Sequelae of traumatic stress: psychopathology, cortisol, and attentional function in the aftermath of a disaster
Meewisse, M.L.

Citation for published version (APA):

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
Chapter 6

Longitudinal effects of posttraumatic stress disorder and depressive symptoms on attentional functioning in disaster survivors

Marie-Louise Meewisse
Johannes B. Reitsma
Miranda Olff
Rolf Kleber
Berthold P.R. Gersons

1 Center for Psychological Trauma, Department of Psychiatry, Academic Medical Center, University of Amsterdam
2 Department of Clinical Epidemiology and Biostatistics, Academic Medical Center, University of Amsterdam
3 Department of Clinical & Health Psychology, Utrecht University, Utrecht, The Netherlands.
5 Centrum ‘45, Diemen, The Netherlands.

Submitted for publication
Abstract

Previous studies have shown that posttraumatic stress disorder (PTSD) and depressive symptoms are associated with attentional deficits. While symptoms may improve over time, it is unknown whether this improvement is mirrored in recovery of attentional functioning. This study aimed to examine the longitudinal effects of PTSD and depressive symptoms on attentional function. Therefore, PTSD and depressive symptom severity measures were repeatedly administered in a community-based sample of survivors (n = 1567) between 3 weeks and 4 years postdisaster. Attentional functioning was measured with the paced auditory serial addition task (PASAT) in 135 survivors at 2 and 4 years postdisaster. Results showed that the initially high PTSD and depressive symptoms significantly diminished over the course of years and attentional performance improved. PTSD symptoms as early as 3 weeks postdisaster were associated to attentional dysfunction 2 years postdisaster. Bootstrap sampling revealed no differences in predictive power of PTSD symptoms measured at 3 weeks or at 1.5 years postdisaster. Deterioration in attention at 4 years was predicted by depressive symptoms at two years postdisaster, but not by change in depressive or PTSD symptom severity. Thus, PTSD symptoms are early signs and stable predictors for long-term attentional dysfunction. Since depressive symptoms worsened attentional dysfunction, findings elucidate the burden of comorbidity between PTSD and depressive symptoms for chronic difficulties. Targeting at improvement of PTSD and depressive symptoms appears to be insufficient for enhancement of attentional functioning.
Introduction

In the first weeks after a disaster, high rates of posttraumatic stress disorder (PTSD) and depressive symptoms have been observed in the community (Galea et al., 2002a; van Kamp et al., 2006). Previous cross-sectional studies have shown associations between these symptoms and neurocognitive deficits, like attention, working memory, and declarative memory. Of these domains, attentional deficits are the most prominent neuropsychological problems found both in patients with depression (e.g. (Zakzanis, Leach, & Kaplan, 1998)) and in patients with PTSD (for review see (Horner et al., 2002)). Coexisting depressive symptoms in people with PTSD have been put forward as a factor that is accountable for the attentional problems in PTSD. However, in our previous study we showed that the observed attentional deficits in a non-clinical community-based sample of disaster survivors are definitely also attributable to PTSD symptoms (Meewisse et al., 2005). Little is known about the longitudinal course of neurocognitive functioning in relation to PTSD and depressive symptoms. So far only one study has been described (Yehuda et al., 2006). In this five year follow up study neurocognitive test were administered in elderly Holocaust survivors with and without PTSD at baseline assessment, and in non-exposed subjects. Verbal learning and memory, implicit memory, and explicit and cued recall were assessed. Findings showed that Holocaust survivors with PTSD showed a greater decline in explicit and cued recall compared to non-exposed subjects. This was suggested to be an accelerated age-related decline due to trauma exposure, regardless of symptom severity. Nevertheless, it also showed that the Holocaust survivors with PTSD improved in verbal learning and memory at 5 years follow up, whereas non-exposed subjects showed no change. These improvements were that good that decrements observed at the baseline assessment were no longer apparent between the groups. Holocaust survivors also showed a significant decline in PTSD symptoms over time, which was substantially related to improvements in verbal learning and memory performance. While explicit memory was influenced by age, but not PTSD symptoms, implicit memory performance was strongly associated with symptom severity, but not age. Interestingly, sub-analysis showed that these implicit memory improvements could be subscribed to better attentional function and test orientation.

Yet, no other longitudinal studies have been performed, therefore it is unknown whether findings of attentional improvement related to a decline in PTSD symptoms are specific for elderly Holocaust survivors or may be generalizable to other traumatized
populations. For that matter, our study aimed to longitudinally investigate the course of attentional function in a fairly recent traumatized group of adults in the community. Therefore, we linked the above mentioned cross-sectional disaster community study (Meewisse et al., 2005) to a large questionnaire survey performed in the same study population (n=1,567). This survey gathered data at several points in time at 3 weeks, 1.5 years and 4 years posttrauma. This enabled us to investigate whether early PTSD or early depressive symptoms were predictive of attentional functioning at 2 years in our cohort. A follow up attentional test at 4 years posttrauma was administered to test the hypotheses whether improvement in attentional functioning can be predicted by PTSD or depressive symptoms, and whether improvement in attention is related to change in symptom severity.

**Method**

**Participants**

Participants were survivors of the fireworks disaster in the city of Enschede, the Netherlands, on May 13, 2000. The explosion of a fireworks storage depot completely destroyed the surrounding residential district. Twenty-two people were killed outright and almost one thousand were injured. Over 10,000 local residents were evacuated for one or more days, while over 1,200 people lost their homes completely (Roorda et al., 2004). Inhabitants of the disaster area were invited by a letter of the Dutch Ministry of Health Welfare and Sports to participate within 3 weeks postdisaster. In addition, announcements for the study were made in the media. Participants of the present study were Dutch speaking adults, over age 18 years, living in the affected area at the time of the disaster. They were a random sample of participants in a large prospective study monitoring health (n = 1567) after the disaster (van Kamp et al., 2006) and agreed to participate in neuropsychological testing as a two and four years follow-up to their initial participation.

**Measures**

**Symptom severity measures.** To determine the severity of the impact of trauma, PTSD and depressive symptoms, participants completed three self-report measures at
LONGITUDINAL EFFECTS OF PTSD AND DEPRESSIVE SYMPTOMS ON ATTENTION

multiple time points. The Dutch 15-item version of the Impact of Event Scale (IES) (van der Ploeg et al., 2004) was administered to obtain scores for subscales of intrusive (7 items) and avoidance (8 items) symptoms that are rated 0 (not at all), 1 (seldom), 3 (sometimes) or 5 (often), reflecting their occurrence in the past week. The IES total score ranges between 0 and 75. The reliability and structure of the Dutch IES has proven to be adequate across various traumatic stressors. It has a robust structure, supporting the composition (Intrusions and Avoidance scale) of the original IES (van der Ploeg et al., 2004). At all measurement points of the large survey, the internal consistency was excellent, Cronbach’s $\alpha \geq .94$. The Self-Rating Scale for PTSD (SRS-PTSD; Carlier et al., 1998) was administered to obtain a severity score for PTSD symptoms based on DSM-IV criteria. The internal consistency and interjudge reliability of this self-report are found to be satisfactory. Participants were asked specifically to consider the fireworks disaster when completing this measure and the IES.

The Dutch version of the Symptom Check List-90 (SCL-90) (Arrindell et al., 2003) was administered to measure the severity of depressive symptoms (16 items). These items are scored on a 5-point Likert scale. The internal consistency of the test is good, and both the construct and the predictive validity are adequate.

Neuropsychological testing. The Dutch version of the Paced Auditory Serial Addition Task (PASAT; Aarnoudse et al., 1995) was used as measure for attentional functioning. The PASAT requires the successful completion of numerous cognitive functions, such as sustained attention and working memory, and the simultaneous performance of multiple cognitive operations under a time restraint. The objective of this test is to add 60 pairs of randomized digits in the range of 1 to 6, which are presented at 5 rates of speed with 3.2, 2.8, 2.4, 2.0 and 1.6 seconds between successive digits on an audiotape. The PASAT has shown high levels of internal consistency and test–retest reliability, high convergent validity and modest discriminant validity, because of its relationship to general intelligence (Tombaugh, 2006). Aarnoudse et al. (Aarnoudse et al., 1995) found high reliabilities for the Dutch version. Since PASAT performance is significantly correlated with age and education, we adjusted for these variables in all analyses.
**Timing and preparation of measurements**

For the purpose of this study, self-report measures at 4 time points were included: 3 weeks (T1), 1.5 years (T2), 2 years (T3), and 4 years (T4) postdisaster. Attentional tests were administered at T3 and T4.

Prior to participation in clinical interviews (not reported in this paper) and attentional testing, brochures with extensive information were sent to participants and upon agreement two appointments were set by trained research employees. Clinical interviews and PASAT were administered on separate days to avoid a potential impact of the evocation of traumatic memories on subsequent cognitive functioning, and to circumvent the confounding effect of diurnal variation (Porterfield, Cook, Deary, & Ebmeier, 1997), all participants were tested between 13.00 and 17.00 hours. At least one hour before PASAT administration survivors were deprived from food, beverage intake and smoking. The study was approved by the Institutional Review Board of the Academic Medical Center, Amsterdam, The Netherlands. After complete description of the study to the subjects, written informed consent was obtained.

**Statistical Analyses**

Symptom severity scores were used over clinical diagnoses in the analyses because continues scores are better in following the course of recovery of the impact of the disaster on survivors. Correlations between the IES and the SRS-PTSD were high on all time points (T2: $r=0.82$, $p<0.01$; T3: $r=0.85$, $p<0.01$; T4: $r=0.83$, $p<0.01$) For the sake of simplicity, we decided to use only one PTSD symptom severity measure. We chose for the IES scores since these were available at all time points, whereas the SRS-PTSD was not administered at 3 weeks postdisaster. Chi-square test and independent t-tests were used to examine whether survivor groups in this follow-up with attentional testing differed in terms of socio-demographic features and symptom severity from survivors of the initial study at T1, and whether selective drop-out was present between T3 and T4 when attentional measures were administered. The course of attentional functioning (2 waves) was examined with a t-test, and symptom severity over 4 waves was examined with general linear models repeated measures.

Multivariable linear regression analysis, enter method, was used to investigate associations between potential prognostic indicators and attentional functioning at T3.
and T4. The percentage of explained variance (adjusted $R^2$) was calculated to give an indication of the predictive power of the final model.

To examine whether the predictive strength of predictors measured at 3 weeks differed from the same predictors measured at 1.5 years when analysing attentional performance at 2 years, we used bootstrapping techniques to account for the correlated nature of the data. In each bootstrap sample we estimated the coefficient for every predictor measured at 3 weeks and the corresponding coefficient for the same predictor at 1.5 years. Within each bootstrap we calculated the difference between corresponding coefficients and the distribution of these differences across 2000 bootstrap samples was used to obtain 95% confidence intervals and p-values.

All statistical tests were two-tailed, and p values of less than .05 were considered statistically significant.

**Results**

*Sample characteristics*

Out of the prospective study monitoring health in adult survivors of the Enschede fireworks disaster ($n = 1,567$) a community-based sample of 135 survivors participated in attentional testing at two years postdisaster (T3). The nature of the participants’ exposure consisted of: felt severely frightened (66.7%), fear of death (62.2%), panic (69.6%), felt pain 13.3%), ran away (50.0%), fled into one’s home (40.0%) or out of one’s home (14.8%), saw death people (7.4%), saw slightly (70.4%) and severely (30.4%) wounded victims, helped the wounded (11.1%), searched for loved ones (54.8%), warned others for danger (31.1%) saw explosions (75.6%), smoke (92.6%) or fire (60.0%), damaged houses (71.1%) and had heavy damage or total destruction of one’s house (23.3%).

When we compared the subgroup of survivors that participated in neuropsychological testing at T3 to other participants in the main study on measures collected at three weeks (T1), no differences in terms of age, having an occupation, or sickness-leave from work were apparent. However, we did find a between-group difference for gender: $\chi^2 (1, N = 1566) = 6.91$, $p = .00$, and for years of education $t(153.74) = 2.67$, $p = .00$. A higher proportion of women and higher educated persons
participated in this part of the study. No differences in clinical measures were found between the groups.

Socio-demographic characteristics, clinical characteristics, and ability to sustain attention at T3 are summarized in Table 1. A median split for high versus low score on the attentional test showed that survivors that score better on the attentional test were younger, higher educated, and had lesser intrusive, avoidant and total PTSD symptoms.

Comparing survivors who participated in follow up of attentional testing at T4 with survivors that dropped out this follow up on measures collected at T3, showed that there was no selective drop-out, neither in socio-demographic characteristics, neuropsychological test, nor in clinical characteristics.

### Table 1. Characteristics of survivors at 2 years postdisaster, and comparison of survivors with low versus high scores (median split) on completed attentional test (PASAT).

<table>
<thead>
<tr>
<th></th>
<th>Study population (n&lt;sub&gt;max&lt;/sub&gt;=135)</th>
<th>Attentional test (n&lt;sub&gt;max&lt;/sub&gt;=126)</th>
<th>Low score</th>
<th>High score</th>
<th>t or χ&lt;sup&gt;2&lt;/sup&gt;</th>
<th>df</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socio demographic characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>84 (62.2%)</td>
<td>40 (63.5%)</td>
<td>35 (55.6%)</td>
<td>.82</td>
<td>1</td>
<td>.47</td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>51 (37.8%)</td>
<td>23 (36.5%)</td>
<td>28 (44.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, yrs M (SD)</td>
<td>46.9 (14.4)</td>
<td>52.3 (14.2)</td>
<td>39.1 (10.2)</td>
<td>6.00</td>
<td>112.2</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Education, yrs M (SD)</td>
<td>13.1 (3.8)</td>
<td>11.8 (3.5)</td>
<td>14.6 (3.2)</td>
<td>-4.81</td>
<td>124</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single N</td>
<td>18 (14.8%)</td>
<td>5 (35.7%)</td>
<td>9 (64.3%)</td>
<td>2.71*</td>
<td></td>
<td>.28</td>
<td></td>
</tr>
<tr>
<td>Married/ Cohabiting with partner</td>
<td>97 (79.5%)</td>
<td>49 (53.3%)</td>
<td>43 (46.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>7 (5.7%)</td>
<td>2 (28.6%)</td>
<td>5 (71.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clinical characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD intrusions M (SD)</td>
<td>14.2 (10.2)</td>
<td>16.9 (10.0)</td>
<td>11.2 (9.8)</td>
<td>3.14</td>
<td>114</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>PTSD avoidance M (SD)</td>
<td>12.7 (10.9)</td>
<td>14.5 (10.3)</td>
<td>9.9 (10.0)</td>
<td>2.43</td>
<td>114</td>
<td>.017</td>
<td></td>
</tr>
<tr>
<td>PTSD total M (SD)</td>
<td>26.8 (20.0)</td>
<td>31.4 (19.1)</td>
<td>21.0 (19.0)</td>
<td>2.93</td>
<td>114</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td>Depressive symptoms M (SD)</td>
<td>25.4 (11.0)</td>
<td>26.0 (12.2)</td>
<td>24.9 (10.4)</td>
<td>.51</td>
<td>116</td>
<td>.611</td>
<td></td>
</tr>
<tr>
<td>PASAT score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stopped premature</td>
<td>9 (6.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>test score when completed M (SD)</td>
<td>211.1 (50.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations:** PTSD, posttraumatic stress disorder; PASAT, Paced Auditory Serial Addition Task; M, mean; SD, standard deviation.

*Fisher exact test
Course of attentional functioning, PTSD and depressive symptoms

Figure 1 shows the course of PASAT score, PTSD and depressive symptoms, and a scatterplot for the relationships between change in PTSD or depressive symptoms and change in PASAT score from T3 to T4. The paired or correlated samples t-test indicated that the score on the PASAT improved significantly over time, mean difference: 16.6; 95% CI: 11.8-21.6; p=.000, d=0.76. The difference in attentional functioning is large, using Cohen’s (1988) guidelines (see Figure 1a).

A repeated measures ANOVA, with Greenhouse-Geisser correction, was conducted to assess whether there were differences in PTSD and depressive symptoms over time. Results indicated a significant decline over time in both PTSD symptoms (F (2.8, 288.6) = 60.54, p < .001), and depressive symptoms (F(2.1, 217.8)=23.18, p < .001), see Figure 1b and 1c. The paired samples t-test indicated that the reductions in PTSD symptom severity were found significant between the following succeeding time points: T1 and T2 (mean difference: 13.3; 95% CI: 10.5-16.1; p=0.000; d=0.73: large effect size), and T3 and T4 (mean difference: 9.2; 95% CI: 5.9-12.5; p=.000; d=0.48: medium effect size). The decrease in depressive symptom severity scores was only significant between T1 and T2 (mean difference: 5.5; 95% CI: 3.5-7.4; p=.000; d=0.46: medium effect size).
**FIGURE 1a.** Course of cognitive functioning (PASAT) in survivors over a 2 years period postdisaster

![Graph showing PASAT scores over time postdisaster](image)

$t(78)=6.78, p=.000, d=0.76$

**FIGURE 1b.** Course of posttraumatic stress (IES) symptoms in survivors over a 4 years period

![Graph showing IES scores over time postdisaster](image)

$F(2.8, 288.8) = 60.54, p < .001$
For further analyses we used the data of 110 survivors, because of missing values of 25 survivors on self-report measures at T1 or T2. Table 2 shows potential prognostic indicators at T1 and T2 for attentional functioning at T3. Multivariable linear regression analyses showed, as expected, that higher age and lower education over time were consistently associated to attentional dysfunction at T3. Additionally, PTSD symptoms at both T1 and T2 were associated to attentional dysfunction, whereas depressive symptoms were unrelated to attentional functioning. Both models explained 34% of the total variability in attentional functioning at T3. The model of T1 predicts that, for example, if age, education and depressive symptoms were identical for all survivors, survivors that score one point higher on PTSD symptoms score on average 0.8 points lower on the PASAT at T3. Bootstrap sampling showed no differences in predictive power between prognostic indicators measured at T1 and T2.
**Table 2.** Multivariable linear regression of prognostic indicators of attentional functioning at T3 (n=110) and bootstrap sampling for differences in predictive power of indicators at T1 and T2

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
<th>Mean difference T1 and T2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \beta ) (95% CI)</td>
<td>( \beta ) (95% CI)</td>
<td>( \beta ) (95% CI)</td>
</tr>
<tr>
<td>Constant</td>
<td>203.8 (153.9, 253.6)</td>
<td>207.0 (156.8, 257.2)</td>
<td>3.0 (-18.9, 24.8)</td>
</tr>
<tr>
<td>Age, per yr</td>
<td>-0.9 (-1.5, -0.3)</td>
<td>-1.1 (-1.7, -0.5)</td>
<td>-0.1 (-0.3, 0.03)</td>
</tr>
<tr>
<td>Education, per yr</td>
<td>-0.8 (-1.4, -0.2)</td>
<td>5.2 (2.9, 7.5)</td>
<td>-0.2 (-1.0, 0.5)</td>
</tr>
<tr>
<td>PTSD symptoms (IES)</td>
<td>-0.8 (-1.4, -0.2)</td>
<td>-0.5 (-1.1, -0.02)</td>
<td>0.2 (-0.3, 0.7)</td>
</tr>
<tr>
<td>Depressive symptoms (SCL90)</td>
<td>0.3 (-0.4, 1.1)</td>
<td>0.02 (-0.9, 0.9)</td>
<td>-0.3 (-1.0, 0.4)</td>
</tr>
<tr>
<td>Adjusted ( R^2 ) (%)</td>
<td>34%</td>
<td>34%</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: T1, 3 weeks posttrauma; T2, 1.5 years posttrauma; T3, 2 years posttrauma; \( \beta \), unstandardized regression coefficient; \( \beta \) positive, better attentional functioning per unit prognostic indicator; \( \beta \) negative, worse attentional functioning per unit prognostic indicator; 95% CI, 95% confidence interval; Adjusted \( R^2 \) (%), proportion of the total variance explained by the final model.
Prognostic indicators of change in attentional functioning over time

Multivariable linear regression analysis (ANCOVA) was used to test the hypothesis whether change in attentional functioning between T3 and T4 can be predicted by PTSD or depressive symptoms at the time of T3. Prognostic indicators for better attentional functioning at T4 were high initial test scores and low depressive symptoms at T3, see Table 3.

Table 3. Multivariable Linear Regression (n=65) of prognostic indicators at T3 of attentional functioning at T4

<table>
<thead>
<tr>
<th>T4</th>
<th>β (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>71.3 (33.5, 109.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Socio demographic characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, per year</td>
<td>0.3 (-0.1, 0.7)</td>
<td>0.1</td>
</tr>
<tr>
<td>Education, per year</td>
<td>0.5 (-1.2, 2.2)</td>
<td>0.5</td>
</tr>
<tr>
<td>Attentional test (PASAT) at T3</td>
<td>0.8 (0.6, 0.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Clinical characteristics at T3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PTSD symptoms (IES)</td>
<td>-0.03 (-0.4, 0.3)</td>
<td>0.9</td>
</tr>
<tr>
<td>Depressive symptoms (SCL-90)</td>
<td>-0.9 (-1.7, -0.1)</td>
<td>0.02</td>
</tr>
<tr>
<td>Adjusted R² (%)</td>
<td>75%</td>
<td></td>
</tr>
</tbody>
</table>

β: unstandardized regression coefficient; β positive: better attentional functioning per unit prognostic indicator; β negative: worse attentional functioning per unit prognostic indicator. 95% CI: 95% confidence interval; Adjusted R² (%): proportion of the total variance explained by the final model.

Abbreviations: T3, 2 years posttrauma; T4, 4 years posttrauma; PTSD, posttraumatic stress disorder; PASAT, Paced Auditory Serial Addition Task.

Partial correlations, corrected for initial attentional scores, showed no associations between change in attentional functioning and change in PTSD or depressive symptoms from T3 to T4, see Figure 2.
Discussion

This longitudinal study evaluated the course over the years of symptoms of PTSD and depression, sustained attention and working memory in recently exposed survivors of a disaster. In order to get insight into risk factors for long-term difficulties in these cognitive functions, we studied the prognostic influence of PTSD and depressive symptoms in a community-based sample of survivors of the fireworks disaster in Enschede, the Netherlands. A four years period is covered, including data from 3 weeks till 4 years postdisaster.

PTSD symptoms within 3 weeks of the disaster were predictive of poor sustained attention and working memory in the following two years. In longitudinal studies, the rule of thumb is that measurements closer in time to each other have stronger relationships. However, remarkably, the present study showed that cognitive functioning was predicted equally well by PTSD symptom severity whether measured as early as 3 weeks or at 1.5 years postdisaster, and regardless of the significant decline in symptom severity. This finding showed that PTSD symptoms are early signs and stable longitudinal predictors for sustained attention and working memory. We also demonstrated associations between attentional dysfunction and PTSD symptom severity.
at 2 years postdisaster. Findings show that the impact of PTSD symptoms on long-term neurocognitive problems can be foreseen in the initial aftermath of the disaster already.

In general, cognitive functioning in survivors improved over time, and initial cognitive functioning was a very strong predictor of cognitive functioning at 4 years postdisaster. These findings were expected, given the practice effect commonly seen with the PASAT (Tombaugh, 2006). However, this has not been shown before for a test-retest period with a duration of 2 years. While taking into account this long intermitted period and the large effect size of improvement, we -at least in part- deal with a genuine improvement in attention.

Depressive symptom severity at two years post-trauma predicted deterioration of cognitive function at 4 years, while PTSD symptoms did not have any additional predictive value in the model for improvement in cognitive functioning. The variance of PTSD symptoms, however, was accounted for in initial cognitive functioning which determined retest performance to a large extent. Depressive symptoms decreased significantly in the first 1.5 years, and remained stable in the succeeding years. Apparently at two years postdisaster survivors with enduring depressive symptoms were filtered out. In addition, comorbidity of depression with PTSD leads to more severe suffering and more difficulties to recover from PTSD (e.g. (North, 2001)), therefore on the long-term depressive symptoms might be better than PTSD symptoms in selecting the more severe PTSD cases. The burden of depression in itself is emphasized by a study in which depressive patients were successfully treated. These patients performed better on cognitive tests than untreated patients, but not quite as well as healthy controls (Gualtieri, Johnson, & Benedict, 2006). On the other hand a possible explanation for the predictive value of depressive symptoms on cognitive dysfunction can be sought in that survivors with depressive symptoms might profit less from the practice effects of the PASAT, since encoding and recognition of information have consistently been reported to be impaired in acute depression (Zakzanis et al., 1998). Summing up, PTSD symptoms determine low attentional scores, whereas depressive symptoms additionally worsen attentional function. These findings illuminate the burden of comorbidity between PTSD and depressive symptoms for chronic difficulties.

In contrast to our expectations, the decrease in PTSD and depressive symptoms was unrelated to improvement in cognitive functioning. This result might have implications for the anticipations of treatment results. Successful treatment of PTSD or depression
apparently does not simply imply simultaneous enhancement of sustained attention and working memory. The association between PTSD and cognitive performance over the course of time has been studied only once before in elderly Holocaust survivors (Yehuda et al., 2006). This study showed that greater improvement in PTSD symptoms related to greater improvement in verbal learning and memory performance on the California Verbal Learning Task (CVLT) over a five years period. However this finding was only evident in patients with PTSD. When survivors without PTSD were considered, no relationship was found between their diminished PTSD symptoms and improvements on their CVLT performance. Apparently, our community sample seems to resemble the Holocaust survivors without PTSD to a greater extent.

Although, most studies have found PTSD to be related to attentional dysfunction, several more studies could not confirm these findings (e.g. (Golier et al., 1997; Neylan et al., 2004)). Yet, our study is the first to control for the enhancing effect of substances like nicotine (Rezvani & Levin, 2001), L-Theanine, and caffeine (Haskell, Kennedy, Milne, Wesnes, & Scholey, 2008) which are known for improving performance on cognitively demanding tasks. Faster working memory reaction time, improved sustained attention, and reaction speed in all sorts of reaction-time tasks have been observed. Restrictions regarding smoking are specifically important since studies have shown that people with depression tend to smoke more per day (Olff et al., 2006) and PTSD symptom variables as well as stress and anxiety are significantly associated with ad lib smoking (Beckham et al., 2008). The reason why studies have not found any impact of PTSD might also be due to data analyses in terms of group means which may obscure the degree of impairment (Gualtieri & Morgan, 2008). Someone with severe PTSD symptoms might still be called healthy due to a count of only one symptom less than necessary for the diagnosis.

This study has some limitations. The question of causality remains. By no doubt, those specific characteristics of intrusive memories that seem to be predictive of subsequent PTSD (Michael, Ehlers, Halligan, & Clark, 2005) the perceived nowness and lack of context of the intrusive memories, and the distress associated with them will interfere during a test that requires the simultaneous performance of multiple cognitive operations under a time restraint, since working-memory has a limited capacity. On the other hand, cognitive impairments may hinder recovery from mental trauma, a process that requires re-learning and adaptation (Shalev, 2000). Moreover, poorer performance on neurocognitive tests may also be a vulnerability factor for developing symptoms of
PTSD, as was found in a community based sample of young adults who participated in neuropsychological testing before and after they were struck by a disaster (Parslow & Jorm, 2007). Future studies need to address these concerns about causality, ideally by following cohorts before the experience of a traumatic event.

Although, the prospective influence of PTSD and depressive symptoms on cognitive difficulties was mild in this study, difficulties in performing a test in a laboratory might be translated into larger consequences in a more demanding environment. Moreover, persistent neurocognitive impairment has been shown a major predicting factor for illness-related deterioration of quality of life in several patient groups (e.g. see (Fujii, Wylie, & Nathan, 2004) for patients with schizophrenia, and (Depp et al., 2007) for patients with bipolar disorder).

In the aftermath of a disaster while one suffers the losses of family members and friends, of irreplaceable treasured belongings and residence, and loss of community cohesion, many problems have to be faced by survivors. Without question, specifically in these times people need to be able to stand up for themselves and their families. Poor cognitive functioning is an extra handicap that might increase feelings of loss of control and thereby maintain or even aggravate psychological problems. Therefore, practical assistance in the immediate aftermath seems essential, and for the longer term cognitive training may need to be incorporated into trauma-focused treatments since recovery alone of PTSD and depression in particular seems to be insufficient to deal adequately with cognitive difficulties.
Reference List


LONGITUDINAL EFFECTS OF PTSD AND DEPRESSIVE SYMPTOMS ON ATTENTION


