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Relation of Positive Memory Recall Count and Accessibility with Post-trauma Mental Health

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Abstract

Positive memory encoding and retrieval deficits have an empirical relation with several post-trauma outcomes. Drawing from the Contractor et al. model, we examined relations between positive memory characteristics and post-trauma mental health indicators. A trauma-exposed community sample of 203 participants (M_{age} = 35.40 years; 61.10% female) was recruited via Amazon's Mechanical Turk. Participants completed measures of posttraumatic stress disorder (PTSD; PTSD Checklist for DSM-5), depression (Patient Health Questionnaire-9), posttraumatic cognitions (Posttraumatic Cognitions Inventory), affect (Positive and Negative Affect Schedule), count/number of recalled specific positive memories (Autobiographical Memory Test) and accessibility of a specific positive memory (i.e. subjective ease of recalling details of a memory; Memory Experiences Questionnaire-Short Form). Linear regression results indicated that PTSD intrusion severity, PTSD negative alterations in cognitions and mood (NACM) severity, PTSD alterations in arousal and reactivity (AAR) severity, self-blame, and positive affect significantly and negatively predicted the count of specific positive memories. Further, PTSD NACM severity, PTSD AAR severity, negative cognitions about the self, and negative affect significantly and negatively predicted accessibility of a specific positive memory. Thus, count/accessibility of specific positive memories was associated with several post-trauma mental health indicators; this highlights the relevance and potential impact of integrating positive memories into trauma treatment.

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Declaration of interest statement

The authors report no conflict of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author, AC, upon reasonable request.

Keywords

PTSD; depression; affect; cognitions; positive memories

Introduction

Deficits in the encoding, consolidation, and/or retrieval of positive memories play a role in the symptomatology of posttraumatic stress disorder (PTSD; Brewin and Holmes, 2003; McNally, Lasko, Macklin, & Pitman, 1995; Schönfeld and Ehlers, 2017). However, most current trauma research and clinical work primarily targets traumatic memories (Bernsten and Rubin, 2007; Schnurr, 2017). To incorporate a unique and primary focus on positive memories into the current trauma paradigm, Contractor et al. (2018) proposed a conceptual model outlining hypothesized mechanisms underlying the effects of positive memory processing on post-trauma outcomes with a focus on PTSD severity. Drawing from this model, we empirically examined the relation of the count of specific positive memories and accessibility of a specific positive memory (i.e. subjective ease of recalling a positive memory; Sutin and Robins, 2007) to post-trauma mental health indicators related to PTSD.

Positive Memories and PTSD

Positive memory processes and characteristics may contribute to the etiology and maintenance of PTSD severity (Contractor, Brown, et al., 2018). For example, evidence indicates that fewer positive memories pre-trauma was associated with greater PTSD severity post-trauma, both among pregnant women hospitalized with anticipated late-pregnancy and delivery complications (Hauer, Wessel, Engelhard, Peeters, & Dalgleish, 2009) and male fire-fighters (Bryant, Sutherland, & Guthrie, 2007). Further, trauma-exposed individuals with PTSD symptoms report difficulties in autobiographical memory specificity (de Decker, Hermans, Raes, & Eelen, 2003; Hayes, VanElzakker, & Shin, 2012; Ono, Devilly, & Shum, 2016), wherein they have greater difficulties recalling specific positive memories compared to individuals without PTSD (McNally, et al., 1995; McNally, Litz, Prassas, Shin, & Weathers, 1994). Indeed, a review of trauma studies indicated overgenerality (i.e., non-specificity) of memories for both positive and negative cues among trauma-exposed individuals (Williams et al., 2007). Attentional biases towards negative information (Aupperle, Melrose, Stein, & Paulus, 2012; Fani et al., 2012), rumination on negative memories cued by trauma reminders (Ehlers and Clark, 2000), and numbing/emotion dysregulation symptoms (Litz, Orsillo, Kaloupek, & Weathers, 2000; Weiss, Dixon-Gordon, Peasant, & Sullivan, 2018) experienced by trauma-exposed individuals may contribute to difficulties in recalling specific positive memories. In line with these findings, interventions increasing specific (positive) memory recall have been found to be effective for emotional disorders (Barry, Sze, & Raes, 2019), including for PTSD severity (Callahan, Maxwell, & Janis, 2019; Moradi et al., 2014). Thus, memory-based interventions show promise in addressing PTSD symptoms (Hitchcock, Werner-Seidler, Blackwell, & Dalgleish, 2017). In fact, increasing specific positive memory recall may serve as a resilience factor when coping with stressors (Askelund, Schweizer, Goodyer, & van Harmelen, 2019). Overall, evidence indicates that positive memory recall may inversely relate to PTSD severity.

Positive Memories and Depression

Trauma-exposed individuals may experience depression comorbid with PTSD (Bonde et al., 2016; Contractor, Roley-Roberts, Lagdon, & Armour, 2017; Rytwinski, Scur, Feeny, & Youngstrom, 2013). Given that both PTSD and depression have common underlying mechanisms (Post, Feeny, Zoellner, & Connell, 2016), some positive-memory processes and effects may be shared across the two constructs. Indeed, evidence indicates that individuals with depressed mood report difficulty recalling (specific) positive memories (Clark and Teasdale, 1982; Williams, et al., 2007), are more likely to recall unpleasant and unhappy events (Snyder and White, 1982), and rate positive memories as less vivid (Werner-Seidler and Moulds, 2011), than individuals without depressed mood; this, in turn, may maintain a chronic negative mood (Matt, Vázquez, & Campbell, 1992). Potential contributing factors outlined in the extant research include an over-focus on negative cognitions and stimuli (Beck, 1976; Murphy et al., 1999), reduced positive outcome expectancies (Clark and Teasdale, 1982), deficits in processing positive content (Joormann and Siemer, 2004; Werner-Seidler and Moulds, 2011), overgeneralized memory biases (Brittlebank, Scott, Williams, & Ferrier, 1993), and mood repair difficulties integral to depression (Gross and Muñoz, 1995; Tomarkenand and Keener, 1998).

Following from this, increasing specific positive memory recall has been shown to relate to beneficial outcomes for individuals with depression. For example, targeting positive memory recall caused reductions in sad mood among individuals meeting criteria for at least two major depressive episodes (Foland-Ross, Cooney, Joormann, Henry, & Gotlib, 2014) and mood improvements among individuals with major depressive disorder (Werner-Seidler, Tan, & Dalgleish, 2017). Extending from this, interventions focused on increasing retrieval of specific memories have caused reductions in depression severity among trauma-exposed adolescents (Neshat-Doost et al., 2013); training focused on increasing access to specific positive memories has repaired induced negative mood among individuals with depression (Arditte Hall, De Raedt, Timpano, & Joormann, 2018); and interventions focused on using positive stories to strengthen a positive self-image have improved self-esteem among individuals with depression (Korrelboom, Maarsingh, & Huijbrechts, 2012). Overall, evidence supports an inverse relation between positive memory recall and depression severity among trauma-exposed individuals.

Positive Memories and Affect

Trauma-exposed individuals, especially those with PTSD, report dysregulation for negative and positive affect (Keane, Fairbank, Caddell, Zimering, & Bender, 1985; Litz, et al., 2000; Weiss, et al., 2018). Positive memory recall may aid emotion regulation processes by downregulating negative affect and upregulating positive affect (Quoidbach, Mikolajczak, & Gross, 2015; Rusting and DeHart, 2000) among trauma-exposed individuals. Indeed, experimental evidence supports a negative relation between positive memories and negative affect, and a positive relation between positive memories and positive affect (Joormann, Siemer, & Gotlib, 2007; Josephson, 1996; Rusting and DeHart, 2000). To elaborate, an experiment by Josephson (1996) demonstrated that after a sad mood induction, participants who followed a negative memory with a positive one reported a more positive mood than participants who recalled two consecutive negative memories. Another study by Rusting and

DeHart (2000) using four distinct samples indicated that after inducing a negative mood, engaging in positive reappraisal enhanced retrieval of more positive memories, and focusing on negative events enhanced retrieval of more negative memories. Related to interventions, procedures focused on enhancing recall of specific positive memories have found to increase positive emotions and reduce negative emotions among individuals with PTSD (Panagioti, Gooding, & Tarrier, 2012). Overall, evidence supports that positive memory recall may relate to enhanced positive affect and reduced negative affect among trauma-exposed individuals.

Positive Memories and Cognitions

Trauma-exposed individuals have predominantly negative self, other/world, and future schemas (Foa and Kozak, 1986; Janoff-Bulman, 1992), which creates difficulties in therapeutically disputing trauma-related maladaptive cognitions (McNally, et al., 1994). Positive memory recall may enhance adaptive cognitions; enhanced positive affect following positive memory retrieval may activate positive interpretations of events and pleasant thoughts/memories (mood-congruency effect; Blaney, 1986; Rusting and DeHart, 2000; Rusting and Larsen, 1998) and increase positive content in thoughts (broaden-and-build theory; Fredrickson, 2001). Further, greater positive memory specificity may reduce cognitive (primarily negative self-cognitions) vulnerability to depression over time among individuals with stressful life experiences (Askelund, et al., 2019), suggesting that engaging with positive memories particularly impacts negative beliefs about self. Overall, supporting evidence indicates that positive memory recall may beneficially impact schemas and self-image among trauma-exposed individuals.

Current Study

Despite the aforementioned findings, little research has examined relations between positive memory recall and a broad range of post-trauma mental health indicators including PTSD, depression, affect, and cognitions. Additionally, when PTSD has been researched in relation to positive memories, the heterogeneity in its symptom clusters has rarely been considered; evidence suggests variable relations between the different PTSD symptom clusters and psychopathology (Armour, Contractor, Palmieri, & Elhai, 2014; Contractor, Armour, Forbes, & Elhai, 2016; Contractor et al., 2014; Contractor, Greene, Dolan, & Elhai, 2018). Lastly, investigators have rarely examined objective and subjective facets of positive memory recall in the same study. Notably, factors such as emotional status have been found to differentially impact subjective memory ratings and objective memory performance (Smith, Petersen, Ivnik, Malec, & Tangalos, 1996), highlighting the importance of examining multiple facets of autobiographical memory recall.

Addressing these limitations and drawing from the Contractor et al. (2018) model, we examined the relation between positive memory characteristics (count of specific positive memories and accessibility of a specific positive memory) and several theoretically relevant post-trauma mental health indicators (PTSD subscale severity [intrusions, avoidance of trauma reminders, negative alterations in cognitions and mood, alterations in arousal and reactivity]; depression severity; positive and negative affect; and post-trauma cognitions). Further, we examined objectively assessed (i.e., count of specific positive memories

measured via a performance-based task of the Autobiographical Memory Test; Williams and Broadbent, 1996) and subjectively reported (i.e., ease of accessing a specific positive memory measured via a self-report measure of the Memory Experiences Questionnaire-Short Form; Luchetti and Sutin, 2016) facets of positive memory recall (Holland and Kensinger, 2010). Notably, these two positive memory characteristics are related; greater accessibility of a specific positive memory may enhance one's ability to recall more specific positive memories consistent with mood-congruent memory recall (Bower, 1981) as discussed by Clark and Collins (1993).

Given that the conceptual relations of the Contractor et al. (2018) model (*see* Figure 1) have not been empirically examined in prior studies, the primary aim of the current study was to establish whether the hypothesized relations were present within this sample. Specifically, we hypothesized that a significant negative relation between specific positive memory recall count/accessibility with PTSD symptom cluster severity (McNally, et al., 1994; Moradi, et al., 2014), depression severity (Clark and Teasdale, 1982; Snyder and White, 1982), maladaptive post-trauma cognitions (Blaney, 1986; Fredrickson, 2001; Rusting and Larsen, 1998), and negative affect (Joormann, et al., 2007; Josephson, 1996; Rusting and DeHart, 2000) would have greater difficulties recalling specific positive memories (count/accessibility). Further, we hypothesized a significant positive relation between specific positive memory recall count/accessibility with positive affect (Joormann, et al., 2007; Josephson, 1996; Rusting and DeHart, 2000).

Methods

Procedure and Participants

The study was approved by the University of North Texas Institutional Review Board. The current study was part of a larger study conducted via Amazon's Mechanical Turk (MTurk) online recruitment platform; it was described as a 60-minute study examining relations between the recall of positive memories, positive memory processes, and emotional distress indicators among individuals experiencing stressful life events. The inclusionary criteria included being >/=18 years, having a working knowledge of English, endorsing a stressful life experience, and no current or previous diagnosis of sleep apnea. Sleep apnea, which includes brief awakenings during sleep, is related to lower quality sleep (Ho and Brass, 2011), influences sleep disturbances (American Psychiatric Association, 2013), and interferes with memory consolidation (Kloepfer et al., 2009). All such factors may adversely influence one's ability to accurately report on other sleep indicators (e.g., sleep quality and quantity) as well as on symptomatology; information on these variables were collected as part of the larger study to examine the relation between PTSD severity, self-reported sleep indicators, and memory functioning. Eligible participants who provided informed consent and completed the entire survey without failing validity checks received $1.50 as compensation, consistent with recommended (Barger, Benrend, Sharek, & Sinar, 2011; Schmidt, 2015) and implemented compensation practices (e.g., Contractor, Frankfurt, Weiss, & Elhai, 2017; Seligowski and Orcutt, 2016; van Stolk-Cooke et al., 2018). Additionally, compensation rates have not been found to negatively influence data quality (Buhrmester, Kwang, & Gosling, 2011).

Exclusions, Missing Data, and Sample Characteristics

A total of 695 participants attempted the survey; 299 duplicate responses were excluded based on multiple attempts (remainder $n = 466$). We excluded 89 participants for not meeting study inclusionary criteria (remainder $n = 377$); 138 participants for failing validity checks inserted to ensure attention and comprehension (reminder $n = 239$; Meade and Craig, 2012; Oppenheimer, Meyvis, & Davidenko, 2009; Thomas and Clifford, 2017); one participant for not endorsing any traumatic event on the Life Events Checklist for *DSM-5* (reminder $n = 238$; LEC-5; Weathers et al., 2013); 32 participants for not following instructions on the Memory Experiences Questionnaire-Short Form (reminder $n = 206$; MEQ-SF; Luchetti and Sutin, 2016); and three individuals with > 30% missing data on any variable of interest (reminder $n = 203$). The final sample of 203 participants averaged 35.40 years of age ($SD = 11.52$); 124 were female (61.10%). Eighty-five (41.90%) participants had probable PTSD based on the PTSD Checklist for *DSM-5* (PCL-5; Weathers et al., 2013) cut-off score > 31 (Blevins, Weathers, Davis, Witte, & Domino, 2015; Bovin et al., 2016; Wortmann et al., 2016). Detailed information on demographics and psychopathology variables is provided in Table 1.

Measures (in order of their presentation)

Demographic information.—We obtained information on age, gender, income, educational level, racial and ethnic status, relationship status, and mental health treatment.

Life Events Checklist for DSM-5 (LEC-5; Weathers, et al., 2013).—The LEC-5 is a 17-item self-report measure evaluating lifetime traumatic events. The 18th item assessed the most distressing of the endorsed traumatic events (subsequent PTSD measure was completed in reference to this distressing trauma). Participants indicated their exposure to each event on a 6-point nominal scale: happened to me, witnessed it, learned about it, part of my job, not sure, and does not apply. For the current study, positive endorsement of a traumatic event equated endorsing either of the first four response options for either of the first 16 LEC-5 items consistent with the *DSM-5* Criterion A for PTSD (American Psychiatric Association, 2013).

PTSD Checklist for DSM-5 (PCL-5; Weathers, et al., 2013).—The PCL-5 is a 20-item self-report measure assessing past-month PTSD symptom severity. Response options range from 0 (*not at all*) to 4 (*extremely*). The four subscales include intrusions, avoidance, negative alterations in cognitions and mood (NACM), and alterations in arousal and reactivity (AAR). The PCL-5 has excellent psychometric properties (Blevins, et al., 2015; Bovin, et al., 2016; Wortmann, et al., 2016). In the current study, the Cronbach's α for the intrusions, avoidance, NACM, and AAR subscales was .90, .87, .89, and .87, respectively.

Posttraumatic Cognitions Inventory (PTCI; Foa, Ehlers, Clark, Tolin, & Orsillo, 1999).—The PTCI is a 36-item self-report measure that assesses thoughts related to an experienced trauma. Response options range from 1 (*totally disagree*) to 7 (*totally agree*). The measure yields 3 subscales: Negative Cognitions about the Self (assessing feelings of unworthiness and incompetence), Negative Cognitions about the World (assessing the view that the world is dangerous), and Self-Blame (assessing blame of oneself for causing or

failing to prevent a trauma). The PTCI has demonstrated adequate psychometric properties (Beck et al., 2004). In the current study, Cronbach's α was .96, .91, and .85 for the subscales of Negative Cognitions about the Self, Negative Cognitions about the World, and Self-Blame respectively.

Autobiographical Memory Test (AMT; Williams and Broadbent, 1996).—The AMT was used to examine the count of specific positive memories participants were able to recall. Participants were presented with 10 positively valenced cue words: friendly, happy, honest, kind, humorous, cheer, pleased, relieved, lively, and glorious (Kleim and Ehlers, 2008; McNally, et al., 1995). Each cue word was followed by a prompt to recall a specific and meaningful memory of an event related to the cue word within 60 seconds, and participants subsequently typed the description of the recalled memory (Williams and Broadbent, 1996). Instructions for the AMT task were adapted from previous autobiographical memory studies (Henderson, Hargreaves, Gregory, & Williams, 2002; Williams et al., 1996; Zinbarg, Rekart, & Mineka, 2006). Based on recommended coding procedures (Griffith et al., 2009; Sutherland and Bryant, 2008b), AMT responses were coded as *specific* (i.e., memories of events that occurred within one day in a particular place), *extended* (i.e., memories of events which lasted longer than one day), *categoric* (i.e., memories that were summations of multiple repeated events), *semantic associate* (i.e., information that was not a personal memory), *omission* (i.e., did not recall the memory within 60 seconds or indicated inability to recall a memory), or *non-positive* (i.e., recalled a negative memory). For *non-positive* memories, we adapted coding criteria from the Coding and Assessment System for Narratives of Trauma (CASNOT); a response was coded as non-positive if the emotional tone and/or valence of the response was coded as predominantly negative (i.e., ratings of 3–4 on a scale from 0 [completely positive] to 4 [completely negative]; Fernández-Lansac and Crespo, 2017). Total number of responses coded as specific represented the count of specific positive memories variable in the current study (Sutherland and Bryant, 2008b). Interrater reliability for coding AMT responses as "specific" versus "overgeneral" (i.e., *categoric* or *extended*) for all cue words ranged from substantial to almost perfect (kappa range = .63 - .92; Landis and Koch, 1977).

Memory Experiences Questionnaire–Short Form (MEQ-SF; Luchetti and Sutin, 2016).—The MEQ-SF is a 31-item self-report measure comprising of 10 subscales examining 10 phenomenological characteristics of a described specific positive memory on a 5-point rating scale from 1 *(strongly disagree)* to 5 *(strongly agree)*. Among the 10 phenomenological domains, the current study used the accessibility subscale scores (higher scores indicated greater accessibility and thus ease of recall of a specific positive memory). Items included in this subscale were as follows: "This memory was easy for me to recall;" "It was difficult for me to think of this memory;" and "I had to think for a while before I could recall this event." Participants were asked to recall and write two paragraphs about one specific, positive memory using instructions adapted from existing studies (Boyacioglu and Akfirat, 2015; Janssen, Hearne, & Takarangi, 2015; Sutin and Robins, 2007; Wing, Schutte, & Byrne, 2006), and then completed the MEQ-SF. To ensure that the MEQ-SF memory responses were positively valenced, the memories were coded using CASNOT dimensions of emotional tone and emotional valence as described above (Fernández-Lansac and Crespo,

2017). The MEQ-SF has demonstrated adequate psychometric properties (Luchetti and Sutin, 2016); Cronbach's α was .83 for the accessibility subscale in the current study. Interrater reliability for coding MEQ-SF responses as positive versus non-positive was substantial (kappa = .66; Landis and Koch, 1977).

Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988).—The PANAS is a self-report measure consisting of two, 10-item subscales assessing positive and negative affect. Participants rated the degree to which they experienced positive or negative affect over the past week on a 5-point Likert scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). The PANAS demonstrates adequate psychometric properties (Crawford and Henry, 2004). In the current study, Cronbach's α for the PANAS negative and positive scales were .91 and .94, respectively.

The Patient Health Questionnaire-9 (PHQ-9; Kroenke and Spitzer, 2002).—The PHQ-9 is a 9-item self-report measure assessing depression symptom severity within the past 2 weeks. Response options range from 0 (*not at all*) to 3 (*nearly every day*). The PHQ-9 has excellent psychometric properties (Kroenke and Spitzer, 2002; Kroenke, Spitzer, & Williams, 2001). In the current study, the Cronbach's α for the total scale was .92.

Statistical Analyses

First, we examined normality (skewness < 2; kurtosis < 7; Curran, West, & Finch, 1996); the assumption of normality was not violated for the primary variables of the current study. Next, based on bivariate correlation results, post-trauma mental health indicators found to significantly correlate with the positive memory variables ($p < .05$) were entered as independent variables in subsequent linear regression analyses, in order to examine hypothesized relations in the Contractor et al. (2018) model conceptual model.

Following from this, we conducted nine linear regressions. We utilized linear regressions, rather than multiple regressions for two reasons. First, this study aimed to examine relations between positive memory variables and distinct post-trauma mental health constructs (PTSD subscale severity, depression severity, types of post-trauma cognitions, and affect) without adjusting for their influence on each other within the same model. When multiple variables are included in a multiple regression model, model effects can become inflated and/or dependent on which variables (of an infinite number of variables) are included in the model (Simmons, Nelson, & Simonsohn, 2011). As many of these variables are related, we wanted to understand each specific relationship, rather than the relationships in concert with other variables we could include in the analyses. Second, the study aims were consistent with the distinctiveness of these post-trauma mental health constructs in the Contractor et al. (2018) conceptual model, which has not been examined empirically. For the dependent variable of count of specific positive memories, we examined associations with five independent variables of PTSD intrusion severity, PTSD NACM severity, PTSD AAR severity, self-blame, and positive affect. For the dependent variable of accessibility of a specific positive memory, we examined associations with four independent variables of PTSD NACM severity, PTSD AAR severity, negative cognitions about self, and negative affect. Effect

sizes were interpreted using standardized beta (β) estimates. Additionally, the Benjamini and Hochberg (B-H; 1995) method was used to control for the false discovery rate.

Results

Participants recalled an average of 6.88 (*SD* = 2.48) specific positive memories, and the average accessibility rating of a specific positive memory was 4.38 (*SD* = .86). See Table 2 for bivariate correlation results. Count of specific positive memories was significantly, negatively correlated with PTSD intrusion severity, PTSD NACM severity, PTSD AAR severity, self-blame, and positive affect. Accessibility of a specific positive memory was significantly, negatively correlated with PTSD NACM severity, PTSD AAR severity, negative cognitions about the self, and negative affect. The significance of the results of each regression analysis was determined based on the B-H critical value of .05 (Table 3).

Count of specific positive memories

Results of linear regressions indicated that count of specific positive memories (i.e., number of specific positive memories recalled) was significantly and negatively associated with PTSD intrusion severity (R^2 = .03; F[1, 201] = 5.25, p = .023), PTSD NACM severity (R^2 = .02; F[1, 201] = 3.97, p = .048), PTSD AAR severity (R^2 = .04; F[1, 201] = 7.53, p = .007), self-blame (R^2 = .03; F[1, 201]= 5.53, p = .020), and positive affect (R^2 = .06; F[1, 201]= 12.04, p = .001). Specifically, participants with greater PTSD intrusion severity (β = −.16, t = 2.29), PTSD NACM severity (β = −.14, t = 1.99), PTSD AAR severity (β = −.19, t = 2.74), self-blame (β = −.16, t = 2.35), and positive affect (β = −.24, t = 3.47) recalled fewer specific positive memories.

Accessibility of a specific positive memory

Results of linear regressions indicated that reported accessibility of a specific positive memory (i.e., self-reported ease of recalling details of a specific positive memory) was significantly and negatively associated with PTSD NACM severity (R^2 = .03; F[1, 200] = 6.19, p = .014), PTSD AAR severity (R^2 = .05; F[1, 200] = 9.37, p = .003), negative cognitions about the self (R^2 = .04; F[1, 200] = 8.99, p = .003), and negative affect (R^2 = .04; F[1, 200] = 8.47, p = .004). Specifically, participants with greater PTSD NACM severity (β = −.17, t = 2.49), PTSD AAR severity (β = −.21, t = 3.06), negative cognitions about the self (β = −.21, t = 3.00), and negative affect (β = −.20, t = 2.91) reported less accessibility of a specific positive memory.

Discussion

Drawing from the Contractor et al. (2018) conceptual model, the current study is the first to examine the relations between objective (i.e., count of specific positive memories) and subjective (i.e., reported accessibility of a specific positive memory) memory facets with a broad range of post-trauma mental health indicators. Broadly, within the current study, trauma-exposed individuals with more severe symptomatology demonstrated deficits in positive memory-related processes, consistent with past research and theory (e.g., Joormann, et al., 2007; Josephson, 1996; McNally, et al., 1994; Moradi, et al., 2014; Schönfeld and

Ehlers, 2017). Specifically, participants with greater PTSD intrusion severity, PTSD NACM severity, PTSD AAR severity, self-blame, and positive affect recalled fewer specific positive memories. Further, participants with greater PTSD NACM severity, PTSD AAR severity, negative cognitions about the self, and negative affect reported greater difficulties accessing details of a specific positive memory. Across analyses, PTSD AAR symptoms, PTSD NACM symptoms, self-related post-trauma cognitions, and positive/negative affect were most consistently associated with positive memory processes. Results are important from an intervention perspective as they as they highlight difficulties with positive memory recall, which could be an intervention target.

Associations between Positive Memory Processes and Post-trauma Mental Health Indicators

There are a couple of possible factors explaining the associations between PTSD AAR severity and positive memory processes. First, neuroimaging results demonstrate that individuals with PTSD, who have higher hyperarousal symptoms, have lower hippocampal activity, which leads to poorer trauma-related memory encoding (Hayes et al., 2011). It is possible that chronic PTSD-related hyperarousal symptoms impair memory encoding and retrieval more broadly, including for positive memories. Indeed, chronic hyperarousal is associated with elevated glucocorticoid secretion, which negatively impacts the hippocampus (Kim and Diamond, 2002), thus negatively impacting memory-related processes over time. Second, PTSD AAR symptoms may diminish cognitive capacity for the retrieval of count/details of specific (positive) memories (Harvey, Bryant, & Dang, 1998). Thus, PTSD AAR symptoms, in particular, may increase difficulties accessing multiple specific positive memories, as well as the details of those memories. In regards to PTSD NACM severity, by virtue of the inherent greater negative affect and reduced positive affect associated with these symptoms (American Psychiatric Association, 2013), these symptoms may trigger more negative versus positive memories (associative network theory; Bower, 1981). Relatedly, the content of maladaptive cognitions associated with PTSD NACM symptoms may impede individuals' capacities to retrieve numerous and detailed specific positive memories, because of an over-focus on negative aspects of experiences. Future work is necessary to better understanding these findings.

Although less robust than the findings for PTSD AAR severity and NACM severity, PTSD intrusions were negatively associated with the count of specific positive memories. Trauma-exposed individuals may block out traumatic memories to avoid aversive physiological/psychological distress and intrusive thoughts/flashbacks (PTSD intrusions symptoms; Dalgleish, Rolfe, Golden, Dunn, & Barnard, 2008; Hermans, Defranc, Raes, Williams, & Eelen, 2005; Moradi et al., 2008). Perhaps, some trauma-exposed individuals may simultaneously block out positive memories along with intrusive traumatic memories because they experience any intense emotion consequent to memory retrieval – regardless of its valence – as aversive (Weiss, et al., 2018). Separately, previous research suggests PTSD intrusion symptoms lead to depleted working memory capacity, which then limits memory retrieval (Kuyken and Brewin, 1995) and contributes to over-general memory retrieval (Brewin, Reynolds, & Tata, 1999). In this manner, increased PTSD intrusion severity may impact one's capacity to retrieve specific positive memories. Taken together, these factors

help to explain why PTSD-related intrusions were associated with recalling fewer specific positive memories.

Existing research and theory help to explain why affect (negative or positive) was consistently associated with both positive memory processes. Consistent with the mood-congruency hypothesis (Ingram, 1984; Teasdale, 1988), the presence of negative affect contributes to increased recall of negative memories, particularly among individuals with a ruminative style (McFarland and Buehler, 1998), making it potentially more difficult to retrieve specific positive memories. Following from this, higher levels of baseline negative affect (perhaps related to the experience of traumatic events and PTSD symptoms) may have negatively impacted participants' ability to recall details of a specific positive memory with ease in the current study. Referencing positive affect, contrary to study hypotheses, participants with greater positive affect recalled fewer specific positive memories. Given that this was a cross-sectional study, regression results reference strength of predictive relations rather than direction or causality. Perhaps, the recall of positive memories is experienced as aversive (i.e., increased negative affect and/or lower positive affect) for some trauma-exposed participants due to difficulties regulating positive affect (Weiss, et al., 2018; Weiss, Nelson, Contractor, & Sullivan, in press), which may explain the negative association between positive affect and count of specific positive memories. Future research can empirically examine positive emotion regulation abilities as well as factors such as engaging in experiential processing (awareness of sensory and bodily experiences) that may mediate the relation between positive affect and positive memory processes (Gadeikis, Bos, Schweizer, Murphy, & Dunn, 2017).

In terms of post-trauma cognitions, self-blame was associated with fewer recalled specific positive memories, whereas negative cognitions about the self were associated with less accessibility of a specific positive memory. Trauma-exposed individuals have a negative biases for their self-schemas/concepts (Janoff-Bulman, 1992; Ono, et al., 2016), which may be amplified when asked to recall positive autobiographical memories that inherently are memories about the self (Conway and Pleydell-Pearce, 2000). To elaborate, trauma-exposed individuals may become more aware of the discrepancy between currently experienced negative self-concept and positive self-concept experienced during the recalled positive event (Agar, Kennedy, & King, 2006; O'Donnell, Elliott, Wolfgang, & Creamer, 2007), and may engage in further negative rumination about self (as seen with individuals reporting high levels of dysphoric mood; Hetherington and Moulds, 2015; Joormann and Siemer, 2004). This discrepancy may account for greater retrieval of traumatic (versus positive) memories in response to positive cues (Sutherland and Bryant, 2008a). Future research is necessary to better understand these findings, while accounting for the potentially moderating impact of co-occurring depressive disorders, processing mode of the memories (abstract/analytical versus concrete), and rumination based on existing research (Hetherington and Moulds, 2015; Joormann and Siemer, 2004).

Variability in Findings across Constructs

What is less clear is why some PTSD symptom clusters and associated constructs were correlated with the count of specific positive memories, but not accessibility of a specific

memory, or vice versa, as well as why PTSD avoidance severity, negative cognitions about the world, and depression severity were not significantly correlated with either positive memory process. Such findings are inconsistent with existing literature (e.g., Blaney, 1986; Brittlebank, et al., 1993; D. M. Clark and Teasdale, 1982; Werner-Seidler and Moulds, 2011). A number of factors may help explain these differences, including (1) our examination of distinct PTSD symptom clusters, (2) our inclusion of both objective (i.e., count of specific positive memories recalled) and subjective (i.e., self-reported ease of accessing a specific positive memory) facets of positive memory processes, and (3) particular sample characteristics impacting obtained results. These factors are explored more in depth below.

First, most relevant prior work has examined overall PTSD symptom severity (i.e., total PTSD severity score; e.g., Bryant, et al., 2007; de Decker, et al., 2003; McNally, et al., 1994), rather than the distinct PTSD symptom clusters (i.e., AAR, NAMC, intrusions, and avoidance). Existing research indicates that the distinct PTSD symptoms clusters are differentially associated with various clinical correlates (Contractor, et al., 2016; Contractor, et al., 2014; Contractor, Weiss, Dolan, & Mota, in press; Silverstein, Dieujuste, Kramer, Lee, & Weathers, 2017); for example, PTSD NACM and AAR symptoms have been found to strongly relate with non-somatic depression compared to other PTSD symptom clusters (Contractor, Greene, et al., 2018) and PTSD externalizing behavior symptoms (part of the PTSD AAR symptom cluster) have been found to strongly associate with reckless/self-destructive behaviors compared to other PTSD symptom clusters (Contractor, et al., in press). Thus, examining the relation of these individual PTSD symptom clusters with distinct positive memory processes is informative and adds to the Contractor et al. (2018) conceptual model. In the context of the current study, it is not particularly surprising that some/all PTSD symptom clusters would differentially relate to particular positive memory processes; specifically, all PTSD symptom clusters (except avoidance) were associated with difficulties with positive memory processes. Future research would benefit from further examining why particular PTSD symptom clusters are associated with particular positive memory processes.

Second, results may be partially attributed to unique differences across the two examined positive memory processes. Indeed, the count of specific positive memories is an objective measure (count data) drawn from a performance-based task, whereas the ease of accessing a specific positive memory is a self-reported subjective measure of participants' perceptions of their ability to recall details of a specific positive memory with ease. Given that these two measures capture different facets of positive memory processes and that emotional status differentially impacts performance across these facets (Smith, et al., 1996), it is not surprising that outcomes for each positive memory facet in the current study differs. Further research is needed to better understand underlying mechanisms that link some post-trauma facets to count of specific positive memories and other post-trauma facets to accessibility of a specific positive memory. Further, intervention development work will benefit from considering the distinct aspects of positive memory recall. For example, when considering how intentionally recalling and processing specific positive memories might impact post-trauma symptomatology over time, it is important to understand how these symptoms impact individuals' abilities to recall *any* specific positive memory (count), as well as individuals'

perceived difficulties in accessing details of these positive memories (accessibility), in order to guide intervention development efforts. Third, study results may be partly attributed to the unique sample-related characteristics. For instance, individuals with a PTSD diagnosis seeking clinical care may be more strongly impacted by avoidance symptoms in positive memory retrieval tasks, as compared to our convenience-based community sample. Further replications and extensions of this work are necessary to better understand how these, and other aspects of positive memories, relate to PTSD and associated constructs.

Limitations and Future Directions

Some limitations need to be considered when interpreting our findings. First, we utilized self-report assessments; future research would benefit from using clinician-administered measures of the assessed constructs, such as the Clinician Administered PTSD Scale (Weathers et al., 2017). However, clinician-administered and self-report measures of PTSD are highly correlated (Monson et al., 2008), making the PCL-5 more practical to administer within the current study. Second, this was a convenience-based community sample with women overrepresented and minorities underrepresented. It will be necessary to determine whether these results generalize to more diverse clinical samples with more severe symptomatology. Importantly, this sample did experience substantial psychopathology, for which they had sought treatment (i.e., 62% had received mental health treatment) and had clinically significant PTSD symptoms (i.e., 42% of sample). Relatedly, given this level of symptomatology, we acknowledge potential ethical concerns involved with having participants identify traumas/symptoms (we only asked them to identify if and which traumatic event was experienced rather than to describe the traumatic event) and suicidal ideation in an online survey (Chandler and Shapiro, 2016). We had limited control over intervening in the event of participant distress given the anonymous nature of the online surveys; we, thus, provided several national mental health resources in the informed consent (e.g., telephone and website information for National Suicide Prevention Lifeline, National Sexual Assault Hotline, Veterans Crisis Line, Samaritans state-wide helpline), ensured IRB approval prior to conducting the study, and emphasized that participants could stop study participation at any time. Importantly, research has shown that inquiring about suicidal ideation does not induce/increase suicidal ideation (Dazzi, Gribble, Wessely, & Fear, 2014; Mathias et al., 2012).

Third, we acknowledge that in-person studies are ideal given better ability to intervene in the event of participant distress, better ability to assess comprehension and provide clarification, and ability to provide practice tests for performance-based tasks. This being said, it is worth noting that MTurk is widely used in trauma studies, and captures individuals with PTSD symptoms in a cost- and time-effective manner, with PTSD prevalence rates similar to those found in epidemiological studies (van Stolk-Cooke, et al., 2018). Moreover, MTurk and other online-recruitment platforms have been widely used in research which has included questions on suicidal ideation/thoughts (Contractor and Weiss, 2019; Shapiro, Chandler, & Mueller, 2013), and participants have reported comfort in disclosing mental health information with MTurk (Shapiro, et al., 2013). Fourth, although, we examined overall comprehension of the survey using validity checks, and provided detailed examples of what would (versus not) constitute a specific memory in response to two hypothetical cue words

as part of the AMT instructions, we did not explicitly examine comprehension of the AMT task by providing practice items (Griffith, et al., 2009) given the online format of this task (Henderson, et al., 2002; Zinbarg, et al., 2006). Hence, it is possible some participants had difficulties comprehending the AMT, especially those experiencing greater psychological distress and/or PTSD severity, which can impede cognitive abilities (Vasterling, Brailey, Constans, & Sutker, 1998; Wilson et al., 2005). Additionally, we are unsure if eliciting positive (versus traumatic) memories on the AMT could have contributed to participant distress. Hence, future research would benefit from replicating this preliminary study by concurrently assessing comprehension and subsequent distress levels experienced by participants as they complete the tasks (including AMT). Finally, given that this is a relatively new area of inquiry, there may be other positive memory processes (e.g., vividness) impacted by PTSD and depressive symptom severity that would benefit from empirical examination.

Despite these limitations, this is the first study, to our knowledge, to delineate the specific relations of particular PTSD symptom clusters and associated post-trauma symptomatology with two distinct positive memory processes drawing from the Contractor et al. (2018) conceptual model. This work provides the impetus to further examine how positive memory processes are impacted among trauma-exposed populations and to utilize this information to inform intervention development efforts. Specifically, when providing therapeutic treatment to trauma-exposed individuals, practice recalling specific positive memories and/or their details may contribute to improving PTSD severity and cognitions about self while reducing negative affect (Contractor, Banducci, Jin, Keegan, & Weiss, in Review; Ono, et al., 2016). Future research can empirically examine these questions within the context of a clinical trial, as well as explore the contribution of positive memory recall deficits in particular to the onset/maintenance of post-trauma clinical symptoms.

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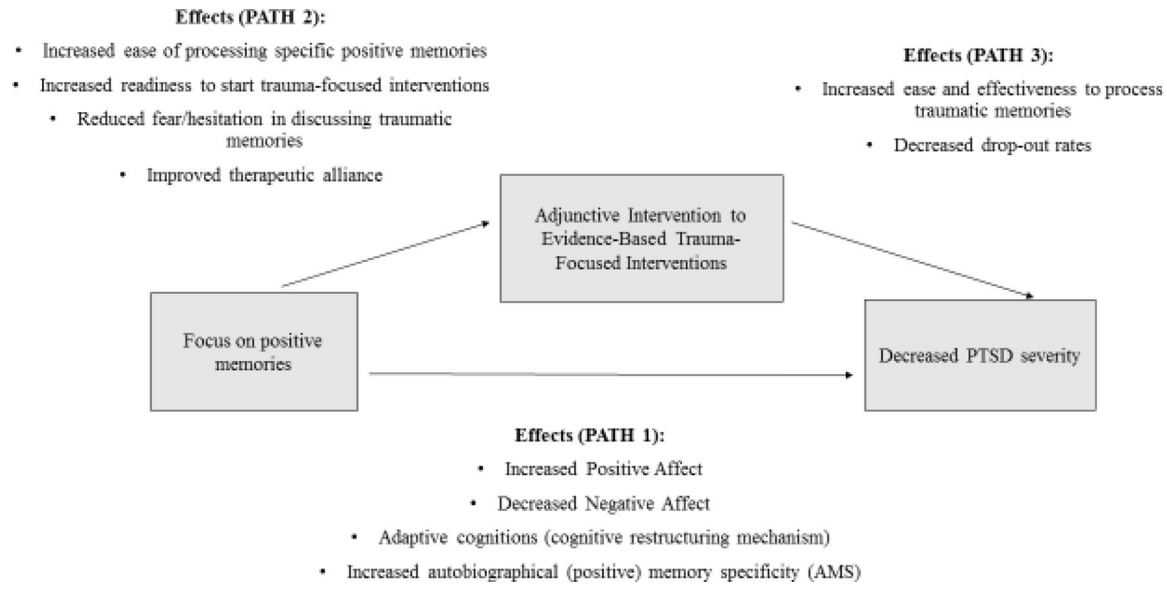

Figure 1.

Contractor et al. (2018) Conceptual Model outlining Proposed Effects of Targeting Positive Memories on Post-trauma Outcomes

Table 1.

Demographic and psychopathology variables-related information (n=203)

Variable	Mean (*SD*)	Range
Age	35.40 (11.52)	19–72
Years of schooling	15.36 (2.38)	6–27
Count of specific positive memories	6.88 (2.48)	0–10
Accessibility of a specific positive memory	4.38 (.86)	1–5
PTSD intrusion severity	7.33 (5.34)	0–20
PTSD avoidance severity	7.03 (3.19)	2–14
PTSD NACM severity	8.98 (7.29)	0–26
PTSD AAR severity	7.54 (6.11)	0–24
Negative cognitions about self	2.76 (1.40)	1–6
Negative cognitions about the world	4.19 (1.55)	1–7
Self-blame	2.62 (1.51)	1–6
Positive affect	31.86 (9.23)	10–50
Negative affect	18.44 (8.82)	10–46
Depression severity	7.00 (6.84)	0–27
	***n* (%)**	
Gender		
Male	77 (37.90%)	
Female	124 (61.10%)	
Transgender	1 (.50%)	
Gender Queer	1 (.50%)	
Agender	0 (0%)	
Other	0 (0%)	
Employment Status		
Part time	31 (15.30%)	
Full time	143 (70.40%)	
Retired	4 (2.00%)	
Unemployed	20 (9.90%)	
Unemployed Student	5 (2.50%)	
Relationship Status		
Single	63 (31.00%)	
Living with significant other	36 (17.70%)	
Married	83 (40.90%)	
Divorced	18 (8.90%)	
Separated	2 (1.10%)	
Widowed	1 (.50%)	

Variable	Mean (*SD*)	Range
Ethnicity		
Hispanic or Latino	17 (8.40%)	
Not Hispanic or Latino	183 (90.10%)	
Unknown	3 (1.50%)	
Racial Status (could endorse more than one category)		
Caucasian or White	168 (82.80%)	
African American or Black	27 (13.30%)	
Asian	8 (3.90%)	
American Indian or Alaskan Native	7 (3.40%)	
Native Hawaiian/other Pacific Islander	1 (.50%)	
Unknown	1 (.50%)	
Income		
Less than $15,000	15 (7.40%)	
$15,000 – $24,999	26 (12.80%)	
$25,000 – $34,999	18 (8.90%)	
$35,000 – $49,999	42 (20.70%)	
$50,000 – $64,999	42 (20.70%)	
$65,000 – $79,999	24 (11.80%)	
$80,000 and higher	36 (17.70%)	
Treatment for Mental Health/Emotional Problem (could endorse more than one category)		
Currently in therapy	28 (13.80%)	
Been in therapy in the past	88 (43.30%)	
Currently taking medications for mental health/emotional problem	44 (21.70%)	
Have taken medications in the past for mental health/emotional problem	59 (29.10%)	
Never received treatment (therapy/medications) for mental health/ emotional problem	78 (38.40%)	
Worst Traumatic Event endorsed on the LEC-5		
Natural disaster	26 (12.80%)	
Fire or explosion	5 (2.50%)	
Transportation accident	32 (15.80%)	
Serious accident at work/home/during recreational activity	9 (4.40%)	
Exposure to a toxic substance	0 (0%)	
Physical assault	16 (7.90%)	
Assault with a weapon	7 (3.40%)	
Sexual assault	34 (16.70%)	
Other unwanted/uncomfortable sexual experience	8 (3.90%)	
Combat or exposure to war	1 (.50%)	
Forced captivity	0 (0%)	
Life-threatening illness	11 (5.40%)	

Variable	Mean (*SD*)	Range
Severe human suffering	3 (1.50%)	
Sudden, violent death	15 (7.40%)	
Sudden, accidental death	15 (7.40%)	
Serious injury/harm/death you caused to someone else	4 (2.20%)	
None of these events happened to me	17 (8.04%)	

Note. LEC-5 = Life Events Checklist for DSM-5. PTSD = posttraumatic stress disorder. NACM = negative alternations in cognitions and mood. AAR = alterations in arousal and reactivity. Valid percentages were used to account for missing data.

Table 2.

Pearson's Correlations between PTSD Severity, Negative Cognitions, Affect, Depression Severity, and Memory Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Count of specific positive memories	-											
2. Accessibility of a specific positive memory	.25***	-										
3. Intrusion severity	−.16*	−.09	-									
4. Avoidance severity	−.02	−.08	.39***	-								
5. NACM severity	−.14*	−.17*	.75***	.58***	-							
6. AAR severity	−.19**	−.21**	.75***	.49***	.83***	-						
7. Negative cognitions about the self	−.07	−.21**	.54***	.74***	.73***	.64***	-					
8. Negative cognitions about the world	.07	.05	.34***	.78***	.48***	.43***	.59***	-				
9. Self-blame	−.16*	−.14	.39***	.47***	.50***	.43***	.66***	.38***	-			
10. Positive affect	−.24**	.07	−.01	−.25***	−.18*	−.08	−.33***	−.13	−.10	-		
11. Negative affect	−.11	−.20**	.46***	.42***	.60***	.60***	.66***	.35***	.41***	−.34***	-	
12. Depression severity	.01	−.13	.50***	.51***	.69***	.67***	.72***	.45***	.40***	−.35***	.68***	-

Note.

* $p < .05$

** $p < .01$

*** $p < .001$

PTSD = posttraumatic stress disorder; NACM = negative alternations in cognitions and mood; AAR = alterations in arousal and reactivity.

Table 3.

Regression Results of the Relation between PTSD Severity, Negative Cognitions, Affect, and Memory Variables

	B	*SE*	β	*t*	R^2	*F*
DV = Count of specific positive memories (n = 203)						
Intrusion severity	−.07	.03	−.16	**−2.29** p=.023 *	.03	**5.25** p=.023 *
NACM severity	−.05	.02	−.14	**−1.99** p=.048 *	.02	**3.97** p=.048 *
AAR severity	−.08	.03	−.19	**−2.74** p=.007 **	.04	**7.53** p=.007 **
Self-blame	−.27	.11	−.16	**−2.35** p=.020 *	.03	**5.53** p=.020 *
Positive affect	−.06	.02	−.24	**−3.47** p=.001 **	.06	**12.04** p=.001 **
DV = Accessibility of a specific positive memory (n = 200)						
NACM severity	−.02	.01	−.17	**−2.49** p=.014 *	.03	**6.19** p=.014 *
AAR severity	−.03	.01	−.21	**−3.06** p=.003 **	.05	**9.37** p=.003 **
Negative cognitions about the self	−.13	.04	−.21	**−3.00** p=.003 **	.04	**8.99** p=.003 **
Negative affect	−.02	.01	−.20	**−2.91** p=.004 **	.04	**8.47** p=.004 **

Note.

* $p < .05$

** $p < .01$

boldface indicates statistical significance compared to the Benjamini–Hochberg (B-H) critical value of .05. PTSD = posttraumatic stress disorder; DV = dependent variable; NACM = negative alternations in cognitions and mood; AAR = alterations in arousal and reactivity.