Behavioural and Cognitive Psychotherapy, 2023, **51**, 459–474
doi:10.1017/S1352465823000140

BABCP
www.babcp.com

MAIN

Post-Traumatic Cognitions Inventory (PTCI): psychometric properties in clients with serious mental illness and co-occurring PTSD

Weili Lu[1], Kim T. Mueser[2], Philip T. Yanos[3], Amanda Siriram[1], Yuane Jia[1], Alyssa Leong[1], Steven M. Silverstein[4], Jennifer Gottlieb[5] and Mary K. Jankowski[6]

[1]Rutgers University, New Brunswick, USA, [2]Boston University, Boston, USA, [3]City University of New York, New York, USA, [4]University of Rochester, Rochester, New York, USA, [5]Cambridge Health Alliance/Harvard Medical School, Boston, USA and [6]Geisel School of Medicine at Dartmouth, Hanover, New Hampshire, USA
Corresponding author: Weili Lu; Email: luwe1@shp.rutgers.edu

(Received 18 July 2022; revised 20 February 2023; accepted 10 March 2023; first published online 22 May 2023)

Abstract

Background: People with post-traumatic stress disorder (PTSD) exhibit negative cognitions, predictive of PTSD severity. The Post-Traumatic Cognitions Inventory (PTCI) is a widely used instrument measuring trauma-related cognitions and beliefs with three subscales: negative thoughts of self (SELF), negative cognitions about the world (WORLD), and self-blame (BLAME).
Aims: The current study attempted to validate the use of the PTCI in people with serious mental illness (SMI), who have greater exposure to trauma and elevated rates of PTSD, using confirmatory factor analysis (CFA) and examining convergent and divergent correlations with relevant constructs.
Method: Participants were 432 individuals with SMI and co-occurring PTSD diagnosis based on the Clinician Administered PTSD Scale, who completed PTCI and other clinical ratings.
Results: CFAs provided adequate support for Foa's three-factor model (SELF, WORLD, BLAME), and adequate support for Sexton's four-factor model that also included a COPE subscale. Both models achieved measurement invariance at configural, metric and scalar levels for three diagnostic groups: schizophrenia, bipolar and major depression, as well as for ethnicity (White *vs* Black), and gender (male *vs* female). Validity of both models was supported by significant correlations between PTCI subscales, and self-reported and clinician assessed PTSD symptoms and associated symptoms.
Conclusions: Findings provide support for the psychometric properties of the PTCI and the conceptualization of Sexton's four-factor and Foa's three-factor models of PTCI among individuals diagnosed with SMI (Foa *et al.*, 1999).

Keywords: Confirmatory factor analysis; PTCI; Serious mental illness; Trauma

Introduction

It is well established that people with post-traumatic stress disorder (PTSD) have negative cognitions, i.e. a negative perception of self and negative world view (e.g. Ehlers and Clark, 2000; Foa and Cahill, 2001; Foa and Rothbaum, 1998), which have recently been incorporated into the *DSM-5* criteria for PTSD (American Psychiatric Association, 2013). Research has shown clinically meaningful connections between negative post-traumatic cognitions and PTSD symptoms (e.g. Beck *et al.*, 2004; Foa *et al.*, 1999; Shin *et al.*, 2020), and demonstrated that

such beliefs are predictive of PTSD severity (Brown *et al.*, 2018). According to cognitive models of PTSD, negative beliefs about the self and others can maintain perceptions of continuing threat and prevent effective coping (Ehlers and Clark, 2000; Foa and Rothbaum, 1998). Furthermore, when individuals with PTSD experience distress, they may feel vulnerable, which can promote the development of negative beliefs, which may in turn maintain other PTSD symptoms (Shahar *et al.*, 2013).

Individuals diagnosed with serious mental illness (SMI), typically defined as any major psychiatric disorder, such as schizophrenia, schizoaffective disorder, major depression and bipolar disorder, accompanied by persistent functional impairments (Martínez-Martínez *et al.*, 2020; Substance Abuse and Mental Health Services Administration, 2017), who have experienced childhood trauma, have poorer clinical outcomes than those not exposed, including higher levels of repetitive negative thinking, dysfunctional metacognitive beliefs, and more severe symptoms (Grubaugh *et al.*, 2011; Mansueto *et al.*, 2021; Struck *et al.*, 2020). Although SMI has typically been linked to schizophrenia, bipolar disorder and treatment refractory major depression (Bigdeli *et al.*, 2022; Grubaugh *et al.*, 2021; Parabiaghi *et al.*, 2006), consensus is lacking in terms of the specific disorders included (Martínez-Martínez *et al.*, 2020). SMI categorizations in many jurisdictions in the United States include DSM diagnoses, other than the typical SMI-related conditions above, when there is accompanying persistent impairment in functioning. SMI in this study is broadly defined as a major psychiatric disorder such as schizophrenia, bipolar and major depressive disorder, with resultant serious functional impairment. Individuals with SMI are at greater risk for trauma exposure (Grubaugh *et al.*, 2011; Grubaugh *et al.*, 2021; Struck *et al.*, 2020) than people in the general population, with multiple traumatizations common (Lu *et al.,* 2008; Mueser *et al.*, 2004). The high exposure to trauma in persons with SMI is associated with high rates of co-occurring PTSD, typically ranging between 25 and 48% of current PTSD (Grubaugh *et al.*, 2011), considerably higher than the estimated 3.5% current prevalence in the general population (Kessler *et al.*, 2005). PTSD contributes to a worse course of SMI, and more severe symptoms, including anxiety, depression and psychosis (Mueser *et al.,* 2004; Seow *et al.*, 2016). PTSD can be effectively treated in people with SMI and there is evidence that changes in PTSD symptoms are mediated by changes in trauma-related cognitions in people with SMI (Mueser *et al.,* 2008, 2015), as reported in the general population (e.g. Brown *et al.*, 2018; Germain *et al.*, 2016). Scales for measuring negative trauma-related cognitions in SMI populations are therefore important.

The Post-Traumatic Cognitions Inventory (PTCI; Foa *et al.*, 1999) is a commonly used measure of trauma-related cognitions and beliefs. The PTCI contains 36 statements, with three subscales assessing negative cognitions about the self (SELF subscale; 21 items), the world (WORLD subscale; 7 items), and self-blame (BLAME subscale; 5 items). The initial three-factor model was based on the 33 items of its initial validation study (Foa *et al.*, 1999). Three items were added to the original scale for exploratory purposes, and inclusion of these items in further analyses in other studies led to a four-factor solution in some of those studies (Sexton *et al.*, 2018). The PTCI also discriminated between traumatized individuals with and without PTSD and was found to be sensitive to treatment changes (Foa and Rauch, 2004; Germain *et al.*, 2016).

Since its initial development and validation, studies have examined whether the three-factor structure of the PTCI is supported across a range of trauma-exposed samples (Table 1). Supporting the original three-factor structure was a study with a Dutch sample with primarily non-sexual interpersonal violence experiences (van Emmerik *et al.*, 2006). However, results inconsistent with the three-factor structure were reported by Beck *et al.* (2004) in a sample of people who had experienced a serious motor vehicle accident (MVA). In the Beck *et al.* (2004) study, an adequate fit was achieved only by removing four items from the SELF factor items (2, 4, 24 and 29). While SELF and WORLD subscales had concurrent and discriminant

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

Table 1. Model fit indices of nine prior studies of PTCI (between years 1999 and 2020)

Models	χ^2	d.f.	χ^2/d.f.	CFI	TLI	RMSEA	90% CI	AIC	BIC	SABIC	SRMR
Foa's 3-factor model (SELF, WORLD, BLAME)											
Daie-Gabai *et al.* (2011)(29-item; removed 2, 4, 24, 29)	673.17	—	—	.90	—	.05	—	—	—	—	—
Beck *et al.* (2004)(29-item; removed 2, 4, 24, 29)	540.52	—	—	.88	—	.06	—	—	—	—	—
Su and Chen (2008)(29-item; removed 16, 22, 24, 29)	731.38	374	1.96	.91	—	.06	—	—	—	—	—
Müller *et al.* (2010)(29-item; removed 11, 12, 28, 35)	1030.58	374	2.76	.90	—	.07	.06 –.07	—	—	—	—
Andreu *et al.* (2017)(27-item; removed 2, 4, 10, 16, 24, 29)	—	—	—	.92[c]	—	.05	—	—	—	—	—
Hyland *et al.* (2015)(25-item; removed 2, 5, 9, 11, 12, 17, 24, 26)	825.37	272	3.03	.90	.91	.05	.05 –.06	—	—	—	.05
Shin *et al.* (2020)(28-item; removed 2, 19, 24, 29, 31)	806.28	347	2.32	.91	.90	.08	—	924.28	—	—	.22
Sexton *et al.* (2018)(33-item; removed 13, 32, 34)	1322.90	483	2.74	.92	.91	.06	.06 –.07	1544.90	—	—	—
Current study[a](33-item; removed 13, 32, 34)	**935.04**	**487**	**1.92**	**.91**	**.91**	**.05**	**.04 –.05**	**53725.80**	**54161.12**	**53821.56**	**.05**
Sexton's 4-factor model (SELF, WORLD, BLAME, COPE)											
Sexton *et al.* (2018)(34-item; removed 14, 24)	1278.77	513	2.49	.93	.92	.06		1510.77			
Current study[b](34-item; removed 14, 24)	**948.88***	**516**	**1.84**	**.92**	**.91**	**.04**	**.04 –.05**	**55112.29**	**55572.02**	**55213.42**	**.05**

χ^2, diagonally weighted least squares chi-square; d.f., degrees of freedom; CFI, comparative fit index; TLI, Tucker-Lewis index; RMSE, root mean square error of approximation; SRMR, standard root mean square residual; *$p<.05$, [a]Foa's three-factor model with 33 items removing items 13, 32 and 34 and five pairs of error covariances (error covariance between item 3 and 12, 4 and 5, 5 and 14, 10 and 11, 25 and 36). [b]Four-factor model with 34 items removing items 14 and 24 and five pairs of error covariances (error covariance between item 3 and 12, 4 and 13, 10 and 11, 25 and 36, 32 and 33); [c]NFI, normed fit index.

validity, the BLAME subscale demonstrated poor convergent validity by failing to correlate with measures of PTSD, depression or quality of life, and poor discriminant validity by failing to discriminate between individuals with versus without PTSD. Similar findings were reported by Su and Chen (2008) and Daie-Gabai *et al.* (2011) in samples of participants with mixed trauma histories. One possible explanation for the discrepant findings on the factor structure of the PTCI across these studies may be differences in the traumatic events experienced by the participants. The samples of Foa *et al.* (1999) and van Emmerik *et al.* (2006) included victims of interpersonal violence, the sample of Beck *et al.* (2004) consisted solely of survivors of MVAs, while Su and Chen (2008) and Daie-Gabai *et al.* (2011) included individuals with mixed trauma histories.

While most studies of the PTCI have focused on the three-factor model, a recent study among veterans found support for a four-factor model (Sexton *et al.*, 2018). In this study, exploratory and confirmatory factor analyses of PTCI supported the presence of a stable fourth factor (labelled COPE, consisting of three items that originally loaded onto the SELF subscale) that can be described as perceived lack of competence at handling strong negative emotional states.

Although the psychometric properties of the PTCI have been examined in a range of trauma-exposed groups, they have not yet been investigated among individuals with SMI (Table 1). Prior studies suggest that clients with SMI and co-occurring PTSD score significantly higher on the PTCI (Mueser *et al.*, 2008, 2015) than sexual assault survivors (Andreu *et al.*, 2017), MVA victims (Beck *et al.*, 2004), and veterans (Sexton *et al.*, 2018). Given that trauma is highly prevalent and disabling among people with SMI, there is a need to investigate the factor structure and construct validity of PTCI in this population. The aims of the study therefore were to explore the factor structure and psychometric properties of the PTCI among individuals with SMI. We hypothesized that the Sexton *et al.* (2018) four-factor model would have the best fit, while the three-factor model would demonstrate adequate fit based on existing studies on the factor structure of the PTCI (Table 1). Prior studies have found mixed support for the three-factor model, whereas the study of Sexton *et al.* (2018) in a large treatment-seeking veteran sample supported the four-factor model over the three-factor model. We further hypothesized that the PTCI subscales would show good internal consistency across three different samples of people with SMI, and that PTCI subscales would be moderately and significantly correlated with PTSD symptom severity and other psychiatric symptoms (suggesting convergent validity), but not PTSD knowledge or working alliance, constructs unrelated to post-traumatic cognitions (suggesting divergent validity).

Method

Participants

Participants for analyses came from three studies (see Table 2). The first sample was drawn from a randomized controlled trial (RCT) and conducted in New Hampshire/Vermont, USA at four community mental health centers (Study 1; $n = 108$; Mueser *et al.*, 2008). Participants met the following criteria: (1) >18 years old; (2) determination by New Hampshire or Vermont as having a SMI, defined as a *DSM-IV* Axis I disorder and persistent impairment in work, school, or ability to care for oneself; (3) diagnosis of major depression, bipolar disorder, schizoaffective disorder, or schizophrenia confirmed through Structured Clinical Interview of DSM-IV disorders (SCID; First *et al.*, 1996); and (4) current diagnosis of PTSD based on Clinician Administered PTSD Scale (CAPS; Blake *et al.*, 1990).

The second sample was drawn from participants in a RCT conducted in partial hospitalization programs and out-patient programs within a community mental health service system in New Jersey, USA (Study 2; $n = 199$; Mueser *et al.*, 2015). Inclusion criteria were: (1) >18 years old; (2) met State of New Jersey definition of SMI; (3) diagnosis of schizophrenia, schizoaffective disorder, major depression, or bipolar disorder, based on the SCID (First *et al.*, 1996); and

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

Table 2. Characteristics of the sample ($N = 432$)

Variable	(Study 1) NH sample ($n = 108$)	(Study 2) NJ sample ($n = 199$)	(Study 3) NIDILRR sample ($n = 125$)	Total ($N = 432$)	χ^2/F	*P*
Demographics						
	N (%)	*N* (%)	*N* (%)	*N* (%)		
Male	23 (21.3)	63 (31.7)	47 (37.6)	133 (30.8)	7.36	.03
Ethnicity						
White	91 (84.3)	67 (33.7)	55 (44)	220 (50.9)	91.85	.00
Black	2 (1.9)	110 (55.3)	51 (40.8)	163 (37.7)		
Other	15 (14.0)	22 (11.0)	19 (15.2)	56 (13.0)		
Education (high school completion)	77 (71.3)	137 (68.8)	110 (88.0)	324 (75.0)	16.08	.00
Never married	38 (35.2)	111 (55.8)	83 (66.4)	232 (53.7)	23.35	.00
Age *M* (*SD*)	44.21 (1.64)	43.70 (11.10)	46.03 (11.88)	44.50 (8.97)	2.18	.11
Currently employed	9 (8.3)	—	34 (27.2)	—	13.70	.00
Primary diagnosis					51.53	.00
Schizophrenia	8 (7.4)	8 (4.0)	8 (6.4)	24 (5.5)		
Schizoaffective	9 (8.3)	59 (29.6)	24 (19.2)	92 (21.3)		
Major depression	66 (61.1)	71 (35.7)	37 (29.6)	174 (40.3)		
Bipolar disorder	25 (23.1)	60 (30.2)	49 (39.2)	134 (31.1)		
Other	0 (0.0)	1 (0.5)	7 (5.6)	8 (1.9)		
Secondary diagnoses						
Borderline personality	27 (25.0)	52 (26.1)	4 (3.2)	83 (19.2)	29.12	.00
BDI-II *M* (*SD*)	31.62 (13.45)	30.22 (12.32)	26 (11.88)	29.72 (12.59)	3.75	.02
BAI *M* (*SD*)	48.99 (13.11)	33.49 (11.77)	23.4 (11.99)	32.22 (16.45)	106.69	.00
CAPS	75.31 (17.25)	85.31 (12.73)	—	82.00 (15.41)	35.03	.00
CAPS-5	—	—	37.28 (10.13)	—	—	—
PTCI *M* (*SD*)						
Total	133.95 (71.60)	141.97 (38.89)	137.92 (40.45)	138.87 (49.16)	.93	.40
SELF	3.98 2.28)	4.10 (1.35)	3.93 (1.35)	4.02 (1.63)	.49	.62
WORLD	4.97 (2.02)	5.53 (1.21)	5.21 (1.33)	5.30 (1.50)	5.19	.01
BLAME	3.09 (2.47)	3.41 (1.65)	3.80 (1.72)	3.44 (1.92)	3.91	.02
Psychiatric history						
Median no. of hospitalizations (range)	4 (0-100)	—	3 (0-100)	—	—	—
Age at 1st hospitalization *M* (*SD*)	25.49 (12.05)	—	20.49 (17.03)	22.81 (14.72)	6.50	.01
Months since last hospitalization *M* (*SD*)	41.01 (65.39)	—	53.73 (78.75)	47.83 (72.56)	1.77	.19

BDI, Beck Depression Inventory; BAI, Beck Anxiety Inventory; CAPS, Clinician-Administered PTSD Scale; PTCI, Posttraumatic Cognitions Inventory.

(4) diagnosis of severe PTSD, based on the CAPS, schizophrenia version (Gearon *et al.*, 2004), with a minimum total score of 65. Exclusion criteria included having a hospitalization, suicide attempt, or substance dependence within the past three months.

The third sample was drawn from a RCT for treatment of PTSD among 132 participants recruited from 12 vocational rehabilitation programs at community mental health centres in three Northeastern states in the USA (Study 3; $n = 125$; Lu *et al.*, 2022). Inclusion criteria for Study 3 were: (1) >18 years old; (2) received supported employment services within the past 24 months; (3) in treatment for SMI, with diagnosis based on self-report; (4) current diagnosis of PTSD, determined by the CAPS-5 (Weathers *et al.*, 2018); (5) no current chart diagnosis of alcohol or drug dependence; and (6) no hospitalizations or suicide attempts in the past two months.

Across all three studies, participants had SMI diagnosis and confirmed co-occurring PTSD diagnosis using CAPS or CAPS-5. The majority of participants were female (69%) and in their late 40s (Table 2). Participants predominantly (98%) had diagnosis of schizophrenia,

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

schizoaffective disorder, bipolar disorder, or major depressive disorder. For primary SMI diagnosis, all studies had more representation of non-psychotic (i.e. mood disorders) than psychotic disorders (16% for Study 1, 34% for Study 2, and 36% for Study 3). The racial composition differed significantly between studies, with the majority of participants in Study 1 being White, the majority being non-White in Study 2, and an approximately equal proportion of White and non-White participants in Study 3. Across all studies, 51% of participants were White and 38% were Black.

Measures

Participants in all three studies completed baseline assessments prior to randomization. Only baseline data were used for the present analyses.

Posttraumatic Cognitions Inventory (PTCI; Foa et al., 1999)

The PTCI was used to assess trauma-related cognitions. The PTCI is a self-report measure pertaining to common negative thoughts and beliefs about self, other people, and the world in individuals with PTSD (Foa *et al.*, 1999). The PTCI consists of 36 items ranging from 1 (totally disagree) to 7 (totally agree). It has good test–retest reliability and has been shown to be particularly effective at discriminating between traumatized individuals with PTSD and those without (Foa *et al.*, 1999). In detecting PTSD, sensitivity ranged from .70 to .78 and specificity ranged from .81 to .93 (Beck *et al.*, 2004; Foa *et al.*, 1999). Both subscale scores and total scores are based on the original 33 items (Foa *et al.*, 1999). In the current investigation, Cronbach's alpha for the 36-item PTCI total score was .95, .94, .96 and .95 in Studies 1–3, and total combined sample, respectively.

PTSD Checklist for DSM-5 (PCL-5; Weathers et al., 2013)

The PCL-5 was used in Study 3 to assess the severity of PTSD symptoms. The PCL-5 is a 20-item self-report measure that assesses the 20 *DSM-5* symptoms of PTSD on a 0–4 scale (Weathers *et al.*, 2013). The PCL-5 has demonstrated strong internal consistency ($\alpha > .90$; Blevins *et al.*, 2015), and convergent validity (Wortmann *et al.*, 2016). The internal consistency of the PCL-5 was .89 for Study 3.

Beck Depression Inventory (BDI-II; Beck et al., 1988; Beck, 1996)

The BDI-II is a 21-item self-report questionnaire used in all three studies to measure depression. Average internal consistency coefficient was .86 with excellent validity (Beck *et al.*, 1988). The internal consistency of the BDI-II was .93, .91 and .91 for Studies 1–3, respectively.

Beck Anxiety Inventory (BAI; Beck and Steer, 1993)

The BAI is a 21-item scale measuring self-reported anxiety in all three studies. The BAI discriminates between anxiety and depression and has high test–retest reliability (Beck *et al.*, 1988). The questionnaire describes emotional, physiological and cognitive symptoms of anxiety. The internal consistency of the BAI was .93, .94 and .91 for Studies 1–3, respectively.

Expanded version of the Brief Psychiatric Rating Scale (BPRS; Lukoff et al., 1986)

The expanded version of the BPRS was used in Studies 1 and 3 to assess psychiatric symptoms. This interview-based measure includes 24 items, rated on a 7-point Likert scale. The BPRS is a measure of the severity of psychiatric symptoms; it has excellent psychometric properties and has established factor structure in SMI population (Mueser *et al.*, 1998).

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

Positive and Negative Syndrome Scale (PANSS; Kay et al.*, 1987)*

The PANSS is a 30-item interview-based measure used in Study 2 to measure psychiatric symptoms. Each item is rated on a 7-point Likert scale (from 'absent' to 'extreme'). The scale consists of three subscales: positive, negative, and general psychopathology. Internal consistency ranged from .85 to .88 (Citrome *et al.*, 2011; Lancon *et al.*, 2000) and test–retest reliability ranged from .77 to .89 (Kay *et al.*, 1987).

Structured Clinical Interview for DSM-IV Axis-II Personality Disorders (SCID II; First et al., 1995)

The SCID II Borderline Personality Module was used in Studies 1 and 2 to assess interpersonal functioning with items including unstable relationships, recurrent self-injurious/suicidal behaviour, mood instability and more.

Quality of Life Interview (QOLI; Lehman et al., 1995)

The QOLI is a 74-item instrument used in Study 2 to assess quality of life on a 7-point scale. Internal consistency ranged from 0.68 to 0.85 (Lançon *et al.*, 1999). Test–retest reliability ranged from .28 to .98, and validity is good based on confirmatory factor analyses and multivariate predictive models (Lehman, 1996).

PTSD Knowledge Scale (K-PTSD; Pratt et al., 2005)

The K-PTSD was used in Studies 1 and 2 and assessed understanding of PTSD. It contains 15 multiple choice questions in relation to PTSD. Previously it has demonstrated sensitivity to changes following psychoeducational interventions about trauma for people with psychiatric disabilities (Pratt *et al.*, 2005). The internal consistency of the K-PTSD was .65 for Study 1 and .48 for Study 2.

Patient version of the Working Alliance Inventory (WAI; Horvath and Greenberg, 1989)

The patient version of the WAI was used in Studies 1 and 2 to rate the therapeutic alliance with case managers (i.e. not the therapist providing CBT treatment). Internal consistency estimates for the patient version ranged from .83 to .97 (Hanson *et al.*, 2002). The measures utilized in each study are presented in the Supplementary material.

Data analysis

Confirmatory factor analyses (CFA) with maximum likelihood estimation with robust standard errors (i.e. MLR estimator) using Mplus 8.7 was conducted to identify the best fitting model. There were 15,552 data points on PTCI for the total sample ($N = 432$), of which 306 (1.95%) were missing data. Missing data were included in the analysis by using Full Information Maximum Likelihood (FIML) in Mplus software. Missing data were handled using pairwise deletion in correlational analysis.

Model goodness of fit was evaluated using indices: model χ^2 test, comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA). Models with reasonably good fit may have CFI and TLI values that exceed 0.90 (Kline, 2005). Using two-index presentation strategy, a cut-off value close to .95 for CFI and TLI, a cut-off value close to .08 for SRMR, and a cut-off value close to .06 for RMSEA are needed to establish relatively good fit (Hu and Bentler, 1999).

Multi-group CFA was conducted to examine measurement invariance of models across the three primary diagnostic samples of SMI (schizophrenia-schizoaffective disorder, major depression, and bipolar disorder). Configural, metric and scalar invariance were used to

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

determine the degree of invariance of PTSD between groups, as suggested by Gregorich (2006) and Meredith (1993). Configural invariance determined if there was adequate fit and if the relationships between variables could be considered equivalent. Metric invariance tested if both groups contributed similar regression weights to the latent construct. Scalar invariance determined if both groups had equivalent intercept values in the latent construct on the observed variable of item scores (Gregorich, 2006; Meredith, 1993). More stringent criteria were applied when the total $N>300$, including a change <.01 in CFI supplemented with a change of <.015 in RMSEA and <.03 in SRMR for metric invariance; and a change of <0.01 in CFI supplemented with a change of <.015 in RMSEA and <.01 in SRMR for scalar invariance (Chen, 2007). Convergent validity was calculated using correlations between PTCI scales and measures of trauma symptom severity, anxiety, depression, psychiatric symptoms, and quality of life. Divergent validity was evaluated by correlations between PTCI scales, knowledge of PTSD, and working alliance.

Results

Participants in the three studies met PTSD criteria using CAPS or CAPS-5, and had moderate to severe depression on average and moderate to severe anxiety. Participants in both Studies 1 and 2 had severe PTSD on average (CAPS >65). Total PTCI scores did not differ across the three samples (see Table 2).

To examine whether the PTCI had a similar factor structure in SMI clients to the three-factor model with 33 items (excluding items 13, 32 and 34; Foa *et al.*, 1999), a CFA was performed using MLR estimator (see Table 1). This initial model without error covariance did not result in good fit (χ^2/d.f. = 2.14, $p<.001$; CFI = .89, TLI = .89, RMSEA = .05, SRMR = .05). After allowing five pairs of error terms (all between items loading on the same factor; error covariance between item 3 and 12, 4 and 5, 5 and 14, 10 and 12, 25 and 36) to covary, suggested by modification indices, the model fit improved but was not ideal (χ^2/d.f. = 1.92, $p<.001$; CFI = .91; TLI = .91, RMSEA = .05, SRMR = .05, see Table 1).

Next, analysis on the four-factor model (Sexton *et al.*, 2018) was carried out with 36 items of PTCI (excluding items 14 and 24). The initial model also did not result in a good fit (χ^2/d.f. = 2.05, $p<.001$; CFI = .90; TLI = .89, RMSEA = .05, SRMR = .05). After allowing five pairs of error terms (all between items loading on the same factor; error covariance between item 3 and 12, 5 and 14, 10 and 11, 25 and 36, 4 and 5) to covary, indicated by modification indices, the model fit improved substantially and suggested adequate fit (χ^2/d.f. = 1.84, $p<.001$; CFI = .92; TLI = .91, RMSEA = .04, SRMR = .05, see Table 1). The four-factor model performed similarly to the three-factor model, both reaching adequate fit by the commonly accepted standard of a RMSEA value less than .08, SRMR less than .08, and CFI and TLI values higher than .90 (Hu and Bentler, 1999; Kline, 2005) (CFI = .92 *vs* .91; TLI = .91 *vs* .91; RMSEA = .04 *vs* .05; SRMR = .05 *vs* .05, respectively). Both established relatively good fit, using the commonly accepted standard of a cut-off value close to .95 for CFI and TLI, .06 for RMSEA, and .08 for SRMR (Hu and Bentler, 1999).

To examine measurement invariance of Foa's three-factor model and Sexton's four-factor model across the three diagnostic groups traditionally associated with SMI (schizophrenia-schizoaffective, bipolar, major depression), multi-group CFA was conducted (Table 3). We examined configural, metric and scalar invariance levels. Two out of the four fit indices for Foa's three-factor model indicated good model fit (CFI = .86, TLI = .85, RMSEA = .06, SRMR = .068) and suggested invariance of the factor structure (configural invariance) across diagnostic groups. Sexton's four-factor model indicated slightly better fit than Foa's model (CFI = .87, TLI = .85, RMSEA = .000, SRMR = .066) and suggested configural invariance. Following Chen (2007), in the multi-group CFA, changes in CFI, RMSEA and SRMR values

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

Table 3. Measurement invariance across three diagnostic samples, gender, and ethnic groups for the 3-factor and 4-factor model

	χ^2	d.f.	χ^2/d.f.	*p*	$\Delta\chi^2$	Δd.f.	*p*	CFI	ΔCFI	TLI	RMSEA	ΔRMSEA	SRMR	ΔSRMR	SABIC
Total sample															
Foa 3-factor[a]	935.04	487	1.92	.00	—	—	—	.914	—	.907	.046	—	.049	—	53821.56
Sexton 4-factor[b]	948.88	516	1.84	.00	—	—	—	.920	—	.913	.044	—	.047	—	55213.42
Diagnostic group invariance testing (schizophrenia/schizoaffective *vs* bipolar *vs* major depressive disorder)															
Foa 3-factor															
Configural	2226.93	1461	1.52	.00	—	—	.71	.864	—	.853	.061	—	.067	—	53184.20
Metric	2284.07	1521	1.50	.00	57.14	60	.11	.865	−.001	.859	.060	−.001	.074	.007	53064.59
Scalar	2359.45	1581	1.49	.00	75.38	60	.31	.862	−.003	.862	.059	−.001	.075	.001	52966.09
Sexton 4-factor															
Configural	2346.27	1548	1.52	.00	—	—	.60	.866	—	.854	.000	—	.066	—	54557.80
Metric	2405.42	1608	1.50	.00	59.16	60	.16	.866	.000	.860	.001	.001	.073	.007	54442.44
Scalar	2485.62	1668	1.49	.00	80.20	60	.05	.863	-.003	.862	.002	.001	.074	.001	54349.33
Gender invariance testing (male *vs* female)															
Foa 3-factor															
Configural	1563.42	974	1.61	.00	—	—	—	.894	—	.885	.053	—	.058	—	53981.78
Metric	1596.95	1004	1.59	.00	31.18	30	.41	.893	−.001	.888	.052	-.001	.062	.004	53925.33
Scalar	1638.04	1034	1.58	.00	40.26	30	.10	.892	−.001	.889	.052	.000	.063	.001	53878.91
Sexton 4-factor															
Configural	1652.42	1032	1.60	.00	—	—	—	.894	—	.885	.053	—	.057	—	55398.82
Metric	1681.72	1062	1.58	.00	26.61	30	.64	.894	.000	.888	.052	−.001	.060	.003	55338.23
Scalar	1722.22	1092	1.58	.00	39.64	30	.11	.892	−.002	.889	.052	.000	.061	.001	55291.10
Race invariance testing (White *vs* Black)															
Foa 3-factor															
Configural	1465.31	974	1.55	.00	—	—	—	.898	—	.89	.052	—	.060	—	47208.52
Metric	1490.77	1004	1.48	.00	22.35	30	.84	.899	.001	.894	.051	−.001	.064	.004	47147.52
Scalar	1555.85	1034	1.50	.00	67.64	30	.00	.892	-.007	.89	.052	.000	.065	.001	47132.58
Sexton 4-factor															
Configural	1600.75	1032	1.55	.00	—	—	—	.890	—	.88	.054	—	.059	—	48435.37
Metric	1626.61	1062	1.53	.00	23.37	30	.80	.891	.001	.884	.053	−.001	.063	.004	48376.04
Scalar	1687.66	1092	1.55	.00	62.9	30	.00	.885	−.006	.881	.054	.001	.065	.002	48356.21

Diagnostic group (schizophrenia/schizoaffective $n = 116$, bipolar $n = 134$, and major depression $n = 174$); gender (male $n = 133$ *vs* female $n = 299$); ethnic groups (White $n = 214$ *vs* Black $n = 164$); CFI, comparative fit index; TLI, Tucker-Lewis index; RMSEA, root mean square error of approximation; SRMR, standard root mean square residual; $^*p <= .05$; [a]Foa's 3-factor model (33-item, removed 13, 32, 34; error covariance between item 3 and 12, 4 and 5, 5 and 14, 10 and 11, 25 and 36); [b]Sexton's 4-factor model (34-item, removed 14, 24; error covariance between item 3 and 12, 4 and 13, 10 and 11, 25 and 36, 32 and 33).

Table 4. Pearson correlation between the PTCI, trauma symptom measures, and other psychiatric measures ($N = 432$)

		Foa's 3-factor model			Sexton's 4-factor model			
	Total	SELF	WORLD	BLAME	SELF	COPE	WORLD	BLAME
Convergent validity								
CAPS[a]	.32**	.28**	.31**	.15**	.29**	.23**	.31**	.15**
CAPS-5	.61**	.61**	.43**	.39**	.61**	.53**	.44**	.39**
PCL-5[b]	.57**	.60**	.35**	.34**	.59**	.49**	.36**	.34**
BDI-II	.70**	.74**	.46**	.32**	.73**	.53**	.46**	.32**
BAI	.51**	.53**	.32**	.25**	.52**	.39**	.32**	.25**
SCID II items[c]	.34**	.32**	.24**	.20**	.31**	.32**	.25**	.21**
BPRS 24-item Total[d]	.28**	.24**	.24**	.22**	.25**	.20**	.25**	.22**
BPRS Thought Disturbance [d]	.16*	.15*	.13	.10	.14*	.16*	.14*	.11
BPRS Anergia[d]	.05	.01	.07	.04	.04	−.01	.06	.05
BPRS Affect[d]	.27**	.23**	.22**	.23**	.25**	.20**	.21**	.24**
BPRS Disorganization[d]	.36**	−.01	-.01	.12	−.01	−.07	.00	.12
PANSS Total[c]	.38**	.38**	.31**	.16*	.37**	.29**	.31**	.15*
PANSS Positive[c]	.25**	.20**	.29**	.16*	.21**	.15*	.30**	.15*
PANSS Negative[c]	.24**	.25**	.20**	.09	.25**	.17*	.19**	.09
QOL General[c]	−.46**	−.53**	−.26**	−.11	−.53**	−.25**	−.26**	−.10
Divergent validity								
WAI[c]	−.04	−.07	−.04	.08	−.07	−.03	−.04	.09
Knowledge PTSD[a]	−.15*	−.17**	−.07	−.07	−.17**	−.13*	−.06	−.07

CAPS-5, Clinician Administered PTSD Scale for DSM-5; PTCI, Posttraumatic Cognitions Inventory; BDI-II, Beck Depression Inventory-II; BAI, Beck Anxiety Inventory; BPRS, Brief Psychiatric Rating Scale; PANSS, Positive and Negative Syndrome Scale; QOL, Quality of Life Interview; WAI, Working Alliance Inventory; SCID II, Structured Clinical Interview for DSM-IV Axis-II Personality Disorders. *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$; [a]$n = 307$ (Study 1+Study 2 sample only); [b]$n = 125$ (Study 3 sample only); [c]$n = 199$ (Study 2 sample only); [d]$n = 233$ (Study 1 + Study 3 samples only).

were used to determine between-model statistical significance; ΔCFI<−.01, ΔRMSEA<.015, and ΔSRMR<.030 for the metric invariance model or ΔSRMR<.010 for the scalar invariance model. Both Foa's and Sexton's models demonstrated configural, metric and scalar invariance across diagnostic groups with associated changes in CFI, RMSEA and SRMR values of less than .01 (Table 3).

Further, multi-group CFA was conducted to examine measurement invariance of Foa's three-factor model and Sexton's four-factor model across gender (male vs female) and ethnic groups (White vs Black) (Table 3). Similarly, for the invariance analysis concerning gender, Foa's three-factor model indicated acceptable model fit (CFI = .89, TLI = .89, RMSEA = .05, SRMR = .06) while Sexton's four-factor model performed similarly (CFI = .89, TLI = .89, RMSEA = .05, SRMR = .06), indicating configural invariance regarding gender. The value differences in CFI, RMSEA, and SRMR were smaller than .01, meeting the criteria for both metric and scalar invariance for gender. For the ethnic group analysis (White vs. Black), fit indices for Foa's three-factor model indicated acceptable model fit (CFI = .90, TLI = .89, RMSEA = .05, SRMR = .06), whereas Sexton's four-factor model performed similarly for ethnic group invariance testing (CFI = .89, TLI = .88, RMSEA = .05, SRMR = .06), indicating configural invariance. Further, the changes in values were smaller than .01 for CFI, RMSEA, and SRMR, thus establishing metric and scalar invariance for ethnicity.

Altogether, CFA analysis and multi-group CFA indicated that four-factor models had a similar fit to the three-factor model. To evaluate convergent validity, correlations were computed between the PTCI total score and its factor scores for Foa's three-factor model, Sexton's four-factor model, measures of clinician-rated (CAPS, CAPS-5) and self-reported PTSD symptoms (PCL-5), depression (BDI-II), and anxiety (BAI), (Table 4). PTCI total scale and subscales for each of the three models were significantly correlated with clinician-rated PTSD symptoms, and client's self-reported PTSD symptoms and depression severity. The PTCI subscale of SELF

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

Table 5. PTCI item CFA factor loadings ($N = 432$)

	Foa's three-factor model			Sexton's four-factor model			
Item	SELF	WORLD	BLAME	SELF	COPE	WORLD	BLAME
1			.62				.62
2	.51			.51			
3	.51			.51			
4	.49				.59		
5	.65				.76		
6	.58			.57			
7		.69				.67	
8		.70				.7	
9	.74			.73			
10		.61				.63	
11		.65				.68	
12	.63			.63			
13	—	—	—		.72		
14	.60			—	—	—	—
15			.76				.76
16	.61						
17	.71						
18		.65				.66	
19			.36				.36
20	.69			.69			
21	.74			.74			
22			.67				.66
23		.66				.64	
24	.66			—	—	—	—
25	.69			.69			
26	.57			.57			
27		.71				.71	
28	.61			.61			
29	.75			.75			
30	.69			.69			
31			.82				.82
32	—	—	—	.66			
33	.74			.74			
34	—	—	—			.63	
35	.71			.72			
36	.68			.69			
Alpha	.94	.82	.78	.94	.75	.85	.78
Alpha for Total Scale	.95						

Foa's 3-factor model was based on 33 items, excluding 13, 32 and 34 consistent with (Foa *et al*., 1999; p. 314), and five pairs of error covariances (error covariance between item 3 and 12, 4 and 5, 5 and 14, 10 and 11, 25 and 36). Sexon's 4-factor model was based on 34 items excluding 14 and 24 consistent with Sexton *et al*. (2018), and five pairs of error covariances (error covariance between item 3 and 12, 4 and 13, 10 and 11, 25 and 36, 32 and 33); COPE subscale includes items 4, 5, 13.

was more strongly correlated with BDI-II ($r = .74$; 95% CI: .69–.77; $p < .01$) than the other subscales in the models (r's ranged from .32 to .54; 95% CI ranged from .23–.40 to .47–.61; $p < .01$). For both models, the correlations were of comparable magnitude. The fourth PTCI subscale of COPE reported in Sexton's model, was significantly correlated with depression, PTSD symptoms, clinician-rated and self-reported PTSD symptoms, and anxiety (r ranged from .23 to .53). Its correlation patterns were similar to that of SELF subscale in Sexton's model, though at a lesser magnitude. Convergent validity studies thus support both models.

To evaluate divergent validity, we examined correlations between PTCI factor scores, working alliance (WAI) and PTSD knowledge (K-PTSD; Table 4). The PTCI total score and subscale scores in all three models were weakly or not significantly correlated with working alliance or PTSD knowledge ($r = -.06$ to $-.17$), suggesting divergent validity of both PTCI models.

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

The internal consistency for the overall PTCI was .95 for the combined data sets from three studies ($n = 432$) [.95 for Study 1 ($n = 108$); .94 for Study 2 ($n = 199$); .95 for Study 3 ($n = 125$)]. The internal consistencies of the PTCI subscales for the three and four factor model were also high, ranging from .77 to .94 (Table 5).

Discussion

Our study used CFA as well as multi-group CFA to assess two different models proposed by previous literature. Sexton *et al.* (2018) found the superiority of the four-factor model over Foa's three-factor model. We did not find support for the hypotheses that Sexton's four-factor model would be superior to Foa's three-factor model, and instead found that the four-factor model performed similarly to the three-factor model, with both having adequate fit. Our study offers support for Sexton's four-factor model; however, support is also found for Foa's three-factor model. Both models have adequate fit in this sample, which contributes to their credibility for continued use, although future research is warranted.

The findings from this study strongly support the reliability and validity of the PTCI in people with SMI and co-morbid PTSD. Furthermore, we found adequate support for the three-factor structure of the PTCI initially reported by Foa *et al.* (1999), as well as for the four-factor model of Sexton *et al.* (2008).

Consistent with Sexton *et al.* (2018), the current study found that the four subscales in the four-factor model of PTCI had good internal consistency. Moreover, the PTCI total scale and subscales also had moderate convergent correlations with measures of PTSD symptom severity, depression and anxiety. Evidence for divergent validity of PTCI was also found with weaker correlations with measures of PTSD knowledge and working alliance (r ranged from –.07 to –.16), a construct unrelated to post-traumatic cognition.

While the three-factor solution was found to show good fit, CFA analysis and multi-group CFA across the three diagnostic groups indicated that the four-factor solution had a better fit than the three-factor solution. Both models performed similarly across gender and race (White *vs* Black). Sexton's model has previously been used with veterans seeking treatment for military trauma but not among individuals with SMI until this study. Similarly, this study is the first time Foa's model was examined among individuals with SMI and co-occurring PTSD. With regard to PTCI subscales, results are consistent with Su and Chen (2008) in that all subscale scores had moderate to high correlations with depression as measured by the BDI. The SELF subscale was the strongest predictor of depression and a stronger predictor of PTSD severity than the other scales, in both the three- and four-factor solutions. In contrast to Su and Chen (2008), our study found that PTSD severity (CAPS and PCL) was most weakly correlated with the PTCI BLAME subscale. These findings are consistent with Daie-Gabai *et al.* (2011), who reported that the BLAME subscale had the lowest correlations with PTSD severity and depression symptoms compared with the SELF subscale, which was the strongest predictor of PTSD severity and depression, followed by the WORLD subscale.

Interestingly, the COPE subscale in Sexton's four-factor model was moderately correlated with PTSD symptoms, psychiatric symptoms, borderline personality functioning, and quality of life. Next to SELF subscale, COPE had the second strongest correlations with depression (BDI), anxiety (BAI), and PTSD symptoms (PCL) among all the subscales (r ranged from 0.22 to 0.54). The findings suggest the importance of addressing coping mechanisms in PTSD treatment due to its strong correlations with PTSD symptoms and overall psychiatric symptoms. The COPE subscale suggests that a perceived lack of competence in coping is also a strong predictor of borderline personality functioning, quality of life, and psychiatric symptoms among individuals with SMI and co-morbid PTSD. The findings are consistent with Mueser *et al.* (2008, 2015)'s treatment in which cognitive restructuring was used to help

https://doi.org/10.1017/S1352465823000140 Published online by Cambridge University Press

people with SMI to increase their competence in coping with upsetting situations. This is consistent with PTSD treatment guidelines in which non-trauma-focused therapies (i.e. stress inoculation training, present-centered therapy, and interpersonal psychotherapy) also facilitate recovery from PTSD (Cusack *et al*., 2016; Watts *et al*., 2013).

Several important limitations should be noted. First, our study included clients with SMI and co-occurring PTSD who sought treatment. Therefore, these participants may have more severe psychiatric symptoms and higher scores on post-traumatic cognition than those without PTSD, or not currently in treatment. In Studies 1 and 2, participants' PTSD was assessed using *DSM-IV* criteria. Future research with the updated PTSD criteria in the *DSM-5* (American Psychiatric Association, 2013) is needed to verify that findings are generalizable. Additionally, divergent validity was examined using correlations of PTSD knowledge and working alliance rather than measures of different symptoms or cognitions, which future studies may utilize instead.

These limitations notwithstanding, the current study is the first to examine the factor structure of the PTCI among three heterogeneous samples of people with SMI and co-occurring PTSD, and adds to the knowledge of the psychometric properties of this measure with special populations. Even though the three-factor model (SELF, WORLD, BLAME) appeared robust with SMI clients, the four-factor models (SELF, WORLD, BLAME, COPE) provided an alternative and better fit for this population. Overall, the PTCI appears to be a reliable and valid tool for assessing trauma-related beliefs in people with SMI and co-occurring PTSD.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/S1352465823000140

Data availability statement. At the time that the grant was awarded, the funding agency did not require grantees to share data. We do not have participant consent or IRB approval to share data publicly.

Acknowledgements. We wish to thank the following individuals for their assistance with this project: Edward Kim, Lee Hyer, Rachael Fite, Kenneth Gill, Rosemarie Rosati, Christopher Kosseff, Karen Somers, John Swanson, Avis Scott, Rena Gitlitz, John Markey, Zygmond Gray, Marilyn Green, Janice Belarmino, William Waynor, Joseph Dephillips, Kevin Harris, Carol Gao, Audra Schulman and Ke Wang.

Author contributions. **Weili Lu:** Conceptualization (equal), Funding acquisition (equal), Investigation (equal), Methodology (equal), Project administration (lead), Supervision (lead), Writing – original draft (equal); **Kim Mueser:** Conceptualization (equal), Resources (equal), Writing – review & editing (equal); **Philip Yanos:** Conceptualization (equal), Investigation (equal), Writing – original draft (equal), Writing – review & editing (equal); **Amanda Siriram:** Writing – original draft (equal), Writing – review & editing (equal); **Yuane Jia:** Data curation (equal), Formal analysis (equal), Software (equal); **Alyssa Leong:** Formal analysis (equal); **Steven Silverstein:** Investigation (equal), Writing – review & editing (equal); **Jennifer Gottlieb:** Investigation (equal); **Mary Jankowski:** Investigation (equal).

Financial support. This research was supported by a National Institutes of Mental Health grant (R01MH064662; R01MH064662-02) and by the NIDILRR Field Initiated Grant no. HHS-Administration for Community Living number 90IF0074.

Competing interests. All authors declare that they have no competing interests.

Ethical standards. Authors abided by the Ethical Principles of Psychologists and Code of Conduct as set out by the BABCP and BPS. Research has conformed to the Declaration of Helsinski.

References

American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th edn). https://doi.org/10.1176/appi.books.9780890425596

Andreu, J. M., Peña, M. E., & de La Cruz, M. Á. (2017). Psychometric evaluation of the Posttraumatic Cognitions Inventory (PTCI) in female survivors of sexual assault. *Women & Health*, *57*, 463–477. https://doi.org/10.1080/03630242.2016.1153019

Beck, A. T. (1996). *Beck Depression Inventories – II*. Psychological Corporation. https://doi.org/10.1037/t00742-000

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: psychometric properties. *Journal of Consulting and Clinical Psychology*, *56*, 893. https://doi.org/10.1037/0022-006X.56.6.893

Beck, A. T., & Steer, R. A. (1993). *Beck Anxiety Inventory Manual*. Harcourt Brace and Company.

Beck, A. T., Steer, R. A., & Garbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: twenty-five years of evaluation. *Clinical Psychology Review*, *8*, 77–100. https://doi.org/10.1016/0272-7358(88)90050-5

Beck, J. G., Coffey, S. F., Palyo, S. A., Gudmundsdottir, B., Miller, L., & Colder, C. R. (2004). Psychometric properties of the Posttraumatic Cognitions Inventory (PTCI): a replication with motor vehicle accident survivors. *Psychological Assessment*, *16*, 289–298. https://doi.org/10.1037/1040-3590.16.3.289

Bigdeli, T. B., Voloudakis, G., Barr, P. B., Gorman, B. R., Genovese, G., Peterson, R. E., ... **& Gill, S.** (2022). Penetrance and pleiotropy of polygenic risk scores for schizophrenia, bipolar disorder, and depression among adults in the US Veterans Affairs health care system. *JAMA Psychiatry*, *79*, 1092–1101. http://doi.org/10.1001/jamapsychiatry.2022.2742

Blake, D. D., Weathers, F. W., Nagy, L. N. et al. (1990). A clinician rating scale for assessing current and lifetime PTSD: the CAPS-1. *Behavior Therapist*, *18*, 187–188.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The posttraumatic stress disorder checklist for DSM-5 (PCL-5): development and initial psychometric evaluation. *Journal of Traumatic Stress*, *28*, 489–498

Brown, L. A., Belli, G. M., Asnaani, A., & Foa, E. B. (2018). A review of the role of negative cognitions about oneself, others, and the world in the treatment of PTSD. *Cognitive Therapy and Research*, *43*, 143–173. https://doi.org/10.1007/s10608-018-9938-1

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling*, *14*, 464–504. https://doi.org/10.1080/10705510701301834

Citrome, L., Meng, X., & Hochfeld, M. (2011). Efficacy of iloperidone in schizophrenia: a PANSS five-factor analysis. *Schizophrenia research*, *131*(1–3), 75–81. https://doi.org/10.1016/j.schres.2011.05.018

Cusack, K., Jonas, D. E., Forneris, C. A., Wines, C., Sonis, J., Middleton, J. C., ... **& Gaynes, B. N.** (2016). Psychological treatments for adults with posttraumatic stress disorder: a systematic review and meta-analysis. *Clinical Psychology Review*, *43*, 128–141. https://doi.org/10.1016/j.cpr.2015.10.003

Daie-Gabai, A., Aderka, I. M., Allon-Schindel, I., Foa, E. B., & Gilboa-Schechtman, E. (2011). Posttraumatic Cognitions Inventory (PTCI): psychometric properties and gender differences in an Israeli sample. *Journal of Anxiety Disorders*, *25*, 266–271. https://doi.org/10.1016/j.janxdis.2010.09.012

Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy*, *38*, 319–345. https://doi.org/10.1016/S0005-7967(99)00123-0

First, M. B, Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (1995). *Structured Clinical Interview for DSM-III-R Personality Disorders (SCID-II). APA PsycTests.* https://doi.org/10.1037/t07827-000

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B.W. (1996). *Structured Clinical Interview for DSM-IV Axis I Disorders, Clinician Version (SCID-CV)*. American Psychiatric Press, Inc. https://doi.org/10.1037/t07827-000

Foa, E. B., & Cahill, S. P. (2001). Psychological therapies: emotional processing. In Smelser, N. J. & Bates, P. B. (eds), *International Encyclopedia of Social and Behavioral Sciences* (pp. 12363–12369). Elsevier. https://doi.org/10.1016/B0-08-043076-7/01338-3

Foa, E. B., Ehlers, A., Clark, D. M., Tolin, D. F., & Orsillo, S. M. (1999). The Post-Traumatic Cognitions Inventory (PTCI): development and validation. *Psychological Assessment*, *11*, 303–314. https://doi.org/10.1037/1040-3590.11.3.303

Foa, E. B., & Rauch, S. A. (2004). Cognitive changes during prolonged exposure versus prolonged exposure plus cognitive restructuring in female assault survivors with posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology*, *72*, 879–884. https://doi.org/10.1037/0022-006X.72.5.879

Foa, E. B., & Rothbaum, B. O. (1998). *Treating the Trauma of Rape: Cognitive-Behavioral Therapy for PTSD*. Guilford Press.

Gearon, J. S., Bellack, A. S., & Tenhula, W. N. (2004). Preliminary reliability and validity of the Clinician-Administered PTSD scale for schizophrenia. *Journal of Consulting and Clinical Psychology*, *72*, 121. https://doi.org/10.1037/0022-006X.72.1.121

Germain, C. L., Kangas, M., Taylor, A., & Forbes, D. (2016). The role of trauma-related cognitive processes in the relationship between combat-PTSD symptom severity and anger expression and control. *Australian Journal of Psychology*, *68*, 73–81. https://doi.org/10.1111/ajpy.12097

Gregorich, S. E. (2006). Do self-report instruments allow meaningful comparisons across diverse population groups? Testing measurement invariance using the confirmatory factor analysis framework. *Medical care*, *44*(11 Suppl 3), S78. https://doi.org/ 10.1097/01.mlr.0000245454.12228.8f

Grubaugh, A. L., Brown, W. J., Wojtalik, J. A., Myers, U. S., & Eack, S. M. (2021). Meta-analysis of the treatment of posttraumatic stress disorder in adults with comorbid severe mental illness. *Journal of Clinical Psychiatry*, *82*. https://doi.org/10.4088/JCP.20r13584

Grubaugh, A. L., Zinzow, H. M., Paul, L., Egede, L. E., & Frueh, B. C. (2011). Trauma exposure and posttraumatic stress disorder in adults with severe mental illness: a critical review. *Clinical Psychology Review*, *31*, 883–899. https://doi.org/10.1016/j.cpr.2011.04.003

Hanson, W. E., Curry, K. T., & Bandalos, D. L. (2002). Reliability generalization of working alliance inventory scale scores. *Educational and Psychological Measurement*, *62*, 659–673. https://doi.org/10.1177/0013164402062004008

Horvath, A. O., & Greenberg, L. S. (1989). Development and validation of the Working Alliance Inventory. *Journal of Counseling Psychology*, *36*, 223. https://doi.org/10.1037/0022-0167.36.2.223

Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55. https://doi.org/10.1080/10705519909540118

Hyland, P., Murphy, J., Shevlin, M., Murphy, S., Egan, A., & Boduszek, D. (2015). Psychometric properties of the Posttraumatic Cognition Inventory within a Northern Ireland adolescent sample. *British Journal of Clinical Psychology*, *54*(4), 435–449. https://doi.org/10.1111/bjc.12089

Kay, S. R., Fiszbein, A., & Opler, L. A. (1987). The Positive And Negative Syndrome Scale (PANSS) for schizophrenia. *Schizophrenia Bulletin*, *13*, 261–276. https://doi.org/10.1093/schbul/13.2.261

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*, 593–602. https://doi.org/10.1001/archpsyc.62.6.593

Kline, T. (2005). *Psychological Testing: A Practical Approach to Design and Evaluation*. Sage.

Lancon, C., Auquier, P., Nayt, G., & Reine, G. (2000). Stability of the five-factor structure of the Positive and Negative Syndrome Scale (PANSS). *Schizophrenia Research*, *42*(3), 231–239. https://doi.org/10.1016/S0920-9964(99)00129-2

Lançon, C., Auquier, P., Toumi, M., Launois, R., Llorca, P. M., Lehman, A., & Bebbington, P. (1999). Validation of the brief Quality of Life Interview (QoLI): I. Internal structure.

Lehman, A. F. (1996). Measures of quality of life among persons with severe and persistent mental disorders. *Social psychiatry and psychiatric epidemiology*, *31*, 78–88.

Lehman, A. F., Kernan, E., & Postrado, L. (1995*). Toolkit for Evaluating Quality of Life for Persons with Severe Mental Illness: To be used in Conjunction with the Lehman Quality of Life Interview*. Evaluation Center at HSRI.

Lu, W., Mueser, K. T., Rosenberg, S. D., & Jankowski, M. K. (2008). Correlates of adverse childhood events in adults with severe mood disorders. *Psychiatric Services*, *59*, 1018–1026. https://doi.org/10.1176/ps.2008.59.9.1018

Lu, W., Yanos, P. T., Waynor, W., Jia, Y., Siriram, A., Leong, A., Gill, K., & Mueser, K. T. (2022). Psychometric properties of post-traumatic stress disorder (PTSD) checklist for DSM-5 in persons with serious mental illness. *European Journal of Psychotraumatology*, *13*, 2038924. https://doi.org/10.1080/20008198.2022.2038924

Lukoff, D., Nuechterlein, K. H., & Ventura, J. (1986). Manual for the expanded Brief Psychiatric Rating Scale. *Schizophrenia Bulletin*, *12*, 594–602.

Mansueto, G., Cavallo, C., Palmieri, S., Ruggiero, G. M., Sassaroli, S., & Caselli, G. (2021). Adverse childhood experiences and repetitive negative thinking in adulthood: A systematic review. *Clinical Psychology & Psychotherapy*, *28*(3), 557–568. https://doi.org/10.1002/cpp.2590

Martínez-Martínez,C., Richart-Martínez, M., & Ramos-Pichardo, J. D. (2020). Operational definition of serious mental illness: heterogeneity in a review of the research on quality-of-life interventions. *Journal of the American Psychiatric Nurses Association*, *26*, 229–244. https://doi.org/10.1177/1078390320902823

Meredith, W. (1993). Measurement invariance, factor analysis, and factorial invariance. *Psychometrika*, *58*, 525–543.

Mueser, K. T., Goodman, L. B., Trumbetta, S. L., Rosenberg, S. D., Osher, F. C., Vidaver, R., Auciello, P., & Foy, D. W. (1998). Trauma and posttraumatic stress disorder in severe mental illness. *Journal of Consulting and Clinical Psychology*, *66*, 493. https://doi.org/10.1037/0022-006X.66.3.493

Mueser, K. T., Gottlieb, J. D., Xie, H., Lu, W., Yanos, P. T., Rosenberg, S. D., Silverstein, S. M., Duva, S. M., Minsky, S., Wolfe, R. S., & McHugo, G. J. (2015). Evaluation of cognitive restructuring for post-traumatic stress disorder in people with severe mental illness. *British Journal of Psychiatry*, *206*, 501–508. https://doi.org/10.1192/bjp.bp.114.147926

Mueser, K. T., Rosenberg, S. D., Xie, H., Jankowski, M. K., Bolton, E. E., Lu, W., Hamblen, J. L., Rosenberg, H. J., McHugo, G. J., & Wolfe, R. (2008). Cognitive behavioral treatment of posttraumatic stress disorder in severe mental illness: a randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *76*, 259–271. https://doi.org/10.1037/0022-006X.76.2.259

Mueser, K. T., Salyers, M. P., Rosenberg, S. D., Goodman, L. A., Essock, S. M., Osher, F. C., Swartz, M. S., Butterfield, M. I., & **Site Health and Risk Study Research Committee** (2004). Interpersonal trauma and posttraumatic stress disorder in patients with severe mental illness: demographic, clinical, and health correlates. *Schizophrenia Bulletin*, *30*, 45–57. https://doi.org/10.1093/oxfordjournals.schbul.a007067

Müller, J., Wessa, M., Rabe, S., Dörfel, D., Knaevelsrud, C., Flor, H., … **& Karl, A.** (2010). Psychometric properties of the Posttraumatic Cognitions Inventory (PTCI) in a German sample of individuals with a history of trauma. *Psychological Trauma: Theory, Research, Practice, and Policy*, *2*, 116.

Parabiaghi, A., Bonetto, C., Ruggeri, M., Lasalvia, A., & Leese, M. (2006). Severe and persistent mental illness: a useful definition for prioritizing community-based mental health service interventions. *Social Psychiatry and Psychiatric Epidemiology*, *41*, 457–463. https://doi.org/10.1007/s00127-006-0048-0

Pratt, S., Rosenberg, S. D., Author, Brancato, J., Salyers, M., Jankowski, M. & Descamps, M. (2005). Evaluation of a PTSD psychoeducational program for psychiatric inpatients. *Journal of Mental Health*, *14*, 121–127. https://doi.org/10.1080/09638230500066356

Seow, L. S. E., Ong, C., Mahesh, M. V., Sagayadevan, V., Shafie, S., Chong, S. A., & Subramaniam, M. (2016). A systematic review on comorbid post-traumatic stress disorder in schizophrenia. *Schizophrenia Research*, *176*, 441–451. https://doi.org/10.1016/j.schres.2016.05.004

Sexton, M. B., Davis, M. T., Bennett, D. C., Morris, D. H., & Rauch, S. A. (2018). A psychometric evaluation of the Posttraumatic Cognitions Inventory with Veterans seeking treatment following military trauma exposure. *Journal of Affective Disorders*, *226*, 232–238. https://doi.org/10.1016/j.jad.2017.09.048

Shahar, G., Noyman, G., Schnidel-Allon, I., & Gilboa-Schechtman, E. (2013). Do PTSD symptoms and trauma-related cognitions about the self constitute a vicious cycle? Evidence for both cognitive vulnerability and scarring models. *Psychiatry Research*, *205*, 79–84. https://doi.org/10.1016/j.psychres.2012.07.053

Shin, K. M., Chung, Y. K., Kim, N. H., Kim, K. A., & Chang, H. Y. (2020). Factor structure and reliability of the posttraumatic cognitions inventory in Korean female victims of sexual violence. *Journal of Interpersonal Violence*, *35*, 2254–2270. https://doi.org/10.1177/0886260517696866

Struck, N., Krug, A., Yuksel, D., Stein, F., Schmitt, S., Meller, T., Brosch, K., Dannlowski, U., Nenadić, I., Kircher, T., & Brakemeier, E.-L. (2020). Childhood maltreatment and adult mental disorders – the prevalence of different types of maltreatment and associations with age of onset and severity of symptoms. *Psychiatry Research*, *293*, 113398–113398. https://doi.org/10.1016/j.psychres.2020.113398

Substance Abuse and Mental Health Services Administration (SAMHSA) (2017). Mental and substance use disorders. https://www.samhsa.gov/disorders.

Su, Y. J., & Chen, S. H. (2008). The Posttraumatic Cognitions Inventory-Chinese revised: validation and refinement with a traumatized college sample in Taiwan. *Journal of Anxiety Disorders*, *22*, 1110–1119. https://doi.org/10.1016/j.janxdis.2007.11.008

van Emmerik, A. A. P., Schoorl, M., Emmelkamp, P. M. G., & Kamphuis, J. H. (2006). Psychometric evaluation of the Dutch version of the Post-Traumatic Cognitions Inventory (PTCI). *Behaviour Research and Therapy*, *44*, 1053–1065. https://doi.org/10.1016/j.brat.2005.07.002

Watts, B. V., Schnurr, P. P., Mayo, L., Young-Xu, Y., Weeks, W. B., & Friedman, M. J. (2013). Meta-analysis of the efficacy of treatments for posttraumatic stress disorder. *Journal of Clinical Psychiatry*, *74*, e541–e550. https://doi.org/10.4088/JCP.12r08225

Weathers, F. W., Bovin, M. J., Lee, D. J., Sloan, D. M., Schnurr, P. P., Kaloupek, D. G., Keane, T. M., & Marx, B. P. (2018). The clinician-administered PTSD scale for DSM5 (CAPS-5): development and initial psychometric evaluation in military veterans. *Psychological Assessment*, *30*, 383. https://doi.org/10.1037/pas0000486

Weathers, F. W., Litz, B. T., Keane, T. M., Palmieri, P. A., Marx, B. P., & Schnurr, P. P. (2013). National Center for PTSD. *PTSD Checklist for DSM-5 (PCL-5)*. http://www.ptsd.va.gov

Wortmann, J. H., Jordan, A. H., Weathers, F. W., Resick, P. A., Dondanville, K. A., Hall-Clark, B., Foa, E. B., Young-McCaughan, S., Yarvis, J. S., Hembree, E. A., Mintz, J., Peterson, A. L., & Litz, B. T. (2016). Psychometric analysis of the PTSD Checklist-5 (PCL-5) among treatment-seeking military service members. *Psychological Assessment*, *28*, 1392. https://doi.org/10.1037/pas0000260

Cite this article: Lu W, Mueser KT, Yanos PT, Siriram A, Jia Y, Leong A, Silverstein SM, Gottlieb J, and Jankowski MK (2023). Post-Traumatic Cognitions Inventory (PTCI): psychometric properties in clients with serious mental illness and co-occurring PTSD. *Behavioural and Cognitive Psychotherapy* **51**, 459–474. https://doi.org/10.1017/S1352465823000140