

Associations Between Trauma Type, Timing, and Accumulation on Current Coping Behaviors in Adolescents: Results from a Large, Population-based Sample

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Abstract The development of adolescents' coping in response to stress is critical for adaptive functioning; these coping strategies may be shaped by numerous environmental factors during childhood, including experiences such as exposure to trauma. Childhood trauma has been shown to undermine contemporaneous coping, but how does a history of exposure to trauma and the characteristics of that trauma (type, timing, and accumulation) relate to current coping among adolescents? We addressed this question using a nationally-representative sample of 9427 adolescents (ages 13–18; 48.9% female; 66% White). Adolescents reported on their lifetime exposure to 18 different traumas, including witnessing or experiencing interpersonal violence, accidents, disasters, and violent or accidental loss of loved ones, as well as their current use of coping behaviors when under stress (*problem-focused*, *positive emotion-focused*, and *negative emotion-focused* coping strategies). The study's results highlight that exposure to nearly all forms of trauma

was unrelated to *problem-focused* and *positive emotion-focused coping* behaviors, but strongly associated with increased *negative emotion-focused coping*. Use of each coping style did not vary with age at first exposure to trauma, but increased with the number of lifetime traumatic events experienced. The findings suggest that the extent of prior exposure to trauma, including variations across type and timing, may be related to a particular form of coping that has been linked to increased risk for mental health problems. Study results highlight coping strategies as a potential target for prevention and treatment efforts, and indicate a need to better understand the malleability and trajectory of coping responses to stress for promoting healthy youth development.

Keywords Childhood Trauma · Coping · Stress · Sensitive Periods

Introduction

Large-sample epidemiological studies suggest that nearly 89% of the U.S. population, including approximately 40% of children under thirteen, have been exposed to at least one traumatic event, including accidents, disasters, the violent or accidental death of loved ones, and witnessing or experiencing interpersonal violence (Kilpatrick et al. 2013; Koenen et al. 2010). The ubiquity of exposure to trauma is concerning, given that traumatic events have been associated with many short and long-term negative outcomes including increased risk for mental and physical health problems (Danese and Baldwin 2017; Sledjeski et al. 2008), and structural and functional changes in the brain (De Bellis et al. 2013; Teicher et al. 2003). Although the association between trauma and negative outcomes is well-established,

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our understanding of the mechanisms that promote resilience or engender poor functioning after exposure to trauma remains limited. One process often highlighted in the link between exposure to trauma and maladaptive outcomes is the coping styles young people use in response to stress.

Why Study Coping Processes Among Youth Exposed to Trauma?

The coping behaviors that youth use in response to perceived life stress may be influenced by their history of exposure to trauma during earlier stages in childhood development. Such early exposure to trauma may impact future coping strategies in several ways, both biologically and behaviorally (Cicchetti and Rogosch 2009). First, studies show that exposure to trauma alters the ability to regulate stress responses and make decisions; this is likely attributed, in part, to effects of the trauma on the hypothalamic-pituitary-adrenal (HPA) axis and the prefrontal cortex (PFC). Trauma-exposed individuals may thus show increased stress reactivity and more difficulty in selecting and executing given coping strategies (Compas 2006; Danese and Baldwin 2017). Additionally, research demonstrates that youth with post-traumatic stress disorder (PTSD) have increased right-amygdala volume (Weems et al. 2013), suggesting that traumatic stress alters the developmentally-normative variation in amygdala volume seen among healthy controls in this neural region, which is key for assessing emotional input to the brain and processing fear and anxiety. These effects are consistent with studies demonstrating that exposure to early life stress and trauma, especially child maltreatment, leads to an increase in perceived threat during subsequent times of stress (e.g., increased salience of threat cues and threat-related biases in perception of emotion; Danese and Baldwin 2017). Heightened threat perception may make individuals more likely to withdraw and less likely to seek support. Finally, trauma may disrupt cognitive functions such as working memory (Dunn et al. 2016) and attentional control (Hayes et al. 2012). Deficits in working memory and cognitive flexibility are important, considering evidence that these domains predict decreased use of active and problem-focused coping strategies (Evans et al. 2016). Relatedly, attentional deficits may interfere with appropriate and timely selection and implementation of adaptive coping skills (Compas and Boyer 2001).

The ability to effectively cope with life stressors after experiencing trauma may be one of the key pathways through which trauma influences emotional and behavioral outcomes. For example, the use of behavioral and cognitive coping strategies (e.g., problem-solving, engaging in pleasurable activities, hopeful cognitions) has been found to

mitigate negative effects of life stress in youth exposed to the trauma of living in a war zone (Fayyad et al. 2016). The well-established associations between exposure to stress and poor psychological health may be ameliorated, in part, by fostering skills to manage stress effectively (Aldridge and Roesch 2008), which may ultimately reduce the likelihood of mental health problems following exposure to trauma (Mohammad et al. 2015). Conversely, use of coping behaviors involving emotional and behavioral disengagement have been found to be less effective and to exacerbate symptoms of psychopathology, including depression, in youth (Evans et al. 2015; Morris et al. 2014). Thus, greater insight into whether and how current coping behaviors are impacted by a history of trauma is needed, as coping plays an important role in shaping both resilience and risk for psychopathology. Efforts to understand the trauma-coping relationship are important for identifying youth at risk of poor outcomes or in need of intervention, as coping skills are known to be malleable through psychological treatment (Santucci et al. 2015).

Conceptualizing Coping Behaviors Among Adolescents

Over the last several decades, numerous forms and domains of coping have been identified and multiple definitions and frameworks for coping behaviors have been proposed. One prominent conceptualization defines coping as an effortful response to stress (for reviews see Carver and Connor-Smith 2010; Compas et al. 2001). In the earliest models of coping, first articulated by Folkman and Lazarus (1980), emphasis was placed on individuals and their environments (Folkman 1984; Folkman and Lazarus 1980). Two main coping domains emerged from this early work: (1) *emotion-focused coping*, in which individuals focus on their internal state to reduce stress, namely by regulating their emotions; and (2) *problem-focused coping*, in which individuals interact with their external environment to address or modify the stressor.

Carver and Connor-Smith's (2010) comprehensive review of the coping literature indicates that two higher-order domains, engagement and disengagement coping, may serve as an umbrella for problem-focused and emotion-focused coping. Engagement coping refers to approach strategies for managing the situation (stressor) or emotions. This includes *problem-focused coping* and some forms of *emotion-focused coping* such as keeping a sense of humor about the situation, restructuring cognitions, acceptance strategies, and certain types of cognitive distractions. In the current study, we conceptualize these emotion-focused strategies as *positive emotion-focused coping strategies*, or assertive internal responses used to handle the stressor. Disengagement coping refers to emotion-focused strategies for escaping or avoiding the stressor and the emotions using

denial, avoidance, or wishful thinking/fantasizing. In this study, we refer to this construct as *negative emotion-focused coping*, in which responses such as yelling, crying, or ruminating on negative thoughts are deployed (Carver and Connor-Smith 2010). Among youth, the stability of coping behaviors across time is unclear. Compared to adults, there may be more plasticity or flexibility in the use of coping strategies with less evidence that these behaviors are trait-like during childhood development. Identifying whether the characteristics of exposure to trauma influence coping behaviors in response to subsequent life stressors may provide a fuller picture of the nature of experiences that impact how coping develops in youth.

The Effects of Trauma on Coping Behaviors

Numerous empirical studies have examined the effects of exposure to trauma on specific coping strategies. Results indicate that individuals exposed to trauma are more likely than their non-exposed peers to use negative emotion-focused coping (Mc Elroy and Hevey 2014) as well as emotion-focused coping overall (Jaser et al. 2007). For example, children exposed to certain types of trauma, such as sexual trauma, have been shown to be more likely than those with non-sexual trauma to engage in avoidance behaviors (e.g., avoid thinking about the events; avoid people and places that remind one of the events). These avoidant coping behaviors have been shown to mediate the association between trauma and subsequent symptoms (e.g., post-traumatic stress, fear, anger, depression; Bal et al. 2003). Further, the use of negative emotion-focused coping is associated with a history of multiple exposures to trauma and correlates with higher rates of PTSD symptoms, with avoidant and emotion-focused coping behaviors accounting for 25% of the variance in those symptoms (Christiansen et al. 2014). However, problem-focused coping has been less well studied, and extant research has produced mixed findings. Specifically, some studies indicate that problem-focused coping is associated with better psychological outcomes, while others report that use of certain problem-focused strategies is associated with poorer outcomes after exposure to trauma. Still others find no association between coping and trauma or coping and mental health (see for example Braun-Lewensohn et al. 2009; Fayyad et al. 2016; McQuaid et al. 2015).

Further, as described below, several limitations of prior studies hinder our understanding of how and why certain behaviors differentially relate to coping with subsequent exposure to life stress. For example, the three domains of coping described refer to specific types of engagement and disengagement coping, but are not inherently classified as adaptive or maladaptive forms of responding to stress. Some studies indicate that adaptive strategies for stress

include behaviors such as problem-solving and social support (Chua et al. 2015), or relaxation and acceptance (Moritz et al. 2016), while maladaptive coping behaviors include rumination, denying the situation, engaging in distracting activities (Chua et al. 2015; Moritz et al. 2016) and engaging in behavioral avoidance through emotional discharge like yelling to let off steam (Elliot et al. 2011). In these studies, however, there have been exceptions where strategies assumed to be maladaptive (i.e., keeping emotional reactions inside) have been associated with resilience, indicating that further research is needed to determine the circumstances under which problem-focused, positive emotion-focused, and negative emotion-focused coping are adaptive vs. maladaptive.

Limitations of Prior Research

Determining whether exposure to trauma is related to differential use of coping strategies in problem-focused, negative emotion-focused, and positive-emotion focused coping domains can serve as a step toward understanding how the effects of trauma affect youth functioning. Questions remain about the developmental course of coping abilities, including whether coping with age-typical stressors differs for youth with vs. without a history of trauma. Identifying coping patterns in youth with and without a history of trauma may also inform work aimed at addressing the unanswered questions related to typical developmental trajectories of coping across childhood. Prior research addressing this gap in knowledge has been limited in a number of specific ways, which we sought to address in the current study.

Assessment of Traumatic Events

Many studies of coping and stress have not also measured exposure to prior trauma, instead focusing only on exposure to constructs such as daily life stressors and economic strain (Aldridge and Roesch 2008; Wadsworth et al. 2005). While this approach is helpful for understanding contemporaneous predictors of coping strategies, it may have limited value for several reasons. First, assessing only current stressors excludes investigation of whether previous stressful experiences, such as exposure to trauma, influence the use of current coping skills. Second, few published studies have examined multiple traumas, limiting the ability to discern whether different types of trauma and their accumulation (i.e., either the total number of traumas experienced or multiple types of unique exposures to trauma) affect later coping responses. This is an important variable in the study of trauma and coping, as prior evidence indicates that higher levels of accumulated trauma are associated with poorer recovery trajectories in adolescents (Kronenberg et al.

2010). To address these gaps, we examined direct reports of multiple types of traumatic life events, and the accumulation of experienced traumas, in relation to current coping behaviors for dealing with stress.

Nationally Representative Samples

To the best of our knowledge, only one published study of stress and coping has used data from a large, nationally-representative sample of adolescents; that study (Sawyer et al. 2009) examined coping with stressful life events as a predictor of depressive outcomes. Studies based on specific population subgroups or using local, regional, clinical, or convenience samples may not provide generalizable associations. Indeed, lack of generalizability may be a key contributor to the lack of consensus about the role of coping behaviors in the association between exposure to trauma and future mental health outcomes. To address this gap, we examined exposure to trauma and coping behaviors in response to current stress in a population-based sample of 9427 adolescents. The sampling procedures were designed to produce a representative sample of the U.S. adolescent population, with adjustment for regional, urban, and demographic characteristics so that generalizable estimates of the association between exposure to trauma and specific domains of coping were made.

Developmental Timing of Exposure to Trauma

The question of whether age at exposure to trauma impacts the use of specific coping skills has received little attention to date. Although early research indicated that individuals switch from emotion- to problem-focused strategies as they age (Band and Weisz 1988; Ebata and Moos 1994), and that approach strategies (positive-emotion coping) increase while avoidance (negative-emotion coping) decreases from early to late adolescence, knowledge remains limited on potential developmental timing differences in the impact of trauma on coping with stress (Griffith et al. 2000). Specifically, it is unclear whether there are “sensitive periods” in development, or stages of heightened sensitivity to environmental experience when individuals may be most susceptible to the negative effects of trauma (Dunn et al. 2013; Knudsen 2004). At least one prior study found that age at first exposure to trauma, specifically exposure in childhood and adolescence compared to adulthood, was associated with marginally lower global coping ability in older adults (Ogle et al. 2013). To address these limitations, we examined whether first exposure to trauma during different life stages (early childhood, middle childhood, adolescence) was associated with use of different coping behaviors to respond to current stress. Developmental timing was examined as opposed to year of age at exposure to the most

severe trauma, due to retrospective reporting, to maintain consistency with prior literature (Dunn et al. 2013), and based on evidence demonstrating that youth report traumas that are greater in severity as they get older (based on independent ratings; Taylor and Weems 2009).

Specific Domains of Coping Behaviors

Finally, the lack of attention to specific coping behaviors is a limitation found in much of the literature, with only a few studies examining the association between childhood exposure to trauma and specific domains of coping behavior. In most studies, the focus is on a narrow set of coping domains, most notably emotion-related coping (e.g., emotion regulation) or a broader set of cognitive aspects of coping, such as cognitive appraisals (Agoston and Rudolph 2011; Dempsey et al. 2000). To address these limitations, we distinguished among three domains of coping: problem-focused, negative emotion-focused, and positive emotion-focused strategies.

Current Study

The goals of the current study were threefold. First, we aimed to examine how exposure to specific types of trauma was associated with use of specific coping strategies for current stress. We hypothesized that exposure to any form of trauma, especially interpersonal and sexual traumas, would be associated with the use of more negative emotion-focused coping skills and less positive-emotion focused coping skills at present. Based on the inconclusive findings in the extant literature, we did not hypothesize that exposure to specific traumas would be associated with use of problem-focused coping skills in a specific direction. Second, we aimed to observe how the developmental timing of exposure to traumatic events was associated with current coping outcomes, and whether earlier first exposure to trauma would be positively associated with use of negative emotion-focused coping and inversely associated with problem- and positive emotion-focused coping. Specifically, we hypothesized that first exposure to trauma in early childhood would be associated with the highest use of negative emotion-focused coping, and the lowest use of positive-emotion and problem-focused coping, followed by first exposure in middle childhood, and then first exposure in adolescence. Third, we aimed to understand how the accumulation or total number of traumas reported (within and across trauma type) was associated with use of coping strategies. We hypothesized that greater numbers of traumatic events reported would be associated with more negative emotion-focused coping and less positive emotion-focused coping. No directional hypotheses were generated

for problem-focused coping based on the limited literature demonstrating associations between problem-focused coping strategy use and exposure to trauma.

Methods

Sample and Procedures

Data came from the National Comorbidity Survey Replication—Adolescent Supplement (NCS-A), the first nationally representative study to provide estimates of the prevalence and correlates of DSM-IV mental disorders among English-speaking U.S. adolescents (see full procedures in Kessler et al. 2009). Face-to-face surveys were conducted with 10,148 adolescents aged 13–18 from the continental United States. The dual-frame sample included adolescents living in households with respondents from the National Comorbidity Survey Replication (NCS-R), a population-based sample of adults (Kessler and Merikangas 2004, household subsample $n = 904$), and adolescents from a representative sample of schools in the areas sampled during the NCS-R (school subsample $n = 9244$ adolescents in 320 schools). Data were collected in the adolescents' homes using laptop assisted personal interviews averaging 210 min (range 69–347). The overall response rate was 75.6% (74.7% school based sample and 85.9% household sample; Kessler et al. 2009). The Human Subjects Committees of Harvard Medical School and the University of Michigan approved NCS-A procedures. Parent written, informed consent and adolescent written, informed assent were obtained prior to interview completion. In the current study, we analyzed data from adolescents who had valid sampling weights (see data analysis, below) and complete data on all variables ($n = 9427$; 92.90% of the total sample). Participants included in our analytic sample ($n = 9427$) did not differ from those who were excluded ($n = 721$) with respect to most demographic characteristics, including age, gender, poverty level, region, and urbanicity. However, the excluded sample comprised more adolescents from families with less than a high school education (28.6 vs. 14.8%; $p < 0.001$) and more adolescents who identified as Hispanic (21.2 vs. 14.1%; $p = 0.02$).

Measures

Exposure to Trauma

Lifetime exposure to 18 traumatic events was ascertained in the PTSD screener section of the Composite International Diagnostic Interview (CIDI; Green et al. 2012; Wittchen 1994), a structured interview used in epidemiological studies to assess the presence of psychiatric disorders. The

CIDI, which was adapted in this study for adolescents, demonstrates good concordance with other well-established diagnostic interviews (the Kiddie Schedule for Affective Disorders and Schizophrenia, K-SADS) and DSM-IV diagnostic criteria, and good discriminant validity for the disorders assessed (see Green et al. 2012 for more detail). Adolescents indicated whether they had experienced each traumatic event and if so, the age at their first experience. Consistent with prior studies based on the NCS-A (McLaughlin et al. 2012) and other datasets (Breslau et al. 1998), we grouped these events into four types: (1) *interpersonal violence* (i.e., beaten by parents; beaten by other person; rape; other sexual violence; kidnapped); (2) *accidents and injuries* (e.g., car accident; natural disaster; physical illness; poisonous chemical exposure; other serious accident); (3) *social network or witnessing events* (i.e., witnessed fighting at home; witnessed injury or death of other; unexpected death of loved one; threat to significant person; war/terror; refugee); and (4) *other events* (i.e., experienced any other extremely upsetting or life threatening event not asked about or not wanting to disclose).

To maintain consistency with prior studies, age at first exposure to trauma was characterized within three developmental timing windows: (1) *early childhood* (ages 0–5); (2) *middle childhood* (ages 6–10); and (3) *adolescence* (ages 11–18). Age at first exposure to each trauma was assessed using question probes shown in a prior experiment to increase recall accuracy among adults; individuals were guided through a focused, thorough, memory search using specific questions about the event timing and individuals' confidence in their reports, followed by direct prompts to help participants locate the exact events and time surrounding onset (Knauper et al. 1999). In this study, adolescents appeared to be very good reporters of their age at first incidence of specific events. For instance, the correlation between parent- and child-reported age at onset to child major depressive disorder was $r = 0.81$ in the original NCS-A study.

Using the data about exposure to trauma and age at first exposure, we generated four sets of predictor variables: (1) presence or absence of each individual exposure, (2) presence or absence of each type of exposure to trauma (4 types), (3) age at first exposure to each trauma or trauma type (to test for sensitive periods), and (4) a count of the total number of exposures reported across types, and the total number of traumas within each trauma type (to test for accumulation).

Coping strategies

Coping strategies were assessed using 17 items adapted from commonly-used measures of coping styles implemented across the lifespan, including the 60-item COPE

inventory (Carver et al. 1989) and the Ways of Coping Questionnaire (WCQ; Folkman and Lazarus 1988). Adolescents were prompted with the following introduction to these items: “The next questions are about the things you do to handle stress.” Adolescents were asked to imagine the experience of a stressful event, with examples in the prompt such as a break-up or constant arguments and criticisms from a friend, and rate how much they would do each of the things that followed to cope with the situation. For each statement, adolescents indicated their extent of agreement (1 = a lot; 2 = some; 3 = a little; 4 = not at all).

Results of a maximum likelihood ordinal exploratory factor analysis conducted using polychoric correlations (see Supplementary Table 1 for details) suggested that three factors should be retained, consistent with the three-domain model of coping reviewed by Carver and Connor-Smith (2010). We therefore examined three coping dimensions in this study: (1) *problem-focused coping* ($M = 8.49$, $SD = 2.16$; sample items included: “try to analyze the problem and see how to make it better”; “seek advice from other people”); (2) *positive emotion-focused coping* ($M = 11.23$, $SD = 3.11$; sample items included: “try not to think about it at all”; “keep your feelings to yourself to avoid embarrassment”; “keep a sense of humor”); and (3) *negative emotion-focused coping* ($M = 7.92$, $SD = 4.13$; sample items included: “get mad and break something or cause a scene”; “avoid being with people and spend lots of time alone”). All items were coded in the same direction so that higher scores indicated greater use of the coping strategy. To facilitate comparison between coping domains, coping scores were standardized (mean = 0; $SD = 1$) prior to all analyses. Of note, both the COPE and WCQ demonstrate moderate internal consistency ($\alpha > 0.60$) and test–retest reliability. Similar estimates for internal consistency reliability across the three domains were observed in this study (negative emotion-focused, $\alpha = 0.72$; positive emotion-focused, $\alpha = 0.62$; problem-focused, $\alpha = 0.64$). The three sub-scales ranged from four to seven items and the scale length likely contributes to lower Cronbach alpha estimates. However, mean inter-item correlations support acceptable internal consistency reliability (negative emotion-focused, $r = 0.33$; positive emotion-focused, $r = 0.26$; problem-focused, $r = 0.36$) based on standard cut-offs (Clark and Watson 1995).

Covariates

To produce more generalizable estimates of associations between exposure to trauma and coping responses to stress, we included several covariates. To reduce potential confounds related to differential prevalence rates of exposure to certain types of trauma, we examined individual demographic characteristics such as sex, given evidence that exposures such as sexual assault differ in incidence rate

between males and females (Tolin and Foa 2006). We also examined characteristics related to region and environment, and household and family factors, to account for differential associations with the outcomes and the complex survey design. Based upon the results in Table 1, the following covariates were included in all models: *sex*, *age* (continuous), *highest level of parent education* (less than high school; high school; some college; college graduate), *poverty index ratio*, which was derived based on family size and the ratio of family income to the family’s poverty threshold (≤ 1.5 = low income; 1.6–3 = low-middle income; >3 – ≤ 6 = high-middle income; and >6 = high income), *race/ethnicity* (Non-Hispanic White; Non-Hispanic Black; Hispanic; other), *region of the country* (Northeast; Midwest; South; West), and *urbanicity*, (major metropolitan area; other urbanized area; rural area).

Primary Analysis

We generated a series of multiple linear regression models to estimate average coping scores by exposures to trauma, after adjusting for covariates. Model 1 focused on the presence vs. absence of exposure to each individual trauma and trauma type (0 = unexposed; 1 = exposed). To examine possible time-dependent effects of trauma, Model 2 included predictors for age at first exposure to each trauma and trauma type, coded as 1 = *early childhood* (ages 0–5) 2 = *middle childhood* (ages 6–10), and 3 = *adolescence* (ages 11–18). Post-hoc Tukey tests were used to evaluate whether the beta coefficients (indicating the effect of timing of exposure relative to never exposed) were significantly different from each other, thus pointing to possible differences in use of each coping domain among children exposed during different age periods after correction for multiple testing. Model 3 then estimated the effect of the accumulation score, meaning the total number of traumas reported, on each coping domain. For Models 2 and 3, comparisons were made to the referent group of non-exposed during any developmental period (Model 2) and non-exposed or zero accumulated traumas (Model 3).

All analyses were conducted using the survey regression procedures available in SAS Version 9.4 to account for the complex survey design. We used sampling weights to account for (1) the differential probability of selection of respondents within households (for the household subsample), (2) differential non-response, and (3) to adjust for differences between the sample and the U.S. population on selected socio-demographic characteristics. Therefore, this sample was nationally representative of the U.S. population on the variables included in this analysis. A false discovery rate (FDR) correction was used to adjust p -value estimates for multiple, independent tests of 18 different traumas (Benjamini and Hochberg 1995). The FDR correction is

Table 1 Distribution of covariates in the total sample, by trauma exposure, and by coping domains

	Total Sample		Exposed to any Trauma		χ^2	p value	Problem-focused coping		Positive emotion-focused coping		Negative emotion-focused coping	
	N (%)	N (%)	M (SD)	F value			p value	M (SD)	F value	p value	M (SD)	F value
Total sample			8.5 (2.2)				11.2 (3.1)		7.9 (4.1)			
			Range (0–12)				Range (0–18)			Range (0–21)		
Age												
13	1512 (14.7)	741 (47.9)	8.4 (2.2)	1.09	74.89	<.0001	11.4 (3.2)	1.6	7.6 (3.9)	0.1841	2.0	0.099
14	2051 (20.6)	1089 (53.5)	8.4 (2.2)				11.3 (3.1)		7.6 (4.1)			
15	1776 (20.9)	1053 (57.6)	8.4 (2.2)				11.2 (3.1)		7.9 (4.1)			
16	1885 (21.0)	1197 (61.9)	8.5 (2.2)				11.1 (3.0)		8.0 (4.2)			
17	1643 (17.1)	1128 (69.0)	8.6 (2.1)				11.1 (3.1)		8.3 (4.2)			
18	560 (5.6)	399 (69.1)	8.6 (2.1)				11.3 (3.0)		8.4 (4.2)			
Sex												
Male	4612 (51.1)	2721 (58.0)	8.3 (2.2)	21.37	0.54	0.4628	11.5 (3.1)	56.2	7.4 (4.0)	<.0001	87.8	<.0001
Female	4815 (48.9)	2886 (59.6)	8.7 (2.1)				10.9 (3.1)		8.4 (4.2)			
Race												
White	5280 (66.1)	2943 (55.0)	8.6 (2.1)	1.3	67.72	<.0001	10.9 (3.0)	18.6	7.5 (3.9)	<.0001	10.60	<.0001
Black	1818 (15.0)	1247 (71.0)	8.4 (2.3)				12.0 (3.3)		8.6 (4.4)			
Hispanic	1769 (14.1)	1086 (63.6)	8.4 (2.3)				11.5 (3.2)		8.3 (4.3)			
Others	560 (4.8)	331 (59.3)	8.4 (2.0)				11.0 (3.1)		8.2 (4.3)			
Poverty												
Low	1569 (14.5)	1001 (65.1)	8.3 (2.3)	0.26	14.14	0.0027	11.6 (3.2)	4.97	8.4 (4.4)	0.0038	3.88	0.0155
Second	1875 (19.1)	1148 (60.8)	8.5 (2.1)				11.5 (3.1)		8.0 (4.1)			
Third	2900 (32.1)	1694 (57.3)	8.5 (2.1)				11.1 (3.1)		7.9 (4.1)			
High	3083 (34.4)	1764 (56.4)	8.6 (2.1)				11.0 (3.1)		7.6 (4.0)			
Parental education												
<High school	1489 (14.8)	906 (58.5)	8.1 (2.4)	21.88	44.5	<.0001	11.6 (3.3)	10.78	8.5 (4.4)	<.0001	11.76	<.0001
High school	2878 (29.8)	1781 (62.6)	8.4 (2.2)				11.6 (3.2)		8.1 (4.3)			
Some college	1876 (19.4)	1196 (64.8)	8.6 (2.1)				11.2 (3.0)		8.0 (4.1)			
College or Graduate	3184 (36.0)	1724 (52.5)	8.7 (2.0)				10.8 (3.0)		7.4 (3.9)			

Cell entries for total sample and exposure to trauma are the number and percent. Exposed to any trauma was defined as reporting at least one of the following events: parent violence, other violence, rape, kidnapping, other sexual assault, car accident, disaster, illness, chemical exposure, other accident, witnessing fights at home, witnessing death, other person died unexpectedly, other person experienced unexpected threat, war/terror, refugee, other trauma, or non-disclosed trauma. Rao-Scott chi-square values indicate whether the distribution of demographic covariates was significantly different by those reporting trauma exposure. Cell entries for each coping domain are the mean and standard deviation at each level of the covariates. F-values indicate whether the average coping scores differed by the demographic categories.

designed to control for the average proportion of rejected null hypotheses that are falsely discovered as positive. We examined residual plots and residual values to evaluate model diagnostics, enabling us to ensure our results were robust to regression assumptions.

Sensitivity Analysis

In light of research demonstrating an association between specific coping strategies (e.g., behavioral and emotional avoidant coping, aspects of negative emotion-focused coping), the increased incidence of further exposure to stress, and depression (Evans et al. 2015; Sawyer et al. 2009), we conducted a sensitivity analysis to examine whether the association between exposure to trauma and coping behaviors for stress confounded with the incidence of depressive episodes. All primary analyses were repeated, excluding adolescents meeting DSM-IV diagnostic criteria for a past year major depressive episode as assessed by the CIDI. Without accounting for psychopathology, it is possible that results related to exposure to trauma and coping responses would be attributed to, in part, depressive symptoms. For example, an association has been found between higher depressive symptoms and endorsement of more coping strategies that adolescents do not perceive to be effective, or strategies they do not believe will improve the moment or situation long-term (Ng et al. 2016). By conducting these sensitivity analyses, we aimed to test the robustness of our findings independent of a closely correlated form of psychopathology, and evaluate the degree to which adolescents with current or recent depression influenced the results. Although coping was associated with other disorders, including PTSD (negative emotion-focused, $r = -0.33$; positive emotion-focused, $r = -0.03$, problem-focused, $r = 0.03$), the strength of these associations was small in magnitude on average across all three coping domains. We therefore focused on depression based on the existing evidence base and the association with negative emotion-focused coping in particular ($r = -0.40$, $p < 0.001$), which was the highest in this study.

Results

Primary Analysis

The three coping domains were weakly correlated with one another, with the strongest correlation observed between positive and negative emotion-focused coping ($r = 0.23$; $p < 0.001$) and the weakest correlation between negative emotion-focused and problem-focused coping ($r = 0.07$; $p < 0.001$). Exposure to trauma was common, with 59% of the total analytic sample reporting exposure to at least one traumatic event (mean = 1.98 traumas per person).

Adolescents in lower socioeconomic status families, identifying as black, and who were older tended to report more trauma exposure (Table 1). Modest though statistically significant differences were observed between several covariates and coping domains (Table 1).

Exposure to Trauma and Coping

Table 2 shows the results of analyses examining the association between exposure to trauma and each coping domain. Overall, use of problem-focused coping was related to only select types of trauma. Specifically, adolescents reporting exposure to rape ($\beta = -0.39$; $p = 0.003$), witnessing fights at home ($\beta = -0.20$; $p = 0.008$), or any social network trauma ($\beta = -0.09$; $p = 0.011$), were less likely to use problem-focused coping compared to those who were never exposed to these events. With respect to use of positive emotion-focused coping, no differences were observed between those exposed to trauma and those who were unexposed. Conversely, use of negative-emotion focused coping was more often reported for adolescents indicating exposure to nearly any type of trauma compared to their non-exposed peers. For example, adolescents reporting exposure to any interpersonal violence had, on average, scores that were half a standard deviation higher on the negative emotion-focused coping scale compared to their unexposed peers. For those exposed to rape specifically, the difference was nearly one standard deviation higher.

Age at Onset of Exposure to Trauma and Coping

Table 3 presents results of the set of models evaluating the association between coping and exposure to trauma during each of three different age stages (early childhood, middle childhood, adolescence) to determine whether there may be sensitive periods when exposure to trauma is most harmful. Compared to unexposed adolescents, there were no differences in the use of problem-focused coping or positive-emotion focused coping based on age at first exposure to trauma. However, consistent with results reported previously, exposure to each main type of trauma at each time period was associated with greater use of negative-emotion focused coping (except *other events* at early childhood). That is, although adolescents exposed to trauma at any developmental stage were more likely than their unexposed peers to report more negative emotion-focused coping, results of the post-hoc Tukey tests revealed that between each age group, there were no significant differences in use of coping behaviors (all p -values < 0.05). For example, exposure to first trauma in early childhood did not differ from first exposure in middle childhood or adolescence in terms of negative emotion-focused coping behaviors, but exposure in any of those age stages was associated with

Table 2 Association between type of exposure and current coping behaviors

	Problem-focused coping				Positive emotion-focused coping				Negative emotion-focused coping			
	Beta	LL	UL	<i>p</i> -value	Beta	LL	UL	<i>p</i> -value	Beta	LL	UL	<i>p</i> -value
Exposure to any trauma	-0.07	-0.13	-0.01	0.1767	0.06	0.00	0.12	0.1266	0.29	0.24	0.34	<0.0001
Interpersonal violence												
Parent violence	-0.19	-0.48	0.09	0.4955	0.23	0.02	0.44	0.1266	0.50	0.28	0.71	<0.0001
Other violence	-0.10	-0.28	0.07	0.5996	-0.01	-0.14	0.13	0.9663	0.55	0.40	0.70	<0.0001
Rape	-0.39	-0.57	-0.21	0.0029	0.04	-0.18	0.26	0.9663	0.70	0.49	0.90	<0.0001
Other sexual assault	-0.01	-0.21	0.18	0.9512	0.01	-0.16	0.17	0.9663	0.48	0.17	0.79	0.0055
Kidnapped	0.06	-0.33	0.45	0.9512	0.19	-0.06	0.43	0.2650	0.38	0.05	0.70	0.0348
Any of above	-0.12	-0.24	0.00	0.2350	0.07	-0.01	0.14	0.2455	0.53	0.42	0.65	<0.0001
Accidents and injuries												
Car accident	-0.02	-0.16	0.12	0.9512	0.11	-0.01	0.23	0.1986	0.21	0.06	0.35	0.0105
Disaster	0.01	-0.06	0.08	0.9512	0.00	-0.09	0.08	0.9663	0.10	0.02	0.19	0.0308
Illness	0.06	-0.01	0.14	0.3078	0.05	-0.06	0.16	0.6412	0.19	0.07	0.30	0.0050
Chemical	0.03	-0.18	0.25	0.9512	0.03	-0.21	0.26	0.9663	0.10	-0.10	0.29	0.3431
Other accident	-0.03	-0.16	0.10	0.9512	0.05	-0.07	0.16	0.6412	0.33	0.17	0.48	0.0003
Any of above	0.00	-0.06	0.07	0.9512	0.05	0.00	0.11	0.1986	0.20	0.15	0.26	<0.0001
Social network and witness events												
Witness fights at home	-0.20	-0.31	-0.09	0.0080	0.12	0.01	0.23	0.1266	0.42	0.28	0.56	<0.0001
Witness death	-0.10	-0.24	0.03	0.4206	0.07	-0.03	0.17	0.3131	0.25	0.18	0.33	<0.0001
Close person died unexpectedly	-0.03	-0.10	0.03	0.6385	0.08	0.02	0.13	0.0529	0.20	0.12	0.29	<0.0001
Close person threatened unexpectedly	0.01	-0.08	0.10	0.9512	0.01	-0.09	0.11	0.9663	0.27	0.19	0.35	<0.0001
War terror	-0.08	-0.39	0.22	0.9512	0.03	-0.18	0.25	0.9663	-0.01	-0.19	0.18	0.9363
Refugee	-0.27	-1.11	0.58	0.9512	-0.40	-0.84	0.04	0.1986	-0.22	-0.46	0.01	0.0772
Any of above	-0.09	-0.15	-0.04	0.0107	0.07	0.02	0.12	0.0529	0.26	0.20	0.32	<0.0001
Other events												
Other trauma	0.15	-0.01	0.32	0.3005	0.01	-0.11	0.13	0.9663	0.23	0.06	0.40	0.0149
Non disclosed	-0.06	-0.21	0.09	0.8217	0.18	0.05	0.32	0.0529	0.51	0.36	0.66	<0.0001
Any of above	0.00	-0.13	0.12	0.9512	0.14	0.04	0.25	0.0529	0.42	0.28	0.55	<0.0001

Cell entries are the estimate (beta) and confidence intervals generated from a set of generalized estimating equations (GEE) examining the effect of each traumatic event and type on the three coping styles, after adjusting for covariates. A false discovery rate (FDR) correction was applied to adjust *p*-values for the multiple testing of 18 different individual exposures, plus exposure type and exposure to any trauma. Statistical significance after imposing the FDR correction is denoted in bold. Coping values were standardized (mean = 0; sd = 1) to allow comparison across coping type. LL refers to lower confidence level. UL refers to upper confidence level

greater negative emotion-focused coping than no exposure to trauma at all. Thus, the effect of exposure to trauma on negative emotion-focused coping seemed to be similar across the three developmental periods—as indexed by the similar beta coefficients for the three periods.

Accumulation of Traumatic Experiences and Coping

Table 4 presents the results of the tests of association between the accumulation score and each coping domain. Overall, there was no relationship between the number of traumas reported and use of either problem-focused or positive emotion-focused coping. The only significant

associations detected were within social network or witnessing events, where a single exposure to trauma was associated with lower use of problem-focused coping compared to no exposure (subsequent exposures did not significantly relate to use of this type of coping), and experiencing at least two social network traumas was associated with increased use of positive-emotion focused coping compared to no exposure. In contrast, accumulation of trauma was consistently associated with negative emotion-focused coping, regardless of trauma type. Specifically, there was a gradient whereby each additional trauma reported was associated with greater use of negative emotion-focused coping behaviors (Fig. 1).

Table 3 Association between age group for first exposure and current coping behaviors

	Problem-focused coping			Positive emotion-focused coping			Negative emotion-focused coping					
	Beta	LL	UL	p-value	Beta	LL	UL	p-value	Beta	LL	UL	p-value
Exposure to any trauma												
Early childhood	-0.02	-0.11	0.07	0.7775	0.07	-0.03	0.17	0.5226	0.35	0.27	0.43	<.0001
Middle childhood	-0.04	-0.13	0.05	0.6607	0.07	-0.04	0.17	0.6019	0.28	0.18	0.37	<.0001
Adolescence	-0.12	-0.20	-0.03	0.2240	0.06	-0.02	0.13	0.5226	0.26	0.20	0.33	<.0001
Interpersonal violence												
Early childhood	-0.09	-0.36	0.18	0.7261	0.18	0.01	0.34	0.3239	0.65	0.42	0.87	<.0001
Middle childhood	-0.10	-0.30	0.10	0.6607	-0.01	-0.18	0.16	0.9257	0.38	0.13	0.63	0.0105
Adolescence	-0.14	-0.29	0.00	0.3713	0.07	-0.06	0.21	0.6019	0.59	0.45	0.73	<.0001
Accidents and injuries												
Early childhood	0.07	-0.04	0.17	0.6151	0.02	-0.07	0.11	0.8184	0.22	0.12	0.32	0.0003
Middle childhood	0.04	-0.06	0.14	0.6825	0.06	-0.04	0.16	0.6019	0.21	0.08	0.34	0.0071
Adolescence	-0.07	-0.18	0.04	0.6151	0.07	-0.02	0.16	0.5226	0.19	0.09	0.28	0.0011
Social network or witness events												
Early childhood	-0.10	-0.27	0.07	0.6188	0.10	-0.01	0.21	0.4441	0.28	0.17	0.40	<.0001
Middle childhood	-0.09	-0.20	0.03	0.5594	0.08	-0.04	0.19	0.5468	0.24	0.14	0.34	<.0001
Adolescence	-0.10	-0.17	-0.02	0.2240	0.06	-0.02	0.14	0.5226	0.27	0.20	0.33	<.0001
Other events												
Early childhood	-0.08	-0.57	0.41	0.8575	0.14	-0.06	0.34	0.5226	0.15	-0.20	0.51	0.4997
Middle childhood	-0.02	-0.29	0.25	0.9111	-0.03	-0.19	0.14	0.8733	0.32	0.08	0.56	0.0236
Adolescence	0.01	-0.10	0.13	0.8788	0.20	0.06	0.33	0.1340	0.49	0.34	0.65	<.0001

Cell entries are the estimate (beta) and confidence intervals generated from a set of generalized estimating equations (GEE) examining the effect of each traumatic event and type on the three coping styles, after adjusting for covariates. A false discovery rate (FDR) correction was applied to adjust p-values for the multiple testing of 18 different individual exposures, plus exposure type and exposure to any trauma. Statistical significance after imposing the FDR correction is denoted in bold. Coping values were standardized (mean = 0; sd = 1) to allow comparison across coping type. LL refers to lower confidence level. UL refers to upper confidence level

Table 4 Association between number of traumatic events experienced and current coping behaviors

	Frequency (%)	Problem-focused coping			Positive emotion-focused coping			Negative emotion-focused coping					
		Beta	LL	UL	Beta	LL	UL	Beta	LL	UL			
Any trauma													
0	3820 (41.2)	(Ref)											
1	2763 (28.9)	-0.05	-0.13	0.02	0.3456	0.03	-0.04	0.10	0.4475	0.18	0.12	0.24	<.0001
2	1458 (15.8)	-0.10	-0.21	0.01	0.2088	0.09	0.00	0.17	0.1297	0.23	0.15	0.31	<.0001
3	704 (6.9)	0.00	-0.09	0.09	0.9980	0.08	-0.03	0.19	0.2586	0.49	0.38	0.61	<.0001
4+	682 (7.2)	-0.14	-0.28	0.00	0.1932	0.15	0.03	0.28	0.0799	0.74	0.63	0.85	<.0001
Interpersonal violence													
0	8438 (89.2)	(Ref)											
1	784 (8.6)	-0.10	-0.19	-0.01	0.1784	0.07	-0.01	0.15	0.1843	0.47	0.35	0.59	<.0001
2+	205 (2.2)	-0.20	-0.53	0.12	0.3893	0.05	-0.17	0.26	0.6805	0.79	0.54	1.03	<.0001
Accidents and injuries													
0	6740 (70.9)	(Ref)											
1	2127 (23.2)	0.00	-0.07	0.07	0.9980	0.05	0.00	0.10	0.1297	0.18	0.12	0.23	<.0001
2+	560 (5.9)	0.01	-0.11	0.14	0.9980	0.06	-0.07	0.19	0.4475	0.31	0.16	0.46	0.0002
Social network and witness events													
0	5257 (57.0)	(Ref)											
1	2978 (30.9)	-0.09	-0.16	-0.03	0.0496	0.05	0.00	0.11	0.1297	0.20	0.13	0.26	<.0001
2	866 (9.1)	-0.04	-0.14	0.07	0.7658	0.11	0.04	0.19	0.0422	0.41	0.29	0.54	<.0001
3+	326 (3.0)	-0.27	-0.52	-0.01	0.1784	0.12	-0.06	0.30	0.2594	0.52	0.37	0.66	<.0001
Other events													
0	8696 (92.5)	(Ref)											
1+	731 (7.5)	0.00	-0.13	0.12	0.9980	0.14	0.04	0.25	0.0629	0.42	0.28	0.55	<.0001

Cell entries are the estimate (beta) and confidence levels generated from a set of generalized estimating equations (GEE) examining the effect of each traumatic event and type on the three coping styles, after adjusting for covariates. A false discovery rate (FDR) correction was applied to adjust p-values for the multiple testing of 18 different individual exposures, plus exposure type and exposure to any trauma. Statistical significance after imposing the FDR correction is denoted in bold. Coping values were standardized (mean = 0; sd = 1) to allow comparison across coping type. LL refers to lower confidence level. UL refers to upper confidence level

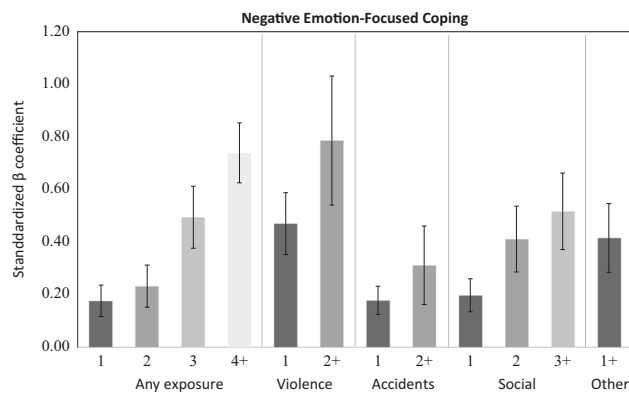


Fig. 1 Associations between accumulated trauma exposure and negative emotion-focused coping behavior. The standardized beta coefficients for cumulative number of exposures within each domain of trauma represent the comparison of each count (measured categorically) of total exposure to the reference group of no trauma exposure. Compared to unexposed adolescents, each subsequent trauma exposure is associated with greater endorsement of negative emotion-focused coping behavior. Violence = interpersonal violence, including physical and sexual abuse and assault; Accidents = accidents and injuries, including natural disasters and physical illnesses; Social = social network or witnessing events, including witnessing witness injury or death, threat to significant person, war/terror, refugee; Other = other events that were extremely upsetting or life threatening and not asked about or disclosed in detail

Sensitivity Analysis

A total of 9% of the sample ($n = 822$) experienced a past year major depressive episode. Overall, as shown in Supplementary Tables 2–4, the effect estimates for the associations between coping behaviors and exposure to each type of traumatic event were similar to the results including the depressed adolescents, though some increased or decreased modestly and inconsistently (Model 1 mean $\Delta \beta = 0.05$, Model 2 mean $\Delta \beta = 0.07$, Model 3 mean $\Delta \beta = 0.06$).

Discussion

There is mounting evidence that exposure to trauma in childhood is associated with the coping strategies and skills youth employ to respond to these experiences (Bal et al. 2009; Braun-Lewensohn et al. 2009; Christiansen et al. 2014); yet it is unclear whether there are lasting effects of trauma on the patterns of coping behaviors youth continue to use. With exposure to trauma affecting around 40% of U. S. children under 13 years of age (Koenen et al. 2010), and the knowledge that these experiences can have long-term consequences for cognition, neural development, and behavior (Danese and Baldwin 2017), it is critical to understand the mechanisms through which traumatic events influence and shape later coping responses. Indeed, prior

studies that demonstrate harmful effects of exposure to life stress on coping behaviors, mental health, and well-being (Elliot et al. 2011; Evans et al. 2015) would suggest that assessing coping ability among youth exposed to trauma should include their responses to future life stressors as well as responses to the traumatic event. An unanswered question in the search for mechanisms is how the experience of childhood trauma influences the coping strategies that adolescents deploy *beyond* the traumatic event, namely the strategies used to deal with these typical life stressors. If the effects of traumatic events are ongoing, the consistency or inconsistency of coping responses may shed some light on processes of risk and resilience.

In the present study, we used data from a large, nationally-representative sample of adolescents to examine the association between multiple types of traumatic events and the use of different coping behaviors that youth deploy to respond to stress generally. By examining the relationship between exposure to trauma across childhood and specific patterns of current coping behaviors in this sample, we could generate generalizable estimates regarding how adolescents respond to stress after experiencing prior trauma. In addition to examining the types of traumatic events that adolescents experienced, we also examined how the timing and accumulation of trauma were related to coping styles. To date, there remains little evidence on how adaptive coping may be disrupted by traumatic experiences (e.g., via deployment of maladaptive coping strategies when adaptive coping would have been a developmentally appropriate response) and whether the timing of exposure (e.g., early life or more current) impacts the use of differing coping behaviors. The current study supports efforts to understand how environmental influences on multiple systems of development, such as cognition in generating coping responses, relate to the deployment of strategies to manage and cope with stress.

Three primary findings emerged from this study. First, consistent with our first hypothesis exposure to nearly all forms of trauma was associated with increases in negative emotion-focused coping behaviors in response to current stress. Thus, adolescents exposed to trauma were more likely than unexposed adolescents to report higher use of behaviors such as letting off steam by yelling or crying alone, and avoiding others and spending time alone. While negative emotion-focused coping was endorsed more frequently for trauma-exposed compared to unexposed youth, overall it was the least frequently endorsed form of coping. Contrary to our prediction that exposure to trauma would be associated with less positive emotion-focused coping behaviors, exposure to trauma was largely unassociated with use of positive emotion-focused or problem-focused coping. The present results build on prior findings, including work by Elzy and colleagues (2013) which

demonstrated greater avoidant coping behaviors in response to traumatic experiences. Adolescents with a history of exposure to trauma in the present study report similar coping strategies, but in response to life stress after their exposure to trauma. Additionally, other studies that report greater use of negative emotion-focused coping behaviors have found that the use of these strategies at least partially explains the association between exposure to trauma and poor mental health outcomes, such as PTSD and depression (Howell et al. 2015; Sawyer et al. 2009; Tierens et al. 2012). Given the stress-generation hypothesis of depression (Liu 2013), coping responses to current stressors may be equally as critical as prior exposure to trauma to consider as links to psychopathology.

Second, we found that increases in negative-emotion focused coping were consistent across all ages of first exposure to trauma (early childhood, middle childhood, adolescence) compared to no history of exposure to trauma. Thus, contrary to our hypothesis that earlier life exposure to trauma would be associated with greater negative coping behaviors, there were no developmental periods when exposure to trauma had an elevated effect on the types of coping strategies adolescents used presently. Age at first exposure to trauma was also unassociated with positive emotion-focused and problem-focused coping skill use. Further, differences in coping behaviors did not appear to be a function of mere aging, as the correlations between age and each coping domain were weak in both the overall sample as well as adolescents with and without exposure to trauma ($r = 0.03$ – 0.07 for problem-focused, negative emotion-focused, and positive emotion-focused coping). These results do not support the notion that there are sensitive periods when reported exposure to trauma has stronger associations with the use of specific coping skills.

What might explain our inability to identify a sensitive period? It is possible that sensitive periods cannot be detected from lifetime reporting, emphasizing the need for a longitudinal study. The results could also reflect a true lack of sensitive periods related to coping, as found in a study of timing of exposure to trauma across the full lifespan in older adults (Ogle et al. 2013). Another possibility is that the results reflect a limitation in the measures used in this study, such that developmental timing of exposure is associated with other, more distal factors in ways that indirectly shape coping. For example, prior research has found that increases in avoidant or negative-emotion focused coping after traumatic events are predicted by increasingly negative appraisals of the events (Bal et al. 2009; Tierens et al. 2012). Future studies seeking to identify sensitive periods would likely benefit from including a wider array of measures related to coping and trauma that are assessed shortly after the onset of trauma (e.g., cognitive functioning, stress reactivity, HPA-axis functioning). It is also important to

note that the existing coping literature is limited by a lack of robust knowledge on the development of coping in typically developing children, which is critical for identifying maladaptive change, or lasting effects of exposure to trauma and stress on the development of specific skills. This gap presents a challenge for interpreting the current study's findings and the lack of sensitive periods, as insights regarding the developmental course of coping behaviors are needed to understand the typical developmental occurrence of these behaviors.

Third, higher cumulative exposure to trauma was associated with greater reported use of negative-emotion focused coping, consistent with our hypothesis and prior research (Bal et al. 2003), but was unassociated with positive emotion-focused and problem-focused coping, contrary to our hypothesis. Importantly, cumulative exposure to trauma has been found to be associated with adverse negative mental health outcomes in studies that did not include assessment of coping (Kronenberg et al. 2010; Mullett-Hume et al. 2008). Those findings, together with the present study, suggest that future work is warranted to discern whether repeated exposure to trauma could incrementally influence coping style, and whether ongoing exposure to trauma could amplify risk for the development of negative emotional and behavioral outcomes (e.g., if coping behaviors deteriorate in effectiveness). Understanding youth's coping responses to a single traumatic event may not be comprehensive or stable enough to detect the lasting effects of these exposures to trauma on youth's ability to manage future stressful situations. Our understanding of these complex relations may be sharpened by research examining coping strategies for life stressors as candidate moderators or mediators of the association between exposure(s) to trauma and mental health outcomes.

As discussed previously, the use of coping behaviors often thought to be maladaptive (i.e., avoidance based behaviors and cognitions) may contribute to the need for interventions and services. A better understanding of the experiences that predict these coping behaviors may aid in identifying treatment needs among—and treatment strategies for—adolescents recovering from prior exposure to trauma. Recent meta-analyses of early interventions for trauma-exposed adolescents conclude that individual coping skills are a key ingredient of effective treatments (Kramer and Landolt 2010). This conclusion is supported by meta-analytic work on psychotherapy, which suggests that coping-focused interventions have small to medium effects on increasing effective coping skills and reducing symptoms of psychopathology (Harvey and Taylor 2010). Thus, the study of coping behaviors that youth use to cope with stress—assessed before and after exposure to trauma—has implications for advancing research on the types of coping skills to target for reduction or enhancement during

treatment. The present findings highlight the possibility that teaching alternatives to negative emotion-focused coping may improve interventions aimed at increasing youth's ability to manage stress in their day to day lives, and ameliorate any negative impact of prior trauma that may influence these capabilities. Increased focus on developing adaptive coping skills is already receiving attention in intervention research. Coping strategies are often included within social-emotional learning curricula, including in school-based programs, and some of these have led to significant increases in child well-being and achievement from early childhood through high school (see Durlak et al. 2011), underscoring the potential value of intervening during the school years, when coping abilities may be particularly modifiable.

Results from the present study should be evaluated in light of several limitations. First, some limitations pertain to measurement. The assessments relied on adolescents' reports of the occurrence and timing of past trauma, which may not be accurate due to memory lapses or discomfort with disclosure; both over- and under-reporting may be possible (Hardt and Rutter 2004). However, recent work has shown that retrospective and concurrent measures produce similar estimates of effects for mental disorders (Scott et al. 2012), suggesting that ascertainment strategy may not influence findings markedly. Additionally, it is possible that the adolescents without complete survey data differed from the youth included in the study in meaningful ways; some demographic differences between the excluded and included sample are correlated with prevalence of exposure to traumas and the present study may underestimate some effects. Finally, the assessment of coping behaviors included brief subscales for the three coping domains. With fewer items to capture a broad range of behaviors within each coping domain, the Cronbach's alpha values are modest. The use of coping assessments with greater comprehensive coverage of coping domains would strengthen future work.

Second, there are limitations related to timing of the assessments and inclusion of explanatory factors. The present analysis was cross-sectional, with exposure to trauma and coping data obtained at the same time. A useful direction for the future will be prospective longitudinal research that can shed light on developmental trajectories of coping with stress, and whether, when, and if so, how coping behaviors are disrupted or altered by exposure to trauma. Such studies can also provide more fine-grained study of timing of exposure. The cut-points in the present study limit the identification of more specific age-related effects, however this approach is consistent with prior literature investigating sensitive periods and was appropriate for retrospective reports of exposure. Third, we did not examine all the factors that might have been related to youth

trauma and coping—factors such as parental mental illness, parental incarceration, and exposure to child neglect or poverty. These constructs were either unmeasured in the NCS-A or were measured without regard to developmental timing of exposure. Studies examining the role of these and other potentially powerful factors will ultimately be needed if we are to fully understand the interplay of exposure to trauma with future coping abilities for life stressors in adolescence and beyond.

Yet, this study had a number of strengths and addressed several gaps in the literature and limitations of prior research. The large, representative sample produced generalizable estimates of the correlation between multiple aspects of exposure to trauma and the style of coping adolescents use to manage current stress. Further, the classifications of exposure to trauma that assessed content, timing, and accumulation bolstered the consistent finding that youth with a history of trauma differ from those without in terms of reported use of negative emotion-focused coping behaviors. These characteristics represent some of the key features that have limited prior empirical studies of coping and trauma in youth, and could strengthen future work intended to extend and further explain the present results.

Conclusion

Our findings link the experience of trauma during childhood to current negative emotion-focused coping in adolescence. This association was evident for multiple types of exposure to trauma, across all ages of first exposure from early childhood through adolescence, and was stronger with increased accumulation of exposure to traumatic events. The findings highlight the importance of tracking developmental trajectories of normative coping and stress management across childhood and adolescence, and examining the impact of trauma on youth functioning at multiple time points, to clarify the nature and timing of causal patterns in the trauma-coping-stress nexus. The present findings, together with prior work linking exposure to trauma to significant mental health problems, suggest the need for research to evaluate whether interventions designed to alter youth coping strategies for present stressors might soften the adverse impact of prior trauma on mental health outcomes.

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Authors' Contributions R.V. participated in the design and coordination of the current study, performed the statistical analysis, interpreted the data, and drafted the manuscript; Y.W. participated in the

design and coordination of the study, performed the initial statistical analyses, and reviewed drafts of the manuscript; J.K. participated in the design and coordination of the study, performed early statistical analyses, and helped draft sections of the manuscript; J.W. helped interpret findings and critically revised the manuscript; E.C.D. conceived of the current study, and participated in its design and coordination, interpreted the data, and helped to draft the manuscript. All authors read and approved the final manuscript.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval All procedures performed in this study involving human participants were in accordance with the ethical standards of The Human Subjects Committees of Harvard Medical School and the University of Michigan, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent from parents and informed assent from adolescents was obtained from all individual participants included in the study.

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Supplemental Table 1. Factor analysis of coping items within the NCS-A

Item	Factor 1		Factor 2		Factor 3	
	Negative Emotion-Focused Coping		Problem-Focused Coping		Positive Emotion-Focused Coping	
(1) Analyze problem to see how to make it better	0.11	0.71	-0.18			
(2) Seek advice from others	0.13	0.50	-0.07			
(3) Make a plan of action and follow it	0.05	0.61	-0.03			
(4) Try not to think about it at all	0.08	-0.14	0.52			
(5) Keep a sense of humor	-0.14	0.33	0.49			
(6) Look at the situation in a different way	-0.06	0.38	0.46			
(7) Day dream about how things used to be	0.62	0.11	0.09			
(8) Go over situation again and again in mind	0.59	0.24	-0.11			
(9) Keep emotions in control to think clearly	-0.15	0.57	0.15			
(10) Get mad and break something/cause a scene	0.40	-0.29	0.13			
(11) Keep feelings to self to avoid embarrassment	0.18	-0.14	0.47			
(12) Do things to take mind off of situation	0.08	0.1	0.58			
(13) Accept that nothing can be done and move on	0.02	-0.09	0.49			
(14) Fantasize about how things will turn out	0.57	0.15	0.09			
(15) Let off steam by yelling/crying alone	0.63	-0.01	-0.02			
(16) Avoid being with people/spend time alone	0.54	-0.12	0.11			
(17) Watch sad/angry movies, listen to sad/angry music	0.64	-0.07	-0.01			
Cronbach's alpha	0.72	0.64	0.62			

A maximum likelihood ordinal exploratory factor analysis (EFA) was conducted using polychoric correlations and a promax (oblique) rotation, allowing for inter-factor correlation. The highest factor loading for each item above 0.35 is denoted in bold. Items loading onto more than one factor, such as item six, were designated to the factor on which the loading was the highest. Examination of the eigenvalues and scree plot suggest that additional factors do not account for significantly greater variance, and the "proportion" criterion in the SAS package identifies the three-factor solution as the point at which 100% of cumulative variance is accounted for. Results are consistent with the "elbow criterion" (Thornthike, 1953; visual detection of the point where change is greatest and at which adding another factor results in minimal gain in variance accounted for) in the scree plot, and this solution demonstrated acceptable reliability (Tucker-Lewis reliability coefficient = 0.78). TLI values should be interpreted with caution in the context of an EFA, as the widely used cut-offs are designed for confirmatory factor analysis. The results were consistent with the three-domain model of coping reviewed by Carver and Connor-Smith (2010).

Supplemental Table 2. Sensitivity analysis of association between type of trauma exposure and current coping behaviors

PTEs (Potentially Traumatic Events)	Problem Coping Ability					Positive Emotion Coping					Negative Emotion Coping				
	Beta	SE	LL	UL	p-value	Beta	SE	LL	UL	p-value	Beta	SE	LL	UL	p-value
Exposure to any trauma	-0.05	0.03	-0.11	0.01	0.4960	0.05	0.03	-0.01	0.10	0.3756	0.25	0.03	0.20	0.30	<.0001
Interpersonal violence															
Parent violence	-0.19	0.16	-0.51	0.13	0.6689	0.22	0.13	-0.04	0.49	0.3756	0.38	0.15	0.10	0.67	0.0185
Other violence	-0.08	0.10	-0.28	0.12	0.6689	-0.02	0.07	-0.15	0.12	0.8941	0.56	0.08	0.40	0.73	<.0001
Rape	-0.38	0.13	-0.64	-0.12	0.0743	0.07	0.12	-0.16	0.31	0.7621	0.44	0.11	0.23	0.65	0.0005
Other sexual assault	0.02	0.11	-0.19	0.24	0.8640	0.03	0.09	-0.14	0.21	0.8797	0.29	0.17	-0.05	0.63	0.1357
Kidnapped	0.21	0.28	-0.34	0.75	0.6689	0.19	0.15	-0.11	0.48	0.4558	0.28	0.20	-0.11	0.67	0.1862
Any of above	-0.10	0.07	-0.22	0.03	0.5883	0.06	0.05	-0.03	0.16	0.4558	0.44	0.06	0.32	0.57	<.0001
Accidents & Injuries															
Car accident	0.04	0.06	-0.09	0.16	0.7852	0.10	0.06	-0.03	0.22	0.3778	0.22	0.07	0.08	0.37	0.0079
Disaster	0.02	0.04	-0.06	0.09	0.8301	0.00	0.04	-0.09	0.09	0.9899	0.08	0.05	-0.02	0.18	0.1509
Illness	0.04	0.04	-0.05	0.12	0.6689	0.05	0.06	-0.08	0.17	0.7621	0.15	0.06	0.02	0.27	0.0339
Chemical	0.04	0.12	-0.19	0.26	0.8640	0.01	0.13	-0.24	0.27	0.9564	0.13	0.11	-0.08	0.34	0.2379
Other accident	0.00	0.07	-0.14	0.14	0.9601	0.04	0.07	-0.10	0.18	0.7621	0.28	0.08	0.13	0.44	0.0017
Any of above	0.03	0.03	-0.03	0.10	0.6689	0.04	0.03	-0.02	0.10	0.4682	0.17	0.03	0.12	0.23	<.0001
Social network & witness events															
Witness fights at home	-0.23	0.07	-0.36	-0.09	0.0583	0.13	0.06	0.02	0.24	0.2446	0.40	0.08	0.24	0.55	<.0001
Witness death	-0.09	0.08	-0.23	0.06	0.6689	0.05	0.06	-0.06	0.16	0.7199	0.27	0.04	0.19	0.36	<.0001
Close person died unexpectedly	-0.03	0.04	-0.10	0.04	0.6689	0.05	0.03	-0.01	0.11	0.3756	0.16	0.05	0.06	0.26	0.0051
Close person threatened unexpectedly	0.05	0.05	-0.06	0.16	0.6689	0.03	0.05	-0.06	0.12	0.7621	0.24	0.04	0.15	0.32	<.0001
War terror	-0.04	0.16	-0.36	0.28	0.8640	0.05	0.11	-0.17	0.26	0.8719	0.04	0.10	-0.15	0.23	0.6728
Refugee	-0.38	0.45	-1.25	0.49	0.6689	-0.36	0.24	-0.84	0.12	0.3778	-0.22	0.15	-0.50	0.07	0.1736
Any of above	-0.08	0.03	-0.14	-0.02	0.1150	0.05	0.03	0.00	0.10	0.3756	0.24	0.03	0.17	0.30	<.0001
Other events															
Other trauma	0.20	0.09	0.03	0.38	0.1555	0.02	0.08	-0.13	0.17	0.8941	0.12	0.09	-0.06	0.30	0.2313
Non disclosed	0.02	0.09	-0.15	0.19	0.8640	0.22	0.07	0.08	0.36	0.0603	0.47	0.09	0.30	0.64	<.0001
Any of above	0.06	0.07	-0.08	0.20	0.6689	0.17	0.06	0.06	0.28	0.0603	0.35	0.08	0.20	0.50	0.0001

Cell entries are the estimate (beta), standard error, and confidence intervals generated from a set of generalized estimating equations (GEE) examining the effect of each traumatic event and type on the three coping styles, after adjusting for covariates, with adolescents who had a past year experience with depression removed from the sample. A false discovery rate (FDR) correction was applied to adjust p-values for the multiple testing of 18 different individual exposures, plus exposure type and exposure to any trauma. Statistical significance after imposing the FDR correction is denoted in bold. Changes from the initial analyses are noted in red. Coping values were standardized (mean=0; sd=1) to allow comparison across coping type. LL refers to lower confidence level. UL refers to upper confidence level.

Supplemental Table 3. Sensitivity analysis of association between age group at first trauma exposure and current coping behaviors

Timing of PTEs (Potentially Traumatic Events)	Problem Coping Ability					Positive Emotion Coping					Negative Emotion Coping				
	Beta	SE	LL	UL	p-value	Beta	SE	LL	UL	p-value	Beta	SE	LL	UL	p-value
Exposure to any trauma															
Early childhood	0.01	0.05	-0.09	0.10	0.9254	0.06	0.05	-0.04	0.17	0.7094	0.27	0.04	0.19	0.35	<.0001
Middle childhood	-0.04	0.04	-0.12	0.05	0.6901	0.04	0.06	-0.06	0.15	0.7094	0.24	0.05	0.13	0.34	0.0005
Adolescence	-0.09	0.04	-0.17	-0.01	0.3916	0.04	0.04	-0.04	0.11	0.7094	0.25	0.03	0.18	0.31	<.0001
Interpersonal violence															
Early childhood	0.08	0.15	-0.22	0.38	0.8332	0.17	0.09	-0.02	0.35	0.4711	0.51	0.14	0.23	0.79	0.0035
Middle childhood	-0.12	0.12	-0.37	0.12	0.6901	-0.03	0.11	-0.25	0.18	0.8884	0.21	0.15	-0.08	0.51	0.2572
Adolescence	-0.13	0.08	-0.29	0.03	0.6901	0.09	0.07	-0.05	0.23	0.6707	0.56	0.08	0.40	0.72	<.0001
Accidents and injuries															
Early childhood	0.08	0.06	-0.04	0.20	0.6901	0.01	0.05	-0.08	0.10	0.9179	0.16	0.06	0.05	0.28	0.0177
Middle childhood	0.04	0.05	-0.06	0.14	0.6901	0.05	0.06	-0.07	0.17	0.7094	0.19	0.07	0.05	0.33	0.0300
Adolescence	-0.01	0.05	-0.11	0.09	0.9074	0.05	0.05	-0.05	0.14	0.7094	0.16	0.04	0.08	0.25	0.0031
Social network or witness events															
Early childhood	-0.09	0.08	-0.25	0.06	0.6901	0.09	0.06	-0.03	0.20	0.5779	0.22	0.06	0.11	0.34	0.0029
Middle childhood	-0.09	0.07	-0.22	0.04	0.6901	0.06	0.05	-0.05	0.16	0.7094	0.21	0.06	0.09	0.33	0.0042
Adolescence	-0.07	0.04	-0.15	0.01	0.6251	0.03	0.04	-0.05	0.12	0.7094	0.25	0.04	0.18	0.32	<.0001
Other events															
Early childhood	0.09	0.18	-0.25	0.43	0.8332	0.23	0.13	-0.03	0.48	0.4711	0.00	0.23	-0.45	0.44	0.9887
Middle childhood	0.04	0.16	-0.29	0.36	0.9074	-0.09	0.10	-0.28	0.11	0.7094	0.23	0.12	0.01	0.46	0.1030
Adolescence	0.06	0.07	-0.07	0.20	0.6901	0.24	0.07	0.11	0.37	0.0331	0.45	0.10	0.26	0.64	0.0002

Cell entries are the estimate (beta), standard error, and confidence intervals generated from a set of generalized estimating equations (GEE) examining the effect of each traumatic event and type on the three coping styles, after adjusting for covariates, with adolescents who had a past year experience with depression removed from the sample. A false discovery rate (FDR) correction was applied to adjust p-values for the multiple testing of 18 different individual exposures, plus exposure type and exposure to any trauma. Statistical significance after imposing the FDR correction is denoted in bold. Changes from the initial analyses are noted in red. Coping values were standardized (mean=0; sd=1) to allow comparison across coping type. LL refers to lower confidence level. UL refers to upper confidence level.

Supplemental Table 4. Sensitivity analysis of associations between number of traumatic events experienced and current coping behaviors

PTEs (Potentially Traumatic Events)	Frequency (%)	Problem Coping Ability					Positive Emotion Coping					Negative Emotion Coping					
		Beta	SE	LL	UL	p-value	Beta	SE	LL	UL	p-value	Beta	SE	LL	UL	p-value	
Any trauma																	
0 (Ref)	3662 (43.2)																
1	2541 (29.2)	-0.05	0.03	-0.11	0.02	0.5299	0.02	0.04	-0.06	0.10	0.6744	0.15	0.03	0.09	0.22	0.0000	
2	1300 (15.1)	-0.07	0.05	-0.17	0.04	0.5299	0.05	0.04	-0.03	0.13	0.4937	0.21	0.05	0.12	0.31	0.0001	
3	599 (6.7)	0.02	0.05	-0.08	0.12	0.8249	0.07	0.06	-0.04	0.19	0.4937	0.45	0.06	0.34	0.57	0.0000	
4+	503 (5.8)	-0.09	0.09	-0.27	0.09	0.5841	0.16	0.08	0.00	0.32	0.2224	0.66	0.06	0.54	0.77	0.0000	
Interpersonal violence																	
0 (Ref)	7843 (90.8)																
1	615 (7.4)	-0.09	0.05	-0.19	0.01	0.5299	0.07	0.05	-0.02	0.16	0.4459	0.42	0.07	0.27	0.56	0.0000	
2+	147 (1.8)	-0.13	0.21	-0.55	0.29	0.6698	0.04	0.13	-0.21	0.28	0.7657	0.55	0.12	0.31	0.80	0.0001	
Accidents & Injuries																	
0 (Ref)	6234 (72.0)																
1	1902 (22.4)	0.04	0.03	-0.03	0.10	0.5841	0.03	0.03	-0.03	0.09	0.5102	0.14	0.03	0.09	0.19	0.0000	
2+	469 (5.6)	0.01	0.08	-0.14	0.16	0.8679	0.06	0.07	-0.08	0.20	0.5273	0.30	0.09	0.13	0.47	0.0012	
Social network & witness events																	
0 (Ref)	4972 (59.0)																
1	2666 (30.3)	-0.08	0.04	-0.15	-0.01	0.4250	0.03	0.03	-0.03	0.09	0.5102	0.18	0.03	0.11	0.25	0.0000	
2	739 (8.4)	-0.03	0.06	-0.14	0.08	0.6698	0.11	0.05	0.01	0.21	0.2224	0.41	0.07	0.28	0.54	0.0000	
3+	228 (2.3)	-0.24	0.16	-0.56	0.08	0.5299	0.09	0.11	-0.14	0.32	0.5276	0.41	0.10	0.23	0.60	0.0001	
Other events																	
0 (Ref)	8021 (93.6)																
1+	584 (6.4)	0.06	0.07	-0.08	0.20	0.6365	0.17	0.06	0.06	0.28	0.0630	0.35	0.08	0.20	0.50	0.0001	

Cell entries are the estimate (beta), standard error, and confidence intervals generated from a set of generalized estimating equations (GEE) examining the effect of each traumatic event and type on the three coping styles, after adjusting for covariates, with adolescents who had a past year experience with depression removed from the sample. A false discovery rate (FDR) correction was applied to adjust p-values for the multiple testing of 18 different individual exposures, plus exposure type and exposure to any trauma. Statistical significance after imposing the FDR correction is denoted in bold. Changes from the initial analyses are noted in red. Coping values were standardized (mean=0, sd=1) to allow comparison across coping type. LL refers to lower confidence level. UL refers to upper confidence level.