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Future Thinking in PTSD: Preliminary Evidence for Altered Event Construction

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Abstract

Using a future event fluency task, the current study sought to examine future event construction in PTSD and to identify clinical profiles associated with altered event construction. Thirty-eight trauma exposed war-zone veterans with (n=25) and without (n=13) PTSD generated within one minute as many positive and negative future events as possible in the near and distant future. The PTSD group generated fewer specific, but not generic, events than the no-PTSD group, a difference that was amplified for positive events as a result of comorbid depression. Clinical correlates of event construction varied as a function of event valence.

Keywords: future event fluency; future event generation

1. INTRODUCTION

Extending findings from memory research (Ono and Devilly, 2016), recent studies have demonstrated PTSD-associated alterations in future thinking. Future events generated in response to cue words are overgeneral (Brown et al., 2013; Kleim et al., 2014), containing fewer event-specific details in individuals with PTSD (Brown et al., 2014; Verfaellie et al., 2023). Imagining in detail a future event entails (1) event construction (i.e., the initial search for and specification of an event) and (2) event elaboration (i.e., subsequently filling in the event with details) (Addis et al., 2007). Prior research suggests PTSD-associated abnormalities in elaborating future events, but little is known about event construction and PTSD. Understanding future thinking in PTSD more comprehensively is important, as anticipation of future events helps shape one's outlook towards the future.

We examined future event construction in PTSD using a future event fluency task (MacLeod and Byrne, 1996) previously administered to other clinical populations (MacLeod and O'Connor, 2018). Participants generate in one minute as many future positive and negative events as possible that may happen in different time periods. We considered separately the number of specific (i.e., unique) and generic (i.e., recurrent or ongoing) events generated, assuming that overgenerality would be reflected in a paucity of specific events.

Because PTSD is associated with difficulty retrieving specific positive memories (Harvey et al, 1998), we reasoned individuals with PTSD might also have difficulty imagining specific future positive events. Additionally, because dysphoric symptoms - a component of PTSD - are associated with reduced generation of positive future events (MacLeod and O'Connor, 2018), we predicted that future event fluency would be more reduced for positive than negative events. We predicted that both PTSD and no-PTSD groups would generate fewer specific events for the distant versus proximal future, because the distant future is construed more abstractly (Trope and Liberman, 2010).

We additionally examined relations between specific event generation and PTSD symptom profiles. Given that thought suppression as an emotion regulation strategy is related to avoidance symptoms (Seligowski et al., 2016), we predicted an inverse relation between avoidance and specific event construction. Because avoidance in PTSD concerns positive and negative emotions (Roemer et al., 2001), we predicted associations between avoidance and the generation of positive and negative specific future events. By contrast, because depression has been associated specifically with generating positive future events (MacLeod and O'Connor, 2018), we predicted that depression symptoms and PTSD symptoms categorized taxonomically as “negative alterations in cognition and mood” (NACM) would be inversely associated only with specific positive event generation.

2. METHOD

2.1. Participants

Participants were 38 trauma-exposed U.S. military veterans (n=25 with current PTSD; n=13 without history of PTSD or other mental disorders), recruited from a larger study of future thinking in PTSD (Verfaellie et al., 2023). Exclusion criteria were lifetime history of psychotic disorder, bipolar I disorder, and obsessive-compulsive disorder; substance use disorder, past 3 months; active suicidal ideation; and major neurological disorders (e.g., moderate/severe traumatic brain injury).

All participants provided informed consent. The study was approved by the research oversight committees at Veterans Affairs Boston Healthcare System. Effect sizes of d = 1.17 (MacLeod et al., 1997) and 2.46 (MacLeod and Salaminiou, 2001) in studies examining future event fluency in depression informed sample size. We used a 2:1 allocation ratio for the PTSD vs. no-PTSD group based on prior enrollment experience. Power calculations (Champely, 2020) indicated that 30 participants (20 and 10, respectively) would achieve 80% power to detect an effect size of d = 1 with $\alpha = .05$ (one-tailed).

2.2. Instruments

PTSD/PTSD symptoms were assessed by a clinical psychologist using the Clinician Administered PTSD Scale for DSM-5, (CAPS-5; Weathers et al., 2018) and showed excellent inter-rater reliability (Cronbach’s α for total and symptom cluster scores all >.93). Exclusion criteria were assessed using the Structured Clinical Interview for DSM-5, research version (First et al., 2016), the Boston Assessment of Traumatic Brain Injury-Lifetime (Fortier et al., 2014), and a health survey confirmed by chart review. Depression severity was measured by the Beck Depression Inventory-II (BDI-II; Beck et al., 1996).

The future event fluency task required participants to generate possible future positive and negative events they might experience one month and 10 years into the future. Excluding repetitions, events were scored as specific or generic (see Supplementary Materials for examples). Participants also performed a phonemic verbal fluency test not involving future thinking (Delis et al., 2001).

2.3. Procedure

Early study participants (n=29) were tested in person. Due to Covid-19 precautions, later participants (n=9) engaged via videoconferencing.

2.4. Analytic Approach

Associations between PTSD and number of specific or generic future events were examined using linear mixed models including group (PTSD, no PTSD), valence (positive, negative), time (1 month, 10 years) and their interactions as fixed effects and participant as a random factor. Phonemic fluency scores and demographic variables were included as covariates. A secondary analysis excluded participants with comorbid depressive disorders. The relationship between clinical symptoms and events generated was examined separately for positive and negative events using partial least squares (PLS) correlation analyses. (See Supplementary Materials.)

3. RESULTS

Sample descriptives are provided in Supplementary Table 1.

For *specific* events, there was a significant effect of time, with more events generated for the close vs. distant future, and a significant group x valence interaction, indicating fewer events generated in the PTSD vs. no-PTSD group for positive vs. negative events (Figure 1). After excluding participants with comorbid depression, only main effects of group and valence remained significant. For *generic* events, only the effect of time was significant, indicating more events for the distant vs. close future across groups. (Supplementary Table 2.)

PLS analysis for specific *positive* events revealed one significant latent variable, indicating that all CAPS cluster scores and BDI-II scores were inversely associated with positive events generated at 1 month and 10 years. PLS analysis for specific *negative* events revealed one significant latent variable, indicating that CAPS intrusion and avoidance scores were inversely associated with generation of negative events at the 10-year timepoint. (Supplementary Figure 1).

4. DISCUSSION

PTSD was associated with construction of fewer specific (but not generic) future events, regardless of temporal distance. This association was greater for positive than negative events, an effect driven in part by comorbid depression. PTSD avoidance and intrusion symptoms were inversely associated with generation of positive and negative specific events, but NACM, arousal, and depression symptom scores were inversely related only to generation of positive events.

Future thinking abnormalities in PTSD thus are not limited to elaborating events but also concern how events are initially constructed. Construction of future events requires hierarchical access to knowledge at different levels of specificity (Conway et al., 2019; D'Argembeau and Mathy, 2011). That alterations in event anticipation were limited to specific events suggests that PTSD is associated with selective difficulty forming representations of unique future events, a mechanism likely affecting both the initial construction and subsequent elaboration of future events.

Individuals with PTSD were more deficient in constructing specific positive versus negative events. Even without comorbid depression, PTSD NACM symptoms include dysphoric symptoms. Accordingly, both PTSD NACM and depressive symptoms were correlated with the construction of specific positive future events, consistent with findings in depression (MacLeod and Salaminiou, 2001; MacLeod et al., 1998) and dysphoric mood (Kosnes et al., 2013). The basis of the association between fewer specific positive future events and more severe arousal symptoms in our study is less clear, but hypervigilance to threat, reflected in PTSD arousal symptoms, may interfere with anticipation of enjoyable experiences.

Avoidance was inversely related to positive and negative specific event generation. Positive, like negative, memories can trigger trauma related thoughts and feelings (Contractor et al., 2018); so may imagined future events. Therefore, anticipation of positive and negative events may be curtailed to regulate potential emotional distress (Williams et al., 2007). The inverse association between intrusion symptom severity and event generation may reflect that intrusions and trauma reminders anchor individuals in the past, reducing anticipation of the future.

Difficulty constructing future events in PTSD holds implications for emotional wellbeing (MacLeod, 2017). The pursuit of goals depends on the ability to imagine and evaluate possible future events and organize actions accordingly, whether in planning for envisioned opportunities or preparing for anticipated threats (Miloyan et al., 2014). Reduced anticipation of future positive events appears detrimental to positive affect (Grant and Wilson, 2021; Quoidbach et al., 2009). Reduced generation of future negative events may interfere with regulation of emotions, as envisioning future negative events allows for “antecedent-focused” strategies (Gross, 1998) that help regulate emotions (e.g., approaching or avoiding contexts that influence emotions; tailoring situations to optimize emotional response to aversive or threatening situations).

Our findings require replication in a larger sample more diverse demographically and in trauma type. Inclusion of individuals diagnosed with past but not current PTSD would help determine if alterations in future event construction depend on current symptomatology. Limitations notwithstanding, the current findings hold clinical relevance given that constructing future event representations has implications for how individuals with PTSD think about and prepare for the future.

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CONFLICT OF INTEREST

None of the authors have any conflicts of interest to disclose.

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FIGURE CAPTIONS

Figure 1: Mean number of specific events generated, broken down by group and valence

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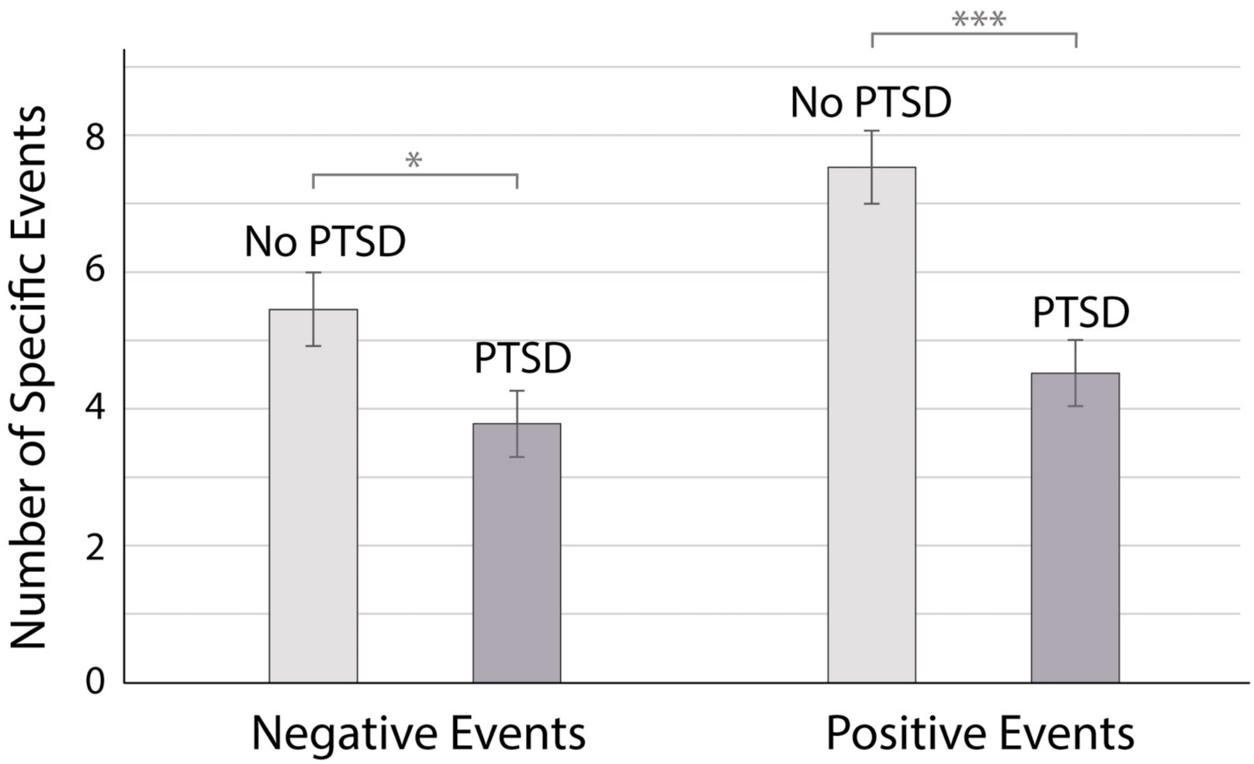
Figure 1



Note. The mean estimates were calculated using linear mixed modeling, with model comprising fixed effects for group, valence, and time. The error bars represent the 95% confidence interval of the estimates.

Supplementary Materials

METHODS

Scoring of future event fluency task. We excluded exact repetitions and semantic repetitions (i.e., events generated in immediate succession that differed only in the subject of the event). Acceptable events were scored as specific (i.e., unique, time-limited events) or generic (i.e., recurrent events or temporally extended states). Scoring by two independent raters of each event from 35% of participants yielded high agreement ($\kappa = .82$). Examples of specific events include: I visit with my nephew; We find ourselves unable to make a mortgage payment; I win a writing contest that I entered; Examples of generic events include: We are unable to have children; Having more money at work; I can't keep up with the workload.

Analytic Approach. Linear mixed modeling analyses used the R-package lme4 (Bates et al., 2014). Model comparisons were evaluated using Akaike's Information Criterion (AIC; Akaike, 1974), the Bayesian Information Criterion (BIC; Schwarz, 1978), the amount of variance explained by the fixed effects (marginal R^2, Nakagawa and Schielzeth, 2013), and a Likelihood Ratio Test with χ^2-distribution.

Partial least squares correlation (PLS-C) is a multivariate technique that assesses the relationships between two sets of variables (matrices x and y) by modeling their covariance with latent variables (Krishnan et al., 2011). PLS-Cs were run using the tepPLS function in the R-package TexPosition (Beaton et al., 2013). The x-matrix consisted of scores on the CAPS-5 symptom clusters and BDI-II. The y-matrix consisted of the number of specific events generated 1 month and 10 years in the future, with one PLS considering positive and the other negative events. Significance levels for the omnibus inertia (total amount of cross-covariance) and eigenvalues of the covariance matrix were determined with a permutation test (6000 iterations), using perm4PLSC in R-package data4PCCAR (Abdi and Beaton, in press). P-values were calculated as the probability that the permutated values exceeded the observed values and were considered significant if $< .05$. For each significant latent variable, contributions of the x and y measures were assessed by examining their saliences. Salience reliabilities were calculated as the ratios of salience to bootstrap standard errors, using bootstrapping function Boot4PLSC (Abdi and Beaton, in press) with 10,000 samples with replacement. Akin to z-scores, a salience was considered reliable if ≥ 2 (Krishnan et al., 2011).

RESULTS

Supplementary Table 1. *Sample Characteristics*

Characteristic	Overall N = 38			PTSD n=25			No PTSD N=13			Test statistics
	No. or *M*	% or *(SD)*	Range	No. or *M*	% or *(SD)*	Range	No. or *M*	% or *(SD)*	Range	
Gender, no.										$\chi^2(1)$ = 0.01, p = .926
Females	7	18%		4	16%		3	23%		
Males	31	82%		21	84%		10	77%		
Age, y	38.9	9.0	27-60	39.1	(9.5)	27-60	38.5	(8.3)	27-55	*t(27.4)* = 0.19, *p* = .847
Education, y	15.3	2.3	10-20	14.7*	(2.4)	10-20	16.5	(1.5)	13-19	*t(34.3)* = -2.83, *p* = .008
Race/Ethnicity, no.										
White	29	76%		18	72%		11	85%		
Latino	6	16%		5	20%		1	8%		
Asian	1	3%		1	4%		0	0%		
Black	1	3%		1	4%		0	0%		
Multiracial	1	3%		0	0%		1	0%		
PTSD Assessment Criterion A Traumatic Event, no.										
Combat related	25	66%		18	72%		7	54%		
Sexual assault	2	5%		2	8%		0	0%		
Physical assault	1	3%		1	4%		0	0%		
Fire	3	8%		1	4%		2	15%		
Transportation accident	2	5%		0	0%		2	15%		
Sudden violent death	2	5%		2	8%		0	0%		
Severe human suffering	2	5%		1	4%		1	8%		
Serious accident	1	3%		0	0%		1	8%		
CAPS-5 total score, *M*	24.3	(18.4)	0-63	36.0***	(10.1)	21-63	1.9	(3.1)	0-11	*t(31.5)* = 15.47, *p* < .001
Intrusions score, *M*	6.4	(4.9)	0-17	9.3***	(3.2)	4-17	0.7	(1.2)	*0-4*	*t(33.5)* = 11.93, *p* < .001
Avoidance score, *M*	3	(2.5)	0-7	4.5***	(1.6)	2-7	0.2	(0.4)	*0-1*	*t(28.7)* = 12.78, *p* < .001
NACM score, *M*	7.7	(6.8)	0-24	11.6***	(5.0)	4-24	0.2	(0.6)	*0-2*	*t(25.1)* = 11.25, *p* < .001
Arousal score, *M*	7.3	(5.5)	0-17	10.6***	(3.5)	4-17	0.9	(1.6)	*0-5*	*t(35.6)* = 11.94, *p* < .001
Clinical Assessments										
DSM-5 Depressive disorders, no.	9	24%		9	36%		0	0%		
DSM-5 Anxiety disorders, no.	10	26%		10	40%		0	0%		
Psychotropic medication, no.	14	37%		12	48%		2	15%		
BDI-II score, *M*	16.2	(11.2)		21.8***	(8.7)		5.4	(6.7)		*t(30.6)* = 6.50, *p* < .001

For specific events, the model that included group, valence, time, and group x valence (*AIC* = 697.9, *BIC* = 731.2, R^2 *marginal* = 0.364) yielded significantly better fit ($\chi^2(1)$ = 4.18, *p* = .041) than the model without the interaction (*AIC* = 700.1, *BIC* = 730.3, R^2 *marginal* = 0.353). Follow up analyses of the group x valence interaction showed that for positive events the model including group (*AIC* = 365.2, *BIC* = 386.2, R^2 *marginal* = = 0.435) provided better fit ($\chi^2(1)$ = 14.28, *p* = .001) than that without group (*AIC* = 377.5, *BIC* = 396.1, R^2 *marginal* = 0.258) and the effect of group was significant (*β* =-2.98, SE = 0.72, t(38) = -4.16, p < 0.001). Likewise, for negative events, the model including group (*AIC* = 360.3, *BIC* = 381.3, R^2 *marginal* = 0.258) provided better fit ($\chi^2(1)$ = 5.53, *p* = .019) than that without group (*AIC* = 363.9, *BIC* = 382.5, R^2 *marginal* = 0.178) and the effect of group was significant (*β* =-1.70, SE = 0.70, t(38) = -2.44, p = 0.019). The amount of variance explained by group for positive events had a larger effect size (ΔR^2 *marginal = 0.177*) than for negative events (ΔR^2 *marginal = 0.080*). A model that additionally included group x cue time (*AIC* = 699.8, *BIC* = 736.1, R^2 *marginal* = 0.364) did not improve model fit ($\chi^2(1)$ = 0.07, *p* = .796). Excluding participants with comorbid depression, the model that included group, valence and time (*AIC* = 594.2, *BIC* = 576.7, R^2 *marginal* = 0.395), yielded significantly better fit ($\chi^2(1)$ = 9.27, *p* = .002) than the model without group (*AIC* = 556.5, *BIC* = 581.3, R^2 *marginal* = 0.231); the model that included the group x valence interaction (*AIC* = 549.2, *BIC* = 576.7, R^2 *marginal* = 0. 400) did not provide better fit ($\chi^2(1)$ = 1.62, *p* = .203).

For generic events, the model that included group in addition to valence and time (*AIC* = 643.4, *BIC* = 673.6, R^2 *marginal* = 0.107) did not provide better fit ($\chi^2(1)$ = 0.40, *p* = .526) than the model without group (*AIC* = 641.8, *BIC* = 669.0, R^2 *marginal* = 0.102) and the effect of group was not significant (*β* = 0.38, SE = 0.59, t(38) = 0.64, p = 0.529). Models incorporating interactions with group did not enhance model fit. Coefficient estimates for models described above are in Supplementary Table 2.

Supplementary Table 2. *Coefficient estimates from linear mixed models examining associations between the generation of future events and PTSD diagnosis, valence, and time, with age, gender, ethnicity, and FAS fluency as covariates*

2a. specific future events

Sample	Model	Coefficient	Std.err.	t value	p
All participants N = 38	(Intercept)	1.29	2.03	0.63	0.530
	Age	0.06	0.03	1.80	0.080
	Gender	-0.99	0.79	-1.25	0.218
	Ethnicity	0.71	0.72	0.98	0.331
	FAS fluency	0.04	0.02	1.70	0.098
	Valence	2.08	0.53	3.95	< 0.001
	Time	1.20	0.31	3.89	< 0.001
	Group	-1.67	0.72	-2.31	0.025
	Valence * Group	-1.34	.65	-2.06	0.041
Excluding co-morbid depression N = 29	(Intercept)	0.98	2.45	0.40	0.692
	Age	0.04	0.04	0.86	0.397
	Gender	-0.58	1.01	-0.58	0.566
	Ethnicity	1.85	1.01	1.83	0.078
	FAS fluency	0.04	0.03	1.36	0.186
	Valence	2.08	0.55	3.76	< 0.001
	Time	1.31	0.37	3.51	< 0.001
	Group	-2.00	0.84	-2.39	0.021
	Valence * Group	-0.95	0.74	-1.28	0.204

2b. Generic future events

Sample	Model	Coefficient	Std.err.	t value	p
All participants N = 38	(Intercept)	2.65	1.84	1.44	0.158
	Age	-0.02	0.03	-0.54	0.595
	Gender	0.18	0.72	0.25	0.806
	Ethnicity	0.70	0.66	1.07	0.292
	FAS fluency	0.01	0.02	0.53	0.601
	Cue Valence	0.00	0.25	0.00	1.000
	Cue Time	-1.26	0.25	-5.02	< 0.001
	Group	0.38	0.59	0.64	0.529

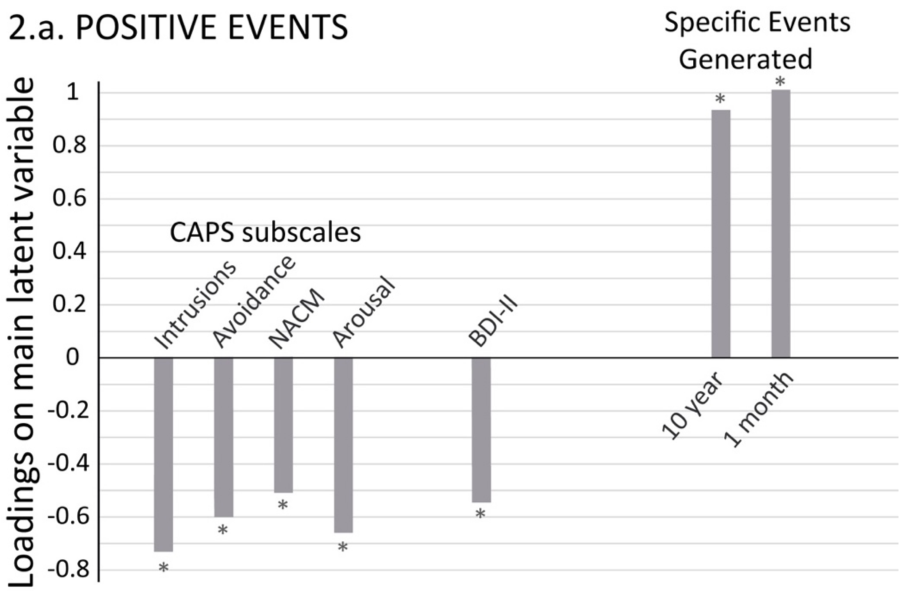
Note. Binary variables were coded as follows: Gender (1 = male, 0 = female), Ethnicity (1 = White, 0 = Other), Cue Valence (1 = Positive, 0 = Negative), Cue Time (1=one month, 0 = 10 years), and Group (1 = PTSD, 0 = No PTSD).

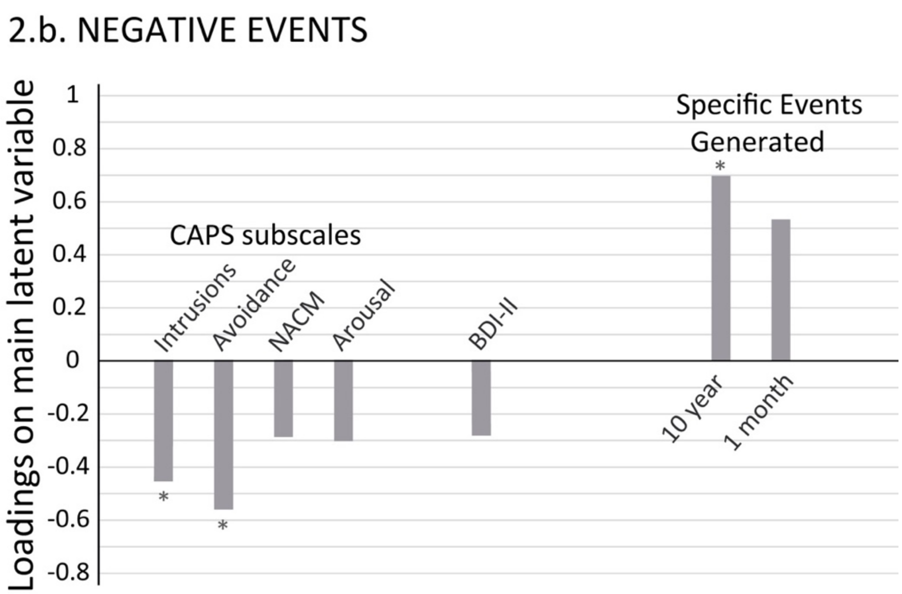
The PLS-correlation examining relations between number of specific *positive* events and CAPS-5 subscale and BDI-II scores revealed a significant overall association among the variables (inertia = 1.90, p

$< .001$). One latent variable was significant (eigenvalue = 1.89, $p < .001$) and accounted for 99.5% of the covariance. The PLS-correlation examining relations between number of specific *negative* events and scores on the CAPS-5 subscales and BDI-II revealed a significant overall association among the variables (inertia = 0.84, $p < .001$). One latent variable was significant (eigenvalue = 0.77, $p < .001$) and accounted for 91.4 % of the variance. Loadings on the primary latent variable of the number of specific future events categorized by time (y-measures) and of the CAPS subscale and BDI-II scores (x-measures) are illustrated in Supplementary Figure 1.

Supplementary Figure 1.

Loadings on the PLS primary latent variable of the number of specific positive (2.a.) and negative (2.b.) future events categorized by time (y-measures) and of the CAPS subscale and BDI-II scores (x-measures)





Note. NACM = Negative Alterations in Cognition and Mood; BDI-II = Beck Depression Inventory-II. Asterisks indicate measures that were deemed reliable contributors to the primary latent variable (salience to standard error ratios z ≥ 2.0).

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