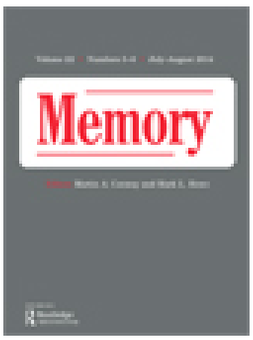

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Autobiographical recall of a stressful negative event in veterans with PTSD

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ABSTRACT

Posttraumatic stress disorder (PTSD) is characterised by alterations in autobiographical memory for traumatic and non-traumatic events. Studies that focus on event construction – the ability to search for and identify a specific event – have documented overgeneral memory in PTSD. However, the quality of autobiographical memory also depends on the ability to elaborate on an event once constructed by providing additional details. In a prior study, individuals with PTSD generated as many episodic (event-specific) details as trauma-exposed controls when demands on event construction were minimized, albeit the PTSD group generated more non-episodic details. The current study sought to further characterize PTSD-related alterations in event elaboration by asking participants to describe a stressful negative event specified by the experimenter, thus minimizing event construction demands. Narratives were scored for episodic and non-episodic details and relations with measures of executive function and self-reported avoidance were examined. Compared to controls, the PTSD group generated narratives with equivalent episodic detail but greater non-episodic detail, including semantic information and repeated or extended events. Non-episodic detail generation was associated with greater avoidance but not executive functions. Elaborated non-trauma memories may be perceived as overgeneral in PTSD due to greater generation of non-episodic details, rather than diminished episodic detail.

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autobiographical memory; PTSD; avoidance; executive functions

Introduction

Memory abnormalities are a central feature of post-traumatic stress disorder (PTSD) (American Psychiatric Association, 2013; Brewin, 2018; Ehlers & Clark, 2000; Foa & Rothbaum, 1998; Rubin et al., 2008a; Rubin et al., 2008b; Verfaellie & Vasterling, 2009). Indeed, re-experiencing symptoms, taking the form of unwanted memories, nightmares, and flashbacks, constitute one of the diagnostic criteria of PTSD in the DSM-V (American Psychiatric Association, 2013). These symptoms reflect an inability to regulate retrieval of the traumatic event, leading to its involuntary intrusion into consciousness. PTSD is also associated with changes in the voluntary retrieval of trauma memories. Trauma memories are frequently characterised as more fragmented and disorganised in individuals with PTSD (Jelinek et al., 2009), at least for the most severe moments of a traumatic event (for reviews, see Brewin, 2018; 2016; Crespo & Fernández-Lansac, 2016), although such findings are not universal (Römisch et al., 2014; Rubin et al., 2016).

PTSD-associated abnormalities in autobiographical memory, however, are not limited to the traumatic event. The intentional recall of non-trauma memories has been characterised as overgeneral (for reviews, see Lapidow & Brown, 2015; Moore & Zoellner, 2007; Ono et al., 2016; Verfaellie & Vasterling, 2009). When asked to generate personal memories in response to a single word cue – as in the Autobiographical Memory Test (AMT) (Williams & Broadbent, 1986) – individuals with PTSD tend to provide memories that are categorical rather than specific (Brown et al., 2013; Bryant et al., 2007; McNally et al., 1995; Moradi et al., 2012; Sutherland & Bryant, 2007). That is, they are more likely to respond with an abstract or general memory than to retrieve a singular event that occurred at a specific time and place. For instance, in response to the cue "birthday" they may respond "we always have a party for my husband's birthday" rather than "this past June, we had a barbeque in the back yard for my husband's birthday". Notably, given the open-endedness of the cue, such tasks pose heavy demands on event construction, the process of search for a memory and reconstruction of a specific event within a spatial–temporal context. According to Conway and Pleydell-Pearce (2000), this process entails a hierarchical, top-down search through one's personal knowledge base through a process of successive cueing, starting with the activation of abstract knowledge and resulting in the activation of a specific event. Event construction is

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guided by executive control processes that implement goal-relevant plans, and is thought to be complete when an event that satisfies the cue is brought to mind. Although much of this search process may not enter into consciousness, in the case of the cue "birthday", it might entail focusing on the concept of birthday parties rather than birthday gifts, selecting one's husband as the person whose birthday is celebrated, and ultimately, activation of information pertaining to a specific birthday party. It has been postulated that overgeneral memory in PTSD may reflect a failure in hierarchical, top-down memory search whereby the search process is aborted at the level of general event descriptions (Williams et al., 2007), leading to a failure to identify a specific event.

The quality of autobiographical memory, however, depends not only on event construction but also on subsequent event elaboration, the process of retrieving additional details about the specific event, which renders the memory more vivid (Addis et al., 2007). Focusing on event elaboration, Levine and colleagues (2002) developed a scoring protocol that distinguishes between different types of details that uniquely characterise an event (episodic details) and details that are generic or factual (non-episodic details). To our knowledge, only two studies have used this approach to study autobiographical memory in PTSD. Using single word cues as memory probes, Brown and colleagues (2014) found that veterans with combat-related PTSD generated fewer episodic details and more non-episodic details than those without PTSD. However, this paradigm also posed heavy demands on event construction, as participants were required to search for and identify specific memories in response to cue words; thus, it is possible that deficits in event elaboration were secondary to deficits in event construction. McKinnon and colleagues (2015) asked participants to recall a specific negative event (September 11th) and a neutral event predetermined by the participant, thus greatly reducing demands on event construction. In that study, individuals with PTSD did not differ from trauma-exposed controls in their generation of episodic details, albeit that they generated more non-episodic details.

The current study sought to further examine the status of event elaboration in individuals with deployment-related PTSD by probing recall of a specific stressful negative event from deployment that did not meet criteria for a trauma event. The use of a specific memory probe that minimized demands on event construction in combination with a "testing the limits" approach in which the examiner used prompts to elicit additional detail allowed us to evaluate whether PTSD is associated with reduced ability to generate event-specific details – the information that contributes to the richness and vividness of an autobiographical memory. The selection of an experience that was common to all participants (namely, participants' most severe blast exposure) allowed us to utilize a similar set of examiner prompts across all participants and ensured a similar emotional valence of recalled memories.

An additional aim of this study was to assess neurocognitive and psychological factors that may contribute to alterations in event elaboration in PTSD. According to a predominant model of overgeneral memory in emotional disorders, the Capture and Rumination, Functional Avoidance and Impaired Executive Control model (CaRFAX; Williams et al., 2007), the tendency of individuals with PTSD and other emotional disorders to generate less specific memories is related to greater rates of functional avoidance and rumination as well as executive dysfunction, processes thought to disrupt generative retrieval processes. Evidence for this notion in studies with a primary focus on event construction is mixed (see Sumner, 2012 for a review; Ros et al., 2017; Wilson & Gregory, 2018). Here, we examined whether functional avoidance and executive dysfunction were associated with alterations in event elaboration.

Methods

Participants

Participants were recruited through the VA Boston Polytrauma Network and through flyers and outreach events as part of a larger study of traumatic brain injury and psychological trauma, which involved neuropsychological testing, diagnostic interviews, and self-report questionnaires (see Verfaellie et al., 2013). Participants were excluded from the larger study if they had a history of psychosis, neurological diagnoses other than mild traumatic brain injury (mTBI), or questionable effort based on performance validity measures. Inclusion in this study required (a) exposure to a blast explosion within 100 metres; and (b) exposure to a DSM-IV Criterion A event (involving actual or perceived life threatening or serious injury) during deployment, not including exposure to blast.

Forty-five veterans with PTSD and 34 veterans without PTSD, between the ages of 22 and 50 were included in the study. Diagnosis of PTSD was based on the Clinician Administered PTSD Scale (CAPS) for the Diagnostic and Statistical Manual of Mental Disorders 4th Edition (DSM-IV-TR; Blake et al., 1995), a semi-structured interview that was administered by a clinical neuropsychologist. Participants meeting criteria for PTSD endorsed a subjective response of fear, helplessness, or horror during or immediately after the Criterion A event, and reported at least 1 re-experiencing symptom, 3 avoidance symptoms, and 2 hyperarousal symptoms.

The two groups did not differ in terms of age. Participants in the PTSD group reported greater symptoms of depression and anxiety than those in the no PTSD group, demonstrating the high comorbidity between these disorders. A diagnosis of mTBI was more frequent in the PTSD group (78%) compared to the no PTSD group (44%). Demographic information and psychological characteristics are presented in Table 1. Participants

provided written informed consent in accordance with the VA Boston Healthcare System Institutional Review Board.

Materials and procedure

Blast narratives

As part of a semi-structured clinical interview aimed at assessing TBI, participants were asked to recall the most severe blast event they had experienced during military deployment. Because participants were given a specific cue that greatly constrained the search process and helped guide them to a specific memory, demands on event construction were minimized, allowing closer examination of group differences in event elaboration. Participants were prompted to describe this event in detail, including the events occurring just prior to, during, and immediately following the blast. These narratives were audiotaped for later transcription. Based on the responses of each participant, the examiner, who was blind to PTSD status, utilized a structured list of prompts to elicit additional information. Additional prompts were used as needed to obtain as complete a description of the event as possible. Some prompts elicited additional episodic information (i.e., episodic prompts), such as "Where was your convoy going?" and "Can you say more about the fire fight?" Other prompts elicited additional general or personal semantic information (i.e., semantic prompts), such as "What kind of tank is that?" and "How far is the base from the city center?" This approach is similar to methods utilized in the autobiographical memory literature that rely on semi-structured interviews with prompts to facilitate recall (Levine et al., 2002). The instruction for participants to recall a specified event (i.e., the blast exposure) allowed for an examination of event elaboration while minimizing the demands on event construction. Further, it allowed for the use of a semi-structured interview, with grossly similar prompts across participants.

Narratives were segmented into informational elements, which were coded as internal to the main event described (i.e., episodic details) or external to it (i.e., non-episodic details), according to the criteria of Levine and colleagues (2002). Episodic details were further divided into event, time, place, perceptual, and thought/emotion (see Table 2 for examples). Non-episodic details were categorized based on a more fine-grained classification scheme put forth by Strikwerda-Brown and colleagues (2018), shown to be more sensitive to the presentation of distinct patient groups (see Table 3 for examples). Accordingly, non-episodic details were classified as general semantic information, personal semantic information, extended or repeated events, or specific episodes external to the event being described (i.e., other episode). Metacognitive statements and repetitions were not analyzed due to the fact that our interview format encouraged self-reflective statements and repetition for clarification purposes. Probes were coded as episodic, semantic, or other.

Interrater reliability

Raters were blind to group status during narrative coding. A primary rater scored all blast narratives, whereas a second rater independently scored 20% of the narratives. Intraclass correlation analyses utilising Cronbach's α indicated excellent interrater reliability for episodic details (.98) and non-episodic details (.94). When further subdivided by detail type, reliability was excellent for each episodic detail type (.94-.99), but somewhat more variable for non-episodic detail types (.67-.97). Notably, details reflecting specific events other than the index event were the least reliable detail type (.67), with reliability for other

Table 1. Demographic information and descriptive statistics for psychological measures and executive functions.

	No PTSD (n = 34)		PTSD (n = 45)			
	M	SD	M	SD	t/χ2	p
Age (yrs)	29.29	6.60	28.88	6.08	.28	.778
Education (yrs)	13.78	2.08	13.18	2.09	1.27	.208
Time since blast (mo)	57.32	37.80	51.98	28.82	.71	.478
Presence of mTBI (n)	15		35		9.45	.002
CAPS	27.82	14.80	72.31	17.84	−11.79	<.001
CAPS Avoidance Scale	6.56	6.55	27.78	8.57	−12.02	<.001
BDI-II	12.00	9.03	21.53	10.00	−4.37	<.001
BAI	8.44	7.21	19.71	10.60	−5.33	<.001
Stroop Inhibition (Contrast scaled score)	9.18	3.12	9.89	2.68	−1.07	.286
Digit Span Backwards	6.71	2.47	6.93	2.28	−.42	.673
Consonant Trigrams Total Correct	26.32	9.20	26.69	7.90	−.19	.850
Executive Composite	−.29	.79	−.22	.58	−.49	.626

Table 2. Definitions and Examples of Episodic Details.

Detail Type	Description	Examples
Event	Happenings, individuals present, weather descriptions, physical/ emotional actions, or reactions in others	There was a lot of confusion. They kept yelling at me. We started taking fire. An IED went off.
Perceptual	Auditory, olfactory, tactile, taste, and visual details, body position, duration	Maybe 1–2 h … I looked down. I could hear gunfire. I was losing consciousness.
Time	Year, season, month, day of week, time of day	It was September. 2006.
Place	Localization of an event including the city, street, building, room, part of room	(I saw a bullet hit) behind the vehicle. (I kind of collapsed) to the ground. (Something happened) outside. I was in the back right seat. I was in a Humvee.
Thought/ Emotion	Emotional state; thoughts	I was freaking out. I realised I may be hurt. We were excited. The first thought I had was that it was in the truck … .

Descriptions adapted from Levine et al., 2002.

Table 3. Definitions and Examples of Non-episodic Details.

Detail Type	Definition	Examples
General Semantics	Details not linked to a specific event that are not explicitly self-relevant	Mosul is 400 km away from Baghdad. He was a good kid. A medical striker is basically an ambulance.
Personal Semantics	Details not linked to a specific event that are personally or autobiographically relevant. This includes statements about personal roles, traits, facts about oneself, beliefs not linked to the episode, and facts about others that are described in relation to oneself.	I was the team leader. I was the funny one. I have 3 kids.
Other Episode	Details related to a specific event other than the central event described	We had just bolted down the armour three days before.
Extended Event	Description of generic or extended events (lasting >24 h or repeated) that contain some spatiotemporal information but do not refer to a singular episode	The guys in the front are usually on the radio. We were not getting much sleep at the time. After 6 months, we don't look anymore.
Metacognitive Statement	Characterization of one's own thought process or memory recall, editorialising	I honestly don't know how close it was. I remember about half of the blast. I'm not sure.
Repetition	Unsolicited repetition of details	

Descriptions adapted from Strikwerda-Brown et al., 2018.

non-episodic categories ranging from good to excellent (.84-.97). Reliability was excellent for episodic (1.0) and semantic prompts (.93).

Executive function

Participants completed a neuropsychological battery including measures of attention/executive functioning, verbal and visual memory, and motor ability (for more details, see Verfaellie et al., 2013). For purposes of the present study, we created a composite measure of executive function based on two measures of working memory (Digit Span Backwards, Consonant Trigrams) and one measure of inhibition (Stroop Interference minus Color Naming), domains thought to contribute to cognitive control processes. Age-corrected standardized scores were calculated. Scores for the two working memory tasks were averaged, and then an overall average was computed based on working memory and inhibition scores.

CAPS Avoidance

Total scores on the avoidance section (Criterion C) of the CAPS for DSM-IV were utilized to determine if self-reported symptoms of avoidance were associated with autobiographical memory. This scale includes seven questions that assess frequency and intensity of efforts to avoid thoughts or feelings about an event, avoidance of activities, people or places that serve as reminders of the event, decreased memory for the event, anhedonia, feelings of detachment from others, restricted affect, and sense of a foreshortened future. Because our goal was to explain variance in autobiographical memory, we omitted the two questions from the CAPS Avoidance Scale that specifically ask about autobiographical memory.

Statistical analyses

Group differences in demographic variables (age, education), clinical factors (whether or not the blast event resulted in mTBI, time since blast event), neuropsychological (inhibition, working memory)[1] and psychological measures (avoidance), and number of probes provided were examined with independent samples t-tests for continuous data and chi-square tests for categorical data.

Linear mixed-effects models were fit separately for episodic details and non-episodic details, with number of details log-transformed prior to analysis to account for non-normal distribution of the data. The models were fit with maximum likelihood estimation in the R statistical software (R Core Team, 2017), using the lme4 package (Bates et al., 2015). A model comparison approach was employed to select the best-fit model and determine the random effect structure. Models were compared using likelihood ratio tests, and models with significantly lower ($p < .05$) Akaike information criterion (AIC) values were chosen. If model AIC values were not significantly different, the simpler model was chosen. *P*-values and confidence intervals were calculated using the lmerTest package (Kuznetsova et al., 2017) and Satterthwaite's approximation for degrees of freedom (Littell et al., 1996).

Several factors were included as covariates in the mixed effects models. mTBI status was included due to differences between groups in the number of participants who incurred a mTBI and prior evidence that individuals with a history of mTBI generate more episodic details than those without mTBI (Palombo et al., 2015). Age and time since the event were considered due to evidence that episodic specificity decreases with each of these variables (Levine et al., 2002; St Jacques & Levine, 2007). Here, time since the blast event was related to non-episodic detail generation ($r = -.23$, $p = .04$), but not episodic detail generation ($r = -.09$, $p = .44$). Therefore, it was only included in the model examining non-episodic details. Finally, number of prompts given by the experimenter was included as a covariate. Prompts were classified as episodic, semantic, or other. Other prompts were rare (an average of .01 per interview) and not associated with detail generation (episodic: $r = .06$, $p = .59$; non-episodic: $r = .09$, $p = .44$). As such, they were excluded from further analyses. Episodic prompts were associated with episodic details ($r = .34$, $p = .002$) but not non-episodic

details (r = .10, p = .40), and semantic prompts were associated with non-episodic details (r = .25, p = .03) but not episodic details (r = .10, p = .36). Therefore, episodic prompts were included as a covariate when examining episodic details and semantic prompts when examining non-episodic details. Age and number of prompts were mean-centered prior to analysis.

Group and mTBI status were dummy-coded, with no PTSD and no mTBI serving as the reference levels. Detail type was also dummy-coded, with event details as the reference level for the episodic model and general semantic details for the non-episodic model. To evaluate the group effect for each detail type, the model included an interaction between group and detail type. The interaction between group and number of prompts was also included in the model.

To investigate the relationship between non-episodic detail generation and functional avoidance, a linear regression analysis was conducted across the entire sample. The model controlled for semantic prompts, age, and time since the blast. Independent variables were mean-centered prior to analysis. Following identification of a significant association between functional avoidance and non-episodic detail generation, a mediation analysis was conducted to examine whether the significant relationship identified between group and non-episodic details was mediated by functional avoidance. Direct and indirect effects were examined using the PROCESS macro for SPSS (Hayes, 2012), including number of semantic prompts, age, and time since the blast as covariates. Both non-episodic details and semantic prompts were log-transformed. Bootstrapping was used to estimate the sampling distribution (n=5,000) and 95% confidence intervals for the indirect effect. We hypothesised that functional avoidance would account for differences in the generation of non-episodic details according to group.

Because depression and PTSD are highly comorbid, depression was not included in the above models. However, given the known contribution of depression to overgeneral memory (Wilson & Gregory, 2018), follow-up analyses investigated the contribution of depression to episodic and non-episodic detail generation. Scores from the BDI-II were substituted for group in the final models of episodic and non-episodic detail generation described above.

Table 4. Number of episodic and non-episodic details generated by each group.

	No PTSD		PTSD	
	M	SD	M	SD
Episodic Details				
Event	58.59	30.50	79.44	41.50
Perceptual	12.35	7.60	15.96	8.31
Place	14.56	7.15	18.42	9.93
Thought/Emotion	6.29	5.56	8.40	6.86
Time	3.79	2.29	3.22	2.14
Non-Episodic Details				
General Semantic	4.12	3.86	9.33	8.24
Personal Semantic	1.47	2.51	2.29	2.41
Extended Event	2.09	2.08	3.40	3.00
Other Episode	0.79	1.10	1.24	1.87

Results

Prompts

Groups did not differ in the number of episodic (t(77) = −1.75, p = .084) and semantic prompts (t(77) = −.97, p = .336) provided. Both groups received more episodic (No PTSD M = 29.50, SD = 12.66; PTSD M = 34.64, SD = 13.15) than semantic prompts (No PTSD M = 0.56, SD = 0.93; PTSD M = 0.78, SD = 1.04).

Episodic details

An initial model was fit to include random intercepts for subject and detail type, and the following fixed effects: group, detail type, group x detail type, number of episodic prompts, group x number of episodic prompts, mTBI status, and age. The best-fit model for our data, on the basis of model comparisons using likelihood ratio tests, included a random intercept for subject and the following fixed effects: group, detail type, group x detail type, number of episodic prompts, and age. All other fixed and random effects failed to improve model fit and were therefore removed.

If anything, the PTSD group generated more episodic details than did the non-PTSD group, but neither the main effect of group nor the interaction between group and detail type was significant. Number of details generated significantly differed by detail type (see Tables 4 and 5). The most commonly provided detail type was event details, followed by place, perceptual, thought/emotion, and time.

Non-episodic details

An initial model was fit to include random intercepts for subject and detail type, and the following fixed effects: group, detail type, group x detail type, number of semantic prompts, group x number of semantic prompts, mTBI status, time since blast, and age. The best-fit model for our data, on the basis of model comparisons using likelihood ratio tests, included a random intercept for subject and the following fixed effects: group, detail type, number of semantic prompts, time since blast, and age. All other fixed and random effects failed to improve model fit and were therefore removed.

Group significantly predicted number of details generated, such that individuals in the PTSD group generated more details. Number of semantic prompts was also significant, such that participants who received more probes generated more details (see Tables 4 and 5). Time since blast was a significant predictor, such that individuals with a more recent blast occurrence generated more details. Age significantly predicted number of details, such that older

Table 5. Models examining the effects of PTSD group and detail type on episodic and non-episodic detail generation.

Model 1. Episodic Details				
	Unstandardized Coefficients	t	*p*-value	95% CI
Intercept	3.95	41.25	<.001	[3.76, 4.14]
Age	0.02	3.15	.002	[0.01, 0.03]
Episodic Prompts	0.01	3.97	<.001	[0.01, 0.02]
PTSD Group	0.25	1.92	.056	[−0.01, 0.50]
Detail Type – Perceptual	−1.63	−14.45	<.001	[−1.85, −1.41]
Detail Type – Place	−1.36	−12.08	<.001	[−1.59, −1.14]
Detail Type – Time	−2.47	−21.90	<.001	[−2.70, −2.25]
Detail Type – Thought/Emotion	−2.21	−19.56	<.001	[−2.43, −1.99]
Group x Perceptual Details	0.02	0.11	.913	[−0.28, 0.31]
Group x Place Details	−0.09	−0.59	.559	[−0.38, 0.21]
Group x Time Details	−0.46	−3.04	.003	[−0.75, −0.16]
Group x Thought/Emotion Details	−0.03	−0.20	.840	[−0.32, 0.26]
Model 2. Non-Episodic Details				
Intercept	1.52	15.69	<.001	[1.33, 1.71]
Age	0.03	3.59	<.001	[0.01, 0.05]
Time Since Blast	−.004	−2.18	.032	[−0.01, 0.00]
Semantic Prompts	0.14	2.66	.009	[0.04, 0.24]
PTSD Group	0.33	3.19	.002	[0.12, 0.53]
Detail Type – Other Episode	−1.19	−12.51	<.001	[−1.38, −1.00]
Detail Type – Extended Event	−0.61	−6.38	<.001	[−0.80, −0.42]
Detail Type – Personal Semantic	−0.90	−9.47	<.001	[−1.09, −0.71]

participants generated more details than younger participants. The average number of details generated significantly differed by detail type. The most commonly provided detail type was general semantic, followed by extended event, personal semantic, and other episode.

Executive functions

As can be seen in Table 1, there were no group differences in the executive functions composite nor in either of the subdomains assessed.[2]

Avoidance

As expected, self-reported symptoms of avoidance were higher in the PTSD group than in the no PTSD group (see Table 1). There was a significant positive association between avoidance and non-episodic detail generation across groups (see Table 6). Given these associations, we conducted a follow-up analysis to examine whether avoidance mediates the relationship between group and non-episodic detail generation. In Step 1 of the mediation model, the regression of group on non-episodic details, ignoring the mediator, was significant (B = .49, SE = .17, t(74) = 2.82, p = .006; 95% CI [.14, .83]). Step 2 showed that the regression of group on the mediator, avoidance, was also significant (B = 19.87, SE = 1.71, t(74) = 11.64, p < .001; 95% CI [16.47, 23.28]). Step 3 of the mediation process showed that the regression of the mediator (avoidance) on non-episodic details, controlling for PTSD group, was not significant (B = −.004, SE = .01, t(73) = −.34, p = .738; 95% CI [-.03,.02]). Therefore, avoidance did not mediate the effect of group on non-episodic detail generation.

Table 6. Regression model measuring the relationship between non-episodic detail generation and functional avoidance.

	β	t	*p*-value	95% CI
Semantic Prompts	.26	2.46	.016	[0.04, 0.40]
Age	.28	2.43	.017	[0.01, 0.07]
Time Since Blast	−.24	−2.16	.034	[−0.01, 0.00]
CAPS Avoidance	.22	2.07	.042	[0.001, 0.03]

Post hoc analysis of depression

Depression was not significantly associated with total number of episodic details (β = −0.004, t(285.3) = −0.72, p = 0.473; 95% CI [−0.02, 0.01]), and there was no interaction between depression and episodic detail type (p-values > 0.05). Similarly, depression was not significantly associated with number of non-episodic details (β = 0.001, t(79) = 0.13, p = 0.899; 95% CI [−0.01, 0.01]) and there was no interaction between depression and non-episodic detail type (p-values > 0.05). Thus, effects of PTSD were not simply due to co-morbid depression.

Discussion

The notion that autobiographical memory in PTSD is overgeneral stems primarily from studies that pose a heavy demand on event construction – the ability to search for and identify a specific autobiographical event. The present study sought to determine whether PTSD also impacts the ability to elaborate on a specified event, as reflected in the description of the key players, actions, perceptual and emotional aspects of an event. To do so, we utilized an autobiographical interview that minimized demands on event construction and assessed the nature and number of narrative details provided by participants when describing a specific stressful negative event. Replicating McKinnon and colleagues (2015), the most notable finding was the greater generation of details external to

the event, including repeated or extended events, general knowledge, and personal facts, by participants with PTSD compared to those without PTSD. Despite the high comorbidity between PTSD and depression, these findings were specific to PTSD. Further, as in McKinnon et al. (2015), the PTSD group generated an equivalent number of episodic details as their no PTSD counterparts. Together, our findings suggest that PTSD impacts the elaboration of an autobiographical event through the incorporation of details not specific to the described event rather than through omission of event-specific details.

Our finding that individuals with PTSD demonstrate intact episodic detail generation, taken together with the well-established finding of overgeneral event construction (Brown et al., 2013; Bryant et al., 2007; McNally et al., 1995; Moradi et al., 2012; Sutherland & Bryant, 2007), suggests that the processes that support event construction and event elaboration are differentially affected in individuals with PTSD. Consistent with this notion, evidence suggests that distinct neural networks support these processes. Whereas event construction relies on interactions between frontal and anterior hippocampal brain regions, event elaboration is thought to be mediated by a distributed posterior hippocampal-visual perceptual network (McCormick et al., 2015). PTSD is most consistently associated with hypoactivity in ventromedial and inferior frontal regions (Hayes, 2012) as well as reduced functional and structural connectivity in the anterior hippocampus (Abdallah et al., 2017). Examining neural responses during the retrieval of autobiographical memories, St. Jacques and colleagues (2011) found that PTSD was associated with increased activation of ventromedial prefrontal cortex during the retrieval of intensely negative events, and increased activation in the amygdala and hippocampus was observed specifically during the initial construction phase associated with bringing to mind negative events. Thus, PTSD-related structural and functional brain abnormalities may disproportionately impact a frontal-hippocampal network subserving event construction, with lesser disruption of the network supporting event elaboration (but see St. Jacques et al., 2013).

Despite equivalent generation of event-specific details, recall of the blast event differed qualitatively across groups in that individuals with PTSD incorporated additional non-episodic details in their event description. The incorporation of generic information not directly tied to the event could also yield memories that appear reduced in episodic specificity, albeit due to a decrease in the ratio of episodic to non-episodic details rather than a lack of episodic details per se. There was no evidence that the greater generation of non-episodic details in the PTSD group compared to the no-PTSD group was linked to either functional avoidance or executive dysfunction – processes postulated by the CaRFAX model to mediate overgeneral event construction (Williams et al., 2007). Functional avoidance was associated with non-episodic detail generation in all participants, regardless of PTSD diagnosis. Although the blast event was not in itself a traumatic event, as part of war-zone experience it may share similarities with trauma experienced during deployment. Reminders of the emotional state and the perceptual and spatiotemporal surroundings of military combat may elicit involuntary memory of traumatic events that participants experienced. Therefore, avoidance strategies utilized to suppress negative emotions related to traumatic events may be applied more widely in trauma-exposed individuals (regardless of whether they develop PTSD) when autobiographical recall involves thematically related negative events. This interpretation needs to be treated with caution, however, as our sample size may have been too small to obtain a stable correlation that converges to the population value (Schönbrodt & Perugini, 2013). Additionally, we did not collect information about the degree to which recall of the blast event elicited memories of traumatic events or the degree of similarity between the blast event and participants' experienced traumas. As such, it is not possible to quantify how thematic or perceptual similarity between the blast event and a participant's trauma history may contribute to the generation of non-episodic details. This issue will be important for future studies to examine.

We found no evidence that executive functions were associated with PTSD in our sample, or with the generation of non-episodic details. However, it is possible that standard neuropsychological measures of executive function are not sufficiently sensitive because they pose no demands on emotional processing. Prior research suggests that executive functions may be disrupted in PTSD particularly when recruited in contexts that require processing of emotional information (Morey et al., 2009; Schweizer & Dalgleish, 2016). For example, individuals with PTSD exhibit greater interference on inhibitory control tasks when stimuli include combat-related words (Ashley et al., 2013) and are less capable of suppressing aversive memories than trauma-exposed controls (Catarino et al., 2015; Schweizer & Dalgleish, 2016). Thus, it remains possible that individuals with PTSD generate more abstract and factual details during recall of a stressful negative event to avoid bringing to mind information that may trigger recall of prior trauma. Support for a contribution of suppression deficits to autobiographical memory impairment in PTSD stems from a study by Schönfeld and colleagues (Schönfeld et al., 2007), in which participants performed a standard autobiographical memory test under instructions to either suppress or not suppress their trauma memory. Participants with PTSD generated fewer and more general memories than trauma-exposed controls under suppression instructions, but not when suppression was not required. Given that autobiographical memories were cued by single words, this study posed high demands on event construction. Nonetheless, it is possible that a similar mechanism might be responsible for the generation of excessive non-episodic details during event elaboration.

An alternative explanation for increased non-episodic detail generation in PTSD is that the incorporation of information from negative events into pre-existing schemas of the self, others, and society results in increased semanticization of negative memories. Indeed, greater PTSD symptomology is associated with greater self-reported importance of emotional events (Niziurski et al., 2018), increasing the likelihood that these events and the meaning attached to one's actions, thoughts/emotions, or role in these events are incorporated into the self-schema. According to the trace transformation hypothesis (Winocur & Moscovitch, 2011), detailed episodic memories and gist-like semanticized versions of these memories, which draw more strongly on schematised information can co-exist and interact depending on the situation. Individuals with PTSD may more flexibly shift between retrieval "modes," incorporating information from detailed episodic traces and gist-like semantic reprsesentations during event recall. The current study identified avoidance as one factor associated with increased non-episodic detail generation; however, other psychological and biological (e.g., age) factors likely impact one's tendency to draw from semantic versus episodic representations of events, an issue that warrants future investigation.

Given the association between the specificity of autobiographical memory and prognosis for recovery across emotional disorders (Moradi et al., 2014; Sumner et al., 2010; McBride et al., 2007), our findings have potentially important clinical implications. Memory Specificity Training has been shown to be an effective technique to increase elicitation of a specific memory during event construction and to reduce PTSD symptoms (Moradi et al., 2014). Similar therapeutic and psycho-educational approaches may be useful for increasing the ratio of episodic to non-episodic details during event elaboration. Because the PTSD group generated more non-episodic details during recall, memory training could incorporate psycho-education on the plausible role of non-episodic details as an avoidance mechanism, and assign exercises focused on reducing the generation of semantic abstractions and metacognitive statements during autobiographical recall.

We observed equivalent episodic detail generation across groups in the context of extensive prompting by the examiner for additional information, but it is possible that the PTSD group would have generated fewer episodic details in the absence of such prompts. It will be important for future studies to directly examine how prompts affect the performance of individuals with PTSD. If prompts prove necessary for the elicitation of richly detailed memories, memory training could involve techniques for self-generated prompting. For example, participants could be provided with a mnemonic to remember the various types of detail that they should consider when recalling a memory.

Notably, autobiographical memory is also directly linked to the ability to imagine the future (Brown et al., 2014; Race et al., 2011), and greater episodic specificity of past and future thinking is associated with enhanced problem-solving (Brown et al., 2012; Zlomuzica et al., 2018), social reasoning (Sutherland & Bryant, 2008), and the ability to update representations of the self (Prebble et al., 2013). Our study focused exclusively on memory for a stressful negative event, but McKinnon and colleagues (2015) obtained similar results when eliciting recall of a negative and a neutral event. Our results, in combination with theirs, are promising indications that when prompted to elaborate on an event, individuals with PTSD may be able to imagine future events that are as episodically rich as those of trauma-exposed controls.

Conclusion

Our findings suggest that individuals with PTSD retain the ability to elaborate on their memory of a stressful negative event with equally rich perceptual, spatiotemporal, and emotional detail as individuals without PTSD. However, their recall was characterised by greater incorporation of non-episodic details, including semantic information and information about extended or general events – features that may contribute to the impression that recall of personal events lacks specificity in PTSD even when demands on event construction are minimized. Regardless of PTSD status, the production of non-episodic details was associated with greater self-reported avoidance, possibly indicating that greater generation of abstract and factual information serves to suppress the negative emotions elicited by specific event details. Incorporation of non-episodic details was not associated with traditional measures of working memory and inhibitory control. However, consideration of the affective context in which executive processes are deployed warrants further attention. Similarly, whereas our study incorporated extensive prompts to elicit as much detail as possible, future studies will need to assess how retrieval format impacts the narrative style, quantity, and type of details generated by individuals with PTSD during event elaboration.

Notes

1. One participant without PTSD, who was missing data on the inhibition measure, was excluded from analyses of executive functioning. For one participant with PTSD, the executive composite included data for only one of the two working memory tasks.
2. To further assess support for the null hypothesis, Bayesian analyses were performed using default priors. There was substantial evidence in favour of the null hypothesis for the executive composite (BF_{01} = 5.13), as well as for the subdomains of working memory (BF_{01} = 5.14) and inhibition (BF_{01} = 3.04).

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Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

Data that support the findings of this study are available on the Open Science Framework at https://osf.io/eb9um/?view_only=a0200efd34dd40d08764c84144a00d70

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