Journal of Anxiety Disorders 62 (2019) 77–85

Contents lists available at ScienceDirect

Journal of Anxiety Disorders

journal homepage: www.elsevier.com/locate/janxdis

An investigation of the effect of trauma script exposure on risk-taking among patients with substance use disorders and posttraumatic stress disorder☆

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ARTICLE INFO

Keywords:
Emotion regulation
Experimental psychopathology
Impulsivity
Substance dependence
Trauma

ABSTRACT

Studies show that patients with substance use disorders (SUD) and posttraumatic stress disorder (PTSD) are at high risk for engaging in risky behaviors. However, these studies do not speak to the context in which these behaviors are more likely to occur. This study examined whether SUD patients with current PTSD, compared to those without a history of PTSD, are more likely to exhibit risk-taking on a laboratory-based risk-taking task, the Iowa Gambling Task (IGT), following exposure to a personalized trauma script versus a neutral script. The sample consisted of 122 trauma-exposed SUD patients with and without PTSD. Participants were administered a series of diagnostic interviews and personalized trauma scripts were created. On separate days, participants were exposed to a neutral or trauma script, followed by the IGT. Contrary to expectations, PTSD-SUD patients exhibited significantly greater risk-taking after the neutral (vs. trauma) script than those without PTSD. Moreover, whereas SUD patients without PTSD evidenced stability in IGT performance across scripts, those with PTSD exhibited significantly lower risk-taking on the IGT following the trauma (vs. neutral) script. Results provide support for the context dependent nature of risk-taking in PTSD-SUD patients and suggest they may become more risk averse in the context of trauma-related distress.

1. Introduction

With the publication of the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), several changes were made to the symptom structure of PTSD, including the addition of a symptom focused on the presence of risky or destructive behavior (American Psychiatric Association, 2013). This modification was largely driven by growing evidence that individuals with PTSD are at heightened risk for a variety of impulsive, risky, and self-destructive behaviors (e.g., Brewerton, 2007; Green et al., 2005; Weireich & Nock, 2008). Notably, there is evidence that such behaviors may be more pronounced within certain subgroups of PTSD patients, such as those with substance use disorders (SUDs; Tull, Weiss, & McDermott, 2016). For example, studies repeatedly demonstrate that SUD patients with PTSD are at high risk for engaging in a variety of risky and impulsive behaviors, including suicidal and non-suicidal self-injury (Dixon-Gordon, Tull, & Gratz, 2014; Harned, Najavits, & Weiss, 2006), risky sexual behavior (Weiss, Tull, Borne, & Gratz, 2013), and other health-risk behaviors (e.g., illegal behaviors, disordered eating behaviors, excessive spending; Weiss, Tull, Viana, Anestis, & Gratz, 2012; Weiss, Tull, Sullivan, Dixon-Gordon, & Gratz, 2015). Furthermore, findings of elevated risky behaviors among SUD patients with PTSD are consistent with evidence that disinhibition may be a shared underlying neurocognitive vulnerability of both PTSD and SUDs (Gilbertson et al., 2006; Sadeh et al., 2015; Tarter et al., 2003).

Although patients with co-occurring SUD and PTSD exhibit elevated rates of risky behaviors, it is not clear whether these behaviors are more likely to occur in certain contexts. One context worth investigating is trauma-related emotional distress. PTSD (alone and in combination with SUDs) is associated with elevated difficulties in emotion regulation (McDermott, Tull, Gratz, Daughters, & Lejuez, 2009; Tull, Barrett, McMillan, & Roemer, 2007). Consequently, individuals with PTSD may have difficulty tolerating the intense distress and/or emotional arousal resulting from exposure to a trauma-related reminder, which, in turn, may increase motivation to engage in behaviors that alleviate distress in the short-term via immediate negative reinforcement (e.g., the rapid reduction of tension and arousal through aggressive behaviors, self-injury, or substance use) or positive reinforcement (e.g., the experience

☆ This study was supported in part by R21 DA030587 awarded to the first author (MTT) and K23 DA039327 and L30 DA038349 awarded to the third author (NHW) from the National Institute on Drug Abuse of the National Institutes of Health.

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https://doi.org/10.1016/j.janxdis.2019.01.002
Received 31 January 2018; Received in revised form 22 November 2018; Accepted 4 January 2019
Available online 07 January 2019
0887-6185/

of intense positive affect through risky sexual behavior). This process is consistent with an affective processing model of negative reinforcement (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004), as well as evidence that risk-taking behaviors may serve an emotion regulating function (Weiss, Sullivan, & Tull, 2015; Weiss, Tull, & Gratz, 2014) and are more likely to occur in the context of intense emotional arousal (Flett, Blankstein, & Obertynski, 1996).

Providing further support for this model, there is emerging research that some of the difficulties experienced by SUD patients with PTSD may be more likely to occur in the context of trauma-related emotional distress. For example, research indicates that, among SUD patients, PTSD is associated with an attentional bias for drug cues (Tull, McDermott, Gratz, Coffey, & Lejuez, 2011) and greater cravings for substances (Saladin et al., 2003) only following exposure to a trauma script (and not following a neutral emotion induction). Moreover, and providing further support for the context dependent nature of certain difficulties among SUD patients with PTSD, Tull et al. (2011) found that SUD patients with PTSD exhibited an attentional avoidance of drug cues following exposure to a non-emotionally evocative script. To date, no studies have examined whether risk-taking in particular is more likely to occur in the context of trauma-related distress among patients with co-occurring SUD-PTSD. Further research in this area may facilitate identification of the specific contexts in which SUD patients with PTSD are at greater risk for engaging in maladaptive behaviors, thus informing the development of targeted interventions aimed at reducing health risk behaviors in this population.

The purpose of the present study was to examine whether trauma-exposed SUD patients with a current diagnosis of PTSD, compared to those without a history of PTSD, are more likely to exhibit risk-taking on a laboratory-based task (the Iowa Gambling Task [IGT]; Bechara, Damasio, Damasio, & Anderson, 1994) following exposure to a personalized trauma script versus a non-emotionally evocative (i.e., neutral) script. The IGT is one of the most commonly-used behavioral assessments of risky decision making (Beitz, Salthouse, & Davis, 2014; Buelow & Blaine, 2015; Schmitz, Kunina-Habenicht, Hildebrandt, Oberauer, & Wilhelm, 2018), and has been used to examine risk taking within SUD (Dom, Sabbe, Hulstijn, & Van Den Brink, 2005; Kovács, Richman, Janka, Maraz, & Andó, 2017) and PTSD (Dretsch, Thiel, Athy, Born, & Prue-Owens, 2013; Roca, Hart, Kimbrell, & Freeman, 2006) samples.

We hypothesized that SUD patients with PTSD would exhibit greater risk-taking following trauma script exposure than those without PTSD. Conversely, and consistent with the hypothesized context dependent nature of risk-taking, we did not expect to observe any between group differences in risk-taking following exposure to a neutral script. We also predicted that there would be a significant increase in risk-taking from neutral to trauma script among SUD patients with PTSD but no change in risk-taking across scripts among SUD patients without PTSD.

Finally, to ensure that any observed between group differences are due to PTSD (vs. the presence of psychopathology in general, or differences in demographic characteristics associated with risk-taking), analyses were repeated covarying variables that have previously shown associations with risk-taking, including age (Deakin, Aitken, Robbins, & Sahakian, 2004; Figner, Mackinlay, Wilkening, & Weber, 2009), gender (Byrnes, Miller, & Schafer, 1999; Zuckerman & Kuhlman, 2000), racial/ethnic background (Halpern et al., 2004; Pflieger, Cook, Niccolai, & Connell, 2013), income level (German & Latkin, 2012; Green, Myerson, Lichtman, Rosen, & Fry, 1996), education level (Chiolero, Weitlisbach, Ruffieux, Paccaud, & Cornuz, 2006; Kelly et al., 1991), anxiety disorder diagnoses (Pawluck & Koerner, 2013; Summerfeldt, Hood, Antony, Richter, & Swinson, 2004), major depression (Chandler, Wakeley, Goodwin, & Rogers, 2009; Peluso et al., 2007), borderline personality disorder (Berlin, Rolls, & Iversen, 2005; Mann, Waternaux, Haas, & Malone, 1999), antisocial personality disorder (Sher & Trull, 1994; Swann, Lijffijt, Lane, Steinberg, & Moeller, 2009), and severity of substance use (Ball, 2005; Mooney et al., 2008). We hypothesized that results would remain the same when these factors were included in the model, demonstrating the unique relevance of PTSD to risk-taking in the context of trauma-related distress.

2. Method

2.1. Participants

Participants were 122 patients (57 women) in a residential SUD treatment facility reporting exposure to a PTSD Criterion A traumatic event (American Psychiatric Association, 2013) on the Clinician-Administered PTSD Scale (Blake et al., 1990) who either met criteria for current PTSD or had no history of PTSD. Standard treatment at this residential SUD treatment facility involves a combination of strategies from Alcoholics Anonymous and Narcotics Anonymous, as well as groups focused on relapse prevention. No exposure-based treatments are available for addressing trauma-related symptoms. The center requires complete abstinence from drugs and alcohol with the exception of caffeine. Aside from scheduled activities, residents are not permitted to leave the treatment facility. Contract duration for the treatment facility is approximately 30 days.

Participants ranged from 18 to 60 years of age (*mean* = 34.78, *SD* = 10.73) and were ethnically diverse (54.9% White; 41.8% African-American; 1.6% Native American; 0.8% Latina/o; 0.8% Asian American). As for the education level of participants, 30.4% reported receiving their high school diploma or GED and 33.6% reported completing some form of higher education. Most participants were unemployed at the time of the study (63.9%) and approximately half of the participants had an annual household income of less than $10,000 (51.6%). Diagnostic data for participants are presented in Table 1. Information on Criterion A traumatic events and overall potentially traumatic events endorsed across all participants is presented in Table 2.

2.2. Measures and stimuli

2.2.1. Diagnostic assessment measures

To establish current and lifetime PTSD diagnoses (as well as Criterion A traumatic event exposure), all participants were interviewed using the DSM-IV version of the Clinician-Administered PTSD Scale (Blake et al., 1990). The Clinician-Administered PTSD Scale is a structured diagnostic interview and the most widely used measure of PTSD (Elhai, Gray, Kashdan, & Franklin, 2005). It assesses the frequency and intensity of the 17 DSM-IV (American Psychiatric Association, 2000) PTSD symptoms (plus eight associated symptoms). Frequency items are rated from 0 (never or none/not at all) to 4 (daily or almost every day or more than 80%). Intensity items are rated from 0

Table 1
Current diagnostic and clinical data across all participants.

	% Present (*n*)
Posttraumatic Stress Disorder	41.0% (50)
Major Depressive Disorder	23.8% (29)
Panic Disorder with/without Agoraphobia	27.9% (34)
Social Anxiety Disorder	27.0% (33)
Obsessive-Compulsive Disorder	12.3% (15)
Generalized Anxiety Disorder	27.9% (34)
Alcohol Dependence	65.6% (80)
Cocaine Dependence	65.6% (80)
Opioid Dependence	22.1% (27)
Marijuana Dependence	32.8% (40)
Sedative Dependence	23.8% (29)
Stimulant Dependence	22.1% (27)
Hallucinogen Dependence	4.9% (6)
Antisocial Personality Disorder	41.0% (50)
Borderline Personality Disorder	38.5% (47)

Table 2
Rates of Criterion A and overall traumatic exposure.

Potentially Traumatic Events	Criterion A % (*n*)	Experienced % (*n*)	Witnessed % (*n*)	Learned About % (*n*)
Natural disaster	1.6% (2)	48.4% (59)	5.7% (7)	1.6% (2)
Fire or explosion	—	23.0% (28)	4.1% (5)	1.6% (2)
Transportation accident	11.5% (14)	68.0% (83)	2.5% (3)	0.8% (1)
Serious accident at work, home, etc.	2.5% (3)	19.7% (24)	2.5% (3)	—
Exposure to toxic substance	—	4.9% (6)	0.8% (1)	—
Physical assault	13.1% (16)	77.9% (95)	2.5% (3)	0.8% (1)
Assault with a weapon	13.9% (17)	47.5% (58)	1.6% (2)	0.8% (1)
Rape	12.3% (15)	29.5% (36)	—	2.5% (3)
Other uncomfortable sexual experience	—	27.9% (34)	—	0.8% (1)
Combat or war-zone exposure	—	5.7% (7)	0.8% (1)	0.8% (1)
Captivity	0.8% (1)	10.7% (13)	—	—
Life-threatening illness or injury	2.5% (3)	27.0% (33)	2.5% (3)	0.8% (1)
Severe human suffering	4.9% (6)	13.9% (17)	4.9% (6)	—
Sudden, violent death	3.3% (4)	—	26.3% (32)	7.4% (9)
Sudden, unexpected death of a loved one	29.5% (36)	47.5% (58)	4.1% (5)	11.5% (14)
Serious injury/harm caused to another	4.1% (5)	18.9% (23)	0.8% (1)	—
Other	—	9.8% (12)	0.8% (1)	0.8% (1)

(none) to 4 (extreme). The Item Severity ≥ 4 (ISEV4) rule, which requires that at least one intrusion, three avoidance/emotional numbing, and two hyperarousal symptoms have a severity rating (frequency + intensity) of ≥4, was used to establish current PTSD diagnoses. The Clinician-Administered PTSD Scale has adequate interrater reliability (0.92–0.99) and convergent validity with the Structured Clinical Interview for DSM-IV Axis I disorders (SCID-I; First, Spitzer, Gibbon, & Williams, 1996) and other established measures of PTSD (Weathers, Keane, & Davidson, 2001). In addition, the robust psychometric properties of the Clinician-Administered PTSD Scale have been supported in combat and civilian samples, including SUD patients (e.g., Blake et al., 1990; Brown, Stout, & Mueller, 1996; Shalev, Freedman, Peri, Brandes, & Sahar, 1997; Weathers et al., 2001).

In addition to PTSD, participants were evaluated for the presence of current mood and anxiety disorders and SUDs. The Mini International Neuropsychiatric Interview, Version 6.0 (MINI; Sheehan, Janavs, Harnett-Sheehan, Sheehan, & Gray, 2009) was used to assess for current DSM-IV Axis I disorders (with the exception of PTSD and SUDs) and antisocial personality disorder. The MINI has shown adequate reliability and validity in the assessment of psychiatric disorders, as well as strong test-retest and inter-rater reliability (Sheehan et al., 1997). The SCID-IV (First et al., 1996), a diagnostic interview with demonstrated validity and reliability (Kranzler et al., 1995; Lobbestael, Leurgans, & Arntz, 2011), was used to assess for current SUDs. Finally, borderline personality disorder was assessed using the borderline personality disorder module of the Diagnostic Interview for DSM-IV Personality Disorders (DIPD-IV; Zanarini, Frankenberg, Sickel, & Yong, 1996). Past research indicates that the DIPD-IV demonstrates good inter-rater and test-retest reliability for the assessment of borderline personality disorder (Zanarini et al., 2000), with an inter-rater kappa coefficient of 0.68 and a test-retest kappa coefficient of 0.69. Interviews were conducted by bachelors- or masters-level clinical assessors previously trained to reliability with the principal investigator (MTT) and co-investigator (KLG) on the Clinician-Administered PTSD Scale, MINI, SCID-IV, and DIPD-IV. Detailed information on each disorder was collected by interviewers, and all data were reviewed by the principal investigator. In the case of ambiguous responses, data were reviewed and discussed by the principal investigator and interviewer until a consensus was reached.

2.2.2. Personalized trauma and neutral scripts

During the initial assessment session, participants were asked specific questions regarding their most traumatic life event as part of the Clinician-Administered PTSD Scale. This portion of the session was tape recorded so that a research assistant affiliated with the study could create a script using the participant's own language. Participants were asked to picture the situation in their mind and try to remember as vividly as possible what the event entailed and their feelings at the time. Participants were then asked to describe the incident in as much detail as possible. The interviewer probed for key aspects of the event (e.g., time and place of the event, as well as emotions, thoughts, and bodily sensations experienced during the event). Prior to the first experimental session, a script consisting of a series of autobiographical statements, appraisals, and emotional responses generated from the interview was recorded onto an audiotape. This script was approximately one minute in length and the narrator was consistent across all scripts. All scripts were presented in a male voice with a neutral tone.

The method for generating this personalized trauma script was based on procedures originally developed by Lang and colleagues (see Lang & Cuthbert, 1984; Levin, Cook, & Lang, 1982) and adapted by Pitman, Orr, Forgue, de Jong, and Claiborn (1987) and Keane et al. (1998) to examine PTSD-relevant arousal in the laboratory. However, there were some modifications to the original procedure (e.g., scripts used in the current study were one minute in length versus 30 s in length, and participants were asked to detail their event verbally as opposed to in writing). The script is designed to maximize emotional responses by depicting the events in a salient, emotion-focused form in second person, present tense. This procedure has been found to reliably induce emotional responses in PTSD samples (Lang, Levin, Miller, & Kozak, 1983; Orr, Pitman, Lasko, & Herz, 1993; Pitman et al., 1987), including SUD patients with PTSD (Tull et al., 2011).

Neutral scripts were also developed for this study. Consistent with Keane et al. (1998), the neutral script was standardized and consistent across participants. It provided a description of activities involved in getting up in the morning (e.g., brushing teeth, getting dressed, etc.). Similar to the personalized trauma script, the neutral script was approximately one minute in length and consisted of descriptions of morning events, as well as thoughts and feelings that a person may experience in response. The neutral script was 216 words in length.

2.2.3. Assessment of self-reported emotional reactivity

To ensure that the personalized trauma script evoked greater negative affect than the neutral script, participants were administered the negative affect subscale of the Positive and Negative Affect Scales (PANAS; Watson, Clark, & Tellegen, 1998) immediately prior to and following presentation of the trauma and neutral script. Specifically, participants were asked to rate the extent to which they were currently ("right now, at this very moment") experiencing 10 forms of negative affect on a scale from 1 (very slightly or not at all) to 5 (extremely). Overall negative affect was calculated by summing all items. Internal

consistencies (raw) of the negative affect subscale pre- ($\alpha = 0.87$) and post-trauma script ($\alpha = 0.91$) and pre- ($\alpha = 0.86$) and post-neutral script ($\alpha = 0.88$) were adequate.

2.2.4. Measurement of risk-taking

Risk-taking was assessed using the computerized IGT (Bechara et al., 1994). The IGT was developed to assess real-world risky decision making in a laboratory setting (Bechara et al., 1994). On the IGT, participants are instructed to maximize profit on a $2000 "loan" by selecting cards from four decks (Decks A, B, C, and D). On each draw, Decks A and B yield an average profit of $100, and Decks C and D yield a profit of $50. However, over the course of 10 selections from Decks A and B, participants incur a net loss of $250, whereas 10 selections from Decks C and D yield a net gain of $250 (Bechara et al., 1994). Given that Decks A and B yield larger rewards but also occasional and unpredictable large losses, they are viewed as disadvantageous, and repeated selection of these decks is considered a risky behavior. Although Decks C and D present smaller rewards, they also present smaller occasional losses, and, thus, are considered to be advantageous (Carlson, Zayas, & Guthormsen, 2009). In addition to long-term gain versus loss, the decks also differ in their frequency of associated reward and loss. Deck B yields the same net loss as Deck A for every 10 trials, but offers high magnitude, low frequency losses. Similarly, Deck D yields infrequent losses of high magnitude, but provides more gains compared to losses over 10 trials. The IGT typically includes 100 trials; however, we reduced the number of trials to 50 due to concerns about the ability of SUD patients to maintain focus throughout the lengthy experimental procedure (similar to what has been done in past studies with other populations; see Burdick, Roy, & Raver, 2013).

Risk-taking is evaluated by calculating the learning of long-term consequences (LTC) index (see Bechara et al., 1994). The LTC index is calculated by subtracting the proportion of disadvantageous deck choices from the proportion of advantageous deck choices ([C + D] − [A + B]). Higher scores indicate a preference for the advantageous decks that incrementally lead to greater total gain and lower loss over time (Burdick et al., 2013), thus representing less risk-taking behavior. The LTC index is a commonly used outcome and considered the primary indicator of performance on the IGT (Schmitz et al., 2018).

There is considerable support for the construct validity of the IGT (Buelow & Suhr, 2009). Of relevance to the current study, both individuals with SUDs and patients with PTSD, as well as other clinical populations characterized by greater risk-taking behaviors (e.g., patients with ADHD and borderline personality disorder), reliably demonstrate greater risk-taking on the IGT than healthy controls (Bartzokis et al., 2000; Bowden-Jones, McPhillips, Rogers, Hutton, & Joyce, 2005; Dom et al., 2005; Dretsch et al., 2013; Kovács et al., 2017; Malloy-Diniz, Fuentes, Leite, Correa, & Bechara, 2007; Maurex et al., 2009; Verdejo-García, Rivas-Pérez, Vilar-López, & Perez-García, 2007).

2.3. Procedure

All procedures were reviewed and approved by the University of Mississippi Medical Center and Mississippi State Department of Mental Health Institutional Review Boards. Data were collected as part of a larger study on PTSD, emotional responding, and risk-taking among patients with alcohol and/or cocaine dependence. To be eligible for inclusion in the larger study, participants were required to: 1) be dependent on cocaine and/or alcohol (although participants could also be dependent on other substances in addition to cocaine and alcohol); 2) have a Mini-Mental Status Exam (Folstein, Folstein, & McHugh, 1975) score of ≥ 24 (indicative of no significant cognitive impairment); and 3) have no current psychotic disorder (as determined by the psychosis screener from the SCID-I; First et al., 1996). Eligible participants were recruited for this study no sooner than 72 h after entry into the facility to limit the possible interference of withdrawal symptoms on study engagement. Those who met inclusion criteria were provided with information about study procedures and associated risks, following which written informed consent was obtained.

This study involved three sessions conducted on separate days. There was usually one day between each session, although some modifications to this schedule occurred due to participant appointments or other treatment-related responsibilities. During the initial assessment session, participants completed the previously described interviews, as well as questionnaires assessing relevant demographic and clinical characteristics (including current use of psychotropic medications). Upon completion of this session, participants scheduled a second and third session and were compensated with $25. The procedures for the second and third sessions were the same, with the exception of the particular script presented. Script presentation was counterbalanced, and the order of script presentation was equally balanced across participants with current PTSD or no history of PTSD. At the start of each experimental session, participants first rated their current negative affect. Next, they listened to the one-minute tape. Once the tape was finished, participants were instructed to close their eyes and imagine vividly the event taking place in real-time for one minute. Afterwards, participants again provided an assessment of their current negative affect. Participants were then administered the IGT. All participants received standard instructions for the IGT. They were told that they would be presented with four decks of cards and asked repeatedly to select a card from one of the four decks, with the objective of trying to win as much money as possible. Participants were told that with each card they selected, they could win or lose money. They were informed that some decks may be more profitable than others; however, they were not given information on the schedule of wins and losses for each deck or the best strategy for choosing decks. After the IGT, the next experimental session was scheduled. Participants were compensated with $15 for each experimental session.

3. Results

3.1. Manipulation check

To ensure that the trauma script resulted in an increase in negative affect and the neutral script did not, a series of 2 (current PTSD vs. no history of PTSD) × 2 (pre- vs. post-script) repeated measures analyses of variance (ANOVAs) were conducted to evaluate change in negative affect from before to after the trauma and neutral scripts. Although all participants reported a significant increase in negative affect from pre- (*mean* = 14.66, *SD* = 6.08) to post-trauma script (*mean* = 21.48, *SD* = 9.77), $F(1, 120) = 95.09$, $p < .001$, $\eta_p^2 = 0.44$, this finding was qualified by a significant PTSD by time interaction, $F(1, 120) = 6.55$, $p = .012$, $\eta_p^2 = 0.05$. Although both participants with current PTSD, $t(49) = -7.89$, $p < .001$, *Cohen's d* = −1.20, and those without PTSD, $t(71) = -5.68$, $p < .001$, *Cohen's d* = −0.72, reported a significant increase in negative affect from pre- to post-trauma script, those with PTSD reported a significantly greater change in negative affect from pre- to post-trauma script, $t(120) = -2.72$, $p = .007$, *Cohen's d* = −0.50.

We also explored changes in specific emotions (fear, anger, shame, and guilt) from pre- to post-trauma script as a function of PTSD status. A significant PTSD by time interaction was found for fear (a variable created by summing participant ratings on the items of *scared*, *jittery*, *nervous*, and *afraid* from the PANAS-NA), $F(1, 120) = 6.67$, $p = .011$, $\eta_p^2 = 0.05$. Post-hoc analyses demonstrated that participants with (vs. without) PTSD reported a significantly greater increase in fear from pre- to post-trauma script, $t(120) = -2.68$, $p = .008$, *Cohen's d* = −0.49. Similar findings were obtained for anger (created by summing participant ratings on the items of *irritable* and *hostile* from the PANAS-NA), $F(1, 120) = 11.11$, $p = .001$, $\eta_p^2 = 0.09$. As with fear, post-hoc analyses demonstrated that participants with (vs. without) PTSD reported a significantly greater increase in anger from pre- to post-trauma script, $t(120) = -3.66$, $p < .001$, *Cohen's d* = −0.67. No significant PTSD by

time interactions were found for shame (a single item from the PANAS-NA), F (1, 120) = 1.15, p = .29, η_p^2 = 0.01, or guilt (a single item from the PANAS-NA), F (1, 120) = 0.23, p = .64, η_p^2 = 0.00.

Across all participants, the neutral script was associated with a significant decrease in negative affect from pre- (*mean* = 14.85, *SD* = 6.29) to post-script (*mean* = 13.97, *SD* = 5.76), F (1, 120) = 7.75, p = .006, η_p^2 = 0.06. No significant PTSD by time interaction was found for changes in negative affect in response to the neutral script, F (1, 120) = 0.96, p = .33, η_p^2 = 0.01.

All scripts were presented using a male voice; thus, scripts could have been more emotionally evocative for women who experienced a traumatic event involving a male perpetrator. In order to ensure that trauma scripts were not more emotionally evocative for women, we explored the moderating role of gender on change in negative affect from pre- to post-trauma script with a 2 (current PTSD vs. no history of PTSD) × 2 (male vs. female) × 2 (pre- vs. post-script) repeated measures ANOVA. Results revealed no significant gender by time, F (1, 118) = 1.55, p = .22, η_p^2 = 0.01, or PTSD by gender by time, F (1, 118) = 0.11, p = .74, η_p^2 = 0.00, interactions, suggesting that the trauma scripts were equally evocative for women and men.

3.2. Counterbalancing

To evaluate the success of counterbalancing, a 2 (neutral script vs. trauma script) × 2 (neutral script presented first vs. trauma script presented first) repeated measures ANOVA was conducted with IGT scores serving as the dependent variable. No significant script by presentation order interaction was found, F (1, 120) = 0.07, p = .79, η_p^2 = 0.001, demonstrating that IGT scores following the neutral and trauma scripts were not influenced by the order in which the scripts were presented.

3.3. Primary analyses

Of the study sample, 41% (n = 50) of participants met criteria for current PTSD. The average word count of the trauma script across all participants was 212.27 words (*SD* = 71.61). There was not a significant difference in length of the trauma script between participants with current PTSD (*mean* = 216.43, *SD* = 69.52) and those without a history of PTSD (*mean* = 209.26, *SD* = 73.47), t (110) = −0.52, p = .60, *Cohen's d* = −0.10.[1] Descriptive data for the IGT across groups and scripts are presented in Table 3.

To evaluate hypotheses, a 2 (neutral vs. trauma script) × 2 (current PTSD vs. no history of PTSD) repeated measures ANOVA was conducted. IGT scores following the neutral and trauma scripts served as the dependent variables. Significant interactions were explored with planned comparisons. The initial test of hypotheses was conducted without the inclusion of any covariates. Results demonstrated a significant script by PTSD interaction, F (1, 120) = 5.85, p = .017, η_p^2 = 0.05 (see Fig. 1). Post-hoc evaluation of the interaction demonstrated that, relative to participants without PTSD, participants with current PTSD demonstrated significantly lower scores (i.e., greater risk-taking) on the IGT after the neutral script, t (120) = 2.05, p = .04, *Cohen's d* = 0.38; however, there was no significant difference between groups on the IGT following the trauma script, t (120) = −0.72, p = .47, *Cohen's d* = −0.13.[2] Moreover, whereas participants without a history of PTSD did not evidence a significant change in IGT performance from post-neutral to post-trauma script, t (71) = 1.05, p = .30, *Cohen's d* = 0.13, participants with current PTSD exhibited a significant increase in IGT scores from post-neutral to post-trauma script, t (49) = −2.03, p = .047, *Cohen's d* = −0.31.

The above analyses were repeated with the following covariates included in the model: age, gender, racial/ethnic background (dichotomously represented as non-White [45.1%] or White [54.9%]), income level (dichotomously represented as less than [51.6%] or greater than [48.4%] $10,000/year), education level (dichotomously represented as high school graduate or less [66.4%] and post-high school education [33.6%]), number of anxiety disorder diagnoses, presence of major depression, presence of borderline personality disorder, presence of antisocial personality disorder, and number of SUDs. The significant script by PTSD interaction remained, F (1, 110) = 7.54, p = .007, η_p^2 = 0.06, as did the pattern of findings associated with the interaction.

4. Discussion

The goal of this study was to evaluate the context dependent nature of risk-taking among patients with a SUD and current PTSD. Specifically, we expected that SUD patients with current PTSD would exhibit greater risk-taking following a personalized trauma script than trauma-exposed SUD patients with no history of PTSD. On average, all participants had LTC scores in the negative range after the neutral and trauma scripts, indicative of greater risk-taking tendencies and consistent with what has been found in other studies using the IGT with SUD patients (e.g., Dom et al., 2005; Kovács et al., 2017; Verdejo-García et al., 2007). However, contrary to hypotheses, a different and unexpected pattern of findings emerged when considering the influence of PTSD on risk-taking after the neutral and trauma scripts. Specifically, SUD patients with current PTSD exhibited significantly greater risk-taking after the neutral (vs. the trauma) script than those without PTSD. Moreover, whereas SUD patients without a history of PTSD evidenced stability in IGT performance following the neutral and trauma scripts, those with current PTSD exhibited significantly lower risk-taking on the IGT following the trauma (vs. neutral) script. Thus, although results suggest that risk-taking among SUD patients with PTSD is context dependent, the nature of this relation was in the opposite direction of what was expected.

Although counter to expectations, this finding is consistent with evidence on the function of fear, which was found to be elicited to a greater extent among participants with PTSD during the trauma script. Specifically, the experience of fear signals the presence of threat and promotes physiological responses that rapidly prepare individuals to respond to the threat in such a way that risk for harm is reduced (Barlow, 2002). Consistent with this function of fear, as well as the results of the current study, Maner et al. (2007) found that patients with anxiety disorders exhibited greater risk aversion on a laboratory-based risky decision-making task than patients with mood disorders and non-clinical controls. In the present study, SUD patients with current PTSD experienced a stronger fear response to the trauma script which, in turn, may have been associated with greater risk aversion on the IGT. That said, the trauma script also resulted in a greater increase in anger among participants with (vs. without) PTSD. Although there is some evidence that anger may result in risk aversion among women (Bagneux, Bollon, & Dantzer, 2012), anger has been found to increase risk-taking among men (Fessler, Pillsworth, & Flamson, 2004) –

[1] Transcripts were missing for seven participants without a history of PTSD and three participants with current PTSD. Therefore, word count for these scripts was not included in analyses.

[2] In addition to the LTC index, a bias for infrequent loss (IFL) index can also be calculated by subtracting the participants' number of frequent-loss deck choices from the number of infrequent-loss deck choices ([A + D] − [B + C]). This index reflects the number of deck choices that lead to infrequent but larger losses relative to the number of deck choices that lead to frequent but smaller losses. Positive scores are indicative of more frequent loss choices (Hooper, Luciana, Conklin, & Yarger, 2004). When the IFL index was used as a dependent variable in analyses, no significant PTSD by script interaction emerged, F (1, 120) = 0.40, p = .84, η_p^2 < 0.001. This suggests that participants with and without PTSD do not differ significantly on sensitivity to information that their decisions may result in losses of greater magnitude.

Table 3
Descriptive statistics for IGT performance across groups and scripts.

	Neutral					Trauma				
	Deck A	Deck B	Deck C	Deck D	LTC	Deck A	Deck B	Deck C	Deck D	LTC
No PTSD	0.35 (0.15)	0.20 (0.08)	0.21 (0.11)	0.24 (0.08)	−0.10 (0.22)	0.37 (0.18)	0.19 (0.09)	0.19 (0.11)	0.24 (0.14)	−0.13 (0.30)
PTSD	0.40 (0.21)	0.20 (0.10)	0.19 (0.10)	0.22 (0.10)	−0.19 (0.30)	0.36 (0.14)	0.18 (0.09)	0.18 (0.09)	0.27 (0.13)	−0.09 (0.25)

Note. For data presented, means are presented first, followed by standard deviations in parentheses. Statistics for each deck are represented as a proportion (number of responses/50 trials). LTC (Learning of Long-Term Consequences) is calculated using this formula: ([C + D] − [A + B]).

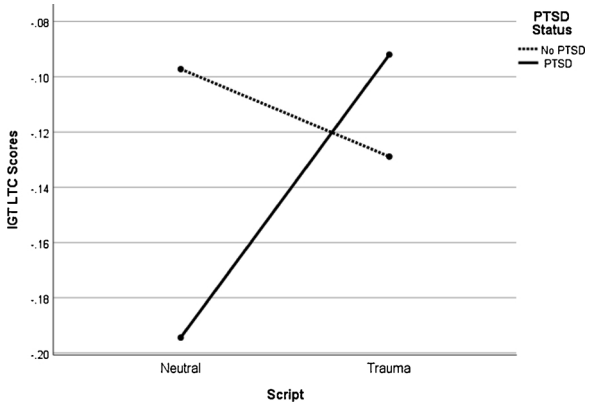

Fig. 1. PTSD by script interaction for IGT learning of long-term consequences scores.

consistent with findings that anger may influence risk perception by increasing the extent of indiscriminate optimism about chances at success (Lerner & Keltner, 2000, 2001). Together, these findings along with the results of our study suggest that fear may have had a stronger influence on risky decision-making following the trauma script among participants with PTSD.

Nonetheless, it is important to note that our study was not designed to test the impact of specific emotions on risk-taking following trauma script exposure among SUD patients with (vs. without) PTSD. Future studies are needed to examine whether risk-taking is increased or decreased among SUD patients with PTSD across other contexts, such as specific emotional states (e.g., anger, happiness, sadness, fear) unrelated to a traumatic event, interpersonal contexts, or substance use-related contexts (i.e., in the presence of cues for substance use). Such research may elucidate the specific ways in which different contexts may modulate risk-taking among SUD patients with PTSD, thus highlighting specific areas to target in treatment. In addition, we should also consider the possibility that risk-taking may not always be maladaptive. There may be certain situations where risk-taking may be adaptive (e.g., to reduce the likelihood of potentially even greater harm from occurring as a result of not acting). Future research is thus needed that explores the influence of context on the adaptive or maladaptive nature of risk-taking.

In identifying possible explanations for our findings, the differential effect of trauma script exposure on PTSD symptoms between participants with and without PTSD should also be considered. For example, relative to trauma-exposed participants without PTSD, participants with PTSD may have been more likely to experience intrusive thoughts in response to the trauma script, which could have influenced risk-taking. The experience of intrusive thoughts may have resulted in increased physiological arousal and hypervigilance, which, in turn, could have led to a greater awareness of the external environment, including contingencies on the IGT. Alternatively, the experience of hyperarousal symptoms stemming from trauma script exposure may have countered baseline emotional numbing symptoms (Frewen & Lanius, 2006), increasing sensitivity and responsiveness to reinforcing contingencies on the IGT and, ultimately, improving performance on the IGT (Contractor, Elhai, Ractliffe, & Forbes, 2013; Nawijn et al., 2015). Unfortunately, this study did not assess the experience of PTSD symptoms following trauma script exposure. Future studies attempting to replicate or extend our findings would benefit from incorporating measures such as the Responses to Script-Driven Imagery Scale (Hopper, Frewen, Sack, Lanius, & Van der Kolk, 2007), which assesses the severity of state PTSD symptoms (i.e., re-experiencing, avoidance, and dissociation symptoms) that can be evoked by a trauma-related reminder.

Despite the presence of theoretical and empirical literature offering support for our findings, results are counter to the growing body of research demonstrating that impulsive and risky behaviors may serve an emotion regulating function among individuals with PTSD (Weiss et al., 2012, 2014). They are also counter to evidence that, at least among nonclinical samples, greater negative mood is associated with riskier performance on the IGT (Suhr & Tsanadis, 2007). Nonetheless, the form of risky behaviors can vary substantially, and it is likely that not all risky behaviors share the same function. Consequently, the IGT may not be capturing the type of risk-taking behavior that would be effective in regulating emotion following exposure to a trauma-related cue. In this particular context, individuals with PTSD may be more likely to engage in behaviors that result in intense positive affect (e.g., risky sexual behavior), the dampening of negative affect (e.g., binge drinking), the substitution of physical pain for emotional pain (e.g., nonsuicidal self-injury), or the rapid release of tension (e.g., aggressive behavior). The innocuous stimuli and non-actualized rewards (i.e., participants do not actually receive the money they "win" during the task) associated with the IGT may make this task an ineffective strategy for regulating intense negative affect in these ways. Consequently, future research is needed to examine the factors that contribute to risk-taking and risk aversion among individuals with PTSD. In particular, there is a need to evaluate the function of different risky behaviors in the presence of different emotional states, as well as across situations (e.g., in the real world, via daily diary methodologies). Studies using daily diary methodology could identify whether greater risk-taking occurs following the experience of different mood states or after different types of emotionally-evocative situations.

The finding that SUD patients with current PTSD demonstrated greater risk-taking on the IGT following the neutral script than those without PTSD was also counter to expectations. This finding may reflect a potential underlying vulnerability associated with PTSD. Compared to those without PTSD, individuals with PTSD report greater trait impulsivity and disinhibition (Gilbertson et al., 2006; Joseph, Dalgleish, Thrasher, & Yule, 1997; Sadeh et al., 2015), and, among SUD patients in particular, those with PTSD have been found to exhibit greater risk-taking propensity than those without PTSD (Tull et al., 2009). Findings from these studies, combined with our finding that SUD patients with current PTSD showed lower risk-taking after the trauma versus neutral script, suggest that SUD patients with PTSD may have access to skills to manage certain forms of risk-taking behaviors in specific contexts despite an underlying vulnerability for such behaviors. Further exploration of these findings may aid in the identification of strengths that can be reinforced and further developed in treatment to reduce the likelihood of other risky behaviors in a variety of situations.

In evaluating the results of this study, it is important to consider

limitations that are present. First, although the use of a clinical sample of SUD patients is a strength of this study, this population is characterized by a high level of psychiatric comorbidity (Chen et al., 2011) and functional impairment (Hasin, Stinson, Ogburn, & Grant, 2007). Therefore, findings may not generalize to other SUD populations (e.g., non-treatment-seeking) or clinical (e.g., psychiatric outpatients) or nonclinical (e.g., college students) populations. In addition, given that all participants had to be dependent on cocaine and/or alcohol to be included in the larger study from which these data were drawn, the extent to which findings generalize to SUD patients who are not dependent on cocaine or alcohol (e.g., those dependent on marijuana or opioids only) is unclear. Results must be replicated using other samples of individuals with PTSD. In addition, all participants were in an inpatient treatment setting and required to have a period of abstinence prior to participating in this study. Therefore, it is not clear how the active use of substances would interact with PTSD to influence risk-taking following the occurrence of trauma-related emotional distress. In addition, the IGT was modified to include only 50 trials due to concerns about participant burden. Although there is precedent for such a modification (Burdick et al., 2013), there may not have been a sufficient number of trials for participants to learn the contingencies associated with each deck. Replication of findings is needed using the IGT as it was originally designed. Finally, in interpreting our findings, it is important to consider that we utilized a diagnostic interview designed to assess the DSM-IV diagnostic criteria for PTSD. The symptoms associated with PTSD and the criteria for determining a PTSD diagnosis were modified in the DSM-5 (see American Psychiatric Association, 2013). Future studies should attempt to replicate our findings among individuals meeting criteria for DSM-5 PTSD.

Although the results of this study were not consistent with expectations and require replication, they do suggest that researchers and clinicians should not assume that difficulties observed among individuals with PTSD are consistent across contexts or that risk-taking necessarily serves an emotion regulatory function. Instead, the presence or absence of problem behaviors among individuals with PTSD may be dependent on a variety of internal (e.g., emotional state, reward processing, personality traits such as disinhibition) and external (e.g., interpersonal context, presence or absence of cues for substance use, potential to escape from a situation) factors. This observation highlights the importance of conducting a functional analysis of problem behavior when working with clients with PTSD. Identification of the function of problem behaviors, as well as the contexts that give rise to or protect against those behaviors, can lead to the development of targeted and more personalized interventions. In addition, considering that all participants exhibited some level of risk-taking and that SUD patients with current PTSD exhibited greater risk-taking when not experiencing trauma-related emotional distress, there is utility in teaching SUD patients impulse control strategies, regardless of the presence or absence of a co-occurring PTSD diagnosis.

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