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Associations between positive memory count and hazardous substance use in a trauma-exposed sample: Examining the moderating role of emotion dysregulation

Sidonia E. Compton[1] | Danica C. Slavish[1] | Nicole H. Weiss[2] | Holly J. Bowen[3] | Ateka A. Contractor[1]

[1]Department of Psychology, University of North Texas, Denton, Texas, USA

[2]Department of Psychology, University of Rhode Island, Kingston, Rhode Island, USA

[3]Department of Psychology, Southern Methodist University, Dallas, Texas, USA

Correspondence

Sidonia E. Compton, University of North Texas, Denton, TX, USA.
Email: sidoniacompton@my.unt.edu

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Abstract

Objectives: Research has demonstrated links between autobiographical memory retrieval and hazardous substance use. However, limited work has examined relations between positive autobiographical memories and hazardous substance use, as well as moderating factors influencing these relations. Thus, we examined the potential moderating roles of negative and positive emotion dysregulation in the relations between count of retrieved positive memories and hazardous substance use (alcohol and drug use separately).

Methods: Participants were 333 trauma-exposed students (M_{age} = 21.05; 85.9% women) who completed self-report measures assessing positive memory count, hazardous alcohol and drug use, negative emotion dysregulation, and positive emotion dysregulation.

Results: Positive emotion dysregulation significantly moderated the association between positive memory count and hazardous alcohol use ($b = 0.04$, 95% confidence interval [CI] [0.01, 0.06], $p = 0.019$), as well as the association between positive memory count and hazardous drug use ($b = 0.02$, 95% CI [0.01, 0.03], $p = 0.002$). Individuals with more positive emotion dysregulation had stronger associations between increases in positive memory count and increased hazardous substance use.

Conclusion: Findings indicate that trauma-exposed individuals who retrieve more positive memories and experience difficulties regulating positive emotions report greater hazardous substance use. Positive emotion dysregulation may be an important target for memory-based interventions among trauma-exposed individuals who report hazardous substance use.

KEYWORDS

hazardous substance use, negative emotion dysregulation, positive emotion dysregulation, positive memory count, trauma

1 | INTRODUCTION

Autobiographical memories for events and for schematic knowledge of an individual's life (H. L. Williams et al., 2008) can be categorized as specific—memories of events that occurred at a specific place spanning less than 24 hours, and overgeneral—a general summary of their past events (Sumner, 2012; J. M. Williams et al., 2007). Autobiographical memory processes play a role in several health outcomes (e.g., Burnside et al., 2004; Contractor, Caldas et al., 2022). Hazardous substance use has been conceptualized as a pathology of memory, as substance use and cravings for substances may be triggered by activation of memories related to past substance use when exposed to substance-related reminders (Gisquet-Verrier & Le Dorze, 2019). Further, evidence suggests that individuals at every phase of addiction—those who are using, those diagnosed with a substance use disorder, and those pursuing recovery—retrieve fewer specific memories (Cuervo-Lombard et al., 2016; Gandolphe & Nandrino, 2011; Gandolphe et al., 2013a, 2013b; Pillersdorf & Scoboria, 2019).

1.1 | Positive memories and hazardous substance use

Positive autobiographical memories have been shown to influence an individual's self-concept and serve a goal-directed function (Rasmussen & Berntsen, 2009). Notably, limited research has examined hazardous substance use in relation to positive autobiographical memories, and existing findings are contradictory. On the one hand, research indicates that hazardous substance use is associated with the retrieval of fewer positive memories, and these memories are poorly integrated within an individual's self-concept (Cuervo-Lombard et al., 2016; Gandolphe et al., 2019; Nandrino & Gandolphe, 2017). Individuals who report hazardous substance use may be motivated to avoid specific negative memories to limit access to distressing content and affect (Roemer et al., 2001); this avoidance may transfer to less retrieval of positive memories. In the long-run, such difficulties in positive memory retrieval may contribute to greater retrieval of negative memories (Cuervo-Lombard et al., 2016) and to difficulties differentiating between emotional states (Gandolphe et al., 2013a), which in turn may contribute to more hazardous substance use (Kashdan et al., 2010; Nandrino, Gandolphe, & El Haj, 2017). On the other hand, research suggests that reactivation of vivid, intense positive memories, especially those associated with substance cues (e.g., drug paraphernalia, environmental context), is linked to an increase in both cravings for and use of substances (Gisquet-Verrier & Le Dorze, 2019). Such contradictory evidence underscores the need for additional research to identify factors that may influence the direction and/or strength of the relations between positive autobiographical memories and hazardous substance use.

Further, limited research has examined positive memory-hazardous substance use relations among individuals reporting traumatic experiences. Such research is critical given that hazardous substance use is prevalent following trauma (Lewis et al., 2019; Weiss, Bold, et al., 2018), and individuals engaging in hazardous substance use are at risk of traumatic exposure (Kingston & Raghavan, 2009). Furthermore, research indicates that traumatic experiences (LaBar, 2007; Mickley & Kensinger, 2009) and posttraumatic symptoms (Contractor et al., 2019; Contractor, Greene et al., 2020; Contractor, Weiss, & Forkus, 2021) affect encoding, storage, retrieval, and characteristics of positive autobiographical memories. Functionally, avoiding specific memories after a trauma helps to deal with distressing affect in the short-run; however, this avoidance also impairs coping skills and cognitive functioning in the long-run, causing detrimental health impacts (J. M. Williams et al., 1996, 2007).

1.2 | Positive memories, emotion regulation, and hazardous substance use

To address these existing research gaps, we examined whether negative and positive emotion dysregulation influenced relations between count of retrieved specific, positive memories (i.e., positive memory count) and hazardous substance use in a sample of individuals reporting traumatic experiences. In this regard, we specifically examined negative and positive emotion dysregulation. Research links negative emotion dysregulation—maladaptive responses to emotions (e.g., difficulty modulating intensity of emotional responses, avoidance of emotional distress; Gratz & Roemer, 2004; Gratz & Tull, 2010)—to hazardous substance use (Weiss et al., 2021). The self-medication hypothesis (Khantzian, 2003) suggests that trauma-exposed individuals engage in maladaptive coping strategies such as hazardous substance use to regulate negative emotions and escape from distress (Roemer et al., 2001; Vujanovic et al., 2011). Indeed, evidence suggests that hazardous substance use is linked to negative emotion dysregulation (Fox et al., 2007; Weiss et al., 2017), especially when trauma-exposed individuals are experiencing posttrauma symptoms and emotional suppression (Tull et al., 2018). According to the tension reduction theory (Conger, 1956), trauma-exposed individuals use substances to also avoid arousal stemming from positive emotional states (Baker et al., 2004). Further, evidence suggests that hazardous substance use is linked to positive emotion dysregulation (Linehan et al., 2002; Sher & Grekin, 2007), and Weiss, Forkus, et al. (2020) found that individuals may use alcohol to down-regulate positive emotions.

Research also links emotion dysregulation to count of retrieved positive memories, especially among trauma-exposed individuals. While positive memory retrieval generally improves positive affect (Rusting & Larsen, 1998) and can counteract negative affect (Bower, 1981), this process may be different for trauma-exposed individuals. Specifically, trauma-exposed individuals believe they do not deserve to experience positive affect (Lawrence & Lee, 2014), are judgmental and nonaccepting of experienced positive affect (Weiss, Contractor, Forkus, et al., 2020; Weiss, Contractor, Raudales, et al., 2020), and/or experience negative affect in response to positive stimuli (i.e., negative affect interference; Frewen, Dozois, Lanius, 2012; Frewen, Dozois, Neufeld, et al., 2012), such as positive memories. In fact, physiological reactions elicited from positive emotions may be paired with aversive events or memories (Salters-Pedneault et al., 2007; Weiss, Dixon-Gordon, et al., 2018), and positive memory content may trigger trauma reminders/memories (Caldas et al., 2022; Joormann & Siemer, 2004; Megías et al., 2007). These processes may contribute to negative affect interference. For these reasons, positive memory retrieval may relate to both greater positive (Contractor, Caldas et al., 2022) and negative (J. M. Williams et al., 2007) emotion dysregulation among trauma-exposed individuals.

1.3 | Current study

Collectively, the extant research suggests that negative and positive emotion dysregulation may influence relations between count of retrieved positive memories (positive memory count) and hazardous substance use. Specifically, among individuals reporting less negative or positive emotion dysregulation, higher positive memory count may be associated with less hazardous substance use. These individuals may be able to regulate their emotions after retrieving positive memories, and positive content from positive memories may serve as an adaptive coping strategy to lessen hazardous substance use. However, among individuals reporting more negative or positive emotion dysregulation, there may be two possible outcomes. First, higher positive memory count may be associated with greater hazardous substance use when individuals cannot regulate affect stemming from positive memory retrieval, and they may use substances to cope with experienced affect dysregulation. Alternatively, lower positive memory count may be associated with greater hazardous substance use when individuals do not retrieve positive memories because they may be unable to deal with distressing affect stemming from positive memory retrieval. Such hypothesized mechanisms are consistent with research indicating that positive memory retrieval is related to engagement in reckless behaviors (Banducci et al., 2020) as well with hazardous alcohol use (Contractor, Banducci, et al., 2022) among trauma-exposed individuals. Critically, such an empirical question has not been examined to our knowledge.

Thus, the current study examined the moderating role of negative and positive emotion dysregulation in the relations between positive memory count and hazardous substance use (drug use and alcohol use). Using data from a trauma-exposed student sample, we hypothesized that greater positive memory count would be associated with less hazardous substance use for individuals reporting less negative and positive emotion dysregulation. However, given conflicting literature, we hypothesized that relations between positive memory count and hazardous substance use would either be positive or negative for individuals reporting more negative and positive emotion dysregulation. Results could inform treatment targets (e.g., emotion dysregulation) for trauma-exposed individuals who report hazardous alcohol or drug use. Further, findings will expand our current knowledge of autobiographical memory and hazardous substance use by elucidating if and when emotion dysregulation influences their relationship, especially among trauma-exposed individuals.

2 | METHODS

2.1 | Procedure and participants

The University of North Texas Institutional Review Board approved this study. Participants were recruited via a participant-recruitment system for universities (SONA) as well as via flyers posted on campus buildings, face-to-face invitations, and classroom announcements. Questionnaires were completed via Qualtrics. Data were collected as part of a large, three-part study. For the current research questions, we only analyzed data obtained from the Baseline Phase, as the measures of interest were only administered during this phase. During the Baseline Phase, participants provided consent and identifying information for study communication purposes. Subsequently, they answered questions to determine if they met inclusion criteria for the study: 18 years or older, experienced a traumatic event, able to speak/read/write in English, and ownership of a mobile phone. Next, they provided demographic information and completed measures assessing psychological symptoms, affect, and cognitive processes. Participants had to pass three embedded validity checks to ensure they were attentive and they were comprehending the questions (Meade & Craig, 2012). Participants who completed the Baseline Phase entirely and validly received four course credits.

2.2 | Measures

2.2.1 | Demographic information

We gathered information on age, years of education, gender, sexual identity, ethnicity, racial background, religion, household income level, employment status, and relationship status.

2.2.2 | **Life Events Checklist for DSM-5 (LEC-5**; Weathers et al., 2013**)**

The LEC-5 is a 17-item self-report screener for potentially traumatic events in a participant's lifetime. An additional 18th item queried for the most distressing trauma. Participants indicate varying levels of exposure to each potentially traumatic 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. Endorsing either of the first four response options was considered a positive trauma endorsement; the variable of number of trauma types was computed by adding the number of positively endorsed traumas for LEC-5 items 1–16. The 17th item was not included in the computation of the trauma type count variable because it references an additional stressor with no specific details (we were unsure what participants were referencing when they endorsed that item).

2.2.3 | **The Autobiographical Memory Test (AMT**; J. M. Williams & Broadbent, 1986)

The AMT was used to measure the count of specific positive memories retrieved by participants (i.e., positive memory count). AMT utilizes a memory cueing methodology. Participants are presented with emotionally valanced words and then prompted to retrieve a personally meaningful and specific memory of an event that occurred within 24 hours (Kleim & Ehlers, 2008; McNally et al., 1995). For the current study, 10 positive memory cues were presented and participants had to retrieve a memory within 60 seconds (J. M. Williams & Broadbent, 1986). We utilized instructions adapted from previous studies (e.g., Henderson et al., 2002; Zinbarg et al., 2006; J. M. Williams et al., 1996).

All AMT responses were coded on several dimensions to derive a final code. First, responses were coded as *recalled* (i.e., the participant was able to retrieve and describe a positive memory within the allotted time) or *failed to recall* (i.e., the participant was not able to retrieve and describe a positive memory within the allotted time). Next, if a memory was categorized as *recalled*, they were coded as specific (a memory of an event that occurred at a particular place in a period of less than 24 hours), extended (memory of an event that lasted longer than 24 hours), or categoric (memories that are summaries of multiple recurring events; Bryant et al., 2007; Sutherland & Bryant, 2005; J. M. Williams et al., 2007). If a memory was categorized as *failed to recall*, they were then coded as either nonpositive (i.e., participant responded to the positive cue word with a negative memory or statement), semantic associate (i.e., semantic information, i.e., not a positive memory), or an omission (i.e., could not think of a memory within the time limit or indicated that they were unable to think of a memory; Griffith et al., 2009; Sutherland & Bryant, 2005; J. M. Williams et al., 2007). For the current study, a positive memory count variable indicated the total number of AMT responses that were coded as *specific* and as such *positive*. In line with existing research on autobiographical memory specificity, omissions were counted as nonspecific responses (Crane et al., 2007).

Regarding inter-rater reliability, two teams of raters trained in the coding methodology independently coded an initial subset of the memory narratives (26% of AMT responses) to ensure coding integrity and fidelity. Across all 10 words, the percentage agreement for coding memory narratives as *positive* versus *nonpositive* and as *specific* versus *nonspecific* was 72.60%–94.60% and 69.50%–86.40%, respectively. The majority of agreement estimates were in the excellent range (>75%) according to guidelines provided by Landis and Koch (1977). The trained raters had >83% agreement for *positive* versus *nonpositive* ratings for all but 1 cue word (*Honest*). The trained raters had >75% agreement for *specific* versus *nonspecific* ratings for all but 1 cue word (*Honest*). Discrepancies were resolved as a team; no discernible pattern of disagreement was observed. Based on these results, one of the trained raters coded the remaining memory narratives due to the increased likelihood of generalizability from one rater to another with similar training experience and after the resolution of any rating discrepancies (Anastasi & Urbina, 1997).

2.2.4 | **Alcohol Use Disorders Identification Test (AUDIT**; Saunders et al., 1993**)**

The AUDIT is a 10-item self-report screening questionnaire developed by the World Health Organization to assess for hazardous alcohol use. It assesses three domains: amount and frequency of drinking, alcohol dependence, and problems from alcohol consumption. The response scale ranges from 0 (*never*) to 4 (*daily or almost daily*). A total score was calculated by summing the items. Total scores can range from 0 to 40 with higher scores reflecting greater hazardous alcohol use. The AUDIT score demonstrates good reliability and validity (Saunders et al., 1993). For the current study, Cronbach's α was 0.83 for the total scale score.

2.2.5 | **The Drug Abuse Screening Test (DAST-10**; Skinner, 1982**)**

The DAST-10 consists of 10 self-report items designed to screen for hazardous drug use (e.g., occupational problems, relational problems, illegal acts, and regret) in the past 12 months. The DAST-10 measures problems related to nonmedical drug use (e.g., cannabis, cocaine) and nonprescription medication use. Participants indicated if an item applied to them by choosing a *yes* or *no* response (Skinner, 1982). A total score was obtained by summing the items; a score of three or higher represents a possible drug use disorder (Skinner, 1982). The DAST-10 score demonstrates adequate psychometric properties (Yudko et al., 2007). For the current study, Cronbach's α was 0.82 for the total scale score.

2.2.6 | **Difficulties in Emotion Regulation Scale—Brief 16-Item Version (DERS-16**; Bjureberg et al., 2016**)**

The DERS-16 is a 16-item self-report measure of negative emotion regulation difficulties. The DERS-16 includes subscales examining nonacceptance of emotions (DERS-16 Nonacceptance), difficulties engaging in goal-directed behavior when distressed (DERS-16 goals), difficulties controlling impulsive behaviors when distressed (DERS-16 Impulse), limited ability to access emotion regulation strategies perceived to be effective (DERS-16 Strategies), and lack of emotional clarity (DERS-16 Clarity). Participants indicated the degree to which a statement applies to them on a 5-point Likert scale ranging from 1 (*almost never*) to 5 (*almost always*). A total score was calculated by summing responses. A higher score represents more difficulties in regulating negative emotions. The DERS-16 scores demonstrate adequate psychometrics (Bjureberg et al., 2016). For the current study, Cronbach's α was 0.95, 0.90, 0.90, 0.86, 0.91, and 0.91 for the total scale score, DERS-16 Nonacceptance subscale score, DERS-16 Goals subscale score, DERS-16 Impulse subscale score, DERS-16 Strategies subscale score, and DERS-16 Clarity subscale score, respectively.

2.2.7 | **Difficulties in Emotion Regulation Scale-Positive (DERS-Positive**; Weiss, Gratz, et al., 2015**)**

The DERS-Positive is a 13-item self-report questionnaire examining difficulties in the regulation of positive emotions. The DERS-Positive assesses three domains within its subscales: nonacceptance of positive emotions (DERS-Positive Nonacceptance), difficulties engaging in goal-directed behavior when experiencing positive emotions (DERS-Positive Goals), and difficulties controlling impulsive behaviors with experiencing positive emotions (DERS-Positive Impulse). Participants indicated the extent to which a statement applied to them on a 5-point-Likert scale ranging from 1 (*almost never*) to 5 (*almost always*). A total score was calculated by summing the responses with higher scores suggesting more positive emotion regulation difficulties. The DERS-Positive scores have excellent psychometrics (Weiss, Gratz, et al., 2015; Weiss, Darosh, et al., 2019). For the current study, Cronbach's α was 0.93, 0.84, 0.87, and 0.91 for the total scale score, DERS-Positive Nonacceptance subscale score, DERS-Positive Goals subscale score, and DERS-Positive Impulse subscale score, respectively.

2.3 | Sample truncation and characteristics

We received a total of 1108 responses from participants who provided informed consent and participant information. Of those, we excluded 254 responses from participants who did not proceed to the Baseline Phase, 140 responses from participants who attempted the Baseline Phase multiple times (retaining one of their responses with most complete data), and six responses because they were not linked to a Participant Identifier or had unclear temporal ordering of survey completion. From the remaining sample of 720 participants, we excluded 196 participants due to being ineligible for the study, 96 participants for failing any of the embedded validity checks, 2 individuals for reporting their age as <18, and 9 participants for not endorsing any trauma on the LEC-5 (Weathers et al., 2013).

From this sample of 417 participants, we excluded 84 participants who were missing >30% of item-level data on any measure of interest. In doing so, we retained a sufficient number of items on measures of interest to use recommended missing data procedures (Graham, 2009; Schafer & Graham, 2002; Scheffer, 2002), consistent with prior research (Contractor et al., 2019). Next, in this sample of 333 participants, we determined missing data patterns and estimated missing values on the measures of interest following recommended guidelines (Graham, 2009; Schafer & Graham, 2002) with the Statistical Package for the Social Sciences (SPSS) expectation-maximation algorithm (Enders, 2001; Scheffer, 2002). Notably, we did not estimate missing data for the positive memory count variable because participants were asked to provide qualitative responses (i.e., memory narratives) in response to AMT cue words. The positive memory count variable represented a second level of coding derived from qualitative responses. Also, missing data on the AMT was minimal in the final sample. For instance, of the 147 participants who omitted responses on the AMT, 30 participants omitted 3 responses, 45 participants omitted 2 responses, and 72 participants omitted 1 response. As mentioned previously, omissions were coded as nonspecific memories. For the variable of hazardous alcohol use, data were missing completely at random (MCAR); Little's χ^2 (36) = 40.16, $p = 0.291$. For the variable of hazardous drug use, data were not MCAR; Little's χ^2 (44) = 107.44, $p < 0.001$. For the variable of positive emotion dysregulation, data were MCAR; Little's χ^2 (24) = 31.46, $p = 0.141$. There were no missing data for the variable of negative emotion dysregulation.

The final sample of 333 participants averaged 21.04 years old (standard deviation [SD] = 4.502) and were primarily female ($n = 286$, 85.9%). Ethnically, the majority of the participants identified as non-Hispanic or Latinx ($n = 228$, 68.5%). Racially, the majority of the participants identified as white ($n = 208$, 62.5%). See Table 1 for detailed demographic information.

2.4 | Data analytic plan

All data analyses were conducted via SPSS statistics version 27 utilizing PROCESS SPSS macro procedures (Model 1; Hayes, 2022). The PROCESS procedures use ordinary least squares and bootstrapping methods. In this study, bootstrapping was conducted with 5000 random samples generated from the observed covariance matrix to estimate bias-corrected 95% confidence intervals (CIs) and significant values. We utilized mean-centered predictor and moderator variables to facilitate accurate interpretation of the main effects. We utilized simple slope analyses at the mean and one at the SD above and below the mean values of the moderator when significant interaction effects were obtained (Aiken & West, 1991). Johnson–Neyman's output was obtained to identify ranges of the moderator for which the interaction effect was significant (Johnson & Fay, 1950).

TABLE 1 Information on demographics (*N* = 333).

Variables	*M* (SD)	*n* (%)
Age	21.05 (4.50)	
Years of education	14.07 (1.55)	
Endorsed trauma types (LEC-5)		
Natural disaster		230 (69.1)
Fire or explosion		181 (54.4)
Transportation accident		284 (85.3)
Serious accident at work/home/during recreational activity		186 (55.9)
Exposure to a toxic substance		105 (31.5)
Physical assault		248 (74.5)
Assault with a weapon		165 (49.5)
Sexual assault		246 (73.9)
Other unwanted/uncomfortable sexual experience		257 (77.2)
Combat or exposure to war		109 (32.7)
Forced captivity		79 (23.7)
Life-threatening illness		193 (58.0)
Severe human suffering		136 (40.8)
Sudden, violent death		195 (58.6)
Sudden, accidental death		178 (53.5)
Serious injury/harm/death you caused to someone else		58 (17.4)
Gender		
Woman		286 (85.9)
Man		35 (10.5)
Woman to man (FTM) transgender		4 (1.2)
Genderqueer/nonbinary		5 (1.5)
Not listed		1 (0.3)
Prefer not to respond		2 (0.6)
Sexual identity		
Straight		231 (69.4)
Lesbian or gay		14 (4.2)
Bisexual		56 (16.8)
Pansexual		11 (3.3)
Don't know, unsure, not listed, prefer not to respond		21 (6.3)
Ethnicity		
Not Hispanic or Latinx		228 (68.5)

TABLE 1 (Continued)

Variables	*M* (SD)	*n* (%)
Hispanic or Latinx		97 (29.1)
Prefer not to respond		8 (2.4)
Race		
White		208 (62.5)
Hispanic or Latinx		92 (27.6)
Black or African American		56 (16.8)
Asian		27 (8.1)
American Indian/Alaska native		14 (4.2)
Native Hawaiian or other Pacific Islander		4 (1.2)
Not listed		3 (0.9)
Prefer not to respond		3 (0.9)
Religion		
Christian		176 (52.9)
None		104 (31.2)
Muslim		3 (0.9)
Hindu		3 (0.9)
Buddhist		1 (0.3)
Not listed		33 (9.9)
Prefer not to respond		13 (3.9)
Household income		
Less than $15,000		65 (19.5)
$15,000–24,999		46 (13.8)
$25,000–34,999		27 (8.1)
$35,000–44,999		23 (6.9)
$45,000–54,999		23 (6.9)
$55,000–64,999		18 (5.4)
$65,000–79,999		14 (4.2)
$80,000 and higher		59 (17.7)
Prefer not to respond		58 (17.4)
Employment status		
Full time (35+ h per week)		43 (12.9)
Part time (less than 35 h per week or sporadic employment)		138 (41.4)
Not in labor force (student, homemaker)		94 (28.2)
Unemployed		55 (16.5)
Prefer not to respond		3 (0.9)

(Continues)

TABLE 1 (Continued)

Variables	M (SD)	n (%)
Relationship status		
Married		13 (3.9)
Divorced		2 (0.6)
Not dating		121 (36.3)
Seriously dating (I do not date other people)		157 (47.1)
Casually dating (I date other people as well)		37 (11.1)
Prefer not to respond		3 (0.9)

Abbreviation: LEC-5, Life Events Checklist for *DSM-5*.

For the primary analyses, we conducted four moderated regression analyses; two analyses examined moderating effects of negative emotion dysregulation in the relation between positive memory count and hazardous alcohol or drug use, and two analyses examined moderating effects of positive emotion dysregulation in the relation between positive memory count and hazardous alcohol or drug use. We used number of trauma types as a covariate in all models given the link between trauma exposure and hazardous substance use (Weiss, Bold, et al., 2018) and between trauma exposure and positive memory retrieval (Cuervo-Lombard et al., 2016). Two sets of supplementary analyses were conducted to test the moderating roles of the DERS-16 subscales (DERS-16 Nonacceptance, DERS-16 Goals, DERS-16 Impulse, DERS-16 Strategies, and DERS-16 Clarity) and the DERS-Positive subscales (DERS-Positive Nonacceptance, DERS-Positive Goal, and DERS-Positive Impulse) in the relation between positive memory count and hazardous alcohol or drug use. Each subscale was examined within its own model. Assumptions of moderated regression analyses and zero-order correlations were examined among the primary variables.

Our sample size of 333 individuals was considered sufficient for main effects analyses according to the a priori power analyses conducted with G*Power 3.1 (Faul et al., 2007). With no prior research to serve as guidance for estimating effect size estimates, we conservatively chose a small to medium effect size estimate for power analyses to increase the likelihood of clinically relevant results. We determined that a sample of 222 individuals would be needed to detect a small to medium effect size ($f^2 = 0.05$; Cohen, 1988) with 0.80 power and an α set to .05 for main effects analyses with three predictors in our regression-based model. With power set at 0.80 based on recommendations by Cohen (1988), the study investigating a true effect will accurately reject the null hypothesis 80% of the time and Type II errors will occur in the remaining 20% of the case. Posthoc power analyses for the interaction effects indicated that the models were likely underpowered to detect significant effects. Therefore, we interpreted results cautiously and focused more on describing general patterns of results rather than solely on statistical significance.

3 | RESULTS

Positive skewness and leptokurtosis were observed for the variable of positive emotion dysregulation (DERS-Positive total score; skewness = 3.40, kurtosis = 14.47); all other variables were normally distributed. The assumptions of homoscedasticity and linearity were met for each analysis as indicated by the scatterplots of standardized residual values and predicted dependent variable (DV) values. On average, participants retrieved 6.14 positive memories (*SD* = 2.46). On the AUDIT and DAST-10, participants' average score was 4.39 (*SD* = 4.76) and

1.11 (*SD* = 1.85), respectively. Participants reported an average score of 40.56 (*SD* = 16.10) for the DERS-16 scale and an average score of 16.92 (*SD* = 6.81) for the DERS-Positive scale. For the DERS-16 subscales, the average scores were 7.95 (*SD* = 3.84), 9.09 (*SD* = 3.67), 5.51 (*SD* = 2.92), 13.09 (*SD* = 6.05), and 4.93 (*SD* = 2.30) for DERS-16 Nonacceptance, DERS-16 Goals, DERS-16 Impulse, DERS-16 Strategies, and DERS-16 Clarity, respectively. For the DERS-Positive subscales, the average scores were 4.93 (*SD* = 2.14), 5.94 (*SD* = 2.93), and 6.05 (*SD* = 2.76) for DERS-Positive Nonacceptance, DERS-Positive Goals, and DERS-Positive Impulse, respectively. The average count of traumas endorsed on the LEC-5 was 8.56 (*SD* = 4.29). The most endorsed trauma types on the LEC-5 were transportation accidents (*N* = 284, 85.3%), other unwanted/uncomfortable sexual experience (*N* = 257, 77.2%), and physical assault (*N* = 248, 74.5%). See Table 2 for the correlation estimates between the variables. See Table 3 for detailed results of the moderated regression analyses. The covariate of trauma count had no significant associations with any of the DVs in any of the primary and supplementary models.

3.1 | Negative emotion dysregulation

The overall moderation model predicting hazardous alcohol use, including the interaction of positive memory count and negative emotion dysregulation, was not significant (F [4, 328] = 1.33, $p = 0.258$, $R^2 = 0.02$). There were no significant main effects of positive memory count and negative emotion dysregulation on hazardous alcohol use. The interaction between positive memory count and negative emotion dysregulation on hazardous alcohol use was nonsignificant ($b = -0.004$, 95% CI [−0.02, 0.01], $p = 0.577$).

The overall moderation model predicting hazardous drug use, including the interaction of positive memory count and negative emotion dysregulation, was significant (F [4, 328] = 6.38, $p < 0.001$, $R^2 = 0.07$). There was no significant main effect of positive memory count on hazardous drug use. There was a significant main effect of negative emotion dysregulation on hazardous drug use ($b = 0.03$, 95% CI [0.02, 0.04], $p < 0.001$). The interaction between positive memory count and negative emotion dysregulation on hazardous drug use was not significant ($b = 0.001$, 95% CI [−0.004, 0.01], $p = 0.676$).

3.2 | Positive emotion dysregulation

The overall moderation model predicting hazardous alcohol use, including the interaction of positive memory count and positive emotion dysregulation, was significant (F [4, 328] = 3.27, $p = 0.012$, $R^2 = 0.04$). There was no significant main effect of positive memory count on hazardous alcohol use. There was a significant main effect of positive emotion dysregulation on hazardous alcohol use ($b = 0.12$, 95% CI [0.04, 0.20], $p = 0.003$). The interaction between positive memory count and positive emotion dysregulation on hazardous alcohol use was significant ($b = 0.04$, 95% CI [0.01, 0.06], $p = 0.019$). A small to medium effect size was observed for this interaction of positive memory count and positive emotion dysregulation on hazardous alcohol use ($f^2 = 0.04$). Initial simple slope analyses (Figure 1) revealed a significant negative association between positive memory count and hazardous alcohol use at 1 SD below the mean of positive emotion dysregulation ($b = -0.28$, SE = 0.12, $p = 0.022$), and a nonsignificant positive association at 1 SD above the mean of positive emotion dysregulation ($b = 0.10$, SE = 0.15, $p = 0.513$). Follow-up Johnson–Neyman analyses were then conducted to determine at what *specific* value of the moderator the slopes changed (Johnson & Fay, 1950). These analyses showed that the association between positive memory count and hazardous alcohol use became statistically significant and negative at very low levels of positive emotion dysregulation (centered; −3.92 to −2.17), and that the slope between positive memory count and hazardous alcohol use became statistically significant and positive only at very high levels of positive emotion dysregulation (centered; 28.47 to 48.08). In other words, more retrieved positive memories were associated with *lower* hazardous alcohol use when participants endorsed *less difficulty* regulating positive emotions. However, more retrieved positive

TABLE 2 Means, standard deviations, and Pearson Correlations for all variables ($N = 333$).

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. LEC-5 Trauma Count		**−0.05**$^{p=0.401}$	−0.02$^{p=0.754}$	**0.13**$^{p=0.021}$	0.01$^{p=0.818}$	−0.01$^{p=0.889}$	0.01$^{p=0.792}$	−0.04$^{p=0.513}$	0.02$^{p=0.742}$	−0.05$^{p=0.338}$	0.03$^{p=608}$	0.07$^{p=0.186}$	**0.13**$^{p=0.016}$	**0.12**$^{p=0.032}$
2. AMT Count			−0.02$^{p=0.783}$	−0.06$^{p=0.265}$	−0.08$^{p=0.147}$	0.03$^{p=0.602}$	−0.01$^{p=0.900}$	0.02$^{p=0.699}$	−0.02$^{p=0.674}$	−0.04$^{p=0.508}$	−0.003$^{p=0.508}$	−0.06$^{p=0.254}$	−0.03$^{p=0.572}$	−0.07$^{p=0.207}$
3. DERS-16				**0.36**$^{p<0.001}$	0.09$^{p=0.087}$	**0.27**$^{p<0.001}$	**0.85**$^{p<0.001}$	**0.86**$^{p<0.001}$	**0.77**$^{p<0.001}$	**0.94**$^{p<0.001}$	**0.73**$^{p<0.001}$	**0.30**$^{p<0.001}$	**0.32**$^{p<0.001}$	**0.32**$^{p<0.001}$
4. DERS-Positive					**0.13**$^{p=0.018}$	**0.20**$^{p<0.001}$	**0.27**$^{p<0.001}$	**0.26**$^{p<0.001}$	**0.36**$^{p<0.001}$	**0.33**$^{p<0.001}$	**0.32**$^{p<0.001}$	**0.80**$^{p<0.001}$	**0.88**$^{p<0.001}$	**0.91**$^{p<0.001}$
5. AUDIT						**0.39**$^{p<0.001}$	0.07$^{p=0.193}$	0.04$^{p=0.501}$	0.14$^{p=0.012}$	0.09$^{p=0.109}$	0.07$^{p=0.188}$	0.06$^{p=0.279}$	0.12$^{p=0.033}$	**0.15**$^{p=0.007}$
6. DAST-10							**0.19**$^{p<0.001}$	**0.19**$^{p<0.001}$	**0.31**$^{p<0.001}$	**0.24**$^{p<0.001}$	**0.20**$^{p<0.001}$	0.11$^{p=0.043}$	**0.15**$^{p=0.008}$	**0.24**$^{p<0.001}$
7. DERS-16 Nonacceptance								**0.63**$^{p<0.001}$	**0.56**$^{p<0.001}$	**0.75**$^{p<0.001}$	**0.61**$^{p<0.001}$	**0.23**$^{p<0.001}$	**0.25**$^{p<0.001}$	**0.23**$^{p<0.001}$
8. DERS-16 Goals									**0.61**$^{p<0.001}$	**0.78**$^{p<0.001}$	**0.55**$^{p<0.001}$	**0.20**$^{p<0.001}$	**0.26**$^{p<0.001}$	**0.21**$^{p<0.001}$
9. DERS-16 Impulse										**0.67**$^{p<0.001}$	**0.48**$^{p<0.001}$	**0.29**$^{p<0.001}$	**0.28**$^{p<0.001}$	**0.38**$^{p<0.001}$
10. DERS-16 Strategies											**0.62**$^{p<0.001}$	**0.28**$^{p<0.001}$	**0.30**$^{p<0.001}$	**0.28**$^{p<0.001}$
11. DERS-16 Clarity												**0.27**$^{p<0.001}$	**0.29**$^{p<0.001}$	**0.27**$^{p<0.001}$
12. DERS-Positive Nonacceptance													**0.53**$^{p<0.001}$	**0.64**$^{p<0.001}$

TABLE 2 (Continued)

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14
13. DERS-Positive Goals														**0.70**$^{p<0.001}$
14. DERS-Positive Impulse														

Note: Bolded values represent significant or marginally significant results.

Abbreviations: AMT Count, The Autobiographical Memory Test count variable was the number of retrieved specific positive memories (positive memory count); AUDIT, Alcohol Use Disorders Identification Test total score; DAST-10, The Drug Abuse Screen Test total score; DERS-16, Difficulties in Emotion Regulation Scale—Brief 16-Item Version total score; DERS-16 Clarity, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Clarity subscale score; DERS-16 Goals, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Goals subscale score; DERS-16 Impulse, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Impulse subscale score; DERS-16 Nonacceptance, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Nonacceptance subscale score; DERS-16 Strategies, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Strategies subscale score; DERS-Positive, Difficulties in Emotion Regulation Scale-Positive total score; DERS-Positive Goals, Difficulties in Emotion Regulation Scale-Positive Goals subscale score; DERS-Positive Impulse, Difficulties in Emotion Regulation Scale-Positive Impulse subscale score; DERS-Positive Nonacceptance, Difficulties in Emotion Regulation Scale-Positive Nonacceptance subscale score; LEC-5, Life Events Checklist for *DSM-5*. LEC-5 Trauma Count was the number of endorsed trauma types.

TABLE 3 Moderated Regression Results ($N = 333$).

Predictors	*b*	95% CI [LL, UL]	SE	*t*	R^2	*F* (*df*)
Model 1 (AUDIT)						
					0.02	$1.33\ (4, 328)^{p=0.258}$
LEC-5 Trauma Count	$0.01^{p=0.853}$	[−0.11, 0.13]	0.06	0.19		
AMT Count	$-0.15^{p=0.150}$	[−0.36, 0.06]	0.11	−1.44		
DERS-16	$0.03^{p=0.099}$	[−0.01, 0.06]	0.02	1.65		
AMT Count × DERS-16	$-0.004^{p=0.577}$	[−0.02, 0.01]	0.06	−0.56		
Model 2 (DAST-10)						
					0.07	$\mathbf{6.38\ (4, 328)^{p<0.001}}$
LEC-5 Trauma Count	$-0.001^{p=0.981}$	[−0.05, 0.05]	0.02	−0.02		
AMT Count	$0.03^{p=0.527}$	[−0.05, 0.10]	0.04	0.63		
DERS-16	$\mathbf{0.03^{p<0.001}}$	[0.02, 0.04]	0.01	5.02		
AMT Count × DERS-16	$0.001^{p=0.676}$	[−0.004, 0.01]	0.02	−0.02		
Model 3 (AUDIT)						
					0.04	$\mathbf{3.26\ (4, 328)^{p=0.012}}$
LEC-5 Trauma Count	$0.004^{p=0.951}$	[−0.12, 0.12]	0.06	0.06		
AMT Count	$-0.14^{p=0.180}$	[−0.35, 0.07]	0.11	−1.34		
DERS-Positive	$\mathbf{0.12^{p=0.003}}$	[0.04, 0.20]	0.04	2.98		
AMT Count × DERS-Positive	$\mathbf{0.04^{p=0.019}}$	[0.01, 0.06]	0.02	2.37		
Model 4 (DAST-10)						
					0.07	$\mathbf{6.08\ (4, 328)^{p<0.001}}$
LEC-5 Trauma Count	$-0.01^{p=0.732}$	[−0.05, 0.04]	0.02	−0.34		
AMT Count	$0.03^{p=0.467}$	[−0.05, 0.11]	0.04	0.73		
DERS-Positive	$\mathbf{0.07^{p<0.001}}$	[0.04, 0.10]	0.02	4.62		
AMT Count × DERS-Positive	$\mathbf{0.02^{p=0.002}}$	[0.01, 0.03]	0.01	3.14		

Note: Bolded values represent significant or marginally significant results.

Abbreviations: AUDIT, Alcohol Use Disorders Identification Test total score; *b*, unstandardized regression weights; CI, confidence interval; DAST-10 = The Drug Abuse Screen Test total score; DERS-16, Difficulties in Emotion Regulation Scale—Brief 16-Item Version total score; DERS-Positive, Difficulties in Emotion Regulation Scale-Positive total score; LEC-5, Life Events Checklist for *DSM-5*. Number of endorsed trauma types (LEC-5 Trauma Count) served as a covariate in each of these models; LL, lower limit of a confidence interval; SE, standard error; UL, upper limit of a confidence interval.

memories were associated with *greater* hazardous alcohol when participants endorsed *a very high level of difficulty* regulating positive emotions.

The overall moderation model predicting hazardous drug use, including the interaction of positive memory count and positive emotion dysregulation, was significant $F\ (4, 328) = 6.08$, $p < 0.001$, $R^2 = 0.07$). The main effect of positive memory count on hazardous drug use was nonsignificant. The main effect of positive emotion dysregulation on hazardous drug use was significant ($b = 0.07$, 95% CI [0.04, 0.10], $p < 0.001$). There was a significant moderating effect of positive emotion dysregulation on the association between positive memory count

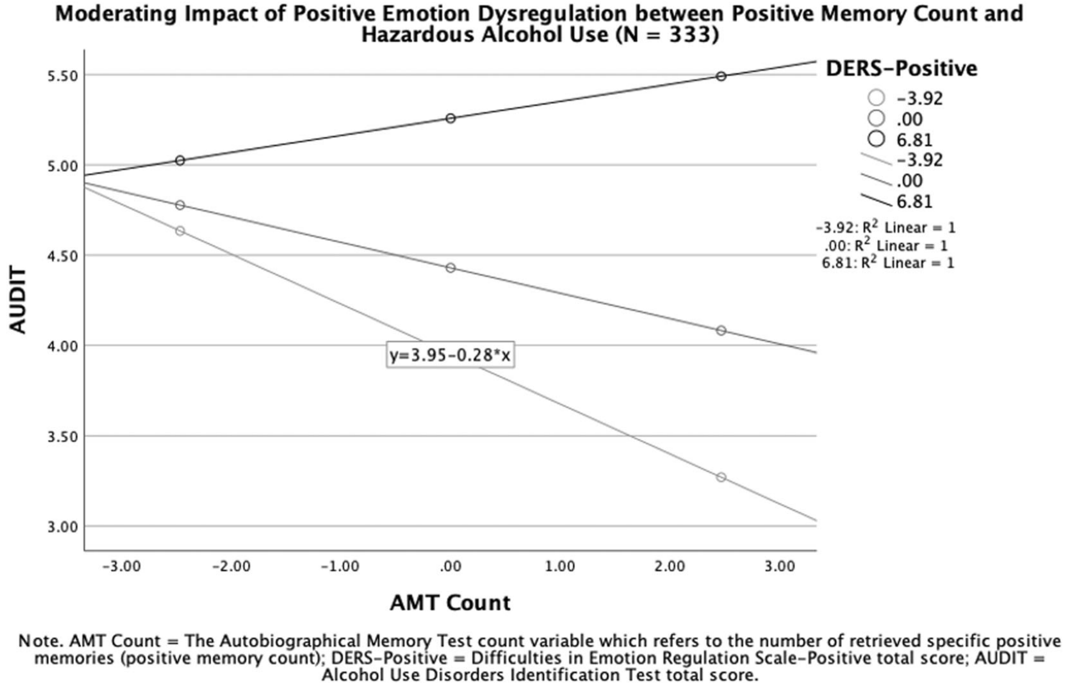


FIGURE 1 Moderating impact of positive emotion dysregulation between positive memory count and hazardous alcohol use (N = 333).

and hazardous drug use (b = 0.02, 95% CI [0.01, 0.03], p = 0.002). There was a small to medium effect size for the interaction of positive memory count and positive emotion dysregulation on hazardous drug use (f^2 = 0.07). Simple slope analyses (Figure 2) revealed a nonsignificant association between positive memory count and hazardous drug use at 1 SD below the mean of positive emotion dysregulation (b = −0.04, SE = 0.05, p = 0.387), and a significant positive association at 1 SD above the mean of positive emotion dysregulation (b = 0.15, SE = 0.06, p = 0.007). Follow-up Johnson–Neyman analyses were then conducted to determine at what *specific* value of the moderator the slopes changed (Johnson & Fay, 1950). Results showed that the association between positive memory count and hazardous drug use became statistically significant and positive at moderate to very high levels of positive emotion dysregulation (centered; range of observed values of 3.27 to 48.08). Therefore, more retrieved positive memories were associated with greater hazardous drug use in the context of *more difficulty* regulating positive emotions.

3.3 | Domains of emotion dysregulation

See Table 4 for results of the supplemental analyses. Results indicated no significant interaction effects for the negative emotion dysregulation subscales. The main effect of positive memory count on hazardous drug use was nonsignificant. The main effect of DERS-Positive Goals on hazardous drug use was significant (b = 0.11, 95% CI [−0.06, 0.10], p = 0.002). Further, results indicated a significant interaction between positive memory count and DERS-Positive Goals on hazardous drug use (b = 0.03, 95% CI [0.001, 0.06], p = 0.044). There was a small to medium effect size for the interaction between positive memory count and DERS-Positive Goals on hazardous drug use (f^2 = 0.04). A nonsignificant slope (Figure 3) was observed at 1 SD below the mean of DERS-Positive Goals (b = −0.03, SE = 0.05, p = 0.538) and at 1 SD above the mean of DERS-Positive Goals (b = 0.11, SE = 0.06, p = 0.066).

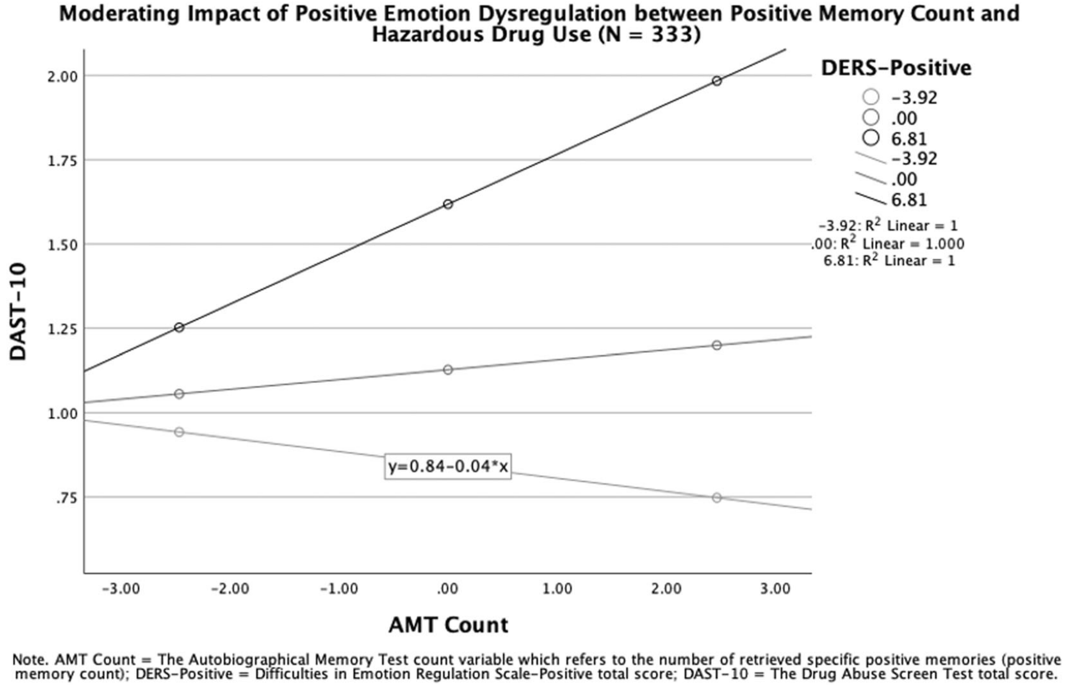


FIGURE 2 Moderating impact of positive emotion dysregulation between positive memory count and hazardous drug use ($N = 333$).

Follow-up Johnson–Neyman analyses (Johnson & Fay, 1950) revealed that the association between positive memory count and hazardous drug use became statistically significant and positive at moderate to very high levels of DERS-Positive Goals (centered; range of observed values of 3.89 to 14.06). Thus, more retrieved positive memories were associated with greater hazardous drug use in the context of *more difficulties* engaging in goal-directed behavior when experiencing positive emotions.

The main effect of positive memory count on hazardous drug use was nonsignificant. The main effect of DERS-Positive Impulse on hazardous drug use was significant ($b = 0.32$, 95% CI [0.13, 0.51], $p < 0.001$). Additionally, results indicated a significant interaction between positive memory count and DERS-Positive Impulse on hazardous alcohol use ($b = 0.01$, 95% CI [0.03, 0.17], $p = 0.009$). The effect size of the aforementioned interaction was small to medium ($f^2 = 0.05$). For positive memory count and hazardous alcohol use, simple slope analyses (Figure 4) showed a significant negative association at 1 SD below the mean of DERS-Positive Impulse ($b = -0.23$, $SE = 0.11$, $p = 0.038$), and a nonsignificant association at 1 SD above the mean of DERS-Positive Impulse ($b = 0.15$, $SE = 0.15$, $p = 0.319$). Follow-up Johnson–Neyman analyses (Johnson & Fay, 1950) showed that the association between positive memory count and hazardous alcohol use became statistically significant and negative at low levels of impulse control difficulties (centered; range of observed values −1.05 to −0.89) and statistically significant and positive at high levels of DERS-Positive Impulse (centered; range of observed values 6.77 to 18.95). Thus, more retrieved positive memories were associated with *lower* hazardous alcohol use when participants endorsed *less difficulty* controlling impulsive behaviors in the context of positive emotions. However, more retrieved positive memories were associated with *greater* hazardous alcohol when participants endorsed *more difficulties* controlling impulsive behaviors in the context of positive emotions.

Finally, results revealed a nonsignificant main effect for positive memory count on hazardous drug use. The main effect of DERS-Positive Impulse was significant ($b = 0.05$, 95% CI [0.13, 0.28], $p < 0.001$). There was a significant interaction between positive memory count and DERS-Positive Impulse on hazardous drug use ($b = 0.05$,

TABLE 4 Moderated Regression Results for the Domains of Emotion Dysregulation Analyses (N = 333).

Predictors	b	95% CI [LL, UL]	SE	t	R^2	F (df)
Model 1 (AUDIT)						
					0.01	1.06 (4, 328)$^{p=0.377}$
LEC-5 Trauma Count	0.01$^{p=0.879}$	[−0.11, 0.13]	0.06	0.15		
AMT Count	−0.16$^{p=0.150}$	[−0.36, 0.06]	0.11	−1.45		
DERS-16 Nonacceptance	0.09$^{p=0.200}$	[−0.05, 0.22]	0.07	1.28		
AMT Count × DERS-16 Nonacceptance	−0.02$^{p=0.513}$	[−0.08, 0.04]	0.03	−0.66		
Model 2 (DAST-10)						
					0.04	**3.30 (4, 328)$^{p=0.011}$**
LEC-5 Trauma Count	−0.004$^{p=0.865}$	[−0.05, 0.04]	0.02	−0.17		
AMT Count	0.02$^{p=0.582}$	[−0.06, 0.10]	0.04	0.55		
DERS-16 Nonacceptance	**0.09$^{p<0.001}$**	[0.03, 0.15]	0.03	3.59		
AMT Count × DERS-16 Nonacceptance	0.002$^{p=0.865}$	[−0.02, 0.02]	0.01	0.13		
Model 3 (AUDIT)						
					0.01	1.01 (4, 328)$^{p=0.403}$
LEC-5 Trauma Count	0.01$^{p=0.847}$	[−0.11, 0.13]	0.06	0.19		
AMT Count	−0.16$^{p=0.135}$	[−0.37, 0.05]	0.11	−1.50		
DERS-16 Goals	0.05$^{p=0.498}$	[−0.09, 0.19]	0.07	0.69		
AMT Count × DERS-16 Goals	−0.04$^{p=0.239}$	[−0.11, 0.02]	0.03	−1.17		
Model 4 (DAST-10)						
					0.04	**3.32 (4, 328)$^{p=0.013}$**
LEC-5 Trauma Count	0.0002$^{p=0.994}$	[−0.05, 0.04]	0.02	0.01		
AMT Count	0.02$^{p=0.655}$	[−0.06, 0.10]	0.04	0.45		
DERS-16 Goals	**0.10$^{p<0.001}$**	[0.04, 0.15]	0.03	3.55		
AMT Count × DERS-16 Goals	−0.003$^{p=0.828}$	[−0.03, 0.02]	0.01	−0.22		
Model 5 (AUDIT)						
					0.03	2.09 (4, 328)$^{p=0.082}$
LEC-5 Trauma Count	0.01$^{p=0.897}$	[−0.11, 0.13]	0.13	0.06		
AMT Count	−0.15$^{p=0.167}$	[−0.36, 0.06]	0.11	−1.39		
DERS-16 Impulse	**0.22$^{p=0.013}$**	[0.05, 0.40]	0.09	2.49		
AMT Count × DERS-16 Impulse	0.01$^{p=0.897}$	[−0.07, 0.08]	0.04	0.15		

(Continues)

TABLE 4 (Continued)

Predictors	b	95% CI [LL, UL]	SE	t	R^2	F (df)
Model 6 (DAST-10)						
					0.10	**8.89 (4, 328)**$^{p<0.001}$
LEC-5 Trauma Count	−0.01$^{p=0.828}$	[−0.05, 0.04]	0.02	−0.22		
AMT Count	0.03$^{p=0.498}$	[−0.05, 0.10]	0.04	0.68		
DERS-16 Impulse	**0.20**$^{p<0.001}$	[0.13, 0.26]	0.03	5.92		
AMT Count × DERS-16 Impulse	0.001$^{p=0.918}$	[−0.03, 0.03]	0.01	0.10		
Model 7 (AUDIT)						
					0.02	1.21 (4, 328)$^{p=0.305}$
LEC-5 Trauma Count	0.02$^{p=0.801}$	[−0.11, 0.14]	0.06	0.25		
AMT Count	−0.15$^{p=0.164}$	[−0.36, 0.06]	0.11	−1.40		
DERS-16 Strategies	0.07$^{p=0.127}$	[−0.02, 0.15]	0.04	1.53		
AMT Count × DERS-16 Strategies	−0.01$^{p=0.610}$	[−0.04, 0.03]	0.02	−0.51		
Model 8 (DAST-10)						
					0.06	**5.14 (4, 328)**$^{p<0.001}$
LEC-5 Trauma Count	0.003$^{p=0.902}$	[−0.04, 0.05]	0.02	0.12		
AMT Count	0.03$^{p=0.477}$	[−0.05, 0.11]	0.04	0.71		
DERS-16 Strategies	**0.07**$^{p<0.001}$	[0.04, 0.11]	0.02	4.50		
AMT Count × DERS-16 Strategies	0.002$^{p=0.740}$	[−0.01, 0.02]	0.01	0.33		
Model 9 (AUDIT)						
					0.01	0.97 (4, 328)$^{p=0.423}$
LEC-5 Trauma Count	0.01$^{p=0.892}$	[−0.11, 0.13]	0.06	0.14		
AMT Count	−0.15$^{p=0.153}$	[−0.36, 0.06]	0.11	−1.43		
DERS-16 Clarity	0.15$^{p=0.190}$	[−0.07, 0.37]	0.11	1.31		
AMT Count × DERS-16 Clarity	0.01$^{p=0.902}$	[−0.09, 0.10]	0.05	0.14		
Model 10 (DAST-10)						
					0.05	**4.25 (4, 328)**$^{p=0.002}$
LEC-5 Trauma Count	−0.002$^{p=0.916}$	[−0.05, 0.04]	0.02	−0.11		
AMT Count	0.03$^{p=0.538}$	[−0.06, 0.11]	0.04	0.62		
DERS-16 Clarity	**0.17**$^{p<0.001}$	[0.06, 0.20]	0.04	3.86		
AMT Count × DERS-16 Clarity	0.03$^{p=0.136}$	[−0.01, 0.06]	0.02	1.50		

TABLE 4 (Continued)

Predictors	*b*	95% CI [LL, UL]	*SE*	*t*	R^2	*F* (df)
Model 11 (AUDIT)						
					0.01	1.04 (4, 328)$^{p=0.388}$
LEC-5 Trauma Count	0.01$^{p=0.882}$	[−0.11, 0.13]	0.06	0.15		
AMT Count	**−0.15**$^{p<0.001}$	[−0.36, 0.06]	0.11	−1.44		
DERS-Positive Nonacceptance	0.17$^{p=0.201}$	[−0.09, 0.43]	0.13	1.28		
AMT Count × DERS-Positive Nonacceptance	0.04$^{p=0.310}$	[−0.04, 0.12]	0.04	1.02		
Model 12 (DAST-10)						
					0.02	1.92 (4, 328)$^{p=0.108}$
LEC-5 Trauma Count	−0.004$^{p=0.868}$	[−0.05, 0.04]	0.02	−0.17		
AMT Count	0.02$^{p=0.589}$	[−0.06,0.11]	0.04	0.54		
DERS-Positive Nonacceptance	**0.13**$^{p=0.011}$	[0.03,0.23]	0.05	2.56		
AMT Count × DERS-Positive Nonacceptance	0.03$^{p=0.083}$	[−0.004, 0.05]	0.02	1.74		
Model 13 (AUDIT)						
					0.03	**2.40 (4, 328)**$^{p=0.050}$
LEC-5 Trauma Count	0.003$^{p=0.960}$	[−0.12, 0.12]	0.06	0.05		
AMT Count	−0.15$^{p=0.160}$	[−0.36, 0.06]	0.11	−1.41		
DERS-Positive Goals	**0.22**$^{p=0.017}$	[0.04, 0.40]	0.09	2.39		
AMT Count × DERS-Positive Goals	0.06$^{p=0.085}$	[−0.01, 0.13]	0.04	1.73		
Model 14 (DAST-10)						
					0.04	**2.97 (4, 328)**$^{p=0.020}$
LEC-5 Trauma Count	−0.01$^{p=0.778}$	[−0.05, 0.04]	0.02	−0.28		
AMT Count	0.02$^{p=0.558}$	[−0.05, 0.10]	0.04	0.59		
DERS-Positive Goals	**0.11**$^{p=0.002}$	[0.04, 0.18]	0.04	3.06		
AMT Count × DERS-Positive Goals	**0.03**$^{p=0.044}$	[0.001, 0.06]	0.01	2.02		
Model 15 (AUDIT)						
					0.05	**4.05 (4, 328)**$^{p=0.003}$
LEC-5 Trauma Count	0.01$^{p=0.930}$	[−0.11, 0.13]	0.06	0.09		
AMT Count	−0.13$^{p=0.232}$	[−0.33, 0.08]	0.10	−1.20		
DERS-Positive Impulse	**0.32**$^{p=0.001}$	[0.13, 0.51]	0.10	3.28		
AMT Count × DERS-Positive Impulse	**0.10**$^{p=0.009}$	[0.03, 0.17]	0.04	2.64		

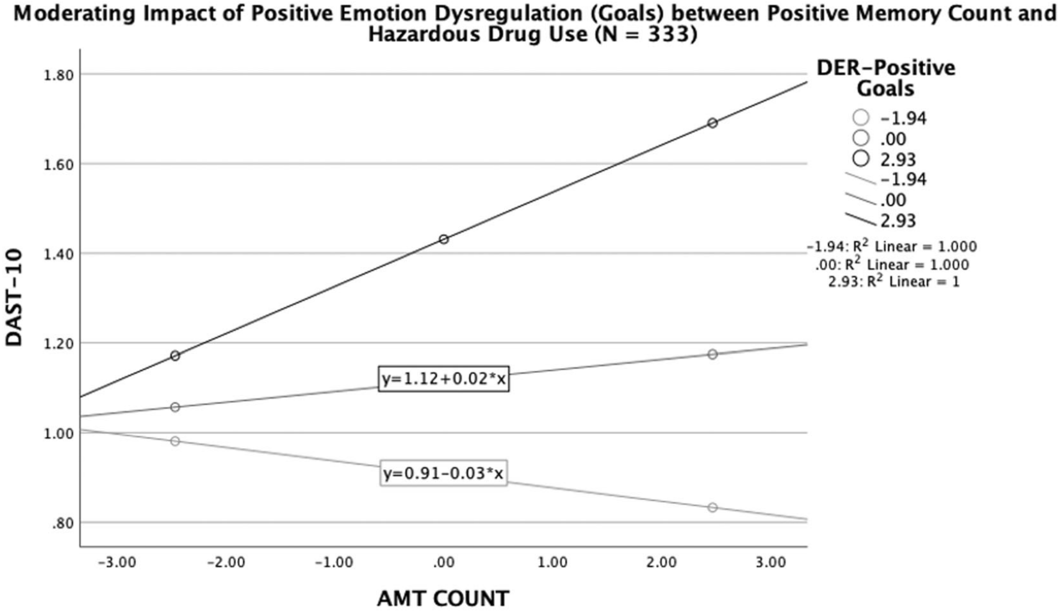
(Continues)

TABLE 4 (Continued)

Predictors	b	95% CI [LL, UL]	SE	t	R^2	F (df)
Model 16 (DAST-10)						
					0.09	**8.43 (4, 328)$^{p<0.001}$**
LEC-5 Trauma Count	$-0.01^{p=0.709}$	[−0.05, 0.03]	0.02	−0.37		
AMT Count	$0.04^{p=0.335}$	[−0.04, 0.12]	0.04	0.97		
DERS-Positive Impulse	**$0.20^{p<0.001}$**	[0.13, 0.28]	0.04	5.46		
AMT Count × DERS-Positive Impulse	**$0.05^{p=0.001}$**	[0.02, 0.08]	0.01	3.33		

Note: Bolded values represent significant or marginally significant results.

Abbreviations: AMT Count, The Autobiographical Memory Test count variable which refers to the number of retrieved specific positive memories (positive memory count); AUDIT, Alcohol Use Disorders Identification Test total score; *b*, unstandardized regression weights; CI, confidence interval; DAST-10, The Drug Abuse Screen Test total score; DERS-16 Clarity, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Clarity subscale score; DERS-16 Goals, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Goals subscale score; DERS-16 Impulse, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Impulse subscale score; DERS-16 Nonacceptance, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Nonacceptance subscale score; DERS-16 Strategies, Difficulties in Emotion Regulation Scale—Brief 16-Item Version Strategies subscale score; DERS-Positive, Difficulties in Emotion Regulation Scale-Positive total score; DERS-Positive Goals, Difficulties in Emotion Regulation Scale-Positive Goals subscale score; DERS-Positive Impulse, Difficulties in Emotion Regulation Scale-Positive Impulse subscale score; DERS-Positive Nonacceptance, Difficulties in Emotion Regulation Scale-Positive Nonacceptance subscale score; LEC-5, Life Events Checklist for *DSM-5*. Number of endorsed trauma types (LEC-5 Trauma Count) served as a covariate in each of these models; LL, lower of a confidence interval; SE, standard error; UL, upper limits of a confidence interval.



Note. AMT Count = The Autobiographical Memory Test count variable which refers to the number of retrieved specific positive memories (positive memory count); DERS–Positive Goals = Difficulties in Emotion Regulation Scale–Positive Goals subscale score; DAST–10 = The Drug Abuse Screen Test total score.

FIGURE 3 Moderating impact of positive emotion dysregulation (goals) between positive memory count and hazardous drug use ($N = 333$).

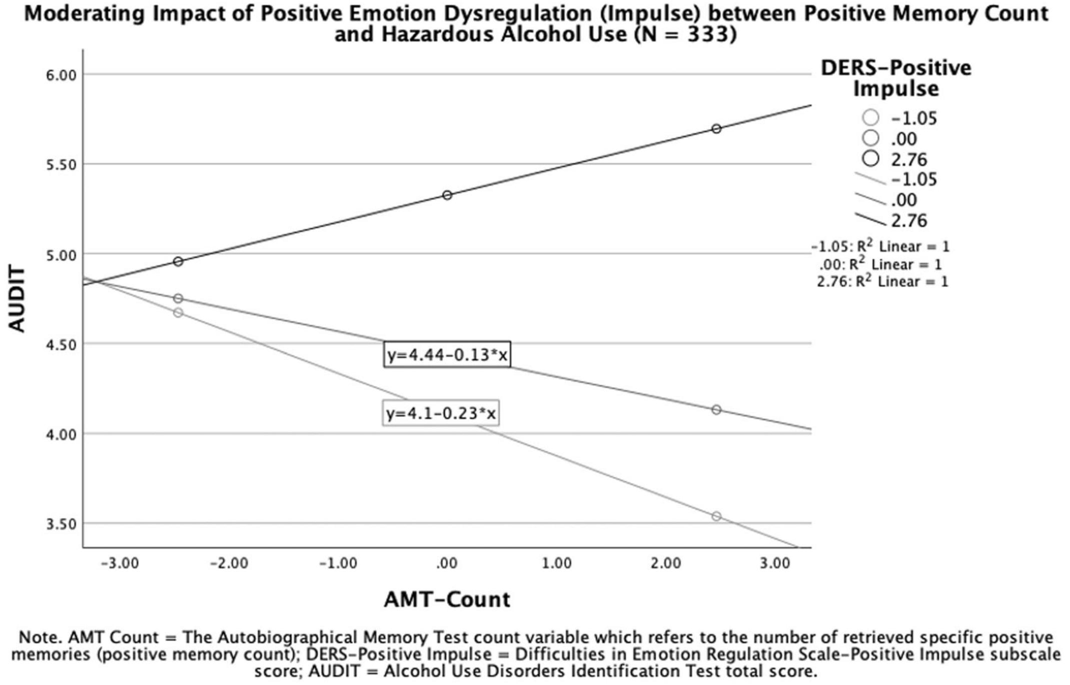


FIGURE 4 Moderating impact of positive emotion dysregulation (impulse) between positive memory count and hazardous alcohol use (*N* = 333).

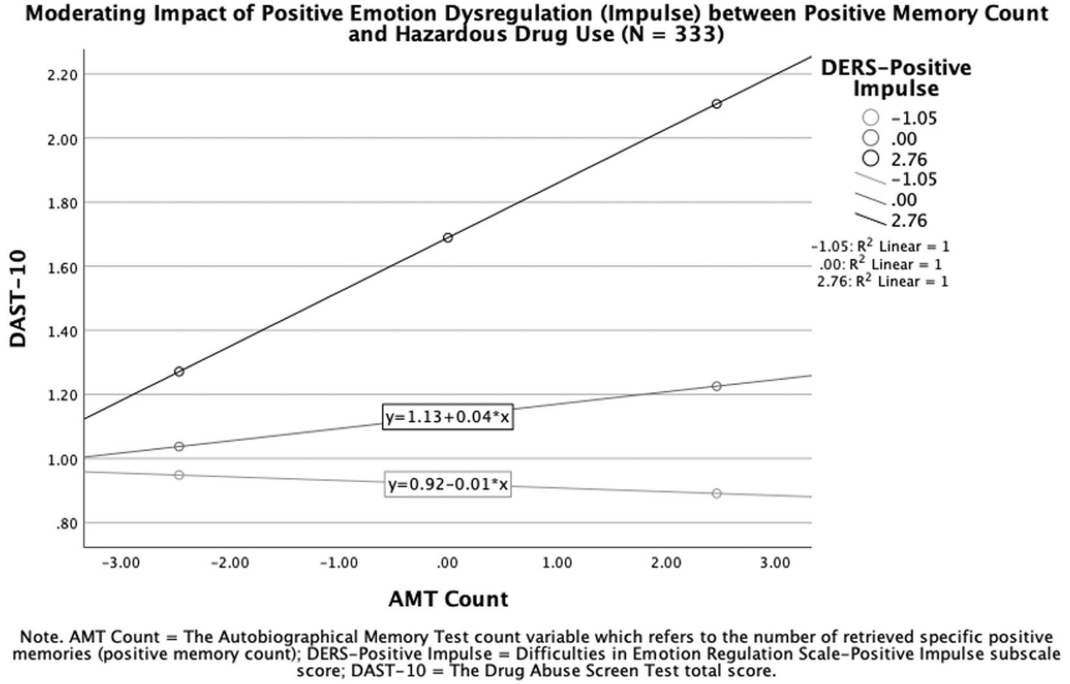


FIGURE 5 Moderating impact of positive emotion dysregulation (impulse) between positive memory count and hazardous drug use (*N* = 333).

95% CI [0.02, 0.08], $p = 0.001$). There was a small to medium effect size for this interaction ($f^2 = 0.10$). A nonsignificant slope (Figure 5) was observed at 1 SD below the mean of DERS-Positive Impulse ($b = -0.01$, SE = 0.04, $p = 0.780$), and a significant positive association was found at 1 SD above the mean of DERS-Positive Impulse ($b = 0.17$, SE = 0.06, $p = 0.003$). Follow-up Johnson–Neyman analyses (Johnson & Fay, 1950) revealed a statistically significant positive slope between positive memory count and hazardous drug use at moderate to very high levels of DERS-Positive Impulse (centered; range of observed values of 0.94 to 18.95). Therefore, more retrieved positive memories were associated with *greater* hazardous drug use when participants reported *more difficulties* controlling impulsive behavior in the context of positive emotions.

4 | DISCUSSION

The current study examined the moderating roles of negative and positive emotion dysregulation in the associations between positive memory count and hazardous alcohol and drug use. We hypothesized that greater positive memory count would be associated with less hazardous substance for individuals reporting less negative or positive emotion dysregulation. Further, we hypothesized that greater positive memory count would be associated with either less or more hazardous substance use for individuals reporting more negative and positive emotion dysregulation. Our results did not support our hypotheses referencing negative emotion dysregulation. However, our findings indicated that greater positive memory count was associated with more hazardous substance use among individuals who reported more positive emotion dysregulation. When individuals better regulated their positive emotions, more retrieved positive memories were associated with less hazardous alcohol use.

When trauma-exposed individuals were unable to regulate the experienced positive emotions, retrieving more specific positive memories was associated with more hazardous substance use. Findings are consistent with literature suggesting that hazardous substance use is linked to difficulties regulating positive emotions (Weiss, Forkus, et al., 2020), with literature linking risky behaviors to positive memory retrieval (Banducci et al., 2020), and with literature suggesting that retrieving positive memories are associated with greater posttrauma distress when there is difficulty regulating positive emotions (Contractor, Weiss, & Forkus, 2021). Taken together, increased difficulties regulating positive emotions may contribute to a positive relationship between positive memory count and hazardous substance use.

When positive emotion dysregulation was broken down into nuanced domains, participants who retrieved more positive memories engaged in more hazardous drug use in the context of difficulties pursuing goal-directed behavior when experiencing positive emotions. A similar pattern emerged for both hazardous alcohol and drug use when participants had difficulties controlling impulsive behaviors when experiencing positive emotions. Supporting these findings, the theory of urgency posits that individuals, including those experiencing traumas, may have limited cognitive resources when experiencing high levels of positive emotions, which, in turn, may interfere with rational decision-making and the pursuit of long-term goals (Cyders & Smith, 2008). Study findings are also consistent with literature suggesting that positive urgency, or the tendency to behave rashly when experiencing high levels of positive emotions (Cyders & Smith, 2007), can contribute to engagement in risky behaviors such as hazardous substance use (Cyders et al., 2009; Zapolski et al., 2009) among trauma-exposed individuals (Weiss, Tull, et al., 2015). Therefore, when trauma-exposed individuals retrieve more positive memories, they may experience positive emotions; however, they may experience difficulties controlling impulsive behaviors or engaging in goal-oriented activities (i.e., they may not be able to effectively regulate these positive emotions; Weiss, Tull, et al., 2015). In turn, they may engage in substance use to regulate these positive emotions (Weiss, Dixon-Gordon, et al., 2018). Such hypothetical mediation pathways can be explored in future research.

Considering the complexity of the relationship between positive memory count and hazardous substance use, it is unsurprising that we did not find significant direct associations between these two constructs. Further, our findings indicated that negative emotion dysregulation was not a significant moderator in any examined model.

However, we found main effects between negative emotion dysregulation and hazardous substance use in several models. Perhaps, negative emotion dysregulation interacts with or modifies the effect of positive emotion regulation abilities. Indeed, research suggests that trauma-exposed individuals may experience negative interference (e.g., experiencing negative affect in situations in which positive affect is typically expected, such as when retrieving positive memories). The ability to regulate this negative affect may influence the experience and/or regulation of positive emotions (Frewen, Dean, et al., 2012; Frewen, Dozois, Neufeld, et al., 2012). Also, other positive memory characteristics beyond positive memory count may be more relevant for the study's research question; examples include emotional valence, intensity, and vividness of retrieved positive memories (D'Argembeau et al., 2003; Holland & Kensinger, 2010; Talarico et al., 2004). In this regard, research suggests that positive valence, accessibility, and coherence are some positive memory characteristics that are related to posttrauma distress (Contractor et al., 2019; Contractor, Greene et al., 2020). Additionally, the content of the positive memory matters, as indicated by research showing that reactivation of vivid, intense positive memories, especially those associated with substance cues (e.g., drug paraphernalia, environmental context), is linked to an increase in craving for and the likelihood of hazardous substance use (Gisquet-Verrier & Le Dorze, 2019). Thus, future research would benefit by examining content and characteristics of positive memories in relation to hazardous substance use.

Study findings have clinical and theoretical implications. One, current study findings suggest that similar patterns between positive memories, substance use, and emotion dysregulation emerge regardless of the type and number of traumas experienced by individuals. In this regard, the current study included participants who endorsed both interpersonal and noninterpersonal traumatic events (i.e., diverse traumatic events) and the prevalence estimates of traumatic events in our sample are on par with the national average (70% of individuals will report trauma exposure in their lifetime; Kessler et al., 2017). Further, study findings inform substance use interventions that target emotion dysregulation among trauma-exposed individuals. Research indicates that trauma exposure is related to risky behavior engagement, such as hazardous substance use (Jacobsen et al., 2001), which can serve as a means to cope with posttrauma distress (Khantzian, 1985). Perhaps, when trauma-exposed individuals are able to therapeutically and repeatedly retrieve, process, and focus on the content of specific positive memories, they may experience sustained positive affect (Contractor, Banducci, et al., 2020; Joormann et al., 2007; Rusting & DeHart, 2000) and an enhanced ability to regulate such positive emotions (Contractor, Jin et al. 2022). If this occurs, these individuals may experience less of a need to use drugs to cope with posttrauma distress. In this regard, memory-based interventions such as Processing of Positive Memories Technique (Contractor, Weiss, & Shea, 2021) and Memory Specificity Training (Callahan et al., 2019) may be useful clinical interventions for trauma-exposed individuals struggling with hazardous substance use.

Study findings also add to the importance of parsing negative versus positive emotion dysregulation, rather than assuming trauma-exposed individuals experiencing positive affect will report more well-being. Further, it would be useful to assess what contributes to positive emotion dysregulation among trauma-exposed individuals who are at risk for hazardous substance use, such as beliefs that that they are undeserving of positive feelings (Lawrence & Lee, 2014) or aversion to physiological arousal (Litz et al., 2000). Relatedly, while positive memory interventions used for trauma-exposed individuals may improve posttrauma symptoms and reduce distress, they may need to target one's ability to regulate positive emotions for enhanced effectiveness. Finally, results also add to the theories linking substance use and emotions. For instance, the self-medication hypothesis, which posits that individuals use substances to reduce distressing emotions (Khantzian, 2003), could be expanded to include distressing positive emotions. In line with this, findings are consistent with the tension reduction theory (Conger, 1956), which indicates that trauma-exposed individuals may use substances to avoid arousal stemming from positive emotional states (Baker et al., 2004).

Limitations to the current study should be noted when interpreting study findings. Importantly, our finding should be interpreted with caution given that our interaction effect results were likely underpowered. Our small effect sizes also indicate limited strength in the associations between the study variables. Replication of our analyses in larger sample sizes is warranted to elucidate the role of emotion dysregulation in the relationship between positive memory count and hazardous substance use. Further, the use of cross-sectional data hinders the ability to infer causal or directional relationships amongst these constructs. Also, the sample consisted of trauma-exposed, college students, and most identified as women. Thus, we are limited in the generalizability of findings to diverse samples characterized by clinically significant levels of substance use. This being said, we note that our sample was quite diverse in terms of race/ethnicity compared to other studies (Rodriguez & Read, 2020; Shebuski et al., 2020), and research suggests that college students report substantial levels of trauma experiences and posttrauma distress (Boals et al., 2020) as well as substance use (Schulenberg & Maggs, 2002). Despite these limitations, the current study uniquely examined the associations between positive memory count and hazardous substance use (drug use and alcohol use) in the context of positive and negative emotion dysregulation among trauma-exposed individuals. Primarily, results revealed a significant, positive association between positive memory count and hazardous substance use at greater levels of positive emotion dysregulation. Findings highlight the importance of exploring the relationships between positive memory count and hazardous substance use further, with potential implications to improve clinical treatments.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

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

ETHICS STATEMENT

This study was approved by the University of North Texas IRB.

ORCID

Sidonia E. Compton http://orcid.org/0000-0001-8953-2844
Danica C. Slavish https://orcid.org/0000-0002-1924-4895
Nicole H. Weiss https://orcid.org/0000-0002-8245-0616
Holly J. Bowen https://orcid.org/0000-0002-3855-8961
Ateka A. Contractor https://orcid.org/0000-0003-3032-4578

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