Published in final edited form as:

J Subst Abuse Treat. 2015 March ; 50: 59–66. doi:10.1016/j.jsat.2014.10.014.

Aggressive Behavior Among Military Veterans in Substance Use Disorder Treatment: The Roles of Posttraumatic Stress and Impulsivity

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Abstract

This study examined posttraumatic stress disorder (PTSD) symptom severity and impulsivity as predictors of aggressive behavior among 133 male military Veterans entering substance abuse treatment who endorsed difficulty controlling anger in the past year. At treatment intake, participants completed measures assessing PTSD symptom severity, impulsivity and aggressive behavior. Perpetration of aggressive behavior was reassessed four months later. Results from multivariate models indicated that PTSD symptom severity and impulsivity explained unique variance in aggressive behavior at intake but not follow-up. Mediation models indicated that the association between PTSD symptom severity and aggressive behavior was accounted for by impulsivity. The identification of impulsivity as a key mediator between trauma symptoms and aggressive behavior has significant clinical and research implications. Based on these findings, clinicians are encouraged to consider a standard assessment of impulsivity and the selection of interventions that target impulsivity as a trans-diagnostic process among at-risk client populations.

Keywords

Aggression; Violence; PTSD; Impulsivity; Substance Use Disorder; Alcohol

1. Introduction

A wealth of epidemiological data demonstrates that aggressive behavior is dramatically more prevalent among individuals with substance use disorders (SUD) compared to those without an SUD (Arseneault, Moffitt, Caspi, Taylor, & Silva, 2000; Bell, Hanford,

McCarroll, & Senier, 2004; Coid, 2006; Corrigan & Watson, 2005; Pan, Neidig, & O'leary, 1994). Estimates of past-year violence perpetration among clinical samples in SUD treatment are 2–3 times greater than those observed in community samples and have been documented as high as 75% (Brown, Werk, Caplan, Shields, & Seraganian, 1998; Chermack, Fuller & Blow, 2000, Chermack, Walton, Fuller, & Blow, 2001; Chermack et al., 2010; O'Farrell, Fals-Stewart, Murphy, & Murphy, 2003). The personal and social costs of aggressive behavior are tremendous and include physical and emotional injuries, relationship and legal problems, lower social functioning and higher utilization of health care services (Campbell, 2002; Marshall, Panuzio, & Taft, 2005). In addition, aggressive behavior has been linked to poorer SUD treatment outcomes (e.g., higher drop-out, earlier relapse; Gossop, Trakada, Stewart, & Witton, 2005; Mignone, Klostermann, & Chen, 2009; Murphy & Ting, 2010; Ravndal & Vaglum, 1991), which suggests the need for integrated interventions (Chermack et al., 2009; Fals-Stewart & Kennedy, 2005; Klostermann, Kelley, Mignone, Pusateri, & Fals-Stewart, 2010).

Given both the negative impact of aggressive behavior on life functioning and treatment outcomes, it is critical to gain a better understanding of the psychological mechanisms that confer risk for interpersonal aggression. Previous research has established that PTSD symptoms and impulsivity operate as potent risk factors for aggressive behavior (Orth & Wieland, 2006; Taft, Watkins, Stafford, Street, & Monson, 2011; Vigil-Colet, Morales-Vives, & Tous, 2008; Wakai & Trestman, 2008), yet virtually no studies have simultaneously examined these factors in an SUD population. In addition, although PTSD symptoms are associated with heightened aggression, the mechanisms by which this occurs are not well understood (Beckham, Moore, & Reynolds, 2000). Finally, the preponderance of extant research on aggressive behavior in SUD populations has tended to focus on a specific SUD (e.g., alcohol use disorder), a single type of aggression (either physical or psychological) or within either intimate partnerships or non-partner relationships. As such, more research is needed among diverse samples of SUD patients to assess a wider range of interpersonal difficulties (i.e., psychological and physically aggressive behavior) beyond the context of partner relationships (i.e., strangers, acquaintances, other family members, friends, co-workers). The current study aims to address these knowledge gaps.

1.1 Posttraumatic Stress and Aggression

Trauma exposure and PTSD are over-represented among individuals with SUD, with estimates that one-third of individuals in SUD treatment also have a diagnosis of PTSD (Gielen, Havermans, Tekelenburg, & Jansen, 2012; Kessler, Berglund, Demler, Jin, & Walters, 2005; Mills, Teesson, Ross, & Peters, 2006; Ouimette & Brown, 2003). Veterans are at particularly high risk for SUD-PTSD comorbidity (e.g., Carter, Capone, & Short, 2011). For example, among a sample of nearly half a million Iraq and Afghanistan Veterans, 63–76% of those with an alcohol or drug use disorder also met criteria for PTSD (Seal et al., 2011). Further, meta-analytic studies indicate that PTSD symptom severity is strongly associated with aggressive behavior and that this association is stronger among Veterans as compared to civilians (Orth & Wieland, 2006; Taft et al., 2011). PTSD symptom severity has also been shown to prospectively predict aggression following treatment (Makin-Byrd, Bonn-Miller, Drescher, & Timko, 2012) and those meeting subthreshold or full criteria for

PTSD report significantly more anger reactivity and interpersonally aggressive behavior than those without the diagnosis (Beckham, Feldman, Kirby, Hertzberg, & Moore, 1997; Jakupcak et al., 2007; Taft, Street, Marshall, Dowdall & Riggs, 2007). Although PTSD is related to aggression, and is critical to assess when determining risk for aggressive behavior among individuals with SUD (Barrett, Mills & Teesson, 2011), the mechanisms by which PTSD symptom severity is linked to aggressive behavior remains poorly understood (Beckham et al., 2000).

1.2 Impulsivity

Impulsivity is a multifaceted construct (e.g., cognitive, behavioral) characterized by rash, poorly conceived and unplanned actions and a disregard for long-term consequences (de Wit, 2009; Evenden, 1999) and is a hallmark component of various psychological disorders. Higher levels of impulsivity are thought to denote poor executive control, which is seated in the prefrontal cortex and responsible for goal-directed behavior and self-regulation (Bickel, Jarmolowicz, Mueller, Gatchalian, & McClure, 2012; Crews & Boettiger, 2009; Hofmann, Schmeichel, & Baddeley, 2012). Impulsivity has been described in the self-report literature as a cluster of distinct personality traits (e.g., lack of planning, positive and negative urgency, sensation seeking, lack of premeditation, lack of perseverance) that engender impulsive behavior, with lack of premeditation and planfulness being one of the most common conceptualizations of impulsivity (Whiteside & Lynam, 2001; Whiteside, Lynam, Miller & Reynolds, 2005).

Impulsivity is a determinant and consequence of substance use (Crews & Boettiger, 2009; de Wit, 2009), and also functions as a predisposing factor for a number of externalizing problems including aggressive behavior (Brady, Myrick, & McElroy, 1998; Edwards, Scott, Yarvis, Paizis, & Panizzon, 2003; Wakai & Trestman, 2008). Individuals with trauma exposure and higher PTSD symptom severity demonstrate elevated levels of impulsivity and risk-taking, as indexed by a variety of behavioral and self-report measures (Casada & Roache, 2005; Chamorro et al., 2012; Killgore et al., 2008; Lohr, 2013; Strom et al., 2012; Weiss, Tull, Anestis, & Gratz, 2013). Given the associations between PTSD and impulsivity, and between impulsivity and aggressive behavior, it is plausible that impulsivity mediates the impact of PTSD symptoms on aggressive behavior among individuals with SUD. In terms of clinical utility, although impulsivity is strongly associated with aggressive behavior, it is not routinely or formally assessed in treatment settings. If assessment of impulsivity can lend additional explanatory power to predict who is most at risk for perpetrating aggressive behavior, clinicians may be able to pre-emptively employ interventions (e.g., psychopharmacology, distress tolerance training) to reduce impulsive tendencies.

1.3 The Current Study

This study has three objectives. First, it examines the extent to which PTSD symptom severity and impulsivity explain variance in aggressive behavior among Veterans in SUD treatment, both cross-sectionally and longitudinally. After accounting for substance use severity, we expect PTSD symptom severity and impulsivity to be positively associated with aggressive behavior both at treatment intake and at follow-up. Second, given that substance

use severity and PTSD symptoms are commonly assessed in clinical settings, and are well-established risk-factors for aggressive behavior, we examine the extent to which impulsivity explains additional, unique variance in aggressive behavior. Third, we assess whether impulsivity serves as a mediator of the pathway between PTSD symptom severity and aggression. Specifically, we hypothesize that after controlling for substance use severity, impulsivity will account for the association between PTSD symptom severity and aggressive behavior.

2. Method

2.1 Participants

Participants were 133 male military Veterans (mean age = 52.52, SD = 8.12; 49% Caucasian; 34% African American; 11% Hispanic; 2% Asian; 4% other) entering outpatient SUD treatment at a VA Medical Center. In terms of treatment history, participants reported an average of 3.22 (SD = 6.46), 3.25 (SD = 6.20), and 1.65 (SD = 2.06) previous outpatient treatment episodes for alcohol, drug, and mental health problems, respectively. In the 30 days prior to treatment intake, participants reported receiving treatment for alcohol and drug problems in outpatient settings an average of 10.86 (SD = 9.70) days and in inpatient settings, 5.49 (SD = 10.78) days. Retention at 4-month follow-up was 80%, excluding five participants who were incarcerated, had died, or were incapacitated/hospitalized (follow-up data available for 101 participants). Participants received abstinence-based outpatient SUD treatment that had a combined Cognitive Behavioral Therapy/Twelve-Step Facilitation orientation. Veterans in this program received at least three hours a week of group and individual therapy plus case management.

2.2 Measures

Aggressive Behavior - The Revised Conflict Tactics Scale (RCTS; Straus, Hamby, Boney-McCoy, & Sugarman, 1996)—At intake and follow-up, a modified version of the RCTS was administered to assess the perpetration of 20 aggressive behaviors: 8 psychologically aggressive behaviors (e.g., insulted or swore at, destroyed something belonging to target, threatened to hit or throw something at target), and 12 physically aggressive behaviors (e.g., pushed or shoved, slapped, grabbed, punched or hit, kicked target) against another adult in the past 30 days. The RCTS is a highly reliable and well-validated measure of aggression perpetration and has been used extensively with SUD populations and military Veterans (Beckham et al., 1997; Bye, 2007; O'Farrell et al., 2003). Aggression perpetrated against intimate partners and other adults was combined to capture the full range of aggression perpetrated against any adult. Thus, aggressive behavior was measured as the number of days in the past month that participants had engaged in each of the 20 aggressive behaviors. Internal consistency on the RCTS was .72 for both intake and follow-up.

Substance Use Patterns and Severity - Addiction Severity Index (ASI; McLellan et al., 1992)—The ASI is a structured clinical research interview used in the current study to collect demographic information (age, race, education, employment, marital status, partner status, partner cohabitation status) and assess drug and alcohol use along with

number, extent and duration of SUD symptoms. ASI drug and alcohol composite scores are derived with algorithms and indicate drug and alcohol use severity in the past 30 days. Composite scores are highly reliable and valid (McLellan et al., 1992). The drug composite includes questions assessing use of all major classes of drugs of abuse (e.g., “How many days in the past 30 days did you use cocaine?”). Composite scores range from 0 to 1, with higher scores indicating greater severity.

Posttraumatic Stress Disorder Symptom Severity – PTSD Checklist (PCL; Ruggiero, Del Ben, Scotti, & Rabalais, 2003; Weathers, Litz, Herman, Huska, & Keane, 1993)—The PCL comprises 17 items that correspond to the 17 DSM-IV (American Psychiatric Association, 2000) symptoms of PTSD. Respondents indicate the degree to which they have been bothered by each symptom, in response to a stressful life situation, within the past month, using a 5-point Likert scale (1=not at all bothered; 5=extremely bothered). Responses are summed to yield a total score that is reflective of global posttraumatic stress symptom severity. Scores range from 17–85, and a score of 50 (the currently recommended cut-off; Weathers et al., 1993; McDonald & Calhoun, 2010) indicates that present symptoms are suggestive of PTSD. Additionally, the three subscales of the PCL correspond to the three PTSD symptom clusters (B: Re-experiencing, C: Avoidance/Numbing, and D: Hyperarousal), and are calculated by summing the PCL item scores corresponding to each symptom cluster. To derive a PTSD diagnosis from the PCL, a symptom cluster method was employed (McDonald & Calhoun, 2010) in which scores of 3 (*moderately bothered*) or greater were required for 1 or more of the 5 re-experiencing symptoms, 3 or more of the 7 avoidance/numbing symptoms, and 2 or more of the 5 hyperarousal symptoms. The PCL is the most frequently used self-report measure of PTSD symptoms and has excellent psychometric properties, and strong convergent and divergent validity (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; McDonald & Calhoun, 2010; Ruggiero et al. 2003; Yeager, Magruder, Knapp, Nicholas, & Frueh, 2007). In the present study, the internal reliability for the PCL and its subscales was excellent ($\alpha = .96$ [total], .92 [B], .90 [C], and .89 [D]).

Impulsivity - Multidimensional Personality Questionnaire – Brief Form (MPQ-BF) – Control subscale (Patrick, Curtain, & Tellegen, 2002)—The Control subscale of the MPQ, a factor-analytically derived personality measure, was used as an index of impulsivity. The Control subscale comprises 12 True/False items (e.g., “I often act on the spur of the moment”). Four items are reverse coded and “True” responses are summed and converted into T-scores that can range from 22–66. High scorers on this scale are reflective, cautious, careful, plodding, rational, sensible, level-headed and prefer to plan activities ahead in detail (Tellegen & Waller, 2008). In contrast, low scorers do not view themselves as deliberative or cautious, and tend to do things on the spur of the moment without regard for the consequences of their actions. Previous research demonstrates that lower scores on the control subscale are associated particularly with high scores on scales measuring lack of planfulness and premeditation as indexed by other well-validated measures of impulsivity (e.g., UPPS, BIS-11; Patrick et al., 2002; Whiteside & Lynam, 2001). The MPQ has excellent psychometric properties and has been used in Veteran and other high-risk psychiatric populations (DiLalla, Gottesman, Carey, & Vogler, 1993; Miller, Greif, &

Smith, 2003; Tellegen & Waller, 2008). In the present study, the internal reliability for the MPQ Control subscale was good ($\alpha = .83$). To facilitate interpretation of results, the MPQ Control subscale was reverse scored so that higher scores indicated higher impulsivity.

2.3 Procedures

This investigation was approved by the local institutional review board. Patients who entered outpatient SUD treatment during study recruitment were screened in consecutive order by their case manager for self-reported "trouble controlling anger or violent behavior" in the past year. Patients who screened positive were asked for permission by their case manager to be contacted about the project. Participants completed all measures in the baseline research interview at treatment intake and returned for a 4-month follow-up research interview in which they completed the RCTS.

2.4 Data Analyses

First, descriptive statistics and alpha reliability coefficients were calculated for each measure for the entire sample at intake. The RCTS aggression composites and the ASI drug and alcohol composite scores were positively skewed and thus were log transformed prior to statistical analysis. Following transformation, all final variables had acceptable levels of skewness and kurtosis (-1 to 1). For each variable, values that were greater than or equal to 3.29 standard deviations above the mean were Winsorized to be one unit greater than the greatest nonoutlier value (Tabachnick & Fidell, 2001). T-tests revealed that participants who returned for 4-month follow-up did not differ significantly from those who did not on alcohol and drug use severity, PTSD symptom severity, impulsivity or aggression at intake. Third, zero-order correlations were conducted to assess relations between aggressive behavior perpetrated against any adult in the past month at intake and follow-up and intake levels of (1) alcohol and drug use severity (ASI alcohol and drug composite scores), (2) PTSD symptom severity (PCL total score, symptom clusters) and PTSD diagnosis and (3) impulsivity (MPQ Control Subscale).

Hierarchical Multiple Regression (HMR)—To address study objective 1, two HMR models were tested to determine the extent to which drug use severity, PTSD symptom severity and impulsivity explained variance in aggressive behavior both cross-sectionally and longitudinally. All continuous variables were standardized prior to entry (Cohen, Cohen, West, & Aiken, 2003) and alcohol use severity was trimmed from the model as it was not associated with aggression. Analyses were also performed controlling for having a partner/spouse, age and race; results were not affected, thus they were removed in the interest of model parsimony. Aggression at intake and follow-up was entered as the dependent variable in models 1 and 2, respectively. Consistent with hypotheses, drug use severity was entered on Step 1 as it was the most robust correlate of aggressive behavior and PTSD symptom severity was entered on Step 2. To address study objective 2, impulsivity was entered on Step 3 to determine whether it accounted for unique variance after controlling for drug use severity and PTSD symptom severity. For the model in which aggression at follow-up served as the dependent variable, intake levels of aggression were entered on Step 1 as a covariate.

Mediation Analyses—To address objective 3, a series of regression models was performed to determine whether impulsivity mediated the relation between PTSD symptom severity and aggressive behavior (Baron & Kenny, 1986; see Figure 1). Mediation models were tested cross-sectionally and longitudinally, dependent on initial associations observed. Drug use severity was entered as a covariate on Step 1 in all models to ensure that it did not account for any relations observed. First, to test for mediation, aggressive behavior was regressed on PTSD symptom severity (pathway C). Second, pathway A was established by regressing impulsivity (the hypothesized mediator) on PTSD symptom severity. Third, the outcome variable (i.e., aggressive behavior) was regressed on impulsivity, after controlling for PTSD symptom severity (Pathway B and C'). Both bootstrapping and Sobel tests (see Preacher & Hayes, 2004; Sobel, 1982) were used to confirm findings from the Baron and Kenny (1986) mediational tests.

3. Results

3.1 Descriptive Statistics

The sample had a mean of 13.42 (SD = 2.04) years of education, and a mean of 4.72 (SD = 8.58) days employed in the past month. Only 10% of the sample was married, 50% was divorced, 8% was separated and 24% was never married; 39% reported having current spouse or partner and 24% lived with a spouse or partner. In terms of substance use at intake, the majority of patients reported past-30 day abstinence from alcohol (85%) and other drugs (81%). With regard to use of specific drugs in the 30 days prior to intake, 10% reported cocaine use, 9% reported cannabis use, 3% reported amphetamine use, and 1% reported heroin use. Results from the PCL cluster scoring method indicated that 36% of the sample met DSM-IV criteria for current PTSD. See Table 1 for descriptive statistics for alcohol and drug use severity, PTSD symptom severity and impulsivity at intake and for aggressive behavior at intake and follow-up.

3.2 Substance Use and PTSD Symptom Severity, Impulsivity and Aggressive Behavior

Intake—Pearson correlations demonstrated that greater drug use severity, PTSD symptom severity (total score and individual symptom clusters) and higher impulsivity were positively associated with number of aggressive days in the past month. Spearman correlations with dichotomous variables indicated that having a PTSD diagnosis was positively associated with aggression. For correlations between independent variables, higher impulsivity was associated with having a diagnosis of PTSD and higher PTSD symptom severity and symptom clusters. Greater drug use severity was associated with higher PTSD symptom severity and avoidance/numbing and hyperarousal symptoms. Alcohol use severity was associated only with avoidance and numbing symptoms (see Table 2). Abstinence from drugs, but not alcohol, was associated with fewer aggressive days ($\rho = -.21, p < .05$).

Follow-up—Drug use severity at intake was positively associated with number of aggressive days in the past month at follow-up (see Table 2).

3.3 Hierarchical Multiple Regression (HMR)

Two independent HMR analyses were conducted to address study objectives 1 and 2. At intake, all predictors (drug use severity, PTSD symptom severity and impulsivity) explained significant variance in number of aggressive days. However, the amount of variance explained by PTSD symptom severity was no longer significant after including impulsivity in the model in Step 3 (Regression 1, Table 3). After controlling for intake levels of aggression, none of the examined risk factors at intake predicted aggression at follow-up (Regression 2, Table 3).

3.4 Cross-sectional Mediation Analyses

Finally, to address study objective 3, impulsivity was examined as a potential mediator in the relation between PTSD symptom severity and number of aggressive days in the past month at intake (see Figure 1). After controlling for variance accounted for by drug use severity, PTSD symptom severity was significantly and positively related to both the number of aggressive days (Pathway C; $\beta = .19, p < .05$) and to impulsivity (Pathway A; $\beta = .28, p < .01$). Higher impulsivity (hypothesized mediator) was associated with higher number of aggressive days (Pathway B; $\beta = .32, p < .01$). However, the significant relation between PTSD symptom severity and number of aggressive days became non-significant after accounting for variance associated with impulsivity (Pathway C'; $\beta = .10, p = .20$) suggesting that impulsivity fully mediated the relation between PTSD symptom severity and number of aggressive days. A Sobel test suggested that the inclusion of impulsivity significantly decreased the strength of the association between PTSD symptom severity and number of aggressive days ($z = 2.55; p < .02$). The bootstrapped 95% confidence interval with 5000 iterations was .02 - .10.

4. Discussion

The primary objective of the current study was to examine the extent to which two independent risk factors, PTSD symptom severity and impulsivity, explained perpetration of aggressive behavior among Veterans in SUD treatment, both cross-sectionally and longitudinally. We also sought to determine whether impulsivity may contribute to the observed relation between PTSD symptom severity and aggressive behavior (Marshall et al., 2005; Orth & Wieland, 2006; Taft et al., 2011). In this study of male Veterans self-reporting trouble with anger and violence who were entering SUD treatment, drug use severity, PTSD symptom severity, symptom cluster severity, PTSD diagnosis, and impulsivity tended to be interrelated and were all independently related with aggression at treatment intake. In a multivariate model, drug use severity, PTSD symptom severity and impulsivity explained variance in aggressive behavior at treatment intake. However, as hypothesized, impulsivity fully mediated the relation between PTSD symptom severity and aggressive behavior at intake (i.e., PTSD symptom severity no longer explained variance in aggressive behavior after accounting for impulsivity).

Impulsivity extends across a number of mental health difficulties, and is often not specifically targeted in evaluation and treatment of aggressive behavior. These findings suggest that assessment of impulsivity, in addition to posttraumatic stress symptoms, may

yield a richer, more informative clinical case conceptualization and treatment plan for substance users struggling to gain control over aggressive tendencies. For example, rather than focus predominantly or exclusively on treating symptoms of PTSD in these individuals, it may be important for treatment plans to include specific recommendations and behavioral exercises for improving response inhibition, decision-making and planning.

Prevalence rates of aggressive behavior and PTSD observed in the current sample are consistent with reports from previous research conducted among individuals in SUD treatment. Eighty-four percent of the sample reported perpetration of some form of aggressive behavior against another adult in the past month at intake. The current study offers unique and novel information by combining partner and non-partner psychological and physical aggression and is thus not directly comparable to other studies. However, similar studies of individuals in SUD treatment have reported rates of past-year combined partner and non-partner physical aggression at 75% (Chermack et al., 2000) and partner-only and non-partner only psychological and physical aggression at 77% and 54% (Chermack et al., 2008) and 83% and 61% (Murray et al., 2008), respectively. Approximately one third of our sample met criteria for PTSD (36%), which is similar to prevalence rates typically observed among individuals in SUD treatment (Ouimette & Brown, 2003). Finally, study participants demonstrated average T-scores for the MPQ Control scale, indexed here as impulsivity, well below the mean of 50. As such, the current sample of individuals in SUD treatment was more impulsive relative to the general population.

Our results suggest that the role of PTSD symptom severity and impulsivity appear to hold more relevance for aggressive behavior upon treatment entry rather than during or after treatment. Indeed, past aggression tends to be the best predictor of future aggression (e.g., Capaldi et al., 2005; O'Leary, 1999); thus, other temporally-distal risk factors may offer less predictive power as they do not reflect the more proximal risk factors that trigger later aggressive episodes. Given that the vast majority of participants reported one-month abstinence from alcohol and drugs at intake, another potential explanation for why PTSD symptom severity and impulsivity did not predict aggressive behavior at follow-up is that protracted symptoms of abstinence (e.g., irritability, dysphoria, sleep disruption; Brady et al., 1998; Satel, Kosten, Schuckit, & Fischman, 1993) may have influenced aggressive behavior at intake. However these effects may have dissipated by follow-up when participants had been in active treatment. In addition, participants were in a treatment setting where the immediate consequences of aggressive behavior tend to be more salient. Therefore, remaining in a treatment environment may have impacted expression of aggressive behavior independent of proposed risk factors. Future research is needed to determine whether changes in these factors are associated with changes in aggressive behavior.

Findings from the current study provide more information on the predictors of aggressive behavior in SUD populations and therefore hold several implications for informing violence prevention and treatment efforts. They reveal that although PTSD symptom severity explains variance in SUD patients' engagement in aggressive behavior, this link may be better accounted for by impulsivity. This is consistent with research examining subtypes of

internalized and externalized PTSD symptom expression (Miller, 2003) and suggests that more formalized assessment of impulsivity has potential utility in SUD treatment settings. Finally, the present study was able to observe a wider range of PTSD symptom severity because it included individuals who did not meet full criteria for PTSD. As such, regular assessment of symptom severity among individuals who fall below diagnostic criteria may be helpful in assessing risk for aggressive behavior.

Impulsivity may be conceptualized as a common, trans-disease phenomenon that operates across both SUD and PTSD and renders significant impacts on a client's life functioning. For example, individuals with both SUD and PTSD and high impulsivity may demonstrate additional struggles in securing and sustaining employment and relationships which in turn, exacerbate symptoms and hinder recovery. Given these concerns, impulsivity is a potentially useful target for both assessment and intervention efforts. Also of note, higher levels of impulsivity are thought to denote poorer executive control and self-regulation (Bickel et al., 2012; Crews & Boettiger, 2009; Hofmann et al., 2012). Accordingly, interventions to reduce impulsivity and improve related cognitive functions (e.g., inhibition, planning) such as neuroscience-based computerized cognitive training (e.g., Bickel, Yi, Landes, Hill, & Baxter, 2011; Fals-Stewart & Lam, 2010; Vinogradov, Fisher, & de Villiers-Sidani, 2012), may help bolster existing empirically supported SUD treatments for this vulnerable and high-risk population. In addition, impulsivity, aggressive behavior and SUDs are associated with disruptions in serotonergic neurotransmission (Heinz, Beck, Meyer-Lindenberg, Sterzer, & Heinz, 2011; Kreek, Nielsen, Butelman, & LaForge, 2005) pharmacotherapy (i.e., selective serotonin reuptake-inhibitors - Fluoxetine) can help reduce aggression among alcohol-dependent male perpetrators of violence (George et al., 2011). Future research should examine whether adjunctive interventions that target these cognitive and biological mechanisms can help reduce impulsive and aggressive behavior among individuals with SUD.

4.1 Limitations and future directions

Despite several strengths, including a clinically and theoretically-informed multivariate model, prospective design and examination of the full range of interpersonal aggression (i.e., psychological and physical) in the context of partner and non-partner relationships across multiple types of SUDs, limitations should be noted. First, as the mediational analyses were conducted among cross-sectional data, we cannot imply directionality of the observed effects. Second, the current study employed the ASI, which did not allow for assessment of quantity of alcohol and drug use, such as binge drinking, in relation to perpetration of aggressive behavior. Indeed, binge drinking, rather than general alcohol use, tends to better predict engagement in aggression (Chermack et al., 2008; Chermack et al., 2010; Murphy, Winters, O'Farrell, Fals-Stewart, & Murphy, 2005) and this may help account for why we did not find a relation between alcohol use severity and aggression outcomes. Of note though, the vast majority of the sample reported past-month abstinence from alcohol and other drugs at intake. This suggests that PTSD symptoms and impulsivity can help account for aggressive behavior in the absence of active substance use. In addition, while acute and heavy substance use may lead to disinhibition and facilitate aggressive behavior (Boles & Miotto, 2003), abstinent substance users have demonstrated higher levels of aggression

(laboratory measures) than individuals without a substance use history (Allen, Moeller, Rhoades, & Cherek, 1997). Such a finding suggests that aggressive behavior is still problematic among abstinent substance users embarking upon early recovery. Future research should examine micropredictors of aggression in close proximity to the act that includes type and consumption pattern of specific psychoactive substances.

Third, the current study did not include women. Gaining a better understanding of how these mechanisms might operate differently among women is of great clinical importance. For instance, a meta-analytic investigation by Taft and colleagues (2011) concluded that relative to men, women's experience of PTSD symptomatology appears more likely to impact relationship satisfaction rather than manifest in interpersonal aggression, ostensibly because women have a greater tendency to experience and express internalizing psychopathology. Fourth, impulsivity was assessed using only a self-report measure. Although this measure was selected for its appropriateness in a busy clinical setting and is psychometrically strong, self-perceptions of impulsivity may not fully reflect real-life behavior and higher levels of impulsivity may be associated with decreased validity of self-reports. Finally, although past-year difficulty with anger as a selection criterion was a strength of this study (i.e., examines malleable clinical risk factors among those with the highest risk for the poorest outcomes), it also presents a limitation in that the sample size was relatively small and the sample may not be representative of the larger veteran population.

Results from the current study help to highlight several areas for future research. First, it is important to determine how PTSD symptom severity and impulsivity may influence other facets of aggressive behavior such as victimization (i.e., receipt of aggressive behavior) as well as injurious impacts (e.g., need for hospitalization). Second, impulsivity is a multidimensional construct (de Wit, 2009); however, the current study examined only one facet, using a single measurement modality. Although the lack of planfulness facet captures the most frequent conceptualization of impulsivity in the self-report literature (Whiteside and Lynam, 2001) and is a robust predictor of aggressive behavior (Derefinko, DeWall, Metze, Walsh, & Lynam, 2011; Lynam & Miller, 2004), additional information could be gained by using a multimodal approach (e.g., behavioral, self-report, observer-report) to understanding how different facets of impulsivity (e.g., behavioral inhibition, sustained attention, sensation seeking, negative urgency) interact with PTSD to influence aggressive behavior. Indeed, different components of impulsivity recruit different brain circuitries and may be susceptible to diverse behavioral, cognitive and pharmacological influences. Thus, a better understanding of which particular impulsivity aspects are related to aggressive behavior may lead to more specific treatment implications. Third, given previous research demonstrating that hyperarousal is uniquely associated with aggressive behavior (Hellmuth, Stappenbeck, Hoerster, & Jakupcak, 2012; Taft, Kaloupek, et al., 2007) and the compelling associations we observed between impulsivity and PTSD symptom clusters, future work should consider how individual symptom clusters influence perpetration of interpersonal aggression.

In summary, the current study offers a novel contribution to the substance abuse treatment literature via a multivariate examination of two key risk factors (PTSD symptom severity and impulsivity) that have previously been assessed independently as they relate to

interpersonal aggression. Examination of these research questions within a treatment-seeking sample has direct implications for clinicians and researchers to better address aggression-related issues in SUD treatment. Specifically, impulsivity may offer a malleable target to help reduce aggressive behavior in SUD patients, especially among those who struggle with posttraumatic stress. Dually-focused treatments for violence and SUD (e.g., Anger Management for Substance Abuse and Mental Health Clients, Reilly & Shopshire, 2002; Control of Violence for Angry Impulsive Drinkers, Bowes, McMurran, Williams, David, & Zammit, 2012) that address trauma symptoms and impulsivity have yielded compelling data demonstrating reductions in violence as well as problematic substance use. Accordingly, they may help stem the tide of these destructive behaviors.

Acknowledgements

This research was supported by Department of Veterans Affairs (VA) Health Services Research & Development (HSR&D) Service awards (IIR 07-264 and RCS 00-001) to Dr. Timko, HSR&D funds and a Career Development Award-2 (Rehabilitation Research & Development) to Dr. Heinz, and a Career Development Award-2 (Clinical Sciences Research & Development) to Dr. Blonigen. The expressed views are the authors' and do not necessarily represent those of the VA.

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Figure I. Impulsivity functioning as a mediator of the association between posttraumatic stress disorder symptom severity and number of aggressive days in the past month at intake. $^{**}p < .01$; $^{*}p < .05$.

Table 1

Descriptive statistics for substance use severity, posttraumatic stress symptoms and impulsivity at intake and aggressive behavior at intake and follow-up.

	M(SD)	% Meeting Full Criteria
Intake (n = 133)		
ASI – Alcohol Use Severity	.135(.168)	-
ASI – Drug Use Severity	.057(.074)	-
PTSD Checklist (PCL)	40.8 (17.38)	36
B – Re-experiencing	11.64(5.44)	56
C – Avoidance/Numbing	16.8(7.6)	46
D - Hyperarousal	12.37(5.53)	51
MPQ - Control (Impulsivity)	44.62(10.91)*	-
	M(SD)	%+
Aggressive Days	9.67(17.91)	84
Follow-Up (n = 101)		
Aggressive Days	7.89(16.31)	61

Note. % + = percent of participants endorsing any aggression. MPQ = Multidimensional Personality Questionnaire. ASI = Addiction Severity Index.

* indicates standardized t-score relative to the general population (lower scores indicate higher impulsivity).

Table 2

Correlations between patient characteristics at intake and aggression at intake and follow-up.

	1	2	3	4	5	6	7	8	9
1. Alcohol Use Severity	-								
2. Drug Use Severity	.20*	-							
3. PTSD Symptom Severity	.14	.20*	-						
4. Re-experiencing	.06	.13	.91**	-					
5. Avoidance/Numbing	.20*	.21*	.95**	.79**	-				
6. Hyperarousal	.12	.21*	.94**	.80**	.84**	-			
7. PTSD Diagnosis	.15	.14	.80**	.70**	.78**	.77**	-		
8. Impulsivity	.15	.07	.28**	.23**	.29**	.27**	.22*	-	
9. Number of Aggressive Days Intake	.11	.37**	.26**	.22**	.24**	.28**	.21*	.37**	-
10. Number of Aggressive Days Follow up	.08	.22*	.07	.05	.09	.11	.12	.11	.41**

Note. Spearman correlations denoted by italicized text.

**
 $p < .01$;*
 $p < .05$.

Table 3

Results from Hierarchical Multiple Regression Analyses

	$\beta(\text{sr}^2)$	R^2	R^2
Regression 1 DV: Number of Aggressive Days Intake			
<i>Step 1</i>		.13**	.13
Drug Use Severity	.36** (.13)		
<i>Step 2</i>		.04*	.17
Drug Use Severity	.32** (.10)		
PTSD Symptom Severity	.19* (.04)		
<i>Step 3</i>		.09**	.26
Drug Use Severity	.32** (.10)		
PTSD Symptom Severity	.10		
Impulsivity	.32** (.09)		
Regression 2 DV: Number of Aggressive Days Follow-Up			
<i>Step 1</i>		.17**	.17
Intake Aggressive Days	.41** (.17)		
<i>Step 2</i>		.00	.17
Intake Aggressive Days	.39** (.13)		
Drug Use Severity	.06		
<i>Step 3</i>		.00	.17
Intake Aggressive Days	.39** (.13)		
Drug Use Severity	.06		
PTSD Symptom Severity	-.02		
<i>Step 4</i>		.00	.17
Intake Aggressive Days	.40** (.12)		
Drug Use Severity	.05		
PTSD Symptom Severity	-.02		
Impulsivity	-.03		

Note.

**
 $p < .01$;*
 $p < .05$.DV = Dependent Variable. sr^2 = squared semi-partial correlation coefficient