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Positive and Negative Affect in the Daily Life of World Trade Center Responders with PTSD: An Ecological Momentary Assessment Study

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Abstract

Objective: The ability to experience positive affect (PA) has clinical and quality of life implications, particularly in vulnerable populations such as trauma-exposed disaster responders. Low PA is included in the diagnostic criteria for Post-Traumatic Stress Disorder (PTSD), however evidence for PA reduction in PTSD has been mixed. In contrast, negative affect (NA) has consistently been found to be elevated among individuals with PTSD. Multi-day, ecological momentary assessment (EMA) can provide more ecologically valid evidence about experiences of

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affect; however no such studies have been conducted in traumatized individuals with PTSD to date.

Method: World Trade Center (WTC) responders (N = 202) oversampled for the presence of PTSD were recruited from the WTC Health Program. Participants were administrated the Structured Clinical Interview for *DSM-IV* and the PTSD Checklist for *DSM-5* at baseline, then completed EMA surveys of affect four times a day over seven consecutive days.

Results: Participants with current PTSD (19.3% of the sample) showed significantly higher levels of daily NA compared to those without PTSD. However, there was no group difference in daily PA, nor was PA associated with a dimensional measure of PTSD.

Conclusions: Results suggest that for chronic PTSD among disaster responders, positive emotions are not inhibited across daily living. Such findings add to evidence suggesting that PA reduction may not be diagnostically relevant to PTSD, while NA remains an important target for therapeutic interventions. Moreover, results show that WTC responders can experience and benefit from positive emotion, even if they continue to have PTSD symptoms.

Keywords

Positive affect; Negative affect; EMA; PTSD; World Trade Center

Emotional numbing, described as the experience of dampened positive affect (PA) as well as a restricted range of emotions (American Psychiatric Association, 1994), has long been considered a core component of post-traumatic stress disorder (PTSD; Litz, 1992). Although it is no longer referred to as emotional numbing, the *Diagnostic and Statistical Manual of Mental Disorders, 5th Edition* (*DSM*-5; American Psychiatric Association, 2013) still includes "persistent inability to experience positive emotions" as a PTSD symptom of the negative alterations in mood and cognitions cluster (APA, 2013). In addition to the *DSM-5* model, other empirically supported PTSD structural models contain factors related to emotional numbing, such as dysphoria, (e.g., King, Leskin, King, & Weathers, 1998; Simms, Watson, & Doebbeling, 2002), although whether this reflects restricted PA or general distress is not often specified.

Regardless of the model, studies have consistently found that a PTSD diagnosis and PTSD symptoms are associated with significantly higher levels of negative affect (NA; Badour, Resnick, Kilptrick, 2017; Beckham et al., 2000; Bradley et al., 2011; Depierro, D'Andrea, Frewen, & Todman, 2017; DiMauro, Renshaw, & Kashdan, 2016; Marshall-Berenz, Morrison, Schumacher, & Coffey, 2011; Rademaker, van Zuiden, Vermetten, & Geuze, 2011; Watson, Clark, & Stasik, 2011). NA has been shown to be correlated with all facets of PTSD, not simply those related to dysphoria or numbing (Brown et al., 2016; Charak, Armour, Elklit, Koot, & Elhai, 2014; Watson, Gamez, & Simms, 2005).

Comparatively, the relationship of PA as an emotional numbing symptom to PTSD has been minimally explored, with mixed research findings. Some evidence has suggested disrupted PA in relation to PTSD severity. For example, veterans with PTSD (n = 61) tracked every 30 minutes during waking across a 12 to 14-hour period reported lower PA than those without PTSD (n = 56; Beckham et al. 2000). Women with PTSD (n = 49) have also demonstrated

less PA when viewing pictures of themselves and listening to trait adjectives than women without PTSD (n = 36; Frewen et al., 2011). Furthermore, evidence also suggests that individuals with PTSD experience heighted anhedonia, or the inability to experience pleasure. Using measures of anhedonia, studies have found that women with PTSD (n = 55) demonstrate greater anhedonia than those without PTSD (n = 35; Frewen, Dozois, & Lanius, 2012). Specifically, anhedonia demonstrates a positive relationship with the emotional numbing cluster of PTSD among male combat veterans (N = 246; Kashdan, Elhai, & Frueh, 2006).

Other studies, however, find that PTSD is not associated with diminished PA. For instance, in a sample of 200 natural disaster victims, PA was unrelated to re-experiencing and numbing symptoms of PTSD, and *positively* related to avoidance and hyperarousal ones (Charak et al., 2014). Further, no evidence of PA disruption in PTSD has been found in samples of veterans (N = 61; Litz, Orsillo, Kaloupek, & Weathers, 2000) and females who have experienced interpersonal trauma (N = 54; Brown et al., 2016). Such findings are not state dependent, as state and trait PA have demonstrated no association with PTSD (N = 75; Watson et al., 2011). Findings also appear to be unique to PTSD, as one previous study found reduced PA for individuals with chronic PTSD and comorbid depression (n = 92), but not for those with PTSD alone (n = 81; Post, Zoellner, Youngstrom, & Feeny, 2011). These studies suggest that a restricted range of affect is not inherent to PTSD, but may result from comorbid diagnoses.

A major limitation of current studies examining PTSD and affect is their cross-sectional nature. With the exception of Beckham and colleagues' (2000) study of less than 24 hours, all aforementioned studies have been cross-sectional and measure PA at a single point in time, with none except Beckham's involving data collection under ecologically valid conditions. Affect is known to fluctuate throughout the day and can be influenced by a multitude of daily events (Clark & Watson, 1988). In healthy individuals, PA has been shown to be lowest in the morning, rise during the day, and then retreat again at night (Clark, Watson, & Leeka, 1989; Murray, Allen, & Trinder, 2002; Stone et al., 2006). In contrast, evidence linking NA to diurnal rhythms have been mixed (Clark et al., 1989; Stone et al., 2006; Wood & Magnello, 1992). Specific examinations of the diurnal pattern of affect in PTSD are limited, demonstrating a need for further daily examinations of affect in PTSD samples. This can be accomplished through the use of ecological momentary assessment (EMA), which allows for the monitoring of affect across multiple time points. EMA can overcome limitations of past research in this area by assessing affect in a person's natural environment, as well as repeatedly over time to provide more reliable estimates free from recall biases (Shiffman, Stone, & Hufford, 2008).

To our knowledge, no studies to date have assessed the daily patterns of affect among disaster responders. One of the largest groups of responders to date are the thousands of police, fire, and other rescue workers who responded to the World Trade Center disaster and/or participated in the cleanup and recovery efforts (Herbert et al., 2006). They were exposed to environmental hazards, chemical toxins, injury, death, and other traumatic stressors (Landrigan et al., 2004; Neria, Gross, Marshall, & Susser, 2006). These responders faced unique challenges as a result, including high rates of PTSD (Bromet et al., 2016;

Stellman et al., 2008; Wisnivesky et al., 2011) as well as a number of co-occurring health conditions (Herbert et al., 2006; Sloan et al., 2013). Given the magnitude and persistence of health and mental health conditions, we tested the degree to which PA has also been affected in responders generally and among those with PTSD in particular. The ability to experience frequent PA and the full range of positive emotions has salutary effects (Fredrickson & Losada, 2005; Lyubomirsky, King, & Diener 2005) and represents an important component of well-being for this population.

To address these gaps, the aim of the present study was to assess positive and negative affect in the daily lives of WTC responders with and without PTSD. WTC responders (N = 202) oversampled for PTSD completed surveys of PA and NA on a smartphone or handheld electronic devices four times a day for one week. Given the weight of evidence reviewed above, we hypothesized WTC responders with PTSD would endorse significantly higher levels of daily NA, but not PA. Consistent with the literature, we hypothesized that effects would be independent of depression, a key potential confounding factor (Post et al., 2011).

We also explored the degree to which affect followed expected diurnal rhythms. Given previous findings, we hypothesized that PA would peak during the midday, with the lowest levels occurring in the morning and evening (Clark et al., 1989; Murray et al., 2002). In line with research findings regarding NA and diurnal rhythms, we hypothesized that NA would be less closely tied to diurnal rhythms but would peak in mid-morning and mid-afternoon (Clark et al., 1989; Stone et al., 2006; Wood & Magnello, 1992).

Method

Participants

Participants (N = 202) were recruited from the Long Island site of World Trade Center Health Program between October 2014 and February 2016 as part of an EMA study focused on the daily relationships between PTSD and health. All participants worked or volunteered in the rescue, recovery, restoration, and/or cleanup of the WTC.

The mean age of the sample was 54.28 (SD = 9.69). The group was primarily male (82.7%, n = 167), White (88.1%, n = 178), and non-Hispanic (80.7%, n = 163) with an average of 14.82 (SD = 2.26) years of education. The majority of participants worked in law enforcement at the time of 9/11 (62.9%, n = 127) and almost half (48.5%, n = 98) were retired, although many continued to work part-time. The sample was oversampled for current PTSD, such that 39 (19.3%) had a current diagnosis of PTSD. Thirty-two (15.8%) participants had a current diagnosis of Major Depressive Episode (MDE), and 20 (9.9%) participants had comorbid PTSD and MDE at baseline. The study was approved by the Stony Brook University Committees on Research Involving Human Subjects, and all participants provided written informed consent.

Measures

PTSD diagnosis.—The Structured Clinical Interview for *DSM-IV* (SCID; First, Spitzer, Gibbon, & Williams, 1997) was used to assess for current PTSD at baseline. The SCID interviews were administrated by experienced interviewers, who were closely supervised by

two clinical psychologists (C.R. and R.K.). Previous assessments of interrater reliability in this clinic demonstrated very good inter-rater agreement (κ = .82; Bromet et al., 2016).

PTSD symptoms.—The PTSD Checklist for *DSM-5* (PCL-5; Weathers et al., 2013) was used to assess PTSD symptom severity at baseline. Participants were cued to the WTC disaster and were instructed to rate the extent to which they experienced each of 20 symptoms in the past month on a 5-point Likert scale from 0 (*not at all*) to 4 (*extremely*). A total score was calculated, and the scale had excellent internal consistency in the sample (Cronbach's α = .95).

EMA affectivity.—Six affective items drawn from the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) were used to assess daily PA and NA. PA items were: attentive, excited, and proud. NA items were guilty, nervous, and upset. Each item began with the stem "Right now" and participants were instructed to report, "To what extent do you feel …" on a 5-point Likert scale from 1 (*not at all*) to 5 (*extremely*). The items were administrated four times a day (i.e., immediately upon awaking, morning, afternoon, and evening) over seven consecutive days. Mean scores were calculated for PA and NA by averaging the corresponding items. Using the equations provided in Mehl and Conner (2012), within-person reliability and between-person reliability were calculated for PA items and NA items, respectively. For the three PA items, the within-person reliability (i.e., reliability of change) R_C = .53 and the between-person reliability R_{KF} = .99. For the three NA items, the within-person reliability R_C = .58 and the between-person reliability R_{KF} = .99.

Procedure

Participants first completed a baseline interview that included the SCID, PCL, and other survey measures. They were then trained to complete the EMA either on an iPod provided by the study or on their smartphone. Participants were instructed to complete EMA surveys four times a day (i.e., upon awakening, mid-morning, afternoon, and evening before bed) over seven consecutive days. Prior to starting the EMA, participants provided their availabilities for the following seven days, and the assessment times were then fixed to each participant based on the schedules they provided. Participants were prompted by an alarm prior to the designated assessment times and had to complete the surveys within two hours of their scheduled times. Individual adherence rates (i.e., percentage of completed surveys per participant) in the present study ranged from 57.7% to 100%. The average of these individual adherence rates was 93.8%.

Analytic Plan

Two-level longitudinal multilevel modeling (MLM) was used to test hypotheses since it can account for the nested nature of the data (repeated assessments nested within participants). Missing data were estimated using maximum likelihood and a first-order autoregressive structure (i.e., AR[1]) was estimated for errors in the models. Random intercepts were estimated in all the models. Study variables, including predictors and outcome variables, were standardized prior to analyses. The analyses were conducted using the PROC MIXED procedure, which by default uses restricted maximum likelihood estimation method, in

SAS® 9.3 (SAS Institute Inc., 2011). Prior to testing hypotheses, an unconditional model was estimated for PA and NA independently, and intraclass correlations (ICCs) were calculated for each outcome.

To test the hypotheses, we examined the effects of PTSD on daily PA and NA using separate models in which current PTSD diagnosis was added as a between-person (i.e., Level 2) predictor of affect. Specifically, at the within-person level (i.e., Level 1), no predictor was included. At the between-person level, the intercept was allowed to vary across participants and was also predicted by current PTSD diagnosis. Analyses were repeated using PTSD symptom severity (from the PCL-5) at baseline instead of diagnosis to ensure subthreshold effects were not responsible for results. Moreover, to ensure results were not due to confounding factors, analyses were repeated with comorbid PTSD/MDE as a separate between-person predictor of affect.

Finally, to examine the daily rhythm of PA and NA, the mean scores of PA and NA over seven days for each time period (i.e., waking, morning, afternoon, and evening) were computed for each participant. MLM was then repeated by adding “time-of-day” as a within-person (i.e., Level 1) predictor and contrasting PA and NA levels for the morning, afternoon, and evening periods to that of waking (i.e., the reference period).

Results

Descriptive statistics and ICCs of PA and NA estimated from unconditional models are summarized in Table 1. Values of ICCs suggested that 64% of the variance in PA and 66% of the variance in NA was accounted by the between-person level, warranting examination with MLM.

The associations of PTSD with daily PA and NA are summarized in Table 2. Results showed that current PTSD diagnosis, PTSD symptom severity, and PTSD/MDE comorbidity were not significantly associated with PA.[1] In contrast, all three were significantly associated with NA, indicating that participants with PTSD had higher levels of daily NA. Figure 1 illustrates patterns of daily affect in participants with and without a current PTSD diagnosis.

With respect to diurnal patterns, Figure 2 plots the diurnal rhythm of PA and NA in participants with and without a current PTSD diagnosis. Specific contrasts among different time periods showed that PA levels during the morning ($\beta = .50$, $p < .001$), afternoon ($\beta = .28$, $p < .001$), and evening ($\beta = .24$, $p < .001$) were significantly higher than PA levels at waking (i.e., the “reference period”). PA levels showed a sharp increase from waking to morning, reached their peak in the morning, and then gradually declined from afternoon to evening (the difference between the two was not significant; $\beta = -.04$, $p = .100$). NA levels were similarly lowest at waking and then peaked in the morning ($\beta = .31$, $p < .001$), although the slope for NA was not as sharp as the one for PA. Like PA, NA levels also showed a gradual decrease from afternoon to evening ($\beta = -.02$, $p = .355$). NA levels at afternoon and evening remained significantly higher than the levels at waking (βs = .24

[1]When analyzed separately, there was a non-significant trend for MDE to be associated with lower PA ($\beta = -.23$, $p = .136$).

and .22, respectively; $ps < .001$). The effects of covariates were further tested in the time-of-day analyses. Across all three covariates (current PTSD diagnosis, PTSD symptom severity, and PTSD/MDE comorbidity), the interaction with time-of-day was not significant for PA, but was significant for NA ($\beta s = .10$, .06, and .14, respectively; $ps < .01$), suggesting circadian patterns for NA are more pronounced for those with PTSD. Finally, given sparse work examining PA in those with PTSD, particularly among responders, Box 1 provides a case illustration of PA in a responder with a PTSD diagnosis.

Discussion

The present study represents the first examination of daily affect in a large sample of WTC responders using EMA for more than 24 hours. The results provide evidence that PA does not differ between those with and without PTSD, nor is it related to subthreshold symptoms. Findings suggest that WTC responders can and do experience positive affect even as they struggle with persistent PTSD symptoms (see case example in Box 1). Overall, these results add to a growing body of literature suggesting that restricted positive emotion may not be inherent to PTSD (Brown et al., 2016; Charak et al., 2014; Litz et al., 2000; Post et al., 2011; Watson et al., 2011), a finding which contradicts current *DSM-5* diagnostic criteria for PTSD. In contrast, the findings regarding elevated NA in PTSD are consistent with previous studies and diagnostic criteria (Badour et al., 2017; Beckham et al., 2000; Bradley et al., 2011; Depierro et al., 2017; DiMauro et al., 2016; Marshall-Berenz et al., 2011; Rademaker et al., 2011; Watson et al., 2011).

Findings regarding daily PA in WTC responders with PTSD are consistent with prior cross-sectional studies (Brown et al., 2016; Charak et al., 2014; Litz et al., 2000; Post et al., 2011; Watson et al., 2011). Such results are important, since they suggest that even those responders most affected by tragedy can experience and report positive emotions to the same degree as their unaffected peers. The findings may be consistent with studies suggesting that PTSD may not be associated with difficulties experiencing PA per se, but rather may be associated with the inability to regulate emotion broadly, including regulation of PA (Ehring & Quack, 2010; Tull, Barrett, McMillan, & Roemer, 2007; Weiss, Dixon-Gordon, Peasant, & Sullivan, 2018). If individuals with PTSD are able to experience a normal range of emotions but are unable to effectively regulate those emotions (e.g., unable to effectively downregulate emotional stimuli, unable to differentiate emotions), they are more likely to engage in compensatory strategies to manage their emotional experience. Strategies such as avoidance and heightened fear acquisition may serve to perpetuate symptoms characteristic of PTSD (Tull et al., 2007). In accordance with this theory, PA suppression may only be related to deficits in regulating emotions under certain circumstances, such as when reminded of the trauma (Litz, 1992; Litz et al., 2000). In contrast to results from the present study, future studies using event-contingent recording (Moskowitz & Young, 2006) may find PA restricted, but only during specific triggering events (e.g., construction sites, bones in food; See Box 1). We could not test these hypotheses, but results from the present study suggest that even if this is the case, effects are temporary rather than pervasive.

Results are important since habitual experience of PA has a number of health benefits (e.g., Hu, Zhang, & Wang, 2015; Lyubomirsky et al., 2005), including health-protective biological

responses (e.g., decreased cortisol), positive health behaviors (e.g., increased physical activity), improved sleep, social support, adaptive coping styles (e.g., seeking help, rational decision-making; reviewed in Steptoe, Dockray, & Wardle, 2009), better mental health (e.g., preventing anxiety and depression; Fredrickson, 2000; Lyubomirsky et al., 2005), and greater success in several life domains (Lyubomirsky et al., 2005). Additionally, positive emotions can broaden one's scope of thoughts and behaviors, and can enhance enduring personal resources (e.g., intellectual, social; Fredrickson, 2001). Indeed, such health benefits appear to be reflected in the case example present in Box 1. The fact that participants with PTSD experience and report positive emotions suggests that to some extent, the deleterious effects of PTSD are offset by the presence of PA and its positive effects. Thus, our results suggest that rendering activities that promote PA may be a potentially important target in PTSD interventions.

Results also confirm past work (Clark et al., 1989; Murray et al., 2002) showing a clear diurnal pattern of PA. PA has been shown to steadily rise until midday and then decline, while NA's diurnal pattern is less demarcated (Clark et al., 1989; Stone et al., 2006; Wood & Magnello, 1992). These rhythms were especially pronounced for participants with PTSD. Patients with PTSD can be educated about these patterns, and anticipate changes in affect, with plans to address these changes. Additionally, results point to an optimal therapeutic window to practice affective regulation strategies and address affect changes in individuals with PTSD.

From a theoretical standpoint, the results lend support to models such as the Tripartite Model of Anxiety and Depression (Clark & Watson, 1991). In that model, disorders related to both anxiety and depression are characterized by elevations in NA. However, only depression is characterized by the presence of low PA. Our results provide support for this pattern by finding that low PA is not relevant to PTSD. The presence of PTSD symptoms may therefore be indicative of healthy levels of positive affect, even in individuals with comorbid depressive episodes.

These results contrast with current emotion-based *DSM-5* diagnostic criteria for PTSD, which include the inability to experience PA and increased NA (APA, 2013). While more research needs to be conducted to determine if these effects are due to sample-specific factors (e.g., longevity of PTSD symptoms), the results suggest it may be warranted to remove the "positive affect" criterion from the diagnostic criteria for PTSD. Several studies have indicated that PTSD's numbing/dysphoria symptoms may be non-specific to PTSD and may be driving PTSD's comorbidity with distress-based disorders (Contractor et al., 2014; Elhai et al., 2015; Hurlocker, Vidaurri, Cuccurullo, Maieritsch, & Franklin, 2018). Potentially, the "positive affect" criterion may be driving these findings, an important avenue for future research.

While the present study provides important contributions to our understanding of daily affect in PTSD and had a number of strengths, including one of the largest samples to use EMA to address these questions, some limitations should be noted. First, the present sample consisted overwhelmingly of white males, most of whom were in law enforcement. The findings may lack generalizability and should therefore be replicated in other samples.

Specifically, results may differ in women. Second, we used abbreviated measures of PA and NA. More nuanced measures, or measures for specific types of PA (e.g., Gilbert et al., 2008; Watson et al., 1988; Watson & Clark, 1994), may find differences. Third, affect is known to be influenced by various factors including physical health, stress, social interactions, and rewards (Clark & Watson, 1988; Watson, 1988). The impact of these factors on the findings should be explored. Fourth, study participants were assessed over 10 years after experiencing the index trauma. Future studies should explore the daily experience of affect in individuals with recent exposure to trauma and should examine whether affective differences (e.g., high NA) place individuals at greater risk for development of long-term PTSD. Fifth, the present study utilized time-based intervals in the EMA design. However, event-contingent recording, through its examination of daily experiences in response to specific events, may have greater sensitivity to detect restricted PA, especially when triggered by trauma reminders. Sixth, low within-person reliability was found for both PA and NA. The degree to which this is a limitation, however, is not clear. Affect varies, and given the time interval in the present study (i.e., approximately 5 hours), low reliability may instead reflect normal variability.

Despite these limitations, the present study provides new evidence about the nature of PA in first responders, and shows how PTSD does not lead to its restriction. Results provide evidence for considering revision to the disorder's diagnostic criteria, and can guide interventions focused on using affective patterns to promote well-being in those with PTSD.

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References

American Psychiatric Association. (1994). Diagnostic and Statistical Manual of Mental Disorders (4th ed). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders (5th ed.). Arlington, VA: American Psychiatric Publishing 10.1176/appi.books.9780890425596

Badour CL, Resnick HS, & Kilpatrick DG (2017). Associations between specific negative emotions and DSM-5 PTSD among a national sample of interpersonal trauma survivors. Journal of Interpersonal Violence, 32(11), 1620–1641. 10.1177/0886260515589930 [PubMed: 26088902]

Beckham JC, Feldman ME, Barefoot JC, Fairbank JA, Helms MJ, Haney TL, … & Davidson JR (2000). Ambulatory cardiovascular activity in Vietnam combat veterans with and without posttraumatic stress disorder. Journal of Consulting and Clinical Psychology, 68(2), 269–276. 10.1037/0022-006X.68.2.269 [PubMed: 10780127]

Bradley B, DeFife JA, Guarnaccia C, Phifer J, Fani N, Ressler KJ, & Westen D. (2011). Emotion dysregulation and negative affect: Association with psychiatric symptoms. Journal of Clinical Psychiatry, 72(5), 685–691. 10.4088/JCP.10m06409blu [PubMed: 21658350]

Bromet EJ, Hobbs MJ, Clouston SAP, Gonzalez A, Kotov R, & Luft BJ (2016). DSM-IV post-traumatic stress disorder among World Trade Center responders 11–13 years after the disaster of 11

September 2001 (9/11). Psychological Medicine, 46(04), 771–783. 10.1017/S0033291715002184 [PubMed: 26603700]

Brown WJ, Bruce SE, Buchholz KR, Artime TM, Hu E, & Sheline YI (2016). Affective dispositions and PTSD symptom clusters in female interpersonal trauma survivors. Journal of Interpersonal Violence, 31(3), 407–424. 10.1177/0886260514555866 [PubMed: 25389192]

Charak R, Armour C, Elklit A, Koot HM, & Elhai JD (2014). Assessing the latent factor association between the dysphoria model of PTSD and positive and negative affect in trauma victims from India. Psychological Injury and Law, 7(2), 122–130. 10.1007/s12207-014-9192-0

Clark LA, & Watson D. (1988). Mood and the mundane: relations between daily life events and self-reported mood. Journal of Personality and Social Psychology, 54(2), 296–308. 10.1037//0022-3514.54.2.296 [PubMed: 3346815]

Clark LA, & Watson D. (1991). Tripartite model of anxiety and depression: psychometric evidence and taxonomic implications. Journal of Abnormal Psychology, 100(3), 316–336. 10.1037/0021-843X.100.3.316 [PubMed: 1918611]

Clark LA, Watson D, & Leeka J. (1989). Diurnal variation in the positive affects. Motivation and Emotion, 13(3), 205–234. 10.1007/BF00995536

Contractor AA, Durham TA, Brennan JA, Armour C, Wutrick HR, Frueh CB, & Elhai JD (2014). DSM-5 PTSD's symptom dimensions and relations with major depression's symptom dimensions in a primary care sample. Psychiatry Research, 215(1), 146–153. 10.1016/j.psychres.2013.10.015 [PubMed: 24230994]

Depierro J, D'Andrea W, Frewen P, & Todman M. (2017). Alterations in Positive Affect: Relationship to Symptoms, Traumatic Experiences, and Affect Ratings. Psychological Trauma: Theory, Research, Practice and Policy. 10.1037/tra0000317

DiMauro J, Renshaw KD, & Kashdan TB (2016). Beliefs in negative mood regulation and daily negative affect in PTSD. Personality and Individual Differences, 95, 34–36. 10.1016/j.paid.2016.02.030

Ehring T, & Quack D. (2010). Emotion regulation difficulties in trauma survivors: The role of trauma type and PTSD symptom severity. Behavior Therapy, 41(4), 587–598. 10.1016/j.beth.2010.04.004 [PubMed: 21035621]

Elhai JD, Contractor AA, Tamburrino M, Fine TH, Cohen G, Shirley E, … & Galea S. (2015). Structural relations between DSM-5 PTSD and Major Depression symptoms in military soldiers. Journal of Affective Disorders, 175, 373–378. 10.1016/j.jad.2015.01.034 [PubMed: 25665497]

First MB, Spitzer RL, Gibbon M, & Williams JB (1997). Structured clinical interview for DSM-IV clinical version. New York: Biometrics Research Department, New York State Psychiatric Institute.

Fredrickson BL (2000). Cultivating positive emotions to optimize health and well-being. Prevention & Treatment, 3(1), 1a. 10.1037/1522-3736.3.1.31a

Fredrickson BL (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. American Psychologist, 56(3), 218–226. 10.1037/0003-066X.56.3.218 [PubMed: 11315248]

Fredrickson BL, & Losada MF (2005). Positive affect and the complex dynamics of human flourishing. American Psychologist, 60(7), 678–686. 10.1037/0003-066X.60.7.678 [PubMed: 16221001]

Frewen PA, Dozois DJ, & Lanius RA (2012). Assessment of anhedonia in psychological trauma: psychometric and neuroimaging perspectives. European Journal of Psychotraumatology, 3(1), 1–12. 10.3402/ejpt.v3i0.8587

Frewen PA, Dozois DA, Neufeld RW, Densmore M, Stevens TK, & Lanius RA (2011). Self-referential processing in women with PTSD: Affective and neural response. Psychological Trauma: Theory, Research, Practice, and Policy, 3(4), 318–328. 10.1037/a0021264

Gilbert P, McEwan K, Mitra R, Franks L, Richter A, & Rockliff H. (2008). Feeling safe and content: A specific affect regulation system? Relationship to depression, anxiety, stress, and self-criticism. The Journal of Positive Psychology, 3(3), 182–191. 10.1080/17439760801999461

Herbert R, Moline J, Skloot G, Metzger K, Baron S, Luft B, … & Todd A. (2006). The World Trade Center disaster and the health of workers: five-year assessment of a unique medical screening

program. Environmental Health Perspectives, 114(12), 1853–1858. 10.1289/ehp.9592 [PubMed: 17185275]

Hu T, Zhang D, & Wang J. (2015). A meta-analysis of the trait resilience and mental health. Personality and Individual Differences, 76, 18–27. 10.1016/j.paid.2014.11.039

Hurlocker MC, Vidaurri DN, Cuccurullo LAJ, Maieritsch K, & Franklin CL (2018). Examining the latent structure mechanisms for comorbid posttraumatic stress disorder and major depressive disorder. Journal of Affective Disorders, 229, 477–482. 10.1016/j.jad.2017.12.076 [PubMed: 29334642]

Kashdan TB, Elhai JD, & Frueh BC (2006). Anhedonia and emotional numbing in combat veterans with PTSD. Behaviour Research and Therapy, 44(3), 457–467. 10.1016/j.brat.2005.03.001 [PubMed: 16446151]

King D, Leskin G, King L, & Weathers F. (1998). Confirmatory factor analysis of the clinician-administered PTSD scale: evidence for the dimensionality of posttraumatic stress disorder. Psychological Assessment, 10(2), 90–96. 10.1037/1040-3590.10.2.90

Landrigan PJ, Lioy PJ, Thurston G, Berkowitz G, Chen LC, Chillrud SN, … & Perera F. (2004). Health and environmental consequences of the world trade center disaster. Environmental Health Perspectives, 112(6), 731–739. 10.1289/ehp.6702 [PubMed: 15121517]

Litz BT (1992). Emotional numbing in combat-related post-traumatic stress disorder: A critical review and reformulation. Clinical Psychology Review, 12(4), 417–432. 10.1016/0272-7358(92)90125-R

Litz BT, Orsillo SM, Kaloupek D, & Weathers F. (2000). Emotional processing in posttraumatic stress disorder. Journal of Abnormal Psychology, 109(1), 26–39. 10.1037//0021-843X.109.1.26 [PubMed: 10740933]

Lyubomirsky S, King L. & Diener E. (2005). The benefits of frequent positive affect: Does happiness lead to success? Psychological Bulletin, 131(6), 803–855. 10.1037/0033-2909.131.6.803 [PubMed: 16351326]

Marshall-Berenz EC, Morrison JA, Schumacher JA, & Coffey SF (2011). Affect intensity and lability: The role of posttraumatic stress disorders symptoms in borderline personality disorder. Depression and Anxiety, 28(5), 393–399. 10.1002/da.20798 [PubMed: 21538723]

Mehl MR, & Conner TS (2012). Handbook of Research Methods for Studying Daily Life. New York, NY: The Guilford Press.

Moskowitz DS, & Young SN (2006). Ecological momentary assessment: what it is and why it is a method of the future in clinical psychopharmacology. Journal of Psychiatry and Neuroscience, 31(1), 13. [PubMed: 16496031]

Murray G, Allen NB, & Trinder J. (2002). Mood and the circadian system: Investigation of a circadian component in positive affect. Chronobiology International, 19(6), 1151–1169. 10.1081/CBI-120015956 [PubMed: 12511032]

Neria YE, Gross RE, Marshall RD, & Susser ES (2006). 9/11 Mental Health in the Wake of Terrorist Attacks. Cambridge University Press: New York 10.1017/CBO9780511544132

Post LM, Zoellner LA, Youngstrom E, & Feeny NC (2011). Understanding the relationship between co-occurring PTSD and MDD: Symptom severity and affect. Journal of Anxiety Disorders, 25(8), 1123–1130. 10.1016/j.janxdis.2011.08.003 [PubMed: 21899984]

Rademaker AR, van Zuiden M, Vermetten E, & Geuze E. (2011). Type D personality and the development of PTSD symptoms: A prospective study. Journal of Abnormal Psychology, 120(2), 299–307. 10.1037/a0021806 [PubMed: 21171726]

SAS Institute Inc. (2011). SAS/IML 9.3 User's Guide. Cary, NC: SAS Institute Inc.

Shiffman S, Stone AA, & Hufford MR (2008). Ecological momentary assessment. Annual Review of Clinical Psychology, 4, 1–32. 10.1146/annurev.clinpsy.3.022806.091415

Simms LJ, Watson D, & Doebbeling BN (2002). Confirmatory factor analyses of posttraumatic stress symptoms in deployed and nondeployed veterans of the Gulf War. Journal of Abnormal Psychology, 111(4), 637–647. 10.1037//0021-843X.111.4.637 [PubMed: 12428777]

Solan S, Wallenstein S, Shapiro M, Teitelbaum SL, Stevenson L, Kochman A, … & Crane M. (2013). Cancer incidence in world trade center rescue and recovery workers, 2001–2008. Environmental Health Perspectives, 121(6), 699–704. 10.1289/ehp.1205894 [PubMed: 23613120]

Stellman JM, Smith RP, Katz CL, Sharma V, Charney DS, Herbert R, … & Harrison D. (2008). Enduring mental health morbidity and social function impairment in world trade center rescue, recovery, and cleanup workers: the psychological dimension of an environmental health disaster. Environmental Health Perspectives, 116(9), 1248–1253. 10.1289/ehp.11164 [PubMed: 18795171]

Steptoe A, Dockray S, & Wardle J. (2009). Positive affect and psychobiological processes relevant to health. Journal of Personality, 77(6), 1747–1776. 10.1111/j.1467-6494.2009.00599.x [PubMed: 19796062]

Stone AA, Schwartz JE, Schkade D, Schwarz N, Krueger A, & Kahneman D (2006). A population approach to the study of emotion: diurnal rhythms of a working day examined with the Day Reconstruction Method. Emotion, 6(1), 139–149. 10.1037/1528-3542.6.1.139 [PubMed: 16637757]

Tull MT, Barrett HM, McMillan ES, & Roemer L. (2007). A preliminary investigation of the relationship between emotion regulation difficulties and posttraumatic stress symptoms. Behavior Therapy, 38(3), 303–313. 10.1016/j.beth.2006.10.001 [PubMed: 17697854]

Watson D. (1988). Intraindividual and interindividual analyses of positive and negative affect: their relation to health complaints, perceived stress, and daily activities. Journal of Personality and Social Psychology, 54(6), 1020–1030. 10.1037/0022-3514.54.6.1020 [PubMed: 3397861]

Watson D, & Clark LA (1994). The PANAS-X: Manual for the Positive and Negative Affect Schedule-Expanded Form. Iowa City, IA: The University of Iowa.

Watson D, Clark LA, & Stasik SM (2011). Emotions and the emotional disorders: A quantitative hierarchical perspective. International Journal of Clinical and Health Psychology, 11(3), 429–442.

Watson D, Clark LA, & Tellegen A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. Journal of Personality and Social Psychology, 54(6), 1063–1070. 10.1037/0022-3514.54.6.1063 [PubMed: 3397865]

Watson D, Gamez W, & Simms LJ (2005). Basic dimensions of temperament and their relation to anxiety and depression: A symptom-based perspective. Journal of Research in Personality, 39(1), 46–66. 10.1016/j.jrp.2004.09.006

Weathers FW, Litz BT, Keane TM, Palmieri PA, Marx BP, & Schnurr PP (2013). The PTSD Checklist for DSM-5 (PCL-5). Scale available from the National Center for PTSD at www.ptsd.va.gov.

Weiss NH, Dixon-Gordon KL, Peasant C, & Sullivan TP (2018). An examination of the role of difficulties regulating positive emotions in posttraumatic stress disorder. Journal of Traumatic Stress, 31, 775–780. [PubMed: 30338577]

Wisnivesky JP, Teitelbaum SL, Todd AC, Boffetta P, Crane M, Crowley L, … & Kim H. (2011). Persistence of multiple illnesses in World Trade Center rescue and recovery workers: a cohort study. The Lancet, 378(9794), 888–897. 10.1016/S0140-6736(11)61180-X

Wood C, & Magnello ME (1992). Diurnal changes in perceptions of energy and mood. Journal of the Royal Society of Medicine, 85(4), 191–194. [PubMed: 1433057]

Box 1.

Case Example of PA in daily life.

The participant was in his late 30's when the 9/11 attacks occurred. He arrived in lower Manhattan two days after the attack and spent the majority of his time adjacent to the pit helping with the recovery. He spent a few days working with family members who were looking for their loved ones. Although not personally threatened, he reported processing human remains during the recovery and knowing people killed on 9/11. He operated at the site for approximately three weeks. Fourteen years after the attack, he is now in his early 50's and met criteria for current WTC-related PTSD. He reported sporadic flashbacks within the past month, most often occurring in the shower. Nightmares of 9/11 started a few months after the attacks and still occur occasionally to this day. The most common triggers for PTSD symptoms are construction sites and seeing bones in food. On the first day of the EMA period, he reported only a few PTSD symptoms (below threshold), as well minimal levels of PA. However, both fluctuated substantially across the week. His PTSD symptoms spiked on the third day of the study, when he reported experiencing more than a moderate number of symptoms. They gradually diminished over the next three days, but then spiked again on his last day of the study. Despite these symptoms, he reported moderate PA almost every day of the study. On the third day of the study, despite his worsened PTSD symptoms, he reported higher than usual PA (more than moderate). He was socially active throughout the week, reporting many interactions on almost all days, although his satisfaction with these interactions varied and he described difficulty with most of them. On most days, he reported feeling "jumpy" and "nervous." Despite these feelings, he reported several positive events and reported accomplishing important goals that sustained his positive affect.

Clinical Impact Statement

First responders with Post-Traumatic Stress Disorder (PTSD) experience daily levels of positive affect that are similar to those without the disorder. Given the numerous health benefits associated with the ability to experience positive affect, findings suggest that even after experiencing significant trauma, disaster responders with PTSD can nevertheless benefit from interventions that promote positive affect. Moreover, results underscore how circadian patterns of affect can be anticipated and addressed in treatment of PTSD.

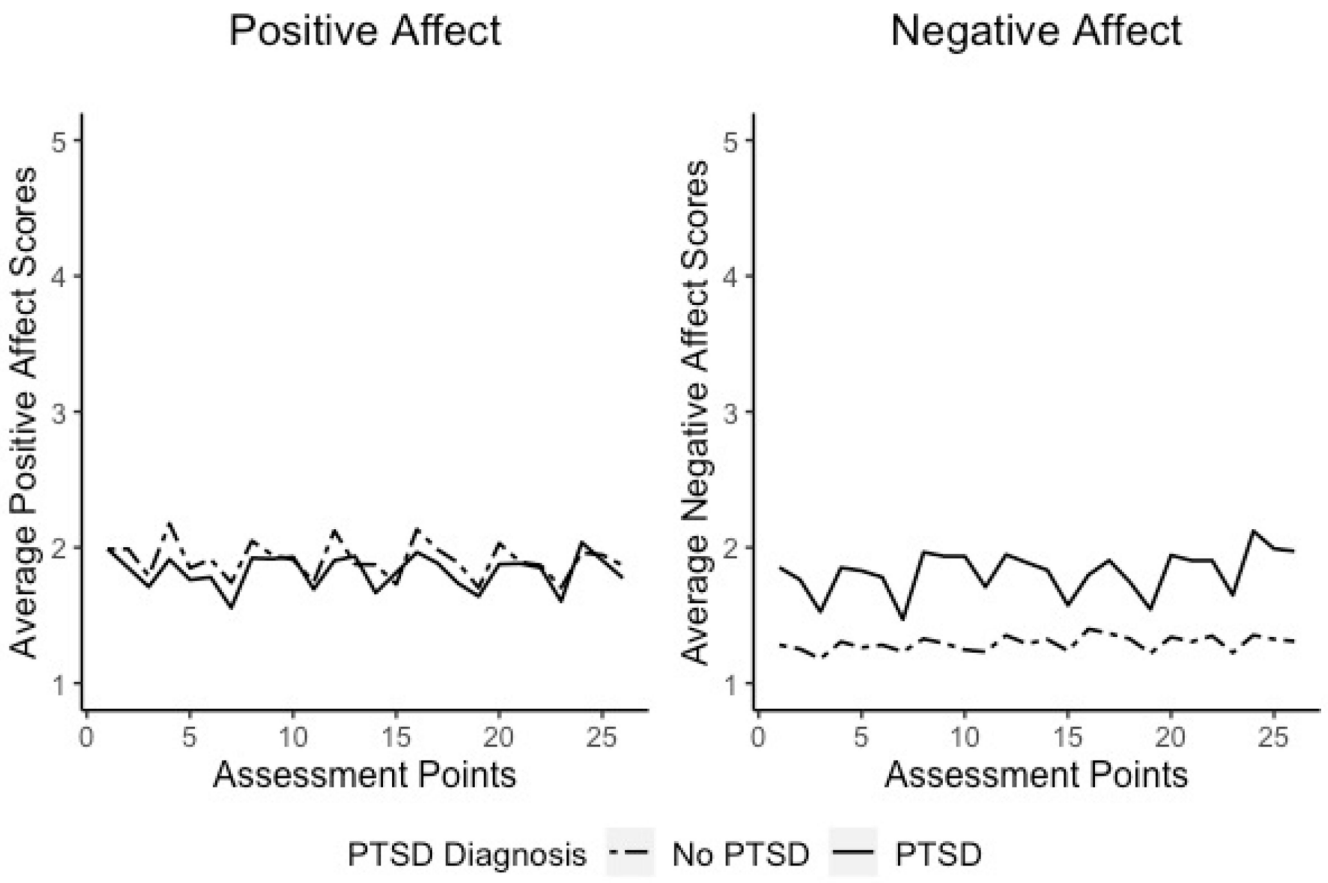

Figure 1.
Daily patterns of Positive Affect (PA) and Negative Affect (NA) for current PTSD diagnosis and non-PTSD groups in the present study.

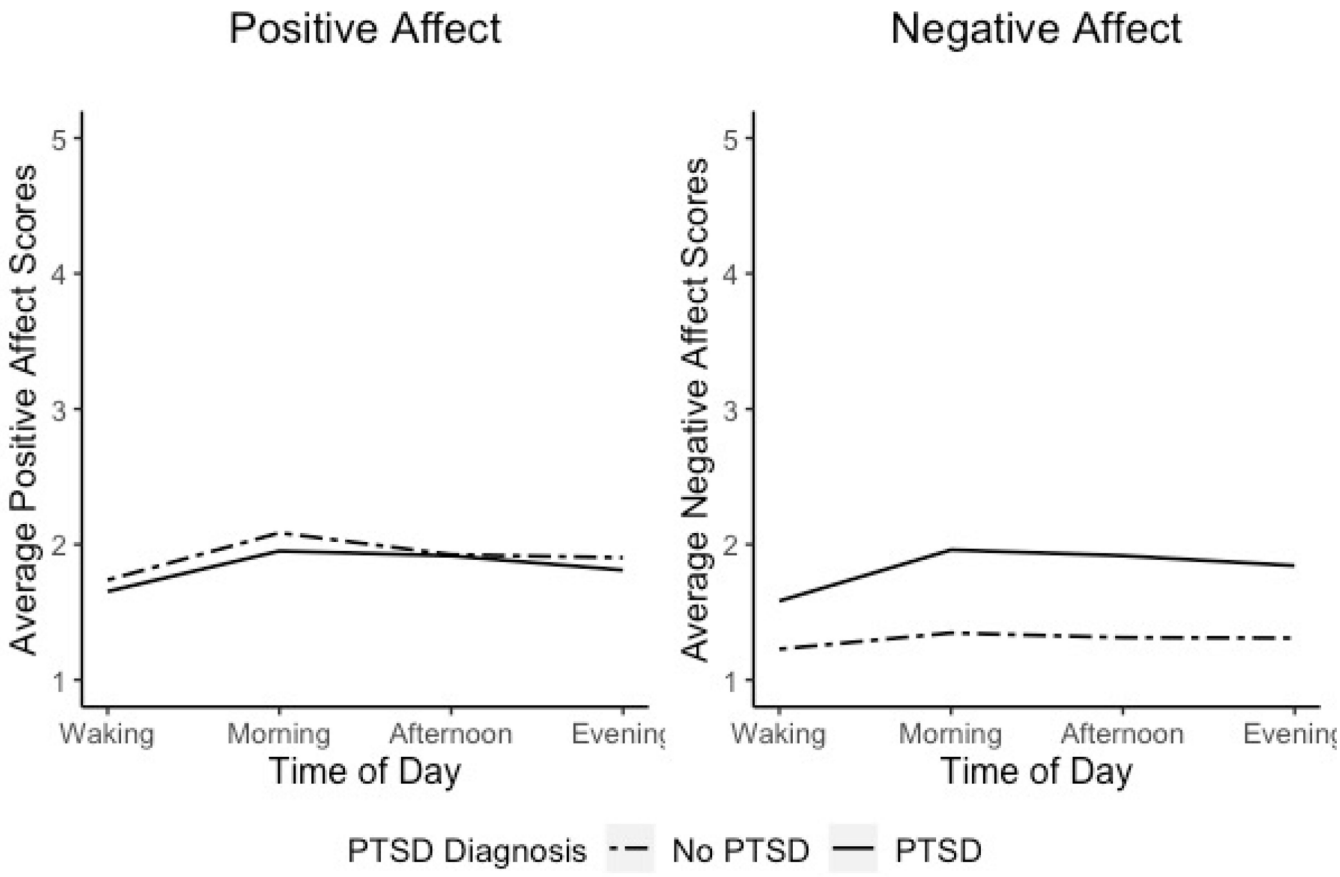

Figure 2.
Time of day patterns of Positive Affect (PA) and Negative Affect (NA) for current PTSD diagnosis and non-PTSD groups in the present study.

Table 1:

Descriptive Statistics and Intraclass Correlation for Unconditional Models of Positive Affect and Negative Affect

EMA Affectivity [a]	Current PTSD (*n* = 39)				Non-PTSD (*n* = 163)				ICC
	M	*SD*	Minimum	Maximum	*M*	*SD*	Minimum	Maximum	
PA	1.83	.59	1.00	3.40	1.92	.62	1.00	3.92	.64
NA	1.86	.70	1.05	3.78	1.29	.39	1.00	3.42	.66

Notes. *N* = 202. ICC = Intraclass correlation; EMA = Ecological momentary assessment; PTSD = Posttraumatic stress disorder; PA = Positive affect; NA = Negative affect.

[a]For the EMA variables, between-person mean, standard deviation, minimum, and maximum were calculated using within-person averages. That is, an average of PA and NA was calculated for each participant across the entire EMA reporting period, then descriptive statistics were calculated based on the person-averaged data for current PTSD group and non-PTSD group.

Table 2:

Fixed-effect Parameter Estimates for Positive Affect and Negative Affect

Model predictor	PA				NA			
	AIC	BIC	*β (SE)*	*p*	AIC	BIC	*β (SE)*	*p*
PTSD diagnosis [a]	9617.3	9627.2			9338.7	9348.6		
Intercept			.022 (.06)	.733			−.154 (.06)	.010
Current PTSD [b]			−.101 (.15)	.487			.830 (.14)	< .001
PTSD symptom severity	9413.8	9423.7			9097.5	9107.4		
Intercept			.005 (.06)	.931			.001 (.05)	.990
PTSD severity			−.007 (.06)	.899			.490 (.05)	< .001
PTSD & MDE comorbidity [c]	9616.4	9626.3			9334.5	9334.5		
Intercept			.022 (.06)	.739			−.107 (.06)	.056
Comorbidity			−.181 (.19)	.348			1.149 (.18)	< .001

Notes. PTSD = Posttraumatic stress disorder; PA = Positive affect; NA = Negative affect; SE = Standard error. To accurately report the size of each estimate, all values were reported on three decimal points.

[a] Analyses with current PTSD and PTSD symptom severity were repeated controlling for time. The overall result patterns had no substantial change.

[b] The non-PTSD diagnosis group was used as a reference group in the model.

[c] The group without comorbidity was used as a reference group in the model.