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Pathways to traumatic stress: the roles of emotion regulation strategies and traumatic memory characteristics

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Abstract
The persistence of distressing memories is a core feature of posttraumatic stress disorder (PTSD). Both the phenomenological characteristics of these memories and individual differences in emotion regulation are known to influence PTSD maintenance, yet the interplay between these factors is not well understood. This study examined the distinct pathways through which two emotion regulation strategies—cognitive reappraisal and expressive suppression—are associated with traumatic stress via their influence on the characteristics of traumatic memory. A sample of 278 adults (211 female, 76%; 67 male, 24%) who reported experiencing a traumatic event completed an online survey assessing emotion regulation styles, phenomenological qualities of their traumatic memory (e.g., vividness, coherence, centrality), and current traumatic stress symptoms. The mean age of the participants found to be 27.80 years (SD=4.5), with a range of 18 to 43 years. As statistical analyses, two separate structural equation models were tested. Results supported the proposed models. Cognitive reappraisal was found to be associated with traumatic stress through a pathway of enhanced event characteristics and increased voluntary recall. In contrast, suppression was related to traumatic stress through a pathway involving heightened event characteristics and memory intrusion. These findings suggest that emotion regulation strategies do not act in isolation; rather, they shape the way traumatic events are processed in memory, which in turn drives trauma-related distress. This highlights the clinical importance of targeting maladaptive memory processes, such as rumination and intrusion management, in therapeutic interventions for PTSD.

Keywords Autobiographical memory · PTSD · Traumatic memory · Cognitive reappraisal · Suppression

Introduction

The persistence of distressing memories following a traumatic event is a hallmark of posttraumatic stress disorder (PTSD). While these intrusive memories may diminish over time, they can remain vivid, emotional, and easily triggered for a significant minority, sustaining the disorder's symptoms (Ehlers & Clark, 2000). A central question in trauma research, therefore, concerns the mechanisms that maintain these distressing memories. These memories are characterized by a distinct phenomenology, including sensory fragmentation, narrative incoherence, and a strong negative valence (Bedard-Gilligan et al., 2017; Crespo & Fernández-Lansac, 2016; Van der Kolk & Fisler, 1996). Furthermore, the impact of trauma extends to the broader autobiographical memory system; it can impair memory specificity, fostering an overgeneral recall style (Moore & Zoellner, 2007), while the perceived centrality of the event is a robust predictor of symptom severity (Berntsen & Rubin, 2007; Fitzgerald et al., 2016).

Alongside the characteristics of the memory itself, Individual differences in emotion regulation are also a critical factor in the development and maintenance of PTSD (Seligowski et al., 2015). Two commonly studied strategies are cognitive reappraisal, which involves reframing an event's emotional impact, and expressive suppression, the inhibition of emotional expression. Although a large body of literature indicates that habitual suppression is linked to psychopathology, while reappraisal is generally considered adaptive (Gross & John, 2003), this distinction is not absolute. The effectiveness of these strategies may be context-dependent, as some research has linked even reappraisal

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to PTSD symptoms under certain conditions (Sistad et al., 2021; Tyra et al., 2021).

This complexity suggests that symptoms are not caused by the traumatic event itself, but by how the event is processed in memory (Rubin et al., 2008). Factors such as an individual's interpretation of their memories and their cognitive responses to them are crucial (Ehlers, 2010). Despite extensive research on emotion regulation, the interplay between these strategies and the specific characteristics of traumatic memory remains unclear. Therefore, There is a growing recognition of the need for comprehensive and integrative research in this field.

In order to understand how emotion regulation strategies influence posttraumatic stress through memory processes, it is essential to first pay attention to the role of autobiographical memory. The fact that the memories of individuals affected by trauma lead to various symptoms and problems underlines the central role played by autobiographical memory after trauma (Bryant, 2015).

Although the central role of autobiographical memory is accepted by many researchers, there are different explanations about the mechanisms underlying traumatic memories. Based on the special mechanisms view, Halligan et al. (2003) have posited that traumatic memories undergo distinct processing pathways when compared with other autobiographical memories. The encoding, recall, and retrieval of autobiographical information are possible provided that such information does not contradict an individual's self-system. Conversely, traumatic experiences often result in encoding difficulties due to the challenges they pose to coping resources, hindering their successful integration. These difficulties can result in the re-emergence of traumatic memories characterized by intrusiveness, inconsistency, and sensory fragmentation (Bedard-Gilligan et al., 2017). For instance, Brewin et al.'s (1996) dual representation theory argues that traumatic memories are uniquely encoded, separated from the general memory network, and difficult to recall verbally. In contrast, the basic mechanisms view suggests that traumatic memories are processed through the same mechanisms as non-traumatic memories, and just like other memories, traumatic memory is influenced by the individual characteristics of the person exposed/witnessed to the event and the characteristics of the event. Consistent with this, the accessibility of a highly stressful event is expected not to differ in terms of voluntary and involuntary recall (Berntsen, 2009; Rubin et al., 2008).

Despite theoretical disagreements on the mechanisms, there is a consensus that traumatic events profoundly impact both the specific traumatic memory and general autobiographical memory. For instance, reduction in specificity, characterized by difficulty in recalling specific everyday events in detail (Barry et al., 2018; Griffith et al., 2016; Ono et al., 2016), diminishing in the specificity of future-oriented thoughts (Khan & Haque, 2022; Kleim et al., 2014), reduced consistency in event narratives (Halligan et al., 2003; Jones et al., 2007; Miragoli & Camisasca, 2022; Tuval-Mashiach et al., 2004), the centrality of the memory to identity (Berntsen & Rubin, 2007; Berntsen et al., 2003), changes in the phenomenology of memory itself (Berntsen et al., 2003; O'Kearney & Perrott, 2006; O'Kearney & Parry, 2014) and distorted temporal context (Hackmann et al., 2004; Michael et al., 2005; Speckens et al., 2007) can be considered core memory components affected by trauma.

While the characteristics of a traumatic memory are undeniably central, the development of PTSD is profoundly multifactorial. PTSD is rarely caused by a single factor, but is rather the product of a complex interplay between biological, environmental, and life experience variables (Ford et al., 2015). The literature points to a wide array of contributing risk factors. These include demographic variables such as age and gender (Kessler et al., 2005; Tolin & Foa, 2008); pre-existing vulnerabilities like prior trauma exposure or a history of psychiatric illness (Breslau, 2002; Follette & Vijay, 2009); and personality traits including neuroticism and anxiety sensitivity (Engelhard et al., 2007; Lebeaut et al., 2022).

Among this wide array of individual differences, emotion regulation strategies have consistently emerged as a significant risk factor. The general finding is that individuals with PTSD symptoms tend to overuse seemingly ineffective strategies, such as suppression, while underusing more effective ones, like cognitive reappraisal. This pattern has been documented across diverse trauma populations, including war veterans (Osgood et al., 2023; Sippel et al., 2016), motor vehicle accident victims (Wisco et al., 2013), and has been observed across both individualistic and collectivistic cultures (Chukwuorji et al., 2017).

However, the role of emotion regulation is more complex than a simple adaptive/maladaptive dichotomy. Studies have demonstrated that even cognitive reappraisal, typically seen as protective, can be associated with PTSD symptoms under specific conditions (Sistad et al., 2021; Tyra et al., 2021). This complexity suggests that the influence of these strategies is not straightforward. It is therefore hypothesized that emotion regulation strategies like reappraisal and suppression may exert their influence indirectly, being associated with PTSD symptoms by affecting the phenomenological dimensions of autobiographical memory in distinct and disparate ways.

The current study

As noted previously, the direct relationships between PTSD, memory phenomenology, and emotion regulation are well-documented. However, to our knowledge, no study has integrated all three variables into a unified model. Given that both memory characteristics and regulation strategies independently are associated with traumatic stress, the pathways between emotion regulation and traumatic memory may be critical for understanding posttraumatic distress. The present study aimed to address this gap by adopting the theoretical framework of Fitzgerald and Broadbridge's (2013) latent constructs model. Their model posits that memory formation, retrieval, and evaluation are distinct but related processes. Extending this, subsequent research has shown that individual differences, such as attachment styles, influence these latent memory structures (Öner & Gülgöz, 2016). We therefore apply this framework to examine how another key individual difference -emotion regulation- is related to the latent constructs of traumatic memory in relation to traumatic stress. Based on this framework, we hypothesized that cognitive reappraisal and suppression would be associated with traumatic stress through two distinct autobiographical memory pathways. Accordingly, we developed and tested two separate models, as illustrated in Figs. 1 and 2.

In the Cognitive Reappraisal Pathway, we hypothesized that increased use of this strategy would be positively associated with voluntary recall. This pathway, in turn, was expected to increase the phenomenological characteristics of the memory and the associated traumatic stress. On the other hand, in the Suppression Pathway, we hypothesized that suppression would be positively associated with involuntary recall (i.e., intrusions). This pathway was also expected to increase the phenomenological qualities of the memory and, consequently, the severity of traumatic stress.

Method

Participants

Participants were recruited via convenience sampling through social media channels. Prior to running the structural equation models, a power analysis was conducted to determine the required sample size. Based on a G*Power analysis ($\alpha = 0.05$, effect size = 0.15), the minimum required sample size was found to be194 participants. Therefore, 310 individuals over the age of 18 have been reached. Participants were excluded if they reported no traumatic

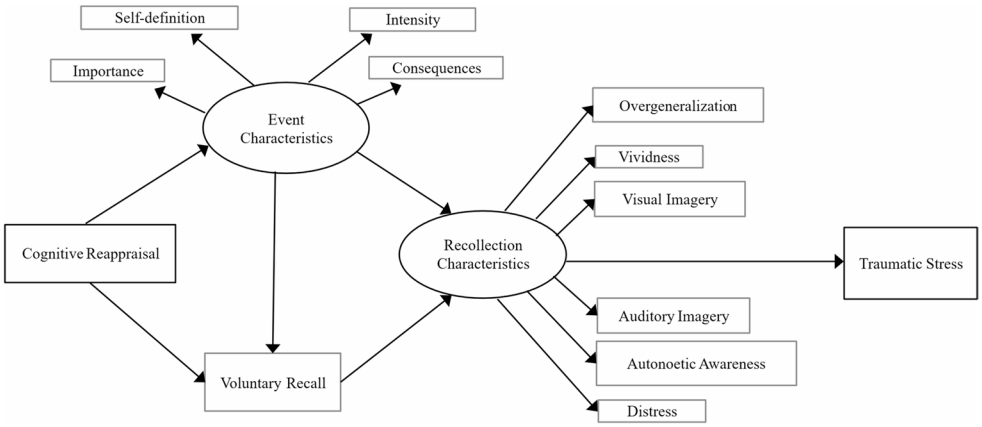


Fig. 1 Cognitive reappraisal model

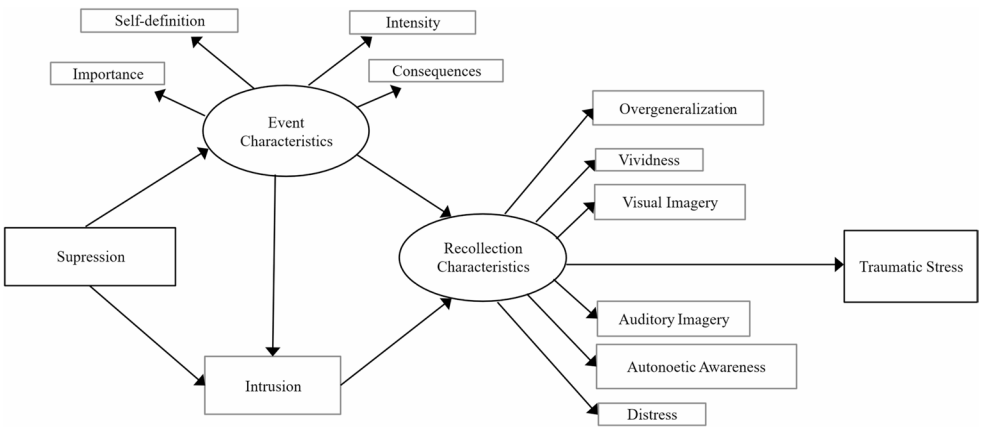


Fig. 2 Suppression model

memories ($n=11$), declined to describe their experience ($n=4$), had duplicate data ($n=5$), or were outliers in age and education ($n=12$). The final analyses were conducted with the remaining 278 participants (211 female, 76%; 67 male, 24%). The mean age was 27.80 years ($SD=4.5$), with a range of 18 to 43 years.

Materials and measures

An online survey battery was created, including the following measures and a demographic information form.

Phenomenological characteristics of traumatic memory form

This form was developed by the researchers by collecting relevant single items from Er and Uçar's (2004) study, the Intrusive Memory Interview Form (Williams & Moulds, 2007), and the Memory Characteristics Questionnaire (MCQ; Johnson et al., 1988), which was adapted and used by Öner and Gülgöz (2016). Each item is evaluated separately on a 7-point Likert-type scale (1=*strongly disagree*, 7=*strongly agree*). Different phenomenological features—such as the significance of the traumatic event, its emotional intensity, the presence or absence of consequences, self-definition, the way it is remembered (e.g., intrusive or voluntary recollection), vividness, and sensory modalities—are evaluated independently of each other.

Emotion regulation questionnaire

The Emotion Regulation Questionnaire (Gross & John, 2003) was used to assess individual differences in emotion regulation strategies. The questionnaire, which consists of two subscales, Suppression and Cognitive Reappraisal, is scored on a 7-point Likert scale (1=*strongly disagree*, 7=*strongly agree*). The Turkish adaptation study of the scale was conducted by Eldeklioğlu and Eroğlu (2015), and the original two-factor structure was confirmed. In the adaptation study, Cronbach's alpha coefficients were reported as 0.73 for suppression and 0.78 for cognitive reappraisal, while test-retest correlations were 0.74 for cognitive reappraisal and 0.72 for suppression. In the current study, internal consistency coefficients were calculated as 0.75 for the Suppression subscale and 0.78 for the Cognitive Reappraisal subscale.

Impact of events scale - revised (IES-R)

The Impact of Events Scale-Revised (IES-R), developed by Horowitz et al. (1979) to assess traumatic stress symptoms, was revised by Weiss and Marmar (1997) to improve its psychometric properties. The adaptation of the revised form to Turkish was conducted by Çorapçıoğlu et al. (2006). The IES-R, which consists of 3 subscales—Hyperarousal (6 items), Avoidance (8 items), and Intrusion (8 items)—is scored on a 5-point Likert scale (0=*not at all*, 4=*very much*). The correlation of the whole scale with the CAPS scale was found to be $r=.71$, with the subscales correlating as follows: $r=.70$ for intrusion, $r=.64$ for hyperarousal, and $r=.50$ for the avoidance subscale. The Cronbach's alpha coefficient for the scale has varied between 0.87 and 0.94 in different groups, indicating good internal consistency. In the present study, the Cronbach's alpha for the total scale was 0.91.

Data analysis

Data were analyzed using IBM SPSS Statistics 26 and LISREL 8.80. Before the structural equation model (SEM) analyses were performed, data has been screened in order to ensure the suitability. Firstly, skewness and kurtosis values were examined for testing the assumption of normality, The results indicated that skewness (−1.35 to 0.738) and kurtosis (−0.816 to 1.094) values fell within this range, supporting the assumption of normality according to Tabachnick and Fidell (2013). Since memory variables are closely related to each other, multicollinearity was assessed using Variance Inflation Factor (VIF) and tolerance values. It is indicated that VIF values ranged from 1,120 to 3,215 and tolerance values were above 0.31, so that multicollinearity was not a concern in the present study (Hair et al., 2018).

Since all assumptions have been met, the data were found to be suitable for SEM. In the study, it was followed the two-step approach recommended by Anderson and Gerbing (1988). In the first step, a measurement model was tested using Confirmatory Factor Analysis (CFA) to verify the construct validity of the latent variables. In the second step, the structural model was tested to evaluate the hypothesized direct and indirect relationships.

Procedure

Following approval from the Ankara University Ethics Committee (decision number 129), the questionnaires were distributed to participants. After providing informed consent, participants completed a demographic form and the ERQ. Then, they were then presented with the instruction: "Describe an event that happened to you in the past that you think had a traumatic effect on you" Following this open-ended memory-writing task, they completed the Phenomenological Characteristics of Traumatic Memory Form and the IES-R.

Results

After requiring assumptions mentioned in the method section had been met, descriptive statistics and correlational analysis were performed in order to reveal the sample structure and the relationships between all variables (see Table 1). The Impact of Events Scale score, representing traumatic stress, showed significant positive correlations with nearly all memory characteristics and with suppression, ranging from 0.13 to 0.55.

Cognitive reappraisal model

Before proceeding to the model analysis, the measurement models were tested with confirmatory factor analysis in order to determine the relationships between latent and observed variables. In the measurement model for the variables of cognitive reappraisal, event characteristics of traumatic memory, voluntary recall, recollection characteristics and traumatic stress level, 2 latent variables and 12 observed variables were used. As a result of the analysis, it was found that the measurement model did not fit the data. It was found that the standardized beta values obtained were in the range of λ = 0.63–1.00.63.00 and the error variance values were in the range of $\varepsilon = 0$ −0.63) ($\chi 2/df = 4.43$, AGFI = 0.81, GFI= 0.89, CFI = 0.95, RMSEA = 0.11). In line with the mode indices proposed to the current model, the error variances of the observed variables of importance-self-definition, intensity- consequences and visual imagery-auditory imagery, which are theoretically compatible with each other, were correlated with each other. According to the findings of the newly proposed measurement model, it was observed that the data and measurement tools were compatible at an acceptable level. It was found that the standardized beta values obtained were in the range of $\lambda = 0.54$ 1.00 and the error variance values were in the range of $\varepsilon = 0$ −0.53 ($\chi 2/df = 3.06$, AGFI = 0.87, GFI = 0.92, CFI = 0.97, RMSEA = 0.087).

After the measurement model was validated, the proposed structural model was tested. The model provided a

Table 1 Means, standard deviations and correlations of variables

	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Importance	4.88 (1.96)	-														
2.Self Definition	3.77 (2.13)	0.64**	-													
3.Emotional Intensity	5.97 (1.56)	0.46**	0.36**	-												
4.Consequences	5.29 (1.85)	0.68**	0.53**	0.52**	-											
5. Autonoetic A.	5.55 (1.81)	0.47**	0.40**	0.53**	0.58**	-										
6.Intrusion	5.04 (2.07)	0.48**	0.32**	0.47**	0.57**	0.50**	-									
7.Distress	5.16 (1.97)	0.39**	0.29**	0.45**	0.53**	0.48**	0.57**	-								
8.Voluntary recall	3.20 (1.91)	0.40**	0.30**	0.34**	0.50**	0.38**	0.63**	0.52**	-							
9.Vividness	5.39 (1.79)	0.51**	0.32**	0.60**	0.55**	0.57**	58**	0.55**	0.48**	-						
10. Auditory Imagery	4.73 (2.04)	0.31**	0.17**	46**	0.38**	0.44**	0.55**	0.42**	0.50**	0.58**	-					
11.Visual Imagery	5.40 (1.83)	0.46**	0.26**	54**	0.54**	0.62**	0.59**	0.55**	0.44**	0.72**	0.68**	-				
12.Over-generalization	2.90 (2.45)	0.09	0.19**	0.025	0.20**	0.061	0.16**	0.13*	0.19**	0.06	0.07	.−00	-			
13. CR	19.63 (4.85)	0.28**	0.16**	0.36**	0.33**	0.18**	0.18**	0.17**	0.14*	0.27**	0.17**	0.28**	0.03	-		
14. Suppression	9.10 (3.56)	0.13*	17**	0.17**	0.12*	0.10	0.10	0.07	0.15*	0.10	0.10	0.12*	−0.12	0.21**	-	
15.IES-R	32.13 (17.90)	0.19**	17**	0.08	0.29**	0.42**	0.42**	0.38**	0.55**	0.21**	0.30**	0.28**	0.16**	0.02	0.13*	-

good fit to the data ($\chi 2/df$=2.99, AGFI = 0.87, GFI = 0.92, CFI = 0.97, RMSEA = 0.085). The standardized coefficients for direct, indirect, and total effects are presented in Table 2. The validated model is shown in Fig. 3.

Table 2 shows that CR scores are directly associated with the event characteristics (β=0.40, t=6.12, p <.001). It was observed that event characteristics are directly associated with both recollection characteristics (β=0.70, t = −9.61, p <.001) and voluntary recall (β=0.56, t=8.18, p <.001). Finally, voluntary recall was found to be related recollection characteristics (β=0.22, t=4.12, p <.001) and traumatic stress (β=0.56, t=8.73, p <.001). The results of the mediation analyses revealed that the relationship between CR and voluntary recall, which was significant in the measurement model (β=0.14, t=2.39, p <.05) became non-significant in the structural model (β = − 0.08, t=−1.46, p >.05), indicating full mediation via event characteristics with an indirect effect of β=0.22 (0.40 × 0.56). Similarly, the direct relationship between event characteristics and traumatic stress (β=0.25, t=4.51, p <.001 became non-significant (β = −0.09, t=−0.91, p >.05), and full mediation was identified through voluntary recall with an indirect effect of β=0.31 (0.56 × 0.56). Finally, regarding the relationship between event characteristics and recollection characteristics, partial mediation was observed with an indirect effect of β=0.12 (0.56 × 0.22) through voluntary recall.

Suppression model

A similar two-step process was used for the suppression model. In this model event characteristics of traumatic memory, involuntary recall, recollection characteristics and traumatic stress level, 2 latent variables and 12 observed variables were used. As a result of the analysis, the measurement model was found to be consistent with the data. It was found that the standardized beta values obtained were in the range of λ=0.64–1.00.64.00 and the error variance values were in the range of ε=0 −0.59) ($\chi 2/df$=4.15, AGFI = 0.83, GFI= 0.89, CFI = 0.96, RMSEA= 0.10). On the other hand, the error variances of the theoretically compatible observed variables of importance-self-definition, intensity-consequences and visual imagery-auditory imagery were correlated with each other in line with the mode indices made to improve the fit indices values a little more. According to the findings of the newly proposed measurement model, it was observed that the data and measurement tools were compatible. It was found that the standardized beta values obtained were in the range of λ=0.55–1.00.55.00 and the error variance values

Table 2 Direct, indirect, and total effects related to cognive reappraisal model

			Direct Effecs (β)	Indirect Effecs (β)	Total Effecs (β)	t (Direct)
CR	→	Event Char.	0.40	-	0.40	6.12***
Event Char.	→	Voluntary Recall	0.56	-	0.56	8.18***
Voluntary Recall	→	Recolleciton Char.	0.22	-	0.22	3.12***
Voluntary Recall	→	Traumatic Stress	0.56	-	0.56	8.73***
Event Char.	→	Recolleciton Char.	0.70	0.12	0.82	9.62***
Event Char.	→	Traumatic Stress	−0.09	0.31	0.22	−0.91
CR	→	Voluntary Recall	−0.08	0.22	0.14	−1.46

Indirect effects were calculated using the product-of-coefficients method

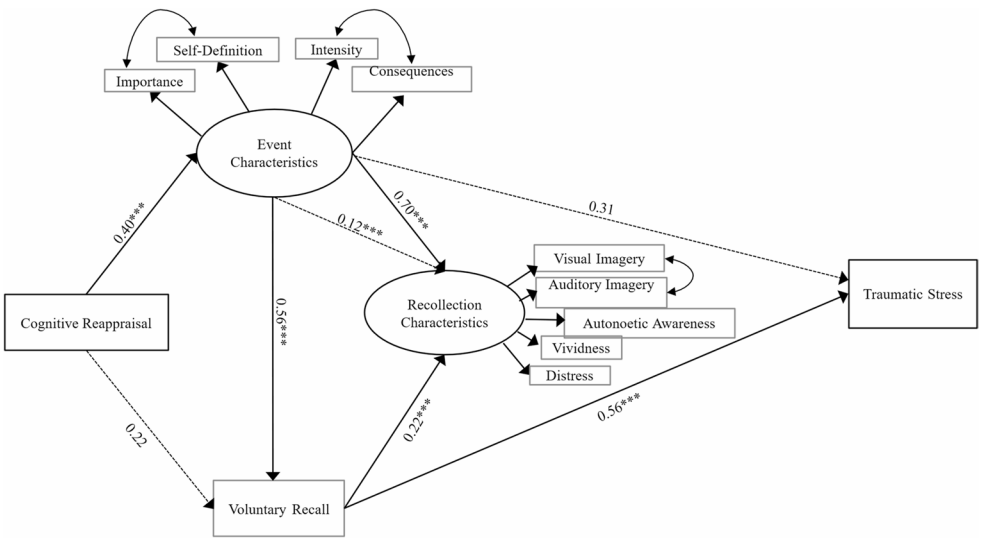


Fig. 3 Latent construct model of traumatic stress led by cognitive reappraisal

were in the range of $\varepsilon = 0 - 0.70$ ($\chi 2/df = 2.84$, AGFI = 0.88, GFI = 0.93, CFI = 0.97, RMSEA = 0.082).

After optimization of the measurement model, the revised model achieved an acceptable fit ($\chi 2/df = 2.69$, AGFI = 0.88, GFI = 0.93, CFI = 0.97, RMSEA = 0.078). The standardized coefficients for direct, indirect, and total effects among the variables are presented in Table 3. The schematic of the model is presented in Fig. 4.

According to the results, suppression scores are directly and positively related to event characteristics ($\beta = 0.27$, $t = 2.65$, $p < .01$). It was found that event characteristics are directly related to both recollection characteristics ($\beta = 0.59$, $t = 8.31$, $p < .001$) and intrusion ($\beta = 0.63$, $t = 10.15$, $p < .001$). Finally, the direct effects of intrusion on recollection characteristics ($\beta = 0.39$, $t = 4.61$, $p < .001$) and traumatic stress ($\beta = 0.35$, $t = 5.85$, $p < .001$) were significant. However, the relationship between event characteristics and traumatic stress score ($\beta = 0.26$, $t = 4.34$, $p < .001$), which was found to be significantly related in measurement model, lost its significance ($\beta = -0.06$, $t = -0.48$, $p > .05$). The indirect effect of event characteristics on traumatic stress through intrusion was calculated as $\beta = 0.25$ (0.63×0.39) The loss of significance in the direct path indicates full mediation. While the direct relationship between event characteristics and recollection characteristics remained significant ($\beta = 0.59$, $t = 8.31$, $p < .001$), an indirect effect of $\beta = 0.22$ (0.63×0.35) was observed through intrusion. This finding confirms partial mediation in this relationship.

Discussion

The present study examined the relations between emotion regulation strategies, including suppression and cognitive reappraisal, and the phenomenological characteristics of traumatic memories and further examined the extent to which these effects are associated with subsequent levels of traumatic stress. Building on the latent construct model of memory (Fitzgerald & Broadbridge, 2013), we found that different emotion regulation strategies may contribute to elevated traumatic stress scores by influencing various characteristics of memory in distinct ways. Our findings support the hypothesis that it is the nature of this memory processing, rather than the regulation strategy in isolation, that drives trauma-related distress.

In their pioneering study, Fitzgerald and Broadbridge (2013) proposed that the formation, retrieval, and evaluation of human memory are distinct cognitive processes and

Table 3 Direct, indirect, and total effects related to suppression model

			Direct Effecs (β)	Indirect Effecs (β)	Total Effecs (β)	t (Direct)
Suppression	→	Event Char.	0.17	-	0.17	2.65**
Event Char.	→	Intrusion	0.63	-	0.63	10.15***
Intrusion	→	Recollection Char.	0.35	-	0.35	5.85***
Intrusion	→	Traumatic Stress	0.39	-	0.39	4.61***
Event Char.	→	Recollection Char.	0.59	0.22	0.81	8.31***
Event Char.	→	Traumatic Stress	−0.06	0.25	0.19	−0.48
Suppression	→	Intrusion	-	0.11	0.11	-

Indirect effects were calculated using the product-of-coefficients method

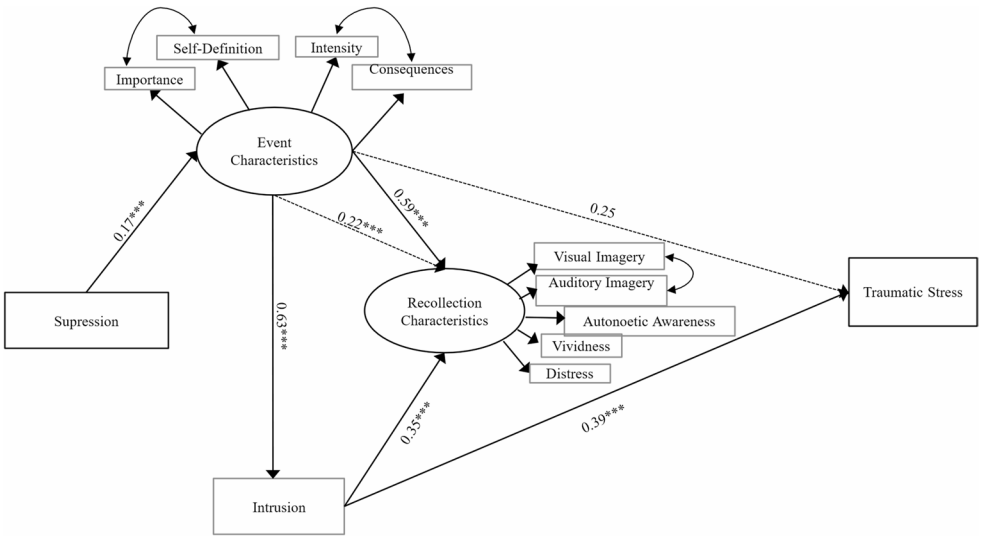


Fig. 4 Latent construct model of traumatic stress led by suppression

proposed a four-factor structural equation model. Building on this, Öner and Gülgöz (2016), arguing that these latent constructs may be influenced by individual differences extended the model by incorporating attachment dimensions. The results of their study indicate that autobiographical memory structures appear to be influenced by individual differences. Therefore, individual differences were also addressed in the present study.

The relationship between emotion regulation strategies and autobiographical memory dimensions, as well as the reflection of these relationship patterns on psychopathology, was investigated from the perspective of clinical psychology. The hypothesis was that the aforementioned relationship networks could be effective in their associations with traumatic stress, with traumatic experiences being selected as the type of memory. The hypothesis that emotion regulation strategies (cognitive reappraisal/suppression), regarded as a type of individual difference, may contribute trauma maintenance by impacting latent memory dimensions was examined using two distinct models.

Cognitive reappraisal model

The analysis of the findings reveals that cognitive reappraisal was positively associated with traumatic event-related characteristics. The participants exhibited a propensity to re-evaluate the traumatic event they had experienced, perceiving it as a significant, self-defining, and intense experience. They attributed various consequences to the event, underscoring its impact on their lives. This finding appears to contradict Colombo et al. (2021) who suggest that individuals using cognitive reappraisal tend to underestimate the negativity of events over time. Similarly, Levine et al. (2012) found that individuals who used cognitive reappraisal during stressful situations reported more positive emotions upon recall, suggesting that, despite similar regulation strategies, negative or stressful events are evaluated differently from traumatic events, whose impact diminishes over time, with the effect of the latter diminishing over time. Whilst the valence of the event was not evaluated in the present study, the negative nature of the traumatic event means that the phenomenological variables in which the event characteristics are expressed are considered to be of negative importance, intense, self-defining, and consequential. In addition, the cognitive reappraisal strategy was found to be correlated with voluntary recall of the memory through event features. This finding emphasizes the pivotal role of event characteristics in the process of memory recall. Through the utilization of the cognitive reappraisal strategy, individuals come to recognize the significance, intensity, and personal defining nature of the traumatic event. This realization might subsequently lead to an increase in deliberate thinking about the event.

Secondly, it was found that event characteristics are positively associated both recollection characteristics and voluntary thinking, and that voluntary thinking are positively correlated with recollection characteristics. In short, significant, self-defining, consequential, and intense traumatic memories are voluntarily revisited. These memories are vivid and distressing and are characterized by vivid sensory experiences, particularly visual and auditory, and are accompanied by a strong sense of self-awareness, known as autonoetic awareness. A review of the extant literature yielded findings that were consistent with the conclusions of the present study. Specifically, Fitzgerald and Broadbridge's (2013) study identified that event characteristics and way of recall (voluntary/intrusive) were associated with recollection characteristics. This pattern was found to be valid for all types of memories investigated in the study (early period/clearly remembered/most stressful/recalled with a cue-word). In a similar vein, Öner and Gülgöz (2016) established that recollection characteristics were correlated. In addition, it was found that the way of recall mediated the relationship between event characteristics and recollection characteristics. This mediation mechanism may be applicable to many studies that demonstrate that negative events are more frequently remembered in detail (see Christianson, 1992).

Regardless of valence, more emotionally intense events tend to be repeated more frequently, thereby ensuring the preservation of recollection characteristics (Walker et al., 2009). Although fading affect bias research suggests that highly intense negative memories fade faster than positive ones (Skowronski et al., 2014), this effect was not observed in the current model, indicating that it may not apply to traumatic memories—possibly because non-traumatic negative events are not repeatedly recalled.

Finally, the hypothesis that recollection characteristics would be related to traumatic stress was not confirmed and did not appear as a significant pathway in the model. Although the effect of autobiographical memory processes on psychological health cannot be denied (for a meta-analysis, see van Vreeswijk & Wilde, 2004), this may have been due to the fact that it was not strong enough to show a statistically significant relationship as much as a predictor variable. It is acknowledged that numerous other variables may also be effective in determining traumatic stress, including demographic variables such as gender, ethnicity, educational level, and marital status (Breslau et al., 1995). A multitude of variables have been identified as significant predictors of traumatic stress. These include pre-traumatic psychological health, previous trauma exposure, personality structure, the type and severity of the traumatic event, perceived threat, social support, and trauma-related cognition

(Sayed et al., 2015). Consequently, the impact of traumatic memory recollection characteristics may be overshadowed by other, statistically stronger variables. Furthermore, when analyzing the model specifically, voluntary recall emerges as a strongly associated with traumatic stress. This voluntary recall has been shown to be directly related to traumatic stress and to mediate the relationship between event characteristics and the traumatic stress score. According to the DSM-5, intrusive memories that are not within a person's control are one of the Cluster B criteria of PTSD (APA, 2013). Conversely, the form of repetition considered in the model, voluntary recall, refers to a different phenomenon. Voluntary recall implies the deliberate consideration of an event by an individual. However, observations revealed that voluntary recall functioned as a type of intervening memory mechanism within the model. This may be due to the fact that the participants in the study perceived the statement, "Since the event happened, I have been thinking about this event, used to measure voluntary recall, as a kind of ruminative process and gave high scores by thinking in this context while scoring the item. Another possible explanation could be that "the memory was recalled intentionally through the cognitive reappraisal strategy; however, the emotion regulation capacity was not effective enough to regulate the memory of the traumatic event, resulting in an increase in the traumatic stress score.

Suppression model

A salient finding in the second model is the non-significant relationship between suppression and intrusion. Hypotheses concerning the relationship between suppression and intrusion have been extensively discussed in the clinical psychology literature, with their origins tracing back to the psychodynamic perspective. Wegner (1994), a pioneering figure in the empirical study of this relationship, noted the phenomenon of the ironic effect of suppression. Subsequent studies on this subject have revealed that the emotions and thoughts that individuals attempt to suppress, paradoxically, become more readily accessible in memory and manifest in a repetitive manner (Wenzlaff & Wegner, 2000). This phenomenon has also been frequently encountered in trauma studies (Aikins et al., 2009; Brewin & Holmes, 2003; Chukwuorji et al., 2017; Ehlers & Steil, 1995).

Although fewer in number, there are also studies in the literature that argue for different directions of relationship between suppression and interference. Firstly, Levy and Anderson (2012) examined studies employing neurocognitive techniques, thereby introducing the concept of retrieval suppression as an individual difference. Suppression of recall is accomplished by control mechanisms that block unwanted memories and impede recollection, even when it is desired. Streb et al. (2016) conducted an experimental study to test this phenomenon, discovering that recall suppression reduced the level of interference. The experimental study procedure involved the performance of a four-step think-no-think (TNT) task by participants, followed by the viewing of a movie with trauma content. The results showed that participants with high performance in suppressing memory recall reported fewer intrusions than participants with low performance. The researchers have discussed this concept in the context of a skill. The lack of association in the present model may reflect individual differences; alternatively, even individuals prone to suppression may not suppress traumatic memories—given their strong recall (e.g., Blix et al., 2020; Morina et al., 2013)—which may explain the positive relationship between suppression and event characteristics.

Event characteristics were positively associated with both recollection characteristics and intrusion level. Additionally, intrusion was positively related to recollection characteristics. The patterns observed in the CR model were also observed in this model. The relationship between intrusions and recollection characteristics is well established, with intrusive memories recalled more clearly than non-intrusive ones (e.g., Bywaters et al., 2004) and associated with heightened visual and auditory detail in both depression (Williams & Moulds, 2007) and PTSD (Ehlers et al., 2002). Consistent with the CR model, a mediating effect of event characteristics on recollection characteristics was also observed.

The relationship between recollection characteristics and traumatic stress did not form a significant path. It is thought that the reason for this situation is that—in parallel with the CR model— the association between recollection characteristics and traumatic stress decreased or disappeared due to the presence of stronger variables associated with trauma.

Finally, the level of intrusion was found to be both directly related to traumatic stress and to mediate the relationship between event characteristics and the traumatic stress score, findings that are consistent with the extant literature. Since intrusion is strongly associated with trauma, it is considered one of the three symptom groups determining the diagnosis (Kaya Kızılöz & Altan Atalay, 2018). Consequently, in the present sample, the finding that intrusion is associated with traumatic stress and attenuates the relationship between event characteristics and traumatic stress symptoms when included in the model is consistent with the extant literature.

General discussion on models

There is a consensus that traumatic experiences and autobiographical memory are inextricably linked. The impact of a trauma-related memory on people underlines the central role autobiographical memory plays after trauma (Bryant, 2015).

Berntsen (2009) mentions two different views regarding how traumatic events are encoded. According to the special mechanisms view, traumatic events are highly accessible as intrusive memories but difficult to retrieve voluntarily. This is attributed to disruptions in normal processing caused by intense emotions and violations of schema-based expectations. As a result of faulty encoding, traumatic memories are poorly integrated into autobiographical knowledge and may be partially or fully dissociated, further hindering voluntary recall.

In contrast, the basic mechanisms view challenges the main principle mentioned in the special mechanisms view. According to this alternative model, it is hypothesized that the emotional arousal and novelty of the traumatic event increase encoding in general and thus subsequent access, both in terms of voluntary and intrusive recollection. In summary, our results show that traumatic memories can be recalled through both voluntary and intrusive pathways, and that both pathways lead to distress. This aligns with the basic mechanisms view, which argues that traumatic memories operate under the same general principles. It seems that traumatic memories characterized by enhanced emotional arousal and novelty lead to stronger encoding and greater accessibility through multiple routes, as do other highly emotional memories (Berntsen, 2009; Rubin et al., 2008).

Model results indicated that both emotion regulation strategies were associated with the characteristics attributed to the traumatic event. In other words, individuals who use both suppression and cognitive reappraisal strategies see the traumatic event as important and self-defining, intense, and consequential. McAdams et al. (1996) suggested that the life story includes experiences called peaks, turning points, and bottom points, and that the meanings attached to these experiences determine many issues. Cox and McAdams (2014) suggest that the ability to regulate emotions in life-story construction predicts emotion regulation in general, and argue that emotionally valuable life-story episodes reveal important themes related to emotional processes and psychological well-being. At this point, the meanings attached to the emerging themes become important. In other words, how an individual construes the meaning of both positive and negative experiences is related to how that individual will manage emotions in the future. Since traumatic memories were interpreted negatively by individuals who used both suppression and cognitive reappraisal strategies, they were associated with traumatic stress scores in both models. On the other hand, there is a need for further research into how individuals utilize different emotion regulation strategies during the processing of trauma and the subsequent impact these strategies have on general emotion regulation. The development of longitudinal studies to investigate these phenomena is recommended.

In conclusion, the current models suggest that different emotion regulation strategies, one of which is considered relatively "healthier," are both associated with traumatic stress through certain pathways. More precisely, the predominant emotion regulation strategy employed by an individual experiencing a traumatic event does not directly determine the severity of the trauma; rather, it is effective through the way the trauma is processed in terms of memory. Consequently, the processing and reprocessing of trauma information within a therapeutic stage is regarded as being of considerable significance.

Limitations

In addition to the evaluation of the research outputs and the points that will be reflected in the field of practice, it is considered important to also identify the points that could not be addressed within the scope of the current study due to practical or technical limitations. Firstly, the current study is characterized by a limited age and education level range. Moreover, the majority of the sample consists of women. It is recommended that a more heterogeneous sample in terms of variables such as age, gender, and education level should be preferred in future studies to increase generalizability. Secondly, the research design was based on memory variables; potential variables such as the type of trauma, personality traits of the victim, perceived level of control and threat status, and sources of social support, etc., that could be related to trauma were not taken into account. Although the effect of autobiographical memory variables on psychological health cannot be ignored, it has been observed that when considered as a related variable, it cannot compete with other variables and reflects weaker statistical relationships. For this reason, it is suggested that confounding variables that may be effective in future studies should be determined and included in the equation.

Conclusion

In summary, notwithstanding certain limitations, the current study can be regarded as one of the pioneering efforts to examine the relationship between emotion regulation strategies and the latent constructs of traumatic autobiographical memory. In this regard, the study not only offers an original contribution to the existing body of knowledge but also facilitates a profound understanding of how affective processes interact with the mental representations of past experiences. From a clinical perspective, this underscores the importance of therapeutic interventions that target not only the content of a traumatic memory but also the maladaptive cognitive processes—be it rumination or the management of intrusions—that keep it alive and distressing.

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Data availability The supporting data for this study is available upon request from the corresponding author. Public availability is limited due to confidentiality requirements.

Declarations

Ethics statement Approval for this research was granted by the Ankara University Ethic Committee (decision numbered 129).

Consent to participate Informed consent was secured from each participant before participation.

Disclosure of interest The authors declare that there are no financial, personal, or professional conflicts of interest that could have influenced the work reported in this manuscript.

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