

PSYCHOLOGY

Media exposure to mass violence events can fuel a cycle of distress

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The established link between trauma-related media exposure and distress may be cyclical: Distress can increase subsequent trauma-related media consumption that promotes increased distress to later events. We tested this hypothesis in a 3-year longitudinal study following the 2013 Boston Marathon bombings and the 2016 Orlando Pulse nightclub massacre using a national U.S. sample ($N = 4165$). Data were collected shortly after the bombings, 6 and 24 months post-bombings, and beginning 5 days after the Pulse nightclub massacre (approximately 1 year later; 36 months post-bombings). Bombing-related media exposure predicted posttraumatic stress symptoms (PTS) 6 months later; PTS predicted worry about future negative events 2 years after the bombings, which predicted increased media consumption and acute stress following the Pulse nightclub massacre 1 year later. Trauma-related media exposure perpetuates a cycle of high distress and media use.

INTRODUCTION

Countless mass violence events have stunned the world in recent years, including tragedies such as the massacre at the Pulse nightclub in Orlando, FL, and the mass shooting at a country music festival in Las Vegas, NV, each described at the time as the “worst mass shooting” in the history of the United States. Unfortunately, coverage of these and other large-scale collective traumas (e.g., terrorist attacks and disasters) appears in traditional and social media with increasing frequency; this extensive media coverage is often repetitive and regularly includes graphic images and videos (1), as well as sensationalized descriptions of the events. Repeated exposure to news coverage of these events has been linked to poor mental health outcomes (e.g., acute stress) in the immediate aftermath (2–4) and posttraumatic stress responses and physical health problems over time (2, 5). The 24-hour news cycle and the proliferation of mobile technologies mean that much of the viewing public is regularly plugged into news updates. Thus, media coverage of collective, community-based traumas may transmit distress by broadcasting an event to whole populations, extending the reach of an event that would otherwise have been restricted to local communities (6).

Research also suggests that consumption of media coverage of collective traumas may be a rational response for individuals who are anxious about such events. The uncertainty management hypothesis (7–9) states that individuals may experience anxiety resulting from feelings of uncertainty associated with collective traumas. To mitigate this anxiety and the uncertainty from which it stems, individuals who are concerned about a collective trauma may seek information from the media. Thus, individuals with increased event-related fear should be more likely to cope by consuming trauma-related media. Furthermore, this is likely to be true even for individuals without a history of mental health problems—even healthy individuals pay greater attention to stimuli they perceive as threatening (10–12). However, this strategy of reducing uncertainty by seeking information via the media may backfire when individuals are ex-

posed to graphic trauma-related media content. For example, in the aftermath of the September 11th (9/11) terrorist attacks, individuals who perceived the media as a provider of useful information were more likely to consume 9/11-related media coverage, but this media use was associated with increased distress over time (7).

Thus, an individual’s media use after a collective trauma may fuel a cycle of distress by exacerbating distress and worry about future events, which promotes even greater distress when these events ultimately occur. Worry about the future is commonly associated with posttraumatic stress (13, 14) and is a hallmark symptom of most anxiety disorders. Because worry about the future is associated with protective decision-making (15), to the extent that people consume media to gather information they can use to protect themselves from a perceived threat, previous worries about future events should be associated with future media use as well.

After a collective trauma, other individual-level characteristics and experiences may underpin psychological vulnerability and information-seeking behavior. Those who have experienced more violence in their lives often see themselves at greater risk of exposure to future negative events (16) and are more likely to develop mental health problems following subsequent violent and nonviolent traumas (17). Individuals with previously diagnosed mental health ailments are also more likely to report high distress and greater incidence of physical health ailments over time following community-based traumas (18, 19). Research also finds that individuals with past exposure to collective traumas encounter more media coverage of subsequent collective traumas (1) and suggests that mental health may be implicated in media exposure (1, 20). Thus, it may be the case that individuals with these characteristics and experiences may be at greater risk of falling into patterns of traumatic media exposure and distress in a trauma’s aftermath.

We hypothesize that distress responses to a past collective trauma may sensitize individuals—that is, make them more emotionally responsive—to media coverage of future events, resulting in heightened distress and worry following subsequent media exposure. This heightened distress may also lead to increased attention to media coverage of future events. Although underexplored, there is some evidence for this cyclical pattern. Both direct and media-based indirect exposures to past collective traumas are known risk factors for

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future posttraumatic stress responses to subsequent trauma (2, 21, 22). For example, following the 2014 Ebola public health crisis, worry about contracting Ebola was strongest for individuals who reported both high distress about a prior trauma and greater exposure to Ebola-related media coverage (23). A cycle of sensitization may therefore exist such that individuals who consume extensive media about a collective trauma will respond more strongly both to that event and to future events as a function of their ongoing worry. This cycle has yet to be demonstrated, and a recent meta-analysis confirms that this remains a substantial gap in the literature. To this point, there have been no longitudinal studies examining the potential transactional effects of media use after a collective trauma (24). Such a study would “address the ways in which disaster media use affects reactions, how those reactions drive additional disaster media use, how additional media use affects future reactions, and so on” (24, p. 749). The present study aims to address this gap by demonstrating how these relationships play out over time in the context of exposure to consecutive collective traumas.

RESULTS

We conducted a longitudinal study of a national sample of U.S. residents who were surveyed four times over a 3-year period, including in the days following two mass violence events in the United States: the bombings at the finish line of the 2013 Boston Marathon, which resulted in three deaths and over 260 people injured, and the 2016 massacre in the Pulse nightclub in Orlando, FL, which resulted in 49 deaths and 58 people injured. The first survey was fielded to a representative national sample 2 to 4 weeks following the Boston Marathon bombings and associated lockdown, and included oversamples in New York and Boston metropolitan areas (wave 1, $N = 4675$, 4/29/13 to 5/13/13, 79.1% participation) (3). The second survey was fielded to all available wave 1 participants ($n = 4429$) approximately 6 months later (wave 2, $n = 3588$, 10/17/13 to 11/17/13, 80.9% participation). The third survey was fielded at around the second anniversary of the Boston Marathon bombings (wave 3, $n = 3341$, 4/29/15 to 6/26/15, 78.1% participation) to all available wave 1 participants ($N = 4276$). The final survey was fielded starting 5 days after the Pulse nightclub massacre (wave 4, $n = 3199$, 6/17/16 to 7/22/16, 74.5% participation), again to all available participants ($N = 4292$). The present analyses included only those participants who completed at least two waves of data collection ($N = 4165$; 89.1% of the original sample). The demographic characteristics of this sample and descriptive statistics for all variables of interest are presented in Table 1. This design enabled us to capture individuals' responses to both events, a rare feature among post-disaster studies (25). As a result of this longitudinal design, we were also uniquely positioned to examine how post-event responses to one national trauma might sensitize people to news coverage of another tragedy over time.

Using the Structural Equation Modeling (SEM) Builder of Stata 14.2 (College Station, TX), we examined the relationships among exposure to news coverage of both the Boston Marathon bombings and the Pulse nightclub massacre and acute and posttraumatic stress responses using path analysis. This analysis incorporates several regression analyses simultaneously, which enables testing of possible causal pathways over time. Covariates included age, gender, income, education (Bachelor's degree or greater versus other), ethnicity (white, non-Hispanic versus other), and sample area (Boston

Table 1. Descriptive statistics for all variables of interest ($N = 4165$). AS, acute stress; PTS, posttraumatic stress symptoms; NYC, New York City.

Variable	<i>n</i>	%	Mean (SD)
Gender			
Male	1921	46.12	
Female	2244	53.88	
Ethnicity			
White, non-Hispanic	3148	75.58	
Black/African American	329	7.90	
Other, non-Hispanic	288	6.91	
Hispanic	400	9.60	
Education			
Less than high school	246	5.91	
High school diploma	1063	25.52	
Some college/associate degree	1178	28.28	
Bachelor degree or beyond	1678	40.29	
Household income (\$)			
<25,000	595	14.29	
25,000–49,999	875	21.01	
50,000–74,999	788	18.92	
75,000–99,999	648	15.56	
100,000–124,999	541	12.99	
≥125,000	718	17.24	
Sample area			
Boston metro	839	18.61	
NYC metro	775	20.14	
National	2551	61.25	
Mental health diagnoses			
None (0)	3417	82.04	
Depression or anxiety (1)	553	13.28	
Depression and anxiety (2)	195	4.68	
Age			50.01 (16.78)
Prior violence exposure*			0.81 (1.33)
Boston Marathon bombings daily media (hours) [†]			6.09 (6.84)
Boston Marathon bombings PTS [‡]			5.11 (2.01)
Worry about future events [§]			1.99 (0.71)
Pulse nightclub massacre daily media (hours)			3.21 (3.60)
Pulse nightclub massacre AS [¶]			6.82 (7.38)

*Prior violence exposure range, 0 to 12.

†Daily hours of Boston Marathon bombing–related media range, 0 to 33 hours.

‡PTS range, 4 to 20.

§Worry about future events range, 0 to 5.

||Daily hours of Pulse nightclub massacre–related media range, 0 to 18 hours.

¶AS range, 0 to 56.

metropolitan area, New York City metropolitan area, or national sample).

Model specification was conducted using a complete case analysis ($n = 2450$); the final model was fit using a full information maximum likelihood approach with bootstrapped SEs to account for multivariate nonnormality. In the initial theoretical model, previously diagnosed mental health ailments and prior history of violence exposure predicted both exposure to media coverage of the Boston Marathon bombings and bombing-related posttraumatic stress symptoms (PTS). Exposure to Boston Marathon-related media also predicted wave 2 PTS. Higher bombing-related symptoms predicted wave 3 worry about future events, which predicted wave 4 consumption of Pulse nightclub-related media coverage and acute stress symptomatology. Stability paths were included for wave 1 and wave 4 media consumption, as well as for wave 2 and wave 4 symptoms. Pre-Boston Marathon bombings covariates (i.e., demographics and sample area) also predicted both bombing-related media exposure and PTS. This theoretical model fit the data satisfactorily [$\chi^2(30) = 340.12, P < 0.001$; CFI (Comparative Fit Index) = 0.90; RMSEA (Root Mean Square Error of Approximation) = 0.065], but further analyses were pursued to attain a model with better fit for the data. Modification indices suggested an additional path between pre-bombing violence exposure and wave 3 worry about future events [MI (Modification Index) = 57.62]; the addition of this path improved the model fit significantly [$\chi^2\Delta(1) = 58.31, P < 0.001$]. Further modification indices suggested an additional path between wave 2 PTS and wave 4 media consumption (MI = 38.34); addition of this path also improved model fit relative to the more constrained model [$\chi^2\Delta(1) = 38.29, P < 0.001$]. Model fit indices suggested acceptable fit of this model to the data [$\chi^2(28) = 243.52, P < 0.001$; CFI = 0.93; RMSEA = 0.056].

On the basis of this final model and theoretical considerations, a few additional paths were tested. The first was a path between prior mental health diagnoses and worry about future events. A likelihood ratio test suggested that the addition of this path significantly improved model fit relative to the more constrained model and was

included in the final model [$\chi^2\Delta(1) = 14.79, P < 0.001$]. The second path was between bombing-related media exposure and worry about future events. A likelihood ratio test suggested that the addition of this path did not significantly improve model fit [$\chi^2\Delta(1) = 3.74, P = 0.053$], and the indices of fit remained approximately the same (RMSEA = 0.056; CFI = 0.94); thus, the more constrained model was chosen. However, there was a significant indirect relationship between Boston Marathon bombing-related media exposure and worry about future events through bombing-related PTS ($\beta = 0.12, P < 0.001$).

Figure 1 presents the best-fitting model for the data. Fit indices for this model indicated good fit [$\chi^2(27) = 256.13, P < 0.001$; CFI = 0.941; RMSEA = 0.045]. Correlations for all variables may be found in Table 2; standardized regression coefficients for each of the structural paths that are not shown in Fig. 1 may be found in Table 3. Descriptions of tests of alternative models may be found in the Supplementary Materials.

We found that, controlling for covariates, media exposure to the Boston Marathon bombings was associated with PTS 6 months later, which, in turn, was associated with worry about future negative events at the second anniversary of the bombings. Bombing-related posttraumatic stress and worry about future events each uniquely predicted both hours of media exposure and acute stress responses to the Pulse nightclub massacre. Pulse nightclub massacre-related acute stress symptoms were also uniquely associated with hours of media exposure to this event. Violence exposure that respondents reported experiencing before the Boston Marathon bombings indirectly predicted Pulse nightclub massacre-related acute stress through bombing-related media exposure, PTS, worry about future events, and Pulse nightclub massacre-related media exposure.

DISCUSSION

These results suggest that distress responses to past large-scale collective traumas (e.g., terror attacks) may sensitize some individuals to media coverage of later collective tragedies, thereby exacerbating distress responses in their aftermath. In other words, this sensitization

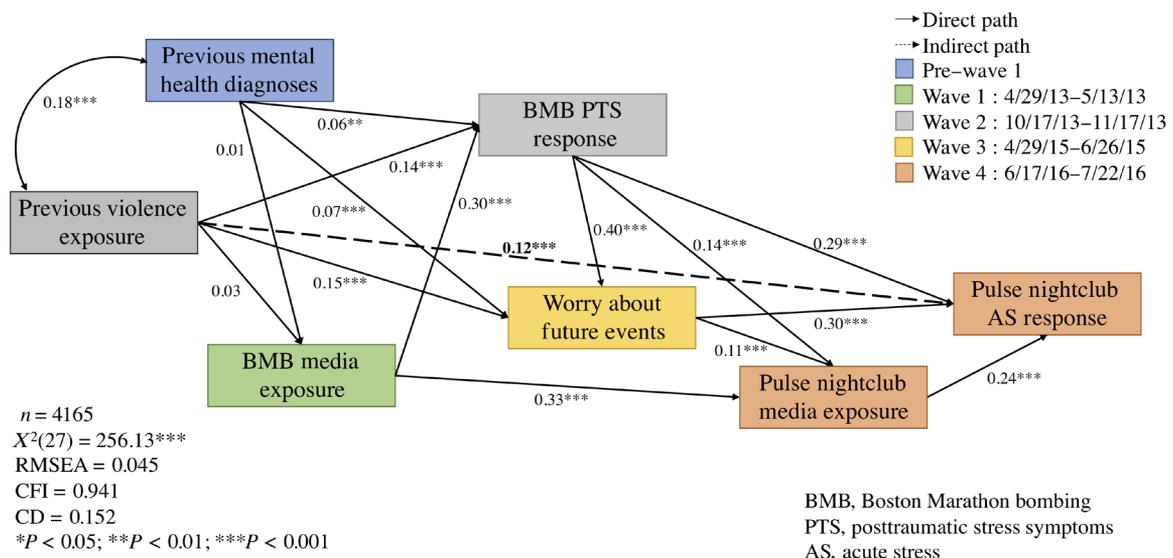


Fig. 1. Path model predicting relationships between media exposure and distress responses over time.

Table 2. Correlations among variables presented in the path model. BMB, Boston Marathon bombing; Dx, diagnosis.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Age	1.00													
2. White ethnicity	0.18***	1.00												
3. Female gender	-0.02	-0.02	1.00											
4. Income	0.01	0.14***	-0.08***	1.00										
5. College degree	0.01	0.09***	-0.05**	0.35***	1.00									
6. Boston metro	0.04*	0.14***	0.07***	0.02	0.14***	1.00								
7. NYC metro	0.09***	-0.08***	-0.07***	0.06***	0.06***	-0.24***	1.00							
8. Prior mental health Dx	-0.01	0.01	0.12***	-0.13***	-0.06***	0.02	-0.01	1.00						
9. Prior violence	-0.00	-0.10***	0.01	-0.14***	-0.07***	-0.01	0.01	0.18***	1.00					
10. BMB-related media exposure	-0.03*	-0.11***	0.05***	-0.07***	-0.02	0.19***	0.02	0.03*	0.05**	1.00				
11. BMB-related PTS	-0.01	-0.12***	0.06***	-0.14***	-0.11***	0.05**	0.04*	0.10***	0.18***	0.33***	1.00			
12. Worry about future events	-0.04*	-0.12***	0.12***	-0.20***	-0.14***	-0.06***	0.05**	0.13***	0.23***	0.17***	0.44***	1.00		
13. Pulse-related media exposure	-0.07***	-0.14***	0.01	-0.08***	-0.06***	-0.03	0.05*	0.04*	0.05**	0.39***	0.29***	0.23***	1.00	
14. Pulse-related acute stress	-0.00	-0.15***	0.09***	-0.13***	-0.07***	-0.00	0.05**	0.16***	0.17***	0.24***	0.49***	0.48***	0.40***	1.00

* $P < 0.05$. ** $P < 0.01$. *** $P < 0.001$.

Table 3. Standardized regression coefficients for paths not presented in the full model (N = 4165).

Variable	Path predicting	
	Boston Marathon bombing-related media	Boston Marathon bombing PTS
Age	-0.02	0.01
Female gender	0.05	0.04*
White ethnicity	-0.11***	-0.08***
Income	-0.04**	-0.07***
College degree	-0.03*	-0.07***
Boston metro	0.21***	0.03
NYC metro	0.08***	0.04**

* $P < 0.05$. ** $P < 0.01$. *** $P < 0.001$.

process may fuel a cycle of distress. Our findings also suggest that exposure to repeated trauma-related media coverage may render some individuals more vulnerable to mental health consequences [e.g., flashbacks and intrusive memories; (26, 27)] as collective traumas accumulate over time. Given the apparent role that worry about the future plays in perpetuating this cycle of sensitivity to distress, this cycle may contribute to a prolonged physiological stress response that heightens risk for stress-related diseases (28, 29). Acute stress responses following a terror attack have also been associated with increased incidence of cardiovascular disease over time, even among individuals who were not directly exposed to the attack (30). Thus, this cycle of media exposure and distress appears to have downstream implications for public health. In a rapidly evolving news climate, the pressure to generate clicks and shares for online content can lead to sensationalism and, in some cases, can even facilitate the spread of unverified rumors (31), which are associated with even greater distress when information is scarce (32). Our findings suggest that media organizations should seek to balance

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the sensationalistic aspects of their coverage (e.g., providing more informational accounts as opposed to lengthy descriptions of carnage) as they work to inform the public about breaking news events. This may reduce the impact of exposure to one event, reducing the likelihood of increased worry and media-seeking behavior over time.

Although we conducted prospective, longitudinal analyses, attrition across the 3 years of data collection suggests that the sample of individuals included in the present path model (i.e., those who completed at least two waves of data collection) was older, wealthier, more educated, and more likely to be white. We note, however, that wealthier, educated, white respondents also reported significantly lower Boston Marathon bombing–related PTS, and white respondents reported significantly less Boston Marathon bombing–related media exposure (see Table 3), suggesting the possibility that the pattern of findings reported here could be a conservative test of the hypothesized downward spiral. That is, if people from other racial and ethnic backgrounds engaged more Boston Marathon bombing–related media, and reported significantly more PTS, then it is possible that our findings underestimate the strength of these associations in the general population. In addition, media use was assessed retrospectively, albeit within a very short time frame after each event. Future research might ask respondents to complete daily reports of media use to obtain more accurate reports of their media exposure. Despite these limitations, longitudinal studies that capture repeated exposure to large-scale collective traumas among individuals drawn from a nationally representative panel are very rare, particularly when they include assessments of acute stress.

Our findings have important policy implications for both the news media and the general population. They suggest that social media platforms and other media organizations need to recognize the vital role they can play in broadcasting distress in the aftermath of mass violence events. Furthermore, there is some evidence that presentation of mass violence events in the media is associated with contagion effects, such that mass killings involving firearms appear to subsequently increase the rate of similar events in the future (33). Together with our findings, this suggests that a more even-handed approach when reporting these events is critical for public health. The sooner that news platforms begin monitoring themselves for potentially sensitive, graphic content, the better the outcomes for their consumers, who may not always be successful at monitoring their own media habits. Although a well-informed public is essential during crisis events, it is also important that viewers understand how they may be putting their long-term mental and physical health at risk by closely following along with collective traumas as they unfold in the news media. That way, consumers will be able to make more mindful and informed choices about how to stay informed about collective traumas across the world.

MATERIALS AND METHODS

Participants were randomly drawn from the GfK KnowledgePanel, a nationally representative panel of U.S. residents recruited using address-based sampling methods. In address-based sampling, individuals are randomly sampled within households to participate on the panel through a series of mailings to randomly selected addresses; if a phone number is attached to an address, then phone invitations may also be used. KnowledgePanelists complete online surveys in exchange for internet access or other compensation (e.g., points that participants may accumulate that can be redeemed for cash, gift

prizes, or sweepstakes opportunities). Households without computer access are supplied with a laptop to facilitate survey completion and ensure panel representativeness. Individuals may only join the KnowledgePanel after being randomly selected. Email, postcard, and telephone reminders were sent to encourage participation. All procedures were approved by the Institutional Review Board of the University of California, Irvine.

Before the start of the first survey, participants provided demographic information (e.g., age, ethnicity, gender, education, income, and region) and mental health history (physician-diagnosed depression or anxiety disorders, coded 0 for no diagnoses, 1 for either depression or anxiety, and 2 for both diagnoses) upon entry to the GfK KnowledgePanel. Media exposure to the Boston Marathon bombings was assessed at wave 1; hours of exposure to each of seven sources of media (television; radio; pictures, videos, or text updates on social media; online news; and print media) were summed to create a composite media exposure variable. Cumulative hours of daily media consumption were capped at 33 (3 SDs above the mean) to account for outliers (because individuals could report up to 11 hours per day across seven sources, many participants reported cumulative media use in excess of 24 hours per day across sources). At wave 2, participants' complete life-event histories were assessed using an inventory of 37 possible events that has been used previously in surveys of national samples (34). Participants indicated whether each event had occurred before or following the Boston Marathon bombings; responses to the 12 violence items (e.g., being physically attacked or assaulted and being hit or pushed by partner/spouse) (16) that had occurred before the bombings were summed to create a composite score for prior violence exposure. PTS from the Boston Marathon bombings were assessed at wave 2 using a slightly modified version of the Primary Care PTSD Screen (35), which used four items to assess the hallmark constructs of PTSD (re-experiencing, avoidance, numbing, and hyperarousal) resulting from the Boston Marathon bombings. Responses are scored on a 1-to-5 Likert-type scale (1 = never to 5 = all the time) and summed to create a composite Boston Marathon bombing–related posttraumatic stress score for each participant ($\alpha = 0.78$). At wave 3, worry about future events was assessed using an eight-item scale that was adapted from one used in previous studies of collective traumas (36). Participants used a 1-to-5 Likert-type scale (1 = never to 5 = all the time) to report how often in the previous week they had fears of terrorism, community violence, natural disaster, or economic hardship affecting them or their families ($\alpha = 0.87$). At wave 4, beginning 5 days after the Pulse nightclub massacre, acute stress symptomatology in response to the shooting was assessed using the Acute Stress Disorder Scale 5 (37). This scale measured the frequency of experiencing 14 Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) (38) symptoms of acute stress resulting from “the Orlando mass shooting and its aftermath” on a five-point Likert-type scale (0 = not at all to 4 = a great deal; $\alpha = 0.88$). Total hours of daily exposure to each of five sources of news media (i.e., television, radio, online news, pictures, and text on social media sources) regarding the Pulse nightclub massacre were also assessed at this time. Hours of daily media consumption were capped at 18 (3 SDs above the mean) to account for outliers. In addition to the data described here, panelists completed two additional waves of data collection between waves 2 and 3 (Boston Marathon bombing anniversary wave: 4/18/2014 to 5/6/14, $n = 3260$ responses, 74.2% participation; Ebola outbreak wave: 12/29/2014 to 2/27/15, $n = 3450$, 79.6% participation). The

data collected at these waves are not relevant to the questions in this manuscript and are not discussed further.

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at <http://advances.sciencemag.org/cgi/content/full/5/4/eaav3502/DC1>

Supplementary Materials and Methods

Supplementary Analyses

Fig. S1. Path model controlling for direct exposure to the Boston Marathon bombing and the Pulse nightclub massacre.

Fig. S2. Path model testing recursive media exposure and distress hypothesis.

Fig. S3. Path model testing alternative directionality hypothesis for media exposure and distress.

REFERENCES AND NOTES

- N. M. Jones, D. R. Garfin, E. A. Holman, R. C. Silver, Media use and exposure to graphic content in the week following the Boston Marathon bombings. *Am. J. Community Psychol.* **58**, 47–59 (2016).
- R. C. Silver, E. A. Holman, J. P. Andersen, M. Poulin, D. N. McIntosh, V. Gil-Rivas, Mental- and physical-health effects of acute exposure to media images of the September 11, 2001, attacks and the Iraq War. *Psychol. Sci.* **24**, 1623–1634 (2013).
- E. A. Holman, D. R. Garfin, R. C. Silver, Media's role in broadcasting acute stress following the Boston Marathon bombings. *Proc. Natl. Acad. Sci. U.S.A.* **111**, 93–98 (2014).
- T. L. Hopwood, N. S. Schutte, Psychological outcomes in reaction to media exposure to disasters and large-scale violence: A meta-analysis. *Psychol. Violence* **7**, 316–327 (2017).
- J. Ahern, S. Galea, H. Resnick, D. Vlahov, Television images and probable posttraumatic stress disorder after September 11. *J. Nerv. Ment. Dis.* **192**, 217–226 (2004).
- P. Vasterman, C. J. Yzermans, A. J. E. Dirkzwager, The role of the media and media hype in the aftermath of disasters. *Epidemiol. Rev.* **27**, 107–114 (2005).
- K. A. Lachlan, P. R. Spence, M. Seeger, Terrorist attacks and uncertainty reduction: Media use after September 11. *Behav. Sci. Terror. Polit. Aggress.* **1**, 101–110 (2009).
- R. L. Heath, C. D. Gay, Risk communication: Involvement, uncertainty, and control's effect on information scanning and monitoring by expert stakeholders. *Manag. Commun. Q.* **10**, 342–372 (1997).
- M. W. Seeger, T. L. Sellnow, R. R. Ullmer, *Communication and Organizational Crisis* (Greenwood Publishing Group, 2003).
- A. P. Field, Watch out for the beast: Fear information and attentional bias in children. *J. Clin. Child Adolesc. Psychol.* **35**, 431–439 (2006).
- O. V. Lipp, N. Derakshan, Attentional bias to pictures of fear-relevant animals in a dot probe task. *Emotion* **5**, 365–369 (2005).
- E. Keogh, D. Ellery, C. Hunt, I. Hannent, Selective attentional bias for pain-related stimuli amongst pain fearful individuals. *Pain* **91**, 91–100 (2001).
- C. S. Piotrkowski, S. J. Brannen, Exposure, threat appraisal, and lost confidence as predictors of PTSD symptoms following September 11, 2001. *Am. J. Orthopsychiatry* **72**, 476–485 (2002).
- K. K. Laubmeier, S. G. Zakowski, The role of objective versus perceived life threat in the psychological adjustment to cancer. *Psychol. Health* **19**, 425–437 (2004).
- N. D. Weinstein, J. E. Lyon, A. J. Rothman, C. L. Cuite, Preoccupation and affect as predictors of protective action following natural disaster. *Br. J. Health Psychol.* **5**, 351–363 (2000).
- S. C. Blum, R. C. Silver, M. J. Poulin, Perceiving risk in a dangerous world: Associations between life experiences and risk perceptions. *Soc. Cogn.* **32**, 297–314 (2014).
- N. Breslau, H. D. Chilcoat, R. C. Kessler, G. C. Davis, Previous exposure to trauma and PTSD effects of subsequent trauma: Results from the Detroit Area Survey of Trauma. *Am. J. Psychiatry* **156**, 902–907 (1999).
- E. A. Holman, R. C. Silver, Health status and health care utilization following collective trauma: A 3-year national study of the 9/11 terrorist attacks in the United States. *Soc. Sci. Med.* **73**, 483–490 (2011).
- M. W. Otto, A. Henin, D. R. Hirshfeld-Becker, M. H. Pollack, J. Biederman, J. F. Rosenbaum, Posttraumatic stress disorder symptoms following media exposure to tragic events: Impact of 9/11 on children at risk for anxiety disorders. *J. Anxiety Disord.* **21**, 888–902 (2007).
- L. de Wit, A. van Straten, F. Lamers, P. Cuijpers, B. Penninx, Are sedentary television watching and computer use behaviors associated with anxiety and depressive disorders? *Psychiatry Res.* **186**, 239–243 (2011).
- C. R. Brewin, B. Andrews, J. D. Valentine, Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *J. Consult. Clin. Psychol.* **68**, 748–766 (2000).
- D. R. Garfin, E. A. Holman, R. C. Silver, Cumulative exposure to prior collective trauma and acute stress responses to the Boston Marathon bombings. *Psychol. Sci.* **26**, 675–683 (2015).
- R. R. Thompson, D. R. Garfin, E. A. Holman, R. C. Silver, Distress, worry, and functioning following a global health crisis: A national study of Americans' responses to Ebola. *Clin. Psychol. Sci.* **5**, 513–521 (2017).
- J. B. Houston, M. L. Spialek, J. First, Disaster media effects: A systematic review and synthesis based on the differential susceptibility to media effects model. *J. Commun.* **68**, 734–757 (2018).
- R. C. Silver, E. A. Holman, D. N. McIntosh, M. Poulin, V. Gil-Rivas, J. Pizarro, B. Raphael, in *9/11: Mental Health in the Wake of Terrorist Attacks*, Y. Neria, R. Gross, R. Marshall, E. Susser, Eds. (Cambridge University Press, 2006), pp. 45–70.
- I. A. Clark, E. A. Holmes, M. W. Woolrich, C. E. Mackay, Intrusive memories to traumatic footage: The neural basis of their encoding and involuntary recall. *Psychol. Med.* **46**, 505–518 (2016).
- C. Bourne, C. E. Mackay, E. A. Holmes, The neural basis of flashback formation: The impact of viewing trauma. *Psychol. Med.* **43**, 1521–1532 (2013).
- J. F. Brosschot, S. Pieper, J. F. Thayer, Expanding stress theory: Prolonged activation and perseverative cognition. *Psychoneuroendocrinology* **30**, 1043–1049 (2005).
- C. Ottaviani, J. F. Thayer, B. Verkuil, A. Lonigro, B. Medea, A. Couyoumdjian, J. F. Brosschot, Physiological concomitants of perseverative cognition: A systematic review and meta-analysis. *Psychol. Bull.* **142**, 231–259 (2016).
- E. A. Holman, R. C. Silver, M. Poulin, J. Andersen, V. Gil-Rivas, D. N. McIntosh, Terrorism, acute stress, and cardiovascular health: A 3-year national study following the September 11th attacks. *Arch. Gen. Psychiatry* **65**, 73–80 (2008).
- C. Silverman, *Lies, Damn Lies, and Viral Content* (Tow Center for Digital Journalism, 2015); <https://towcenter.org/research/lies-damn-lies-and-viral-content/>.
- N. M. Jones, R. R. Thompson, C. Dunkel Schetter, R. C. Silver, Distress and rumor exposure on social media during a campus lockdown. *Proc. Natl. Acad. Sci. U.S.A.* **114**, 11663–11668 (2017).
- S. Towers, A. Gomez-Lievano, M. Khan, A. Mubayi, C. Castillo-Chavez, Contagion in mass killings and school shootings. *PLOS ONE* **10**, e0117259 (2015).
- M. D. Seery, E. A. Holman, R. C. Silver, Whatever does not kill us: Cumulative lifetime adversity, vulnerability, and resilience. *J. Pers. Soc. Psychol.* **99**, 1025–1041 (2010).
- A. Prins, P. Ouimette, R. Kimerling, R. P. Cameron, D. S. Hugelshofer, J. Shaw-Hegwer, A. Thrailkill, F. D. Gusman, J. I. Sheikh, The primary care PTSD screen (PC-PTSD): Development and operating characteristics. *Prim. Care Psychiatry* **9**, 9–14 (2003).
- R. C. Silver, E. A. Holman, D. N. McIntosh, M. Poulin, V. Gil-Rivas, Nationwide longitudinal study of psychological responses to September 11. *JAMA* **288**, 1235–1244 (2002).
- R. A. Bryant, *Acute Stress Disorder: What It Is and How to Treat It* (Guilford, 2016).
- American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Publishing, ed. 5, 2013).

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