Exposure to Prior Negative Life Events and Responses to the Boston Marathon Bombings

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Objective: The objective of the study was to explore how type and timing of prior negative life experiences (NLEs) may be linked to responses to subsequent collective trauma, such as a terrorist attack. *Method:* Using a longitudinal design, we examined relationships between prior NLEs and responses to the 2013 Boston Marathon bombings (BMB). Shortly after the BMB, a representative sample, compiled from metropolitan Boston ($n = 846$), New York ($n = 941$), and the rest of the United States ($n = 2,888$), reported BMB exposure and acute stress symptomatology. Six months later, we assessed prior NLEs, BMB-related posttraumatic stress symptoms, ongoing fear about future terrorism, and functioning. NLEs were classified by *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition, criteria for traumatic events and other stressful experiences and by occurrence in childhood, adulthood (pre-BMB), and recent (past 6 months). *Results:* Cumulative exposure to events, delineated by type and timing of occurrence, were contrasted; analyses adjusted for demographics, BMB-related exposure, and residential region. Post-BMB acute stress was associated with childhood ($b = 0.88$, 95% confidence interval [CI: 0.14, 1.61]) and adulthood ($b = 0.83$, 95% CI [0.21, 1.45]) trauma exposure. Exposure to childhood, adulthood, and recent traumatic events, as well as recent stressful events, was associated with higher BMB-related posttraumatic stress ($ps < .05$). Greater exposure to adulthood ($b = 0.06$, 95% CI [0.01, 0.11]) and recent ($b = 0.30$, 95% CI [0.01, 0.58]) trauma was associated with higher fear about future terrorism. Exposure to childhood ($b = 0.17$, 95% CI [0.07, 0.27]) and adulthood ($b = 0.15$, 95% CI [0.05, 0.25]) trauma and recent stressful events ($b = 0.45$, 95% CI [0.24, 0.66]) was associated with poorer functioning. *Conclusion:* Prior trauma may sensitize negative responses to collective trauma; recent stressors may exacerbate effects.

Clinical Impact Statement
We show that traumatic life events over the life span are associated with higher posttraumatic stress responses following a subsequent collective trauma—in this case, the Boston Marathon bombings. Also, trauma that occurred recently (in adulthood and past 6 months) was associated with higher fears and worry about future acts of terrorism. Findings have theoretical and clinical implications for understanding how different types of lifetime adversity impact the traumatic stress response following community-wide disasters.

Keywords: terrorism, posttraumatic stress, trauma, cumulative exposure, collective trauma

Traumatic events and other negative life experiences (NLEs) are associated with a variety of deleterious psychological outcomes (Breslau et al., 1998; Felitti & Anda, 2010), including posttraumatic stress disorder (PTSD) (American Psychiatric Association, 2013) and posttraumatic stress responses (PTS). Collective traumas, such as terrorist attacks, can impact the populace broadly (Garfin, Poulin, Blum, & Silver, 2018), yet wide variability in

psychological responses exists (Schlenger et al., 2002; Silver, Holman, McIntosh, Poulin, & Gil-Rivas, 2002), necessitating more detailed inquiry into how people respond to these negative collective events.

The variability in postevent responses might be explained, in part, by prior exposure to NLEs. Seminal research among a representative sample of Detroit residents found that multiple expo-

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sures to prior NLEs (particularly violence, injury, or bereavement) were associated with greater likelihood of PTSD in response to a subsequent index trauma (Breslau et al., 1998). Cumulative exposure to prior collective traumas (9/11, Superstorm Sandy, the Sandy Hook Elementary School shooting) was associated with increased distress following the Boston Marathon bombings (Garfin, Holman, & Silver, 2015), although the link between individual-level NLEs and responses was not examined in those analyses. In a nationally representative sample, childhood adversity appeared to amplify the effect of past-year stressful life events on depression, PTSD, and other anxiety disorders, suggesting that prior events may indeed tax an individual's ability to cope with subsequent events as they occur (McLaughlin, Conron, Koenen, & Gilman, 2010). Yet the extant literature has not yet adequately examined type of prior individual-level event or whether these events may sensitize people to an exogenous event like a collective trauma.

However, sensitization effects (where prior exposure correlates with worse outcomes) are not universally indicated: Some research supports inoculation effects, whereby some previous NLE exposure buffers severity of subsequent posttrauma responses (Palgi, Gelkopf, & Berger, 2015; Seery, Holman, & Silver, 2010). Experiencing some lifetime adversity, both in childhood (Gunnar, Frenn, Wewerka, & Van Ryzin, 2009) and adulthood (Schnurr, Rosenberg, & Friedman, 1993), has been linked with improved psychological and physiological outcomes. This may occur through generating toughness, gaining a sense of mastery over prior difficulties, and/or developing effective coping skills (see Seery et al., 2010).

In addition to the number of prior NLE exposures, the type of NLEs to which the individual had previously been exposed may differentially impact posttrauma responses. For example, divergent postevent responses have been found between events classified as traumatic versus those classified as nontraumatic (Mol et al., 2005), violent versus nonviolent (Ford, Gagnon, Connor, & Pearson, 2011), interpersonal versus noninterpersonal (Ford et al., 2011), occurring during childhood versus adulthood (Horesh, Amir, Kedem, Goldberger, & Kotler, 1997), and so on. The present study sought to unpack some of these differences highlighted in prior research. Through a comprehensive approach, we utilized data from a representative national sample of Americans to explore the role of prior individual-level NLE exposure and responses to a national collective trauma: the Boston Marathon bombings (BMB).

Traumatic Events and Stressful Experiences

Exposure to a trauma, according to *Diagnostic and Statistical Manual of Mental Disorders*, fifth edition (DSM-5) PTSD Criterion A, requires experiencing an actual or threatened death, injury, or sexual harm through direct physical exposure or witnessing it in person; by learning of a close friend or relative's trauma; or hearing about a trauma through professional activities (e.g., psychological therapy). Substantial research has also linked PTS to stressful experiences such as bereavement, divorce, unemployment, major relationship termination, and serious financial problems (Mol et al., 2005; Mulder, Fergusson, & Horwood, 2013). Some research has even indicated more severe PTS following stressful experiences not classified as trauma as defined by

DSM-IV (Gold, Marx, Soler-Baillo, & Sloan, 2005), suggesting that both prior traumatic events and stressful experiences can elicit PTS symptoms.

Timing of Negative Life Events

The timing of exposure to NLEs over one's life may also be a key factor in understanding variability in postevent responses, yet findings have been mixed: Some research indicates younger age at event occurrence predicts severity of PTSD (Roberts, Gilman, Breslau, Breslau, & Koenen, 2011); other work indicates protective effects from early exposure to some NLEs (Shapero et al., 2015). In a longitudinal study of responses to 9/11, older adults tended to have lower overall levels of global distress and faster decline in PTS symptoms (S. B. Scott, Poulin, & Silver, 2013). Yet some adulthood events may be more impactful because of greater psychological poignancy and recency effects (Suh, Diener, & Fujita, 1996), particularly when they are compounded by the experience of earlier trauma. For example, one study found women who reported current, adulthood physical or sexual abuse exhibited higher depression, anxiety, somatization, and lower self-esteem than those who experienced physical or sexual abuse during childhood alone or adulthood in the past; women who had current abuse and abuse in childhood fared the worst (McCauley et al., 1997). Yet a recent systematic review did not find strong correlations between age of onset of NLEs and deleterious health outcomes (Afari et al., 2014), necessitating further inquiry.

The Present Study

We explore the influence of prior individual-level NLEs on responses to the 2013 BMB in a representative national sample of Americans, with a particular focus on whether the prior NLE could be classified as stressful or traumatic and when during the life span it occurred. Examining these issues in the context of an exogenous collective trauma like the BMB minimizes some confounds commonly associated with personally selected indicator events. That is, many epidemiological studies of PTSD ask participants to select a traumatic event they experienced previously and then report their PTS to that event, introducing potential bias with respect to event recall and severity of exposure. Moreover, terrorism may be a particularly salient collective trauma; data from nationally representative samples indicate that both single-incident (Garfin et al., 2018; Silver et al., 2002) and chronic terrorism (Hobfoll et al., 2009) may elicit acute and PTS responses (albeit with varying levels of severity) throughout the population. We also examine ongoing fear about future terrorism to capture ruminative processes and the sense of vulnerability, anxiety, and uncertainty frequently elicited by acts of terrorism (Updegraff, Silver, & Holman, 2008). Finally, we assess functional impairment as an outcome, given research indicating a greater number of prior NLEs are linked with poorer functioning (Seery et al., 2010).

Given marked inconsistency in prior results, we use an exploratory approach to examine variability in the link between prior NLEs and psychological responses to a subsequent traumatic event. More specifically, we ask:

1. Do greater number of exposures to traumatic events and stressful experiences predict subsequent psychological

responses to the BMB, ongoing fear about future terrorism, and functional impairment?

2. Are NLEs that occur in childhood, adulthood, or in recent adulthood more strongly correlated with outcomes?

Method

To conduct this study, we collaborated with GfK, a web-based survey research company that uses addressed-based sampling methods to select, recruit, and maintain a representative panel (KnowledgePanel) of American adults. Panelists receive monetary compensation or free Internet access for completing web-based surveys; households without a computer or Internet are provided access. The Wave 1 survey was fielded to 6,098 KnowledgePanelists between April 29 and May 13, 2013 (2–4 weeks after the BMB); 4,675 respondents completed the survey, including representative samples from metropolitan Boston ($n = 846$), New York City ($n = 941$), and the rest of the country ($n = 2,888$), yielding a 79.08% completion rate (Holman, Garfin, & Silver, 2014). Wave 1 panelists who were still available to complete surveys ($N = 4429$) were invited to participate in a follow-up survey between October 17 and November 17, 2013 (some KnowledgePanel participants had left the panel and requested they not be contacted for follow-up). This Wave 2 survey was completed by 3,604 respondents (metropolitan Boston, $n = 711$; New York, $n = 731$; national, $n = 2,162$), representing an 81.37% participation rate. Of these, 3,598 respondents provided adequate data to be included in the calculations of the weights (see below).

GfK provided poststratification weights to correct for discrepancies between the study sample and U.S. Census benchmarks. The panel selection methods provide statistical control on the representativeness of GfK panel samples and ensures sample comparability to population benchmarks (see Holman et al., 2014, for detailed demographic comparisons between the GfK panel and U.S. Census data). Panel design weights are calculated to reflect unequal selection probabilities for different sampled members from the KnowledgePanel. Subsequently, design weights are poststratified to the benchmarks from the most recent U.S. government statistics to compensate for any differential nonresponse that may have resulted during the fielding period. The weighted composition of the respondents closely matched that of the target population as defined by benchmarks from the American Community Survey from the U.S. Department of Commerce, U.S. Census Bureau (2012). More detailed descriptions of the weighting procedures have been previously described (see Holman et al., 2014). All research procedures were approved by the University of California, Irvine.

Measures

Outcome variables. Acute stress symptoms were assessed using the Stanford Acute Stress Reaction Questionnaire at Wave 1, 2–4 weeks after the BMB. This 30-item measure uses a 6-point scale ranging from 1 (*not experienced*) to 5 (*very often experienced*) and is a well-validated and reliable measure of acute stress (Cardeña, Koopman, Classen, Waelde, & Spiegel, 2000). Reliability was excellent, $\alpha = .96$; $M = 42.21$, $SD = 18.86$.

Posttraumatic stress symptomatology (PTS) regarding the Boston Marathon bombings was assessed at Wave 2 with the four-item PTSD-PC, a primary care screening tool validated against clinical diagnostic interviews (Calhoun et al., 2010; Prins et al., 2004). Reliability was acceptable, $\alpha = .78$; $M = 5.11$, $SD = 2.01$.

Ongoing fear about future terrorism was assessed at Wave 2 with a two-item measure previously used in research on terrorism following 9/11 (Silver et al., 2002) (end points 1 = *never*; 5 = *all the time*). Items asked participants to report: "how often in the past week have you had fears about the possibility of another terrorist attack (e.g., bombing, hijacking, etc.)?" and "I worry that an act of terrorism (e.g., bombing, hijacking, etc.) will personally affect me or someone in my family in the future." Reliability was good, $\alpha = .81$; $M = 3.5$, $SD = 1.54$.

Functional impairment was assessed at Wave 2 with a 4-item measure modified from the Short Form-36 (Ware & Sherbourne, 1992). Using a 5-point scale (end points 1 = *none of the time*; 5 = *all of the time*), participants reported how often their physical and emotional health interfered with social and work-related functioning in the prior week. Reliability was good, $\alpha = .86$; $M = 5.91$, $SD = 3.00$.

Because we had very little missing data (less than 2% on any one item), row mean substitution (by subscale, if applicable) was implemented to preserve sample size if respondents answered the majority of questions per measure. Such an approach may produce the least amount of bias compared with other methods (see Bell, Fairclough, Fiero, & Butow, 2016, for an example) and is consistent with prior analyses of these data (Garfin et al., 2015; Holman et al., 2014). Of note, several methods of dealing with missing data were tested (e.g., listwise deletion, halfrule); all produced identical results and nearly identical coefficients to those reported herein.

Predictor variables. Life events history was assessed by asking respondents whether they ever experienced each of 34 specific NLEs and, if so, whether they were exposed prior to age 18 years (in childhood), adulthood before the BMB, or in the previous 6 months (since the BMB). The measure was modified from the Diagnostic Interview Schedule trauma section (Robins, Helzer, Croughan, & Ratcliff, 1981) by including several stressful or traumatic events reported by primary care patients (Holman, Silver, & Waitzkin, 2000) and has provided rates of events comparable to other community-based studies (e.g., Seery et al., 2010). The NLEs were then categorized into traumatic events or stressful experiences according DSM-5 Criteria A for trauma (American Psychiatric Association, 2013) by two independent coders. Kappa was high ($>.70$); all disagreements were resolved by consensus and discussions between coders and authors. See Table 1 for categorization of NLEs. Each traumatic or stressful event was then categorized as occurring in childhood, adulthood prior to the BMB, or recent months (6 months after the BMB); exposure to each type of NLE (e.g., serious accident or injury, lost job, physically attacked or assaulted, etc.) was then summed. Categories were mutually exclusive such that no single event was coded in more than one category. However, participants could have experienced a trauma and/or stressful event during each of the three life stages.

Covariates. Direct exposure to the BMB was assessed using a measure modified from prior research on disaster exposure (Holman & Silver, 1998; Koopman, Classen, & Spiegel, 1994). Participants were asked whether they were directly exposed to the BMB either themselves or through a close other (e.g., "I was a spectator at the Boston Marathon at the time of the bombings")

Table 1
Negative Life Events by Categories

Stressful events	Serious illness; serious illness of a loved one; lost someone not due to suicide or homicide (spouse/partner, child, close family member, or friend); experienced your parents' divorce; got divorced yourself; experienced serious financial difficulties; lost your job; been discriminated against because of your ethnicity, religious background, or sexual orientation; been shamed, embarrassed, or repeatedly told you are no good; unwanted pregnancy
Traumatic events	Serious accident or injury; serious accident or injury of loved one; physically attacked or assaulted; witnessed family member injured or killed; witnessed someone other than a family member injured or killed; been coerced with threats of harm to yourself or your family; experienced forced separation from family/children; had combat experience; suffered a loss in a major fire, flood, earthquake, or natural disaster; suffered a loss in a tragedy or disaster in your community caused by other people; lived in dangerous housing or neighborhood; been exposed to dangerous chemicals or biological agents; hit or pushed by a partner or spouse; lost someone close (spouse/partner, child, close family member, or friend) due to homicide; lost someone close (spouse/partner, child, close family member, or friend) due to suicide; molested; had sexual relations under force or threat; was bullied as a child;[a] were neglected by your parents;[a] physically harmed as a child;[a] witnessed violence between your parents as a child[a]

[a] Asked only for occurrence in childhood.

(Holman et al., 2014). Responses were coded dichotomously as direct or no direct exposure to the BMB, consistent with the DSM-5 (American Psychiatric Association, 2013): 0 (*no direct exposure*), 1 (*self or close other exposed*).

Demographic information (including sampling region: Boston, New York, and the remainder of the country) was obtained by GfK upon panel enrollment.

Analytic Strategy

Statistical analyses were conducted using Stata, version 14.0 (Stata Corp, College Station, TX), a program well suited to handle complex survey data. All results (including descriptive statistics) present weighted statistics. For each dependent variable (acute stress symptoms, PTS, and ongoing fear of future terrorism), a series of multivariate ordinary least squares (OLS) regression models were constructed using a hierarchical variable entry strategy. Variables were entered in two blocks. In Model 1, the six categories of NLEs (stress/trauma in childhood, stress/trauma in adulthood before the BMB, and recent stress/trauma) were entered. (Recent adulthood events were not examined in the acute stress model because they occurred temporally after the assessment of acute stress.) In Model 2, all covariates [demographics and BMB exposure (i.e., direct expo-

Table 2
Multiple Ordinary Least Squares Regression Analyses of Exposure to Traumatic Events and Stressful Experiences on Boston Marathon Bombing–Related Acute Stress (N = 3,598)[a]

Variable	Model 1 (N = 3,598)				Model 2 (N = 3,594)			
	β	b	[95% CI]	p	β	b	[95% CI]	p
Negative life events								
Childhood stress	.05	.79	[−.20, 1.78]	.119	.05	.70	[−.28, 1.67]	.161
Adult (pre-BMB[b]) stress	−.04	−.40	[−.95, .14]	.146	−.04	−.42	[−1.02, .17]	.162
Childhood trauma	.10	1.01	[.27, 1.74]	.008	.09	.88	[.14, 1.61]	.019
Adult (pre-BMB[b]) trauma	.07	.77	[.13, 1.40]	.017	.07	.83	[.21, 1.45]	.009
Demographics								
Female gender[c]					.08	3.20	[1.39, 5.01]	.001
College graduate[d]					−.03	−1.49	[−3.20, .23]	.090
Age					−.02	−.02	[−.09, .04]	.501
Income					−.13	−1.37	[−1.86, −.89]	<.001
Ethnicity[e]								
Black					.02	1.03	[−2.86, 4.91]	.605
Other, non-Hispanic					.14	10.34	[5.09, 15.60]	<.001
Hispanic					.00	.005	[−2.99, 3.00]	.998
Marital status[f]								
Divorced, widowed, separated					.03	1.42	[−1.47, 4.31]	.335
Single					.00	.004	[−2.68, 2.69]	.997
Direct exposure to BMB[b,g]					.12	7.95	[3.96, 11.94]	<.001
Region[h]								
New York area					.04	1.91	[−1.52, 5.33]	.275
National sample					−.04	−1.72	[−4.33, .89]	.196
Model statistics	$F(4, 3,593) = 6.53$, $p < .001$, $R^2 = .027$				$F(16, 3,577) = 7.80$, $p < .001$, $R^2 = .091$			

[a] *N*s vary because of missing data. [b] BMB = Boston Marathon bombings. [c] Male = 0 (reference group); female = 1. [d] Less than college = 0 (reference group); college graduate = 1. [e] White = 0 (reference group); all other groups coded 1. [f] Married = 0 (reference group); divorce/widowed/separated = 1; single = 1. [g] No direct Boston Marathon bombing exposure = 0 (reference group); direct Boston Marathon bombing exposure = 1. [h] Boston area = 0 (reference group); New York area = 1; national sample = 1.

sure and region of residence—Boston, New York, or remainder of the country)] were entered.

Results

Of the sample, 47.97% ($n = 1,726$) reported experiencing at least one type of stressful event in childhood, 82.27% ($n = 2,960$) reported experiencing at least one type of stressful event in adulthood before the BMB, and 24.63% ($n = 886$) reported experiencing at least one type of stressful event in the past 6 months. Traumatic events were also common: 51.97% ($n = 1,870$) reported experiencing at least one type of traumatic event in childhood; 53.03% ($n = 1,908$) reported experiencing one type of traumatic event in adulthood before the BMB; and 7.92% ($n = 285$) reported experiencing at least one type of traumatic event in the prior 6 months. Of the Wave 2 respondents, 10.2% ($n = 366$) reported direct exposure to the BMB (i.e., they or a close other were at or near the site of the bombings).

Table 2 reports results from our OLS regression analyses examining predictors of BMB-related acute stress. Controlling for demographic covariates and direct exposure to the BMB, both experiencing childhood trauma and experiencing adulthood trauma prior to the BMB, were associated with BMB-related acute stress (see Model 2, Table 2). Table 3 presents results from OLS regres-

sion models examining the relationship between stressful and traumatic events and Wave 2 PTS. In adjusted models, experiencing more types of recent (past 6 months) stressful events and childhood, adulthood, and recent (past 6 months) traumatic events were associated with BMB-related PTS 6 months after the bombing. Table 4 presents results from OLS regression models examining the relationship between stressful and traumatic events and Wave 2 ongoing fear about future terrorism. In adjusted models, both experiencing adult traumatic events and recent (past 6 months) traumatic events were associated with ongoing fear about terrorism. As detailed in Table 5, in adjusted models (see Model 2), experiencing recent (past 6 months) stressful events, and both adulthood and childhood traumatic events, were associated with functional impairment 6 months after the BMB.

Discussion

Specificity in the number and type of exposures to prior NLEs helped explain variability in responses to a collective trauma, the Boston Marathon bombings. Experiencing traumatic events throughout the life span was associated with higher acute and posttraumatic stress symptoms in the aftermath of the BMB; experiencing trauma in adulthood and recently was associated with greater ongoing fear about future terrorism. Experiencing trauma

Table 3

Multiple Ordinary Least Squares Regression Analyses of Lifetime Exposure to Traumatic Events and Stressful Experiences on Boston Marathon Bombing–Related Posttraumatic Stress (N = 3,586)[a]

Variable	Model 1 (N = 3,586)				Model 2 (N = 3,583)			
	β	b	[95% CI]	p	β	b	[95% CI]	p
Negative life events								
Childhood stress	.02	.04	[−.06, .14]	.409	.03	.05	[−.05, .15]	.343
Adult (pre-BMB[b]) stress	−.06	−.06	[−.12, .002]	.057	−.07	−.07	[−.14, −.01]	.019
Recent stress	.10	.26	[.13, .40]	<.001	.08	.23	[.09, .36]	.001
Childhood trauma	.11	.12	[.06, .19]	<.001	.10	.10	[.04, .17]	.002
Adult (pre-BMB[b]) trauma	.11	.13	[.05, .21]	.001	.11	.13	[.06, .20]	<.001
Recent trauma	.10	.48	[.18, .78]	.002	.09	.46	[.15, .76]	.003
Demographics								
Female gender[c]					.01	.06	[−.13, .25]	.532
College graduate[d]					−.07	−.35	[−.56, −.13]	.001
Age					.06	.01	[.0001, .01]	.044
Income					−.06	−.07	[−.12, −.01]	.013
Ethnicity[e]								
Black					.04	.30	[−.05, .64]	.092
Other, non-Hispanic					.15	1.26	[.68, 1.85]	<.001
Hispanic					.07	.43	[.11, .74]	.008
Marital status[f]								
Divorced, widowed, separated					.03	.20	[−.06, .47]	.120
Single					.05	.25	[−.04, .55]	.095
Direct exposure to BMB[b,g]					.10	.70	[.24, 1.17]	.003
Region[h]								
New York area					−.01	−.06	[−.41, .28]	.721
National sample					−.07	−.30	[−.59, −.007]	.045
Model statistics	$F(6, 3,579) = 19.10$, $p < .001$, $R^2 = .08$				$F(18, 3,564) = 11.30$, $p < .001$, $R^2 = .13$			

[a] *N*s vary because of missing data. [b] BMB = Boston Marathon bombings. [c] Male = 0 (reference group); female = 1. [d] Less than college = 0 (reference group); college graduate = 1. [e] White = 0 (reference group); all other groups coded 1. [f] Married = 0 (reference group); divorce/widowed/separated = 1; single = 1. [g] No direct Boston Marathon bombing exposure = 0 (reference group); direct Boston Marathon bombing exposure = 1. [h] Boston area = 0 (reference group); New York area = 1; national sample = 1.

Table 4

Multiple Ordinary Least Squares Regression Analyses of Lifetime Exposure to Traumatic Events and Stressful Experiences on Fear About Future Terrorism (N = 3,573)[a]

Variable	Model 1 (N = 3,573)				Model 2 (N = 3,569)			
	β	b	[95% CI]	p	β	b	[95% CI]	p
Negative life events								
Childhood stress	.01	.01	[−.06, .08]	.817	.03	.04	[−.04, .11]	.331
Adult (pre-BMB[b]) stress	.03	.03	[−.01, .07]	.213	−.01	−.01	[−.05, .04]	.790
Recent stress	.05	.09	[−.01, .20]	.071	.04	.09	[−.02, .19]	.099
Childhood trauma	.06	.05	[−.002, .10]	.060	.06	.05	[.001, .10]	.054
Adult (pre-BMB[b]) trauma	.06	.06	[.01, .11]	.031	.07	.06	[.01, .11]	.023
Recent trauma	.08	.29	[.01, .57]	.045	.08	.30	[.01, .58]	.041
Demographics								
Female gender[c]					.08	.24	[.10, .38]	.001
College graduate[d]					−.05	−.17	[−.31, −.02]	.024
Age					.11	.01	[.005, .02]	<.001
Income					−.02	−.01	[−.05, .02]	.479
Ethnicity[e]								
Black					−.03	−.15	[−.39, .10]	.240
Other, non-Hispanic					.08	.51	[.21, .81]	.001
Hispanic					.06	.26	[.01, .52]	.041
Marital status[f]								
Divorced, widowed, separated					−.01	−.04	[−.24, .17]	.730
Single					.00	−.02	[−.22, .18]	.860
Direct exposure to BMB[b,g]					.09	.46	[.19, .73]	.001
Region[h]								
New York area					.05	.20	[−.04, .43]	.107
National sample					−.01	−.03	[−.22, .16]	.735
Model statistics	$F(6, 3,566) = 10.80$, $p < .001$, $R^2 = .04$				$F(18, 3,550) = 7.90$, $p < .001$, $R^2 = .07$			

[a] Ns vary because of missing data.   [b] BMB = Boston Marathon bombings.   [c] Male = 0 (reference group); female = 1.   [d] Less than college = 0 (reference group); college graduate = 1.   [e] White = 0 (reference group); all other groups coded 1.   [f] Married = 0 (reference group); divorce/widowed/separated = 1; single = 1.   [g] No direct Boston Marathon bombing exposure = 0 (reference group); direct Boston Marathon bombing exposure = 1.   [h] Boston area = 0 (reference group); New York area = 1; national sample = 1.

in childhood and adulthood was also associated with greater functional impairment. Greater number of recent stressful experiences was positively associated with PTS and functional impairment. Data suggest that both traumatic and recent stressful events may lead to adverse outcomes following exposure to a collective trauma, bolstering literature suggesting that both stressful and traumatic events are important to consider in the context of PTS responses (Gold et al., 2005; Mol et al., 2005; Mulder et al., 2013). Our findings also expand the prior literature on the relationship between prior exposure to trauma and responses to subsequent events (McLaughlin et al., 2010) by nesting these questions within the context of an exogenous collective trauma, the Boston Marathon bombings. In general, traumatic events across the life span may sensitize people to respond more negatively to collective trauma, with stressful events that occurred recently having a potent effect on both PTS and functional impairment.

Exposure to Traumatic Events

Trauma exposure over the life span. Results highlight the potential sensitization effects of experiencing prior traumatic events in eliciting or exacerbating traumatic stress symptoms above and beyond the effects of direct exposure to a subsequent collective trauma. Indeed, in the wake of the Boston Marathon bombings, traumatic events that occurred earlier in life or more

recently were linked with higher BMB- and terrorism-related symptomatology. This bolsters prior research suggesting cumulative effects of prior trauma sensitizes people to react more adversely following subsequent trauma (Shrira, Palgi, Ben-Ezra, & Shmotkin, 2010). These compound effects have also been indicated after exposure to peer deaths in a sample of college students (Andersen, Silver, Stewart, Koperwas, & Kirschbaum, 2013) and airline workers after exposure to a traumatic crash (Dougall, Herberman, Delahanty, Inslicht, & Baum, 2000).

Results contrast with those reporting inoculation effects of prior trauma exposure (whereby prior exposure builds resiliency to subsequent events) following continuous rocket fire in Israel (Palgi et al., 2015). Importantly, the rocket fire in Israel lasted 7 years, whereas the BMB was a single incident. The chronic nature and longer duration of terrorism in Israel could have resulted in habituation effects, thus dampening the sensitization effects noted following other types of trauma (Bleich, Gelkopf, & Solomon, 2003). Future research should test for potential differences in a target event (e.g., single incident vs. ongoing trauma or stressful event).

Temporal occurrence of traumatic events. Whereas some studies have found inoculation effects of trauma on mental health, depending on temporal occurrence throughout the life span (Shrira, Shmotkin, & Litwin, 2012), our findings suggest that exposure to more trauma throughout the life span may predispose people to

Table 5

Multiple Ordinary Least Squares Regression Analyses of Lifetime Exposure to Traumatic Events and Functional Impairment (N = 3,564)[a]

Variable	Model 1 (N = 3,564)				Model 2 (N = 3,560)			
	β	b	[95% CI]	p	β	b	[95% CI]	p
Negative life events								
Childhood stress	.04	.09	[−.05, .23]	.191	−.04	.10	[−.04, .24]	.149
Adult (pre-BMB[b]) stress	.08	.12	[.04, .19]	.003	.05	.07	[−.01, .16]	.101
Recent stress	.13	.53	[.32, .75]	<.001	.11	.45	[.24, .66]	<.001
Childhood trauma	.12	.18	[.07, .29]	.001	.11	.17	[.07, .27]	.001
Adult (pre-BMB[b]) trauma	.08	.14	[.04, .25]	.006	.08	.15	[.05, .25]	.004
Recent trauma	.04	.26	[−.09, .62]	.148	.04	.26	[−.10, .61]	.154
Demographics								
Female gender[c]					.06	.37	[.12, .63]	.004
College graduate[d]					−.03	−.22	[−.46, .01]	.056
Age					.03	.01	[−.004, .02]	.217
Income					−.15	−.25	[−.31, −.18]	<.001
Ethnicity[e]								
Black					−.02	−.18	[−.68, .33]	.489
Other, non-Hispanic					−.06	.67	[.14, 1.20]	.014
Hispanic					.02	.16	[−.28, .59]	.483
Marital status[f]								
Divorced, widowed, separated					.03	.28	[−.15, .71]	.197
Single					.05	.35	[.001, .69]	.049
Direct exposure to BMB[b,g]					.02	.47	[.002, .94]	.049
Region[h]								
New York area					.08	.62	[.20, 1.03]	.004
National sample					.05	.29	[−.04, .61]	.081
Model statistics	F(6, 3,557) = 28.43,				F(18, 3,541) = 15.76,			
	p < .001, R[2]= .11				p <.001, R[2]= .15			

[a] *N*s vary because of missing data. [b] BMB = Boston Marathon bombings. [c] Male = 0 (reference group); female = 1. [d] Less than college = 0 (reference group); college graduate = 1. [e] White = 0 (reference group); all other groups coded 1. [f] Married = 0 (reference group); divorce/widowed/separated = 1; single = 1. [g] No direct Boston Marathon bombing exposure = 0 (reference group); direct Boston Marathon bombing exposure = 1. [h] Boston area = 0 (reference group); New York area = 1; national sample = 1.

stronger posttraumatic responses following a collective trauma. Similarly, traumatic events that occurred in childhood and adulthood were associated with more functional impairment. These findings are congruent with those indicating that the accumulation of traumatic experiences, beginning in childhood, may have long-lasting implications for mental health (Felitti & Anda, 2010).

The link between temporal occurrence of trauma and ongoing fears of future terrorism was slightly different: Experiencing greater numbers of traumatic events in adulthood and in the past 6 months was associated with higher ongoing fears of future terrorism. This may be due to the potency of events that occurred more recently in the context of an ongoing and potential future threat. Such context representations may be encoded by Pavlovian fear conditioning and neurological processes (Maren, Phan, & Liberzon, 2013), potentally activated after a collective trauma (Lonsdorf, Haaker, & Kalisch, 2014) such as a terrorist attack. Comparatively, traumas that occurred in childhood may be less salient than traumas occurring more recently in exacerbating present anxiety and ongoing worry about current events such as terrorism.

Exposure to Stressful Experiences

In adjusted models, stressful events that occurred recently were correlated with higher PTS and greater functional impair-

ment. Neither stressful experiences in childhood nor in adulthood prior to the BMB were correlated with higher bombing-related acute stress, ongoing fear about future terrorism, or functional impairment. One explanation may be that many of the stressors we assessed (e.g., job loss, financial difficulties, discrimination) were events that were likely chronic in nature with ongoing effects that were captured with our recent stress variable. This is in line with research demonstrating that stressful events that occurred within the past several months were most detrimental to well-being, whereas stressful events in the distal past were not associated with well-being (Suh et al., 1996). Our findings are also in line with meta-analytic findings demonstrating the link between concurrent life stress and worse PTSD to an index trauma identified by the participant (Brewin, Andrews, & Valentine, 2000). Finally, results are congruent with prior research that found secondary stressors in the aftermath of the 2010 Chilean earthquake were correlated with higher acute stress, above and beyond traumatic exposure to the disaster (Garfin, Silver, Ugalde, Linn, & Inostroza, 2014).

Limitations and Future Directions

We examined the relationship between a large number of negative life experiences over the life span and responses to a terrorist attack among a representative, national sample of

Americans. We examined events that were both stressful and traumatic. We demonstrated that both type of negative event and when the event occurred may be important to understanding responses to future events. Nevertheless, we acknowledge several limitations. Reports of prior NLEs were retrospective and are thus subject to recall and reporting bias; corroborating reports of events would reduce bias (Baldwin, Reuben, Newbury, & Danese, 2019). Our study assessed reactions to a collective trauma and may not generalize to individual-level traumatic events. Prior work has indicated specificity in sensitization versus inoculation effects of prior NLEs whereby some events (e.g., repeated peer loss) predispose people to negative outcomes, whereas other types of adverse events (such as bereavement more generally) may be protective in the wake of subsequent trauma (Andersen et al., 2013). Moreover, although we assessed lifetime prevalence of a large number of adverse events, we did not assess reactions to them: Prior responses may be a critical indicator of responses to subsequent events (Cougle, Resnick, & Kilpatrick, 2009). We did not assess trauma severity (S. T. Scott, 2007) or event centrality (Roland, Currier, Rojas-Flores, & Herrera, 2014), two factors that may also impact responses. Moreover, whereas we accounted for cumulative number of different events experienced, we could not account for the number of times a particular event may have occurred nor its duration.

Conclusions

Using a representative national sample of Americans, we improve and expand upon prior work examining the consequences of the accumulation of exposure to NLEs by examining type (stressful and traumatic) and timing of the event. Traumatic events that occurred in childhood and adulthood correlated with acute stress, PTS, and functional impairment. Traumatic events that occurred in adulthood and in recent months correlated with ongoing fear about future terrorism; recent trauma may thus be linked with ruminative processes. Recent stressful events appeared to exacerbate detrimental responses. Results support the sensitization effect of prior trauma exposure; no inoculation effects were indicated. Taken together, our results may be useful to those seeking to understand the precipitates of distress after terrorism and other collective traumas and to those seeking to gain a more comprehensive understanding of how exposure to stress and trauma—and when it occurs—are linked to current functioning.

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