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Shorter communication

Characteristics and organization of the worst moment of trauma memories in posttraumatic stress disorder

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ABSTRACT

It has been proposed that the organization of the worst moment in traumatic memories ("hotspots") is of particular importance for the development of PTSD. However, current knowledge regarding the organization and content of worst moments is incomplete.

In the present study, trauma survivors with ($n = 25$) and without PTSD ($n = 54$) were asked to indicate the worst moment of their trauma and to give a detailed narrative of the traumatic event. The worst moment and the remaining narrative were analyzed separately with regard to organization and emotional content.

Results indicated that worst moments of trauma survivors with PTSD differed from the remaining narrative and from worst moments described by trauma survivors without PTSD in that they were characterized by more unfinished thoughts, more use of the present tense and lower levels of cognitive processing. However, hypotheses regarding differentiating emotional content were not supported. Implications for our theoretical understanding of PTSD and potential therapeutic interventions are discussed.

Introduction

Traumatic events are defined as "events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others" (American Psychiatric Association, 1994, p. 427), referring to frightful, disastrous experiences such as natural disasters, severe accidents, combat, physical or sexual assaults, or torture. Despite the general dreadful character of the experience, trauma survivors can often clearly define one or more discrete worst moment within the trauma. In trauma survivors with posttraumatic stress disorder (PTSD), these worst moments have been termed "hotspots" and have for example been operationalized as the moments of the highest level of emotional distress identified by patients after imaginal exposure (Foa & Rothbaum, 1998). The concept of "hotspots" in PTSD is similar to the term "flashback memories" originally introduced by Hellawell and Brewin (2002, 2004), which also refers to highly emotional and distressing parts of the trauma (see also Ehlers, Hackmann, & Michael, 2004, who argue that these two terms can be equated). In two studies by Hellawell and Brewin (2002, 2004), "flashback memories" were identified by asking PTSD patients to label the parts of a trauma narrative that were written *while* experiencing flashbacks. Accordingly, neither the term "flashback memories" nor the term "hotspots" refers to intrusions or flashbacks per se but to highly emotional parts of the trauma that may, for example, have triggered flashbacks. However, Holmes, Grey, and Young (2005) showed that approximately 78% of intrusions matched with a worst moment.

Recently, the relevance of these worst moments within the trauma memory for the etiology of PTSD has been highlighted. Ehlers, Hackmann, and Michael (2004), for example, propose that the memory organization of the moments that are later reexperienced is of particular importance. With this assumption, they specify the theoretical notion that trauma memory is generally disorganized in PTSD due to dysfunctional information processing (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000). Disorganization of trauma memories is thought to be causally involved in the formation of intrusive memories and has to date mainly been operationalized by a lack in narrative coherence upon the intentional recall of the trauma. Indicators for narrative incoherence in PTSD are confused temporal order, the inability to recall important details of the trauma, repetition, unfinished thoughts, and speech fillers (Foa, Molnar, & Cashman, 1995; Halligan, Michael, Clark, & Ehlers, 2003). Moreover, relative absence of organized thoughts, referring to statements "indicating realization, decision making, or

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planning" (Foa et al., 1995, p. 682) have been suggested to represent an indicator for memory disorganization (Halligan et al., 2003). This aspect of memory (dis)organization may also be captured by a computerized text analysis program (Linguistic Inquiry and Word Count, LIWC, Pennebaker, Francis, & Booth, 2001) counting the use of causal words (i.e. "because", "hence") and other words indicating insight into causal processes (i.e. "consider", "realize"). Evidence for disorganization of trauma memories comes from studies showing that trauma narratives of trauma survivors with PTSD are more disorganized than those of trauma survivors without the disorder (e.g., Halligan et al., 2003; Jelinek, Randjbar, Seifert, Kellner, & Moritz, 2009; Jones, Harvey, & Brewin, 2007). However, the idea that the whole trauma narrative is disorganized has received criticism. As mentioned above, Ehlers et al. (2004) highlight the fact that intrusive memories only encompass a small number of moments from the trauma and hypothesize that these moments are particularly disorganized, rather than the trauma narrative as a whole. To our knowledge, only one published study to date has investigated the organization of specific parts of trauma narratives (Evans, Ehlers, Mezey, & Clark, 2007). In this study, young perpetrators suffering from intrusive memories of their crime were asked to provide a narrative of the event. Within the narratives, sections corresponding to the main intrusion were compared to randomly selected control sections. Results showed that the sections matching the main intrusion were significantly more disorganized than the control sections of the narrative. Although this finding is in line with the assumption of Ehlers, Hackmann, and Michael (2004) that the memory for the moments that are reexperienced is particularly disorganized, it remains to be shown whether disorganization of these hotspots is related to a diagnosis of PTSD. In the study by Evans et al. (2007), only six participants were diagnosed with PTSD, which limits the conclusions that can be drawn from the study.

Besides the aspect of memory disorganization, trauma memories have been suggested to be characterized by particular sensory and emotional content in PTSD (Brewin et al., 1996; Ehlers & Clark, 2000). Based on the Dual Representation Theory (DRT, Brewin et al., 1996), Hellawell and Brewin (2004) predict that reference to fear should be especially prevalent in "flashback memories" in comparison to "ordinary memories" of the trauma. Their hypothesis was confirmed by showing that "flashback memories" were more often dealing with fear, helplessness, and horror. Fear was also the most commonly reported emotion in "worst moments" in a study investigating the emotional content of worst moments within reliving therapy (Grey & Holmes, 2008).

A different line of research has associated PTSD with higher levels of alexithymia (as measured by the Toronto Alexithymia Scale, TAS 20, Bagby, Parker, & Taylor, 1994) referring to difficulties in labeling and identifying emotional feelings (for meta analysis see Frewen, Dozois, Neufeld, & Lanius, 2008), which may counteract a heightened articulation of emotional words in PTSD. However, the relation between (self-reported) alexithymia and the use of emotional words has to our knowledge not been investigated in PTSD up until now.

Levels of emotional involvement may not only be represented by the use of emotional words, but also by other linguistic characteristics. Hellawell and Brewin (2004), for example, hypothesized that participants use more often the present tense in "flashback memories" in line with Pillemer, Desrochers, and Ebanks (1998) who propose that people generally switch from past to present unintentionally at the "emotional high point of a memory narrative" (p. 145). Hellawall and Brewin were able to confirm their hypothesis: "Flashback memories" were accompanied by a more prevalent use of the present tense than in the remaining narrative. However, this finding has not been replicated, yet.

No study has yet, to the best of our knowledge, directly compared worst moments of traumatized participant with and without a PTSD diagnosis (the study by Evans et al., 2007, focused on intrusions rather than PTSD diagnosis). The current study was designed to fill this gap and to test hypotheses inferred from contemporary theories on the organization and content of worst moments in PTSD (Brewin et al., 1996; Ehlers & Clark, 2000). We hypothesized that worst moments of the trauma would be characterized by (a) more disorganization, (b) more emotional words, especially fear, and (c) more use of the present tense than the memory of the remaining narrative in participants with PTSD in comparison to traumatized participants without PTSD. Thus, a significant interaction between Group (PTSD vs. Non-PTSD) and Event (worst moment vs. remaining narrative) was expected.

Methods

Recruitment

Eighty-one victims of single traumatic events (45 victims of assaults; 36 victims of traffic accidents) were recruited by means of advertisement in the media or contacted through the Department of Psychiatry and Psychotherapy of the University Medical Center Hamburg-Eppendorf. Twenty-six fulfilled DSM-IV criteria for current PTSD as assessed with the Structured Clinical Interview for DSM-IV (SCID, First, Spitzer, Gibbon, & Williams, 1996). Details of recruitment and sample characteristics have been published elsewhere (Jelinek et al., 2009). Participants were excluded if they had a history of psychotic symptoms (hallucinations, delusions), neurological disorder, traumatic brain injury, or alcohol- or substance dependence and if they were not fluent in German, <18 or >70 years, or had current suicide ideations. Two participants (one with PTSD and one without PTSD) could not be included in the present analysis because the worst moment could not be identified in the trauma narrative by the rater or no worst moment was reported. Thus, 25 trauma victims with and 54 without PTSD remained. This study was approved by the Ethics Committee of the Medical Board Hamburg (Germany). All participants provided full informed consent.

Measures

Demographic variables and psychopathology

Background information (e.g., regarding age, education, alcohol consumption) and details on the traumatic event (e.g., date of trauma, injuries) were inquired in a standardized interview. In this interview, participants were also asked to indicate what they subjectively considered the worst moment within their traumatic experience. On the basis of this information, worst moments were later identified by a blind rater in the trauma narratives (see section Analyses of trauma narratives).

Comorbid diagnoses were determined with the German Version of the Mini International Neuropsychiatric Interview (MINI, Sheehan et al., 1998). The German Version of the Posttraumatic Diagnostic Scale (PDS, Foa et al., 1997) was administered to measure the severity of PTSD symptoms. Internal consistency for the German version of the PDS is considered excellent with $\alpha = .94$ (Griesel, Wessa, & Flor, 2006, α for the current study $= .93$). Depression severity was assessed using two well-established measures: the German Version of the Beck Depression Inventory (BDI, Beck & Steer, 1993; Hautzinger, Bailer, Worall, & Keller, 1995) and the German Version of the Hamilton Depression Rating Scale (HDRS, AMDP & CIPS, 1990; Hamilton, 1960), which have both shown satisfactory psychometric qualities (see, e.g., Hunsley & Mash, 2008).

The German Version of the Toronto Alexithymia Scale (TAS 20, Bach, Bach, de Zwaan, Serim, & Böhmer, 1996; Bagby et al., 1994) was used to measure alexithymia in participants. It is the most

widely used self-report questionnaire of alexithymia and comprises 20 items rated on a 5-point Likert scale with higher scores indicating greater alexithymic tendencies. Reliability (internal consistency, split-half, and test-retest reliability) and convergent validity have been found to be satisfactory for the German version of the TAS 20 (Bach et al., 1996). Internal consistency for the current sample was good with Cronbach's $\alpha = .84$.

Analyses of trauma narratives

Trauma victims were asked to give a detailed verbal report of the traumatic event. They were requested to recall this event as accurately and in as much detail as possible and to describe the incidents in chronological order. If the participant did not mention the worst moment he or she had specified within the standardized interview (see above) within the narrative, the interviewer probed for the worst moment after the participant finished his or her narrative. Participants were not interrupted (or prompted) while giving the narrative.

These narratives were transcribed verbatim and analyzed with regard to disorganization by a rater blind to the diagnostic status according to scoring rules first introduced by Foa et al. (1995) and modified by Halligan et al. (2003). We have previously reported satisfactory interrater reliability for this method in the current sample showing an intraclass correlation coefficient (ICC) of .85 for the total fragmentation score (Jelinek et al., 2009). In line with prior research, the beginning of the narrative was defined as the first expression of danger and the end was defined as the first expression that danger had ended (Foa et al., 1995). We additionally defined criteria for the identification of the beginning and the end of the worst moment. Scoring of the worst moment began with the first reference to the worst moment as previously specified by the participant in the interview on the trauma event (see above) and ended with the last expression referring to the worst moment. If participants named more than one worst moment, beginning and end of these additional worst moments were also marked and scores of all worst moments were combined. If the worst moment was not initially mentioned in the narrative but following a probe of the interviewer (see above), the participant's answer was coded as the worst moment. The reliability for the scoring of the length of worst moments was satisfactory with an ICC of .7.

In line with previous studies investigating trauma memory disorganization (e.g., Halligan et al., 2003; Jones et al., 2007), the worst moment and the remaining narrative were divided into chunks, defined as utterance units containing only one thought, idea or action. Each chunk was then assigned to one of five different categories: *Repetitions*, *Disorganized Thoughts*, *Organized Thoughts*, *Unfinished Thoughts,* and *Not Coded*. Two "Total Disorganization Scores" were calculated as introduced by Halligan et al. (2003) with $z(\text{repetitions}) + z(\text{disorganized thoughts}) - z(\text{organized thoughts})$: one for the worst moment(s) and one for the remaining narrative. The category "Unfinished Thoughts" is not included in this score and was thus reported separately, as "Unfinished Thoughts" are considered a measure to index memory fragmentation in the original introduction of the method by Foa et al. (1995). "Speech Fillers", however, were not coded. In accordance with prior research, all scores of coding categories were expressed as proportions of the respective narrative component (worst moment or remaining narrative) for analysis (cf. Harvey & Bryant, 1999; Jelinek et al., 2009).

Linguistic Inquiry and Word Count (LIWC)

The Linguistic Inquiry and Word Count (LIWC, Pennebaker et al., 2001) is a text analysis software program for measuring verbal expression of emotion, cognitive processes and other linguistic characteristics of spoken or written language. It analyses texts word by word and calculates the percentage of words that fits into previously defined categories. The following categories were chosen from the LIWC database: "Affect", "Anxiety", "Cognitive Processes", and "Words in Present Tense". Words are assigned to the category "Affect", if they indicate affective or emotional processing, including reference to positive emotions (such as optimism) as well as negative emotions (such as anxiety, anger, or sadness). "Anxiety" thus represents a subcategory of "Affect" including affective words that refer to fear and panic. Text is assigned to the category "Cognitive Processes", if it indicates causation (i.e. "because", "hence"), insight (i.e. "think", "know", "consider"), discrepancy (i.e. "should", "would", "could"), inhibition (i.e. "block", "constrain"), tentativeness (i.e. "maybe", "perhaps"), or certainty (i.e. "always", "never"). We chose to analyze narratives for "Cognitive Processes", because it may represent an additional parameter to index memory organization as conceptionalized by Foa et al. (1995). Finally, all verbs written in present tense were registered by the program and assigned to the category "Words in Present Tense". The validity of the method has been confirmed (Bantum & Owen, 2009; Kahn, Tobin, Massey, & Anderson, 2007). Again, percentages of categories were calculated for each respective component of the narrative (worst moment or remaining narrative).

Strategy of data analysis

To summarize, three measures were chosen to index memory organization (1) the "Total Disorganization Score" (Halligan et al., 2003), (2) "Unfinished Thoughts" (Foa et al., 1995), and (3) "Cognitive Processes" as measured by the LIWC category. As these three indices of memory organization were uncorrelated ($rs < |.2|$, $ps > .08$), they were analyzed separately and not combined in a Multivariate Analysis of Variance (MANOVA, Tabachnick & Fidell, 2001). To provide a thorough analysis of memory organization, it was additionally planned to compare narratives separately on the different components of the "Total Disorganization Score" (i.e. Disorganized Thoughts, Repetitions, and Organized Thoughts). The use of emotional words was measured by the LIWC categories (1) "Affect" and (2) "Anxiety". The use of words in the present tense was indexed by the LIWC category "Words in Present Tense".

Results

Sample description

As can be seen in Table 1, participants with and without PTSD did not differ with regard to gender, age, verbal intelligence, alcohol consumption, type of trauma, length of worst moments (as measured by the number of chunks), time since the traumatic event, or injuries sustained. At trend level, remaining narratives were longer in participants without PTSD than in participants with PTSD as indicated by the number of chunks. The majority of the participants described the worst moment within the initial narrative of trauma (PTSD: $n = 22$ (88%); Non-PTSD: $n = 48$ (89%); Cramer's $V = 0.01$, $p > .9$). Only two participants (9%) in the PTSD group and eight participants (15%) in the Non-PTSD group mentioned a second worst moment (Cramer's $V = 0.09$, $p > .3$). More than two worst moments were not mentioned by any of the participants. Group differences were found with regard to levels of self-assessed and clinician-rated depression. As expected, the PTSD group displayed significantly higher levels of PTSD severity, as measured with the Posttraumatic Diagnostic Scale (PDS), and higher levels of experienced life threat during the traumatic event than the Non-PTSD group. Moreover, participants with PTSD showed higher levels of alexithymia as measured by the TAS 20 than participants without PTSD (see Table 1).

Table 1
Demographic variables in participants with and without PTSD: number or mean (percent or standard deviation).

Variable	PTSD ($n = 25$)	Non-PTSD ($n = 54$)	Statistics
Gender (f/m)	16/9	26/28	$\chi^2(1) = 1.73$; *ns*
Age (in years)	41.40 (12.70)	38.83 (13.94)	$t(77) = 0.78$; *ns*
Verbal intelligence	110.76 (17.06)	113.96 (14.81)	$t(77) = 0.85$; *ns*
Alcohol (g per week)	25.18 (41.84)	36.88 (36.98)	$t(77) = 1.25$; *ns*
Type of trauma			$\chi^2(1) = 0.01$; *ns*
Assault	14 (57.7%)	30 (54.5%)	
Accident	11 (42.3%)	24 (45.5%)	
Length of worst moments (number of chunks)	9.12 (5.08)	11.43 (7.12)	$t(77) = 1.46$; *ns*
Length of the remaining narrative (number of chunks)	44.20 (32.93)	61.15 (42.24)	$t(77) = 1.77$; $p = .08$
Injury Severity Score (ISS)[a]	5.16 (7.30)	5.80 (6.31)	$t(77) = 0.40$; *ns*
HDRS	14.64 (7.35)	4.19 (4.40)	$t(32.20)^b = 6.59^*$
BDI	16.36 (7.73)	4.79 (5.73)	$t(75) = 7.39^*$
TAS 20	54.04 (9.61)	43.76 (9.08)	$t(66) = 4.33^*$
PDS – total score	26.84 (7.65)	5.39 (5.24)	$t(77) = 14.56^*$
Intrusions	8.36 (3.13)	1.78 (2.02)	$t(33.52)^b = 9.62^*$
Avoidance	9.88 (4.18)	1.48 (2.26)	$t(30.71)^b = 9.43^*$
Hyperarousal	8.60 (2.97)	2.13 (2.40)	$t(77) = 10.33^*$

Note. *ns* = non-significant. BDI = Beck Depression Inventory. HDRS = Hamilton Depression Rating Scale. PDS = Posttraumatic Diagnostic Scale. TAS 20 = Toronto Alexithymia Scale.
[a] According to Baker, O'Neill, Haddon, and Long (1974).
[b] Adjusted for unequal variances. $^*p < .001$.

Memory organization

Mixed analyses of variance (ANOVA) were calculated with Group (Non-PTSD/PTSD) as between-subject factor and Narrative (worst moment/remaining narrative) as within-subject factor. A separate ANOVA was calculated for each of the organization measures as dependent variable (Total Score of Disorganization, Unfinished Thoughts, Cognitive Processes) as well as for each of the components of the Total Score of Disorganization (see Table 2). All effects were non-significant for the Total Score of Disorganization, while the Group × Narrative interaction achieved trend level; $F(1,77) = 2.83$, $p < .1$, $\eta^2_{\text{partial}} = .04$. Numerically, however, disorganization was highest in the remaining narrative of PTSD participants. Regarding "Unfinished Thoughts" as a measure for memory disorganization, the expected interaction between Group and Narrative reached significance, $F(1,77) = 4.65$, $p < .05$, $\eta^2_{\text{partial}} = .06$. In line with our hypotheses, more Unfinished Thoughts were found in the worst moments of participants with PTSD in comparison to the remaining narrative. For the percentage of "Cognitive Processes" as measured by the LIWC category, the main effects of Group and Narrative were non-significant. However, the expected Group × Event interaction was significant, $F(1,76) = 5.00$, $p < .05$, $\eta^2_{\text{partial}} = .06$. Subsidiary post-hoc tests (uncorrected *t*-tests) indicated less cognitive processing in the PTSD than in the Non-PTSD group for the worst moments, $t(77) = 2.20$, $p < .05$, but similar levels of cognitive processing between groups for the remaining narrative, $t(76) = 0.24$, $p > .8$. Worst moments that were prompted by the experimenter did not differ from worst moments that were embedded in the initial narrative on all measures of disorganization ($ps > .15$).

Use of emotional words

A 2 × 2 mixed ANOVA with Group as between-subject factor and Narrative as within-subject factor was calculated for the percentage of words indicating "Affect". More affective words were used in the worst moment as indicated by a main effect of Narrative, $F(1,76) = 6.42$, $p < .05$, $\eta^2_{\text{partial}} = .08$. However, no effect involving Group as a factor was significant. If words indicating anxiety were regarded separately, the main effects of Group and Narrative reached significance as well as the Group × Narrative interaction, $F(1,76) = 4.58$, $p < .05$, $\eta^2_{\text{partial}} = .06$. However, contrary to our hypothesis words indicating anxiety were particularly prevalent in worst moments of participants that did not develop PTSD (see Table 2).

The use of affective words (in the whole narrative) and levels of alexithymia as measured by the TAS 20 did not correlate in the total sample, $r = -.15$, $p > .1$. In a second step, we calculated correlations separately for each group. While no relation between alexithymia and the use of affective words was found in the trauma survivors that did not develop PTSD, $r = -.04$, $p > .6$, affective words and alexithymia were negatively related in trauma survivors with PTSD, $r = -.47$, $p < .05$.

Use of time

An additional 2 × 2 mixed ANOVA with Group as between- and Narrative as within-subject factor was calculated. The "Percentage of Words in Present Tense" was used as the dependent variable showing two significant main effects for Group, $F(1,76) = 7.81$, $p < .01$, $\eta^2_{\text{partial}} = .09$, and Narrative, $F(1,76) = 5.84$, $p < .05$, $\eta^2_{\text{partial}} = .07$, that were further qualified by significant Group × Narrative interaction, $F(1,76) = 5.08$, $p < .05$, $\eta^2_{\text{partial}} = .06$. As can be see in Table 2, present tense was used more often in the worst moments of participants with PTSD.

Correlational analysis

Pearson correlations were calculated between all content analyses indices (collapsed across the whole narrative). The Total

Table 2
Autobiographical memory measures: mean (standard deviation).

Variable	PTSD ($n = 25$)		Non-PTSD ($n = 54$)		ANOVA		
	Worst moment [a]	Remaining narrative[a]	Worst moment[a]	Remaining narrative[a]	Group	Narrative	Group × Narrative
Total disorganization score [$z(D) + z(R) - z(O)$]	−0.06 (1.77)	0.54 (1.69)	0.03 (1.64)	−0.25 (1.57)	*ns*	*ns*	$p < .1$
Disorganized thoughts (*D*), %	3.55 (10.18)	5.70 (7.54)	2.61 (5.52)	3.52 (5.13)	*ns*	*ns*	*ns*
Repetitions (*R*), %	0 (0)	0.45 (1.19)	0.50 (2.14)	0.44 (1.02)	*ns*	*ns*	*ns*
Organized thoughts (*O*), %	30.28 (23.36)	15.28 (7.90)	31.71 (21.64)	19.42 (10.38)	*ns*	$p < .001$	*ns*
Unfinished thoughts, %	5.86 (8.83)	1.16 (2.58)	2.42 (6.13)	2.32 (3.02)	*ns*	$p < .05$	$p < .05$
Cognitive processes (LIWC), %	7.28 (4.29)	8.87 (1.74)	9.69 (4.49)	8.98 (1.80)	$p < .1$	*ns*	$p < .05$
Affect (LIWC), %	3.02 (2.40)	2.3 (1.10)	3.58 (2.96)	2.57 (1.03)	*ns*	$p < .05$	*ns*
Anxiety (LIWC), %	0.20 (0.43)	0.23 (0.49)	0.71 (1.07)	0.26 (0.27)	$p < .05$	$p < .1$	$p < .05$
Words in present tense (LIWC), %	7.52 (3.75)	5.66 (1.62)	5.36 (2.78)	5.29 (1.64)	$p < .01$	$p < .05$	$p < .05$

Note. LIWC = Linguistic Inquiry and Word Count. *ns* = non-significant.
[a] Percentages refer to the number of chunks in the respective part of the narrative (worst moment vs. remaining narrative).

Disorganization Score correlated (besides its components) with the LIWC Anxiety category. As expected, the LIWC category Cognitive Processes was positively correlated with Organized Thoughts. Moreover, positive correlations between Cognitive Processes and Disorganized Thoughts as well as the LIWC category Affect were found. Self-evidently, the LIWC category Affect correlated with its component Anxiety. The expected correlations between the Total Score of Disorganization, Unfinished Thoughts and Words in Present Tense were not found (see Table 3).

Discussion

The aim of the current study was to test predictions about the organization and content of worst moments in traumatic memories. Building upon theories of traumatic memory in PTSD (Brewin et al., 1996; Ehlers & Clark, 2000; Ehlers et al., 2004), we hypothesized that the worst moment of participants with PTSD would be characterized by more disorganization than the memory of their remaining narrative and in comparison with the worst moment of traumatized participants without PTSD. The expected interaction between group and memory type was found for two out of three dependent variables measuring memory organization. In individuals with PTSD, worst moments contained more unfinished thoughts and fewer words indicating cognitive processing than the remainder of the narrative, which was not the case for individuals without PTSD. A number of theorists have argued that the disorganization of the trauma memory is involved in the development of PTSD, especially intrusive memories (Brewin et al., 1996; Ehlers & Clark, 2000). The current results are in line with the assumption that not inevitably the recall of the entire trauma is disorganized (see Ehlers et al., 2004). However, not all results were as predicted. In contrast to the hypothesis, the Total Disorganization Score was not more pronounced for the worst moments than for the remainder of the narrative in participants with PTSD. One possible explanation for this finding could be that the sections of the worst moments were too short to reliably identify repetitions and disorganized thoughts, which were used to compute the composite measure. The used method may not be sensitive enough to pick up disorganization in short sections and a floor effect needs to be considered.

In addition to the well-established rater based approach to measure memory (dis)organization, we also used the category "Cognitive Processes" as measured by a computerized text analysis program (LIWC, Pennebaker et al., 2001). We assumed that this index would capture a similar aspect as Foa et al.'s concept of "Organized Thoughts". Indeed, we found a moderate positive correlation between these two indices. However, the LIWC category "Cognitive Processes" also correlated to a similar extent positively with "Disorganized Thoughts", which are defined as statements that refer to "clear expressions of uncertainty with regards to memory, confusion, or consecutive chunks" (Halligan et al., 2003, p. 422). Accordingly, they are conceptualized to oppose "Organized Thoughts". However, the LIWC category "Cognitive Processes" does not differentiate between utterances that indicate understanding (Organized Thoughts) versus confusion (Disorganized Thoughts), but counts words referring to cognitive processing. Thus, the overlap of the two concepts ("Cognitive Processing" and "Organized Thoughts") seems to be smaller than initially assumed. However, as indicated by the significant Group × Memory Type interaction for "Cognitive Processes", worst moments of participants with PTSD seemed to be characterized by less cognitive processing in general. The inclusion of multiple measures for the assessment of memory organization seems to be crucial for future research in order to capture as many facets of the construct as possible.

Regarding the content of worst moments, we hypothesized more emotional words, especially those associated with fear, and more use of the present tense. Indeed, more affective words were used in the worst moments compared to the remaining narrative. While this finding is largely in line Hellawell and Brewin (2004), we aimed to extend their finding by including traumatized participants without PTSD in our study. Contrary to our hypothesis, however, the increased use of affective words was not specific for the worst moment of PTSD participants. In fact, when focusing on anxiety, we found that the percentage of words indicating anxiety was highest in the worst moment of participants who did not develop PTSD. This may at first appear contradictive to some of the theories on PTSD focusing on anxiety (e.g., Foa & Rothbaum, 1998). However, potential explanations are conceivable. A first explanation may be considered in higher levels of alexithymia that have been reported in PTSD (Frewen et al., 2008) and that correlated with decreased use of affective words in the PTSD sample in our study. These may indicate problems generally in verbalizing emotions and feelings. Moreover, avoidance behavior needs to be considered which may lead to decreased articulation of anxiety and fear in the narratives of PTSD participants. Likewise, traumatized participants without PTSD may have benefited in terms of recovery from recognizing and articulating their emotions after the traumatic event. A further explanation may be that anxiety may not be the most prominent emotion in the trauma narratives. It has been shown that emotions other than anxiety, such as anger, guilt, shame, and disgust, play an important role in PTSD (for review see Resick & Miller, 2009), which have also been highlighted, for example, in the model by Ehlers and Clark (2000). This may explain the small percentage of fear expressions in the narratives. At first sight, the finding that the groups did not differ on the total number of affect words used appears to contradict this hypothesis. However, the LIWC category "affect" may not satisfactorily cover the entire range of relevant emotions as feelings of guilt, shame and disgust are not included in this category.

We additionally found that present tense was used particularly often in the worst moments of participants with PTSD. Extending findings of Hellawell and Brewin (2004), our results are in line with

Table 3
Pearson correlations between the content analyses indices ($N = 79$).

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Total disorganization score [$z(D) + z(R) - z(O)$]	–	.51***	−.50***	.49***	.18	.04	.37***	.01	.06
2. Disorganized thoughts (D)			.06	−.21†	.05	−.05	.13	.30**	.16
3. Organized thoughts (O)				.06	−.21	−.05	−.20	.33**	−.02
4. Repetitions (R)					−.02	−.002	.12	.17	.02
5. Unfinished thoughts						.06	−.09	.04	.02
6. Affect (LIWC)							.39***	.25*	−.13
7. Anxiety (LIWC)								.02	.09
8. Cognitive processes (LIWC)									.20†
9. Words in present tense (LIWC)									–

Note. LIWC = Linguistic Inquiry and Word Count. †$p < .1$; *$p < .05$; **$p < .01$; ***$p < .001$.

contemporary theoretical notions suggesting that traumatic memories in PTSD are characterized by a lack of time perspective (Ehlers & Clark, 2000) and the experience that the event is happening in the here and now (Brewin et al., 1996). While this has been particularly suggested for involuntary memories of the trauma, it may also be valid for voluntarily recalled memories of the trauma as investigated in the present study.

Finally, limitations of the study need to be discussed. Firstly, measures of memory disorganization have sometimes been criticized (e.g., Ehlers et al., 2004; Gray & Lombardo, 2001) as an unsatisfactory attempt to capture the construct of memory disorganization via the analysis of *verbal narratives*. Secondly, the cross-sectional design of the present study limits our conclusions. It cannot be determined whether there is a causal impact of memory organization on the development of PTSD, whether deficits in memory content are a vulnerability factor, or whether memory deficits are a consequence of the disorder. Moreover, memory representations of the trauma may have changed over time and the course of the disorder. Thirdly, we asked participants to indicate the worst moment of their traumatic experience without providing a firm definition. Participants may have interpreted the term in different ways (e.g., focus on perceived threat vs. maximal distress). In addition, our procedure deviates from the one used by Evans et al. (2007) who identified the worst moment within the trauma narratives by matching it with participants' main intrusive memory. Reassuringly, there is evidence that the two strategies lead to similar results (Holmes et al., 2005). Nevertheless, future research should directly compare characteristics of the worst moment defined according to the different definitions. Finally, our sample exclusively consisted of survivors of single-event assaults and accidents. It remains to be tested whether results generalize to survivors of different types of traumas and/or multiple traumatic experiences.

Despite these limitations, the present study provides preliminary evidence for the claim that in PTSD, worst moments in trauma memory show different characteristics than the rest of the trauma memory. Specifically, hypotheses regarding the disorganization of worst moments and the use of present tense were mainly supported, whereas hypotheses regarding emotional content were not.

The findings of the current study are largely in line with a theory-based focus on the characteristics of the worst moment within the trauma memory (see Ehlers et al., 2004; Holmes, et al., 2005) and suggest to target these worst memories in PTSD treatment (cf. Ehlers, Clark, Hackmann, McManus, & Fennell, 2005; Grey, Young, & Holmes, 2002).

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