



Posttraumatic Stress Symptoms and its Association with Rumination, Thought Suppression and Experiential Avoidance: a Systematic Review and Meta-Analysis

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Abstract

Posttraumatic stress disorder (PTSD) is a severe mental disorder causing high individual and societal costs. The use of maladaptive emotion regulation (ER) strategies has been identified as a potential contributing factor. This meta-analysis aimed to quantify the associations between PTSD symptoms and rumination, thought suppression and experiential avoidance. The systematic literature search resulted in 5574 studies, 75 of which were included in the analysis. From those eligible studies 189 effect sizes were obtained. For symptoms of posttraumatic stress, large effects were found for associations with rumination ($r = .52$) and experiential avoidance ($r = .48$), whereas a medium effect size was found for thought suppression ($r = .29$). With respect to different PTSD symptom clusters, associations ranged between $r = .35$ and $r = .41$ for associations with intrusive re-experiencing, between $r = .39$ and $r = .41$ for associations with avoidance, between $r = .50$ and $r = .53$ for associations with alterations in cognitions and mood and between $r = .41$ and $r = .45$ for associations with alterations in arousal and activity. Few available studies provide some evidence that associations might be somewhat reduced but still substantial in longitudinal compared to cross-sectional studies. These findings provide valuable targets for future investigations with the long-term goal of improving targeted interventions for the prevention and treatment of PTSD symptoms.

Keywords Posttraumatic stress disorder · Emotion regulation · Rumination · Thought suppression · Experiential avoidance

Introduction

Posttraumatic Stress Disorder (PTSD) is a severe and impairing mental disorder encompassing four symptom clusters: intrusive re-experiencing, avoidance, negative alterations in cognition and mood and alterations in arousal and activity. The global lifetime prevalence of PTSD is 3.9%, with half of all individuals with PTSD experiencing persistent symptoms (Koenen et al., 2017). PTSD is associated with high levels of disability including impaired social functioning, work loss and impaired mental and physical quality of life (Alonso et al., 2004; McFarlane, 2010). Thus, it is important to identify factors associated with posttraumatic stress in

order to develop and improve early interventions for individuals with PTSD.

An important mechanism that has been linked to the development of posttraumatic stress symptoms is the concept of emotion regulation (ER). ER can be conceptualized as a multidimensional construct involving the awareness, understanding, and acceptance of emotions; ability to control impulsive behaviors and engage in goal-directed behaviors when experiencing negative emotions; flexible use of strategies to modulate the intensity and duration of emotional responses to meet individual goals and situational demands; and willingness to experience negative emotions in pursuit of meaningful activities in life (Gratz & Roemer, 2004). The use of maladaptive ER strategies has been associated with psychopathology in general and more specifically with the development and maintenance of PTSD (Seligowski et al., 2016). There are three ER strategies which may be particularly important in the context of PTSD: rumination, thought suppression (TS) and experiential avoidance (EA) (Seligowski et al., 2015).

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Rumination is a cognitive ER strategy which can be defined as a focus on the cause and consequence of particular emotional experiences in a recurrent manner (Ehring et al., 2008). Usually, these experiences are of negative origin, such as the experiences of distress. Instead of trying to solve the problem or change the current situation, people keep concentrating on the negative aspects and therefore the negative feelings (Seligowski et al., 2016). In PTSD, rumination more frequently focuses on trauma-specific content like causes or consequences of the event (e.g. “Why did it happen to me?”) or even wishful thinking (“If only it had never happened.”) than on general content (Speckens et al., 2007). Rumination could increase the risk of PTSD development through its potential to trigger intrusions following a traumatic event (Michael et al., 2007). The intense rumination regarding the trauma may also prevent adaptive processing of trauma-specific details and thus promote the development and maintenance of PTSD (Cox & Olantunji, 2017). This notion is supported by empirical findings showing that rumination mediates the association between the number of traumatic event experiences and PTSD symptomatology (Im & Follette, 2016). It is important to note that rumination is conceptualized as a multidimensional construct. While brooding and intrusive rumination refer to a maladaptive cognitive coping style through which people continue to think about the negative aspects of a distressing event, reflective and deliberate rumination are considered adaptive mechanisms which might even contribute to post-traumatic growth (García et al., 2017).

Thought suppression (TS) is an attempt to subdue thoughts regarding unpleasant and unwanted thoughts and memories while also trying to monitor those thoughts to make sure that the suppression is working (Nixon et al., 2011). As a means of actively coping with distressing cognitions or emotions (Petkus et al., 2012), TS can be seen as an ER strategy. There is evidence that attempts to suppress the unwanted thoughts or feelings related to a traumatic event may foster intrusive cognitions by interfering with the processing of the traumatic memory and preventing its integration into long-term memory (Elzinga & Bremner, 2002; Foa & Kozak, 1986). This is supported by findings suggesting that thought suppression mediates the association between negative moods and PTSD symptoms (Rosenthal et al., 2006).

EA can be seen as an overarching ER strategy to avoid being confronted with emotional stimuli which can either be external or internal (Hayes et al., 2004). It thus involves cognitive (including TS) but also emotional and behavioral avoidance strategies. Cognitive avoidance strategies include, among other things, choosing not to think about or rationalize the event. Behaviorally, EA may manifest in, for example, avoiding places and people that remind the person of the traumatic event, which is in fact a symptom criterion

of PTSD (APA, 2013). Emotional avoidance is often manifested in avoiding feelings associated with the trauma in everyday life (such as anger or guilt) (Boesch et al., 2001). According to the approach-avoidance-theory of coping, EA can be adaptive shortly after traumatic event experiences making confrontation with trauma-related stimuli manageable. However, EA seems to be maladaptive in the long run since it interferes with the integration of traumatic memories as described above (Horowitz, 1986; Roth & Cohen, 1986). The latter is, again, supported by empirical findings suggesting that EA might be an important mechanism in the development of PTSD symptoms (Maack et al., 2012; Orcutt et al., 2005).

In summary, rumination, TS and EA are thought to play an important role in the development and maintenance of PTSD symptoms. This meta-analysis aims to quantify the association between these three maladaptive coping strategies and PTSD symptoms. We focus on these ER strategies because they show the strongest associations with PTSD in previous reviews (Seligowski et al., 2015), are deeply rooted in theoretical models of PTSD (Ehlers & Clark, 2000), and can be well addressed with existing interventions (Hayes et al., 1999; Rennan et al., 2017). Since the described theoretical assumptions suggest that the described ER strategies might be involved in the development of particular PTSD symptoms such as intrusions or avoidance, potential differential associations with the four DSM-5 PTSD symptom clusters will also be analyzed.

Methods and Materials

Inclusion and Exclusion Criteria

In order to be included in the current meta-analysis, studies had to meet the following criteria: (1) observational studies reporting the association between PTSD symptoms and at least one of the particular ER strategies rumination, TS and EA, (2) adult trauma-exposed sample (18 years or older) and (3) published in English language in a peer-reviewed journal. Since this investigation was only interested in examining the association between PTSD symptoms and maladaptive coping styles, results on reflective and deliberate rumination were excluded since those two aspects are considered adaptive mechanisms (García et al., 2017).

Systematic Literature Search

The search strategy was adapted from previous systematic reviews on similar research questions to ensure comparability of findings. The systematic literature search was conducted via the APA PsycINFO database in November 2022. Studies were assessed for eligibility individually by

two individuals. Differences in eligibility evaluations were resolved by a third person. The literature search resulted in 5574 articles of which 4 duplicates were removed. Of the 5570 articles, 5121 were excluded after abstract review and the remaining 449 articles were included for full-text review. 75 studies were then elected as eligible, contributing 189 effect sizes for the current meta-analysis. The number of included effect sizes (k) is reported for each pooled effect size. The study selection process is presented in Fig. 1.

The following information was extracted from the included studies: population, sample size, age of participants, proportion of female participants, type of traumatic event, study design, emotion regulation measures, PTSD symptom measures and effect size information (Table 1). Correlation coefficients were calculated from the available data if it was not the reported effect size measure. In addition to measures of overall symptom severity, PTSD symptom

measures were categorized according to the DSM-5 symptom clusters (1) intrusive re-experiencing, (2) avoidance, (3) negative alterations in cognition and mood and (4) alterations in arousal and activity (APA, 2013).

Statistical Analyses

All analyses were conducted using Stata 15.1. The analyses for heterogeneity were performed using the Q-test for heterogeneity between the studies and the I^2 statistics which provided the percentage of variation explained by the effect sizes among the studies. To examine publication bias, funnel plots of the effect sizes were created for visual assessment. Furthermore, the Egger's test was used to numerically explore the risk of publication bias. In cases where there were indications for publication bias, the trim-and-fill method was used to calculate corrected effect sizes. Random

Fig. 1 PRISMA flow diagram for study selection progress. Note. ER, emotion regulation

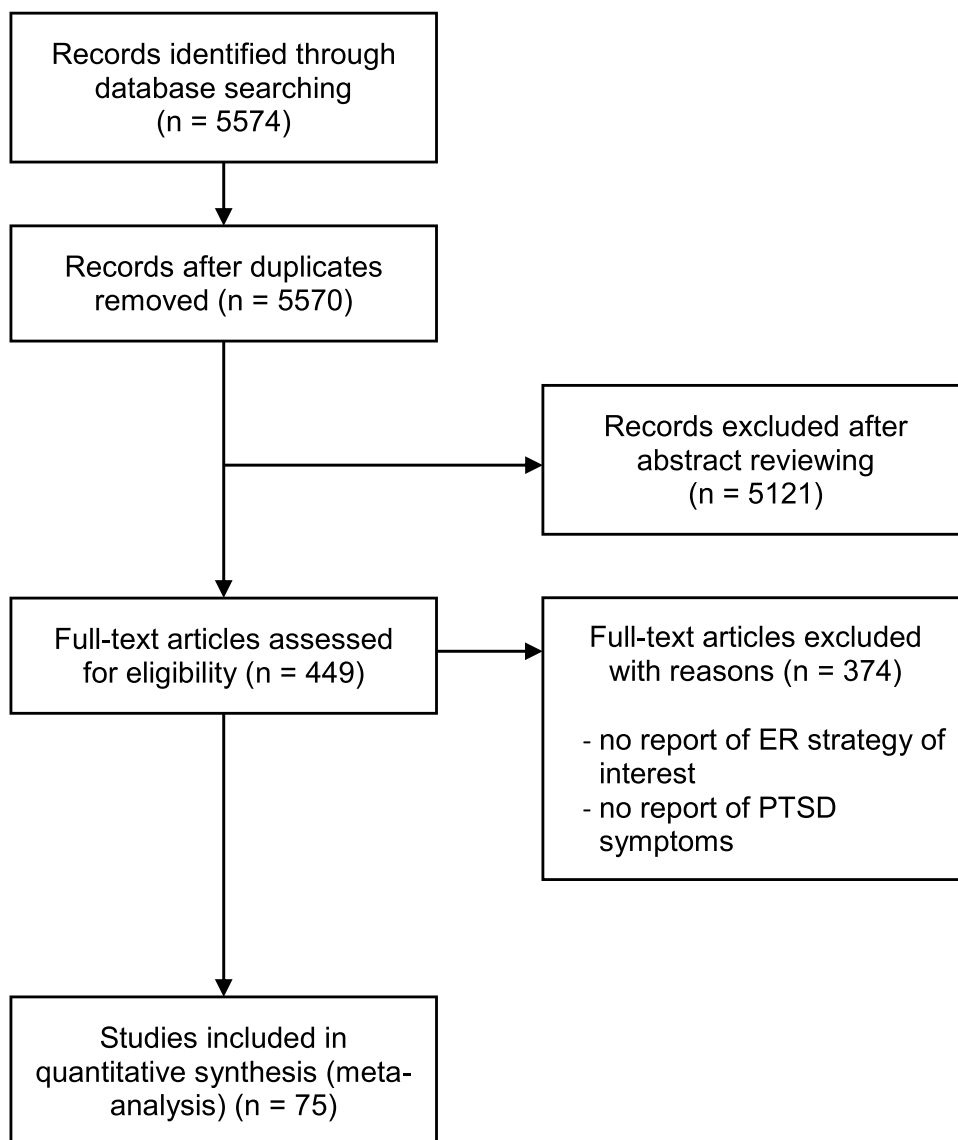


Table 1 Descriptive information for studies included in the meta-analysis

Study	Sample	% female	Trauma type	Emotion regulation measure(s)	PTSD measure(s)	Design
Amstadter and Vernon (2008)	65 trauma-exposed undergraduates	81	Various	WBSI	LEC, PCL	Cross-sectional
Arditte Hall et al. (2019)	91 female veterans	100	Various	RIQ-R	PCL-5	Cross-sectional
Bapolisi et al. (2022)	120 patients in surgery ward	23	War-related violence	CERQ-rumination	SARSQ	Cross-sectional
Birkeland et al. (2021)	183 survivors and bereaved after the Scandinavian Star ferry fire	51	Fire accident	CERQ-rumination	PCL-5	Cross-sectional
Bishop et al. (2018)	193 trauma-exposed community members	72	Various	AAQ-II, RIQ-R	LEC-5, PLC-5	Cross-sectional
Blackburn and Owens (2016)	191 veterans	14	Combat	ERRI	CES, PCL-M	Cross-sectional
Boersma-van Dam et al. (2021)	111 partners of burn survivors	80	Burn event	CERQ-rumination	IES-R	Longitudinal
Bravo et al. (2019)	189 veterans	0	Combat	RTS	PCL-5	Cross-sectional
Brockman et al. (2016)	184 National Guard or Reserve military service members	0	Combat	AAQ-II	DRRI, PCL-M	Cross-sectional
Byllesby et al. (2020)	179 veterans	15	Combat	BEAQ	PCL-5, CAPS-5	Cross-sectional
Byllesby et al. (2020)	257 veterans	29	Combat	BEAQ	PCL-5, CAPS-5	Cross-sectional
Cameron et al. (2010)	248 college students	100	Various	WBSI	PCL-S	Cross-sectional
Carvalho et al. (2022)	650 veterans	0	Combat	AAQ-TS	PCL-M	Cross-sectional
Cécile et al. (2021)	79 flood victims	50	Flood	CERQ-rumination	PCL-5	Cross-sectional
Cernvall et al. (2016)	79 parents of children with cancer	69	Cancer	AAQ-II, RIQ-R	PCL-C	Cross-sectional
Cheng et al. (2021)	167 veterans	n.a.	Combat	AAQ-II	PCL-5	Cross-sectional
Christ et al. (2020)	339 trauma-exposed adults	63	Various	RTS	PCL-5	Cross-sectional
Clohessy and Ehlers (1999)	56 ambulance service workers	33	Various	RIQ	PSS	Cross-sectional
Corman et al. (2022)	91 patients pre/post allogeneic hematopoietic stem cell transplantation (HSCT)	43	Medical procedure	AFQ	PCL	Longitudinal
Cox and Olatunji (2017)	37 veterans	9	Combat	RRQ	PCL	Cross-sectional
Crabtree et al. (2021)	305 veterans	33	Combat	AAQ-II	PCL-M	Longitudinal
Eames and O'Connor (2022)	96 university students	69	Various	ERRI	PDS	Cross-sectional
Ehring et al. (2008)	101 road traffic accident survivors	44	Road traffic accident	RIQ-R, RSQ	SCID, ASDS, PDS	Cross-sectional
Ehring et al. (2008)	148 road traffic accident survivors	33	Road traffic accident	RIQ-R, RSQ	SCID, PDS	Longitudinal
Ehring and Quack (2010)	616 trauma survivors	83	Various	AAQ	THQ, IES-R	Cross-sectional
Farach et al. (2008)	44 undergraduates	86	9/11	AAQ	PDS	Longitudinal
Feingold and Zerach (2021)	189 veterans	0	Combat	AAQ-II	PCL-5	Cross-sectional

Table 1 (continued)

Study	Sample	% female	Trauma type	Emotion regulation measure(s)	PTSD measure(s)	Design
Fisher et al. (2021)	40 caregivers of children with cancer	88	Cancer	RRS	IES-R	Cross-sectional
Friedberg et al. (2005)	71 students and staff members	80	Terrorist attack	self-constructed (Rumination)	IES	Cross-sectional
García et al. (2017)	750 adult participants	46	Various	RRS, ERRI	SPRINT-E	Longitudinal
García-Encinas et al. (2020)	180 patients in a cardiac rehabilitation program	29	Acute coronary syndrome	AAQ-II	IES-R	Cross-sectional
Gold et al. (2009)	72 lesbian women	100	Sexual assault	AAQ	LEQ, PDS	Cross-sectional
Gold et al. (2007)	74 gay males	0	Sexual assault	AAQ	PDS	Cross-sectional
Hammer et al. (2020)	75 para sport athletes	47	Various	ERRI	IES-R	Cross-sectional
Hannan and Orcutt (2020)	83 undergraduates	59	Various	AAQ-II	PCL-5	Cross-sectional
Haspolat and Çirakoğlu (2021)	246 adult participants	59	Various	ERRI	IES	Cross-sectional
Hayes et al. (2004)	257 undergraduates	100	Interpersonal victimization	AAQ	TSI	Cross-sectional
Hetzel-Riggin and Wilber (2010)	86 sexual assault victims	100	Sexual assault	WBSI	PTSD-Q	Cross-sectional
Horsch et al. (2015)	65 women following a stillbirth	100	Stillbirth	RIQ	SCID, PDS, PTCI	Longitudinal
Huang et al. (2022)	259 students	66	Various	ERRI	TLEQ, PDS	Longitudinal
Hussain and Bhushan (2011)	226 Tibetan refugees	50	Refugee-related trauma	CERQ-rumination	IES	Cross-sectional
Im and Follette (2016)	157 undergraduates	60	Various	RRS	SLESQ, PCL-C	Cross-sectional
Kachadourian et al. (2021)	85 veterans with PTSD and alcohol use disorder	9	Various	AAQ-II	CAPS-5	Cross-sectional
Kumpula et al. (2011)	532 undergraduates	100	Shooting	AAQ-II	TLEQ, DEQ	Longitudinal
Lee et al. (2015)	213 undergraduates	78	Various	AAQ-II, RRS, WBSI	PCL	Cross-sectional
Marx and Sloan (2005)	185 trauma survivors	71	Various	AAQ	PDS	Cross-sectional
Mathes et al. (2020)	119 adult participants	49	Various	RRS, RQ	PCL-C	Cross-sectional
Mayou et al. (2002)	546 patients of a motor vehicle accident	n.a.	Motor vehicle accident	self-constructed (Rumination), self-constructed (TS)	PSS, self-constructed	Longitudinal
Michael et al. (2007)	81 assault survivors	41	Various	self-constructed (Rumination)	PDS	Cross-sectional
Michael et al. (2007)	73 assault survivors	45	Various	self-constructed (Rumination)	PDS	Longitudinal
Moore et al. (2008)	62 community sample	100	Various	RRS	PDS	Cross-sectional
Morina (2007)	152 Kosovar civilian war survivors	59	Combat	AAQ	HTQ, IES-R	Cross-sectional
Morina et al. (2008)	84 civilian war survivors	56	Combat	AAQ	HTQ, IES-R	Cross-sectional
Nagulendran and Jobson (2020)	69 adult participants	83	Various	RSQ, RIQ, WBSI, AAQ-II	CAPS-5	Cross-sectional
Naifeh et al. (2012)	62 crack/cocaine dependent patients	47	Various	EAQ	CAPS	Cross-sectional
Orcutt et al. (2005)	229 undergraduates	71	Not specified	AAQ, WBSI, TAS-20	TLEQ, DEQ	Cross-sectional

Table 1 (continued)

Study	Sample	% female	Trauma type	Emotion regulation measure(s)	PTSD measure(s)	Design
Palm and Follette (2011)	92 survivors of interpersonal victimization	100	Various	AAQ	SLEC, PCL-C	Cross-sectional
Philippi et al. (2020)	71 adult participants	100	Interpersonal trauma	RTS	CAPS	Cross-sectional
Pickett et al. (2011)	851 female college students	100	Various	AAQ-II	TLEQ, DEQ	Cross-sectional
Polusny et al. (2011)	228 parents	84	Natural disaster	AAQ	IES-R	Cross-sectional
Ramon et al. (2022)	52 veterans	27	Combat	RRQ	PCL-M	Cross-sectional
Rosenthal et al. (2005)	151 undergraduate women	100	Childhood sexual abuse	AAQ	TSI	Cross-sectional
Rosenthal et al. (2006)	86 sexual assault victims	100	Sexual assault	WBSI	SES, PDS	Cross-sectional
Ruiz-Párraga and López-Martínez (2015)	229 patients with chronic back pain	71	Various	AAQ	SLESQ-R, DTS	Cross-sectional
Russell et al. (2020)	136 university students	100	Sexual assault	BEAQ	LEC-5, PCL-5	Cross-sectional
Schoenleber et al. (2022)	186 undergraduates	61	Various	AAQ	LEC-X, PCL-C	Cross-sectional
Seligowski et al. (2016)	403 individuals from the general population	69	Various	AAQ-II, RRS, WBSI	PCL-5	Cross-sectional
Tull et al. (2004)	160 female participants	100	Various	AAQ, WBSI	PCL	Cross-sectional
Tull et al. (2011)	207 college students	79	Various	EAQ	PCL	Cross-sectional
Tull et al. (2007)	113 male students, faculty, and staff	0	Physical/sexual assault	AAQ	PCL	Cross-sectional
Tull and Roemer (2003)	170 female sexual assault survivors	100	Sexual assault	AAQ	PCL	Cross-sectional
Vásquez et al. (2008)	503 university students and individuals from the general population	67	Terrorist attack	WBSI	PCL-C, self-constructed	Cross-sectional
Weiss et al. (2021)	401 individuals from the general population	70	Various	EAQ	PCL-5, LEC-5	Cross-sectional
Weiss et al. (2022)	465 veterans	28	Various	EAQ	PCL-5, LEC-5	Cross-sectional
Wen et al. (2021)	295 humanitarian aid workers	35	Various	ERRI	IES-R	Cross-sectional

AAQ Action and Acceptance Questionnaire, AAQ-II Action and Acceptance Questionnaire-II, AFQ Avoidance and Fusion Questionnaire for Adults, AAQ-TS Action and Acceptance Questionnaire – Trauma Specific, ASDS Acute Stress Disorder Scale, BEAQ Brief Experiential Avoidance Questionnaire, CAPS Clinician-Administered PTSD-Scale, CAPS-5 Clinician-Administered PTSD Scale for DSM-5, CES Combat Exposure Scale, DEQ Distressing Events Questionnaire, DRRI Deployment Risk and Resilience Inventory, DTS Davidson Trauma Scale, EAQ Emotional Avoidance Questionnaire, ERRI Event-related Rumination Inventory, HTQ Harvard Trauma Questionnaire, IES Impact of Event Scale, IES-R Impact of Event Scale – Revised, LEC Life Events Checklist, LEC-5 Life Events Checklist for DSM-5, LEC-X Life Events Checklist – Expanded, PCL Posttraumatic Stress Disorder Checklist, PCL-C Posttraumatic Stress Disorder Checklist-Civilian Version, PCL-M Posttraumatic Stress Disorder Checklist-Military Version, PCL-S Posttraumatic Stress Disorder Checklist-Specific Version, PCL-5 Posttraumatic Stress Disorder Checklist for DSM-5, PDS Posttraumatic Diagnostic Scale, PSS Posttraumatic Stress Disorder Symptom Scale, PSS Perceived Stress Scale, PTCI Posttraumatic Cognitions Inventory, RIQ Responses to Intrusions Questionnaire, RIQ-R rumination subscale of the Responses to Intrusions Questionnaire, RQ Rumination Questionnaire, RRS Ruminative Responses Scale, RRQ Rumination-Reflection Questionnaire, RTS Ruminative Thought Style Questionnaire, SARSQ Stanford Acute Reaction Stress Questionnaire, SCID Structural Clinical Interview, SES Sexual Experiences Survey, SES-Adult Version Sexual Experiences Scale – Modified, SLEC Stressful Life Events Checklist, SLESQ Stressful Life Events Screening Questionnaire – Modified, SLESQ-R Stressful Life Events Screening Questionnaire – Revised, SPRINT-E Short Posttraumatic Stress Disorder Rating Interview – Extended, THQ Trauma History Questionnaire, TLEQ Traumatic Life Events Questionnaire, WBSI White Bear Suppression Inventory

effects estimates were calculated to quantify the associations between maladaptive emotion regulation strategies and PTSD symptoms. Meta-regressions were calculated for study design (cross-sectional versus longitudinal) and gender (percentage of female participants in the study sample) using the Stata *metareg* package. Estimates were based on the restricted maximum likelihood method. Standard errors and confidence intervals are calculated as suggested by Knapp und Hartung because this procedure has much more appropriate false-positive rates than the standard approach (Knapp & Hartung, 2003). P-values were calculated using a permutation test approach based on Monte Carlo simulation (2000 permutations) which results in more accurate p-values compared to standard methods, particularly if the number of studies in a model is small (Higgins & Thompson, 2004). Where the number of effect sizes did not allow the calculation of meta-regressions, differences are reviewed narratively.

Results

The largest groups examined in the included studies were student samples ($n = 19$, 25.3%) and military samples ($n = 14$, 18.7%). Other samples studied included victims of sexual assault and civilian war survivors. While several studies included exposure to different trauma types ($n = 33$, 44.0%), others focused on specific interpersonal events ($n = 29$, 38.7%) such as sexual or physical abuse, combat, and terrorist attacks or accidental events ($n = 11$, 14.7%) including traffic accidents, life-threatening diseases, and natural disasters. The study design of the total 75 included studies was divided into $n = 64$ cross-sectional (85.3%) and $n = 11$ longitudinal studies (14.7%). The mean percentage of female participants across all studies was 59.8% (SD = 31.8%) with a range from 0 to 100% (data were not reported for two studies).

Association between ER Strategies and Symptoms of Posttraumatic Stress

The Egger's test suggested evidence for publication bias for the associations between symptoms of posttraumatic stress and rumination ($b = -2.37$, 95% CI = [-3.73, -1.02], $p = .001$) and between symptoms of posttraumatic stress and EA ($b = -2.92$, 95% CI = [-4.88, -0.95], $p = .005$). A visual inspection of the funnel plots showed no underrepresentation of small studies with small effect sizes, which is the type of publication bias leading to inflated pooled associations. Accordingly, no studies were added and associations did not change when applying the trim-and-fill method.

The associations between the investigated ER strategies and symptoms of posttraumatic stress are presented

in Fig. 2. Random effect estimates are reported because there was evidence for heterogeneity for all investigated associations (rumination: $I^2 = 87.1\%$; EA: $I^2 = 87.1\%$; TS: $I^2 = 84.3\%$, all $ps < 0.001$). Rumination ($r = .52$, 95% CI = [0.48, 0.56], $p < .001$, $k = 52$), EA ($r = .48$, 95% CI = [0.44, 0.52], $p < .001$, $k = 41$) and TS ($r = .29$; 95% CI = [0.20, 0.38], $p < .001$, $k = 15$) were related to symptoms of posttraumatic stress. It became apparent that one study (Horsch et al., 2015) investigating the association between symptoms of posttraumatic stress and TS consistently found considerably smaller associations compared to all other studies. Recalculating the meta-analysis without this study led to a considerably higher association for TS ($r = .38$; 95% CI = [0.30, 0.45], $p < .001$, $k = 11$).

Association between ER Strategies and PTSD Symptom Clusters

As there were only few results per cluster for each ER strategy, these results are to be considered exploratory in nature. There was evidence for publication bias for the associations between maladaptive ER strategies and intrusive re-experiencing ($b = -2.51$, 95% CI = [-4.88, -0.13], $p = .040$), negative alterations in cognition and mood ($b = -5.07$, 95% CI = [-7.98, -2.16], $p = .003$) and negative alterations in arousal and activity ($b = -3.00$, 95% CI = [-5.73, -0.27], $p = .033$). Visual inspection of the funnel plots supported this. Again, small studies with small effect sizes were not underrepresented, and the trim-and-fill method did not yield different results. There was evidence for heterogeneity for all of the investigated associations ($68.3\% \leq I^2 \leq 91.4\%$; $ps \leq 0.018$) except for one association (rumination and avoidance: $I^2 < 0.1\%$; $p = .445$).

The associations between ER strategies and PTSD symptom clusters are presented in Fig. 3.

Rumination ($r = .41$, 95% CI = [0.31, 0.50], $p < .001$, $k = 7$), EA ($r = .37$, 95% CI = [0.30, 0.44], $p < .001$, $k = 10$) and TS ($r = .35$, 95% CI = [0.20, 0.49], $p < .001$, $k = 4$) were related to the cluster intrusive re-experiencing. For the cluster avoidance, the pooled association was $r = .41$ (95% CI = [0.36, 0.46], $p < .001$, $k = 6$) for rumination, $r = .39$ (95% CI = [0.33, 0.44], $p < .001$, $k = 12$) for EA and $r = .39$ (95% CI = [0.29, 0.49], $p < .001$, $k = 4$) for TS. Rumination ($r = .50$ (95% CI = [0.38, 0.61], $p < .001$, $k = 5$), EA ($r = .53$ (95% CI = [0.44, 0.63], $p < .001$, $k = 7$) and TS ($r = .53$ (95% CI = [0.39, 0.68], $p < .001$, $k = 2$) were related to the cluster negative alterations in cognition and mood. For the cluster alterations in arousal and activity, the pooled association was $r = .45$ (95% CI = [0.35, 0.55], $p < .001$, $k = 7$) for rumination, $r = .41$ (95% CI = [0.32, 0.49], $p < .001$, $k = 11$) for EA and $r = .43$ (95% CI = [0.30, 0.56], $p < .001$, $k = 6$) for TS.

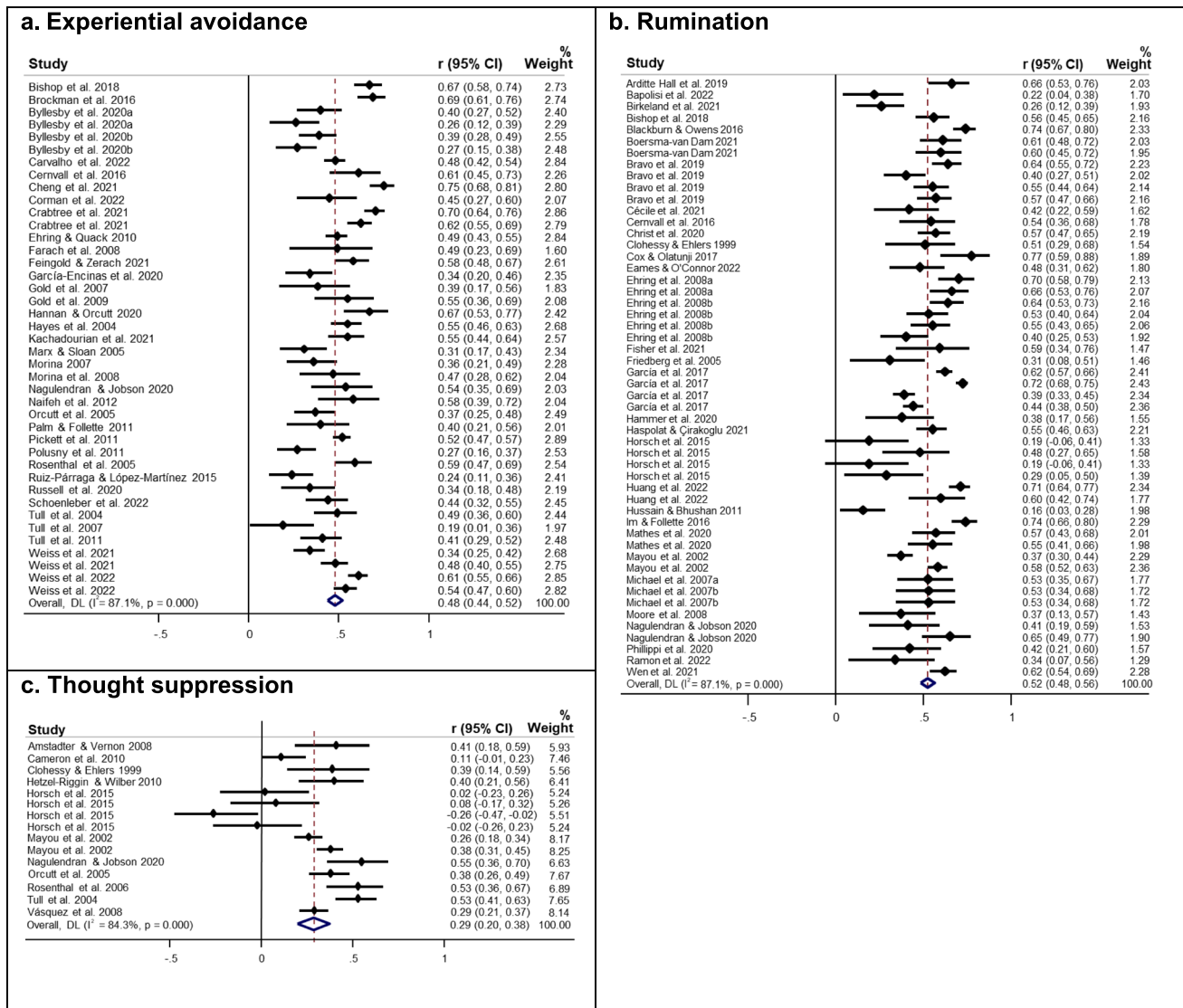


Fig. 2 Meta-analysis for the association between symptoms of posttraumatic stress and ER strategies

Difference between Cross-Sectional and Longitudinal Studies

The associations of symptoms of posttraumatic stress with rumination ($b = -0.10$, 95% CI = [-0.20, 0.00], $p = .045$) and TS ($b = -0.32$, 95% CI = [-0.59, -0.05], $p = .014$) were moderated by study design with associations being weaker in longitudinal than in cross-sectional studies. In cross-sectional studies, the pooled association between rumination and symptom severity was $r = .54$ (95% CI = [0.50, 0.58], $p < .001$, $k = 42$). The same association was $r = .45$ (95% CI = [0.39, 0.51], $p < .001$, $k = 10$) in longitudinal studies. For TS, the pooled association with symptoms of posttraumatic stress was $r = .35$ (95% CI = [0.27, 0.44], $p < .001$, $k = 12$) in cross-sectional studies, whereas for the longitudinal studies, no association could be found ($r = .01$; 95% CI = [-0.33,

0.34], $p = .972$, $k = 3$). The respective forest plots by study design are presented in the supplemental material. The association of symptoms of posttraumatic stress with EA was not moderated by study design ($b = 0.004$, 95% CI = [-0.16, 0.17], $p = .962$)

Regarding associations with different PTSD symptom clusters, there was only one longitudinal study which provided associations for EA (Kumpula et al., 2011), so moderation by study design could not be analyzed for associations between ER strategies and symptom clusters. The reported longitudinal associations between EA and PTSD symptom clusters were consistently smaller than the pooled estimates for these associations from cross-sectional studies.

For the cluster intrusive re-experiencing, the longitudinal association with EA was $r = .32$ (95% CI = [0.24, 0.39]) compared to a pooled cross-sectional association of $r = .37$

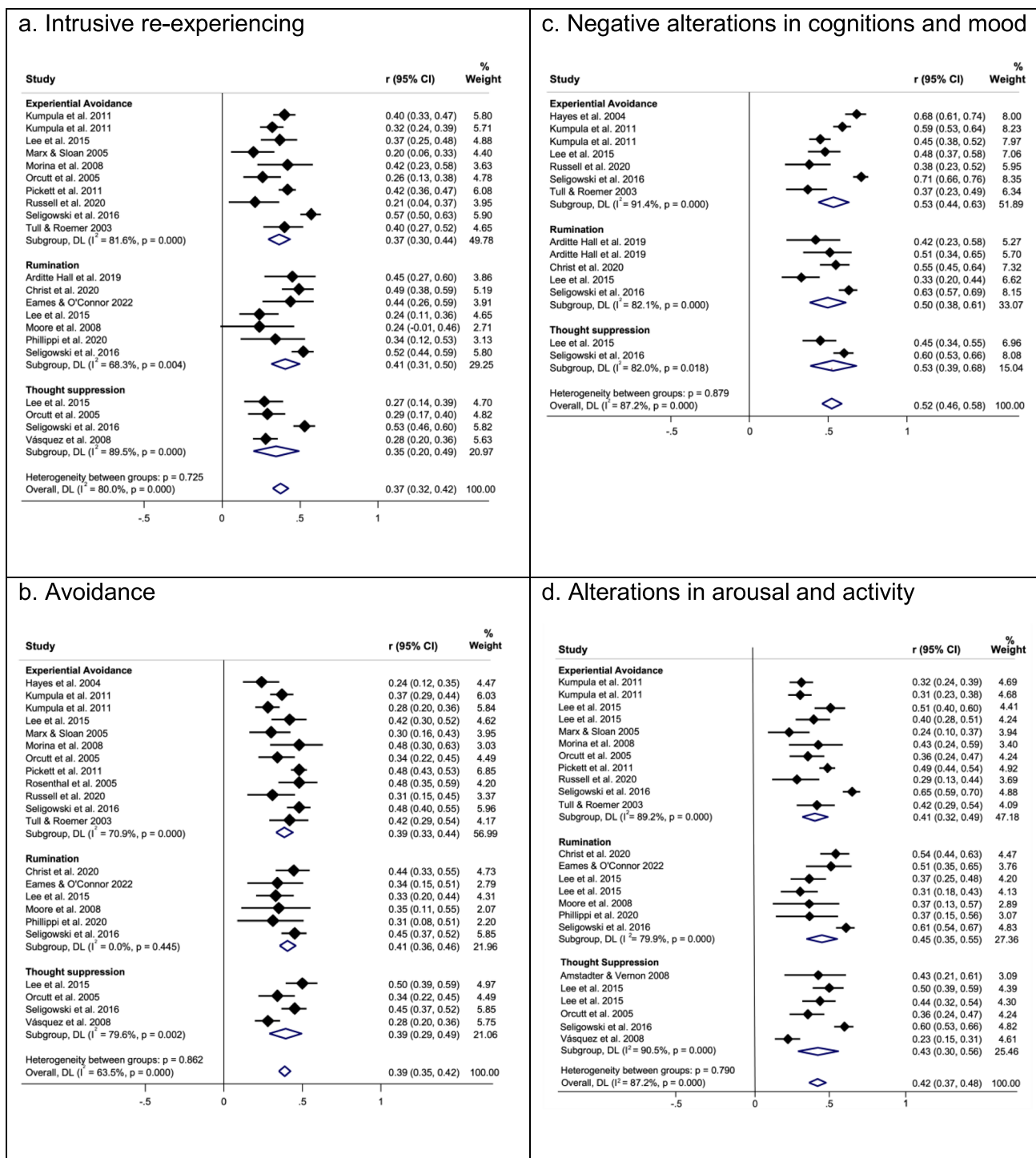


Fig. 3 Meta-analyses for the associations between the four DSM-5 symptom clusters of PTSD and the ER strategies experiential avoidance, rumination and thought suppression

(95% CI = [0.29, 0.45], $p < .001$, $k = 9$). For the cluster avoidance, the reported longitudinal association was $r = .28$ (95% CI = [0.20, 0.36]) compared to a pooled cross-sectional association of $r = .40$ (95% CI = [0.35, 0.45], $p < .001$, $k = 11$), for the cluster negative alterations in cognition and

mood, the longitudinal study found an association of $r = .45$ (95% CI = [0.38, 0.52]) compared to $r = .55$ (95% CI = [0.45, 0.65], $p < .001$, $k = 6$) in all cross-sectional studies, and for the cluster negative alterations in arousal and activity, the reported longitudinal association was $r = .31$ (95% CI

= [0.23, 0.38]) compared to a pooled cross-sectional association of $r = .42$ (95% CI = [0.33, 0.50], $p < .001$, $k = 10$).

Effect of Gender

There was no moderating effect of gender (percentage of female participants) on the associations of posttraumatic stress symptoms with rumination ($b = -0.001$, 95% CI = [-0.002, 0.001], $p = .488$), EA ($b = 0.0001$, 95% CI = [-0.001, 0.001], $p = .904$), or TS ($b = -0.003$, 95% CI = [-0.01, 0.004], $p = .331$).

With respect to the different symptom clusters, the moderating effect of gender could only be analyzed for EA and the clusters intrusive re-experiencing, avoidance, and alterations in arousal and activity, as there were less than 10 studies for the other combinations of ER strategies and clusters. With less than 10 associations, conducting a meta-regression is not recommended (Higgins et al., 2019). There was no moderating effect of gender for the associations of EA with the clusters intrusive re-experiencing ($b = -0.001$, 95% CI = [-0.01, 0.005], $p = .741$), avoidance ($b = -0.001$, 95% CI = [-0.01, 0.003], $p = .464$), or alterations in arousal and activity ($b = -0.002$, 95% CI = [-0.01, 0.003], $p = .368$).

Discussion

This study examined the association between posttraumatic symptoms and the maladaptive ER strategies EA, rumination and TS by integrating previous findings in a meta-analysis. All investigated ER strategies were associated with symptoms of posttraumatic stress with moderate to large effect sizes. This finding supports several theoretical assumptions which propose an important role of emotion regulation for the processing of adverse events, for example by modulating event-related thoughts and memories (Gross, 1998). It is also in line with previous literature reviews showing that EA, rumination and TS are relatively consistently associated with PTSD symptoms (Aldao et al., 2010; Seligowski et al., 2015).

When comparing the three investigated ER strategies, rumination and EA had stronger associations with symptoms of posttraumatic stress than TS. There is in fact a growing body of literature supporting the importance of rumination for the maintenance and aggravation of PTSD symptoms following traumatic events (Moulds et al., 2020). Interestingly, rumination was also found to mediate the association between general difficulties in emotion regulation and PTSD symptoms (Ehring & Ehlers, 2014; Pugach et al., 2020). Thus, rumination could be a more proximal process compared to other ER strategies which might explain why it had the strongest association with symptoms of posttraumatic stress. This could have implications for specific

interventions, although direct comparisons of interventions targeting rumination versus other ER strategies are lacking to date. It is further important to consider that we did not differentiate between different aspects of maladaptive rumination including brooding rumination, intrusive rumination and ruminative thought styles which could, although correlated, be differentially related to PTSD symptoms (García et al., 2017). At least for studies that explicitly measured brooding and intrusive rumination, we observed no considerable differences regarding effect size or standard error compared to studies with a broader conceptualization of rumination.

EA is a relatively broad construct characterized by avoidance of emotional stimuli on different levels of cognition and behavior. As such, it overlaps with other ER strategies and coping mechanisms including rumination (Karekla & Panayiotou, 2011). It seems therefore plausible that the strength of the association with symptoms of posttraumatic stress of EA was only marginally weaker as compared to rumination. This broad conceptualization often leads to very liberal inclusion criteria in reviews of the association of EA and PTSD which include various forms of avoidant coping styles (Orcutt et al., 2020) which led to a relatively small number of included studies in this meta-analysis. The advantage of including only studies which used an explicit EA measure is that all except for eight included studies used a similar assessment instrument (AAQ, AAQ-II) which considerably reduces the variance due to measurement heterogeneity. Nevertheless, the observed heterogeneity in the results for EA was not considerably smaller than for rumination and TS suggesting other potentially relevant moderators of the association with PTSD symptoms. A study in trauma-exposed undergraduates found stronger associations between EA and PTSD symptoms for males compared to females (Leonard et al., 2020). This gender difference could, however, not be supported in our meta-analytic moderation analysis. Another study found an increase in the association between EA and PTSD symptoms with increasing physiological reactivity following the traumatic event (Pineles et al., 2011). Such investigations seem rather fragmented and a systematic investigation of potential moderators as well as of the most relevant aspects of EA might help to further elucidate its relationship with PTSD symptoms. This also underlines the importance to investigate EA, TS, and rumination separately in a nuanced approach despite their conceptual overlap.

It might appear surprising that TS was not as strongly associated with symptoms of posttraumatic stress compared to the two other investigated ER strategies given that several theoretical models such as the ironic control theory (Wenzlaff & Wegner, 2000) and empirical findings (Bomyea & Lang, 2016; Ehlers et al., 1998) connect TS with the occurrence of PTSD symptoms such as intrusions. However, the available literature on the association between TS and

intrusions is fairly inconsistent (Marks et al., 2018). First, it has been suggested that it is not a person's general ability to suppress thoughts (usually measured with TS instruments), but the suppression of trauma-related content, which can lead to intrusions in individuals with PTSD (Amstadter & Vernon, 2006). Second, there is evidence that effective TS might indeed decrease negative affect while only individuals with reduced abilities for effective suppression exhibit elevated levels of intrusions (Gagnepain et al., 2017). It should further be noted that the weaker association with TS in this meta-analysis was partially driven by one study (Horsch et al., 2015) investigating PTSD symptoms following stillbirth. Since the same study found higher associations with rumination, this observation seems to be specific for TS. Potentially traumatic events involving the experience of loss might deserve special attention because theoretical models propose that avoidant ER strategies such as TS might be partially adaptive when coping with experiences of loss and bereavement (Stroebe & Shut, 1999). In summary, further research on the exact conditions under which TS is associated with PTSD symptoms seems warranted.

In addition to their association with overall symptoms of posttraumatic stress, we were interested in potential differential associations with different PTSD symptoms. Unfortunately, only a small number of studies reported associations for specific symptoms, making it difficult to draw conclusions about potential differential associations between the investigated ER strategies and specific PTSD symptoms. Based on the available evidence, the following pattern emerged: First, all investigated ER strategies were relatively uniformly associated with the different PTSD symptom clusters which supports the idea of PTSD as a common latent variable underlying highly correlated PTSD symptom clusters (Gentes et al., 2015). Second, the strongest associations were found with the cluster negative alterations in cognition and mood, which was, however, less pronounced for rumination. Since especially TS and EA include mechanisms to cope with cognitions which are described in this symptom cluster (APA, 2013), this finding seems plausible. Third, although small in magnitude, associations with intrusive re-experiencing were somewhat smaller for TS than for the investigated ER, which is in line with the weaker associations that were observed for the association between TS and overall symptoms of posttraumatic stress.

In order to extend the work of previous meta-analytic reviews (Seligowski et al., 2015), we also aimed to compare associations between cross-sectional and longitudinal studies. In a meta-regression, we found that, for rumination, effect sizes were significantly smaller in longitudinal compared to cross-sectional studies. However, this difference was rather small, which is in line with the assumption that rumination is not only a co-occurring characteristic of PTSD symptomatology, but also a predictor of later development

or aggravation of PTSD symptoms. Although this does not necessarily imply a causal relationship, it is consistent with the theoretically proposed role of rumination in the development and maintenance of PTSD symptoms (Ehlers & Clark, 2000). This is further supported by experimental analogue studies showing that induction of rumination leads to more PTSD symptoms, providing at least some evidence for a potential causal relation (Zetsche et al., 2009). However, in a naturalistic treatment study, this assumption was not fully corroborated, because although rumination predicted symptom severity over the course of treatment, this effect was partially explained by the time factor (Schumm et al., 2022). We also found a significant moderation by study design for TS, and there was no significant association in longitudinal studies. However, only three longitudinal effect sizes from two studies could be analyzed of which one study was the already discussed study of stillbirth which generally found lower effect sizes for TS. For EA, only one longitudinal effect size was available prohibiting a moderation analysis. This effect size was moderate which does at least suggest that a predictive role of EA for the development of PTSD symptoms seems possible. The same applies for the association between ER strategies and individual symptom clusters where the few longitudinal associations were in a similar range compared to the pooled meta-analytic estimates of the respective cross-sectional associations.

The association between posttraumatic stress symptoms after exposure to a traumatic event and different ER strategies did not depend on the gender ratio of the samples in the included studies although women have a higher tendency to use rumination (Johnson & Whisman, 2013) and TS (Blumberg, 2000), and usually report stronger posttraumatic stress symptoms after trauma exposure compared to men (Birke-land et al., 2017; Olf, 2017).

The presented meta-analysis has several limitations which have direct implications for future studies. First, the majority of included studies was conducted with moderate sample sizes and specific samples (e.g. student samples, military personnel). Second, we analyzed associations with dimensional posttraumatic stress symptoms rather than with PTSD diagnosis. Thus, the generalizability and clinical relevance of the presented findings has still to be determined. Moreover, the number of longitudinal studies is still very limited. Thus, population-based cohort studies could provide much stronger evidence for potential associations between the considered ER strategies and PTSD symptoms. Second, the presented analyses on symptom clusters as well as the differentiation between cross-sectional studies have to be interpreted with caution due to the small number of included studies and due to publication bias in the analysis of three of four symptom clusters. However, they are nevertheless reported since they reflect the current level of evidence which should be considered as preliminary. Third, ER is a complex construct including a large

number of regulatory mechanisms. Although we focused on maladaptive strategies that might be of particularly high relevance, other aspects of ER on different levels including attention, appraisal and behavior (McRae & Gross, 2020) might still play an important role for the development and maintenance of PTSD symptoms (Tull et al., 2020). Progress in the uniform assessment and definition as well as a further elucidation of the complex interplay between different strategies holds large promise to explain further variance in PTSD symptom development. Fourth, although well-established, there is accumulating evidence that the distinction between adaptive and maladaptive ER strategies has considerable limitations and that a flexible management of emotions depending on contextual demands is more important (Aldao et al., 2015). Although still in its infancy, this approach has large potential and warrants further investigation. Finally, the presented findings from this meta-analysis do not allow causal inferences. More well-designed studies using causal theories for observational data (Höfler et al., 2021) as well as experimental and interventional designs (Boden et al., 2012; Zetsche et al., 2009) are needed.

In conclusion, rumination, TS and EA are relatively consistently associated with both symptoms of posttraumatic stress and specific symptom clusters with overall moderate effect sizes. These findings together with the identified lack of longitudinal studies, particularly with regard to TS and EA, and considerable unexplained heterogeneity between studies provide valuable targets for future investigation with the long-term goal of improving targeted interventions for the prevention and treatment of PTSD symptoms.

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Author Contributions Sandra Miethe, Annika Wartemann and Sebastian Trautmann developed the study conception and design. The systematic literature search, study selection and data extraction were performed by Annika Wartemann, Janna Wigger and Fée Ona Fuchs. Data analyses were conducted by Sandra Miethe and Sebastian Trautmann. The first draft of the manuscript was written by Sandra Miethe and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Data Availability Raw data can be received from the corresponding author upon reasonable request.

Declarations

Conflict of Interest Sandra Miethe, Janna Wigger, Annika Wartemann, Fée Ona Fuchs and Sebastian Trautmann declare that there are no conflicts of interest.

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