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Neuropsychological performance, psychiatric symptoms, and everyday cognitive failures in Bosnian ex-servicemen with posttraumatic stress disorder

MAIDA KOSO, AIDA SARAČ-HADŽIHALILOVIĆ and STEFAN HANSEN

A previous study of ours (Koso & Hansen, 2006) indicated remarkably large decrements in neuropsychological functioning in Bosnian war veterans with posttraumatic stress syndrome (PTSD). The present study assessed attention (Sustained Attention to Response Task), executive function (Trail Making Test), and memory (Rivermead Behavioural Memory Test) in an additional group of veterans with (n = 45) or without (n = 34) PTSD. Replicating our prior study, sizeable performance decrements were observed. Furthermore, multivariate analyses revealed that (a) good verbal IQ partly buffered against the harmful effect of PTSD on more fluid cognitive functions, (b) cognitive impairment was related to PTSD symptom severity (Posttraumatic Diagnostic Scale scores) and to (c) difficulties in everyday cognitive functioning (Cognitive Failures Questionnaire scores).

Key words: posttraumatic stress disorder, executive function, attention, memory, cognitive failure

In vulnerable individuals, exposure to trauma can lead to posttraumatic stress syndrome (PTSD), characterized by re-experiencing of the event(s), avoidance of reminders of the trauma and hypervigilance (Yehuda, 2002). In addition PTSD may be linked to neuropsychological deficits, involving memory, attention, and executive functions (reviewed by Elzinga & Bremner, 2002; McNally, 2006), and to gray matter loss in limbic and paralimbic brain areas (e.g., Emdad et al., 2006; Kasai et al., 2007). The present paper concerns the neuropsychological decrements in PTSD and addresses three issues arising in a previous study of ours (Koso & Hansen, 2006). In that investigation we examined executive and mnemonic functions in Bosnian ex-servicemen with and without PTSD about seven years after the end of the war. We demonstrated that the PTSD group performed poorly on the tests for memory, attention and executive functions. Interestingly, the magnitude of these decrements seemed considerably larger than those reported in other studies of combat-related PTSD. For example, three studies (Gilbertson, Gurvits, Lasko, & Pitman, 1997; Samuelsson et al., 2006; Vasterling et al., 2002) report significant decrements in Wechsler Adult Intelligence Scale (WAIS) Digit span, the η^2 (Rosenthal & Rubin, 1982) ranging between .10 and .25; in our study the effect size was η^2 = .53. Previous studies of memory deficits in combat-related PTSD report effect sizes between η^2 = .04 and .44 (Gilbertson et al., 1997, Samuelson et al., 2006; Uddo, Vasterling, Brailey, & Sutker, 1993; Vasterling, Brailey, Constans, & Sutker, 1998; Vasterling et al., 2002; Yehuda et al., 1995), which are lower than the η^2 = .86 reported by Koso and Hansen (2006).

Why were the PTSD subjects studied by Koso and Hansen (2006) so severely impaired? One of many possibilities is that the previous PTSD sample was highly atypical due to a sampling bias. The first aim of the present study, therefore, was to examine an additional group (n = 45) of war veterans diagnosed with PTSD. Their performance on a test battery similar to that used by Koso and Hansen (2006) was compared to that of 34 veterans without PTSD.

The second issue addressed in the present paper concerns the broad individual variability in PTSD symptom severity and its relationship to cognitive dysfunction. On the

Maida Koso, Department of Psychology, Filozofski fakultet, Sarajevo University, Franje Račkog 1, 71 000 Sarajevo, Bosnia-and-Herzegovina. E-mail: maida.koso@ff.unsa.ba (the address for correspondence);

Aida Sarač-Hadžihalilović, Institute for Anatomy, Sarajevo University, Bosnia-and-Herzegovina;

Stefan Hansen, Department of Psychology, University of Gothenburg, Sweden.

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Posttraumatic Diagnostic Scale (PDS; Foa, Cashman, Jaycox, & Perry, 1997) the coefficient of variation (i.e., standard deviation/mean) was as high as 0.19 in the PTSD group studied by Koso and Hansen (2006). Coefficients in the same range (Geracioti et al., 2001; Gilbertson et al., 2002; Vasterling et al., 2002) or higher (Bonne et al., 2001; Magruder et al., 2004) are reported in other studies. Previous work on individual differences in PTSD symptom severity has revealed links to broad demographical domains, such as age, employment status, and global measures of mental and physical function (Magruder et al., 2004). Premorbid intellectual function and poor neuropsychological performance on tests for memory and attention are also predictive of PTSD symptom severity (e.g., McNally & Shin, 1995; Sutker, Vasterling, Brailey, & Allain, 1995; Vasterling et al., 2002). Using data from the Koso and Hansen (2006) sample, the second aim of the present report was to determine the extent to which individual differences in the intensity of PTSD symptoms were related to deficits in cognitive function.

The final issue addressed here relates to the fact that PTSD impairs '…social, occupational, or other important areas of functioning' (DSM-IV, p. 429; American Psychiatric Association, 1994). For example, Vietnam veterans diagnosed with PTSD have high rates of unemployment (Frueh et al., 2005) and people with the full PTSD syndrome typically report that anxiety interferes with daily life for about half of the time (Marshall et al., 2001). Difficulties of this nature may partly be due to an increased tendency of making absentminded errors on everyday tasks (i.e., on tasks that the individual normally is capable of completing). The third objective of the present research was to examine whether PTSD increases the proneness for making everyday cognitive mistakes and, if so, whether this enhanced tendency was related to performance on the neuropsychological tests. The Cognitive Failures Questionnaire (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982) was used to assess everyday cognitive difficulties. Previous work using the CFQ shows that everyday cognitive failures correlate with anxiety (Merckelbach, Muis, Nijman, & de Jong, 1996) and that CFQ scores can predict mishaps in working life (Jones & Martin, 2003; Wallace & Vodanovich, 2003).

METHOD

Subject characteristics

Subjects with PTSD (n = 45; age M = 44, SD = 8; years of education M = 10, SD = 2) were recruited among participants in support groups at the Clinical Centre Kosevo Sarajevo (Bosnia-and-Herzegovina). They had been diagnosed with PTSD by experienced psychiatrists according to DSM-IV criteria (American Psychiatric Association, 1994). In line with local clinical practice they were not formally examined for other psychiatric disorders, apart from establishing that they had never suffered from psychosis or bipolar disorder, and that they were free from neurological symptoms or signs. The majority of the PTSD group had served in the armed forces during the war; others were victims of torture; and in several cases both. Eighty per cent received medication for their symptoms.

The subjects in the control group (n = 34; age M = 39, SD = 8, years of education M = 11, SD = 2) were recruited from a Sarajevo primary health care unit, which they visited for the purpose of obtaining a health certificate for employment and/or driving license. They did not report any psychiatric or neurological problems, but were not formally examined. Similar to the men with PTSD, they had been involved during the whole period 1992-1996 in the war in Bosnia-and-Herzegovina. Neuropsychological assessment was carried out about nine years after the end of the war. Subjects received no economic compensation for participating in the study, which in no way connected to the issue of disability payments or war pensions.

The above-mentioned groups will henceforward be referred to the 2004 sample (as data was collected 2004-2005); the paper will also present novel complementary analyses on data from the 2002 sample, which was reported by Koso and Hansen (2006). In 2002 two groups of male subjects were tested (n = 20 per group). All subjects were involved during the whole period 1992-1996 in the war in Bosnia-and-Herzegovina and were enrolled for the study 7 years after the end of the war. At the time of testing they were in their mid 40s and had a comparable level of education.

Psychological assessment

The Swedish version of the Rivermead Behavioural Memory Test (RBMT), a test developed in order to detect impairment of everyday memory (Wilson, Cockburn, Baddeley, & Hiorns, 1989), was translated into Bosnian. It consists of twelve components, including remembering a name, remembering a hidden belonging, picture- and facial recognition, and remembering a newspaper article. Parts of the test (i.e., the newspaper article) were adapted somewhat to fit better with Bosnian conditions. The maximum score is 24 (indicating normal memory). Research show that the RBMT is a reliable and valid test of everyday memory problems (Wilson et al., 1989). The Sustained Attention to Response Task (SART), developed by Robertson, Manly, Andrade, Baddeley, and Yiend (1997), is a computerized continuous performance test (programmed in Super Lab Pro), and involves the withholding of key presses to rare (one in nine) targets. Two hundred and twenty-five single digits (1-9) appear randomly and one at a time (900 msec interval) on a computer screen for 250 msec. Subjects respond with a spacebar press for each digit, except on the 25 occasions when the digit '3' appears, when they have to withhold the response. Test duration is about four minutes. The Trail Making Test (TMT) is a well-established test of scanning and visuomotor tracking, divided attention, and cognitive flexibility (see Lezak, 2004). It is often used to assess neuropsychological function in PTSD (e.g., Beckham, Crawford, & Feldman, 1998). The subject must first draw lines to connect consecutively numbered circles on one work sheet (Part A) and then connect the same number of consecutively numbered and lettered circles on another worksheet by alternating between the two sequences (Part B). Finally, the verbal part of WAIS (VITI; Berger, Marković, & Mitić, 1995) was used to assess verbal intellectual function. In addition to the above-mentioned tests, the 2002 sample was tested also with the Hayling Sentence Completion Test (HSCT; Koso, 2004), which measures the ease with which a subject can suppress readily accessible verbal responses in order to give way to other, more uncommon responses (Burgess & Shallice, 1996). The HSCT consists of 30 sentences read aloud by the experimenter in which the final word is omitted (e.g., 'I went to the cinema to watch a MOVIE'). In the initiation condition (15 sentences) the subjects are asked to complete the sentences with the appropriate word. In the suppression condition, the subjects are asked to complete the sentence with a wholly unrelated word. In the present work, 100 sentences with the last word missing were constructed in Bosnian. They were given to 70 university students who were asked to complete them. Those 30 sentences with the highest agreement rate (95-100%) were used. The variables of interest were the average response latencies in the initiation and suppression conditions, respectively.

The Bosnian version (Powell & Rosner, 2005) of the PDS (part 3) developed by Foa et al. (1997) was used to assess PTSD symptoms. It consists of 17 items on which the subject responds on a 4-point scale (maximum score: 51). The CFQ is a self-report of slips of action and memory in everyday life (Broadbent et al., 1982). It asks about the frequency of minor mistakes that everyone makes from time to time, such as absentmindedly reading something and not remembering, failing to listen to people's names, and accidentally throwing away things one wants to keep. The CFQ consists of 25 items to which the subjects respond a 5-point scale from 0 (*never*) to 4 (*very often*), the maximum score being 100.

Statistical analysis

Some of the variables were skewed and were made to approximate normality by the appropriate transformations (in the case of positive skew = square root of raw data; in the case of negative skew = squared raw data). Untransformed means and standard deviations are presented in Table 1. For the multivariate analyses, the direction of the results of each test was standardized such that high scores represented good performance (i.e., adding minus signs to results from SART and TMT).

We used two multivariate methods, projections to latent structures (PLS) and PLS-discriminant analysis (PLS-DA), to analyze the data (Eriksson, Johansson, Kettaneh-Wold, & Wold, 2001), employing SIMCA-P 9.0 software (www.umetrics.com). PLS-DA, which can be regarded as a form of logistic regression, was used to separate subjects with or without PTSD on the basis of on their cognitive functioning in the multiple neuropsychological tests. It creates of a set of principal components which summarize the original cognitive variables on the basis of their covariances. These novel summaries are not correlated to each other, and they relate significantly and meaningfully to the original variables. The components are rotated in such a way as to separate the specified groups as much as possible. For the PLS-DA we used data from the present study combined with data from the Koso and Hansen (2006) study. For this analysis we included all 65 cases of PTSD patients and 54 control subjects.

PLS can be regarded as a form of multiple regression analysis, and is designed to find connections in the information between two blocks of variables, one being a predictor block, the other a response block. In the context of the present study the predictors were the various cognitive test scores and the response was the scores on the PDS or the CFQ. For both measures the statistical procedure provided a multivariate summary of cognitive functioning in terms of one principal component. This in turn was mathematically aligned in such a way as to fit maximally with the data expressing the intensity of PTSD symptoms or cognitive failures. An attractive feature with both PLS-DA and PLS is that they are not sensitive to violations of multivariate normality and benefits from collinearity among variables (Eriksson et al., 2001; Henningsson, Sundbom, Armelius, & Erdberg, 2001). Hence they do not require statistical independence between the predictor variables. Moreover, they handle data matrices with relatively few subjects well (Eriksson et al., 2001; Henningsson et al., 2001; Nilsson, Waters, Waters, Carlsson, & Carlsson, 2001; Wold & Sjöström, 1998).

For a mathematical and technical treatment of these methods we refer to Eriksson et al. (2001; see also www.umetrics.com) who also describe a number of tools that helps the investigator to determine the success of a particular PLS-DA or PLS model. First and foremost it should be significant, which is determined by the SIMCA software by cross-validation. Related to the concept of significance is the R^2X parameter (range 0-1), which expresses the proportion explained variation in the predictor matrix when pitted against the response matrix. The R^2Y parameter (range 0-1) reveals how well the dependent variable is explained by the model. The term Q^2 (range 0-1) expresses the goodness of prediction of the model. Unlike the R^2 parameters, which measure goodness of fit, Q^2 does not increase simply as a consequence of adding more and more components; at a certain level Q^2 plateaus and deteriorates. Generally $Q^2 > .5$ is regarded as good, but as pointed out by Eriksson et al. (2001), such guidelines are heavily application dependent.

Several key diagnostics are used to determine which of the various predictor variables (or rather the combinations of them that gives rise to a novel latent variable) are the most important. In PLS-DA the weight gives information about how each variable contribute or load onto the novel latent variable. Numerically large weights (be they positive or negative) are important, particularly if their 95% confidence intervals do not overlap with zero. Similarly, in PLS a numerically large regression coefficient signals that the variable in question is important. For both methods the variable influence on projection (VIP) succinctly summarizes the important independent variables. Predictors with a VIP larger than 1 are very influential for the model as a whole (Eriksson et al., 2001).

RESULTS

Neuropsychological assessment of the 2004 sample

The neuropsychological findings are summarized in Table 1. In comparison to controls, subjects with PTSD scored lower on RBMT, made more errors of omission and commission on the SART, and worked more slowly on the TMT. PTSD subjects were also significantly impaired on the Wechsler verbal scales (Table 1). The effect sizes (h²) were large for all comparisons, with the highest value for RBMT.

Discriminant analysis (2002 and 2004 samples combined)

PLS-DA of the data presented above combined with data from our previous study (Koso & Hansen, 2006) created a model, significant by cross-validation, that consisted of two PLS components, which together had a $R^2X = .65$. The variation accounted for by the two PLS components related very well to whether or not an individual had a PTSD diagnosis or not ($R^2Y = .65$). The Q^2 parameter was .63. Adding further components to the model did not increase its explanatory power.

Figure. 1 (upper panel) is a weight scatter plot and illustrates how the multiple psychological test scores formed the two novel dimensions. Parameters contributing similar information are grouped together; those close to the origin contribute little to the model. The horizontal line represents the first and most powerful principal component ($R^2X = .52$). It was mainly defined by scores on the RBMT, SART, and the TMT, and may mainly reflect ‘fluid’ executive function. The vertical line reflects the second and independent component, accounting for $R^2X = .13$. It was defined mainly by scores from the WAIS Arithmetic-, Information-, and Similarities scales, and may summarize general verbal intellectual function.

The score scatter plot in Figure 1 (lower panel) shows the distribution of subjects in the plane defined by the two newly formed dimensions (executive function vs. verbal intellectual function). Each symbol represents one individual. Individuals close to each other in this plane are similar whereas individuals far away from each other are more dissimilar. It is seen that the model differentiated well between the PTSD and control groups. Out of the 56 individuals clustering in the left-hand sector of the score scatter plot (reflecting poor executive function), 51 (91%) had a diagnosis of PTSD. Importantly, Figure 1 also reveals that PTSD subjects being high on general verbal intellectual function tended to perform less poorly on the executive tasks. This was formally addressed by regressing the ‘executive scores’ against the ‘verbal intelligence scores’ in the PTSD group. A significant model was obtained, $F(1, 63) = 7.32$, $p = .009$, $R^2 = .10$, with a regression coefficient b equalling 0.50 ($SE = 0.19$).

Table 1
Performance on neuropsychological tasks in PTSD ($n = 45$) and controls ($n = 34$)

	PTSD		CONTROLS				
	M	*SD*	*M*	*SD*	*t*	*df*	η2
RBMT	15.8	4.8	22.8	1.5	11.62*	77	.60
SART							
Commissions	13.1	5.6	8.5	5.4	3.65*	75	.15
Omissions	50.4	32.6	16.8	18.8	5.75*	75	.31
Reaction time	475	106	473	117	0.07	75	-
TMT Part A	98.8	51.8	40.9	19.1	8.45*	77	.48
TMT Part B	169.2	71.5	77.8	30.0	8.52*	77	.48
TMT index	1.85	0.55	2.07	0.89	1.26	77	-
WAIS scales							
Information	17.0	4.9	20.9	4.0	4.22*	77	.19
Comprehension	11.3	4.0	15.8	2.0	6.67*	77	.36
Digit span	8.7	2.0	10.8	1.7	4.88*	77	.24
Arithmetic	8.2	3.1	10.7	1.9	4.30*	77	.19
Similarities	13.6	4.5	17.1	2.4	4.06*	77	.16

Note. RBMT = Rivermead Behavioural Memory Test; SART = Sustained Attention to Response Task; TMT = Trail Making Test; WAIS = Wechsler Adult Intelligence Scale.
* $p < .001$.

Relationship between PTSD symptoms and cognitive performance (2002 sample)

Subjects with PTSD scored significantly higher on the PDS than controls (42.6 ± 8.0 vs. 1.4 ± 2.3, $t = 22.04$, $p < .001$, h²= .96). Within the PTSD group the range was 26-51. Using PLS we wished to know how individual differences in PDS scores within the patient group related to the overall performance in the cognitive tests. PLS yielded a significant model with $R^2X = .48$, $R^2Y = .34$ and $Q^2 = .19$. Only one principal component of the independent variables was significant. Examination of the appropriate VIP coefficients (Table 2) revealed that the TMT, RBMT, and the Digit span, Information- and Similarities tests from the WAIS were the chief predictors.

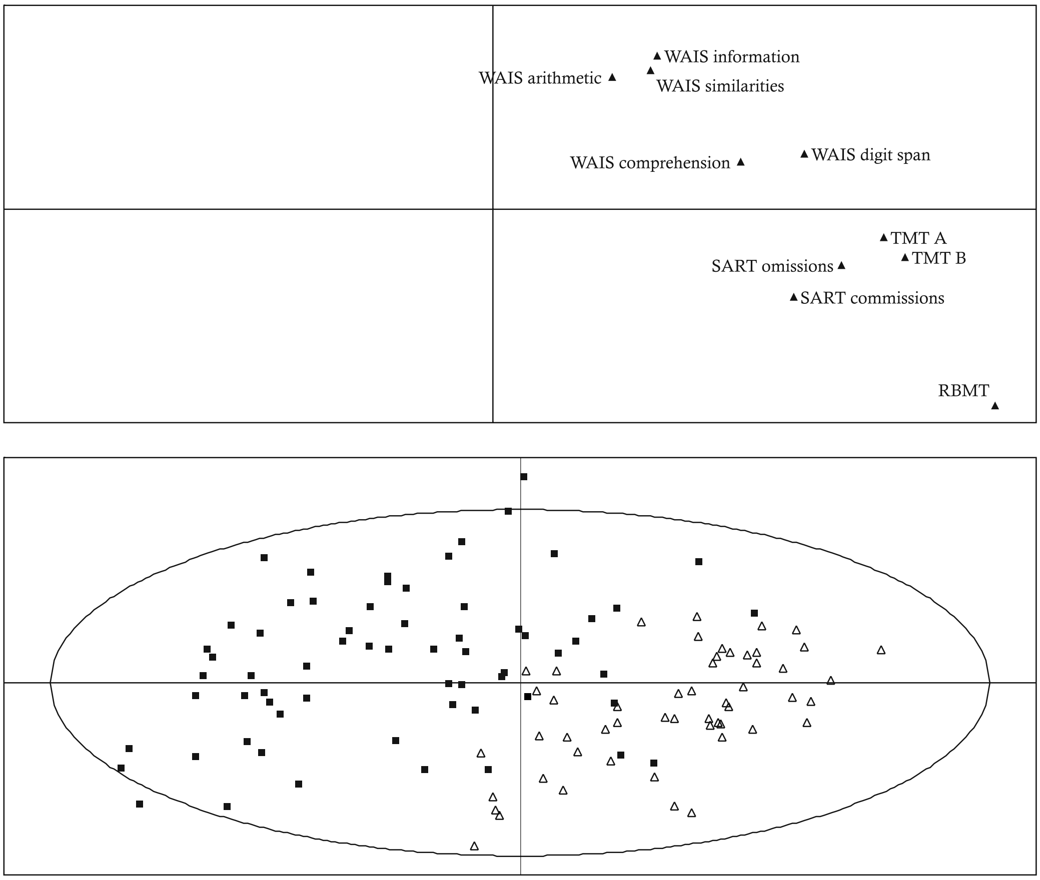

Figure 1. Contribution of various cognitive tasks to the two-dimensional projections to latent structures - discriminant analysis model (upper panel) and subjects of both groups in the two-dimensional space (lower panel). The upper panel is a weight scatter plot depicting how the various cognitive tasks contributed to the two-dimensional model (parameters contributing similar information are grouped together and parameters close to the origin contribute little to the model): the horizontal line represents the first principal component and the vertical line reflects the second and independent component. The lower panel of the figure is superimposable on the upper one and plots the subjects' weighted averages in the two-dimensional model: individuals to the right score high on tests summarized by the first component and individuals aggregating on the top score high on tests summarized by the second component. WAIS = Wechsler Adult Intelligence Scale; TMT = Trail Making Test; SART = Sustained Attention to Response Task; RBMT = Rivermead Behavioural Memory Test; ■ = PTSD; △ = controls.

Table 2
Neurocognitive tests predicting PTSD symptom severity (PDS scores) in PTSD group from 2002 (n = 20)

	PTSD symptom severity	
	VIP [95% CI]	Regression coefficient [95% CI]
RBMT	1.66 [1.21, 2.10]	-0.10 [-0.17, -0.03]
WAIS information	1.54 [1.38, 1.70]	-0.09 [-0.14, 0.04]
TMT Part B	1.45 [1.04, 1.86]	-0.09 [-0.16, -0.01]
TMT Part A	1.38 [1.09, 1.67]	-0.08 [-0.13, -0.03]
WAIS digit span	1.16 [0.64, 1.67]	-0.07 [-0.15, -0.01]
WAIS similarities	1.04 [0.41, 1.67]	-0.06 [-0.11, -0.01]

Note. All variables had VIP values larger or equal to 1 indicating a substantial influence. PDS = Posttraumatic Diagnostic Scale, part 3; VIP = variable influence on projection; CI = confidence interval; RBMT = Rivermead Behavioural Memory Test; WAIS = Wechsler Adult Intelligence Scale; TMT = Trail Making Test.

Relationship between everyday cognitive failures and cognitive performance (2002 sample)

Subjects with PTSD scored significantly higher on the CFQ than controls (75.3 ± 18.3 vs. 16.0 ± 10.5, t = 12.55, p < .001, h^2 = .90). The range within the PTSD group was 35-100. Scores on the CFQ correlated with the PDS scores within the PTSD group (r = .62, p < .01).

How were the scores on the CFQ related to the overall performance in the cognitive tests? PLS yielded a significant model with one principal component summarizing the independent variables (R^2X = .49) and a R^2Y value of .44 with Q^2 = .30. Table 3 shows that errors of commission on the SART, HCST, TMT, RBMT, and WAIS Information re-

Table 3
Neurocognitive tests predicting everyday cognitive slips (CFQ scores) in the PTSD group from 2002 sample (n = 20)

	Everyday cognitive failures	
	VIP [95% CI]	Regression coefficient [95% CI]
TMT Part A	1.58 [1.33, 1.83]	-0.10 [-0.17, -0.04]
TMT Part B	1.38 [0.93, 1.83]	-0.09 [-0.17, -0.01]
HSCT Initiation	1.38 [0.88, 1.88]	-0.09 [-0.12, -0.06]
WAIS Information	1.35 [0.96, 1.74]	-0.09 [-0.12, -0.05]
RBMT	1.12 [0.96, 1.29]	-0.07 [-0.10, -0.04]
HSCT Suppression	1.12 [0.75, 1.49]	-0.07 [-0.15, 0.00]
SART Commissions	1.07 [0.71, 1.43]	-0.07 [-0.14, 0.01]

Note. All variables had VIP values larger or equal to 1 indicating a substantial influence. CFQ = Cognitive Failures Questionnaire; VIP = variable influence on projection; CI = confidence interval; TMT = Trail Making Test; HSCT = Hayling Sentence Completion Task; WAIS = Wechsler Adult Intelligence Scale; RBMT = Rivermead Behavioural Memory Test; SART = Sustained Attention to Response Task.

ceived VIP values larger than 1. Thus, poor neuropsychological performance was associated with higher scores on the CFQ.

DISCUSSION

The present study replicated the results reported by Koso and Hansen (2006) that many Bosnian ex-servicemen with a PTSD diagnosis experience significant decrements in neurocognitive function. The PTSD group had a low memory score on the RBMT, made many errors of omission and commission on the SART, and took a long time to complete both of the TMT subtests. In the 2002 sample, subjects with PTSD also scored lower than controls on WAIS Digit span (Koso & Hansen, 2006). In the present study the PTSD patients scored lower than controls not only on Digit span but also on the other WAIS subscales, and particularly so on the WAIS Comprehension test. We do not know the reason why the present sample scored lower on the WAIS. One possibility is that these differences were present before traumatisation, as it is known that pre-existing differences in brain and intellectual function may constitute vulnerability factors for PTSD and its cognitive consequences (Crowell, Kieffer, Siders, & Vanderploeg, 2002; Gilbertson et al., 2006; Gilbertson et al., 2002; McNally, 2006). It is possible also that the between-groups age difference (the mean age of the PTSD group was »5 years higher than the controls) contributed to the results, although it seems highly unlikely that this dissimilarity would have generated cognitive group differences of this magnitude.

Interestingly, on some test parameters, such as the number of SART omission errors, the present 2004 sample (with somewhat lower intellectual function) performed worse than the 2002 sample reported on by Koso and Hansen (2006). One possible explanation of this difference is the duration of illness is associated with the degree of cognitive decline. That is, the patients in 2004 sample had been ill for longer (»11 years) than the patients in the 2002 sample (»7 years), and this might be reflected in a greater impairment of cognitive function.

As in our previous study, the neurocognitive decrements reported here were substantial and in some cases larger than those reported in other comparable studies (Table 1). We can only speculate as to the reasons for the magnitude of the deficits. One possibility is the severe nature of the trauma (several years of exposure to combat-related stressors both during and after the war). Another hypothesis is that comorbid psychiatric afflictions, such as depression and substance abuse, potentiated the PTSD-related neurocognitive deficits. Regrettably, no measures of psychiatric comorbidity were available in the present study. However, it should be noted that other studies show that PTSD per se is associated with significant decrements in neuropsychological function, such as attention and memory, even when alcohol and depression are controlled for (e.g., Samuelson et al., 2006). Moreover, substance abuse tends to be low in Muslim Bosnian veterans (cf. Koso & Hansen, 2006). A third possibility, particularly relevant when dealing with war veterans with PTSD, is the realization that even distant explosions may harm the brain (see Bhattacharjee, 2008). It is possible, therefore, that in the present population of victims PTSD interacts with blast-related mild traumatic brain injury to produce the unusually severe neuropsychological deficits that we consistently observe. Clearly, further research is required to resolve this issue.

The PTSD group scored considerably higher than controls on the PDS measure of posttraumatic symptoms (Koso & Hansen, 2006). Here, the neuropsychological results were set against the PDS scores in order to detect relations between the two domains within the PTSD group. In the resulting model, cognitive function explained about a third of the variation in PTSD symptoms. Poor performance on the RBMT, TMT, WAIS Digit span-, Information- and Similarities subscales were particularly predictive of symptom severity. With regard to the contribution of memory problems and intelligence to PTSD symptom severity, our findings are in line with a previous study showing that verbal list learning correlated with the intensity of PTSD symptoms (McNally & Shin, 1995; Vasterling et al., 2002). On the other hand, performance on the SART did not predict PTSD symptoms. This is in contrast with previous studies in which performance on an attentional task correlated with PTSD symptom severity (Sutker et al., 1995; Vasterling et al., 2002).

Besides its purely clinical manifestations, PTSD is associated with everyday hassles such as work-related impairment, lower quality of life, less intimacy, marital problems, and social dysfunction (Marshall et al., 2001). In the present work we used the CFQ to capture aspects of such everyday difficulties. Wagle, Berrios, and Ho (1999) reported that, generally, psychiatric patients have elevated scores on this questionnaire and here we found that subjects with PTSD scored considerably higher than controls. Also, CFQ scores correlated positively with PTSD symptom severity, as measured with the PDS. PLS revealed a significant association between self-reported cognitive failures and performance on the TMT, RBMT, and WAIS Information tests. These tests also predicted PDS scores. In addition, however, everyday cognitive failures were related to poor performance on the Hayling task and the SART.

There are limitations to this study which should be considered when evaluating the results. First, it would have been preferable to have a complete psychiatric work-up of all the participants, including the controls. Secondly, and related to the first factor, a more careful knowledge of each individual's medication would have been useful. Thirdly, the RBMT was translated from Swedish to Bosnian with no formal back-translating. Moreover, the TMT part B may be somewhat more demanding for Bosnian subjects because of international differences in the Latin alphabet. Finally, and given new evidence of blast-induced mild traumatic brain injury (Bhattacharjee, 2008), it would have been interesting to know the extent to which the patients were exposed to explosions and shock waves.

On a final note, we have proposed that the pervasive decrements in neuropsychological function recorded in the present sample may be attributable to PTSD induced deficits in a central higher-level resource (Baddeley, 2000; Shallice, 1998) modulating many specific psychological abilities, such as memory, attention, and executive function (Koso & Hansen, 2006). The analyses presented herein suggest that several of these lower-level abilities are associated with PTSD symptom severity and to self-reports of everyday cognitive functioning. Overall, the cognitive variables accounted for 34% and 44% of the variation in the scores on the PDS and the CFQ, respectively. Importantly, although this proportion of explained variation is sizeable, these figures also mean that the symptoms of the illness cannot be reduced to performance deficits on a neuropsychological test battery.

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