The complexity of trauma exposure and response; profiling PTSD and CPTSD among a refugee sample.

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Running title: Alternate measurement models of traumatic stress

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Abstract

Objective: This study investigated the latent dimensional and categorical structure of ICD-11 Complex Posttraumatic Stress Disorder (CPTSD) within a refugee sample.

Method: A subsample that identified as refugee (n = 308) was selected from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC-II). Factor Mixture Modelling (FMM) was employed to establish the dimensional structure of CPTSD symptomology and the categorical distribution of these dimensions. It was then evaluated whether trauma history could differentiate between the distribution of trauma response profiles.

Results: A correlated six-factor model with five latent classes was the best fitting model. Two classes were characterised by symptom profiles that were consistent with ICD-11 CPTSD and PTSD formulations. The remaining classes were characterised by non-specific variation across dimensions. CPTSD class membership was predicted by traumas that were predominantly interpersonal in nature (serious neglect, physical assault and sexual assault) while PTSD class membership was predicted by situational traumatic experiences (unarmed civilian in a conflict environment and a serious accident). A distinct dose response effect was evident between cumulative traumatic exposure and CPTSD class membership.

Conclusion: FMM class profiles distinguished between PTSD and CPTSD symptom formulations. Moreover, class membership was determined by specific trauma exposure histories.

Key words: refugee; post-traumatic stress; complex posttraumatic stress; ICD-11.

To capture the greater variety of clinically relevant symptoms associated with traumatic stress, the 11th revision of the *International Classification of Diseases* (ICD-11) will introduce a diagnosis of Complex Posttraumatic Stress Disorder (CPTSD). CPTSD is conceptualised as a 'sibling disorder' of Posttraumatic Stress Disorder (PTSD) therefore the presence of PTSD is a requirement, at some point, to receive a formal CPTSD diagnosis (Maercker et al., 2013). ICD-11 PTSD consists of three, predominantly fear based, symptom clusters; re-experiencing in the here and now, avoidance and sense of threat. CPTSD is characterised by three additional symptom clusters, which reflect pervasive Disturbances in Self-Organisation (DSO); affective dysregulation, negative self-concept, and disturbances in relationships. There has however been a lack of consensus regarding the nosological status of CPTSD, revisions to the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM–5; American Psychiatric Association, 2013) did not include a CPTSD diagnosis (see Resick et al., 2012). Instead, the diagnostic criteria for DSM-5 PTSD expanded to include an additional arousal symptom that reflects reckless or self-destructive behaviours, a fourth symptom cluster labelled 'negative alternations in cognition and mood', as well as dissociative subtype specifier (American Psychiatric Association, 2013), but it is possible that this expanded symptom set may capture some similar areas of functioning as CPTSD (Friedman, 2013). ICD-11 proposals afford an opportunity to consider the key clinical characteristics of traumatic response and the context within which such responses occur.

Social withdrawal or feelings of disconnection, maladaptive emotion regulation strategies and negative self-perceptions have been found to commonly manifest following repeat or prolonged trauma (Badour & Adams, 2015; Dvir, Ford, Hill, & Frazier, 2014; Herman, 1992; Walsh, Fortier, & DiLillo, 2010). Early findings indicate that ICD-11 CPTSD is more likely to manifest following interpersonal trauma exposure and cumulative trauma exposure (i.e. number of different trauma types experienced) in a dose-response manner, with trauma occurring during formative developmental periods creating a particular vulnerability (Ben-Ezra et al., 2018; Cloitre, Garvert, Brewin, Bryant, & Maercker, 2013; Gilbar, Hyland, Cloitre, & Dekel, 2018; Hyland et al., 2017; Karatzias et al., 2017;

Shevlin et al., 2017). However, greater investigation of the key aetiological trauma history characteristics associated with ICD-11 CPTSD is warranted among culturally diverse samples.

Preliminary investigations assessing the validity of ICD-11 PTSD and CPTSD provide evidence to support a qualitative distinction between the disorders (Brewin et al., 2017). Studies that evaluate the distribution of symptoms of traumatic stress response, utilising either latent class or latent profile analysis, have identified class solutions consistent with ICD-11 diagnostic formulations for PTSD and CPTSD (Ben-Ezra et al., 2018; Cloitre et al., 2013; Cloitre, Garvert, Weiss, Carlson, & Bryant, 2014; Elklit, Hyland, & Shevlin, 2014; Karatzias et al., 2017; Kazlauskas, Gegieckaite, Hyland, Zelviene, & Cloitre, 2018; Knefel, Garvert, Cloitre, & Lueger-Schuster, 2015; Murphy, Elklit, Dokkedahl, & Shevlin, 2016; Palic et al., 2016; Perkonigg et al., 2016; Sachser, Keller, & Goldbeck, 2017). Similarly, factor analytic studies investigating the symptom structure of CPTSD consistently report a distinction between PTSD symptom clusters and DSO symptom clusters (Ben-Ezra et al., 2018; Gilbar et al., 2018; Hyland, Shevlin, Brewin et al., 2017; Hyland, Shevlin, Elkit et al., 2017; Karatzias et al., 2016; Kazlauskas et al., 2018; Knefel & Lueger-Schuster, 2013; Shevlin et al., 2017), with two viable structural representations reported; (1) a correlated six-factor first-order model which suggests that there are six first order latent factors (re-experiencing, sense of threat, avoidance, affective dysregulation, negative self-concept, disturbed relationships) and (2) a correlated two-factor second-order model, in which a second order PTSD construct accounts for the co-variance between re-experiencing, sense of threat and avoidance factors, whereas a second order DSO construct accounts for the co-variance between affective dysregulation, negative self-concept and disturbed relationship factors.

The latent class and factor analytic techniques employed to assess the validity of CPTSD assume alternate hypotheses concerning the conceptualization of psychopathology. Latent class techniques presuppose a categorical structure, homogenous groups of individuals (i.e. classes) can be identified by particular sets of symptoms, these classes are sufficiently distinct such that having one set of symptoms does not predict the likelihood of having another. In theory, should distinct classes be characterised by different etiology, course and prognoses, this would suggest that in the diagnostic taxonomy, these classes would be accounted for by separate diagnoses (Wolf et al., 2015). However,

latent class techniques are limited in that they do not account for the relationships between observed items, the association between items is solely explained by the latent class variable. In contrast, factor analytic techniques presuppose a dimensional structure, such that a common factor influences the co-occurrence of symptoms. Symptoms accounted for by this dimensional factor are considered manifestations of the same phenomenon, there is no assumption of different sub-groups instead differences in the population arise because of differences on the factor level i.e. such as psychopathological severity. Factor Mixture Modelling (FMM) is a more robust technique which involves a mixture of latent class analysis and factor analysis therefore allows the structure of a phenomena to be simultaneously categorical and dimensional (Clark et al., 2013). FMM enables individuals to be differentiated by class but the underlying dimensional structure of a phenomena (i.e. such as severity of a latent trait) is enabled to influence the calculation of class composition (Clark et al., 2013).

Only one study to date has evaluated the associations between ICD-11 trauma symptomology using Factor Mixture Modelling (FMM). Wolf et al. (2015), employed FMM in a U.S. based adult population sample and a veteran sample. In both samples, the best fitting solution comprised of two latent dimensional constructs (PTSD and DSO dimensions) and four classes. In contrast to ICD-11 proposals, the classes differed as a function of symptom severity rather than symptom profile, meaning that groups of individuals were distinguishable in relation to their severity of symptom endorsement (e.g. low, moderate, high) and not in relation to the pattern of their PTSD/DSO symptom responses. Notably, as other competing dimensional models were not tested the findings of this study are somewhat limited and should be interpreted with caution. It was suggested that the findings from existing latent class analysis and latent profile analysis studies, which evidenced that PTSD and CPTSD represented distinct diagnostic entities, may be untrustworthy as the techniques employed fail to acknowledge the underlying dimensionality of CPTSD (Wolf et al., 2015). To more rigorously evaluate the validity of CPTSD, increased investigation is warranted utilising FMM.

A limited amount of research has investigated the validity of ICD-11 CPTSD amongst refugee samples despite representing one of the most severely trauma-exposed populations (Bogic, Njoku, & Priebe, 2015; Porter & Haslam, 2005; Slewa-Younan, Guajardo, Heriseanu, & Hasan,

2015). The refugee experience is typically characterised by an array of single or multiple traumatic experiences (e.g. exposure to war, violence, sexual assault, persecution), further accompanied by displacement to unfamiliar, unstable and often unsafe environments (Porter & Haslam, 2005). An initial latent class analysis study conducted amongst Syrian refugees resettled in Lebanon supports the discriminant validity of PTSD and CPTSD (Hyland et al., In Press). However, among refugee samples, factor analytic studies present with contradictory findings concerning the dimensional structure of CPTSD with evidence found for; (i) the two-factor second-order model in which symptom clusters are subsumed under PTSD and DSO second-order factors (Nickerson et al., 2016), (ii) the correlated six-factor first-order model (Tay, Rees, Chen, Kareth, & Silove, 2015) and (iii) a unitary second-order model in which all symptoms PTSD and DSO symptoms load onto one second-order CPTSD latent factor (Silove, Tay, Kareth, & Rees, 2017). A simultaneous examination of the symptom structure and class structure of CPTSD using FMM has yet to be attempted within a refugee sample.

The Present Study

In this study, FMM was utilised to derive the most accurate dimensional representation and class composition of trauma response symptomology among a refugee sample from a U.S. general population survey. In line with ICD-11 proposals, we predicted that the best fitting solution would represent an underlying dimensional structure that captures the distinction between PTSD and DSO symptoms. Further, unique classes would be identified consistent with ICD-11 symptom profiles (i.e. PTSD and CPTSD). Lastly, an investigation of the etiological risk-factors associated with CPTSD was conducted; interpersonal and cumulative trauma were predicted to increase the likelihood of endorsing a complex symptom profile.

Methods

Participants and Procedures

Data was drawn from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC-II). NESARC is a nationally representative survey conducted from 2001–2002 (Hasin & Grant, 2015), the target population of which was civilians non-institutionalized adults (≥ 18 years)

living in the United States. NESARC focuses on the prevalence, course, and risk factors for psychiatric disorders, as well as alcohol and drug use disorders. Respondents included those living in private households, boarding or rooming houses, shelters, non-transient motels and hotels, college quarters, group homes, and military personnel living off base (Grant & Dawson, 2006). One adult was randomly selected from each dwelling, prospective respondents were informed in writing about the nature of the study, intended use of data, and the confidentiality procedures (Grant et al., 2006). Face-to-face computer assisted interviews were conducted by trained ay persons (Grant et al., 2006). Detailed descriptions of the survey design, and data collection processes are available in detail elsewhere (Grant & Dawson, 2006; Grant et al., 2003). NESARC Wave II involved interviews with 34,653 of the original Wave I participants (70.2% response rate) – this data was weighted to reflect the original design characteristics (Hasin & Grant, 2015). Individuals that endorsed refugee status were selected from Wave II ($N = 428$). As it was necessary to model ICD-11 PTSD and CPTSD, individuals with missing data across all PTSD items were excluded ($n = 120$). This resulted in a final sample size of $n = 308$.

The mean age was 50.94 years (SD = 17.07); 21 – 45 years (43.8%), 46 – 65 years (32.1%), 66 – 90 years (24%). There were slightly more males (51.3%) than females. Overall, 46.8% reported endorsing refugee status for greater than two years. The mean age at which refugee status was reported was 24.02 years (SD = 15.20) with a median of 22 years; 41.6% reported refugee status before or at 18 years. Participants were from over 38 different countries of origin or descent; European (23%), Asian (22.6%), South American (44.6%), African (4.6%), North American (i.e. African American, American Indian and Chicano, 4.3%) and Other (1%). No formal schooling was reported by 2.3%. Information on household income was also obtained; ≤ $24,999 (34.4%), ≥ $25,000 - $79,999 (48.4%), ≥ $80,000- $200,000 (17.2%).

Measures

ICD-11 PTSD and CPTSD. As NESARC-II was conducted prior to the ICD-11 proposals, symptom items for the current analyses were derived from two separate measures contained in the Alcohol Use Disorder and Associated Disabilities Interview Schedule-DSM-IV Version (AUDADIS-IV), the measures selected from the AUDADIS-IV have demonstrated high test re-test reliability in

general population samples (Grant et al., 2003; Ruan et al., 2008). Participants were instructed to select an index trauma when responding to items from this scale, and symptoms were scored as either "Yes/presence" (= 1) or "No/absence" (= 0). Specific items were selected from the PTSD scale to model ICD-11 PTSD symptom clusters and two of the DSO symptoms clusters (affect dysregulation and disturbances in relationships) (see Table 1). Two items from the 'low mood' scale were selected to represent the DSO symptom cluster Negative Self-Concept (NSC) (see Table 1). Items were coded "Yes/presence" (= 1) or "No/absence" (= 0). Both NSC items were preceded by a low mood screener, also scored "Yes/presence" (= 1) or "No/absence" (= 0): ''Since your last interview, have you ever had a time when you felt sad, blue, depressed or down most of the time for at least 2 weeks?'' and ''Since your last interview, have you ever had a time, lasting at least 2 weeks, when you didn't care about the things that you usually cared about, or when you didn't enjoy the things you usually enjoyed?''. Those who responded "No" could not respond to the NSC items. These individuals were therefore coded '0' for these items.

Traumatic Exposure. Individuals were asked if they had experienced being an unarmed civilian during war/revolution/military coup, exposure to a natural disaster, serious accident, physical assault, sexual assault, or serious neglect. Responses were scored as "Yes" (= 1) or "No" (= 0).

Analysis

Diagnostic rates. ICD-11 PTSD and CPTSD were estimated based on the established ICD-11 diagnostic guidelines (Maercker et al., 2013). A diagnosis of PTSD requires that a person endorses one of two symptoms from the re-experiencing, avoidance, and sense of threat clusters. A diagnosis of CPTSD requires that a person screens positive for PTSD and also endorses one of two symptoms from the affective dysregulation, negative self-concept, and disturbed relationships clusters. Importantly, the ICD-11 taxonomic structure only permits a diagnosis of either PTSD or CPTSD, but not both. Therefore, if an individual screens positive for a diagnosis of CPTSD that person does not qualify for a diagnosis of PTSD. Diagnosis of ICD-11 PTSD and CPTSD also requires the presence of functional impairment to be associated with the symptoms however this criterion could not be assessed based on the AUDADIS-IV data that is contained in the NESARC-II. Consequently, diagnostic rates were based solely on symptom endorsement criteria. Sex differences across

diagnoses, trauma exposure, cumulative trauma, and trauma symptomology were compared using the person chi-square test (χ^2).

[Insert Table 1 Here]

Factor Mixture Modelling. FMMs are advanced latent variable models that combine Confirmatory Factor Analysis (CFA) with Latent Class Analysis (LCA). CFA assumes that the interrelationships between a set of variables (individual, observable posttraumatic stress symptoms in this case) can be modelled to identify the optimal number of dimensions (latent unobservable 'clusters' of PTSD/CPTSD symptoms) which underlie a given phenomenon; a method which views traumatic response as a continuous latent variable. LCA on the other hand assigns subjects to classes (i.e. groups) based on their item endorsement patterns; this method conversely views traumatic response as categorical. Using FMM, two latent variables can be estimated and observed simultaneously, (i) a continuous latent dimensional variable (factor(s)) and (ii) a categorical latent class variable (Clark et al., 2013; Lubke & Muthén, 2005). This technique allows the factor structure from CFA to influence the class structure generated by LCA therefore enabling the identification of distinct groups of people in a sample/population, characterised by similar (dimensionally structured) item (e.g. symptom) endorsement patterns (Clark et al., 2013; Lubke & Muthén, 2005).

In this study, a series of CFA models that represented competing formulations of ICD-11 CPTSD were first tested to determine the optimal number of factors that represented the refugee trauma response data (see Figure 1). Model 1 represented a uni-dimensional model in which all symptoms loaded onto a single latent PTSD factor. Model 2 tested a correlated six-factor first-order model (re-experiencing, avoidance, sense of threat, affective dysregulation, disturbances in relationships, negative self-concept). Model 3, replaced the correlations between the six first-order factors with a single second order factor reflecting CPTSD. Model 4 tested a two correlated second-order factor model; a higher order PTSD construct accounted for the co-variance between re-experiencing, sense of threat and avoidance factors, whereas a higher order DSO construct accounted for the co-variance between the first order affective dysregulation, negative self-concept and disturbed relationships factors. Notably, Model 2 and 4 are the most theoretically consistent with ICD-11 proposals. Model 5 tested a hierarchical relationship between DSO items only, whereas

conversely, Model 6 tested a hierarchical structure for PTSD items only. Model 7 tested a correlated first-order factor model, in which PTSD items loaded onto a first order PSTD factor, and DSO items loaded onto a first order DSO factor.

Due to the categorical nature of the data, models were specified and tested using Mplus 7.1 (Muthén & Muthén) with weighted least squares means and variance adjusted estimation [WLSMV (Beauducel & Herzberg, 2006)]. Goodness of fit was assessed for each CFA model using χ^2, the Comparative Fit Index (CFI), the Tucker-Lewis index [(TLI) (Bentler, 1990; Tucker & Lewis, 1973)] and the root mean square error of approximation (RMSEA). RMSEA < 0.05 (Steiger, 1990), CFI and TLI > 0.90, and a non-significant χ^2 reflected acceptable model fit. To differentiate between the best fitting CFA models AIC and BIC values were calculated.

Following this, a series of FMMs were specified (i.e. a two-class FMM model through to a six-class FMM model). To determine the best fitting model, the Lo-Mendell-Rubin adjusted likelihood ratio test was used. For this test, a non-significant value ($p > .05$) suggests that the solution with one less class should be selected (Lo, Mendell, & Rubin, 2001). The Akaike Information Criterion [AIC (Akaike, 1987)], the Bayesian Information Criterion [BIC, (Schwarz, 1978)], and the sample size adjusted Bayesian information Criterion [ssaBIC (Sclove, 1987)] were also used to determine the optimal class solution. For these tests the model with the lowest values is regarded as the best fitting solution (Lubke & Neale, 2006).

[Insert Figure 1 Here]

Testing differential predictors of class membership. Two separate multinomial logistic regression analyses were conducted. In the first analysis, specific trauma types were investigated as predictors of FMM class membership (six trauma exposure variables were entered as factors). The trauma types were summed to create a cumulative trauma exposure variable. In the second analysis, the cumulative trauma variable was entered as a factor to test for a dose response effect between cumulative trauma exposure and class membership. In both analyses sex was also included as a factor (Males = 1, Females = 0), and socio-demographic variables were included as covariates; age, origin, education, income, duration of refugee status (weeks), age of refugee status acquisition.

Results

Descriptive statistics

PTSD and DSO item response frequencies are presented in Table 1. Female endorsement of all trauma response items was significantly higher than male endorsement. A small proportion of the sample reported exposure to four trauma types (3.9%), while 70.8% reported exposure to at least one trauma. The number of different traumas experienced did not significantly differ by sex. Being an unarmed civilian during war/revolution/military coup was the most frequently endorsed trauma type (43.8%), followed by exposure to a natural disaster (30.8%), serious accident (21.8%), physical assault (11.4%), sexual assault (9.8%) and serious neglect (5.9%). Sexual assault was the only trauma that differed by sex, χ^2 (1, N = 308) = 16.29, p < .001; females (16.9%) were significantly more likely to report sexual assault than males (3.2%). Overall, 25.9% of the sample received a PTSD or CPTSD diagnosis; 20.9% screened positive for PTSD and 4.9% for CPTSD. There were no sex differences for the PTSD diagnosis, whereas CPTSD diagnosis significantly differed by sex χ^2 (1, N = 308) = 3.88, p = .049; females (7.4%) were more likely to receive a CPTSD diagnosis compared to males (2.5%).

[Insert Table 2 Here]

CFA and FMM Models

All CFA models demonstrated acceptable model fit according to the CFI and TLI criteria but only Models 2–5 met the RMSEA criterion for acceptable fit (see Table 2). Though Models 3, 4 and 5 were a good fit to the data, Model 2 had the lowest AIC value and the highest TLI value. Model 2 was also theoretically consistent with the ICD-11 proposals and captures the distinction between PTSD and DSO symptoms at the first order factor level. Model 2 therefore, which specified a correlated six-factor structure comprising the dimensions of re-experiencing, avoidance, sense of threat, affective dysregulation, disturbances in relationships and negative self-concept was selected as the most accurate dimensional representation of the refugee trauma response data.

FMM results are presented in Table 2. While the AIC and ssaBIC were both lower for the 6-class solution, and the Lo-Mendell-Rubin statistic indicated that the 3-class solution was not significantly better than the 2-class solution, the BIC was lowest for the five-class solution. The entropy value for the 5-class model was 0.85 and indicated acceptable classification of participants.

While the decision was not clear-cut the performance of the BIC has been shown to reliably identify optimal class solution (Masyn, 2013). Moreover, the latent class profiles in the 5-class model reflected the proposed diagnostic and dimensional structures of PTSD, CPTSD/DSO. The 5-class model was therefore selected as the best fitting solution. The profile plot illustrates the trauma symptom profiles of the five classes, as influenced by the six first-order dimensions identified by the CFA results (see Figure 2). Class 1 was characterised by a high probability of endorsing all PTSD items, and a high probability of endorsing four of the six DSO items. This class was labelled the 'CPTSD class'. Class 2 was characterised by a high probability of endorsing all PTSD items and a low probability of endorsing all DSO items apart from "becoming easily upset" which was highly endorsed. This class was labelled the 'PTSD class'. Class 3 was identified by moderate-to-high probabilities of endorsing each of the PTSD items, high probabilities of endorsing the negative self-concept items, and low probabilities of endorsing the other DSO items. This class was labelled the 'PTSD low mood class'. Class 4 was characterised by low endorsement across all PTSD and DSO items, and therefore labelled the 'low symptom class'. Class 5 was distinguished by moderate probabilities of endorsing three PTSD items and one DSO item ("becoming easily upset"). This class was labelled the 'sub-threshold PTSD class'.

[Insert Figure 2 Here]

Associations between traumatic exposure and class membership

The results of the first multinomial logistic regression analysis are presented in Table 3. For all analyses, the low symptom class was utilised as the reference class. The model was significant χ^2 (52, 308) = 156.24, $p < .001$. CPTSD class membership was significantly predicted by physical abuse (OR = 7.42), neglect (OR = 15.02), sexual assault (OR = 7.60), female sex (OR = 10.49) and a serious accident (OR = 3.53). PTSD class membership was significantly predicted by reporting the experience of being an unarmed civilian during war/revolution/military coup (OR = 3.67), physical abuse (OR = 2.92) and a serious accident (OR = 3.09). Sub-threshold PTSD class membership was significantly predicted by experiencing a serious accident (OR = 3.81) and female sex (OR = 2.26). PTSD low mood class membership was also predicted by female sex (OR = 7.22).

Results of the second multinomial regression analysis (dose response test) are also presented in Table 3. The model as a whole was significant χ^2 (44, 308) = 140.79, $p < .001$. Compared to no trauma exposure, increasing exposure from two through to four traumas significantly increased the likelihood of CPTSD class membership (ORs = 5.81, 19.93, & 29.62 respectively). No clear dose-response effects were observed for any other class (see Table 3).

[Insert Table 3 Here]

Discussion

The aim of this study was to test the latent dimensional and categorical structure of ICD-11 CPTSD utilising a Factor Mixture Modelling (FMM) technique within a refugee sample. The best fitting solution included six first-order factors and five latent classes; a set of results that was consistent with the factorial representation of ICD-11 CPTSD symptomatology, and the discriminant validity of PTSD and CPTSD as distinct constructs. Furthermore, theoretically consistent associations were observed between trauma history and class membership with interpersonal and cumulative trauma significantly increasing the risk of CPTSD class membership, in a manner consistent with a dose response relationship.

The confirmatory factor analysis results were supportive of the ICD-11 proposals of a distinction between PTSD and DSO symptomology. Models 2 and 4 which demarcated the PTSD and DSO symptoms at a first- and second-order level, respectively, provided similarly excellent fit to the sample data. These findings were consistent with several earlier studies which have utilized archival data to model the CPTSD symptoms (Hyland, Shevlin, Elkit et al., 2017; Knefel & Lueger-Schuster, 2013; Shevlin et al., 2017) and those which have used diagnostic-specific measures of CPTSD (Ben-Ezra et al., 2018; Gilbar et al., 2018; Hyland, Shevlin, Brewin et al., 2017; Karatzias et al., 2016; Kazlauskas et al., 2018). Similar support is found for these dimensional models within highly traumatised refugee samples resettled in both high and low income settings (Nickerson et al., 2016; Tay et al., 2015).

The identification of distinct PTSD and CPTSD classes within the best fitting FMM solution corresponded to findings from numerous latent class analysis and latent profile analysis studies conducted with refugee and non-refugee samples (Ben-Ezra et al., 2018; Cloitre et al., 2013; Cloitre et

al., 2014; Elklit et al., 2014; Hyland et al., In Press; Karatzias et al., 2017; Kazlauskas et al., 2018; Knefel et al., 2015; Murphy et al., 2016; Palic et al., 2016; Perkonigg et al., 2016; Sachser et al., 2017). The PTSD class was characterised by a high probability of endorsing each of the PTSD items and an additional affective dysregulation item relating to becoming easily upset. It is very likely that individuals who have a high probability of endorsing symptoms that reflect 'a persistent sense of threat' (being easily startled and being watchful or 'on guard') would also display symptoms of hyperactivity of emotional regulatory functions. The CPTSD class demonstrated a high probability of endorsing all PTSD and DSO items except for the negative self-concept items. The low probabilities of endorsing the negative self-concept items was likely the result of the use of a preceding screener. Alternatively, cultural variation in the sample may have implicated the expression of trauma response (Hinton & Lewis-Fernandez, 2011). Further investigation necessary to evaluate CPTSD symptoms utilizing standardized validated measures among groups from diverse cultural backgrounds.

The current FMM results stand in contradiction to the findings of Wolf et al. (2015), who conducted the only other FMM study to assess the structure of CPTSD symptomatology. Wolf and colleagues identified a dimensional model that represented PTSD and DSO symptoms, but their proposed class solution did not identify unique classes of individuals whose symptom profiles distinguished between PTSD and CPTSD. They argued that existing findings from latent class and latent profile analysis studies, which yielded such distinct classes, were untrustworthy as these models failed to acknowledge the underlying symptom dimensionality. Utilising the same methodological procedures, current results provide support for the ICD-11 proposals to regard CPTSD as a distinct clinical construct. Clearly, given the unique nature of this sample, and the fact that the current study represents only the second attempt to investigate the symptom structure of CPTSD using FMM, conclusions drawn from these results should be tentative. Nonetheless, the current findings add to a large and growing literature which supports the discriminant validity of CPTSD. Continued conversation is warranted to carefully assess classifications of traumatic stress as outlined in the ICD-11 and DSM-5; this would require the identification of priorities regarding the purpose of disease classification including scientific advance, resource allocation and clinical utility (Cloitre et al., 2013).

Cumulative and interpersonal trauma emerged as key predictors of a complex symptom profile, consistent with theory and recent research concerning complex traumatic responses (Cloitre et al., 2013; Herman, 1992; Hyland, Murphy et al., 2017; Van der Kolk, Roth, Pelcovitz, Sunday, & Spinazzola, 2005). Increasing cumulative trauma exposure increased the likelihood of CPTSD class membership in a distinct dose-response manner. Physical assault, sexual assault and serious neglect significantly predicted CPTSD class membership. Having been an unarmed civilian in a conflict environment was a significant predictor of PTSD class membership, however this finding could be expected to vary across future studies as such an experience may be accompanied by other traumatic events that were not evaluated such as prolonged persecution, torture, and witnessing murder (Bogic et al., 2015; Porter & Haslam, 2005; Slewa-Younan et al., 2015). A serious accident slightly increased the risk of endorsing several trauma symptom profiles. Compared to interpersonal trauma, where there is a clear intent to cause harm, the nature of a serious accident and the resulting cognitive interpretation may greatly vary influencing divergent traumatic responses (Ehlers & Clark, 2000).

Overall, 25.9% of the sample received a PTSD or CPTSD diagnosis. The prevalence of CPTSD (4.9%) was substantially lower than PTSD (20.9%), and this was due to the very low endorsement rates for the Negative Self-Concept cluster. Even so, the prevalence of CPTSD in this refugee sample was higher than estimates reported in community or more nationally representative samples, which range from 0.6% to 1.0% (Hyland, Murphy, et al., 2017; Wolf et al., 2015). In comparison to other refugee samples, the rate of CPTSD was higher than that reported among West Papuan refugees (3%) (Silove et al., 2017; Tay et al., 2015) but lower compared to rates reported among treatment seeking refugees resettled in Switzerland (32.8%) (Nickerson et al., 2016). It should be noted that the calculation of probable diagnostic rates in the current study did not include criteria for functional impairment which would make it difficult to compare diagnostic rates across studies. Females were more likely than males to receive a CPTSD diagnosis, a finding consistent with several other studies of CPTSD (Hyland, Murphy, et al., 2017; Perkonigg et al., 2016). When sex was treated as a predictor of traumatic response profile, females were (i) ten times more likely to be in the CPTSD class, (ii) seven times more likely to be in the PTSD low mood class, and (iii) two times more likely to be in the sub-threshold class. These results demonstrate that female refugees now residing in the

U.S. are substantially more likely than their male counterparts to experience trauma-related psychological distress.

Current findings were associated with several limitations that should be taken into consideration. First, the utilisation of archival data to model symptoms from scales not specifically designed to assess ICD-11 CPTSD was not ideal. Specifically, while the low mood indicators used as approximations of NSC symptoms were clearly consistent with DSO symptom content (i.e. both items captured worthlessness and guilt respectively) they were also anchored to primary depression screeners therefore it is possible that endorsement of these items may have been restricted. It is important to note however that the item selection strategy adopted in the current study was consistent with the majority of preliminary investigations evaluating the validity of ICD-11 CPTSD (see Brewin et al., 2017). Replication of these methods using a diagnostic specific measure of CPTSD symptoms however is recommended. Second, it was not possible to capture the developmental timing of one's traumatic exposure. Early childhood trauma is highly predictive of symptom complexity (Cloitre et al., 2013; Van der Kolk et al., 2005), and it is unclear whether highly noxious traumas encountered by refugees during adulthood can influence the development of CPTSD in the absence of child maltreatment. Fourth, cumulative trauma was calculated as the number of different trauma types experienced rather than the frequency of individual trauma types. It may be the case that the frequency of a specific trauma type differently relates to trauma response, for example, an increasing number of sexual abuse acts experienced in childhood has been found to be associated with PTSD symptom clusters as opposed to the core CPTSD symptom clusters (Hyland, Shevlin, Murphy et al., 2017). Finally, limited information was available pertaining to the refugee experience, preventing a fine-grained analysis of this experience as a predictor of trauma symptomology.

The findings of this study support the ICD-11 proposals for PTSD and CPTSD using a novel analytical technique, amongst a unique group of trauma-exposed people. The distinction between PTSD and CPTSD was identified at a both a dimensional and class level. Additionally, traumatic history was found to be a highly robust predictor of CPTSD class membership. Considerable evidence supports the validity of CPTSD as a unique diagnostic entity, yet there exists limited information regarding the specific contexts within which such responses are most likely to emerge. While an

increased number of traumatic exposures during the course of one's life appears to increase the likelihood of CPTSD, it does not guarantee such a response, additional investigation is therefore warranted to determine other aetiological factors that can influence the development of CPTSD.

Declaration of interest

None.

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Table 1
Frequency of endorsing PTSD and DSO items

	Cluster	Symptoms	Male *n* = 158 *% (n)*	Female *n* = 150 *% (n)*	χ^2
PTSD	RE 1	Have unpleasant or bad dreams about it?	33.5 (53)	48.0 (71)	6.6*
	RE 2	Feel that you were reliving (that/that worst) event or that it was happening all over again?	27.8 (44)	45.9 (68)	10.78*
	AV 1	Try to stop thinking about or feeling anything about (that/that worst) event?	45.2 (71)	57.3 (86)	4.5*
	AV 2	Stay away from going places/doing things/seeing people that might bring back memories of the event?	17.2 (27)	32 (48)	9.1*
	SOT 1	Find yourself being more watchful or alert even though there was no real need to be?	30.6 (48)	42.3 (63)	4.53*
	SOT 2	Find that you were more jumpy or easily startled by ordinary noises?	14.6 (23)	27.5 (41)	7.62*
DSO	AD 1	Get very upset when you were reminded of (that/that worst) event?	34.4 (54)	53.0 (79)	10.79*
	AD 2	Find yourself getting angry or irritable more often than usual?	14.6 (23)	26.0 (39)	6.13*
	DR 1	Feel emotionally distant from other people, or cut off from others?	13.5 (21)	32.7 (49)	15.99*
	DR 2	Feel as though you couldn't feel positive or loving towards other people like you used to?	9.7 (15)	23.3 (35)	10.37*
	NSC 2	Feel worthless nearly all the time for at least 2 weeks?	3.2 (5)	13.3 (20)	10.7*
	NSC 2	Feel guilty about things you normally wouldn't feel guilty about, most of the time for at least 2 weeks?	1.9 (3)	11.4 (17)	11.39*

Note. χ^2 = Chi square statistic; Degrees of Freedom = 1; RE = re-experiencing; AV = avoidance; SOT = sense of threat; AD = affect dysregulation; DR = disturbances in relationships; NSC = negative self-concept

*$p < 0.05$.

Table 2
Fit statistics for CFA and FMM analyses

Model	X^2 (*df*)	RMSEA (90% CI)	CFI	TLI	AIC	BIC	ssaBIC	LRT (*p*)	Entropy
CFA 1	125.02 (54)*	0.065 (0.05 - 0.08)	.968	.960	2865	2999			
CFA 2	**32.56 (39)**	**0.000 (0.000 - 0.029)**	**1.000**	**1.005**	**2572**	**2762**			
CFA 3	44.87 (48)	0.000 (0.000 - 0.033)	1.000	1.002	2586	2743			
CFA 4	41.76 (47)	0.000 (0.000 - 0.030)	1.000	1.003	2585	2746			
CFA 5	48.43 (50)	0.000 (0.000 - 0.035)	1.000	1.001	2616	2765			
CFA 6	100.36 (50)*	0.057 (0.041 - 0.073)	0.977	0.970	2811	2960			
CFA 7	105.67 (53)*	0.057 (0.041 - 0.073)	0.976	0.970	3201	3331			
FMM 2					3220	3313	3234	649 (*p*=0.00)	0.889
FMM 3					3131	3251	3149	100 (*p*=0.49)	0.797
FMM 4					3086	3231	3108	140 (*p*=0.24)	0.857
FMM 5					**3054**	**3226**	**3080**	**283 (*p*=0.44)**	**0.846**
FMM 6					3041	3239	3071	122 (*p*=0.27)	0.846

Note. X^2= Chi-Square Statistics; *df* = degrees of freedom; RMSEA = Root Mean Square of Error Approximation; CFI = Comparative Fit Index; TLI = Tucker- Lewis Index; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; ssaBIC = sample size adjusted Bayesian Information Criterion; LRT = Lo-Mendell-Rubin adjusted likelihood ratio test. Best fitting CFA model and FMM solution in **bold**.

* $p < 0.001$.

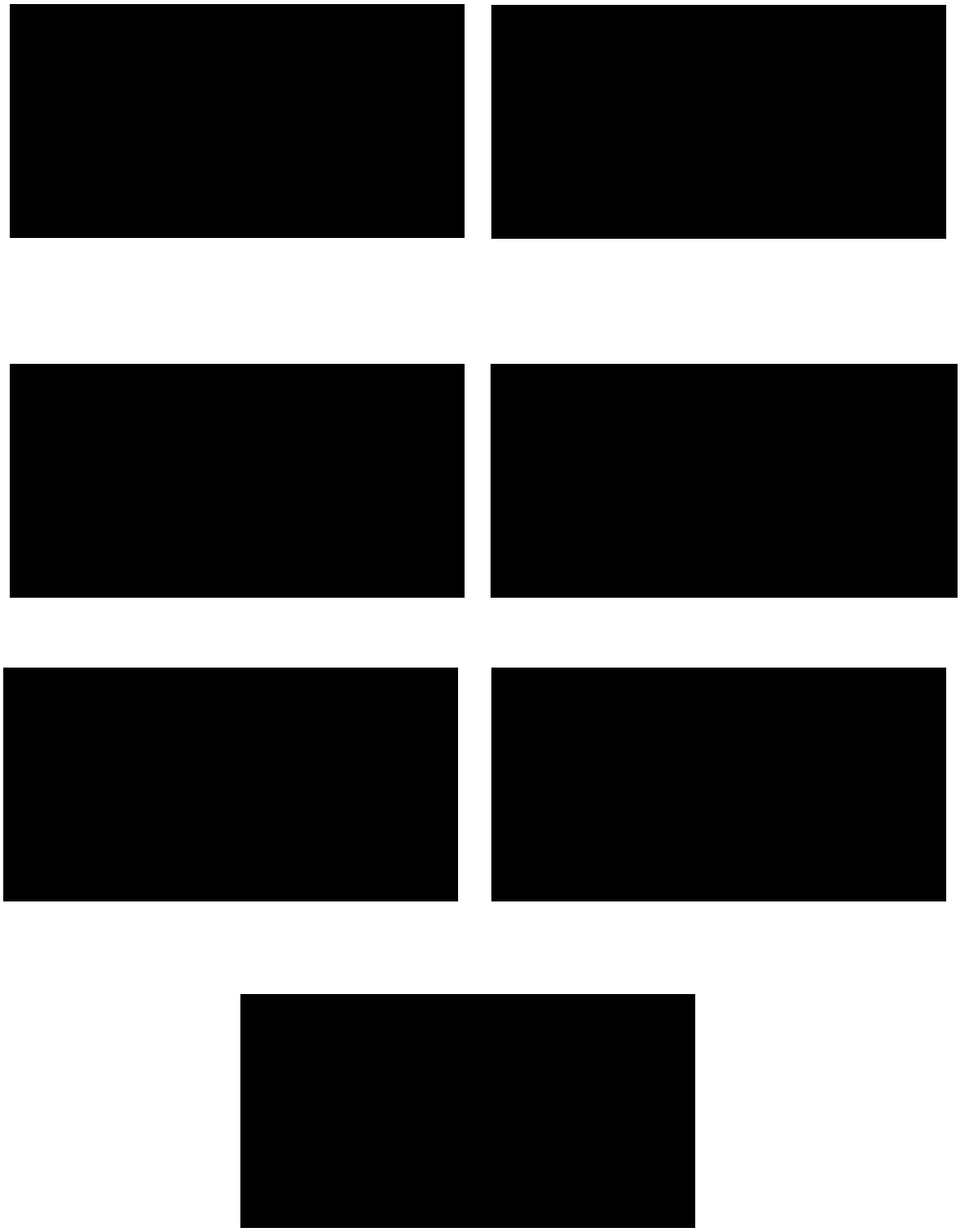

Figure 1. Alternative models of the latent dimensional structure of Complex PTSD symptoms.

Note. RE = re-experiencing; AV = avoidance; SOT = sense of threat; AD = affect dysregulation; DR = disturbances in relationships; NSC = negative self-concept.

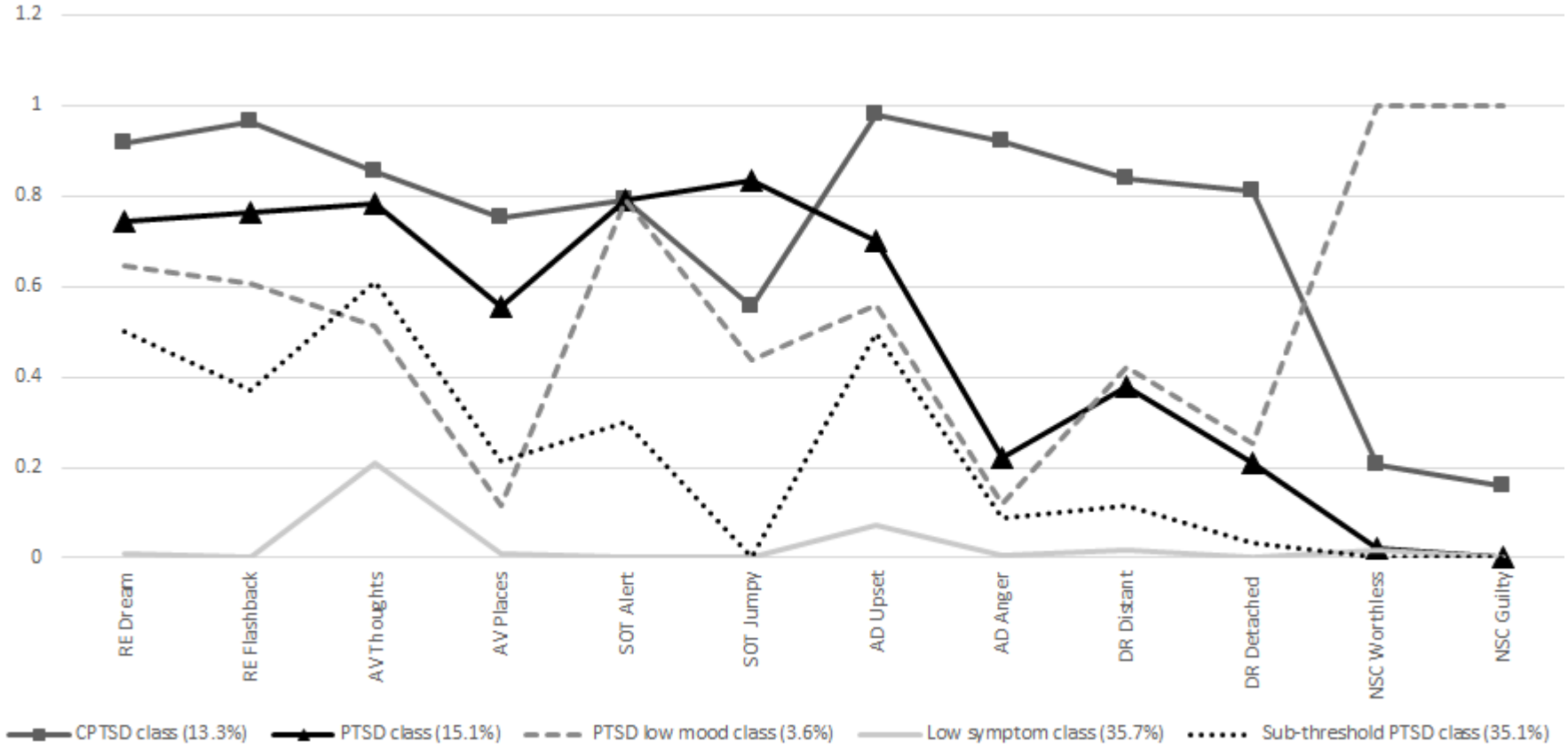

Figure 2. Profile Plot for Factor Mixture Model, best fitting five class solution.

Note. RE = re-experiencing; AV = avoidance; SOT = sense of threat; AD = affect dysregulation; DR = disturbances in relationships; NSC = negative self-concept.

Table 3
Multinomial logistic regression odds ratios between traumatic exposure and class membership

Trauma Type	PTSD OR (95% CI)	CPTSD OR (95% CI)	Sub-threshold PTSD OR (95% CI)	PTSD low mood OR (95% CI)
Serious Neglect	4.60 (0.33 – 63.55)	**15.02 (1.28 – 175.77)**	4.48 (0.40 – 50.85)	9.29 (0.36 – 243.20)
Physical assault	2.92 (0.76– 11.24)	**7.42 (1.91 – 28.85)**	1.87 (0.57 – 6.05)	1.84 (0.14 – 24.44)
Unarmed civilian	**3.67 (1.52 – 8.81)**	1.87 (0.76 – 4.61)	1.83 (0.95 – 3.52)	2.16 (0.51 – 9.10)
Serious accident	**3.09 (1.01 – 9.46)**	**3.53 (1.09 – 11.32)**	**3.81 (1.54 – 9.37)**	3.13 (0.46 – 21.94)
Sexual assault	3.74 (0.50 – 27.91)	**7.60 (1.152 – 50.10)**	1.83 (0.27 – 12.45)	7.15 (0.50 –102.52)
Natural disaster	0.50 (0.20 – 1.29)	0.32 (0.142 – 1.09)	0.57 (0.29 – 1.13)	0.48 (0.90 – 2.34)
Sex (female)	2.35 (0.96 – 5.80)	**10.49 (3.68 – 29.92)**	**2.26 (1.51 – 4.45)**	**7.22 (1.20 – 43.30)**
One trauma	1.74 (0.55 – 5.47)	0.71 (0.22 – 2.26)	**0.48 (0.23 - 0.99)**	0.50 (0.09 – 2.61)
Two trauma	**5.88 (1.62 – 21.31)**	**5.81 (1.77 – 19.22)**	1.84 (0.74 – 4.53)	1.14 (0.98 – 13.33)
Three trauma	**18.17 (2.63- 125.48)**	**19.93 (3.16 – 125.45)**	**6.68 (1.33 – 33.61)**	**22.55 (1.74 – 291.67)**
Four trauma	8.05 (0.40 – 161.79)	**29.62 (2.61 – 336.12)**	4.22 (0.36 – 48.95)	8.26 (0.37 – 185.18)

Note. OR (95% CI) = Odds Ratio with 95% confidence interval; Significant effects in **bold** ($p < 0.05$); Corrected for; age, age when first endorsed refugee status, number of weeks spent as refugee, income status and education.

* Low symptom class set as the reference category.

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