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ORIGINAL ARTICLE

Examining Executive Functioning as a Moderator of Intimate Partner Violence Risk in Veterans

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Abstract

This study examined the inter-relationships among posttraumatic stress disorder (PTSD) symptoms, cognitive bias, executive functioning deficits, and intimate partner violence (IPV) outcomes in a sample of 104 military veterans who had served in conflicts in Afghanistan and Iraq. Veteran participants completed questionnaires, a neuropsychological assessment, and a laboratory procedure assessing social information (SIP) processing biases during a single assessment, and collateral reports of IPV from intimate partners were obtained for 69 participants via telephone interviews. Findings indicated that executive functioning deficits in the areas of inhibition and impulsivity were associated with increased risk for all IPV perpetration outcomes, and these risk factors also moderated the association between cognitive bias and psychological IPV. Cognitive inflexibility also appeared to moderate the associations between both PTSD symptoms and cognitive bias with injurious IPV, though the latter moderated relationship was marginally significant. Findings suggest the salience of executive functioning deficits with respect to understanding IPV perpetration risk from a trauma-informed, SIP perspective, and highlight several possible clinical strategies that may enhance intervention.

Keywords Intimate partner violence · Executive functioning · Trauma · Social information processing

Intimate partner violence (IPV) is a significant public health concern (Ellsberg et al., 2008). Posttraumatic stress disorder (PTSD) symptoms have been consistently shown to represent a robust correlate of IPV perpetration, and this association is particularly strong among military populations (Taft et al., 2011). Given that PTSD symptomatology appears to be a central IPV risk factor, research examining pathways for this relationship takes on importance. Some work suggests the relevance of social information processing (SIP), with evidence that PTSD negatively influences SIP, which in turn increases IPV risk (LaMotte et al., 2017; Taft et al., 2008, 2015). We attempted to build on this initial work by examining the moderating role of executive functioning deficits on these associations.

McFall (1982) developed a SIP model of social skills comprised of three stages through which elements of social information are transformed into responses: (1) the decoding stage, (2) the decision stage, and (3) the enactment stage. The first processing stage involves using decoding skills to receive, perceive, and interpret incoming information according to the schemas available to the individual. The second stage in the sequence involves using decision-making skills to generate potential responses to a given situation, evaluate how response options fit the situation, choose the best response, and assess the usefulness of the chosen response. The final stage requires enactment skills to carry out the chosen response, monitor and assess its impact, and enact any necessary mid-course adjustments to achieve the intended effect.

Particularly relevant for the "decoding" stage of the SIP model, Chemtob and colleagues (1997) developed a theory

General Scientific Summary This study suggests that executive functioning deficits, particularly in the areas of inhibition and impulsivity, relate to increased risk of intimate partner violence perpetration and also strengthen associations between cognitive bias and aggression.

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in the area of PTSD and anger that emphasized the role of the context-inappropriate activation of cognitive processes related to a "survival mode" of functioning. They posited that combat veterans with PTSD, by virtue of their prior experience of trauma and life-threat, were more likely to perceive threats in their environment, even in the absence of realistic threat. In response to these perceived threats, the veteran exhibits heightened arousal and several cognitive biases, including a hostile appraisal of events, an inclination towards threat confirmation, increased vigilance in recognizing a threat, and a lower threshold for responding to the threat. These cognitive processes may override other adaptive cognitive processing once the individual enters survival mode, due to the primacy of dealing with a perceived life threat. These processes negatively impact the ability to regulate arousal and engage in self-monitoring behaviors or other inhibitory processes, leading to a higher likelihood of aggression.

Holtzworth-Munroe (1992), in her adaptation of the SIP model for IPV, posited that anger interferes with cognitive processing, resulting in skills deficits and a higher likelihood of IPV. Eckhardt and colleagues have examined this model by employing the Articulated Thoughts in Simulated Situations paradigm (ATSS; Davison et al., 1983) that assesses thoughts during anger arousal, since relevant thoughts may be more accessible and reportable if assessed when angry mood states are activated and relevant contextual cues are present. This procedure is advantageous since automatic, affectively linked cognitions are often inaccessible in "cold" assessment contexts. Participants are administered audiotaped anger-inducing scenarios and instructed to imagine that they are participating in the scenario and to verbalize their thoughts and feelings when prompted. These verbalizations are then coded for irrational beliefs, cognitive bias, and anger-control strategies. These researchers have consistently found partner violent men to verbalize more irrational thoughts, hostile attributional/cognitive biases, and fewer anger-control statements than nonviolent men experiencing relationship distress (Eckhardt & Crane, 2015; Eckhardt et al., 1998).

This body of research has assisted in elucidating specific cognitive biases and distortions (e.g., dichotomous thinking, overgeneralizing) among violent men that may serve as important targets for intervention. In a prior study, we extended this ATSS literature by showing that maladaptive cognitive processes during anger arousal were associated with IPV severity among returning combat veterans, and these variables help account for the influence of PTSD symptoms on IPV (Taft et al., 2015). The impact of all PTSD symptom scores, aside from avoidance, on anger expression were mediated by general cognitive bias, and hostile attributions were also associated with greater IPV perpetration.

Previous models of IPV and aggression among veterans reporting PTSD symptoms have not accounted for executive functioning deficits. This is a major gap in the literature, given that deployments are associated with increased neuropsychological impairment (Vasterling et al, 2006). Those who use violence report high rates of traumatic brain injury that may be associated with executive functioning deficits (Bannon et al., 2015; Farrer et al., 2012), and veterans may be at particular risk for these problems (Amick et al., 2013). Moreover, executive functioning deficits co-occur with PTSD at high rates (Nelson et al., 2009), and these factors have been associated with IPV perpetration (Cohen et al., 1999). Thus, we were interested in the direct impact of executive functioning on IPV and the interactions between executive functioning deficits, PTSD symptoms, and SIP biases. Deficits in inhibitory mechanisms may make the expression of IPV more likely among those already at risk for IPV, namely those evidencing PTSD symptoms and maladaptive cognitive processes while angry.

Studies using neuropsychological assessment tools to evaluate executive functioning have demonstrated lower performance among IPV perpetrators than non-aggressive comparison groups. Cohen and colleagues (1999) found that performance on neuropsychological measures was a stronger correlate of IPV perpetration than a history of TBI or emotional distress. Tools sensitive to executive functioning, such as The Trail Making Test part B (TMT B; Lezak et al., 2004) and The Wisconsin Card Sort Test (WCST; Heaton, 1981), are related to IPV perpetration; whereas measures not sensitive to executive function, such as The Trail Making Test Part A (TMT A; Lezak et al., 2004), do not appear to be related to IPV (Stanford et al., 2007). Studies have also shown self-report impulsivity measures to be associated with IPV (Cunradi et al., 2009).

Among veterans who suffer from PTSD symptoms or SIP biases, executive functioning impairments can lead to difficulties inhibiting behavior, regulating emotional reactivity, and decreased ability to control aggressive inclinations. In the present study, we proposed a multiplicative impact of these different factors in our tests of moderation, such that the presence of executive functioning impairment potentiates the positive relationships between PTSD symptoms and IPV, and maladaptive cognitive biases during anger arousal and IPV. Hypotheses were as follows: (1) executive functioning deficits would be positively associated with physical and psychological IPV severity; (2) executive functioning deficits would potentiate the positive association between PTSD symptoms and physical and psychological IPV; and (3) executive functioning deficits would potentiate the positive associations between indices of maladaptive cognitive bias during anger arousal and physical and psychological IPV.

Method

Participants

Participants were 104 male U.S. veterans from an urban area in New England who had served in Iraq or Afghanistan during the military conflicts there. Only male veterans were examined in this study because some prior work indicates stronger associations between PTSD symptoms and IPV use in men relative to women (Taft et al., 2011). Participants were recruited through four methods: (a) flyers posted throughout the Veterans Affairs Medical Center (VA); (b) a participant recruitment database already established at the research site that included 113 veterans; (c) mass mailings to veterans whose contact information is in a roster obtained through the Veterans Information Resource Center; and (d) mass mailings to those obtained from a roster of veterans living in Massachusetts, held by the Defense Manpower Data Center (DMDC), and shared with the VA under a data use agreement signed by DMDC and the VA Central Office. Potential participants were contacted and screened by a research assistant. A total of 109 male veterans were recruited for this study, but five did not meet study criteria and were excluded.

Inclusion criteria were as follows: (a) participants must have been married or cohabitating for at least 6 months; and (b) participants must have been over the age of 18, due to our emphasis on adult IPV. Potential participants were excluded if (a) reading difficulties prevented valid completion of the assessment instruments, (b) the mental status of a participant precluded the completion of study procedures, such as severe organicity or active psychosis, or c) they met criteria for current alcohol or drug dependence, or had been in inpatient treatment or begun outpatient treatment for alcohol or drug dependence within the past 60 days. Substance use disorders and active psychosis were assessed with the corresponding subscales of the *Mini International Neuropsychiatric Interview* (MINI; Sheehan et al., 1998). To ensure an adequate representation of IPV in our sample, a cutoff score of 29 on the Quality of Marriage Index (QMI; Norton, 1983) was used such that the final sample would include approximately 65% within this relationship-distressed range.

The majority (72.1%) of veteran participants self-identified as Caucasian, and 12.5%, 8.7%, 1.9%, 1%, and 3.8% identified as African American, Hispanic or Latino, Asian, Native Hawaiian, and Other, respectively. The average age of participants was 37.7 years ($SD = 10.0$) and they had completed an average of 14.6 years of education ($SD = 2.4$). Regarding branch of U.S. military service, the breakdown was as follows: 71.2% Army, 13.5% Marines, 11.5% Navy, and 3.8% Air Force. The majority (71.2%) of participants were married, 26% were cohabitating with their partner, and 2.9% were married but separated. The average length of participants' relationship was 9.8 years ($SD = 8.9$).

Following the male veteran's participation in the study, they were asked to provide contact information for their female partners to obtain additional supplemental data on participant IPV. Upon receiving permission and contact information, female partners were mailed letters asking if they would be willing to participate in the study. Partners indicated interest in participating by mailing study staff a postcard. Of the 104 male veterans, 6 did not consent to partner contact, 8 partners declined to participate, and 21 partners were unable to be reached, yielding a total of 69 partners in the final sample. Of the female partners, 76.8% self-identified as Caucasian, 11.6% as Hispanic or Latino, 5.8% as African American, 1.4% as Asian, and 4.3% as other. The average age for partners was 37.9 ($SD = 11.1$).

Procedure

This study was approved by an institutional review board (IRB) in a VA medical center located in the New England area. Participation involved an initial telephone screening and one all-day session at the study site. The initial participant screening determined study eligibility based on the criteria described above. The day-long session began with informed consent procedures, followed by neuropsychological assessment, structured clinical interviews, self-report forms, and the ATSS laboratory procedure.

For the ATSS, the participant was alone in a room, listening to three fictional, audiotaped anger-inducing scenarios, and was instructed to imagine that he was participating in the scenarios and to verbalize his thoughts and feelings when prompted. These verbalizations were then coded for a number of irrational beliefs, cognitive bias, and anger-control strategies. The first scenario was a general anger-inducing control scenario. The other two scenarios were relationship-specific anger-arousing scenarios, with one involving an overheard conversation (e.g., the participant imagined that he overheard his partner negatively evaluating him with her friend), and the other involving jealousy (e.g., the participant imagined that he overheard his partner flirting with a male acquaintance). The two relationship-specific scenarios were presented in a counterbalanced order. Each scenario was subdivided into eight 30-s segments. At the conclusion of each segment, participants verbalized their thoughts for 30 s.

Recorded ATSS verbalizations were coded by two research assistants trained according to an ATSS coding manual (Eckhardt et al., 1998). A cognitive bias score was derived from participants' verbalizations, comprising five types of automatic thoughts (i.e., "arbitrary inference," "selective abstraction," "overgeneralization,"

"magnification," "personalization," and "dichotomous thinking"). Coders rated each of the five categories according to a 5-point scale indicating the degree to which each variable was present in each segment. Summary scores were calculated by summing the average ratings of the two coders across the eight segments of each scenario. All ATSS ratings are made relative to the total amount of thought articulation to mitigate differential levels of verbal fluency/ability across participants. This procedure has been shown to yield reliable and valid ratings (Eckhardt & Crane, 2015; Eckhardt et al., 1998).

Before and after the ATSS procedures, participants were administered the State Anger Scale (SAS; Spielberger, 1988) and Emotion Rating Form (ERF; Duclos et al., 1989) as a manipulation check to ensure that the procedure elicited anger arousal. The State Anger Scale is a 10-item subscale of the State Trait Anger Expression Inventory that assesses the intensity of angry feelings at the time of assessment. The Emotion Rating Form consists of six scales assessing the following subjective emotional states: anger, sadness, fear, happiness, disgust, and surprise. Participants were asked to rate each of the six emotions on a 10-point scale ranging from "don't feel at all" to "feel very strongly."

After the ATSS was completed, participants were fully debriefed by the doctoral level clinical psychologist to address reactions, concerns, and distress levels and to provide full disclosure of the purposes of the study. The psychologist conducted a careful assessment of participants' present mood prior to leaving the laboratory. If warranted, the doctoral level clinical psychologist provided the participant with treatment referrals for symptoms of PTSD or other psychopathology. If the participant reported IPV and if appropriate, he was offered group therapy focused on changing abusive behavior and offered other treatment referrals.

Participants were paid $150 at the completion of the assessment. Participants who chose not to complete the assessment were compensated $15 per hour for their time.

Partner consent procedures and questionnaires were conducted entirely over the telephone by research assistants. Female partners were assured that their male veteran partner would not have access to any of their data. At the time of the interview, partners were also offered resources including counseling services, shelter services, and hotline numbers, and referrals for individual and legal counseling. Safety planning information was also discussed and provided for those who did not have a safety plan. Partners received $50 for financial remuneration for their completion of the study.

Measures

The Wisconsin Card Sorting Test (WCST; Heaton, 1981). The WCST is a well-established measure of executive functioning and assesses skills such as planning and capacity to establish and change cognitive set. The test is administered and scored according to standardized methods. The number of perseverative errors and total number of errors were examined.

D-Kaplin Executive Function System (*D-KEFS*; Delis et al., 2001). Subtests from the D-KEFS assessment was used to further assess executive functioning, including the Trails and Color-Word Interference. In the Trails task, a widely-used motor task, the participant is asked to first connect numbered dots, then to connect a series alternating between letters and numbers. It taps several executive functions, including the ability to inhibit, sequence, and shift set. Well-established, national norms are available for this population. In the Color-Word Interference subtest, the participant is asked to read color words (red, green, etc.) printed in color that is different from the word. It taps the ability to inhibit information.

Barratt Impulsiveness Scale-11 (BIS-11; Patton et al., 1995). The BIS-11 is the most commonly used measure of impulsiveness in research and clinical settings (Stanford et al., 2009). The self-report measure consists of 30 items for which participants rate the frequency of behaviors on a 4-point scale ranging from 1 (*Rarely/Never*) to 4 (*Almost Always/Always*). The present study used a total score, computed by summing the 30 item scores for a maximum possible score of 120. The BIS-11 has demonstrated excellent reliability and validity (Stanford et al., 2009).

California Verbal Learning Test (*CVLT*; Delis et al., 2000). Verbal learning and memory were assessed using this well-established measure in which the participant is read a list of words and asked to recall them in a series of trials that includes a 15-min delay. The total number of intrusion errors (items *not* included on the original list) from both free and cued recall portions of the task was used in the present study.

Posttraumatic Stress Disorder Checklist (*PCL*; Weathers et al., 1993). The PCL is a 17-item self-report measure used to assess PTSD symptoms. Participants rated the degree to which they had experienced each PTSD symptom over the prior month on a 5-point scale, ranging from 1 (*not at all*) to 5 (*extremely*). A total PTSD symptom severity score was calculated. This measure has been shown to exhibit high internal consistency, test–retest reliability, and convergent validity with other measures of trauma and PTSD (Weathers et al., 1993).

Revised Conflict Tactics Scale (CTS2; Straus et al., 1996). The CTS2 and the original CTS are the most widely used measures of IPV. This study used the 8-item Psychological Aggression and 12-item Physical Assault subscales. Respondents reported on the frequency of each behavior perpetrated by both themselves and their partners during the previous 6 months on a scale ranging from 0 (*Never*) to 6 (*More than 20 times*). When data from both partners were collected, the highest report of each individual item

was used in calculating total scores to protect against underreporting of IPV. Psychological IPV frequency scores were computed by summing the mid-points of the response categories for each item (e.g., 3–5 = 4). For physical IPV and injury variables, "variety scores" were obtained by dichotomizing items for presence versus absence of each item, and number of positively endorsed items were summed. This method for physical forms of IPV increases reliability and reduces error due to memory limitations.

Data Analysis

In order to determine whether the ATSS was successful in inducing anger and arousal, *t*-tests were used to examine whether STAXI State Anger and Emotion Rating Form anger scores obtained following the ATSS procedures were higher than those obtained before the procedures.

Bivariate correlations were then conducted to examine relationships among the study variables. Since multiple measures of executive functioning might assess overlapping processes (e.g., inhibitory processes), a principal components analysis (PCA) was conducted prior to hypothesis testing. The PCA was used to evaluate the domain(s) of functioning that these instruments assessed and provide information about how these multiple measures may be combined to simplify data analyses and a Promax rotation was used to increase interpretability. The PCA was performed to obtain the underlying structure of all executive functioning measures observed *[California Verbal Learning Test* (*CVLT*; Delis et al., 2000); *D-Kaplin Executive Function System* (*D-KEFS*; Delis et al., 2001)*; The Wisconsin Card Sorting Test* (WCST; Heaton, 1981)]. The criterion to determine the number of components was an eigenvalue greater than 1. The saturation for each item in every component was greater than 0.60. The components that emerged were used as moderators between variables of PTSD symptomatology, cognitive bias, and IPV. Moderation analyses were then conducted using sequential regression analyses for each interaction separately. Each executive functioning factor X PTSD interaction was plotted at one standard deviation (*SD*) below the mean (low), at the mean (average), and above the mean (high) for each executive functioning factor (the moderator) and PTSD symptom and cognitive bias level (the independent variable), consistent with the moderation procedure outlined by Hayes (2013). The same analytic approach was used with the interaction of each executive functioning factor and cognitive bias. Note that these regression coefficients are standardized, thus allowing for comparison across coefficients. For rejection criterion of the interaction terms we used $p < 0.10$, rather than the common $p < 0.05$, as we further decomposed these terms into different simple slopes for which we applied the $p < 0.05$ criterion for significance (Hayes, 2013).

Results

Missing Values

There were four missing values in the empirical data: one in the cognitive bias variable and three in the WCST variable across 104 usable responses. With this missingness, the test for randomness yielded complete random pattern (Little's MCAR test: $\chi 2 = 18.444$, $df = 16$, $p = 0.299$), that is, these missing values were not associated with specific rows (respondents) or columns (variables). Thus, we continued with the sample as is, and listwise deletion was used across analyses. A complementary analysis was performed using independent sample *t*-tests to test possible differences across research measurements between participants with and without collateral partner data. No differences were found except for psychological IPV, in which the group with full data showed a lower mean ($t = 2.516$, $df = 89.20$, $p = 0.014$).

Manipulation Checks

To assess whether the ATSS successfully induced anger, a dependent samples *t*-test was conducted on State Anger Scale (SAS) scores and Emotion Rating Form anger from immediately before and after the ATSS procedure. The SAS *t*-test results showed that the mean of anger in men following the ATSS ($M = 14.15$, $SD = 6.13$) was significantly higher than before the ATSS ($M = 11.98$, $SD = 3.66$), $t\,(103) = -6.03$ $p < 0.001$). The Emotion Rating Form *t*-test also showed that men were angrier after the ATSS ($M = 2.72$, $SD = 2.46$) than before the ATSS ($M = 1.98$, $SD = 1.74$), $t\,(103) = -6.03$ $p < 0.001$).

Principal Components Analysis

Thirteen items were taken from well-known subscales of executive functioning measures that captured facets potentially relevant to IPV, namely cognitive inflexibility, inhibition, and impulsivity. The PCA of the 13 items resulted in a three-factor solution. Only three factors had eigenvalues greater than 1.0, and the scree plot was consistent with a three-factor solution. Overall, the three derived factors accounted for a total of 71.4% of the variance. Extracted factors were rotated using a Promax rotation to improve interpretability. The Promax rotation technique belongs to the oblique ration family which implements non-orthogonal factor associations and allows for more realistic factor relationships. Table 1 presents the item loadings on the three derived factors. Item loadings of 0.40 or higher were considered significant (Stevens, 2002). All items loaded on a factor, except for one, Trails_1b, which loaded on

Table 1 Principal Components Analysis

Items included in the analysis	Factor Loading		
	1	2	3
Five items of the Wisconsin Card Sorting Test (WCST; Heaton, 1981)			
Total Errors (Standard)	**.985**	-.032	.088
Total Errors (T Scores)	**.985**	-.034	.088
Perseverative Errors (Standard)	**.931**	.026	.111
Perseverative Errors (T Scores)	**.931**	.026	.108
Total Administered	**-.834**	-.141	.090
Trail-Making Test: D-Kaplin Executive Function System (D-KEFS; Delis et al., 2001)			
Letter Sequencing Scaled Score	.032	**.854**	.032
Visual Scanning Scaled Score	-.167	**.794**	.525
Number Sequencing Scaled Score	.073	**.769**	-.054
Number-Letter Sequencing Scaled Score	.027	**.618**	-.181
Color-Word Interference Test; D-Kaplin Executive Function System (D-KEFS; Delis et al., 2001)			
Inhibition Scaled Score	.019	**.702**	-.313
Inhibition/Switching Scaled Score	.077	**.629**	-.166
Barratt Impulsiveness Scale-11 (BIS-11; Patton, Stanford, & Barratt, 1995)			
Sum Score	.030	-.127	**.735**
California Verbal Learning Test (CVLT; Delis et al., 2000)			
Total Intrusions (Standard)	.141	-.137	**.665**

Item loadings in bold are above .400 cutoff criterion

Note: Factor 1 = Cognitive Inflexibility factor and consists of Wisconsin Card Sorting Task items. Factor 2 = Inhibition factor and consists of D-Kaplin Executive Function System (D-KEFS) Trails-Making Test and Color-Word Interference Test items. Factor 3 = Impulsivity factor and consists of Barratt Impulsiveness Scale-11 & California Verbal Learning Task score

two factors (Inhibition and Impulsivity). However, it was stronger for the Inhibition Factor, which also relates to the content of other items in that factor.

The first factor, labeled Cognitive Inflexibility, accounted for 38.4% of the variance and had an eigenvalue of 4.99. This factor consisted of five WCST items related to cognitive efficiency, executive dysfunction, and cognitive flexibility. The second factor, labeled Inhibition, accounted for 23.1% of the variance and had an eigenvalue of 2.99. This factor consisted of four D-KEFS items related to inhibition and cognitive switching. The third factor, Impulsivity, consisted of the BIS-11 total score and a CVLT item, accounted for 9.9% of the variance and had an eigenvalue of 1.30. Reliability estimates using Cronbach's alpha were conducted for each scale. Reliability for the factors ranged from fair to good ($\alpha = 0.82$ for the Inhibition Factor, $\alpha = 0.61$ for the Cognitive Inflexibility Factor, and $\alpha = 0.88$ for the Impulsivity factor; see, for example, Cortina, 1993 or Taber 2013 for index ranking).

Bivariate Correlations

Table 2 provides descriptive statistics and bivariate relationships amongst study variables. Actual scale ranges are also provided (minimum and maximum values). The bivariate correlation coefficients supported the first hypothesis that executive functioning deficits would be positively associated with severity of physical and psychological IPV perpetration, except for cognitive inflexibility. In addition, PTSD symptoms was positively associated with the same two executive functioning variables, inhibition and impulsivity, as well as cognitive bias and all IPV perpetration outcome variables. Cognitive bias was also associated with psychological IPV.

Moderation Analyses

To test our second hypothesis, we looked at the probability of injurious IPV, recoded as a binary measure. Table 3 shows

Table 2 Bivariate Correlations among Study Variables

	1	2	3	4	5	6	7	8
1. PTSD Symptoms								
2. Cognitive Bias	.22*							
3. Cognitive Inflexibility	-.12	-.01						
4. Inhibition	-.41**	-.09	.23*					
5. Impulsivity	.50**	.16	.09	-.33**				
6. IPV Psychological	.32**	.23**	-.04	-.21*	.30**			
7. IPV Physical	.31**	.17	-.05	-.30**	.27**	.40**		
8. IPV Injury	.26**	.12	.00	-.21**	.26**	.26**	.54**	-
Mean	42.76	2.01	0.00	-0.02	0.00	25.99	0.25	0.15
Standard Deviation	16.05	1.14	0.94	0.76	0.81	28.64	0.44	0.36

Note: PTSD = posttraumatic stress disorder. IPV = intimate partner violence

Table 3 Model Summary Data for Moderation Analyses

Predictor	B	*p*	95% CI	
IPV Injury				
PTSD Symptoms	.06	.01	.01	.12
Cognitive Inflexibility Factor	3.70	.02	0.67	6.74
PTSD Symptoms * Cognitive Inflexibility Factor	-.06	.02	-.12	-.01
IPV Injury				
Cognitive Bias	.32	.22	-.20	.85
Cognitive Inflexibility Factor	-1.19	.13	-2.72	.37
Cognitive Bias * Cognitive Inflexibility Factor	.61	.06	-.04	1.28
Psychological IPV				
Cognitive Bias	3.99	.10	-.78	8.78
Inhibition Factor	8.03	.25	-5.82	21.90
Cognitive bias * Inhibition Factor	-7.13	< .05	-12.60	-1.67
Psychological IPV				
Cognitive Bias	4.06	.08	-.63	8.57
Impulsivity Factor	-4.39	.55	-19.03	10.24
Cognitive Bias * Impulsivity Factor	6.21	< .05	.57	11.86

Note: PTSD = posttraumatic stress disorder. IPV = intimate partner violence

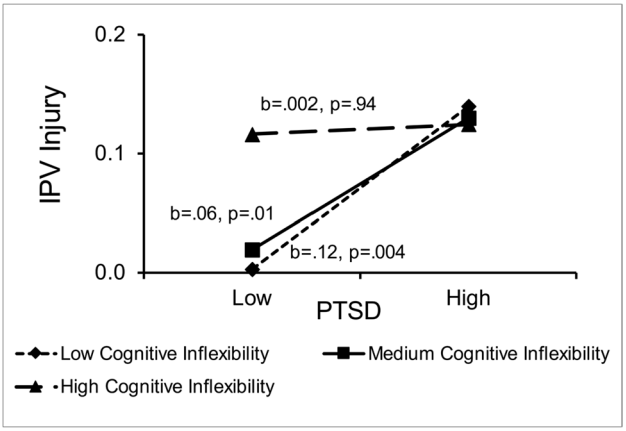

Fig. 1 Plot of the Cognitive Inflexibility x PTSD Symptoms interaction, showing the conditional effect PTSD on the probability of using IPV which cause to Injury when Cognitive Inflexibility was low ($b = 0.12$, $p = .004$), or medium ($b = 0.06$, $p = .01$)

that PTSD symptoms were positively associated with injurious IPV ($b = 0.06$, $p = 01$) and so was the cognitive inflexibility factor. In addition, the moderation effect of the latter was tested to assess the PTSD-injury association at various levels of inflexibility ($b = -0.06$, $p = 0.03$). The decomposition of this interactive association is shown in Fig. 1. For lower and moderate levels of inflexibility, we found the positive association between PTSD and the probability to cause injurious IPV consistent with the PTSD main effect ($b = 0.12$, $p < 0.001$, 95% CI [0.04,0.21], EXP(b) = 1.127; $b = 0.06$, $p < 0.05$, 95%CI[0.01,0.11], EXP(b) = 1.062). However, for those who showed high levels of inflexibility, the positively increasing PTSD-IPV association disappeared and remained relatively high for all PTSD levels.

Similarly, to test our third hypothesis, we estimated the moderating role of inflexibility between cognitive bias and the probability to inflict injurious IPV. The results showed

no main effect of either the cognitive bias or the inflexibility factor on the probability to cause injurious IPV. The interaction effect between the two approached significance at p = 0.06 (b = 0.61; 95%CI[-0.04,1.28]; EXP(b) = 1.84). Specifically, cognitive inflexibility was found to moderate the effect of cognitive bias on injury, such that when the latter was at high levels, the positive association between cognitive bias and injury was in effect ($b = 0.88$, $p = 0.03$), whereas at medium and low levels of cognitive inflexibility, this cognitive bias-injury association remained unchanged ($b = 0.43$, $p = 0.11$; $b = -0.39$, $p = 0.42$; respectively; see Fig. 2). We found a different response of psychological IPV to cognitive bias with respect to the moderation of inhibition factor ($b = -7.13$, $p < 0.05$, CI 95% [-12.60, -1.67]) and impulsivity ($b = 6.21$, $p < 0.05$, CI 95% [0.57, 11.86]). Figure 3 shows the decomposition of the first interaction effect. When the inhibition factor was low, the cognitive bias-psychological IPV association was positive ($b = 8.52$, $p = 0.002$). However, this association was found insignificant as inhibition levels were at a medium and high extent ($b = 2.70$, $p = 0.29$; $b = -0.45$, $p = 0.89$; respectively). Lastly, the interaction between cognitive bias and impulsivity indicated that cognitive bias affected psychological IPV level differently with respect to varying levels of impulsivity ($b = 6.21$, $p < 0.05$, CI 95% [0.57, 11.86]). At high levels of impulsivity, higher psychological IPV levels were associated with higher cognitive bias levels and vice versa ($b = 8.62$, $p = 0.005$), while medium or low impulsivity levels inflicted insignificant association between cognitive bias and psychological IPV ($b = 3.66$, $p = 0.13$; $b = -0.92$, $p = 0.79$; respectively), as shown in Fig. 4.

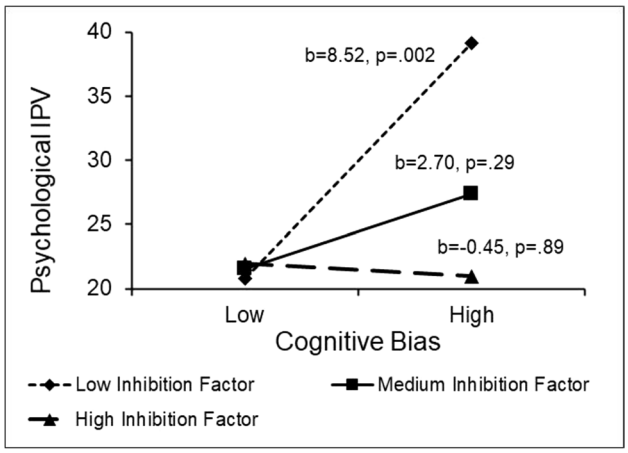

Fig. 3 Plot of the Cognitive Bias x Inhibition Factor deficits interaction, showing the conditional effect of Cognitive Bias on Psychological IPV when Inhibition Factor deficit was low ($b = 8.52$, $p = .002$)

Discussion

This study examined associations between executive functioning and IPV outcomes in a sample of veterans who served in Iraq and Afghanistan, and executive functioning as a moderator of the influence of PTSD symptoms and SIP deficits on these outcomes. Consistent with expectations, two of the three executive functioning composite variables, difficulties with inhibition and impulsivity, were associated with all three IPV outcomes in the expected direction, such that deficits in these areas was associated with increased risk for physical and psychological IPV, as well as injurious IPV. Cognitive inflexibility was not associated with IPV risk in this study at the bivariate level. However, cognitive

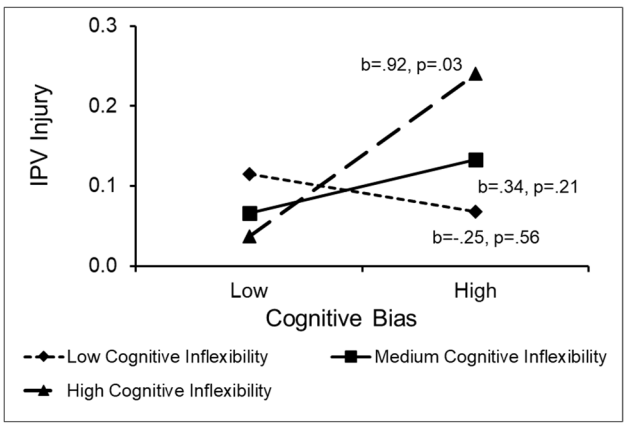

Fig. 2 Plot of the Cognitive Bias x Cognitive Inflexibility, showing the conditional effect of Cognitive Bias on Injury when Cognitive Inflexibility was high ($b = 0.92$, $p = .03$)

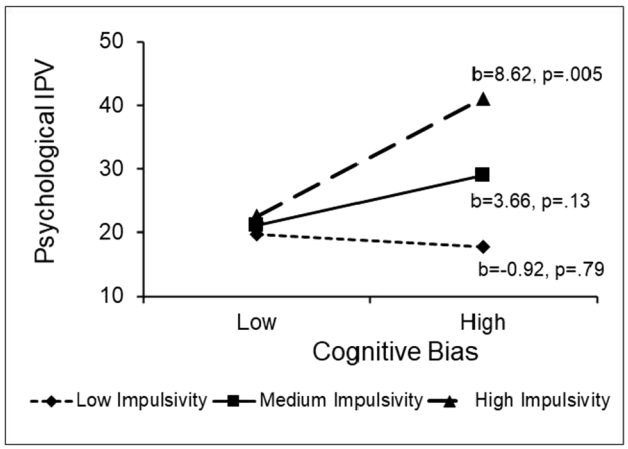

Fig. 4 Plot of the Cognitive Bias × Impulsivity Factor interaction, showing the conditional effect of Cognitive on Psychological IPV when Impulsivity Factor was high ($b = 8.62$, $p = .005$)

inflexibility moderated the association between PTSD symptoms and injurious IPV such that those high in cognitive inflexibility were at high risk for IPV regardless of PTSD level, whereas for those lower in cognitive inflexibility, PTSD exhibited associations with IPV. Finally, deficits in the areas of inhibition and impulsivity appeared to moderate the association between cognitive bias and psychological IPV such that cognitive bias was more strongly associated with IPV when deficits in inhibition and impulsivity were present, and a similar pattern of (marginally significant) results was found for deficits in inflexibility with injurious IPV as the outcome.

Research Implications

Findings for executive functioning deficits in the areas of inhibition and impulsivity are consistent with some prior work among targeted community samples (Cunradi et al., 2009; Easton et al., 2008; Stanford et al., 2007) extending the research base linking executive functioning to IPV risk to contemporary cohorts of military veterans and not only physical IPV, but also non-physical psychological IPV and injurious IPV. Moreover, as expected, it appears that the presence of these deficits together with cognitive bias have a synergistic impact on IPV risk such that the presence of both problems together substantially elevates psychological IPV risk in a multiplicative fashion. More specifically, when a veteran is prone to negative bias with respect to their partners, the presence of inhibition problems and impulsivity may make the expression of abusive behavior more difficult to contain.

Findings for inhibition and impulsivity are also consistent with the Instigating-Impelling-Inhibiting (I^3) Model of aggression (Finkel, 2014) that describes different types of risk factors for aggression that may be more impactful when occurring together, including "instigating" events that may set the stage for an aggressive incident, "impelling" risk factors that increase risk, and weak "inhibiting" factors that may fail to override aggressive impulses. In this instance, one might think of cognitive bias as an impelling risk factor that generally increases aggression risk in the presence of a provoking event, and the executive functioning deficits (disinhibition and impulsivity) as the weakened inhibiting factors. IPV perpetration may therefore emerge from a "perfect storm" of interactive factors (Slotter & Finkel, 2011) rather than any one particular risk factor; that is, an individual may have a generally biased cognitive style when it comes to their intimate partners, but this cognitive bias may only lead to aggressive behavior in some individuals when problems with inhibition or impulsiveness are present and an instigating trigger occurs.

While cognitive inflexibility was not associated with any measure of IPV at the bivariate level, the pattern of results suggest that this executive functioning factor moderated the relation between both PTSD symptoms/cognitive bias and injurious IPV. It may be that individuals lower in cognitive flexibility may have difficulty generating nonaggressive responses in the presence of PTSD symptoms and an underlying tendency to engage in cognitive bias. Since this pattern of results were found for more severe and injurious IPV, the role of cognitive inflexibility deserves greater future research attention to better understand its role.

The current study also replicates prior findings suggesting that SIP deficits at the "decoding" stage of McFall's (1982) SIP model may be relevant for understanding risk for IPV in military veterans (Taft et al., 2015), and extends this work by demonstrating the relevance of executive functioning deficits in moderating the influence of cognitive bias. It is important to note, however, that cognitive bias was only associated with the psychological IPV outcome at the bivariate level, and the only significant moderated associations involving cognitive bias were for this outcome. The reasons for why SIP biases may be especially relevant for psychological IPV are unclear and deserve future attention. Associations for physical and injurious IPV may have been deflated due to a lack of dispersion on these outcomes that have significantly lower occurrence. Future investigations in samples reporting higher levels of physical violence may better explicate these associations. Regardless, psychological IPV is an important outcome as this form of IPV has often been shown to have equal or even greater negative mental and physical health impacts than physical IPV (Follingstad et al., 1990).

Clinical Implications

Study findings may have important consequences for intervention program modification and development. For example, findings suggest the salience of addressing executive functioning and SIP deficits in IPV intervention (for a review, see Murphy, Rosenbaum, & Hamberger, in press). Skills based approaches that assist clients in developing greater inhibition of aggressive responses, curbing impulsive behavior, and developing greater cognitive flexibility (e.g., Zarling et al., 2019), as well as those that focus on less negatively biased interpretations of the intentions of others (Taft et al., 2016), may be especially warranted. Strategies for de-escalation, such as taking "time outs," may be particularly helpful to assist veterans in slowing down their cognitive processing so that they can make more purposeful, rational decisions in conflict situations. Findings also suggest that IPV intervention programs should assist clients in generating a range of nonviolent interpretations and responses to challenging relationship situations. Assertiveness training may be particularly relevant and important for generating nonviolent responses, and cognitive strategies that address

and restructure rigid and biased cognitive styles may also be important, as well as strategies geared towards the re-appraisal of threat-related stimuli.

IPV prevention and intervention programs should also consider the risk associated with severe executive functioning deficits to ensure that program materials are appropriate for and accessible to those with such deficits. Developing programs with considerable repetition of basic concepts that are presented in a manner that is not overwhelming for participants may be especially useful. Theory-guided intervention that does not consist of a "kitchen sink" approach of bombarding clients with several seemingly unrelated concepts and strategies may not be optimal for those who struggle with severe problems related to impulsiveness, disinhibition, and cognitive rigidity. It may be especially important to streamline and focus programming so that the most impactful change elements of the program receive adequate coverage and practice so that sustainable learning may occur.

Limitations

It is also worth noting that while this study found a number of significant and moderated effects, many nonsignificant findings were obtained as well, including a moderated association approaching significance (the moderation effects of cognitive inflexibility on the association between cognitive bias and injurious IPV), and taken together with the low reliability of the cognitive inflexibility factor, results call for future additional studies with larger samples. Further, the study was cross-sectional in nature and thus causality cannot be determined from these results. Findings can also not be generalized to women, who may differ with respect to some of the associations of interest (Taft et al., 2011), and the measure of PTSD used was based on the now outdated DSM-IV (APA, 2000). Thus it is important to not overstate current findings, and to consider these results as preliminary. This is an area of research that has been underexamined and is in need of greater focus and current findings should be replicated in larger and more diverse samples with a fuller, multimodal assessment battery. The data do, however, appear speak to the robustness of the associations between PTSD and various indices of IPV. Regardless of the presence of other risk factors, PTSD symptoms remains a consistent predictor of IPV in both the current study as well as numerous prior studies of veterans and civilians, men and women, etc. (Taft et al., 2011). Thus, while research into the specific mediators and moderators of the association between PTSD and IPV has not been fully explicated, it is very clear that PTSD remains a central risk factor for understanding IPV risk.

Summary

Despite its limitations, this study assists in better understanding the role of executive functioning deficits in military veterans, as well as interrelationships among these deficits, PTSD symptoms, SIP biases, and abusive behavior. Given the potential clinical relevance of these findings, it is hoped that this study will contribute to increased research attempting to better understand these relationships and how we can tailor interventions to be more effective. Such work will likely not only prove important for military populations, but others who experience trauma and are at risk for violent and abusive behavior.

Declarations

Conflicts of Interest The authors declare that they have no conflict of interest.

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