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Evaluating symptom endorsement typographies of trauma-exposed veterans on the Personality Assessment Inventory (PAI): A latent profile analysis

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Abstract
Research on symptom endorsement patterns in those with trauma exposure frequently emphasizes presentation subtypes. Most frequently, internalizing, externalizing, and dissociative symptom clusters are identified; however, evidence for the emergence of disorder subtypes is not always consistent. To expand its clinical utility, this study examines symptom endorsement subtypes on the Personality Assessment Inventory (PAI) within a sample of trauma exposed individuals. Specifically, a series of latent profile analyses (LPA) were conducted on 376 U.S. military veterans evaluated while seeking outpatient treatment for PTSD within the Veteran Affairs system. Results from these analyses identify two primary findings. First, the observed class models support the notion that the PAI clinical scales are a useful aid in detecting broad patterns of distress common to those with trauma exposure (e.g., depression, suicidal thoughts, avoidant behaviors, etc.). Second, the PAI did not demonstrate distinct response styles consistent with the theoretically and empirically supported diagnostic subtypes. Implications for research with, and the clinical use of, the PAI in veterans and those with trauma-associated symptoms are discussed.

Keywords Personality Assessment Inventory · Veteran · Psychological assessment · Posttraumatic stress disorder

Exposure to traumatic events during military service is associated with increased risk for developing sustained mental and physical health problems (Seal et al. 2009). This is, in part, because trauma exposure itself is a core predictive mechanism in development of psychopathology, including Posttraumatic stress disorder (PTSD) (Orcutt et al. 2002). As such, trauma exposure and, subsequently, PTSD impacts a large portion of military veterans and active duty service members (Fulton et al. 2014; Kang et al. 2003; Hoge et al. 2004). Indeed, PTSD occurs at substantially greater frequencies in veteran and military populations than it does in the general population (Kilpatrick et al. 2013). Lifetime prevalence estimates suggest that around 14% of veterans qualify for PTSD (e.g., Tanielian and Jaycox 2008) and approximately 17% of veterans receive disability compensation from the Veteran Affairs (VA) solely because of this diagnosis (National Center for Veterans Analysis and Statistics 2014; Veteran Benefits Administration 2017) and it is one of the most common conditions observed during mental health screenings in VA primary care settings (Trivedi et al. 2015). Highlighting the critical impact of trauma exposure, even fully resolved PTSD results in similar lingering impairment in functional capacity (Bryantet al. 2016) and those with trauma exposure (regardless if they held formal PTSD diagnoses) face similar patterns of mental and physical health problems (Debert et al. 2009).

Part of the challenge to the successful treatment of individuals with trauma exposure is the complexity of the symptom criteria in PTSD. Indeed, there is substantial variability in the ways in which required symptoms occur, and countless ways that those combinations of presentations may qualify a person

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for a diagnosis (Galatzer-Levy and Bryant 2013). Some evidence suggests that index traumatic events are not needed for a diagnosis (Franklin et al. 2018) and concepts of partial PTSD (a term describing lowered symptom severities on key diagnostic clusters) have also been long documented (see Schützwohl and Maercker 1999). Moreover, not only is diagnosing those with trauma exposure complicated by the multidimensional nature of trauma disorders, but there is also substantial comorbidity in those with trauma exposure (Kessler et al. 2005a, 2005b; Miller et al. 2012). These comorbid concerns include a variety of frequent physical and mental health needs (Kang et al. 2003; Kessler et al. 2005a) and this comorbidity is particularly pronounced particularly among veterans (e.g., Hoge et al. 2004). Unsurprisingly, these comorbidities and symptom complexities frequently lead to increased problems in diagnostic accuracy for individuals with trauma exposure (Suris and Lind 2008).

To improve interpretive and diagnostic capacity during evaluations of those with trauma exposure, researchers have classified different types, or subgroups, of symptoms. These subgroups are evident not only among those with formal diagnoses of PTSD (American Psychiatric Association [APA] 2013; Dalenberg et al. 2012; Tsai et al. 2015), but also those who do not qualify for the disorder yet have experienced a traumatic event (e.g., Guetta et al. 2019). As a result, trauma exposure itself results in distinct sets of clinical presentations codified in different subtypes. Frequently, symptom patterns of those with trauma exposure are described as occurring within the broad framework of an internalizing, externalizing, and reality impairing model of psychopathology (Kruger 1999). This three-tiered theoretical framework is based on a widely replicated multivariate model of psychopathological taxonomy utilized in contemporary models of psychopathology (Kotov et al. 2017). This model allows for an emphasis on dimensional, rather than categorical, understandings of psychiatric constructs (Borsoom et al. 2016). It also provides a hierarchical and parsimonious model of disorders by including comorbid and related conditions under these three conceptual domains (Kotov et al. 2011; Kessler et al. 2005b). Indeed, it's broad replication across disorders types, as well as its incorporation of comorbidities into simplified and interpretable presentation formulations, make the internalizing, externalizing, and reality impairing model a particularly popular one for interpreting subtypes of those with trauma exposure.

Those with an internalizing type of trauma symptomology are prone to lower positive emotionality and tend towards inwardly destructive behaviors (e.g., increased depressive symptoms and avoid behaviors). Conversely, those who have an externalizing subtype express more aggression and avoidance behaviors; they also having higher behavioral disconstraint and a propensity towards risk-taking (Miller et al. 2008; Miller et al. 2003; Miller et al. 2004). The reality impairing subtype, frequently described as the dissociative subtype, is characterized by marked increases in psychoticism and derealization (Steuwe et al. 2012; Terhune and Cardena 2015; Tsai et al. 2015; Waelde et al. 2005). It is not only a research identified presentation, but also a codified disorder subtype that is recognized as a formal disorder specifier (American Psychiatric Association 2013). Evidence of the dissociative type includes not only self-report, but also some neuroimaging studies (Nicholson et al. 2015) and variations across clinician ratings in structured interviews (Lanius et al. 2012; Wolf et al. 2012a).

The three symptom groups described above (e.g., internalizing, externalizing, dissociative/reality impairing) are, perhaps, the most common categories utilized in understanding trauma-related symptomology because of their conceptual breadth. However, these presentation groups do not encapsulate all symptom patterns observed nor are they wholly consistent across studies. For instance, the internalizing/externalizing types are not always evident and there is frequent variability in their structure (e.g., Elhai et al. 2003; Forbes et al. 2010). The internalizing subtypes may, for instance, focus on a specific subset of internalizing symptoms (e.g., depressogenic symptoms; Contractor et al. 2017). Likewise, externalizing models are sometimes differentiated into additional sub-groups, such as the reckless or impulsive types of externalization (Contractor and Weiss 2019). The dissociative/reality impairing subtype faces a similar challenge as it varies between studies in the frequency which it emerges (see Hansen et al. 2017). Nonetheless, research on subgroups of those with trauma exposure continues to support a three-tiered model as the hierarchical description of disorder presentation tends to fit generally within its theoretical framework (see Kotov et al. 2017).

In short, evidence on presentation patterns in those with trauma exposure generally suggests these three thematic subtypes (Dalenberg et al. 2012; Miller et al. 2008); however, there are difficulties and inconsistencies in the identification of these groups. Not only are do some not emerge (Thomas et al. 2013), but the even the more frequent internalizing and externalizing subtypes are not always evident (Wolf et al. 2012b). Moreover, there are cases in which individuals meeting PTSD diagnostic criteria follow a low-symptom profile in which no clear patterns of symptom endorsement emerge (Selbom & Bagby 2009). Accordingly, addressing the evaluative needs of trauma exposed individuals faces numerous challenges (Suris and Lind 2008). Instruments used to aid diagnostic understanding and classification of those with trauma exposure must find ways to circumvent the complexity inherent to symptom presentation within associated trauma disorders (Hoge et al. 2007; Kessler et al. 2005a, 2005b). As part of this redressing of challenges, assessment instruments must be evaluated for their capacity to identify presentation subtypes to ensure that clinicians know how these tools may be utilized as diagnostic aids.

As a popular multi-scale personality inventory (Ingram et al. 2019), the Personality Assessment Instrument (PAI; Morey 1991) has shown good utility in use with veterans and with trauma exposure. In a recent study examining scale performance patterns on the PAI, Bellet et al. (2017) found that those with PTSD have marked elevations across internalizing symptom patterns (e.g., depressogenic and anxious patterns of thinking or affective instability), as well as externalizing behaviors related to aggression and irritability. They also observed elevations on scales measuring atypical patterns of thought and psychotic thinking, consistent with literature on the dissociative subtype of PTSD. Their findings of common elevations in PTSD are consistent with other research on the PAI in veterans (e.g., Calhoun et al. 2010; Van Voorhees et al. 2014). Indeed, these three conceptual clusters of symptoms seem to support the notion that those patterns of elevations are characteristic of the clinical core in those with trauma exposure (for support outside of veteran populations see McDevitt-Murphy et al. 2005; McDevitt-Murphy et al. 2007).

However, no research to date has evaluated how symptom subtypes emerge on the PAI. This is surprising given that LCA is a primary method of identifying potential disorder subtypes and that studies on PTSD with the PAI have found enough homogeneity across veteran response patterns to suggest PTSD subgroups (Mozley et al. 2005). Given this heterogeneity, examination of responses on the PAI using veterans seeking treatment for PTSD is warranted and will expand understanding about the emergence of disorder types on this popular assessment instrument. This study utilizes latent profile analysis to evaluate patterns of symptom endorsement to see if PTSD subtypes are detectable on the PAI using a sample of treatment seeking veterans. It was hypothesized that symptom endorsement patterns consistent with the three-factor model of subtypes would emerge on the PAI. Specifically, scales assessing the internalizing (NIM, DEP, ANX, ARD, SUI), externalizing behaviors (MAN, DRG, AGG), and dissociative (PAR and SCZ) types were expected to elevate within distinct groups of respondents.

Methods

Participants

Analysis were conducted on the archival database which included psychological assessments conducted on veterans as they initiated services on an outpatient PTSD Clinical Team (PCT). Assessments were conducted at a Midwestern Tier-1C Department of Veteran Affairs Medical Center (VAMC) between September 2013 and October 2016. This database was composed of 376 individuals with PAI profiles and none of these cases contained missing data. Of these 376 individuals, 32 (6.1%) had scores on the validity indexes which suggest invalid patterns of responding (Morey 1996): Infrequency (INF) ≥ 75 T, Inconsistency (INC) ≥ 73 T, or Negative Impression Management (NIM) ≥ 110 T. However, those with invalidated profiles were not excluded from analyses because research has shown than validity index scores are related to trauma exposure (i.e., NIM and PIM; Bellet et al. 2017; Morey 2003). Of the 344 veterans (n = 318; 92.4% male) with valid profiles, 261 (75.9%) exceeded recommended cut-scores for PTSD screening criteria using a version of the PTSD Checklist (PCL). Demographics of the overall, valid-only, and valid-PTSD probable groups are provided in Table 1. In general, participants are white male combat veterans who served during Operation Enduring Freedom (OEF) or Operation Iraqi Freedom (OIF).

Measures

Personality Assessment Inventory (PAI; Morey 1991)

The PAI is a 344-item personality assessment instrument which includes four validity indicators, 11 clinical scales (each with 3 to 4 subscales), 5 treatment consideration scales, and two interpersonal scales. Items on the PAI are measured on a 4-point scale (*false, somewhat true, mainly true,* or *very true)* with *T*-scores ≥70 indicating clinical elevations. The scales of the PAI have a high median coefficient alpha of .86 and good test-retest reliabilities ranging between .73 and .86 (Morey 1991, 1996). Internal consistency estimates in veteran samples range from moderate to strong (α = .69 to α = .95; Bellet et al. 2017). For additional information about the validation and interpretation of PAI scales, see Morey (1996).

PTSD Checklist-M/C (PCL-M/C; Weathers et al. 1993)

The PCL-M/C is a widely used 17-item self-report inventory which assesses severity of PTSD according to the fourth edition of the Diagnostic and Statistical Manual (American Psychiatric Association 2013) using a five-point Likert-type response range (1 = *Not at all*, 2 = *A little Bit*, 3 = *Moderately*, 4 = *Quite a bit*, 5 = *Extremely*). The M and C designations for the PCL indicate military and civilian sources of trauma, respectively. Items are otherwise identical between these versions of the PCL. Scores of 50 are effective at differentiating those with PTSD from those without the disorder on the PCL-M/C, particularly within research settings where excluding individuals not meeting criteria for PTSD is the primary goal (Keen et al. 2008). The PCL-M/C has produced strong evidence supporting its validity (e.g., Wortman et al. 2016) and diagnostic utility (Griffin et al. 2004; Grubaugh et al. 2006). Blanchard, Jones-Alexander, Buckey, and Forneris (1996) found that the correlations between the PCL-M/C determinations and diagnoses given using a structured interview is high

Table 1 Demographic information

	Full Sample $n = 376$	Valid Only $n = 344$	PTSD and Validn = 261
Age			
M	45.1	45.1	43.4
SD	14.2	14.2	13.1
Has MST?	39 (10.4%)	35 (10.2%)	32 (12.3%)
Saw Combat?	328 (87.2%)	300 (87.2%)	230 (66.8%)
Service Era			
OEF/OIF	199 (52.9%)	182 (52.9%)	152 (58.2%)
Gulf	37 (9.8%)	36 (10.5%)	31 (11.9%)
Vietnam	76 (20.2%)	70 (20.3%)	39 (14.9%)
Other	64 (17.0%)	56 (16.3%)	39 (14.9%)
Male	347 (92.3%)	318 (92.4%)	242 (92.7%)
Ethnicity			
White	248 (66.0%)	233 (67.7%)	172 (65.9%)
African American	64 (17.0%)	56 (16.3%)	45 (17.2%)
Hispanic-Latinx	30 (8.0%)	26 (7.6%)	20 (7.7%)
Other	31 (8.3%)	26 (7.6%)	23 (8.7%)
Missing	3 (0.8%)	3 (0.9%)	1 (0.4%)

MST military sexual trauma, *OEF* Operation Enduring Freedom, *OIF* Operation Iraqi Freedom

(.93) and that estimates of internal consistency is also very high (.94).

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

A 20-item self-report measure of PTSD aligning with the fifth edition of the Diagnostic and Statistical Manual (American Psychiatric Association 2013), the PCL-5 has demonstrated strong psychometric properties in military samples (Wortman et al. 2016), including good convergent and divergent validity, strong diagnostic utility, a good internal consistent (total score $\alpha = .91$). Items on the instrument are measured on a four-point Likert-type scale (1 = *Not at all*, 2 = *A little bit*, 3 = *Moderately*, and 4 = *Quite a lot*). A total score of 33 has been recommended to differentiate those with PTSD from those without the disorder on the PCL-5 (Weathers et al. 2013).

Beck Depression Inventory-2 (BDI-2; Beck et al. 1996)

Utilizing 21-items, each scored on a four-point scale with different anchors, BDI-2 responses are summed to create a single composite score which reflects depressive overall symptomology. Items ask respondents to base their responses on the last two weeks, meaning that scores reflect proximal depressive experiences. The BDI-2 has been used extensively in clinical settings with scores indicating minimal (0–13), mild (14–19), moderate (20–28), and severe (29–63) levels of depression. It also has a high test-retest reliability (.93), as well as a strong coefficient alpha which ranges from .92 to .94 (Beck et al. 1996). Research evaluating its use within military and veteran samples have also found similar evidence of reliability and validity (Palmer et al. 2014).

Procedure and Planned Analysis

Individuals underwent a comprehensive assessment following their referral to the PCT for treatment of PTSD. The source of referral was not recorded in the database; however, veterans are referred for evaluation and treatment by other service providers in the behavioral health service line, generally following the disclosure of a traumatic or potentially traumatic event to that provider. As such, this sample is composed solely of individuals referred by mental health providers within the behavioral health service line at the VA as clients are unable to refer themselves to the PTSD Clinical Team for evaluation/treatment. Additionally, as part of the PCT intake, veterans were asked about the general nature of their trauma such that it could be described generally (e.g., combat event or sexual assault). The specifics of the traumas identified by each veteran was not coded into the database. Exact wording for this information is not available but all interviews were conducted by licensed clinical psychologists working full time on the PCT or by pre-doctoral interns under supervision by those licensed psychologists. They were instructed that they should respond to the PCL-M/C and PCL-5 while considering that trauma. In general, all types of trauma are treated within the PCT. Following computerized administration of the assessment battery, scale and subscale *T*-score values were inputted into a clinical database along with key demographic variables.

This information was then used to generate an interpretive template for a standardized assessment report that was placed into the veteran's medical chart.

Latent Profile Analyses were used to calculate five models (1-class through 6-class) using the validity, clinical, interpersonal, and treatment scales of the PAI. A 6-class model was identified as a planned maximum modeling size as it doubles the number of groups regularly identified on broadband instruments in those with trauma exposure (e.g., Miller et al. 2003; Miller et al. 2004; Rielage et al. 2010; Thomas et al. 2013; Wolf et al. 2012b) as well as the broader order dimensions of disorder presentation identified in contemporary models of pathology (Kotov et al. 2011). As such, the planned doubling provides the opportunity for not only the most frequently documented presentation groups to emerge (e.g., internalizing, externalizing, and dissociative), but also additional or alternative subtypes. A 3-class solution (internalizing, externalizing, and dissociative) was hypothesized as being most evident across these groups, consistent with research on trauma pathology in variety of broadband measures of personality (e.g., Thomas et al. 2013) and higher-order models of psychopathology (Kotov et al. 2017). It was expected that PAI scales would elevate the greatest in their associated symptom group (e.g., DEP, AXY, and SUI for internalizing; MAN, DRG, and AGG for externalizing; PAR and SCZ for dissociative).

Analyses were conducted using MPlus 8.0 (Muthén and Muthén 2017) with a maximum likelihood estimator with robust standard errors to account for any non-normality in the data, as well as 2000 model starts. A theory-driven decision approach was utilized for model interpretation (see Nylund et al. 2007). Specifically, a combination of the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Adjusted Bayesian Information Criterion (ABIC), entropy index, Adjusted Lo-Mendal-Rubin (LMR), and class scale means patterns were used to determine the best fit and profile interpretability. Significance between LPA subgroups using criterion variables were planned if a well-fitted LPA model emerged. Statistical comparisons were planned between extra-test scores on the BDI-II, PCL-M/C, PCL-5, and endorsement across trauma type (combat/sexual) using the three-step approach (Collier and Walter 2017). Significant differences between PAI scales were planned for interpretation only if there was at least a 5 *T*-point difference between means (representing clinical significance; see Rosenthal et al. 2000).

Analyses were conducted separately for each of the following groups: (i) all participants regardless of validity scale scores on the PAI, (ii) only participants with valid PAI profiles, and (iii) only participants with only a valid PAI profile and who also screened positive for PTSD on the PCL administered as part of their intake battery. Different versions of the PCL were given to participants as a result of changes in standard clinical assessment battery used on the PCT. Recommended interpretive cut-scores were utilized for the PCL to identify if a veteran was classified as PTSD-probable, indicating that they met PTSD screening criteria on a self-report inventory (i.e., 50 for the PCL-M/PCL-C and 33 for the PCL-5).

Results

In general, classes did not emerge consistent with the hypothesized subtypes or with subtypes consistent with any distinct sets of clinical pathology. While fit indices increased steadily through the addition of each potential set of classes, models became increasingly problematic and were often unable to be replicated. Increasing indications of fit seen across each proposed class solutions (e.g., values of the AIC, BIC, ABIC, etc.) are small in magnitude and likely result from the addition of indicators into the model. Likewise, profile plots of PAI scores suggest that the increasing number of latent classes generally follow the sample pattern on the various PAI scale indicators, percentage of individuals represented in each class is not consistent across models (Table 2), and models became increasingly unstable in their fit and contained no clear overall best-fitted model (see Table 3).

While the 3-class model had some indication of being the model with the best fit across two of the three sets of analyses (e.g., it was the last class model to demonstrate a significant LMR test and contained the highest entropy), other fit indices continued to decline in subsequent class models, consistent with the overall pattern described above. Thus, the fit and performance of the 3-class model does not suggest clearly differentiated classes with distinct sets of symptoms. Rather, results reflect a single, general symptom severity factor as the same response patterns emerged across each of the class structures. As such, statistical comparisons between emergent subtypes were not conducted as planned. For descriptive extra-test information and PAI means on the three-class model see Tables 3 and 4, respectively.

In short, the most parsimonious explanation for our results are that PAI endorsement patterns follow a unitary dimension of distress severity, rather than result from discrete sets of symptom subtypes in those with trauma exposure. This conclusion is strengthened by the fact that this pattern of findings occurred in all three sample sub-sets, including those classified as PTSD-probable (Table 5).

Discussion

The PAI has shown promise for use in the assessment of veterans with trauma exposure, including research demonstrated that it effectively differentiates between those with PTSD and those without (Bellet et al. 2017). However, evaluations of recognized disorder subtypes (e.g., internalizing,

Table 2 Percentage of Participants in Each Identified LPA Class

LPA Model	1	2	3	4	5	6
2-Class	50%	50%				
3-Class	28%	59%	13%			
4-Class	29%	12%	37%	22%		
5-Class	18%	37%	18%	20%	7%	
6-Class	14%	16%	16%	31%	17%	7%

Percentages displayed are drawn from the subsample with valid profiles and a PTSD-positive screen on the PCL

externalizing, and dissociative/ reality impairing) had not been conducted despite evidence of heterogeneity in veteran presentation and response (Mozley et al. 2005). Accordingly, clinicians lacked knowledge about the degree to which the PAI produces distinct profiles based on empirically based subtypes. In this study, latent profile analyses evaluated response patterns on the PAI to determine if recognized PTSD subtypes were detectable in individuals with trauma exposure who were evaluated within an outpatient PTSD treatment clinic. Results from this study suggest that there the PAI does not make meaningful subtype determinations amongst groups of trauma-exposed veterans. Instead, responses groupings appear more consistent with overall distress severity. Below, we discuss the implications of our results on the practice with, and research on, the PAI within trauma exposed veterans. Specifically, we frame our findings around the observed general elevation across PAI scales.

Table 3 Model fit for Latent Class Analyses across three sample-selection criteria

Model	AIC	BIC	ABIC	Entropy	Adj. LMR
All Cases					
1-Class	65,193.800	65,336.702	65,227.101	–	–
2-Class	63,230.706	63,493.988	63,281.414	0.917	1994.470***
3-Class	62,495.932	62,849.595	62,564.048	0.932	775.090*
4-Class	**62,221.292**	**62,665.336**	**62,306.815**	**0.909**	**318.306**
5-Class	**61,970.524**	**62,504.948**	**62,073.454**	**0.917**	**294.608**
6-Class	**61,850.547**	**62,475.351**	**61,970.884**	**0.918**	**164.769**
Valid Only					
1-Class	59,170.045	59,339.033	59,199.454	–	–
2-Class	**57,444.076**	**57,701.399**	**57,488.857**	**0.904**	**1758.876**
3-Class	**56,793.511**	**57,139.169**	**56,853.666**	**0.938**	**691.418**
4-Class	**56,552.338**	**56,986.33**	**56,627.865**	**0.911**	**285.051**
5-Class	**56,353.668**	**56,875.995**	**56,444.568**	**0.914**	**242.862**
6-Class	**56,252.032**	**56,862.694**	**56,358.305**	**0.909**	**146.545**
Valid PTSD					
1-Class	44,435.050	44,591.889	44,452.390	–	–
2-Class	43,532.894	43,771.717	53,559.299	0.888	940.804*
3-Class	43,147.936	43,468.743	43,183.405	0.918	427.617
4-Class	**42,994.54**	**43,397.331**	**43,039.073**	**0.886**	**197.85**
5-Class	**42,862.766**	**43,347.541**	**42,916.363**	**0.905**	**176.396**
6-Class	**42,788.294**	**43,355.053**	**42,850.956**	**0.908**	**119.538**

Bolded models indicate results which did not replicate due to local maxima

Research has previously found that the DEP, AXY, ARD, and SCZ scales are distinctly elevated amongst those screening positively for PTSD (Bellet et al. 2017). Despite heterogeneity in presentation profiles (Mozley et al. 2005), these scales represent content associated with internalizing (DEP, AXY), externalizing (ARD), and dissociative/reality-impairing (SCZ) symptoms. However, when person-centered analytic methods (e.g., LPA) are utilized, individuals elevate these scale scores concurrently and globally rather than as distinct subgroups. As such, core scales of the PAI associated with PTSD and trauma exposure do not appear to respond independently to their related presentation subtypes. Rather, individuals endorse symptoms on the PAI in a manner which may indicate an overall increasing level of distress; symptom endorsement in those with trauma includes concurrent elevates on scales associated with internalizing, externalizing, and dissociative traits. In short, while there may be a set of core scales that are useful in discriminating those with PTSD from those without, severity of symptom experience appears to be universal across these scales rather than them reflecting disorder subtypes.

Findings which document a general elevation of the PAI scale aligns with broad patterns and problems long observed within multi-dimensional personality assessment inventories. In general, as individuals become more distressed, they are likely to endorse an increasingly wide array of psychological problems, across diagnostic and conceptual content areas (Tellegen et al. 2003). A general elevation in distress severity across all scales, even as increasing scrutiny is placed on group membership (e.g., removing invalid responders and then those not meeting extra-test screening criteria), provides support for a measurement based first-factor problem on the PAI. Indeed, a multidimensional latent structure for general distress has previously been found on the PAI when factor analysis is conducted across item responses (Hoelzle and Meyer 2009). As such, this approach supports those findings and indicates that PAI scales are not independent from an overarching general psychopathology factor (see Caspi et al. 2014). Indeed, this may also explain why some validity scales are used as indicators of clinical distress, rather than screening for patterns of invalid responding (e.g., Bellet et al. 2017; Morey 2003). The PAI is not the only instrument which has demonstrated this first-factor problem (see Welsh 1956) as these very concerns led to revisions on the component scales of the Minnesota Multiphasic Personality Inventory (Ben-Porath 2012). As such, this finding suggests that future develop is needed to refine measured scale content as this problem in scale interpretation has not yet been addressed on the PAI.

Table 4 Extra Test Validity based on Final Class Membership in best-fitted LCA Model

Model	Final Class Count		Extra-test Mean Scores			PTSD Screen Positive	Trauma Exposure	
	#	%	BDI-2	PCL-4	PCL-5		Combat	MST
All Case								
Class 1	119	31.65%	17.5	43.4	31.6	42%	85%	8%
Class 2	57	15.10%	38.6	57.0	50.4	89%	91%	14%
Class 3	200	53.20%	46.2	70.3	62.0	91%	88%	10%
Valid only								
Class 1	108	31.40%	17.8	31.4	38.9	44%	86%	8%
Class 2	189	54.94%	31.4	62.0	51.2	91%	87%	11%
Class 3	47	13.66%	42.4	51.2	63.8	92%	92%	13%
Valid PTSD								
Class 1	72	27.59%	23.7	58.3	48.3	100%	82%	17%
Class 2	156	59.77%	33.1	64.1	58.2	100%	89%	10%
Class 3	33	12.64%	43.3	70.0	58.5	100%	100%	15%

This pattern of scale elevations has implications for the way in which the PAI can be used to classify those with trauma exposure. In general, elevations across numerous PAI scales points to the centrality of a broad array of symptoms in those with trauma exposure. Classification methods which incorporate only select bands of symptoms may exclude traits which are common across these individuals. For instance, the PAI logit function is based on an equation combing five clinical scales derived from logistic regression to predict PTSD/no-PTSD status (see Morey 1996). Presently, the formula restricts the number of included scales and results in a conceptually restrictive (e.g., that it does not measure all aspects of PTSD) approach (Morey 2003). Given that numerous scales of the PAI were elevated across LPA analyses, it is likely that

Table 5 Comparison of Mean Scores across 3 Class LCA analyses

Scale	All Sample			Valid Only			Valid PTSD		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
INC	54.5	54.2	53.8	53.0	53.5	52.2	53.7	53.7	51.2
INF	53.4	52.3	54.7	51.9	51.9	52.6	53.2	51.7	52.3
NIM	55.5	68.0	88.3	55.9	68.0	86.6	60.0	69.2	89.5
PIM	49.1	37.2	27.7	48.5	36.8	27.2	44.6	35.9	25.8
SOM	61.5	71.1	80.0	61.9	71.0	79.1	66.9	71.3	80.6
ANX	59.4	75.0	86.1	59.1	75.1	85.8	64.4	76.4	86.9
ARD	63.2	78.4	86.8	63.9	78.5	86.8	71.5	79.6	88.2
DEP	63.5	81.3	93.5	63.7	81.4	93.4	68.8	83.6	95.2
MAN	50.2	58.5	67.0	51.0	58.5	66.9	54.7	59.3	66.9
PAR	56.4	69.7	85.2	56.4	70.0	85.0	59.1	72.1	87.2
SCZ	57.4	73.0	90.6	57.4	73.2	90.0	62.0	75.4	92.7
BOR	56.7	71.4	85.5	56.9	71.5	84.8	61.8	73.0	85.2
ANT	51.8	59.0	73.9	52.0	58.5	74.0	53.4	60.0	74.7
ALC	52.3	56.7	68.4	52.4	56.5	68.5	52.7	57.6	68.5
DRG	51.5	53.6	60.5	50.7	53.4	60.4	50.6	53.6	59.8
AGG	56.1	68.1	79.7	56.4	67.7	79.6	61.4	68.6	79.8
SUI	52.8	62.6	82.4	52.6	61.8	85.4	53.3	64.7	84.9
STR	53.1	61.9	75.1	53.4	62.0	74.3	54.9	63.5	76.2
NON	56.8	66.9	77.5	56.4	67.1	77.1	57.8	68.9	78.4
RXR	46.3	36.6	31.2	45.8	36.5	30.6	43.5	35.2	31.0
DOM	51.0	51.4	50.7	51.5	51.4	51.2	53.8	51.0	50.6
WRM	41.6	31.5	26.9	41.8	31.3	26.7	39.5	30.1	25.8

the scales which exceed clinically interpretive levels are incrementally useful to predicting a PTSD diagnosis. The somatic concerns (SOM) scale provides an excellent example of this, as somatic concerns are consistently related to PTSD presentation (Gupta 2013) and that scale was one of the highest across all analyses within this study. Exclusion of significantly elevated scales from the logit function may also help explain instances that predictive capacity is lower, such as with veterans (Bellet et al. 2017). We were limited in the capacity to evaluate the addition of scales to an alternative logit function as our sample was not formally diagnosed with PTSD, despite meeting screening criteria on brief symptom inventories. Thus, future research on the PAI should explore a redefinition of the logit function as this may reduce variability in classification accuracy (e.g., Bellet et al. 2017; Mozley et al. 2005) and expand the decisional utility of the PAI during trauma evaluations.

Limitations

This study must be considered within the scope of its limitations. First, no external criteria were used to classify exaggerated symptoms, which raises questions about the degree to which invalid responders were screened from the second and third set of latent profile analyses. Given that veterans seeking treatment within the VA are consistently within a system which would encourage such responding (Ray 2017), this may have led to different groupings were such criteria used. However, diagnostic decisions based on self-report inventories and clinical interviews without the aid of such measures is a common practice within the VA. This means that response patterns observed here are likely to reflect those which providers are likely to see. Likewise, the PAI validity scales have demonstrated effectiveness in screening for invalid responding (Hawes and Boccaccini 2009). Second, it is possible that one reason the analyses did not support the established subtypes is that all veterans within the sample presented for the same set of symptom complaints (e.g., all internalizing). However, we believe this is unlikely given the size of the large sample size, the relative frequency of the different subtypes in other veteran samples (e.g., externalizing type comprises 14% of veterans; Wolf et al. 2012a, 2012b), and the tendency for scales expected on distinct subtypes to elevate together (e.g., AGG for externalizing, DEP for internalizing, and SCZ for dissociative type). Lastly, this sample utilized those with trauma exposure seeking treatment for PTSD and not individuals formally diagnosed with PTSD. As such, it is possible that subtype presentations differ in those meeting diagnostic criteria for PTSD from those with mere trauma exposure. We believe this is also unlikely to have biased the results as most participants in this study screened positive for PTSD, indicating a high level of associated distress and functional impairment. Likewise, these subtypes are regularly visible in other samples with trauma exposure.

Conclusions

In conclusion, the classes of respondents which emerge on the PAI appear to result from a tendency towards an increased general pathology and symptom severity rather than bon-e-fide differences in PTSD subtypes. As such, the observed subgroups do not appear to distinguish between the common subclasses observed in the trauma literature. This finding was contrary to the expectation that the scales of the PAI would have been sensitive to the empirically supported symptom clusters of those with trauma exposure. Having not found support for those symptom response patterns on the PAI does not quell the notion that it is a useful measure during PTSD evaluations as the PAI is a capable instrument of detecting many types of clinical concerns. Indeed, the PAI has a rather robust literature supporting its utility in PTSD evaluations (e.g., Bellet et al. 2017). However, its utility does not appear to extend across symptom subtypes common to those with trauma exposure. Accordingly, clinicians wishing to utilize a broadband measure of personality to assess those with trauma exposure may opt to use another instrument with better performance, such as the Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2-RF; Ben-Porath & Tellegen, 2008/2011). The MMPI-2-RF has not only established national norms for men and women undergoing evaluations in the VA's PCT units (Ingram et al. 2019a, 2019b, 2019c) but also strong utility in making formal PTSD determinations (Arbisi et al. 2011; Sellbom et al. 2012; Wolf et al. 2008). The scales of the MMPI-2-RF have also provided strong measurement potential for the different symptom clusters in those with trauma exposure (Sellbom & Bagby 2009), as well as identifying disorder subtypes (Rielage et al. 2010).

Compliance with Ethical Standards This study was conducted on an anonymous retrospective database and thus it was not feasible to collect consent from participants for inclusion within this study. It is assumed that consent was obtained during the provision of clinical services as this is consistent with the standards of care at Veteran Affairs where services were provided.

Conflict of Interests This research is the result of work supported with resources and the use of VA facilities where two authors of this paper are employed. **AUTHOR** receives research funding from Pearson Clinical Assessments and the University of Minnesota Press. The authors declare no other potential conflicts of interests. The views presented in this paper do not represent those of the US Government of Department of Veteran Affairs.

Data Statement The dataset utilized for this study is not publicly available, in compliance with Department of Veteran Affairs Institutional Review Board requirements.

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