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The Association Between PTSD and Functional Outcome Is Mediated by Perception of Cognitive Problems Rather Than Objective Neuropsychological Test Performance

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Posttraumatic stress disorder (PTSD) has been consistently linked to poorer functional outcomes, including quality of life, health problems, and social and occupational functioning. Less is known about the potential mechanisms by which PTSD leads to poorer functional outcomes. We hypothesized that neurocognitive functioning and perception of cognitive problems would both mediate the relationship between PTSD diagnosis and functioning. In a sample of 140 veterans of the recent wars and conflicts in Iraq and Afghanistan, we assessed PTSD symptoms, history of traumatic brain injury (TBI), depression, self-report measures of quality of life, social and occupational functioning, and reintegration to civilian life, as well as perception of cognitive problems. Veterans also completed a comprehensive neuropsychological battery of tests. Structural equation modeling revealed that perception of cognitive problems, but not objective neuropsychological performance, mediated the relationship between PTSD diagnosis and functional outcomes after controlling for TBI, depression, education, and a premorbid IQ estimate, $b = -6.29$, 95% bias-corrected bootstrapped confidence interval [−11.03, −2.88], showing a large effect size. These results highlight the importance of addressing appraisals of posttrauma cognitive functioning in treatment as a means of improving functional outcomes.

Since 2002, more than 2.5 million service members have served in the wars in Afghanistan and Iraq. A substantial proportion of these veterans experience psychiatric symptoms, including posttraumatic stress disorder (PTSD), depression, and postconcussive symptoms related to traumatic brain injury (TBI). A recent meta-analysis of 33 studies that included almost 5 million veterans of the recent operations in Afghanistan and Iraq reported a PTSD prevalence rate of 23% (Fulton et al., 2015).

Beyond the consequent emotional distress, the impact of PTSD symptoms on functional outcomes is of utmost clinical importance, and the Department of Veterans Affairs and Department of Defense emphasize a focus on functional impairment in the assessment of PTSD (Department of Veteran Affairs & Department of Defense, 2010). Posttraumatic stress disorder is consistently associated with functional impairments including occupational, academic, and social functioning and quality of life (see Holowka & Marx, 2011 and Rodriguez, Holowka, & Marx, 2012 for reviews), as well as increased risk for health disorders (Beckham et al., 1998; Boscarino, 2008; Dobie et al., 2004; Hoge, Terhakopian, Castro, Messer, & Engel, 2007; Kubzansky, Koenen, Spiro, Vokonas, & Sparrow, 2007; Vasterling et al., 2008). Veterans with PTSD are more likely to have problems finding a job, experience conflict with coworkers, and miss more work days than those without PTSD (Hoge et al., 2007; Pietrzak, Johnson, Goldstein, Malley, & Southwick, 2009). Finally, PTSD results in significant costs to society; relative to patients with other psychiatric disorders, patients with PTSD incur even higher health care costs (Ivanova et al., 2010).

As research increasingly investigates the social, health, and occupational outcomes in veterans with PTSD, a compelling area of study includes predictors of difficulties for veterans reintegrating to civilian life. In a large study ($N = 754$) of

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recently returned Iraq and Afghanistan veterans, over 50% reported significant anger problems and one-third reported risky behavior, including greater alcohol and drug use. A majority of respondents reported some to extreme difficulties in social functioning, self-care, productivity, and community involvement (Sayer et al., 2010), and just under half of respondents (44%) reported these same challenges several years later (Sayer, Carlson, & Frazier, 2014). There is also a strong association between PTSD in particular and reintegration difficulties (McGarity et al., 2016; Sayer et al., 2010).

Although the relationship between PTSD and functional outcomes is well documented, less is understood about the potential mechanisms by which PTSD leads to poorer functioning. Identifying mechanisms that drive poorer functioning can aid in developing treatments which target those factors. One such mechanism may be neurocognitive deficits and negative appraisals surrounding neurocognitive functioning.

Posttraumatic stress syndrome is associated with mild neurocognitive deficits; a recent meta-analysis of studies of neuropsychological functioning in participants with PTSD (Scott et al., 2015) showed sizable effect sizes for impairments in the domains of verbal learning ($d = -0.62$), processing speed ($d = -0.59$), attention/working memory ($d = -0.50$), verbal memory ($d = -0.46$), and executive functions ($d = -0.45$). Moreover, patients with PTSD self-report cognitive problems (Blanck et al., 1995; Li, Yu, Long, Li, & Cao, 2015), and more psychological distress is associated with higher perceptions of cognitive impairment (Spencer, Drag, Walker, & Bieliauskas, 2010) as well as actual cognitive performance (Drag, Spencer, Walker, Pangilinan, & Bieliauskas, 2012).

Perception of cognitive problems can be viewed through a cognitive theory framework. Ehlers and Clark's (2000) cognitive theory of PTSD describes negative appraisals about the self and world in individuals with PTSD, which include appraisals of self-blame and beliefs that the world is a dangerous place. In addition, individuals with PTSD are more likely to have negative appraisals related to their performance or competence posttrauma, most notably self-efficacy in the ability to cope with traumatic stress symptoms (Benight & Bandura, 2004). An extension of this theory would be that PTSD can influence one's appraisal of his or her posttrauma cognitive functioning. Patients with PTSD are often aware of a change in cognitive function. Self-perception of cognitive problems is not always correlated with objective neurocognitive performance in patients with PTSD (Binder, Storzbach, Anger, Campbell, & Rohlman, 1999), suggesting that there may be a misalignment between patients' appraisal of cognitive dysfunction and the level of impairment they actually demonstrate on performance-based tests. In addition, Samuelson, Bartel, Valadez, and Jordan (2016) found that perception of cognitive problems was strongly correlated with posttraumatic cognitions about the self and world and trauma coping self-efficacy, suggesting that negative perceptions of cognitive functioning may represent a specific type of posttraumatic appraisal.

Research on individuals with PTSD (Geuze, Vermetten, de Kloet, Hijman, & Westenberg, 2009; Wrocklage et al., 2016), depression (Buist-Bouwman et al., 2008; McCall & Dunn, 2003), and psychotic disorders (Green, Kern, Braff, & Mintz, 2000; Twamley et al., 2002) has demonstrated that cognitive deficits are associated with social and occupational functioning impairments. Geuze et al. (2009) found that PTSD patients' complaints of memory and attention problems were negatively correlated with test performance but associated with self-reported functional impairment. Wrocklage et al. (2016) reported differences in processing speed and executive functioning tasks between veterans with and without PTSD, and reported that executive functioning impairment was associated with self-reported functional and physical outcomes. Mediational studies with depression indicate that cognitive deficits may account for the largest percentage of variance in psychosocial outcomes, most notably work performance (McIntyre et al., 2013). However, neither neurocognitive performance nor the perception of cognitive impairment have been examined as mediators in the relationship between PTSD and functional outcomes. Both observed and perceived difficulties with memory, attention, thinking, and decision-making related to PTSD have the potential to cause greater difficulties in the social and occupational arenas.

The present study examined relationships between PTSD and functional outcomes, testing subjective and objective cognitive functioning as mediators. We hypothesized that both subjective and objective cognitive functioning would exert indirect effects on the relationships between PTSD and functional outcomes, such that difficulties in social, physical, and emotional functioning would be partially explained by difficulties in cognitive functioning. In order to model effects of PTSD while controlling for potentially confounding diagnoses as well as education and premorbid estimate of intelligence, these models were conducted covarying for TBI history, depressive symptoms, and vocabulary and years of education. Both TBI (e.g., French, Lange, & Brickell, 2014; Kontos et al., 2013) and depression (e.g., Lee et al., 2012) are associated with neurocognitive deficits and perception of cognitive problems, so including them in the model as covariates allowed for examination of the unique effects of PTSD over and above those found for TBI and depression. In addition, education and intelligence are associated with other domains of neurocognitive functioning (e.g., Tremont, Hoffman, Scott, & Adams, 1998), as well as PTSD (e.g., McNally & Shin, 1995), so to examine effects of PTSD on cognitive functioning independent of those two confounding factors we included them as covariates.

Method

Participants and Procedure

Male and female veterans of the recent wars and conflicts in Iraq and Afghanistan, ranging in age from 18 to 60 years, were recruited from the San Francisco Veterans Administration

(VA) Hospital and from the community through media advertisements. There were 220 veterans screened by telephone to determine study eligibility; 189 participated in the initial in-person assessment and 140 completed the study and met all inclusion requirements. The study protocol and consent form was approved by the Committee on Human Research, University of California, San Francisco and the Human Research Protection Program at the San Francisco VA Medical Center.

Exclusionary criteria assessed at phone screening included poor English comprehension; undergoing neurocognitive rehabilitation or testing within the past year; diagnosis of brain tumor, advanced HIV, chronic kidney disease, liver disease, and/or stroke; and report of medical diagnosis of moderate or severe TBI or report of loss of consciousness due to head injury of greater than 30 minutes, or diagnosis of psychotic disorder or bipolar disorder. Exclusionary criteria determined at the time of the clinical interview and neuropsychological testing included lifetime history of psychotic disorder or bipolar disorder and current diagnosis of alcohol or drug dependence, assessed through the Structured Clinical Interview for DSM-IV Diagnosis (SCID; First, Spitzer, Gibbon, & Williams, 1997), subthreshold PTSD, and suspected poor effort or malingering based on Test of Memory Malingering (TOMM; Tombaugh, 1996) performance, as defined by scores ≤ 41 on Trial 1. There were two participants who failed the TOMM screen, and five participants were excluded following the clinical interview due to diagnoses of psychotic disorder ($n = 1$) and substance dependence ($n = 4$). Additionally, 19 participants were excluded due to having subthreshold, but not full, PTSD, and 18 participants dropped out before completing neuropsychological assessments.

Measures

PTSD, depression, and TBI. Veterans were administered the Life Stressor Checklist (LSC; Wolfe, Kimerling, Brown. Chrestman, & Levin, 1996) to identify possible Criterion A events, based on the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., txt rev.; *DSM-IV-TR*; American Psychiatric Association [APA], 2000) that participants may have been exposed to in their lifetime. The Clinician Administered PTSD Scale (CAPS; Blake et al., 1995) was then administered; veterans answered questions regarding their worst Criterion A event. A full diagnosis of PTSD was given if the participant experienced a Criterion A event and one or more Cluster B symptoms (reexperiencing), three or more symptoms in Cluster C (avoidance), and two or more symptoms in Cluster D (hyperarousal). The Patient Health Questionnaire–9 (PHQ-9; Kroenke & Spitzer, 2002) was used as a brief self-report measure of major depressive symptoms.

Veterans were administered the VA TBI Screening Tool (VATBIST; Donnelly et al., 2011) by interview. The VATBIST is a 4-item measure including questions assessing potential TBI-causing event (blast or explosion, vehicle crash, fragment or bullet wound above the shoulders, fall, or blow to head), loss or alteration of consciousness including being dazed or confused or not remembering the event, and postconcussive symptoms both at the time of event and currently (including memory problems, balance problems, sensitivity to light, irritability, headaches, and sleep problems). Endorsement of all four items is indicative of a positive TBI screen indicating TBI history as well as current postconcussive symptoms.

Objective cognitive functioning. Veterans were administered a comprehensive neuropsychological battery that included multiple measures assessing neurocognitive skills previously found to be impaired in PTSD including verbal learning and memory, visual learning and memory, working memory, processing speed, and executive functioning.

To assess immediate verbal memory and learning, we used the Hopkins Verbal Learning Test (HVLT; Brandt, 1991) total score and the Verbal Paired Associates (VPA) I score of the Wechsler Memory Scale (WMS-III; Wechsler, 1997). To assess delayed verbal memory, we used the HVLT delayed recall score and the VPA II score, both of which are administered 20 minutes after the immediate learning task.

To assess immediate and delayed visual memory, the Brief Visual Memory Test–Revised (BVMT-R; Benedict, 1997) and Rey-Osterrieth Complex Figure Test (ROCF; Rey, 1944) were used. The BVMT-R immediate recall score and ROCF immediate recall score are measures of recall and reproduction of visual figures and the delayed scores of each task are measures of recall and reproduction after a delay of 20 to 25 minutes.

Working memory was assessed using the Digit Span and Arithmetic subtests of the Wechsler Adult Intelligence Scale (WAIS-IV; Wechsler, Coalson, & Raiford, 2008). Digit Span requires participants to repeat digits forwards, backwards, and sequences in ascending order; the combined score of these three tasks was used. The Arithmetic task requires examinees to mentally solve a series of arithmetic problems.

To assess processing speed, we administered two timed tasks, the Coding and Symbol Search subtests of the WAIS-IV, which constitute the processing speed index. Both measures require the test taker to reproduce or scan and match symbols quickly, efficiently, and accurately.

Multiple measures were administered to assess for subdomains of executive functioning including fluency, planning and problem solving, and set shifting and inhibitory control. To assess visual fluency, we administered the Design Fluency subtest of the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). Planning and problem solving were assessed through the D-KEFS Tower Test. Total scores for these measures were used in analyses. Set shifting, inhibitory control, and cognitive flexibility were assessed with subscores of the D-KEFS Color-Word Interference Test and Trail Making Test (Reitan, 1992). For Color-Word, the Inhibition/Switching task score was used, and for Trails we used the difference score of Part B–Part A.

Veterans were also administered the Vocabulary subtest of the WAIS-IV, which was used as an estimate of intellectual functioning. The Vocabulary subtest is often used as a "hold" test from which estimates of premorbid functioning are derived in brain-injured populations (Lezak, Howieson, Bigler, & Tranel, 2012). Finally, veterans were administered TOMM (Tombaugh, 1996) as a measure of performance validity. Veterans who received scores ≤ 41 on Trial 1 ($n = 2$) were excluded from analyses (Denning, 2012).

Subjective cognitive functioning. Veterans were administered the Neurobehavioral Symptom Inventory (NSI; Cicerone & Kalmar, 1995), a 22-item self-report measure of postconcussive symptoms that includes a Cognitive subscale of symptoms related to cognitive complaints (poor concentration, forgetfulness, difficulty making decisions, and slowed thinking). Although designed for the assessment of postconcussive symptoms, the symptoms are also relevant to patients with PTSD (Soble et al., 2014). The NSI has high internal consistency and scale validity (King & Wray, 2012). Cronbach's alpha for internal consistency of the NSI Cognitive subscale for this sample was .87. The NSI Validity-10 scale is an embedded validity scale that assesses for symptom overreporting or exaggeration (Vanderploeg et al., 2014). The authors recommend a cut score of ≥ 23 as likely of an exaggerated profile (Vanderploeg et al., 2014). None of the veterans in the current study received Validity-10 scores ≥ 23.

Functional outcomes. To assess perceived levels of functional impairment related to physical and mental health, participants were given the Short Form Health Survey (SF-12; Gandek et al., 1998), which is a condensed version of the Short Form Survey–36 (SF-36). The SF-36 has excellent validity and reliability (Brazier et al., 1992) and correlations between the SF-36 and SF-12 are high (rs = .94 to .96; Gandek et al., 1998). Cronbach's alpha for internal consistency for this sample was .90. The SF-12 produces physical and mental health composite scores and contains three specific subscales related to role limitations due to emotional problems, physical health problems, and social functioning problems. These subscales were used in the current study.

The Military to Civilian Questionnaire (M2C-Q; Sayer et al., 2011) assessed levels of postdeployment reintegration difficulty. The M2C-Q is a 16-item self-report measure that has been shown to have high internal consistency and construct validity in a sample of 1,226 Iraq and Afghanistan veterans (Sayer et al., 2011). Cronbach's alpha for internal consistency for this sample was .94.

Data Analysis

To test the hypothesis that both perception of cognitive problems and objective neurocognitive performance mediate the relationship between PTSD status (independent variable) and functional outcomes (dependent variable), we employed structural equation modeling (SEM; see Figure 1) via maximum likelihood estimation. This approach permits estimation of direct and indirect effects with a latent variable outcome, which in this case consisted of physical, emotional, and social functioning, and reintegration. This approach was chosen in lieu of testing each outcome separately because of the high collinearity between the dependent variables, and eliminated the need for multiple hypothesis testing. Significance of the indirect effects was evaluated through bias-corrected bootstrapping with 1,000 replications; bootstrapping is considered more powerful for evaluating the significance of indirect effects than other methods (MacKinnon, Lockwood, & Williams, 2004). Indirect effects were considered significant if the 95% bias-corrected bootstrapped confidence intervals did not contain zero. Overall model fit was evaluated by traditional SEM fit indices; specifically, the root mean square error of approximation (RMSEA), comparative fit index (CFI), and standardized root mean squared residual (SRMR). An RMSEA of ≤ .06, CFI ≥ .95, and SRMR ≤ .08 suggests that the model has adequate fit to the data (Hu & Bentler, 1999). Because there was a large number of neuropsychological tests administered that measured overlapping neurocognitive domains (e.g., verbal learning), principal components analysis (PCA) was conducted prior to the structural equation model to use neurocognitive components, thereby reducing the number of mediators in the model that were potentially redundant. This approach was taken rather than creating latent neurocognitive components within the structural equation model to (a) reduce the number of parameters in the model to conserve power, and (b) to use an agnostic data-driven approach. The number of components retained was determined via parallel analysis with 1,000 simulations of the raw data (Horn, 1965), with components considered meaningful if they exceeded the mean simulated eigenvalue. Oblique (promax) rotation was used, because neurocognitive domains were expected to correlate, and tests were considered to be part of a specific component if they had a loading ≥ .40.

Results of the parallel analysis indicated that four components existed (see Supplementary Table 1), which were comprised of visual learning and memory (BVMT-R and ROCF immediate and delayed trials), verbal learning and memory (HVLT-R and VPA immediate and delayed trials), processing speed/fluency (design fluency, coding, symbol search), and executive functioning (Digit Span, Arithmetic, Towers, Trails, B–A). As expected, all components were associated with one another, with the exception of executive functioning and processing speed/fluency, $r = .11$, $p = .165$. Visual and verbal learning and memory were strongly associated, $r = .39$, $p < .001$, while verbal learning and memory was also associated with executive functioning, $r = .21$, $p = .011$, and processing speed/fluency, $r = .35$, $p < .001$. Visual learning and memory was associated with executive functioning, $r = .24$, $p = .003$, and processing speed/fluency, $r = .17$, $p = .031$. Latent scores of the components for each subject were generated by regressions based on the component weightings, which were used as indirect effects within the SEM. Depression severity, TBI status, years of education, and vocabulary score were included

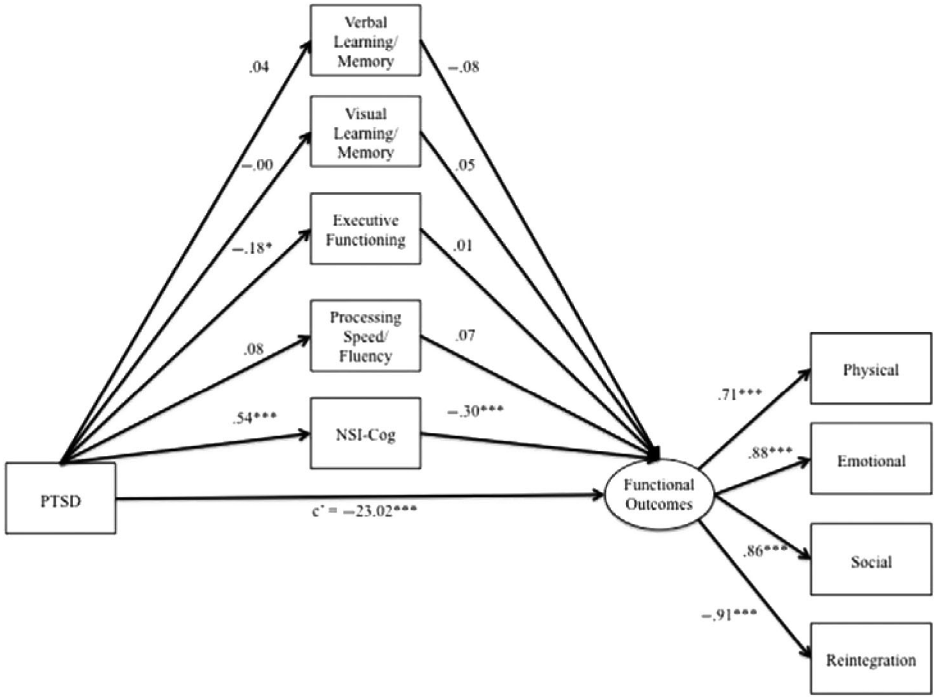

Figure 1. Structural equation model: Hypothesized indirect effects of objective and subjective cognitive performance on functional outcomes. Values reported are beta coefficients.
*$p < .05$. **$p < .01$. ***$p < .001$.

as covariates of the cognitive components, and residuals of the proposed mediators were allowed to correlate in the model. Because depression and PTSD share several symptoms, we constructed a residualized variable of PHQ depression which partials out shared variance with the CAPS and used this residualized variable in the model, a technique used in prior studies (Samuelson et al., 2006). All analyses were conducted in Stata version 14.0 (StataCorp, 2015).

Results

Demographic information can be found in Table 1, and a breakdown of demographics by PTSD status can be found in Supplementary Table 2. Forty percent of the veterans had a full diagnosis of PTSD and 37.7% had positive VATBIST screens. Participants were between the ages of 23 and 57 years ($M = 36.13$, $SD = 8.68$), were ethnically diverse (46.4% Caucasian; 20.7% Asian American, 16.4% Hispanic, and 3.6% African American), and predominantly male (82.9%). Estimated premorbid functioning as measured by the WAIS-IV Vocabulary subtest was nearly two-thirds of a standard deviation above population norms ($M = 11.65$, $SD = 3.16$). Complete data was available for 132 subjects; because of the high percentage of complete cases (94%), we did not implement a missing data estimator.

Goodness-of-fit indices for the structural equation model indicated good model fit overall, χ^2_M with $= 47.301$, $p = .064$, RMSEA = .054, CFI = .982, Tucker-Lewis index (TLI) = .957, and SRMR = .032. Parameter estimates of the SEM can be found in Supplementary Table 3, with significant paths shown in Figure 1. In terms of primary associations between PTSD status and the proposed mediators, PTSD was independently associated with greater perceived cognitive problems, $\beta = .54$, $p < .001$, as well as worse executive functioning, $\beta = -.18$ $p = .029$, but was not associated with the other objective cognitive components, ps = .402 to .974. Posttraumatic stress disorder status predicted functional outcomes, $\beta = -.59$, $p < .001$, and the only proposed mediator to predict functional outcomes was perceived cognitive problems, $\beta = -.30$, $p < .001$. No objective cognitive component predicted functional outcomes, ps = .117 to .909.

Consistent with our hypothesis, tests of mediation (see Table 2) revealed a significant indirect effect of perceived cognitive problems for PTSD, $b = -6.29$, 95% BC CI: [−11.03, −2.88], which corresponds to a large effect size (Preacher & Kelley, 2011). PTSD status maintained a highly significant direct effect on functional outcomes in the model, $b = -23.02$, $p < .001$. Contrary to our hypothesis, objective neurocognitive performance did not mediate the relationship between PTSD and functional outcomes.

Discussion

Posttraumatic stress disorder is associated with poorer functional outcomes, but little is known about the mechanisms by which PTSD influences functioning. We hypothesized that both

Table 1
Demographic and Clinical Characteristics of Study Sample

Demographic Characteristics	*N*	%	*M*	*SD*	Range
Gender					
Male	116	82.9			
Female	24	17.1			
Age range, years					
23–29	34	24.3			
30–39	65	46.4			
40–49	25	17.9			
50–68	16	11.4			
Ethnicity					
Caucasian	65	46.4			
African American	5	3.6			
Asian	29	20.7			
Native Hawaiian/Pacific Islander	2	1.4			
American Indian/Alaskan Native	3	2.1			
Hispanic/Latino	23	16.4			
Multiracial	10	7.1			
Other	3	2.1			
Education					
High school/GED	18	12.9			
Some college	52	37.1			
Bachelor's or Associates	45	32.1			
Some graduate	12	8.6			
Master's or Doctorate	13	9.3			
Time since deployment (days)			1965.54	986.38	165.57 to 3940.39
CAPS total score			33.27	31.37	0 to 99
Positive TBI screen (frequency)	51	36.4			
PHQ-9 total score			8.05	6.96	0 to 26
PTSD (frequency)	57	40.7			
WAIS-IV Vocabulary (scaled score)			11.65	3.16	4 to 19
NSI Cognition			4.92	3.68	0 to 13
SF-12 Social Functioning			66.07	32.31	0 to 100
SF-12 Emotional Functioning			70.45	28.69	0 to 100
SF-12 Physical Functioning			72.68	27.59	0 to 100
M2-C Reintegration Difficulties[a]			19.62	15.19	0 to 54

Note. $N = 140$. CAPS = Clinician Administered PTSD Scale; PHQ-9 = Patient Health Questionnaire–9 Item; GED = general equivalency diploma; PTSD = posttraumatic stress disorder; TBI = traumatic brain injury; WAIS-IV = Wechsler Adult Intelligence Scale; NSI = Neuropsychiatric Symptom Inventory; SF-12 = 12-item Short Form Survey; M2-C = Military to Civilian Questionnaire.
[a]Higher scores indicate greater reintegration difficulties.

objective neuropsychological performance and perceptions of cognitive functioning would have mediating effects on the relationship between PTSD and functional outcomes. In a sample of 154 recent Iraq and Afghanistan war veterans, after covarying for TBI history, depressive symptoms, education, and a premorbid estimate of IQ, we found that perception of cognitive problems, but not objective neurocognitive performance, exhibited an indirect effect on the relationship between PTSD and a latent construct of functioning that included physical, emotional, and social functioning, and reintegration difficulties. Not surprisingly, PTSD status continued to exert a highly significant main effect after accounting for multiple mediators and predictors, highlighting that PTSD symptoms independent of perceived cognitive difficulties contribute to difficulties in functioning. In addition, PTSD was strongly related to perceptions of cognitive impairment even when controlling for TBI and depression, which have been found in previous studies to be related to perceptions of cognitive impairment (Chamelian and Feinstein, 2006; Drag et al., 2012; Spencer et al., 2010).

These results suggest that it is the perception of memory, attention, and concentration problems posttrauma, as opposed

Table 2
Bias-Corrected Bootstrapped Tests of Indirect Effects

Variable	*b*	Bias-Corrected 95% CI[a]
NSI Cognition	−6.29*	[−11.03, −2.88]
Verbal Learning/Memory	−0.13	[−1.12, .31]
Visual Learning/Memory	−0.01	[−.73, .46]
Executive Functioning	−0.04	[−.87, .70]
Processing Speed/Fluency	0.21	[−.21, 1.53]

Note. NSI = Neurobehavioral Symptoms Inventory; CI = confidence interval; [a]95% confidence intervals are based on 1,000 bias-corrected bootstrapped replications.
*$p < .05$.

to objective, neurocognitive performance deficits, that influences social and occupational functioning and reintegration to civilian life. Although PTSD is associated with mild and subtle neurocognitive deficits on performance-based tests (see Scott et al., 2015), these impairments do not appear to exert an effect on functional outcomes to the extent that the subjective experience of cognitive impairment does.

Individuals with PTSD may perceive their cognitive difficulties to be worse than their actual performance demonstrates (Binder et al., 1999). In a recent study, Samuelson et al. (2016) found that posttraumatic cognitions moderated the relationship between PTSD symptoms and perception of cognitive problems, indicating that negative posttraumatic appraisals influence an individual's perception of memory and attention functioning. In addition, perception of cognitive problems was related to poorer perceived quality of life, over and above the influence of PTSD symptoms. Those findings, coupled with the current results, highlight the influence of one's appraisals and perceptions of functioning posttrauma on successful reintegration and quality of life. Our findings also add to two theoretical frameworks for understanding posttraumatic cognitions, cognitive theory (Ehlers & Clark, 2000) and social cognitive theory (Benight & Bandura, 2004), which consider the important role of posttrauma appraisals about the self (including guilt and self-blame) and self-efficacy (beliefs about one's ability to cope with posttraumatic symptoms). We propose that negative appraisals of cognitive functioning represent a specific type of posttrauma performance appraisal.

Several limitations of the study should be noted. First, the data are cross-sectional and limit any causal conclusions. Longitudinal methods can help researchers understand the trajectory of these processes over time, and can provide more causal and directional interpretations. Second, our sample consisted of veterans who responded to research advertisements and were not seen within a clinical setting; as such, they may not be representative of a clinical veteran population that may exhibit more pronounced objective neurocognitive deficits that in turn mediate functional outcomes. Third, it is possible that our cognitive tests may not have been sensitive enough to detect deficits or differences in this sample, although our selection of tests replicates many past studies documenting neurocognitive deficits in PTSD (Scott et al., 2015). It may be that in samples who show more pronounced PTSD-related cognitive performance deficits, there would be a mediational effect of performance on functional outcomes. Fourth, although TBI was not a primary focus of this study, we did include TBI history as a covariate, and its measurement via a screen representing retrospective self-report is not ideal. Finally, we relied on self-report for measures of cognitive problems and functional outcomes. Future research should employ measures of report of significant others, which could aid both researchers and clinicians in receiving a potentially more subjective report of cognitive, social, physical, and emotional problems related to PTSD.

There are important clinical implications of these findings. Trauma-exposed patients often complain to clinicians and health providers of cognitive problems, and providers often struggle with interpreting patient self-report, in part due to inherent bias and inconsistencies. Patients with PTSD may also be aware of the potential impact of their diagnosis on the brain and memory and concentration functioning, and can be especially attuned to perceived changes or deficiencies. Clinicians should be careful not to assume that self-report of cognitive problems equates with objective cognitive deficits, yet be cognizant of their influence on social and occupational functioning. When neuropsychological assessments are conducted, neuropsychologists should be careful to give detailed feedback on the degree (or absence) of impairment as well as its influence on day-to-day functioning. Finally, assisting clients with posttraumatic stress in challenging negative posttraumatic appraisals, including those about cognitive functioning, may be a warranted component of therapy that could influence occupational and social functioning and quality of life.

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