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Associations between impulsivity behaviors and difficulty extinguishing conditioned fear in adults with Post-traumatic Stress Disorder

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ASSOCITATIONS BETWEEN IMPULSIVITY BEHAVIORS AND DIFFIULTY EXTINGUISHING CONDITIONED FEAR IN ADULTS WITH POST-TRAUMATIC STRESS DISORDER

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Abstract

The majority of adults will experience a traumatic event, although only a minority (25%) of people exposed to a potentially traumatic event (PTE) develop Post-traumatic Stress Disorder (PTSD) within 12 months (Zatzick et al., 2007). This discrepancy underscores the importance of identifying risk factors that predict and contribute to the likelihood of developing PTSD. Individuals with PTSD face an increased risk for engaging in impulsive behaviors including substance abuse, risky sexual behaviors, self-harm, and disordered eating. The presence of these behaviors exacerbates impairments associated with PTSD and complicates the treatment and recovery processes (Roley et al., 2017; Goldstein et al., 2016). Using statistical methods in the R computing environment, the present project examined the associations between difficulty extinguishing a fear-potentiated startle response and impulsivity behavior among adults with PTSD. An association was expected between increased impulsive behaviors and decreased ability to inhibit learned fear within adults with PTSD. Preliminary data analyses showed no significant interaction between participants' ability to extinguish conditioned fear and impulsive behaviors.

Introduction

Post-Traumatic Stress Disorder

The majority of adults (89.7% in the United States) will experience or witness a potentially traumatic event (PTE) over the course of their lifetime (Kilpatrick et al., 2013). PTEs extend beyond typical daily stressors, are usually sudden and extreme, and can induce lasting impacts. Individuals who have experienced a PTE are at an elevated risk for developing Post-traumatic Stress Disorder (PTSD) as well as a range of comorbid diagnoses (Zatzick et al., 2007). While most individuals will not develop PTSD following exposure to trauma, the level and manifestations of PTSD and associated emotional distress is highly varied in severity. Within the United States, roughly 7-8% of all adults experience PTSD, which is equivalent to 25% of those who have experienced a PTE. The prevalence of PTSD is higher among women than men, when using the diagnostic criteria outlined in the fifth version of the Diagnostic and Statistical Manual of Mental Disorders (Kilpatrick et al., 2013). There is likely a cumulative effect of elements contributing to the development of PTSD, consisting of a mixture of protective factors (e.g., coping mechanisms or social support) and detrimental circumstances (e.g., history of childhood trauma or low socioeconomic status). Both trauma type and trauma load (i.e., number of traumatic events experienced over a lifetime) exhibit influence on the development of PTSD, with interpersonal trauma and high trauma load having the most significant effects (Overstreet et al., 2016).

Post-traumatic stress disorder consists of 20 symptoms categorized by four symptom clusters: intrusions, avoidance, negative alternations to cognition and mood (NACM), and changes in arousal and reactivity (AAR; American Psychiatric Association, 2013). Intrusions refer to repeated and unwanted memories of trauma, flashbacks, distressing dreams related to the

event, or significant distress that is reminiscent of the event. Avoidance includes actively attempting to avoid thinking or discussing the event or actively avoiding people and places that might trigger reminders of the event. Symptoms of NAMC involve negative thoughts about the world or oneself, hopelessness, issues with memory (especially in reference to the event), and detachment from family, friends, and previously enjoyable activities. AAR symptoms might include overactive startle response, constantly feeling guarded and alert, or trouble sleeping or concentrating (*Clinical Practice Guideline for the Treatment of Posttraumatic Stress Disorder (PTSD) in Adults*, 2017). The intensity of PTSD symptoms fluctuates over time, but to obtain a diagnosis of PTSD, symptoms must persist for minimally one-month post-trauma and must significantly interrupt one's daily functioning.

A proposed mechanism underlying the four symptom clusters of PTSD is fear dysregulation, specifically a diminished capacity for inhibiting fear under safe conditions. Fear is an evolutionary circuit designed for protection from threats, but exposure to trauma can impart lasting changes in traumatized individuals' interpretation and response to perceived threatening stimuli (Maddox et al., 2019). These changes are beneficial in a dangerous context but may contribute to functional impairments associated with trauma and resulting PTSD (Jovanovic et al., 2010a). The current understanding of PTSD is characterized by learned fear and disrupted fear processing due to a traumatic event, and existing data implicate the role of fear dysregulation in the development and maintenance of PTSD symptoms. These maladaptive responses often intrude on daily life and become problematic if left untreated. However, because of the heterogeneity of symptom presentation, current interventions do not adequately address each aspect of a specific diagnosis, and further research is required for design of more effective and personalized treatments.

Conditioned fear

Fear conditioning paradigms have been used extensively to increase understanding of neurobiological responses to fear by pairing neutral stimuli (conditioned stimuli) with an aversive stimuli (unconditioned stimuli). Within the context of trauma, conditioned fear refers to the traumatic event, acting as a previously unconditioned stimulus (US), now evoking an unconditioned response (UR), and eventually relating to the environmental conditions present during the original trauma. The environmental cues associated with the UR ultimately become conditioned stimuli (CS), which can then provoke the UR without the presence of the original US (VanElzakker et al., 2014). Many facets of PTSD are a result of maintained conditioned responses and a disrupted ability to extinguish this response (Norrholm et al., 2011). Further understanding of this malfunctioning fear response pattern and its associations with aspects of PTSD symptomology is necessary for gaining a deeper understanding of neurological mechanisms underlying PTSD and developing effective interventions.

Measuring conditioned fear using fear-potentiated startle response. According to the DSM-5, to receive a diagnosis of PTSD, suspected symptoms must persist for more than a month following the traumatic exposure (American Psychiatric Association, 2013). Thus, the proposed fear dysregulation model for PTSD focuses largely on an individual's ability to extinguish their conditioned fear, or lack thereof. If individuals possessed the ability to typically regulate (extinguish) their fear, PTSD symptoms would not develop or would be short-lasting. Extinction occurs when there is a reduction of a conditioned response because the conditioned stimulus no longer predicts the unconditioned stimulus (Careaga et al., 2016). Failure to sufficiently extinguish conditioned response is especially implicated in the persistence of traumatic memories and the inability to regulate fear even within safe conditions.

Previous studies (Jovanovic et al., 2005; Norrholm et al., 2011) have observed fear processing in PTSD and comorbid disorders (anxiety, depression, etc.) using fear-potentiation of the acoustic startle response (ASR). This paradigm measures the physiological response to a stimulus and can be used to assess fear within a subject. Using fear conditioning, a neutral stimulus (i.e., shapes on a screen) is paired with a threatening or startling cue (e.g., a puff of air or startling noise) to elicit a physiological fear response. This response can be measured using skin conductance (SCR), electromyographic response (EMG), and heart rate response (HRR), which are validated physiological measures of arousal. Within the fear-potentiated startle (FPS) paradigm, there is an expected increase in frequency and/or intensity of the subject's ASR in the presence of the previously neutral cue (conditioned stimulus). A meta-analysis examining the psychophysiology of PTSD determined an association between an exaggerated startle response during fear acquisition and PTSD. This exaggerated fear response presents as greater peak amplitudes in the EMG readings and skin conductance, and increased heart rate readings when compared to a control sample (Pole, 2007). Following fear acquisition, the conditioned stimulus is presented without the aversive cue, and the subject's ability to extinguish the learned fear is measured.

PTSD symptom severity is similarly associated with greater fear potentiation patterns when measured by FPS data. Using the FPS paradigm, Jovanovic (2009) examined ability to inhibit fear within safe conditions for 28 controls and 27 PTSD patients with low or high-severity PTSD. Individuals within the high severity PTSD group were unable to inhibit their fear within the context of the trials and demonstrated significantly increased potentiation of fear to the CS+ (Jovanovic et al., 2009).

Jovanovic et al., (2010) expanded their use of FPS paradigms with 106 individuals and produced consistent findings demonstrating that an inability to inhibit learned fear under conditions of safety underlies several distinctive PTSD symptoms and could impact presence of comorbidities. Due to the high comorbidity between PTSD and depression, especially among victims of childhood trauma, the authors examined the potential association between Major Depressive Disorder (MDD) and impaired inhibition of FPS. Although these disorders can develop independently, they are frequently comorbid in individuals with PTSD, and can present with overlapping clinical symptoms, including suicidality. Because of this significant overlap, determining disorder-specific biomarkers could establish beneficial diagnostic information. Participants of this study were administered a modified PTSD Symptom Scale (PSS), the Beck Depression Inventory (BDI), Childhood Trauma Questionnaire (CTQ), and the Traumatic Events Inventory (TEI). The authors used a conditional discrimination paradigm with shapes presented on a computer screen. The CS+ shape was reinforced with an air blast to the larynx, and the CS- shape was non-reinforced. Participants with comorbid MDD and PTSD demonstrated the highest FPS, although PTSD individuals both with MDD and without demonstrated an inability of discriminating between the safety cues and danger cues. The study suggested that this deficit in fear processing is likely specific to PTSD, although individuals with comorbid MDD and PTSD demonstrated increased impairment (Jovanovic et al., 2010).

Interactions of PTSD and Impulsive Behaviors

A growing body of research shows that individuals with PTSD are at increased risk for additional functional impairments and psychiatric disorders, specifically substance use, major depressive disorder, and related anxiety disorders (Galatzer-Levy et al., 2013). While the neurological mechanisms underlying this risk remain unclear, evidence alludes to the moderating

role of fear dysregulation, specifically when examining the occurrence of impulsive behavior, including substance abuse, unsafe sexual behaviors, self-harm, and disordered eating (Roley et al., 2017; Widom, 1999). The presence of these behaviors likely contributes to the maintenance of the four clusters of PTSD symptomology (intrusions, avoidance, NACM, and AAR).

Impulsivity, defined by Chamberlain and Sahakian (2007) as a "predisposition toward rapid, unplanned reactions to internal or external stimuli with diminished regard to the negative consequences of these reactions to the impulsive individual or to others," is implicit in many personality differences, psychiatric disorders, and risk-taking behaviors (Chamorro et al., 2012). Levels of impulsivity can significantly impact everyday life and maintenance of personal health, and it is therefore imperative to develop methods of assessing and regulating impulsive behaviors, especially when they become problematic.

As a construct, impulsivity is difficult to consistently measure across multiple populations, while accounting for different presentations and understandings of the term impulsivity. The UPPS-P Impulsive Behavior Scale, a measure developed by Whiteside and Lynam (2001), originally defined impulsivity as a four faceted psychological construct including negative urgency, lack of premeditation, lack of perseverance, and sensation seeking. The four traits examined in this measure:

1. *Negative urgency:* acting impulsively when experiencing intense negative emotions
2. *Lack of Premeditation:* a propensity to act without sufficient thought
3. *Lack of Perseverance:* difficulty focusing on tasks at hand
4. *Sensation Seeking:* intentional pursuit of experimental and exciting experiences and feelings

The scale has since been updated to include positive urgency to represent impulsive action under extreme positive emotion (Cyders et al., 2007). A shortened version, created to reduce redundancy and increase efficiency of data collection, eliminated items that demonstrated significant inter-item correlations (Lancaster et al., 2016). The shortening of this survey decreased burden on participants while maintaining its reliability and validity and producing results consistent with the original UPPS-P.

Kim & Choi (2020) investigated the relationship between PTSD resulting from childhood trauma and several dimensions of impulsivity by administering the Childhood Trauma Questionnaire (CTQ), Impact of Event Scale (IES), and the UPPS-P Impulsive Behavior Scale (Kim & Choi, 2020). Using structural equation modelling, the authors determined an association between childhood trauma and PTSD symptoms and four of the five dimensions of impulsivity outlined in the UPPS-P: positive urgency, negative urgency, lack of premeditation, and lack of perseverance. This study highlighted the importance of designing interventions and PTSD treatment that specifically addresses impulsive behavior in the context of childhood trauma.

Extending beyond the influences of childhood trauma, a multidimensional study by Roley et al. (2017) examined the relationship of impulsivity facets and PTSD symptom clusters, as assessed with the Stressful Life Events Screening Questionnaire (SLESQ), the PTSD Checklist for DSM-5 (PCL-5), and the UPPS (Roley et al., 2017). Over four-hundred trauma-exposed adults were included in the sample, and the authors completed linear regression analyses to determine negative urgency was associated with all of PTSD's symptom clusters. In the analysis, sensation-seeking could not predict severity of intrusion symptoms, but did predict presence of avoidance, NAMC, and AAR. Additionally, the authors found that lack of perseverance predicted only symptoms of intrusion, and lack of premeditation likewise predicted only NAMC

symptoms. The results of this study support the previous notion that negative urgency is a primary predictor of PTSD symptomology, emphasizing the influence of difficulties regulating one's behavior while experiencing extreme negative emotions on the presence of PTSD symptomology.

Impulsivity has shown to be a significant predictor of future problematic behaviors and several mental disorders including bipolar disorder, substance abuse, and suicidal ideation. This disruption of emotional regulation strategies is particularly evident in individuals with PTSD in the presence of strong negative emotion, as defined in the UPPS-P as negative urgency. Negative urgency refers to the tendency towards impulsivity when experiencing extreme negative emotions and is understood to be significantly associated with substance abuse (Smith & Cyders, 2016). Extant research indicates the role of emotion dysregulation in both the development and maintenance of impulsive behaviors. Emotion dysregulation involves an inability to respond to emotions and difficulty controlling behavior, due to lack of both emotional awareness and acceptance of challenging emotions. Dysregulation is also evident in difficulty accessing appropriate and effective coping strategies to allow oneself to achieve goals and act according to situational needs. This limited awareness corresponds to a reduced capacity to control behaviors while experiencing distress, and the elevated negative affect associated with a PTSD diagnosis likely exacerbates the difficulty for individuals with PTSD to recognize and regulate their emotions (Weiss et al., 2014).

Role of Emotion Dysregulation in PTSD Individuals

Although the precise relationship is unclear, it is hypothesized that emotion dysregulation influences risky behavior by serving as a means of escape or avoidance of periods of heightened distress observed among individuals with PTSD. A study conducted by Weiss et al. (2015),

examining this relationship measured 158 trauma-exposed individuals, 91 with PTSD, being treated for substance use disorder (SUD), a disorder characterized by impulsivity. The authors administered several diagnostic interviews, and the participants completed self-report questionnaires pertaining to feelings of negative and positive urgency, components of emotion dysregulation involving the tendency to engage in impulsive behavior during both negative and positive contexts. They established significant positive associations between PTSD symptoms, negative and positive urgency, and risky behaviors like substance use (Weiss et al., 2015). These results provide support for emotion dysregulation mediating impulsive behavior in both positive and negative contexts within patients with PTSD. This indicates a potential for interventions designed to decrease impulsive behavior within PTSD individuals by targeting emotional dysregulation. If predictors for impulsivity were identified, interventions could be implemented as protective treatments, possibly reducing the development or severity of related PTSD symptomology.

Despite the compelling evidence, the association between impulsivity and diminished fear extinction remains unexplored. The relationship between these constructs should be examined to provide further insight into the presence and severity of PTSD symptoms to elucidate necessity of designing treatment methods that include addressment of impulsivity when considering PTSD presentation. The current study aimed to investigate this potential association and determine whether the constructs are significantly related.

Methods

Participants

Data was obtained as part of a larger ongoing study at the University of Vermont's Center for Research on Emotions, Stress, and Technology (CREST), and the sample was

recruited primarily through social media ads and posted flyers. Participants were *N=55* adults (M_{age} = 28.02 , SD = 8.99), and they self-reported their gender (n_{female}=36, n_{male}= 12, n_{other}=8). Inclusion criteria required participants to be aged 18-49 and to report a Criterion A traumatic event within the past 12 months. A Criterion A traumatic experience is defined as exposure to actual or threatened death, serious injury, or sexual violence. Exposure encompasses direct exposure, witnessing the event, receiving information that a relative or close friend experienced a trauma, or other related indirect exposure (e.g., as first responders or crisis professionals) (DSM-5; American Psychiatric Association, 2013). Based on the Clinician Administered PTSD Scale for DSM-5 (CAPS-5), all participants met diagnostic criteria for PTSD. During the initial screening process and prior to enrollment, participants voluntarily disclosed their recent traumatic events, and their enrollment was determined by research assistants using the criteria outlined in the DSM-5. Following enrollment, trained graduate and undergraduate psychology students conducted several clinical interviews to gather more information and administered physiological measures, including the CAPS-5, PCL-5, and SUPPS-P, to determine ability to extinguish a conditioned fear and self-reported experiences with impulsive behaviors.

Measures

Short UPPS-P Impulsive Behavior Scale

The UPPS-P is a measure of impulsivity that includes five factors of impulsivity. This model subdivided facets of impulsivity based on the five-factor model of personality (e.g., openness, conscientiousness, extraversion, agreeableness, and neuroticism) identified by Costa & McCrae (1992). Created by Whiteside and Lynam (2001), the UPPS measures four distinct facets of impulsive behavior: urgency (negative and positive), (lack of) premeditation, (lack of) perseverance, and sensation seeking (Whiteside & Lynam, 2001). The present study utilized a

shortened version of the UPPS-P, consisting of 20 items each rated on a Likert scale: (1) disagree strongly, (2) disagree some, (3) agree some, and (4) agree strongly. Four items corresponded to each facet of impulsivity, and the scales were calculated by the summation of these (Dugré et al., 2019).

PTSD Checklist for DSM-5 (PCL-5)

The PCL-5 is a self-report measure consisting of 20 self-report items assessing the 20 PTSD symptoms outlined in the DSM-5. Participants self-report each item using a Likert scale: (0) not at all, (1) a little bit, (2) moderately, (3) quite a bit, and (4) extremely. This measure is scored on a scale from 0-80, with scores from approximately 30-33 or greater being accepted for probable PTSD (*PTSD Checklist for DSM-5 (PCL-5) - PTSD*, 2013). The current study used the PCL-5 checklist to determine the level of PTSD present in each participant.

Clinician-Administered PTSD Scale for DSM-5 (CAPS-5)

The CAPS-5 is a semi-structured clinician-administered interview used to assess PTSD severity utilizing the 20 symptoms outlined in the DSM-5. 30 questions investigate the onset and duration of symptom, and the overall burden of these symptoms. Questions are standardized for each symptom with accompanying clarifying questions. Participants are scored from 0-80, with higher scores representing more severe symptoms (Weathers et al., 2018). In the current study, participants were instructed to answer the questions about their most distressing traumatic incident, if they reported experiencing several. Research assistants or a licensed clinical psychologist administered the interviews, and interviews were periodically reviewed to assess inter-rater reliability. The CAPS-5 was used to verify presence and severity of PTSD symptoms within the participant population.

Procedures

All study activity was conducted in a single in-person appointment. Research assistants administered semi-structured clinical interviews to determine the presence of PTSD and comorbid disorders. Participants then completed several self-report questionnaires, including the SUPPS-P Impulsive Behavioral Scale, the PTSD Checklist for DSM-5, and the Clinician-Administered PTSD Scale for DSM-5, covering a breadth of symptoms and personal histories. The fear-potentiated startle paradigm occurred last, including two phases: fear acquisition and fear extinction.

Fear-potentiated startle. The fear-potentiated startle (FPS) paradigm was administered to measure participant's acquisition and extinction of fearful stimuli within a controlled environment. This paradigm was modeled after previously validated methods assessing physiological response to stressors using an acoustic startle response (Jovanovic et al., 2010). Startle response was assessed using three physiological indicators. Eye blinks were measured using electromyography (EMG) recordings of the orbicularis oculi muscle of the right eye, and electrodermal activity measured the galvanic skin response (GSR) of skin conductance on the left hand. Heart rate was also measured via three electrodes places on each clavicle and the left twelfth rib.

The FPS paradigm consisted of two phases: fear acquisition and fear extinction. Fear acquisition assessed the change in startle response with a conditioned stimulus (CS) paired with an unconditioned aversive stimulus (US). The US was an air blast aimed at the participant's larynx, and the CS's were purple triangles and blue squares. The US accompanied the blue square (CS+) and never occurred with the purple triangle (CS-), to condition the participant to associate the blue square with the aversive US. The CS appears on a monitor in front of the

participant, and sound plays in headphones accompanying the CS+. The air blast (250 msec at 140 psi) occurred .5 seconds following the presentation of the CS+. Fear acquisition persisted across 12 trials, divided into four blocks. The second phase, fear extinction, assessed the startle response to a CS+ (blue square) presented without aversive stimuli. In extinction, five blocks of four trials were conducted, and no US (air blast) occurred for the duration of the extinction blocks. Physiologic measures were obtained to assess participant ability to inhibit their conditioned fear of the CS+.

FPS data preprocessing. The startle data was obtained using Biopac MP150 for Windows. Following the collection of physiological measures, this data was input into Mindware software, allowing for visualization and computation of the physiological data. EMG and GSR data were processed within this software and filtered and exported in preparation for analyses.

Data analysis. Using the R computing environment, data was extracted from Mindware and cleaned before being exported to a secondary script for analysis. A linear mixed model analysis was run using the lmertest package. Participants' conditioned fear response was used as the dependent variable, and fixed effects of the five factors of impulsivity outlined in the SUPPS-P were added. The significance was calculated using the lmertest package, generating p-values for linear mixed models.

Results

A preliminary evaluation indicated that startle reactivity significantly declined during the extinction phase of the study for the CS+ ($b = -32.09$, $SE = 4.11$, $p < .001$). Startle reactivity also significantly declined for the CS- ($b = -39.45$, $SE = 5.09$, $p < .001$). These two findings suggest that fear was successfully extinguished during the extinction phase of the study.

The interaction between SUPPS-P impulsivity facets and FPS

SUPPS-P impulsivity facets were not significantly related to fear extinction. There was no significant block by SUPPS-P interaction for the CS+ and negative urgency (b = 0.65, SE = 1.27, p = 0.61), nor were there significant blocks for lack of premeditation (b = -0.91, SE = 1.75, p = 0.60), lack of perseverance (b = -1.90, SE = 1.55, p = 0.22), sensation seeking (b = -0.68, SE = 1.31, p = 0.60), or positive urgency (b = 1.14, SE = 1.59, p = 0.47) (Table 1). Similarly there was no significant block by SUPPS-P interaction for the CS- and negative urgency (b = -0.34, SE = 1.64, p = 0.83), nor were there significant blocks for lack of premeditation (b = 0.87, SE = 2.26, p = 0.70), lack of perseverance (b = 1.77, SE = 1.64, p = 0.37), sensation seeking (b = 0.36, SE = 1.69, p = 0.83), or positive urgency (b = 3.11, SE = 2.04, p = 0.12) (Table 2). These findings remained the same when controlling for PTSD diagnostic status.

Table 1. Correlations between SUPPS-P Impulsivity Facet and Block A fear extinction.

Comparison	b	SE	p - value
Negative Urgency	0.65	1.27	0.61
Premeditation (Lack of)	-0.91	1.75	0.60
Perseverance (Lack of)	-1.90	1.55	0.22
Sensation Seeking	-0.68	1.31	0.60
Positive Urgency	1.14	1.59	0.47

Table 2. Correlations between SUPPS-P Impulsivity Facet and Block B fear extinction.

Comparison	b	SE	p - value
Negative Urgency	-0.34	1.64	0.83
Premeditation (Lack of)	-0.87	2.26	0.70
Perseverance (Lack of)	1.77	1.64	0.37
Sensation Seeking	0.36	1.69	0.83
Positive Urgency	3.11	2.04	0.12

Discussion

This study examined the role of disrupted fear patterns on impulsivity by observing conditioned fear response patterns in adults with recent trauma experiences. Using data from an ongoing study of adults with PTSD, participants' fear potentiation was assessed using validated FPS techniques. The SUPPS-P self-report questionnaire was used to quantify participants levels of impulsivity, and responses were analyzed alongside their fear potentiation. Contrary to the proposed hypotheses, the results of the present study suggest that there was no significant relation between increased impulsivity behaviors and the ability to extinguish conditioned fear within adults with PTSD. These results suggest that mechanisms other than impulsivity may have a larger impact on the speed at which extinction learning is acquired in those with recent trauma histories.

Several factors likely contribute to the lack of significant findings. First, participants were not originally recruited based on their reported impulsivity behaviors, which could explain the relatively low correlation. The parent study of this analysis did not specifically recruit participants based on their levels of impulsive behaviors, if any; thus, the data only included information regarding an abbreviated range of impulsive behaviors. This likely created a restriction of range because of the potential lack of variability within the reports of impulsivity. If this study drew from a population of PTSD individuals reporting a history of impulsive behavior (i.e., substance use), this might have impacted the relationship between impaired fear extinction ability and the severity of their impulsivity. To support this explanation, there were relatively few participants who reported high levels of impulsivity.

The short UPPS-P questionnaire was this study's primary measure of impulsive behavior, a model that assessed five facets of impulsivity, urgency (both positive and negative),

premeditation (lack of), perseverance (lack of), and sensation seeking (Whiteside & Lynam, 2001). The SUPPS-P relies on the self-report of participants and is one of the most common self-report measures of impulsivity. Although the SUPPS-P is an inclusive and psychometrically sound assessment of the breadth of impulsive behaviors, this measure is inherently limited by the nature of self-report data collection. Negative effects of self-report data might lie in careless and random responding (Meyer et al., 2013), an effect particularly noticeable in college students (Meade & Craig, 2012), a prevalent population in the present study. Pitfalls of self-report data may be particularly prominent when evaluating impulsivity, as characteristics of impulsivity include hasty, unplanned actions, and difficulty focusing (Cyders et al., 2007). These potential qualities of the reporter might increase occurrence of inaccurate or minimized responses. The effects of this method of data collection could skew analyses of models and increase likelihood of Type I error occurring. Integrated validity checks could reinforce the strength of any results and observed interactions. Additional, more complete, measures of impulsivity could include non-self-report approaches like observational reports of behavior and perceptions from individuals involved in the participants' lives.

Part of the enrollment criteria mandated that the trauma occurred recently within the past 12 months, as the overarching study hoped to design effective early interventions. As a diagnosis of PTSD requires persistence of symptoms for at least one month following the trauma exposure, the maximum diagnosis of a participant was eleven months. Because the course of PTSD is highly irregular between individuals, this created variability and inconsistent data collection as participants may have experienced alleviation or relapse of symptoms (Lancaster et al., 2016). This enrollment criterion inadvertently limited sample size to exclude participants with chronic PTSD. In addition, the required recentness of the traumatic event could impact the development

of substantial PTSD behaviors, including increased impulsivity. Much of the prior research surrounding the associations between PTSD and impulsivity focused on individuals with long-established diagnoses of PTSD, and the relative newness of symptoms and diagnosis of participants in this study might have negatively impacted the present study's ability to identify a significant correlation. Symptom severity of the participants may be lessened or not yet developed enough to substantially effect behaviors and feelings measured by the SUPPS-P.

Limitations

This study had several limitations. First, this study occurred primarily during the height of the COVID-19 pandemic, which severely restricted in-person procedures for data collection. Administration of the semi-structured clinical interviews and completion of the FPS protocols required proximity of researcher and participant, posing a risk for disease transmission. Consequently, recruitment efforts slowed, and the sample size was relatively small, exacerbating issues for discernment of potential small or significant effects present in the data. A larger sample would be beneficial to ascertain differences in data that might not be evident with limited participants.

Secondly, the small sample was relatively homogenous, with 46 participants identifying as white. The average income of $20,000-30,000 was likely reflective of student and young adult participation but reflected a relatively low-income sample (Figure 2). This sample underrepresents people of color (Table 5), a population more likely to report traumatic experiences and more at risk for poor mental health (Hatch & Dohrenwend, 2007; McLaughlin et al., 2012). Thus, effects of race, ethnicity, and income levels on trauma were not examined and might provide valuable information about impacts of culture and access to resources on the presence and development of PTSD. This study additionally did not subdivide participant data to

analyze the potential effects of the specific type of trauma that the participant reported. Different types of trauma exert different influences on the presence and presentation of PTSD, although the precise relationship and risk factors remain unclear (Fjeldheim et al., 2014; Voges & Romney, 2003). Preliminary relevant research indicates interpersonal trauma, specifically sexual assault, has significant associations with increased emotional dysregulation (Raudales et al., 2019). The heterogeneity observed in the results might be associated with differences in type and severity of individual trauma exposure.

The lack of gender diversity in the sample may have similarly impacted the results. Sex and gender-related differences in self-reported impulsivity have been consistently observed and developing a strong understanding of these differences would inform effective treatment development (Cross et al., 2011; Mitchell & Potenza, 2015). As our sample consisted of majority cisgender female participants (n_{female}= 36, n_{male}= 12, n_{other}= 8), the effect of gender on impulsive behaviors was not examined. Analyses would benefit from recruitment efforts aimed at including a wider variety of genders within the sample. Additionally, this study only included adult participants (M_{age} = 28.02, SD_{age} = 8.88), and impulsivity might exhibit greater influence in a sample of adolescents or younger adults during a time of significant development, experimentation, and transition (Oshri et al., 2018). The age of trauma exposure might also influence the lasting effects of the event, as trauma in adolescence and young adulthood is a stronger predictor of risk for subsequently developing PTSD (McCutcheon et al., 2010). It is difficult to generalize from this sample as it does not adequately reflect the demographics of the entire population of individuals with PTSD.

Implications

With most adults experiencing a potentially traumatic event within their lifetime, it is

relevant and necessary to explore the impacts of trauma and the possibility for accompanying psychopathology, including PTSD. The lasting effects of trauma are yet to be full elucidated, although there are clear detriments associated with the exposure to trauma at any point in an individual's life. Future research should continue to explore the associations between increased impulsivity and a decreased ability to inhibit conditioned fear responses, as this hindered ability likely underlies many symptoms experienced with PTSD, and many psychosocial struggles accompanying PTSD are rooted in dysregulation of impulsivity. Additional studies should look more specifically at the potentially moderating effects of emotion regulation on the level of impulsivity reported by adults with PTSD. Developing a more robust understanding of this relationship would benefit intervention design and implementation by providing trauma survivors with necessary tools to effectively regulate their emotional reactivity, possibly minimizing difficulties related to increased impulsivity. More thorough analyses of disrupted fear patterns should be conducted with a sample recruited with more specific histories of impulsivity to elucidate any potential relationship.

Conclusion

While not statistically significant, results of the present study indicate directions for future research to address. Post-traumatic Stress Disorder is a debilitating disease that can cause significant functional impairment, and it is imperative and urgent to develop interventions to enhance both treatment and outcomes for trauma victims. The present project aimed to examine the associations between an inability to extinguish one's fear-potentiated startle response and increased impulsivity behaviors among adults with PTSD. There is reason to believe the limitations mentioned above significantly influenced the outcomes of this study, and the importance of this nuanced relationship should not be ignored. Although statistically significant

findings were limited by the available sample size and constrictions of the participants, the results highlighted the heterogeneity of PTSD presentation and identified the need for further elucidation of this multifaceted relationship and underlying neurological mechanisms, as it is likely implicated in several comorbidities commonly experienced alongside PTSD.

Table 3. Summary of Participant Age

Count	Mean Age	Median Age	Standard Deviation
56	28.02	24	8.88

Table 4. Summary of Participant Gender

	Male	Female	Other
Count	12	36	8
Proportion	.214	.643	.143

Table 4. Summary of Participant Race

Race	Count	Proportion
White	49	.875
African American	1	.018
Asian American	1	.018
Pacific Islander/ Native American	1	.018
American Indian	0	0
Bi- Racial	4	.071

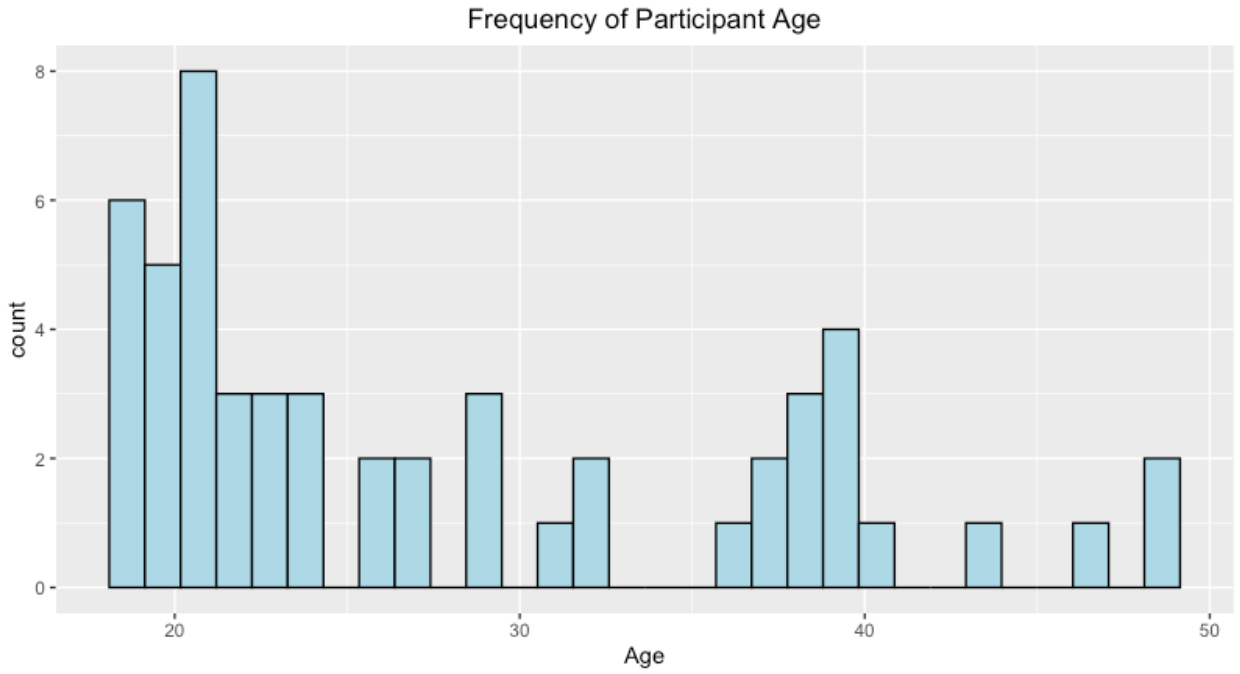

Figure 1. Summary of Participant Age

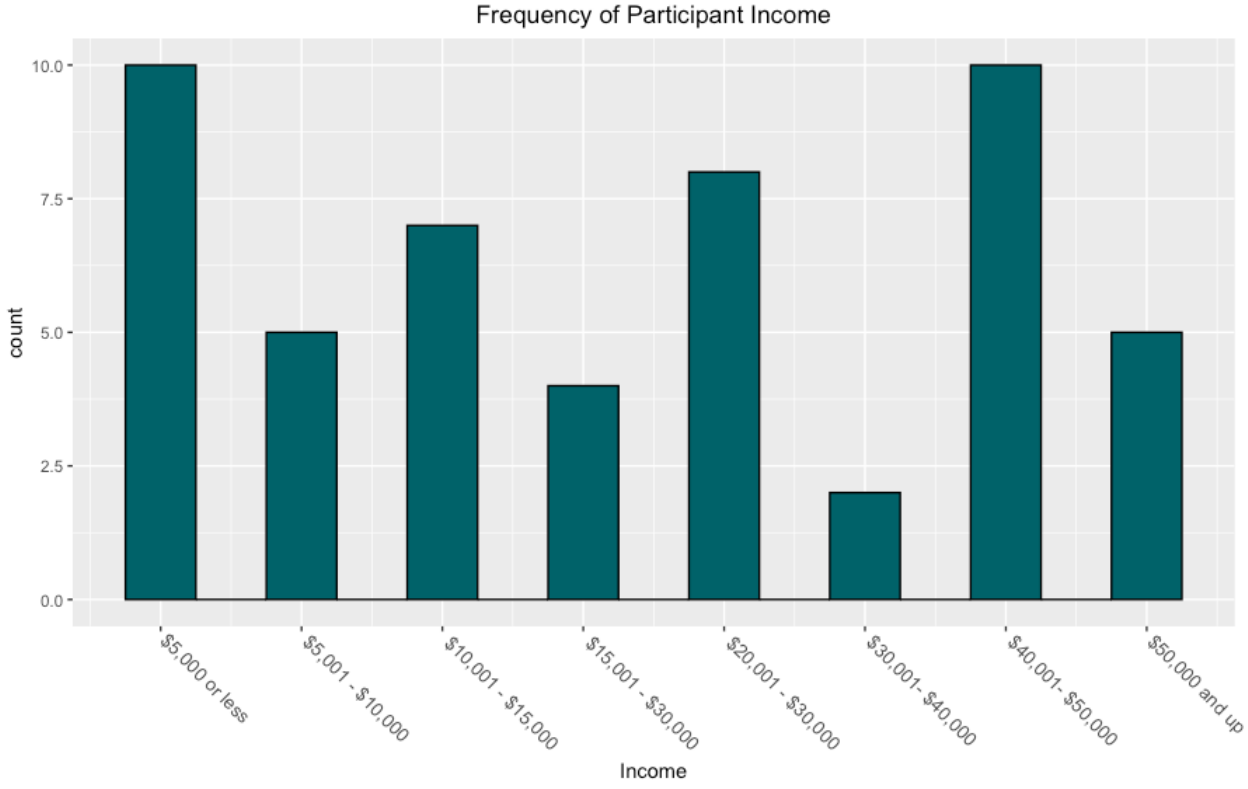

Figure 2. Summary of Participant Income

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References

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). American Psychiatric Association.

Careaga, M. B. L., Girardi, C. E. N., & Suchecki, D. (2016). Understanding posttraumatic stress disorder through fear conditioning, extinction and reconsolidation. *Neuroscience & Biobehavioral Reviews*, *71*, 48–57. https://doi.org/10.1016/j.neubiorev.2016.08.023

Chamorro, J., Bernardi, S., Potenza, M. N., Grant, J. E., Marsh, R., Wang, S., & Blanco, C. (2012). Impulsivity in the general population: A national study. *Journal of Psychiatric Research*, *46*(8), 994–1001. https://doi.org/10.1016/j.jpsychires.2012.04.023

Clinical Practice Guideline for the Treatment of Posttraumatic Stress Disorder (PTSD) in Adults: (501872017-001). (2017). [Data set]. American Psychological Association. https://doi.org/10.1037/e501872017-001

Cross, C. P., Copping, L. T., & Campbell, A. (2011). Sex differences in impulsivity: A meta-analysis. *Psychological Bulletin*, *137*(1), 97–130. https://doi.org/10.1037/a0021591

Cyders, M., Smith, G., Spillane, N., Fischer, S., Annus, A., & Peterson, C. (2007). Integration of Impulsivity and Positive Mood to Predict Risky Behavior: Development and Validation of a Measure of Positive Urgency. *Psychological Assessment*, *19*, 107–118. https://doi.org/10.1037/1040-3590.19.1.107

Dugré, J. R., Giguére, C.-É., Percie du Sert, O., Potvin, S., Dumais, A., & Consortium Signature. (2019). The Psychometric Properties of a Short UPPS-P Impulsive Behavior Scale Among Psychiatric Patients Evaluated in an Emergency Setting. *Frontiers in Psychiatry*, *10*. https://www.frontiersin.org/article/10.3389/fpsyt.2019.00139

Fjeldheim, C. B., Nöthling, J., Pretorius, K., Basson, M., Ganasen, K., Heneke, R., Cloete, K. J., & Seedat, S. (2014). Trauma exposure, posttraumatic stress disorder and the effect of explanatory variables in paramedic trainees. *BMC Emergency Medicine*, *14*(1), 11. https://doi.org/10.1186/1471-227X-14-11

Galatzer-Levy, I. R., Nickerson, A., Litz, B. T., & Marmar, C. R. (2013). Patterns of Lifetime Ptsd Comorbidity: A Latent Class Analysis. *Depression and Anxiety*, *30*(5), 489–496. https://doi.org/10.1002/da.22048

Goldstein, R. B., Smith, S. M., Chou, S. P., Saha, T. D., Jung, J., Zhang, H., Pickering, R. P., Ruan, W. J., Huang, B., & Grant, B. F. (2016). The Epidemiology of DSM-5 Posttraumatic Stress Disorder in the United States: Results from the National Epidemiologic Survey on Alcohol and Related Conditions-III. *Social Psychiatry and Psychiatric Epidemiology*, *51*(8), 1137–1148. https://doi.org/10.1007/s00127-016-1208-5

Hatch, S. L., & Dohrenwend, B. P. (2007). Distribution of traumatic and other stressful life events by race/ethnicity, gender, SES and age: A review of the research. *American Journal of Community Psychology*, *40*(3–4), 313–332. https://doi.org/10.1007/s10464-007-9134-z

Jovanovic, T., Keyes, M., Fiallos, A., Myers, K. M., Davis, M., & Duncan, E. J. (2005). Fear Potentiation and Fear Inhibition in a Human Fear-Potentiated Startle Paradigm. *Biological Psychiatry*, *57*(12), 1559–1564. https://doi.org/10.1016/j.biopsych.2005.02.025

Jovanovic, T., Norrholm, S. D., Blanding, N. Q., Davis, M., Duncan, E., Bradley, B., & Ressler, K. J. (2010). Impaired fear inhibition is a biomarker of PTSD but not depression. *Depression and Anxiety*, *27*(3), 244–251. https://doi.org/10.1002/da.20663

Jovanovic, T., Norrholm, S. D., Blanding, N. Q., Davis, M., Duncan, E., Bradley, B., & Ressler, K. J. (2010b). Impaired Fear Inhibition is a Biomarker of PTSD but not Depression. *Depression and Anxiety*, *27*(3), 244–251. https://doi.org/10.1002/da.20663

Jovanovic, T., Norrholm, S. D., Fennell, J. E., Keyes, M., Fiallos, A. M., Myers, K. M., Davis, M., & Duncan, E. J. (2009). Posttraumatic stress disorder may be associated with impaired fear inhibition: Relation to symptom severity. *Psychiatry Research*, *167*(1–2), 151–160. https://doi.org/10.1016/j.psychres.2007.12.014

Kilpatrick, D. G., Resnick, H. S., Milanak, M. E., Miller, M. W., Keyes, K. M., & Friedman, M. J. (2013). National Estimates of Exposure to Traumatic Events and PTSD Prevalence Using DSM-IV and DSM-5 Criteria. *Journal of Traumatic Stress*, *26*(5), 537–547. https://doi.org/10.1002/jts.21848

Kim, J. H., & Choi, J. Y. (2020). Influence of childhood trauma and post-traumatic stress symptoms on impulsivity: Focusing on differences according to the dimensions of impulsivity. *European Journal of Psychotraumatology*, *11*(1), 1796276. https://doi.org/10.1080/20008198.2020.1796276

Lancaster, C. L., Teeters, J. B., Gros, D. F., & Back, S. E. (2016). Posttraumatic Stress Disorder: Overview of Evidence-Based Assessment and Treatment. *Journal of Clinical Medicine*, *5*(11), 105. https://doi.org/10.3390/jcm5110105

Maddox, S. A., Hartmann, J., Ross, R. A., & Ressler, K. J. (2019). Deconstructing the Gestalt: Mechanisms of Fear, Threat, and Trauma Memory Encoding. *Neuron*, *102*(1), 60–74. https://doi.org/10.1016/j.neuron.2019.03.017

McCutcheon, V. V., Sartor, C. E., Pommer, N. E., Bucholz, K. K., Nelson, E. C., Madden, P. A. F., & Heath, A. C. (2010). Age at trauma exposure and PTSD risk in young adult women. *Journal of Traumatic Stress*, *23*(6), 811–814. https://doi.org/10.1002/jts.20577

McLaughlin, K. A., Green, J. G., Gruber, M. J., Sampson, N. A., Zaslavsky, A. M., & Kessler, R. C. (2012). Childhood adversities and first onset of psychiatric disorders in a national sample of adolescents. *Archives of General Psychiatry*, *69*(11), 1151–1160. https://doi.org/10.1001/archgenpsychiatry.2011.2277

Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods*, *17*(3), 437–455. https://doi.org/10.1037/a0028085

Meyer, J. F., Faust, K. A., Faust, D., Baker, A. M., & Cook, N. E. (2013). Careless and Random Responding on Clinical and Research Measures in the Addictions: A Concerning Problem and Investigation of their Detection. *International Journal of Mental Health and Addiction*, *11*(3), 292–306. https://doi.org/10.1007/s11469-012-9410-5

Mitchell, M. R., & Potenza, M. N. (2015). Importance of Sex Differences in Impulse Control and Addictions. *Frontiers in Psychiatry*, *6*, 24. https://doi.org/10.3389/fpsyt.2015.00024

Norrholm, S. D., Jovanovic, T., Olin, I. W., Sands, L. A., Karapanou, I., Bradley, B., & Ressler, K. J. (2011). Fear Extinction in Traumatized Civilians with Posttraumatic Stress Disorder: Relation to Symptom Severity. *Biological Psychiatry*, *69*(6), 556–563. https://doi.org/10.1016/j.biopsych.2010.09.013

Oshri, A., Kogan, S. M., Kwon, J. A., Wickrama, K. a. S., Vanderbroek, L., Palmer, A. A., & MacKillop, J. (2018). Impulsivity as a mechanism linking child abuse and neglect with substance use in adolescence and adulthood. *Development and Psychopathology*, *30*(2), 417–435. https://doi.org/10.1017/S0954579417000943

Overstreet, C., Berenz, E. C., Sheerin, C., Amstadter, A. B., Canino, G., & Silberg, J. (2016). Potentially Traumatic Events, Posttraumatic Stress Disorder, and Depression among Adults in Puerto Rico. *Frontiers in Psychology*, *7*, 469. https://doi.org/10.3389/fpsyg.2016.00469

PTSD Checklist for DSM-5 (PCL-5) - PTSD: National Center for PTSD. (n.d.). [General Information]. Retrieved April 11, 2022, from https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp

Raudales, A. M., Short, N. A., & Schmidt, N. B. (2019). Emotion dysregulation mediates the relationship between trauma type and PTSD symptoms in a diverse trauma-exposed clinical sample. *Personality and Individual Differences*, *139*, 28–33. https://doi.org/10.1016/j.paid.2018.10.033

Roley, M. E., Contractor, A. A., Weiss, N. H., Armour, C., & Elhai, J. D. (2017). Impulsivity facets' predictive relations with DSM-5 PTSD symptom clusters. *Psychological Trauma : Theory, Research, Practice and Policy*, *9*(1), 76–79. https://doi.org/10.1037/tra0000146

Smith, G. T., & Cyders, M. A. (2016). Integrating Affect and Impulsivity: The Role of Positive and Negative Urgency in Substance Use Risk. *Drug and Alcohol Dependence*, *163*(Suppl 1), S3–S12. https://doi.org/10.1016/j.drugalcdep.2015.08.038

VanElzakker, M. B., Dahlgren, M. K., Davis, F. C., Dubois, S., & Shin, L. M. (2014). From Pavlov to PTSD: The extinction of conditioned fear in rodents, humans, and in anxiety disorders. *Neurobiology of Learning and Memory*, *113*, 3–18. https://doi.org/10.1016/j.nlm.2013.11.014

Voges, M. A., & Romney, D. M. (2003). Risk and resiliency factors in posttraumatic stress disorder. *Annals of General Hospital Psychiatry*, *2*(1), 4. https://doi.org/10.1186/1475-2832-2-4

Weathers, F. W., Bovin, M. J., Lee, D. J., Sloan, D. M., Schnurr, P. P., Kaloupek, D. G., Keane, T. M., & Marx, B. P. (2018). The Clinician-Administered PTSD Scale for DSM–5 (CAPS-5): Development and Initial Psychometric Evaluation in Military Veterans. *Psychological Assessment*, *30*(3), 383–395. https://doi.org/10.1037/pas0000486

Weiss, N. H., Tull, M. T., & Gratz, K. L. (2014). A Preliminary Experimental Examination of the Effect of Emotion Dysregulation and Impulsivity on Risky Behaviors among Women with Sexual Assault-Related Posttraumatic Stress Disorder. *Behavior Modification*, *38*(6), 914–939. https://doi.org/10.1177/0145445514547957

Whiteside, S. P., & Lynam, D. R. (2001). The Five Factor Model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, *30*(4), 669–689. https://doi.org/10.1016/S0191-8869(00)00064-7

Widom, C. S. (1999). Posttraumatic Stress Disorder in Abused and Neglected Children Grown Up. *Am J Psychiatry*, 7.

Zatzick, D. F., Rivara, F. P., Nathens, A. B., Jurkovich, G. J., Wang, J., Fan, M.-Y., Russo, J., Salkever, D. S., & Mackenzie, E. J. (2007). A nationwide US study of post-traumatic stress after hospitalization for physical injury. *Psychological Medicine*, *37*(10), 1469–1480. https://doi.org/10.1017/S0033291707000943