such as memory, higher-level attention and executive function) as patients suffering from chronic PTS, that this impairment would not characterize the other two comparison groups and would, therefore, be specific to the trauma-exposed group with PTSD.

2. Methods

2.1. Participants

With the help of the treating nurse, 42 individuals presenting to the emergency room as a result of trauma exposure were recruited in an extensive imaging study (not reported here), and 39 of them took part in the neuropsychological investigation (one had no availability and two others suffered a panic attack while undergoing their imaging session and did not want to engage in any further testing). Another group of 17 individuals without a history of trauma exposure was recruited via a newspaper advertisement. Participants gave written informed consent and received 75$ CAD for their time and effort. The study was approved by the ethics committee of the Douglas Hospital.

Out of the 56 recruited participants, 1 failed to complete the neuropsychological battery because his fluency in French or English was not good. Another participant was excluded from the study because the PTSD diagnosis was ambiguous. The 54 remaining participants were assigned to one of 3 groups: the acute PTSD group (PTSD+; $n=21$), the trauma-exposed group without acute PTSD (PTSD−; $n=16$), and the normal comparison group (NC; $n=17$).

Of all trauma-exposed participants, 96% of them had no history of prior PTSD, but all met the A1 and A2 criteria for recent trauma exposure (American Psychiatric Association, 1994). Current events included mostly motor vehicle accidents (31), as well as physical assault (3), sexual assault (2), and industrial accident (1). No subject suffered from head injury or loss of consciousness during trauma exposure. Individuals with neurological and/or severe psychiatric disorder were not included. The socio-demographic and clinical variables of the three groups are shown in Table 1.

2.2. Procedure and material

One month after trauma exposure, participants were assessed on two different days with a set of structured diagnostic interviews and a comprehensive neuropsychological battery, each requiring approximately 2.5 h. All instruments were considered reliable and valid.

2.2.1. Trauma-related symptomatology and psychiatric comorbidity

Recalled immediate responses to trauma were documented using the Peritraumatic Dissociative Experiences Questionnaire (Marmar et al., 1997) and the Peritraumatic Distress Inventory (Brunet et al., 2001) in order to establish the subjective intensity of participant's trauma exposure. The self-report Impact of Event Scale-Revised (Brunet et al., 2003) was used to provide a dimensional assessment of PTSD symptoms experienced in the previous week. The Clinician-Administered PTSD Scale (CAPS; Blake et al., 1995), an interviewer-based structured interview, was used to assess history of trauma exposure and to determine PTSD diagnostic status. In addition to meeting the DSM-IV criteria for PTSD (American Psychiatric Association, 1994) and according to our clinical experience, a minimum score of 42 on the CAPS was selected in order to ensure that all participants' PTSD diagnosis was severe enough.

The semi-structured Mini International Neuropsychiatric Interview (Sheehan et al., 1998) was used to verify the presence of several current and past comorbid DSM-IV axis I disorders, including alcohol and drug abuse. Finally, the Beck Depression Inventory (Beck et al., 1961) in its short version (BDI-SF) supplied a dimensional assessment of comorbid symptoms of depression.

2.2.2. Episodic and autobiographical memory functioning

The neurocognitive battery included the Rey Auditory Verbal Learning Test (RAVLT), a well-established measure of explicit verbal list learning and memory function (Vakil and Blachstein, 1993) which assesses immediate and delayed recall, recall with retroactive interference, recognition and total learning (Rey, 1964). The Aggie Figures Learning Test (AFLT; Madjan et al., 1996) was used to provide a measure of visual memory function. Since this new visuoperceptual instrument was developed as a nonverbal equivalent to the RAVLT, it was chosen to allow easier comparisons of visual and verbal memory scores. In addition, specificity of memory for past personal events or experience was assessed with the incidents schedule component of the Autobiographical Memory Interview (AMI), a semi-structured interview that assesses memory across three broad time bands (childhood, early adult life and recent events) and that

Table 1
Mean (and standard deviation) of sociodemographic and clinical variables, and IQ.

	(1) PTSD+ $n=21$	(2) PTSD− $n=16$	(3) NC $n=17$	F or χ^2	df	P	Post hoc tests
Age, years	31.1 (11.7)	29.38 (12.0)	28.7 (11.1)	0.23	2, 51	0.799	
Gender (F\M)	14\7	7\9	9\8	$\chi^2=2.0$	2	0.368	
Education level, years	13.1 (2.7)	15.3 (1.9)	13.9 (2.0)	4.17	2, 49b	0.021	1–2 $p=0.016$
Type of trauma (MVA\other)	14\7	11\5	n.a.	$\chi^2=0.02$	1	0.893	
CAPS, score	68.8 (15.8)	23.3 (10.8)	n.a.	92.62	1, 34	<0.001	
IES-R, score	52.7 (19.1)	20.4 (12.9)	n.a.	32.24	1, 34	<0.001	
PDI, score	26.4 (8.7)	18.5 (7.4)	n.a.	8.25	1, 34a	0.007	
PDEQ, score	28.5 (9.7)	18.9 (6.1)	n.a.	11.22	1, 34	0.002	
BDI, score	10.6 (5.7)	2.0 (2.9)	1.93 (3.0)	24.89	2, 48	<0.001	1–2,3 $p<0.001$
Other axis 1 disorder, current (Y\N)	7\14	2\13	1\14	$\chi^2=4.48$	2	0.107	
Other axis 1 disorder, past (Y\N)	10\11	8\7	4\11	$\chi^2=2.47$	2	0.291	
IQ: vocabulary, scaled score	11.5 (2.2)	14.1 (2.0)	14.4 (2.0)	11.11	2, 51	<0.001	1–2,3 $p \leq 0.001$

n.a. = non applicable; PTSD+ = trauma-exposed group with acute PTSD; PTSD− = trauma-exposed group without PTSD; NC = non-exposed comparison group; MVA = motor vehicle accident; CAPS = clinician-administered PTSD scale; IES-R = Impact of Event Scale-revised; PDI = Peritraumatic Distress Inventory; PDEQ = Peritraumatic Dissociative Experiences Questionnaire; BDI = Beck Depression Inventory.