

RESEARCH ARTICLE

Catastrophizing, rumination, and reappraisal prospectively predict adolescent PTSD symptom onset following a terrorist attack

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Background: Disruptions in emotion regulation are a transdiagnostic risk factor for psychopathology. However, scant research has examined whether emotion regulation strategies are related to the onset of posttraumatic stress disorder (PTSD) symptoms among youths exposed to trauma. We investigated whether pretrauma emotion regulation strategies prospectively predicted PTSD symptom onset after the 2013 Boston Marathon terrorist attack among adolescents and whether these associations were moderated by the degree of exposure to media coverage of the attack.

Methods: A sample of 78 Boston-area adolescents (mean age = 16.72 years, 65% female) who previously participated in studies assessing emotion regulation and psychopathology were recruited following the terrorist attack. Within 4 weeks of the attack, we assessed self-reported PTSD symptoms and attack-related media exposure via an online survey. We examined the association of pretrauma emotion regulation strategies with PTSD symptom onset after adjustment for pretrauma internalizing symptoms and violence exposure.

Results: Greater pretrauma engagement in rumination predicted onset of PTSD symptoms following the attack. Adolescents who engaged in catastrophizing also had greater PTSD symptoms postattack, but only when exposed to high levels of media coverage of the attacks; the same pattern was observed for adolescents who engaged in low levels of cognitive reappraisal.

Conclusions: Engagement in specific emotion regulation strategies prior to a traumatic event predicts the onset of PTSD symptoms among youths exposed to trauma, extending transdiagnostic models of emotion regulation to encompass trauma-related psychopathology in children and adolescents.

KEYWORDS

adolescent, cognition, emotion, posttraumatic, stress disorders, terrorism

1 | INTRODUCTION

Trauma exposure is common. A majority of individuals experience a traumatic event at some point in their lifetime, with most exposed to their first event as a child or adolescent (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; McLaughlin et al., 2013). Despite pervasive exposure to trauma, the probability of developing posttraumatic stress

disorder (PTSD) following a traumatic event is low (Breslau et al., 1998; Kessler et al., 1995; McLaughlin et al., 2013). Most individuals do not develop PTSD, even after exposure to traumatic events associated with the highest conditional risk of PTSD (Dohrenwend et al., 2006; McLaughlin et al., 2013; Widom, 1999). Identifying vulnerability factors that increase the risk of PTSD following trauma exposure is critical to inform models of PTSD etiology and develop effective preventive interventions. Habitual engagement in specific types of maladaptive emotion regulation strategies (i.e., trait emotion regulation) has been identified as a transdiagnostic risk factor for psychopathology (Aldao & Nolen-Hoeksema, 2010; Aldao, Nolen-Hoeksema, & Schweizer, 2010).

Abbreviations: CDI, Children's Depression Inventory; CERQ, Cognitive Emotion Regulation Questionnaire; IES-6, Impact of Events Scale-6; IES-R, Impact of Events Scale-Revised; MASC, Multidimensional Anxiety Scale for Children; PTSD, posttraumatic stress disorder; SAVE, Screen for Adolescent Violence Exposure

However, little is known about whether pretrauma variation in the use of specific emotion regulation strategies prospectively predicts PTSD onset in trauma-exposed youths.

Disruptions in emotion regulation represent a transdiagnostic risk factor for psychopathology, particularly internalizing disorders (Aldao & Nolen-Hoeksema, 2010; Aldao et al., 2010), and have been targeted in PTSD interventions (Cloitre, Koenen, Cohen, & Han, 2002; Cloitre, Stovall-McClough, & Noonan, 2010). In longitudinal studies of adults, cognitive emotion regulation strategies involving conscious efforts to modulate the intensity or duration of responses to emotionally salient cues (Beck, Emery, & Greenberg, 2005; Garnefski & Kraaij, 2007; Garnefski, Kraaij, & van Etten, 2005; Thompson, 1991), have been examined as a predictor of PTSD. Specifically, greater engagement in catastrophizing—overestimating the negative consequences of an event (Bryant & Guthrie, 2005; Gellatly & Beck, 2016) and rumination—the passive and repetitive focus on the causes and consequences of one's distress (Ali, Dunmore, Clark, & Ehlers, 2002; Nolen-Hoeksema & Morrow, 1991; Spinhoven, Penninx, Kremenjiou, van Hemert, & Elzinga, 2015) have each been associated with heightened risk for developing PTSD symptoms following a traumatic event. Alternatively, habitual use of adaptive strategies pretrauma such as positive reappraisal—the tendency to positively reframe the consequences of an event (Ali et al., 2002) and engagement in problem-solving (Dirkzwager, Bramsen, & van der Ploeg, 2003)—may reduce vulnerability for PTSD.

Most studies examining the association between emotion regulation and PTSD among youth have been cross-sectional. In one such study of adolescents exposed to war-related trauma, greater engagement in rumination and blaming others were concurrently associated with higher levels of PTSD symptoms, whereas putting experiences into perspective and problem-solving were associated with lower levels of PTSD symptoms (Amoné-P'Olak, Garnefski, & Kraaij, 2007). Greater engagement in rumination *after* a traumatic event predicted prospective increases in PTSD symptoms in a sample of children and adolescents (Ehlers, Mayou, & Bryant, 2003); however we are unaware of studies among youth examining rumination *prior* to the traumatic event. One prospective study in children with indirect exposure to the 9/11 terrorist attack observed pretrauma negative appraisal and avoidant coping strategies to be associated with the development of PTSD symptoms posttrauma (Lengua, Long, & Meltzoff, 2006). Overall, findings among youth suggest that emotion regulation strategies prior to a traumatic event might predict PTSD symptoms post-trauma. However, prospective investigations including pretrauma assessment of emotion regulation strategies are needed to clarify these relationships.

The use of prospective designs to examine pretrauma risk factors for PTSD onset is of particular importance because individual characteristics, such as preexisting psychopathology and previous exposure to trauma and adversity, are associated with increased risk for both experiencing a traumatic event and PTSD onset (Breslau, 2002; Breslau, Davis, & Andreski, 1995; Breslau et al., 1998; Kessler et al., 1995; Smid et al., 2012). The strong relationship between pretrauma factors and trauma exposure makes it difficult to separate vulnerability factors for PTSD from vulnerability factors that select individuals into

environments that increase risk for trauma exposure, such as sociodemographic characteristics and preexisting psychopathology. However, certain events, such as acts of terrorism, are less related to individual characteristics that may confound risk for trauma exposure with risk for PTSD onset than most traumatic events (i.e. car accidents, interpersonal violence) (Comer et al., 2014; Hoven et al., 2005; Otto et al., 2007; Pfefferbaum et al., 1999). Studying terrorism and other traumatic events that are unassociated with individual characteristics permits identification of vulnerability factors for PTSD that are unrelated to the risk of being exposed to trauma. Accordingly, the present study examined the prospective relationship between pretrauma emotion regulation strategies and the onset of PTSD symptoms among Boston-area adolescents following the 2013 Boston Marathon terrorist attack.

Although direct exposure to terrorism is often limited, exposure to media coverage following acts of terrorism, such as the 9/11 and Oklahoma City terrorist attacks, is pervasive among youth (Otto et al., 2007; Pfefferbaum et al., 2001, 2003). Youth may be especially vulnerable to the impact of media coverage due to perception of increased probability of harm following disasters and terrorism (Comer, Furr, Beidas, Weiner, & Kendall, 2008; Kiser et al., 1993). Indeed, terrorism-related media coverage has been associated with development of PTSD among youth (Comer et al., 2014; Otto et al., 2007; Pfefferbaum et al., 2001), even among those living a substantial distance from the attack origin (Pfefferbaum et al., 2003). However, little is known about how such media exposure moderates the influence of preexisting variation in emotion regulation strategies on PTSD symptom onset.

The terrorist attack at the 2013 Boston Marathon directly affected hundreds of participants and spectators, but had a much broader indirect impact on residents of Boston due to the unprecedented shelter-in-place warning issued by police during the search for the perpetrator (Comer et al., 2014). Schools and workplaces were closed in response to the city lockdown, and many Boston residents observed the televised manhunt and widespread media speculation regarding the presence of other explosive devices throughout the city. We assessed trait emotion regulation strategies among Boston-area adolescents preattack and had the unique opportunity to examine prospective associations with PTSD symptom onset postattack and whether these associations varied as a function of attack-related media exposure.

We hypothesized that greater trait engagement in maladaptive emotion regulation strategies pretrauma, specifically catastrophizing and rumination, would predict higher levels PTSD symptoms. In contrast, we expected that pretrauma adaptive emotion regulation strategies, specifically positive reappraisal and problem-solving, would be negatively associated with PTSD symptoms following the attack. Given the strong associations of both pretrauma internalizing psychopathology and prior trauma exposure with risk for PTSD (Koenen et al., 2008; McLaughlin et al., 2013), we examined whether associations persisted after controlling for pretrauma internalizing symptoms and violence exposure. Finally, we examined whether attack-related media exposure moderated the associations of pretrauma emotion regulation strategies with PTSD symptoms.

2 | MATERIALS AND METHODS

2.1 | Participants and procedures

Within two to four weeks following the 2013 Boston Marathon terrorist attack, we requested parental consent to recontact all adolescents who had participated in one of two studies conducted in the laboratory of the senior author within two years prior to the attack. These prior studies examined stress, emotion regulation, and stress reactivity in adolescence; recruitment for the original two studies utilized community-based advertising within metropolitan Boston (details about these studies are reported elsewhere (McLaughlin, Alves, & Sheridan, 2014; McLaughlin, Sheridan, Alves, & Mendes, 2014)). In these prior studies, adolescents provided information on emotion regulation strategies, violence exposure, and internalizing symptoms during in-person visits to the laboratory. A total of 219 adolescents and parents were recontacted. Of those, 78 adolescents age 14–19 (65% female) agreed to participate in the study within the 2-week window of recruitment following the recontact request. Nonresponse to our request was almost exclusively related to the inability to reach families within this brief 2-week timeframe. The present sample included relatively more females and White participants and had higher preattack rumination and depression symptoms ($P_s < .05$), but did not differ on age, other preattack emotion regulation strategies, preattack violence exposure, or anxiety symptoms ($P_s > .08$) compared to nonresponders. The present sample was diverse with respect to race/ethnicity: 45.5% White, 18.2% Asian, 11.7% Black, 5.2% Latino, 18.2% multi-racial, and 1.3% from other racial/ethnic groups. Once adolescents were consented by their parents to participate in the study, information on attack-related media exposure and current PTSD symptoms was gathered in an online survey. All participants reported exposure to media coverage of the bombings on the day of the marathon, and all but two participants (who declined to respond) reported exposure to media coverage of the shelter-in-place order. No participants reported being injured during the attack and few directly witnessed attack related events (i.e., medical personnel attending injured individuals; $n = 3$). This research was approved by the Institutional Review Board at Harvard University and complied with the Code of Ethics of the World Medical Association (Declaration of Helsinki).

2.2 | Measures

2.2.1 | Pretrauma emotion regulation strategies

Pretrauma emotion regulation strategies were assessed using the Cognitive Emotion Regulation Questionnaire (CERQ) (Garnefski & Kraaij, 2007). The CERQ is a 36-item measure that asks participants to indicate the degree of engagement in specific cognitive strategies when experiencing negative or unpleasant events on a 5-point Likert scale from 1 (almost never) to 5 (almost always). Responses were summed to create subscales for each of the four cognitive strategies hypothesized to relate to PTSD symptoms posttrauma: rumination, catastrophizing, positive reappraisal, and refocus on planning (hereafter called problem-solving). The CERQ measures an additional five emotion regulation strategies that were not relevant to study hypothe-

ses (self-blame, other-blame, putting things into perspective, and positive refocusing/distraction; see Supplement 1). Higher scores indicate greater frequency of engagement in each cognitive strategy. The CERQ has good reliability and validity (Garnefski & Kraaij, 2007) and all subscales demonstrated adequate reliability in this sample ($\alpha = .66-.84$).

2.2.2 | Media exposure to the terrorist attack

Media exposure to the terrorist attack was assessed using two online survey questions administered as part of a larger survey within 2 to 4 weeks of the Boston Marathon terrorist attack. The two survey questions evaluated media exposure on the day of the attack (Monday, April 15th) and the day of the shelter-in-place warning (Friday, April 19th). Survey questions asked “approximately how much of the day on (Monday 15th/Friday 19th) did you spend watching news coverage of the event on a TV, computer, iPad, or other electronic device?” Participants indicated responses on a Likert scale ranging from 1 (none) to 5 (all day). These items were summed to create an overall media exposure composite, with higher scores reflecting greater exposure.

2.2.3 | Pretrauma violence exposure

Pretrauma violence exposure was assessed using the 32-item Screen for Adolescent Violence Exposure (SAVE) (Hastings & Kelley, 1997). The SAVE measures direct and indirect violence in school, home, and neighborhood contexts using a 5-point Likert scale to indicate frequency. The SAVE has good reliability and validity in samples of inner-city youth (Hastings & Kelley, 1997) and good reliability in our sample ($\alpha = .88$).

2.2.4 | Pretrauma internalizing symptoms

Pretrauma internalizing symptoms were assessed using the 26-item Children's Depression Inventory (CDI; suicidal ideation item removed) (Kovacs, 1992) and the 39-item Multidimensional Anxiety Scale for Children (MASC) (March, Parker, Sullivan, Stallings, & Conners, 1997). Both are widely used, well-validated measures of child psychopathology (Craighead, Smucker, Craighead, & Ilardi, 1998; Muris, Merckelbach, Ollendick, King, & Bogie, 2002) and demonstrated excellent internal consistency in our sample ($\alpha_s \geq .96$).

An overall composite of pretrauma internalizing symptoms was created for each participant by first standardizing their CDI and MASC total scores, then summing the two standardized totals to create an internalizing score, with higher scores indicating greater levels of internalizing problems.

2.2.5 | PTSD symptoms

Posttrauma PTSD symptoms *specifically related to the attack* were assessed with a brief 6-item version of the Impact of Events Scale-6 (IES-6) (Thoresen et al., 2007). Respondents rated the frequency of hyperarousal, intrusive thoughts, and avoidance experienced since the bombings on a 5-point Likert scale ranging from 0 (almost never) to 4 (almost always). The IES-6 is an abbreviated version of the Impact of Events Scale-Revised (IES-R) (Weiss, 1999). Previous studies have

TABLE 1 Descriptive statistics for pretrauma psychopathology, trait emotion regulation strategies, media exposure and demographic variables ($n = 78$)

	Mean	Standard deviation	Range
Age	16.72	1.33	14–19
CDI	11.36	6.67	0–25
MASC	48.42	19.12	2–85
Media exposure	6.63	2.13	2–10
SAVE	46.22	11.04	2–85
IES-6	5.75	5.31	0–22
CERQ subscales			
Catastrophizing	7.83	3.36	4–17
Rumination	10.96	3.60	4–20
Problem solving	11.76	3.98	5–20
Positive reappraisal	11.71	4.10	4–20

CDI, Children's Depression Inventory; MASC, Multidimensional Anxiety Scale for Children; SAVE, Screen for Adolescent Violence Exposure; IES-6, Impact of Events Scale-6 Item; CERQ, Cognitive Emotion Regulation Questionnaire.

shown that the IES-6 explains most of the variance of the IES-R (Thoresen et al., 2009), and the measure demonstrated good internal consistency in our sample ($\alpha = .89$). The present study's sample demonstrated good symptom variability. Approximately 37% of the adolescents met clinical criteria for PTSD based on a cut-off score of ≥ 7 , which has good PTSD diagnostic sensitivity and specificity (Thoresen et al., 2009).

2.3 | Data analysis

First, we examined the main effects of each emotion regulation strategy, media exposure, and pretrauma internalizing symptoms on PTSD symptoms. Next, to test our hypothesis that media exposure would moderate the association between emotion regulation strategies and PTSD symptoms, we generated two-way interaction terms between each emotion regulation strategy and media exposure. All predictor variables were standardized prior to performing interaction analyses (Hayes, 2013). For all significant interactions, simple slopes were evaluated in accordance with procedures outlined by Aiken and West (1991). Age and sex were included as covariates in all regression models. We conducted sensitivity analyses controlling for pretrauma violence exposure and internalizing symptoms using the internalizing composite. These analyses were repeated for the five additional emotion regulation strategies measured by the CERQ that were not the focus of study hypotheses (see Supplement 1).

3 | RESULTS

3.1 | Descriptive statistics

Table 1 presents descriptive statistics on all study variables. Zero-order correlations between these variables are presented in Table 2. Notably, PTSD symptoms after the attack were significantly correlated

TABLE 2 Correlations between trait emotion regulation strategies, psychopathology, media exposure, violence exposure, and demographic variables

	1	2	3	4	7	9	10	12
1. Internalizing symptoms	—							
2. Media exposure	.25*	—						
3. SAVE	.47**	.23	—					
4. IES-6	.40**	.26*	.34**	—				
5. CERQ rumination	.32**	-.02	.17	.34*	—			
6. CERQ problem solving	-.05	.10	.06	.18	.39**	—		
7. CERQ reappraisal	.00	.26*	.30*	.03	.12	.44**	—	
8. CERQ catastrophizing	.38**	.17	.13	.33**	.41**	.04	-.19	—

CERQ, Cognitive Emotion Regulation Questionnaire; SAVE, Screen for Adolescent Violence Exposure; IES-6, Impact of Events Scale-6 item.

* $P < .05$.

** $P < .001$.

TABLE 3 Results for regression models predicting PTSD symptoms

	β	SE	95% CI	P-value
Main effects				
Catastrophizing	0.51	.18	[0.15, 0.86]	.01*
Rumination	0.47	.17	[0.14, 0.80]	.01*
Problem solving	0.23	.15	[-0.08, 0.53]	.14
Positive reappraisal	-0.02	.16	[-0.33, 0.30]	.92
Media exposure	0.64	.31	[0.03, 1.25]	.04
Internalizing symptoms	1.12	.34	[0.45, 1.78]	.001
Violence exposure	2.01	.74	[0.54, 3.49]	.008
Interaction effects				
Catastrophizing \times media exposure	1.43	.63	[0.18, 2.67]	.03*
Rumination \times media exposure	0.62	.58	[-0.54, 1.78]	.29
Problem solving \times media exposure	0.05	.67	[-1.29, 1.39]	.94
Positive reappraisal \times media exposure	-1.55	.65	[-2.84, -0.26]	.02 [†]

All models control for age and sex. Separate models were run for each CERQ subscale and for main effects of pretrauma internalizing symptoms and violence exposure. They are presented in one table for ease of interpretation.

*Remained significant when controlling for internalizing psychopathology and violence exposure.

[†]Reduced to a trend when controlling for internalizing psychopathology and violence exposure.

with pretrauma internalizing symptoms, violence exposure, rumination, catastrophizing, and attack-related media exposure.

3.2 | Emotion regulation strategies and PTSD symptoms

Pretrauma catastrophizing ($\beta = .51$, $P = .01$) and rumination ($\beta = .47$, $P = .01$) were each associated with PTSD symptoms following the terrorist attack, controlling for age and sex (Table 3).¹ In contrast, no significant associations were observed between pretrauma positive reappraisal and problem-solving with PTSD symptoms.

We next examined whether emotion regulation strategies and media exposure continued to predict PTSD symptoms after controlling for pretrauma internalizing symptoms and violence exposure (each of which was independently associated with PTSD symptoms). Using this more conservative approach, the association of rumination with PTSD symptoms persisted ($\beta = .35, P = .04$), and catastrophizing maintained trend-level significance ($\beta = .35, P = .05$). See Supplement 1 for associations of emotion regulation strategies that were not the focus of our hypotheses with PTSD symptoms.

3.3 | Interactions of emotion regulation strategies with media exposure

To determine whether media exposure moderated the associations of pretrauma emotion regulation strategies with PTSD symptoms, we examined two-way interactions between each emotion regulation strategy and media exposure in predicting PTSD symptoms (Table 3).¹ Catastrophizing ($\beta = 1.43, P = .03$) and positive reappraisal ($\beta = -1.55, P = .02$) each interacted with media exposure to predict PTSD symptoms, controlling for age and sex. The interaction with catastrophizing ($\beta = 1.62, P = .01$) remained significant when controlling for pretrauma internalizing symptoms and violence exposure, whereas the interaction with positive reappraisal became marginally significant ($\beta = -1.20, P = .06$). No significant interactions were found between media exposure and rumination or problem solving.

Next, we evaluated the simple slopes of each significant interaction and plotted the association between catastrophizing and positive reappraisal and PTSD symptoms at high (+1 SD) and low (-1 SD) levels of media exposure, controlling for age and sex (Fig. 1). At high media exposure, catastrophic thinking significantly predicted PTSD symptoms ($\beta = 2.86, P < .001$), whereas it did not predict PTSD symptoms at low media exposure ($\beta = .01, P = .99$). Positive reappraisal was significantly negatively associated with PTSD symptoms for those with high media exposure ($\beta = -.22, P = .02$), but not low exposure ($\beta = .15, P = .33$). Results remained unchanged when controlling for internalizing symptoms and violence exposure.

4 | DISCUSSION

Disruptions in emotion regulation are a proposed risk factor for PTSD onset (Aldao & Nolen-Hoeksema, 2010; Aldao et al., 2010), yet there is limited prospective research demonstrating a relationship between these constructs among youth. The present study provided novel evidence that pretrauma emotion regulation strategies prospectively predicted development of PTSD symptoms among adolescents following the Boston Marathon terrorist attack. Specifically, greater rumination predicted onset of PTSD symptoms regardless of the degree of attack-related media exposure. Engagement in high levels of catastrophizing and low levels of positive reappraisal were also related to the onset of posttraumatic symptoms, but only among adolescents with high levels of attack-related media exposure. These findings persisted after accounting for pretrauma internalizing symptomatology and violence exposure, indicating that emotion regulation strategies are an important pretrauma risk factor in the development of PTSD among youth.

Greater engagement in rumination predicted PTSD symptom onset and attack-related media exposure did not moderate this relationship. Rumination is a transdiagnostic risk factor for psychopathology, particularly internalizing disorders (Aldao & Nolen-Hoeksema, 2010; Aldao et al., 2010). Given the strong relationship between preexisting internalizing symptoms and the development of PTSD (McLaughlin et al., 2013), it is possible that rumination may function as a mediator of this relationship. Indeed, prior research has shown that pretrauma depression and rumination are associated with acute increases in PTSD symptoms post-trauma in adults (Nolen-Hoeksema & Morrow, 1991), and rumination mediates the association of stressful life events with the onset of anxiety and depression (Michl, McLaughlin, Shepherd, & Nolen-Hoeksema, 2013). However, no prior study has tested the relationship among internalizing psychopathology, rumination, and PTSD within a true multiple time-point mediation framework. Future work utilizing multi-wave measurements of these constructs is necessary to demonstrate whether rumination accounts for the strong relationship between preexisting internalizing psychopathology and PTSD onset following trauma.

The tendency to catastrophize prior to a traumatic event predicts PTSD symptoms and disorder onset among adults exposed to occupational traumas (e.g., firefighters (Bryant & Guthrie, 2005)). We had the unique opportunity to examine whether there was a similar association of pretrauma catastrophizing with PTSD symptoms among trauma-exposed adolescents. We found catastrophizing predicted PTSD symptoms among adolescents with high levels of attack-related media exposure. Catastrophizing is characterized by exaggerated perceptions of harm and risk for future threat. Therefore, it is likely that greater exposure to posttrauma media exacerbated the impact of catastrophic cognitions on PTSD symptoms, particularly as media coverage included speculation about additional possible attacks and ongoing threats to the city. Our findings highlight the importance of evaluating and addressing catastrophic cognitions in the context of terrorism and mass trauma, especially when the event garners high profile media coverage.

We expected greater trait use of adaptive emotion regulation strategies, including positive reappraisal and problem-solving, would predict reduced risk for PTSD symptoms posttrauma. This hypothesis was supported for positive reappraisal, but not problem solving. Pretrauma use of positive reappraisal was negatively associated with PTSD symptoms, but only among adolescents who viewed greater amounts of attack-related media coverage. This suggests that greater use of positive reappraisal strategies is a protective factor that buffered adolescents from the deleterious effects of media exposure. Positive reappraisal is a cognitive strategy frequently utilized in evidenced-based cognitive-behavioral oriented therapies targeting PTSD (Beck et al., 2005; Robertson, Humphreys, & Ray, 2004) and our findings suggest that training in positive reappraisal might be useful in preventive interventions aimed at reducing risk for PTSD. Although problem-solving has been negatively associated with PTSD in previous studies, only posttrauma *cognitive* aspects of problem solving (Amone-P'Olak et al., 2007), or pretrauma *behavioral* aspects of problem solving (i.e., putting problem-solving into action) (Dirkzwager et al., 2003), have been measured. Given our small sample size, future

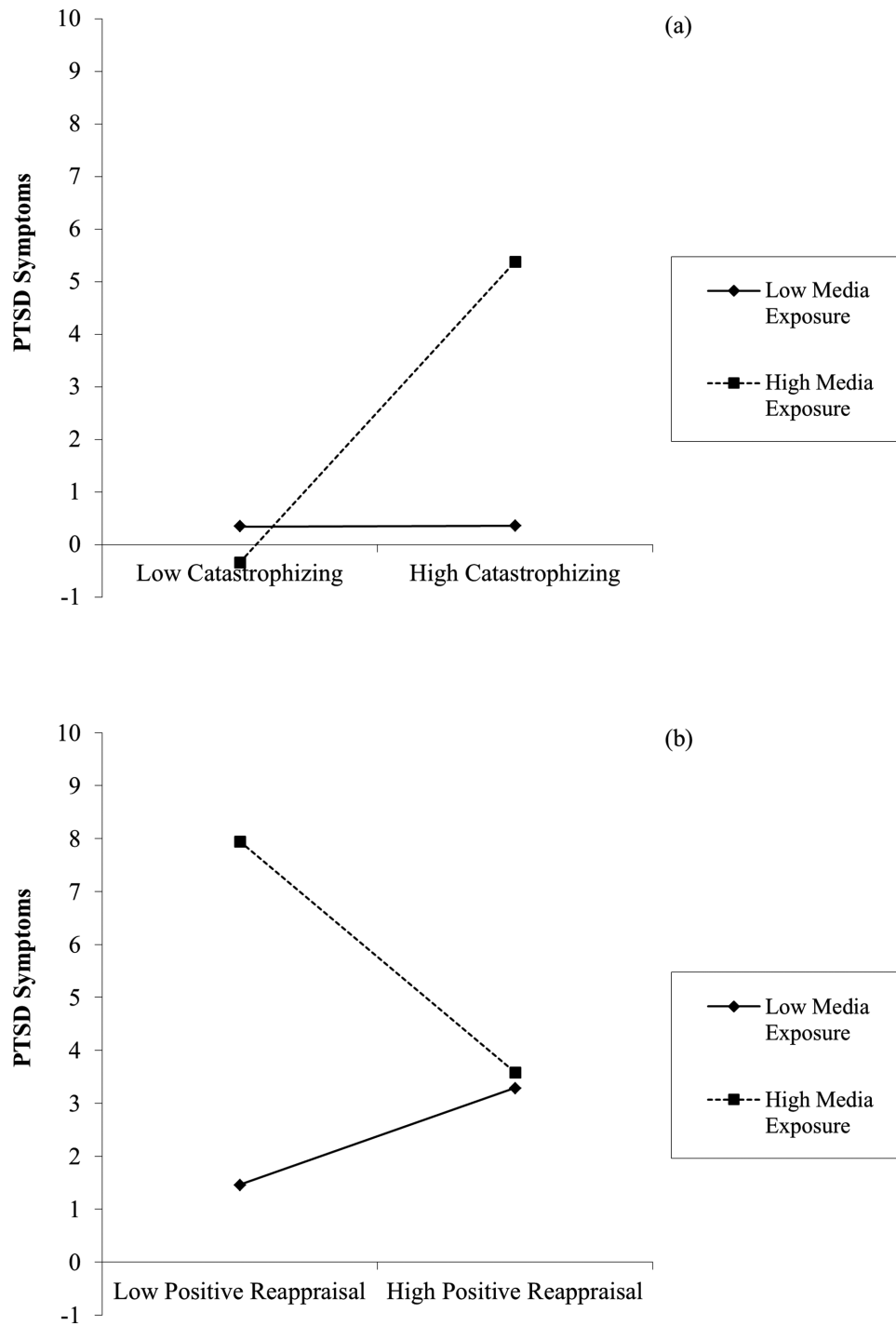


FIGURE 1 Interaction between catastrophizing (a) and positive reappraisal (b) strategies and attack related media exposure. High levels of catastrophizing and low levels of positive reappraisal predicted greater post-trauma PTSD symptom development among adolescents exposed to greater attack related media coverage. All variables depicted at 1 SD above and below the mean.

prospective studies are needed to better understand the relationship between pretrauma use of cognitive and behavioral components of problem solving and PTSD symptom development.

Exploratory analyses examined a range of other emotion regulation strategies that were not part of our focal hypotheses. Most of these strategies, including acceptance, distraction, putting things into perspective, and self-blame, were not associated with PTSD symp-

toms and did not interact with media exposure to predict PTSD symptom development (see Supplement 1). However, adolescents who both viewed greater amounts of media coverage and engaged in the habitual tendency to blame others were at higher risk for PTSD symptoms posttrauma, even after controlling for pretrauma internalizing symptoms and violence exposure. Self-blame has been associated with PTSD following other types of trauma (Ullman, Townsend, Filipas, &

Starzynski, 2007; Weaver & Clum, 1995), suggesting a need for greater research on both self- and other-blame with respect to trauma-related psychopathology.

This is the first study, to our knowledge, that utilizes pretrauma measurement of a broad range of emotion regulation strategies to prospectively predict PTSD symptoms among youth. Identifying pre-existing risk factors that are independent of trauma exposure allows firmer conclusions to be drawn regarding the predictive relationship between emotion regulation strategies and PTSD symptoms. The prospective design also permitted adequate control for preexisting internalizing symptoms and violence exposure. Furthermore, study of PTSD symptoms in relation to the Boston Marathon terrorist attack provided a trauma exposure that is independent of individual characteristics shown to increase risk for experiencing a traumatic event (Breslau et al., 1998; Koenen et al., 2008). However, in the revised PTSD diagnosis in *DSM-5*, media exposure no longer qualifies as a traumatic event (American Psychiatric Association, 2013). Changes in the *DMS-5* PTSD diagnosis have received criticism from PTSD experts (Hoge et al., 2016), and substantial evidence—including the present study's findings—indicates that indirect exposure to traumatic events, particularly terrorist attacks, can trigger PTSD symptoms and clinical diagnosis (Ahern, Galea, Resnick, & Vlahov, 2004; Comer et al., 2014, 2008; Galea et al., 2002; Hoge et al., 2016). Use of mobile devices and technology is ubiquitous among adolescents of diverse economic and demographic backgrounds (Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013), so media exposure to local, national, and international terrorism will likely remain common or even increase over time. Therefore, future studies are needed to empirically evaluate the exclusion of indirect trauma exposure as a traumatic event.

Limitations of the current study provide avenues for future research. First, our sample size was relatively small. Therefore, it is possible that certain nonsignificant findings reflect lack of statistical power, and future studies utilizing larger samples of adolescents to examine a broad range of emotion regulation strategies are needed. Second, findings are based on self-report measures, which could bias results due to shared-method variance. Use of objective measures, such as coded observations of cognitive strategies, might decrease such bias. Third, self-report of PTSD symptoms within 4 weeks postattack may limit conclusions about clinical PTSD onset. However, approximately one-third of our sample met clinical criteria for PTSD (Thoresen et al., 2009), which is consistent with empirical and epidemiological research utilizing diagnostic interviewing techniques post-trauma (McLaughlin et al., 2013, 2012; Shaw, 2003). Fourth, although the media exposure assessment was completed within a relatively short time-frame 2–4 weeks postattack, retrospective report may have influenced the accuracy of responses. Fifth, we found survey responders had higher pretrauma depression symptoms compared to survey nonresponders, so the present sample may reflect more exposed or symptomatic adolescents. Finally, the majority of our sample experienced indirect exposure to the terrorist attack; therefore, findings may not generalize to adolescents who have experienced direct trauma exposure (i.e., adolescents injured during a terrorist attack).

5 | CONCLUSION

Emotion regulation strategies prospectively predict development of PTSD symptoms among adolescents following a terrorist attack. Greater engagement in rumination prior to the attack predicted PTSD symptom onset, whereas catastrophizing, blaming others, and low-positive reappraisal were associated with PTSD symptoms only among adolescents with high levels of attack-related media exposure. These findings highlight the importance of emotion regulation strategies as a risk factor in the development of PTSD among youth.

CONFLICT OF INTEREST

All author declare that they have no conflicts of interest.

¹ Results were unchanged when the three participants who directly witnessed attack related events were removed from analyses.

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