Does highly symptomatic class membership in the acute phase predict highly symptomatic classification in victims 6 months after traumatic exposure?

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ABSTRACT

Recently studies have indicated the existence of both posttraumatic stress disorder (PTSD) and acute stress disorder (ASD) subtypes but no studies have investigated their mutual association. Although ASD may not be a precursor of PTSD per se, there are potential benefits associated with early identification of victims at risk of developing PTSD subtypes. The present study investigates ASD and PTSD subtypes using latent class analysis (LCA) following bank robbery ($N = 371$). Moreover, we assessed if highly symptomatic ASD and selected risk factors increased the probability of highly symptomatic PTSD. The results of LCA revealed a three class solution for ASD and a two class solution for PTSD. Negative cognitions about self (OR = 1.08), neuroticism (OR = 1.09) and membership of the 'High symptomatic ASD' class (OR = 20.41) significantly increased the probability of 'symptomatic PTSD' class membership. Future studies are needed to investigate the existence of ASD and PTSD subtypes and their mutual relationship.

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1. Introduction

Over the past decades numerous studies have found an association between peritraumatic and more persistent dissociation and acute and long-term posttraumatic stress symptoms following multiple forms of traumatic exposures (c.f. Breh & Seidler, 2007; Cardena & Carlson, 2011; Carlson, Dalenberg, & McDade-Montez, 2012; Ozer, Best, Lipsey, & Weiss, 2003). Indeed, the presence of dissociative symptoms in the context of traumatic responses has been long acknowledged (Janet, 1907). Dissociation can be defined as "an experienced loss of information or control over mental processes that, under normal circumstances, are available to conscious awareness, self-attribution, or control, in relation to the individual's age and cognitive development" (Cardena & Carlson, 2011; p. 251). Several different models seeking to explain the relationship between dissociation and posttraumatic stress disorder (PTSD) have been put forward (see Dalenberg & Carlson, 2012 for a review). However, empirical support is best for component and subtype models of PTSD (Dalenberg & Carlson, 2012). Both models assume

that dissociation can be a part of traumatic responding but not necessarily in all victims. The component model assumes that dissociative symptoms are more likely to occur along core symptoms of PTSD (intrusion, avoidance, and arousal), whereas the subtype model assumes that dissociation can change the phenomenology of PTSD. Thus, the subtype model assumes that victims with PTSD with dissociation and victims with PTSD without dissociation are qualitatively different (Dalenberg & Carlson, 2012).

Dissociative symptoms were first acknowledged within diagnostic nosology in connection to early traumatic responses with the introduction of Acute Stress Disorder (ASD) in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA, 1994), but recently dissociation has also been acknowledged in relation to long-term traumatic responses with the release of the DSM-5 (APA, 2013). In the DSM-5 the Posttraumatic Stress Disorder (PTSD) diagnosis has undergone a number of revisions. Notably the most prominent changes concerns the inclusion, removal and rearrangement of symptoms into the previous three symptom clusters and an added fourth symptom cluster of negative cognitions and mood and the addition of a dissociative subtype.

The ASD diagnosis was originally introduced into the DSM nosology to recognize acute posttraumatic stress symptoms and as a way of identifying victims at risk of developing PTSD (APA, 1994). However, the precursor idea was abandoned with the release of the

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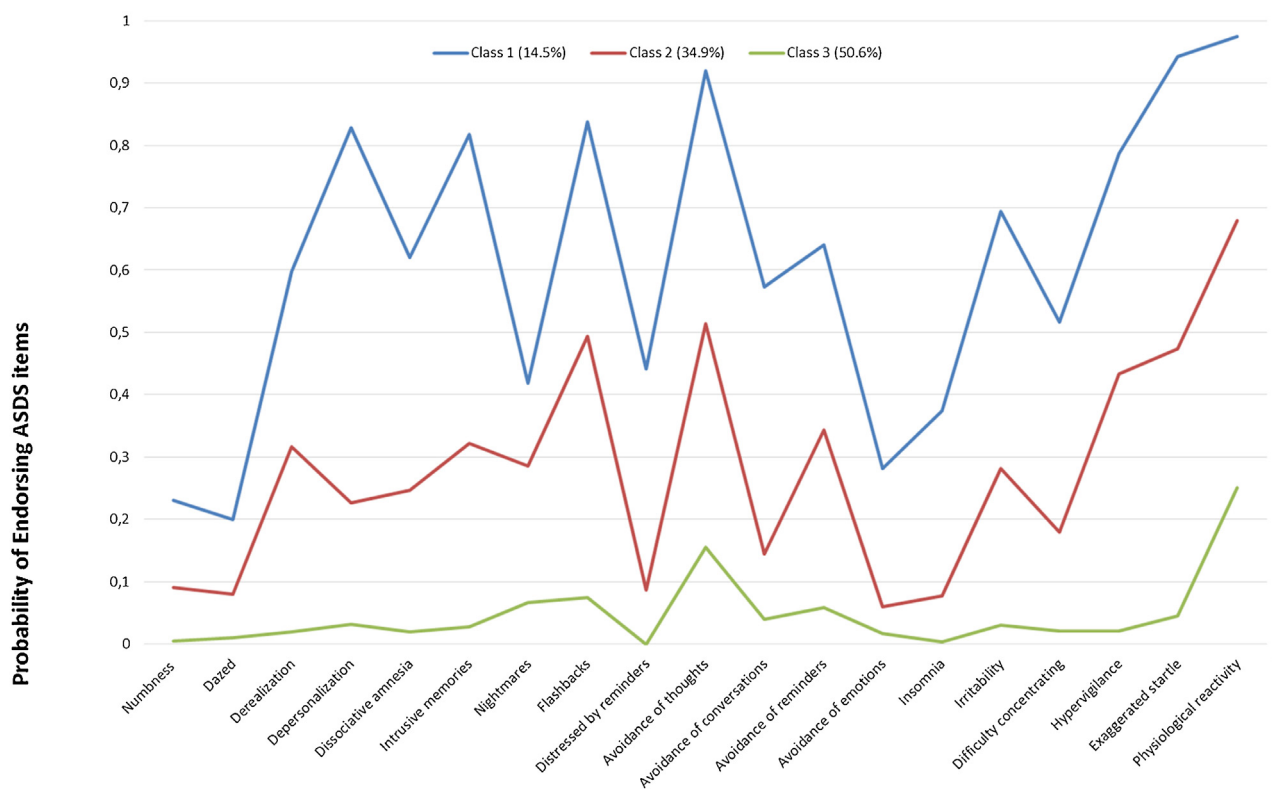 *E-mail address:* mhansen@health.sdu.dk (M. Hansen).

Fig. 1. Latent class plot of three ASD classes.   *Note:* ASD = acute stress disorder, ASDS = acute stress disorder scale.

DSM-5 due to inconsistencies in the capacity of the ASD diagnosis to predict the PTSD diagnosis, primarily attributed to the dissociation symptom cluster (Bryant, 2011). In DSM-5 the ASD diagnosis no longer states a requirement of symptoms belonging to specific clusters (i.e. dissociation, arousal, avoidance, and intrusion), but instead simply states a requirement of 9 out of any of the 14 symptoms specified in five different categories (i.e. intrusion, arousal, negative mood, avoidance, and dissociation). Interestingly, the DSM-5 ASD criteria actually appear to predict PTSD and other psychiatric disorders slightly better than DSM-IV ASD (Bryant et al., 2014). The DSM-5 diagnostic criteria for the PTSD diagnosis also state a requirement of symptoms of intrusion, avoidance, negative cognitions and mood, and arousal, but the individual must endorse a specific number of symptoms belonging to each symptom cluster to meet the criteria. Additionally, in order to meet the criteria for the dissociative subtype, the individual must report persistent or recurrent symptoms of either depersonalization (feelings of disconnectedness or detachment from self or body) or derealization (feelings of unreality of surroundings). Thus, the diagnostic criteria of the two trauma-related disorders are in many ways made more similar in the DSM-5 despite the fact that the precursor idea has been abandoned.

Recently, several studies using latent class analysis (LCA) or latent profile analysis (LPA) have investigated the existence of the dissociative PTSD subtype (Armour, Elklit, Lauterbach, & Elhai, 2014; Armour, Karstoft, & Richardson, 2014; Blevins, Weathers, & Witte, 2014; Frewen, Brown, Steuwe, & Lanius, 2015; Steuwe, Lanius, & Frewen, 2012; Wolf, Lunney et al., 2012; Wolf, Miller et al., 2012). Generally, the studies of PTSD have identified 3–5 classes or profiles of individuals with at least one class supporting the dissociative subtype. Most of the studies have investigated PTSD subtypes using the DSM-IV criteria with estimated prevalence rates ranging from 24% to 100% with PTSD dissociative prevalence rates of 6%–30% (Armour, Elklit et al., 2014; Armour, Karstoft et al.,

2014; Blevins et al., 2014; Steuwe et al., 2012; Wolf, Lunney et al., 2012; Wolf, Miller et al., 2012). Indeed, only Frewen et al. (2015) investigated PTSD subtypes using DSM-5 criteria in a community sample of individuals meeting the cut-off scores for a probable PTSD diagnosis.

Research investigating subtypes of ASD using LCA/LPA is sparse (Armour & Hansen, 2015; Hansen, Armour, Wang, Elklit, & Bryant, 2015; Shevlin, Hyland, & Elklit, 2014). However, existing findings drawn from a range of different trauma types suggests that ASD subtypes may exist. Generally, 4–5 profiles have been identified with at least one class supporting a highly symptomatic profile. However, the specific nature of the highly symptomatic profile is less clear across studies. Indeed, the highly symptomatic class identified by Shevlin et al. (2014) was overall highly symptomatic; whereas the highly symptomatic class in the Hansen et al. (2015) study was marked by high avoidance and dissociation compared to the other classes; and the highly symptomatic class in the Armour and Hansen (2015) study was marked by intrusion compared to the other classes.

In addition to identifying subtypes of ASD or PTSD, research has also investigated risk factors for developing dissociative PTSD compared to non-dissociative PTSD (Armour, Elklit et al., 2014; Armour, Karstoft et al., 2014; Blevins et al., 2014; Frewen et al., 2015; Steuwe et al., 2012; Wolf, Lunney et al., 2012; Wolf, Miller et al., 2012). This research is important from a clinical perspective in relation to facilitating early treatment of victims at risk of developing dissociative PTSD. Indeed, preliminary research suggests that dissociative symptoms can affect the success of PTSD treatments and hence the dissociative PTSD subtype should be taken into consideration when choosing the appropriate treatment (cf. Bovin, Marx, & Schnurr, 2015). Thus, there is potentially great utility in determining whether dissociative subtypes of ASD exist in the acute phase following traumatic exposure. Several risk factors have been identified for a dissociative PTSD subtype, for instance, female sex,
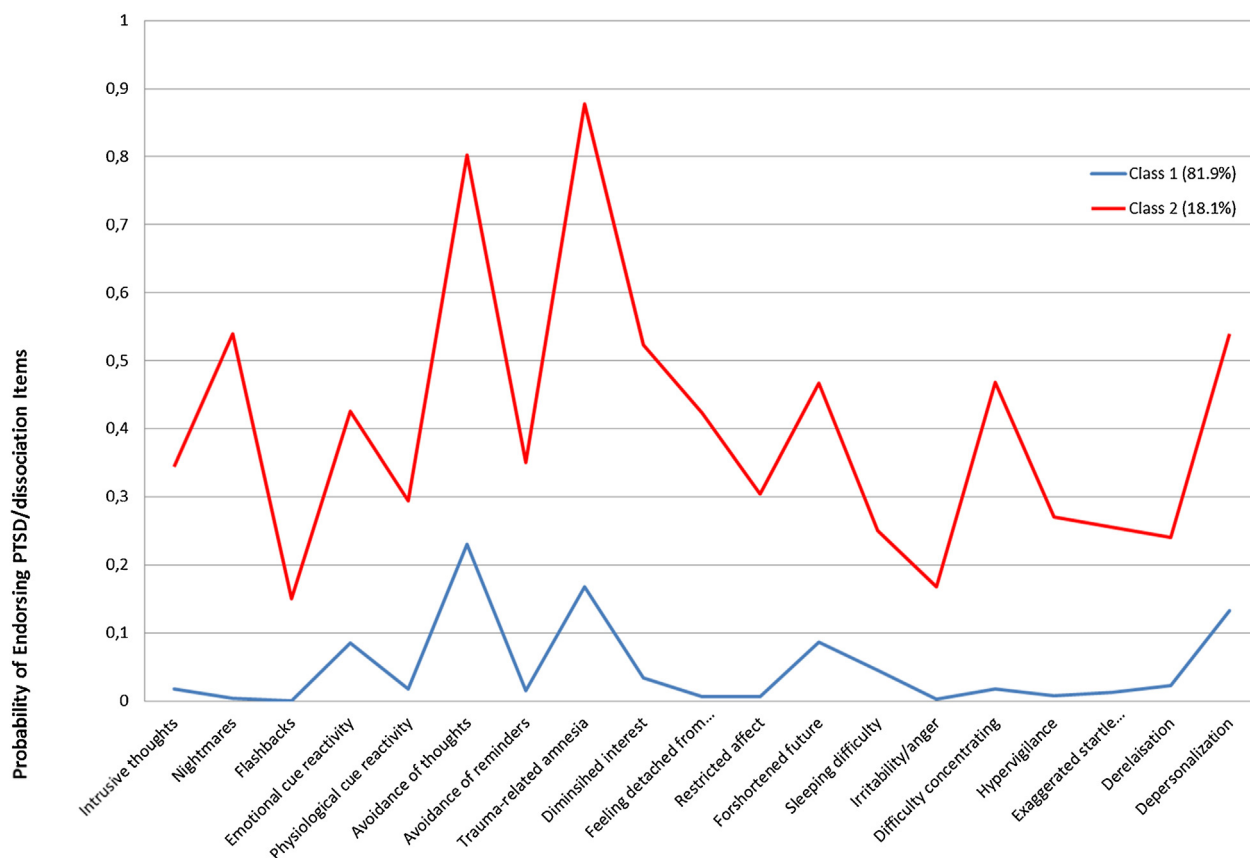
Fig. 2. Latent class plot of two PTSD classes.

Note: PTSD = posttraumatic stress disorder.

age, prior traumatic exposure, peritraumatic dissociation, persistent dissociation and a wider range of psychological distress and diagnoses (cf., Armour, Karstoft et al., 2014; Bennett, Modrowski, Kerig, & Chaplo, 2015; Blevins et al., 2014; Frewen et al., 2015; Wolf, Miller et al., 2012; Steuwe et al., 2012). Of note, research indicates that persistent dissociation consistently appears to predict both PTSD and dissociative PTSD (Blevins et al., 2014; Briere, Scott, & Weathers, 2005; Frewen et al., 2015). Furthermore, research indicates that persistent dissociation may be a better predictor of PTSD than peritraumatic dissociation (Briere et al., 2005). However, a recent study of Bennett et al. (2015 p. 469) indicates that peritraumatic dissociation may be an important mechanism through which more persistent dissociation may develop. Thus, it is possible as implied by the component and the subtype models of the relationship between PTSD and dissociation that there exits different risk factors for PTSD and dissociative PTSD. In a similar vein, although ASD may not be a precursor of PTSD it is possible that individuals with highly symptomatic ASD profiles are the same as those who develop highly symptomatic PTSD profiles. As argued by Shevlin et al. (2014) the mixed results in relation to the predictability of ASD on PTSD may be due to the fact that ASD differs both qualitatively and quantitative; a finding that was supported by subsequent studies (Armour & Hansen, 2015; Hansen et al., 2015). Shevlin et al. (2014) reported that moderate to highly symptomatic ASD subtypes are associated with a higher risk of PTSD. However, only a PTSD diagnosis was assessed and thus failed to also see PTSD as disorder that has qualitative and quantitative variation as indicated by the mentioned existing LPA research. The importance of research connecting ASD subtypes to PTSD subtypes was also underlined by Armour and Hansen (2015) as this opens up for new means of early identification and treatment of highly symptomatic PTSD subtypes. It is potentially beneficial to identify victims at risk

of developing PTSD in general as well as dissociative PTSD as there is evidence that early interventions targeting ASD reduces the risk of subsequent PTSD (Bryant et al., 2008). As pointed out by Bryant et al. (2014) mental health care could be enhanced if victims who go on to develop PTSD are better identified and the mental health resources are targeted at early intervention. The present study is the first to investigate if there is an association between ASD and PTSD subtypes.

The aims of the present study were twofold. The first aim is to test and identify ASD and PTSD subtypes using LCA. The second aim is to investigate whether the membership of the highly symptomatic ASD subtype predict membership of a highly symptomatic PTSD class using logistic regression while controlling for the effect of known risk factors of PTSD and dissociation. The selected control variables are age, sex, neuroticism, peritraumatic panic, somatization, prior traumatic exposure, negative cognitions about self and negative cognitions about the world (c.f. Breslau & Schultz, 2013; Bryant, 2011; Bryant & Panasetis, 2001; Christiansen & Elklit, 2008; Karl, Rabe, Zöllner, Maercker, & Stopa, 2009; Spindler & Elklit, 2003). Unfortunately, we were not able to control for the effect of more persistent dissociation or peritraumatic dissociation beyond how peritraumatic dissociation was measured in relation to ASD symptoms.

2. Method

The present study is part of a national Danish cohort questionnaire survey of the psychological impact of bank robberies conducted in collaboration with the Danish Bankers Association, the National Bank of Denmark, all Danish Banks, and the University of Southern Denmark. All bank employees exposed to bank robbery in Denmark (N = 614) from April 2010 to April 2011 received

Table 1
Descriptive statistics for all continuous variables.

	M	SD	Range	Possible Range
Age	42.11	12.47	20–65	–
Neuroticism	12.16	7.95	0–41	0–48
Peritraumatic Panic	9.66	11.42	0–62	0–80
Somatization	5.45	6.90	0–35	0–48
Number of Trauma Exposures	1.60	1.45	0–10	0–14
Negative Cognitions of Self	32.10	13.57	21–104	21–147
Negative Cognitions of World	16.03	7.78	7–43	7–49
Acute Stress Disorder (ASDS)	34.85	13.26	19–86	19–95
Posttraumatic Stress Disorder (HTQ)	25.18	8.05	17–62	17–68
Dissociation (TSC)	2.14	0.50	2–7	2–10

Note: Acute stress disorder scale (ASDS), Harvard trauma questionnaire (HTQ), Trauma symptom checklist (TSC).

Table 2
Fit statistics for latent class analysis of ASD symptoms.

Classes	Loglikelihood	AIC	BIC	ssaBIC	Entropy	LMRA-LRT (p)	BSLRT (p)
2	−2772	5622	5775	5651	0.91	1132 (0.000)	1141 (0.000)
3	**−2693**	**5505**	**5736**	**5549**	**0.84**	**155 (0.056)**	**157 (0.000)**
4	−2653	5464	5774	5523	0.84	79 (0.157)	80 (0.000)
5	−2620	5438	5825	5511	0.84	66 (0.164)	66 (0.000)
6	−2577	5392	5858	5481	0.86	84 (0.031)	85 (0.000)

Note: AIC = akaike information criterion; BIC = Bayesian information criterion; ssaBIC = sample-size adjusted BIC; LMRA-LRT = Lo-Mendell-Rubin adjusted likelihood ratio test; BSLRT = Bootstrapped LMRA. Selected class solution in bold.

Table 3
Fit statistics for latent class analysis of PTSD symptoms.

Classes	Loglikelihood	AIC	BIC	ssaBIC	Entropy	LMRA-LRT (p)	BS-LRT (p)
2	**−1810**	**3699**	**3851**	**3728**	**0.94**	**878 (0.000)**	**885 (0.000)**
3	−1757	3633	3864	3677	0.90	105 (0.115)	106 (0.000)
4	−1728	3615	3924	3674	0.81	57 (0.254)	57 (0.006)
5	−1703	3605	3993	3679	0.87	49 (0.720)	49 (0.030)
6	–	–	–	–	–	–	–

Note: AIC = akaike information criterion; BIC = Bayesian information criterion; ssaBIC = sample-size adjusted BIC; LMRA-LRT = Lo-Mendell-Rubin adjusted likelihood ratio test; BSLRT = Bootstrapped LMRA. Selected class solution in bold.

the questionnaire. A total of 450 employees (73%) filled out the first questionnaire a week after the robbery (T1, *M* = 9.89 days, *SD* = 6.30), and a total of 371 of these (82%) filled out the second questionnaire six months after the robbery (T2, *M* = 191.7 days, *SD* = 13.15). There were no significant group differences in ASDS scores or any of the control factors or risk factors in relation to the dropout between T1 and T2. For the purposes of the current study, only those individuals who completed the T2 assessment were included in the analyses. Of note the Armour and Hansen (2015) study is based on the first time-point (*N* = 450). Participation was voluntary, and the participants were informed of the purpose of the study orally and in writing. All necessary permissions for conducting this study, according to Danish Law, were obtained. The present study is based on the DSM-IV criteria as the DSM-5criteria was not available when conducting the study. The mean age for the participants was 42.11 (*SD* = 12.47) with 61.5% females (*n* = 228). Please see Hansen and Elklit (2014) for further details on the study.

2.1. Measures

Only the questions relevant for this study are described in the following. All covariates and ASD symptoms were assessed at T1, whereas PTSD symptoms and dissociative symptoms were assessed at T2. Prior traumatic exposure was the sum of endorsements from a checklist of 14 different kinds of traumas used in the U.S. National Comorbidity Survey (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). All of the trauma experience questions were dichotomously scored (*yes* or *no*).

A modified Danish version of the Physical Reaction Scale (PRS; Falsetti & Resnick, 1992) was used to assess symptoms of panic during the robbery (i.e. peritraumatic panic). The PRS is a 16-item self-report questionnaire that measures how severely the participants experienced DSM-IV panic symptoms during the robbery rated on a six-point Likert type scale (0 = *not at all,* to 5 = *extremely*). The reliability coefficient for the scale in the current study was high (Cronbach's α = 0.91).

The somatization subscale of the Danish version of the Symptom Checklist revised (SCL-90-R; Derogatis, 1994) was used as an indicator of symptoms of somatization. The Danish SCL-90-R somatization subscale is a 12 item list of common somatic symptoms rated on a five-point Likert scale (0 = *not at all*, to 4 = *extremely*) (Olsen, Mortensen, & Bech, 2004). Good psychometric properties have been reported for the somatization subscale (Olsen et al., 2004). The reliability coefficient in the current study was satisfactory (Cronbach's α = 0.87).

The Danish version of the Posttraumatic Cognition Inventory (PTCI, Foa, Ehlers, Clark, Tolin, & Orsillo, 1999) was used to assess posttraumatic cognitions. The PTCI is a 33 item self-report scale with three subscales assessing negative cognitions about self, negative cognitions about the world, and self-blame rated on a seven-point Likert Scale (1 = *totally disagree*, to 7 = *totally agree*). The PTCI has demonstrated high convergent validity with other trauma-related cognition scales and good sensitivity and specificity in relation to correctly identifying PTSD diagnostic status (Beck et al., 2004; Foa et al., 1999). Difficulties with the self-blame subscale have been reported previously (cf. Beck et al., 2004) and

Table 4
Binary logistic regression analysis predicting membership of the 'symptomatic PTSD' class.

Variables	B	S.E.	OR with 95% CI	p
Age	0.03	0.03	1.03 (0.98/1.09)	0.201
*Gender (Female)	−0.43	0.67	0.65 (0.18/2.39)	0.515
Neuroticism	**0.09**	**0.04**	**1.09 (1.02/1.18)**	**0.016**
Peritraumatic Panic	0.00	0.04	1.00 (0.93/1.07)	0.940
Somatization	0.04	0.08	1.04 (0.89/1.22)	0.624
Number of Traumas	−0.31	0.28	0.73 (0.42/1.27)	0.267
Negative Cognitions of Self	**0.08**	**0.04**	**1.08 (1.01/1.16)**	**.029**
Negative Cognitions of the World/Others	−0.02	0.05	0.98 (0.90/1.07)	0.659
*High ASD Class (Low ASD class)	**3.02**	**0.68**	**20.41 (5.43/76.92)**	**0.000**

Note: ASD = acute stress disorder, PTSD = posttraumatic stress disorder, B = unstandardized beta value; SE = standard error; OR with 95% C.I. = odds ratio with 95% confidence intervals; p = two-tailed p value; * = binary coded variable with reference group in parentheses. Statistically significant ORs are in bold.

so only the negative cognitions about self ($\alpha = 0.91$) and negative cognitions about the world ($\alpha = 0.84$) scales were used.

Neuroticism was assessed using the Danish version of the neuroticism subscale on the NEO Personality Inventory-revised (NEO PI-R; Costa & McCrae, 2004) short version. The NEO PI-R neuroticism subscale comprises 12 items assessed on a five-point Likert scale (0 = *strongly disagree,* to 4 = *strongly agree*). The NEO PI-R has shown to have good psychometric properties including good reliability (cf. Costa & McCrae, 2004; Rossier, Meyer de Stadelhofen, & Berthoud, 2004) for the neuroticism subscale. The reliability coefficient in the current study was satisfactory (Cronbach's $\alpha = 0.88$).

The DSM-IV ASD symptoms were assessed using the Danish version of the Acute Stress Disorder Scale (ASDS; Bryant, Moulds, & Guthrie, 2000).The ASDS is a 19 item self-report scale developed to assess the four DSM-IV ASD symptom clusters. Questions are answered on a five-point Likert scale (1 = *not at all,* to 5 = *very much*). The diagnostic DSM-IV criteria for ASD are met if the participants endorsed at least one re-experiencing, one avoidance, and one arousal item with scores ≥3 in addition to three dissociative items with a score ≥3. Previous studies have reported good reliability for the ASDS total score (Cronbach's $\alpha = 0.76$–0.96, Hansen, Armour, & Elklit, 2012). The reliability coefficient in the present study for the full combined sample was satisfactory (total scale $\alpha = 0.93$).

The Danish version of the Harvard Trauma Questionnaire (HTQ; Mollica et al., 1992) was used to assess PTSD symptoms. The HTQ is a 17 item self-report scale with three subscales assessing the three separate symptom clusters intrusion, arousal, and avoidance as specified by the DSM-IV rated on a four-point Likert type scale (1 = *not at all,* 4 = *all the time*). The PTSD symptom clusters were considered met if the participants endorsed at least one intrusion symptom, three avoidance symptoms, and two arousal symptoms, all indicated by item scores ≥3. The Danish version of the HTQ has been used in a wide range of trauma populations with reports of good reliability and validity (cf. Bach, 2003). The reliability of the total scale in the current study was high (Cronbach's $\alpha = 0.92$).

The presence of a dissociative PTSD subtype was assessed using the dissociative subscale of the revised Danish version of the Trauma Symptom Checklist (TSC; Briere & Runtz, 1989). The revised TSC comprises 26 items assessing symptoms of general traumatization on a four-point Likert scale (1 = *never,* to 4 = *always*) (Krog & Duel, 2003). We only used the two symptoms assessing symptoms of derealization and depersonalization as these symptoms are the ones included in the DSM-5 PTSD dissociative subtype. The reliability of the total scale in the current study was high (Cronbach's $\alpha = 0.93$).

2.2. Data analysis

Descriptive statistics for all variables included in the study were conducted using SPSS-21. LCA was carried out using Mplus 7.1

(Muthén & Muthén, 2013) to determine the appropriate number and nature of latent classes for ASD and PTSD, respectively. LCA is a statistical method for determining the correct number of homogeneous groups from multivariate, categorical data (Shevlin, Armour, Murphy, Houston, & Adamson, 2011).

Analyses for the current study proceeded in a number of steps. First, an LCA was performed based on endorsement of the 19 ASDS items to determine the correct number of latent classes for ASD. Second, an LCA was performed based on endorsement of the 17HTQ items and the two TSC dissociation items to determine the appropriate number of latent classes for PTSD. Third, posterior probabilities from the relevant LCA model of ASD were used to assign class membership.

For the LCA analyses of ASD and PTSD five latent class models were compared (two- to six-class solutions). Very little missing data existed and all models were estimated using the default robust maximum likelihood (Yuan & Bentler, 2000) estimator under the assumption that all missing data was missing at random (Akaike, 1987). To avoid class solutions based on local maxima, 500 random start values were utilized followed by 50 final stage optimizations.

Selection of the optimal number of latent classes was based on several model comparison indices including the Aikake Information Criteria (AIC; Akaike, 1987), the Bayesian Information Criteria (BIC; Schwarz, 1978), the sample size adjusted Bayesian Information Criteria (ssaBIC; Sclove, 1987), the Lo-Mendell-Rubin's adjusted likelihood ratio test (LMRA-LRT), and the bootstrapped likelihood ratio test (BSLRT). Lower values on the AIC, BIC and ssaBIC are indicative of better fit (Nylund, Asparoutiov, & Muthen, 2007; Nylund, Bellmore, Nishina, & Graham, 2007b; Yang, 2006). Nylund, Asparoutiov et al. (2007) and Nylund, Bellmore, Nishina, and Graham (2007) reported that the most reliable indicator of fit is the BIC; thus we focused our comparisons on this particular indicator. The LMRA-LRT and the BSLRT assess whether a latent model with one additional class is superior to a latent model with one less class. A non-significant value (p > 0.05) for both tests indicates that the latent model with one less class is the preferred option. We also consulted the Entropy (Ramaswamy, Desarbo, Reibstein, & Robinson, 1993) value as an indicator of classification quality within each individual model. Entropy is a standardised measure of how accurately participants are classified to a latent class. Superior classification is indicated by values which approach 1 (Celeux & Soromenho, 1996).

3. Results

The estimated ASD and PTSD prevalence rate were 9.5% and 6.5%, respectively. Table 1 presents the descriptive statistics for all continuous variables included in the study

Results of the LCA analyses for the ASD symptom indicators are presented in Table 2. Results favoured a model that included three latent classes. The BIC value, which has been shown to be the best

indicator of model fit (Li & Nyholt, 2001; Nylund, Asparoutiov et al., 2007; Nylund, Bellmore et al., 2007; Raftery, 1995), was lowest for the three-class solution. Although the LMRA-LRT test was non-significant for the three-class solution (thus favouring a two-class solution), the *p* value was extremely close to the level of statistical significance suggesting that acceptance of the three-class solution was reasonable. The entropy value of 0.84 reflects good classification of participants.

Fig. 1 displays the latent class profile plot for the three-class solution of the ASDS. Class 1 was the smallest group (14.5%) and this class was characterised by moderately-strong endorsement of all ASD symptom indicators. This class was termed the 'High ASD' class. Class 2 was larger (34.9%) and followed a very similar profile to class 1 with the exception that this class had a lower probability of endorsing each ASD symptom especially in relation to dissociation. Class 2 was thus termed the 'Moderate ASD' class. Finally, class 3 was the largest class (50.6%) and was characterised by an extremely low probability of endorsing the ASD symptom indicators. This class was termed the 'Low ASD' class. The 'Low ASD' class was selected as the reference class for the subsequent regression analysis.

The fit statistics for the two- to five-class solutions of the PTSD and dissociative symptom indicators are presented in Table 3 (results for the six-class solution are not provided as this model failed to replicate the best log-likelihood value, thus suggesting the extraction of too many classes). The results favoured a two-class solution. The BIC value was lowest for this solution, and the LMRA-LRT value was non-significant for the three-class solution indicating the appropriateness of the two-class model. The entropy value (0.94) for the two-class model suggests excellent classification of participants.

Fig. 2 displays the latent profile plot for the two-class solution. Class 1 was a large group (81.9%) characterised by very low probabilities of endorsing the PTSD symptom indicators. This class was termed the 'Non-symptomatic PTSD' class and was used as the reference group for the subsequent regression analysis. Class 2 included 18.1% of bank robbery victims and was characterised moderate probabilities of endorsing the PTSD symptom indicators. The class was termer the 'Symptomatic PTSD' class.

Binary logistic regression analysis was conducted to predict membership of the 'Symptomatic PTSD' class (see Table 4 for full details). The strongest effect was observed for membership of the 'High ASD' class which recorded an odds ratio (OR) of 20.41. Higher levels of neuroticism and higher levels of negative cognitions of the self also significantly increased the likelihood of membership of the 'Symptomatic PTSD' class.

4. Discussion

To our knowledge this is the first study to investigate the relationship between ASD and PTSD subtypes using LCA and logistic regression. First, the LCA results indicated a three-class solution for ASD (i.e. high, moderate, and low symptom severity) and a two-class solution for PTSD (i.e. non-symptomatic and symptomatic). Second, the results of binary logistic regression revealed that neuroticism, negative cognitions of the self and the highly symptomatic ASD class significantly increased the probability of membership in the symptomatic PTSD class.

In contrast to previous studies (Armour & Hansen, 2015; Hansen et al., 2015; Shevlin et al., 2014) the results of the LCA did not yield support for the existence of ASD subtypes. Instead the results of the present study suggest that the distinction between the three identified classes are primarily of a quantitative nature and not of a qualitatively nature (i.e. the profiles are very similar and primarily differs only in severity). The present study and the existing studies are based on different statistical analyses (i.e. LCA, LPA and

LPA on mean scores) and different populations with varying symptom severity (clinical and non-clinical populations), which makes them difficult to compare directly. Thus, it is unclear whether the differences in the results are due to the use of different statistical methods, the clinical status of the sample or the specific form of traumatic exposure. It is possible that ASD subtypes only exist in populations with a higher symptom severity as suggested by two previous studies (Shevlin et al., 2014; Hansen et al., 2015). Of note the results of the present study were not completely in accordance with the results of the previous LPA study conducted on a larger part of this sample (Armour & Hansen, 2015). The results of the Armour and Hansen (2015) study revealed a four-class solution with two highly symptomatic classes mainly separated by the intrusion criterion using LPA. In contrast, we only identified three classes with only one highly symptomatic class using LCA. There were no significant differences in the participants' ASD severity or diagnostic status in relation to dropout at T2, thus the difference in the results are likely not attributable to different sample sizes but more likely due to the use of different statistical methods. LPA uses continuous variables and classifies victims according to symptom severity whereas LCA uses categorical variables and classifies victims according to symptom endorsement probability. Thus, the results are likely to be different. Especially in samples of low symptom severity as symptom endorsement will be quite low. Although. LPA may reflect the nature of the ASD data better than LCA we chose to use LCA on both ASD and PTSD symptoms in the current study in order to better facilitate consistency in the proposed comparisons.

Although the results of LPA and LCA are not directly comparable per se we were surprised that we were not able to identify the dissociative PTSD subtype within this sample (Armour, Elklit et al., 2014; Armour, Karstoft et al., 2014; Blevins et al., 2014; Frewen et al., 2015; Steuwe et al., 2012; Wolf, Lunney et al., 2012; Wolf, Miller et al., 2012). Of note the dissociative PTSD subtype was identified in the three class solution of the LCA. It is possible that the overall low prevalence rate of PTSD in the current sample precluded the ability to identify a meaningful class of individuals who are characterised by dissociative symptoms. The estimated PTSD prevalence rate is considerably lower in the present study (i.e. 6.5%) compared to prevalence rates in previous studies (i.e. 24–100%). As pointed out by Hansen et al. (2012) it is possible that the latent structure of post-traumatic stress symptoms may differ in clinical samples compared to mixed samples. Indeed, there have been differences found in the latent structure of PTSD symptoms among veterans with and without PTSD (Biehn, Elhai, Fine, Seligman, & Richardson, 2012). The specific nature of the trauma may also affect the results as dissociative symptoms have been found to be more pronounced following trauma experiences of increased severity and duration (Waelde, Silvern, Carlson, Fairbank, & Kletter, 2009). However, this is unlikely as the dissociative PTSD subtype has been found across many different types of traumatic exposure (i.e. veteran samples, veterans and spouses, victims of rape, victims of childhood abuse, community samples, and trauma-exposed college students) (Armour, Elklit et al., 2014; Armour, Karstoft et al., 2014; Blevins et al., 2014; Frewen et al., 2015; Steuwe et al., 2012; Wolf, Lunney et al., 2012; Wolf, Miller et al., 2012). Finally, dissociation was only assessed with two items in the present study, which may also have affected the results. The use of a full measure of dissociation for instance the Dissociative Experience Scale (Bernstein & Putman, 1986) may have changed the results. However, the dissociative PTSD subtype has previously been identified with a limited number of items (cf. Armour, Elklit et al., 2014).

In assessing risk factors for the probability of belonging to the symptomatic PTSD class, three factors were significant. A higher degree of neuroticism, a higher degree of negative cognitions of the self and highly symptomatic ASD class membership significantly increased the probability of symptomatic PTSD class membership.

This is not surprising as neuroticism and negative cognitions about self have been found associated with increased PTSD and dissociation (Breslau & Schultz, 2013; Karl et al., 2009; Spindler & Elklit, 2003). The highly symptomatic ASD class was the strongest risk factor for symptomatic PTSD class membership with an OR over 20 meaning that victims with high levels of ASD symptoms were more than 20 times more likely to subsequently belong to the symptomatic PTSD class. Thus, although the ASD diagnosis may not be a precursor of a PTSD diagnosis the results suggest that the highly symptomatic ASD class may be a precursor for symptomatic PTSD class membership. This is not surprising given the long documented strong relationship between ASD and PTSD both in form of diagnostic criteria, symptom severity, and latent structure as well as the fact that the highly symptomatic ASD has previously been found associated with increased risk of PTSD (Hansen et al., 2012; Hansen & Elklit, 2013; Shevlin et al., 2014). Furthermore, the victims' overall symptom severity appears to decline over the 6 month period between the assessment of ASD (i.e. 9.5%) and PTSD (6.5%). This may suggest that several victims have moved into the non-symptomatic PTSD class or at least their symptoms have abated to a point where the distinction between "moderate" and "severe" classes are less meaningful. Overall the results of the present study indicate that ASD may simply be an acute variant of PTSD.

The results of the current study have several clinical implications. The results suggest that victims with posttraumatic stress symptom endorsement in the immediate aftermath of traumatic exposure are at the largest risk of developing symptomatic PTSD, controlling for a range of known risk-factors. It is therefore likely to be beneficial to screen victims of traumatic exposure for ASD symptoms in order to identify victims at the greatest risk of developing symptomatic PTSD and offer early treatment and monitoring. Furthermore, the results suggest that when delivering treatment, focusing on restructuring negative cognitions about the self are likely to reduce the risk of developing PTSD. Finally, the results may also have implications for the diagnostic system as the results suggest that ASD is an acute variant of PTSD. Thus, as pointed out by Cardena and Carlson (2011) it would minimize confusion for clinicians and facilitate research into the relationship between ASD and PTSD if ASD and PTSD were standardised so that ASD can be seen as an acute variant of PTSD. Although, the study focus on ASD and PTSD according to the DSM-IV, it is likely that the results will be replicated with the DSM-5 criteria as well. There is great similarity between the ASDS items and the DSM-5 ASD symptoms. As pointed out by Armour and Hansen (2015) the only difference is that the ASDS does not fully assess the symptom representing negative mood (B5). The ASDS assesses numbing in general, whereas the DSM-5 defines this symptom as a persistent inability to experience positive emotions. The results are also likely to be replicated in relation to DSM-5 PTSD as we controlled for the effect of negative cognitions when assessing highly symptomatic ASD as a risk factor for symptomatic PTSD. This means that although we did not assess the fourth symptom cluster of negative cognitions and mood, we did control for some of the effect associated with it.

4.1. Limitations

As with all studies, the present study is subjected to several limitations. Both ASD and PTSD symptoms were assessed using DSM-IV self-report measures. It is possible that the latent structure of ASD and PTSD and their association may differ depending on how it is assessed and according to which diagnostic criteria. In particularly we were not able to assess the fourth DSM-5 PTSD symptom cluster of negative cognition and mood but only control for the effect of it. Additionally, the assessment of dissociative PTSD symptoms was restricted to only two dissociative items, which may not capture the complexity of the dissociative symptoms captures

by the DSM-5. Thus, further investigation should focus on using DSM-5 criteria and a wider coverage of dissociation. Furthermore, we were not able to assess and control for the effect of persistent dissociation or other measurements of peritraumatic dissociation beyond the ASDS. In particularly persistent dissociation has been found associated with both PTSD and dissociative PTSD. Thus, it is possible that the strong association between highly symptomatic ASD and PTSD subtype would be reduced when controlling for the effect of symptoms of persistent dissociation rather than only peritraumatic dissociation. Of note, it is important to remember that further assessment of peritraumatic dissociation and more persistent dissociation may create problems with multicollinearity and singularity as peritraumatic dissociation is already contained by the ASD symptoms and persistent dissociation by the PTSD symptoms in the present study. Finally, the analyses were based on victims of bank robbery with a low estimated PTSD prevalence rate. Thus the results of the present study may only generalize to trauma populations of a similar mild traumatic nature. Replications of the present study should be conducted in populations reporting both specific trauma experiences, and populations reporting a wide range of heterogeneous trauma experiences and in clinical vs. non-clinical populations as well.

4.2. Conclusion

The current study is the first to investigate the association between ASD and PTSD subtypes using LCA. We found support for a three class solution for ASD; highly symptomatic, moderately symptomatic and low symptomatic. Furthermore, we found support for a two class solution for PTSD with a symptomatic and non-symptomatic class. Although there are several possible explanations as to why we were not able to find evidence of the dissociative PTSD subtype in the present study, the most likely reason is attributed to the low estimated PTSD prevalence rate. Negative cognitions about self, neuroticism and membership of the 'High symptomatic ASD' class significantly increased the probability of membership to the 'symptomatic PTSD' class. A very strong effect was found associated with membership of the 'High ASD' class (OR = 20.41, 95% CI = 5.43–76.92). Combined the results suggest that ASD may be an acute variant of PTSD. Future studies are needed to shed more light on both ASD and PTSD subtypes and their mutual relationship in different trauma populations with different symptom severity.

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