The 4-D model represents a promising framework for understanding dissociative experiences related to trauma, categorizing the symptoms into trauma-related altered states of consciousness (TRASC) and normal waking consciousness (NWC), which occur along four dimensions: time, thought, body and emotion. The main aim of the present study was to evaluate the validity of this model in patients with post-traumatic stress disorder (PTSD), with and without comorbid dissociative disorders.

Method: The predictions of the 4-D model were tested in 142 patients with PTSD, with (N = 46) and without (N = 96) comorbid dissociative disorders.

Results: As predicted by the 4-D model, experiences of TRASC were less frequent and more specifically related to other measures of dissociation, dissociative disorder comorbidity and a history of childhood sexual abuse compared to experiences of NWC. The predicted lower intercorrelation of TRASC was not supported.

Conclusion: The 4-D model represents a promising framework for understanding dissociation across trauma-related disorders.
1. Introduction

The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) recognizes a ‘close relationship’ (p. 291) between dissociative disorders and trauma- and stressor-related disorders, such as post-traumatic stress disorder (PTSD). This relationship manifests in both symptomatic overlap and high comorbidity. Patients with PTSD generally experience increased levels of dissociative symptoms compared to trauma-affected people without PTSD (Carlson, Dalenberg, & McDade-Montez, 2012; Dorahy & van der Hart, 2015), while a dissociative subtype of PTSD patients (DPTSD) is characterized by pervasive symptoms of derealization and depersonalization and often related to childhood abuse (Lanius, Brand, Vermutten, Frewen, & Spiegel, 2012; Lanius et al., 2010).

In addition, PTSD symptoms such as flashbacks and trauma-related amnesia are regarded by many theorists as dissociative phenomena (Dell, 2006b; Frewen & Lanius, 2015; Nijenhuis, Hart, & Steele, 2010). Patients with dissociative disorders, which are characterized by pervasive and severe dissociative symptoms, almost invariably also suffer from PTSD, with comorbidity rates from 88% to 97% (Foote, Smolin, Neft, & Lipschitz, 2008; Rodewald, Wilhelm-Göling, Emrich, Reddemann, & Gast, 2011).

However, several authors have noted that confusion remains as to how dissociation should be defined and which symptoms and experiences should be included as dissociative (Brown, 2006; Dell, 2009; Holmes et al., 2005). Empirical data clearly suggest that dissociative experiences do not form a unitary dimension, but are better understood as multidimensional phenomena (Briere, Weathers, & Runtz, 2005; Bryant, 2007; Dell, 2006b; Holmes et al., 2005). It is, for instance, common to differentiate between compartmentalization, involving an inability to access or control normal mental processes, and detachment, such as depersonalization, derealization and numbing. For research, theory and clinical practice it is therefore critical that researchers define clearly the specific phenomenological construct of dissociation to which they are referring (e.g. dissociative flashbacks vs depersonalization vs derealization vs identity dissociation) (Brand & Frewen, 2017).

To better understand and differentiate dissociative phenomena, Frewen and Lanius (2015) argue that it is necessary to distinguish between subtypes of trauma-related reactions that are intrinsically dissociative and those that are not intrinsically dissociative in nature but rather may present as forms of distress within normal waking consciousness (NWC). The four-dimensional (4-D) model emphasizes phenomenological first-person descriptions of conscious experience and how such experiences might be affected by trauma. The more inherently dissociative reactions, involving a distinct non-self-referential form of processing (i.e. ‘this isn’t me’, ‘this is happening to somebody else’) are labelled trauma-related altered states of consciousness (TRASC).

Specifically, four phenomenological dimensions of a person’s awareness that can be affected during as well as in the aftermath of trauma are described: time, thought, body and emotion. TRASC of the time dimension was proposed to involve traumatic flashbacks that involve a profound sense of reliving as compared to the NWC experience of upsetting and intrusive memories that do not exhibit a reliving component. Negative voice-hearing is characterized as a TRASC phenomenon of the thought dimension, whereas NWC experiences involve negative self-referential cognitions occurring in first-person perspective. Along the body dimension, disembodied experiences (e.g. depersonalization) are regarded as TRASC, while embodied forms of distress (e.g. hyperarousal) are considered as a symptom of NWC. Lastly, severe emotional numbing and disowned/compartmentalized emotions are proposed to be TRASC, while NWC expressions will involve generally negative affects (e.g. sadness, anger and shame) that are not disowned/compartmentalized. The 4-D model contends that symptoms of TRASC can be experienced both together with and apart from identity alterations that occur in severe dissociative disorders, such as dissociative identity disorder (DID). As such, experiences of TRASC are not specific for dissociative disorders, but are thought to represent transdiagnostic states across trauma-related disorders.

To investigate the validity of the 4-D model, Frewen and Lanius (2015) make four testable predictions. First, because experiences of NWC distress are conceptualized as being within the typical and normal state of humans, they should be more common and frequently endorsed than experiences of TRASC. Secondly, because experiences of TRASC are hypothesized to be more compartmentalized as dissociative experiences, they are hypothesized to less intercorrelated (Brown, 2006; Holmes et al., 2005) across the four dimensions than in the form of NWC distress, especially when measured over time (i.e. dimensions of NWC should correlate more strongly than dimensions of TRASC). Thirdly, the 4-D model predicts that experiences of TRASC should be more frequently reported by people with high scores on other measures of dissociation, especially other measures of pathological dissociation. Finally, Frewen and Lanius (2015) hypothesize that TRASC typically develop as a result of repeated traumatization at sensitive periods of development, and therefore predict that experiences of TRASC will be related...
more specifically than NWC distress to a history of repeated traumatization and childhood abuse.

Several studies have investigated and largely found support for the predictions of the 4-D model in different samples, such as undergraduate students (Brown & Frewen, 2017; Frewen & Lanius, 2014a), clinical populations with and without PTSD (Frewen, Kleindienst, Lanius, & Schmahl, 2014; Frewen & Lanius, 2014a), acutely traumatized individuals (Frewen et al., 2015) and community samples recruited online (Frewen, Brown, & Lanius, 2017; Tzannidakis & Frewen, 2015). The first prediction, that NWC will be endorsed more frequently than TRASC, and the third prediction, that TRASC will be more strongly associated with other measures of dissociation, have been supported across all studies to date. The second prediction, hypothesizing higher intercorrelations among the dimensions in NWC distress than the TRASC form, was supported in all studies except in a sample of 258 women diagnosed with borderline personality disorder, with and without comorbid PTSD (Frewen et al., 2014). Finally, support for the fourth prediction, that symptoms of TRASC will be specifically related to a history of repeated traumatization and childhood abuse, has been less consistent. Frewen and Lanius (2014a) found an association between a history of childhood sexual abuse (CSA) and voice-hearing in women with PTSD, but no general relationship between experiences of TRASC and other forms of childhood abuse was demonstrated. In comparison, Frewen et al. (2014) found a specific relationship of TRASC with emotional neglect, but not across other forms of childhood trauma. Other investigations have generally found positive correlations between reports of childhood trauma and both NWC distress and TRASC, but with no consistent pattern regarding specificity emerging.

Although the studies described above largely provide support for the 4-D model of dissociation, an important goal of the theory is to describe dissociation transdiagnostically across the spectrum of trauma-related disorders. Therefore, a major limitation of the research to date is that, to our knowledge, the 4-D model has never been investigated in a sample of patients with diagnosed dissociative disorders. The main aim of the present study was therefore to evaluate the validity of the 4-D model of trauma-related dissociation by testing predictions in patients with histories of childhood abuse and diagnostic presentations including PTSD and dissociative disorders.

The hypotheses are:

1. Experiences of TRASC will be specifically related to a self-reported history of childhood abuse.
2. Comorbid dissociative disorder will be specifically associated with higher endorsement of experiences of TRASC, not NWC distress.
3. Experiences of TRASC will be less frequently endorsed than distress associated with NWC in PTSD patients with and without a comorbid dissociative disorder.
4. Experiences of TRASC will be less intercorrelated than experiences of NWC.
5. Experiences of TRASC will be more strongly related to other measures of dissociation than experiences of NWC.

2. Methods

2.1. Participants and procedures

All participants were recruited from patients referred to an outpatient clinic specializing in the treatment of trauma-related disorders, as part of an ongoing clinical trial (Clinical Trials NCT02450617). The study was approved by the Norwegian Regional Committees for Medical and Health Research Ethics (REC) and funded by Modum Bad Psychiatric Hospital. Subjects aged between 18 and 65 years who had sufficient competence in Norwegian and reported childhood abuse and trauma-related symptoms were eligible for inclusion. Exclusion criteria included acute suicidality, severe substance abuse, psychotic illness, current life crisis (e.g. ongoing abuse, divorce, court case, somatic disease in spouse or children), neurological illness, intellectual disability and life-threatening somatic disease.

Participants (N = 177) were enrolled and completed a comprehensive diagnostic assessment by trained interviewers. Only patients who fulfilled criteria for PTSD were included in the present study, as this was a requirement for the clinical trial. One patient with a dissociative disorder failed to meet criteria for PTSD. Also, 34 patients were excluded as they had not filled out the measure used to operationalize 4-D scores. Analysis of available data found that excluded patients did not differ from the included patients on age, gender or symptomatology assessed by other measures. The resulting sample (N = 142) consisted of 46 patients with a comorbid dissociative disorder and 96 without such comorbidity. Of the patients with dissociative disorders, 25 fulfilled criteria for DID (characterized by pronounced dissociative amnesia and the presence of two or more distinct personality states), and 21 fulfilled criteria for other specified dissociative disorders (characterized by chronic dissociative symptoms, but with less distinct identity parts as in DID). These two disorders are collectively categorized as complex dissociative disorders (CDDs) (Dell, 2009). The vast majority of the sample were female (88.7%) and the mean age was 39.1 years (SD = 10.09).

2.2. Measures

All assessments used approved Norwegian translations. Patients could request assistance if they had difficulty understanding the questions or information.
The Post-traumatic Symptom Scale – Interview (Foa, Riggs, Dancu, & Rothbaum, 1993) was used to assess PTSD. Because of a lack of validated diagnostic instruments for DSM-5 at the start of data collection, diagnosis was based on DSM, 4th Edition (DSM-IV) criteria and did not assess DPTSD.

The Structured Clinical Interview for DSM-IV Dissociative Disorders (Steinberg, Cicchetti, Buchanan, & Hall, 1993) was used to assess dissociative disorders.

The Mini-International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998) and Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II) (First, Benjamin, Gibbon, Spitzer, & Williams, 1997) were administered to assess general psychopathology and personality disorders.

Background information and sociodemographic data were registered using a generic form.

The Multidimensional Inventory of Dissociation (MID) (Dell, 2006a) is a self-report measure with 218 items that uses a 11-point Likert scale. Of these items, 168 measure different dimensions of dissociation, while 50 measure validity. The measure was translated into Norwegian and back-translated into English. The back-translation was checked for inconsistencies and approved by the original author. The MID was used in this study to quantify experiences of NWC distress in comparison to TRASC, as described further in Section 2.3.

The Childhood Trauma Questionnaire – Short Form (CTQ-SF) (Bernstein et al., 1994; Dovran et al., 2013) is an extensively used measure for retrospective reporting of experiences of abuse and neglect in the respondents’ childhood. CTQ-SF has 28 items scored from 0 (‘never true’) to 5 (‘very often true’). Cronbach’s alpha for CTQ total score in the present sample was .83, indicating good internal consistency. CTQ has five subscales: emotional neglect (Cronbach’s α = .82), physical neglect (Cronbach’s α = .64), emotional abuse (Cronbach’s α = .93), sexual abuse (Cronbach’s α = .79) and physical abuse (Cronbach’s α = .85).

The Dissociative Experiences Scale (DES) (Bernstein & Putnam, 1986; Carlson & Putnam, 1993) is a 28-item self-report questionnaire designed to measure both pathological and non-pathological dissociative experiences. It uses an 11-point Likert scale, asking respondents to indicate the percentage of their time the experiences affect them. A meta-analysis reported an overall Cronbach’s alpha coefficient of .96 and a significant difference in DES scores between dissociative patients and non-dissociative controls (Van Ijzendoorn & Schuengel, 1996). Cronbach’s alpha in the present sample was also .96.

The Somatoform Dissociation Questionnaire (SDQ) (Nijenhuis, Spinhoven, van Dyck, van der Hart, & Vanderlinden, 1996) has 20 items asking about somatoform dissociative symptoms on a five-point scale. SDQ-20 has shown good reliability and validity (Nijenhuis, Spinhoven, van Dyck, van der Hart, & Vanderlinden, 1998). Cronbach’s alpha in the present sample was .88.

The Symptom Checklist-90 Item – Revised (SCL-90-R) (Derogatis, 1994) is a widely used self-report measure for psychological symptoms and distress consisting of 90 items. The summary score, referred to as a Global Severity Index (GSI), is often used as a measure of general psychopathology. Cronbach’s alpha in the present sample was .97.

### 2.3. Data reduction

The TRASC and NWC factors for each dimension were calculated using items from the MID (Table 1). The originators of the 4-D model (RL and PF) selected items thought to best correspond to NWC and TRASC on each phenomenological dimension, while being blind to the data. The selections were compared to selections of MID items used in previous work (Frewen & Lanius, 2015), and the final items were decided unanimously. Mean scores on the selected items were used to give each participant a score for NWC and TRASC on each dimension (i.e. eight different scores; Table 1).

### 2.4. Statistical analysis

| Time | TRASC | NWC |
|------|-------|-----|
| Item 14, 114, 145 and 146 | Cronbach’s α = .688 | Item 115 |
| Example: ‘Reliving a past trauma so vividly that you see it, hear it, feel it, smell it, etc.’ | ‘Bad memories coming into your mind and you can’t get rid of them.’ |
| Thought | Items 6, 30, 42, 61, 84, 118, 140, 159, 171, 199 and 207 | Cronbach’s α = .936 |
| Example: ‘Hearing a voice in your head that tries to tell you what to do’ | Example: ‘Strong thoughts in your head that “come from out of nowhere”’ |
| Body | Items 3, 91, 126, 164, 172, 191, 197 and 203 | Cronbach’s α = .889 |
| Example: ‘Standing outside of your body, watching yourself as if you were another person.’ | Example: ‘Re-experiencing body sensations from a past traumatic event.’ |
| Emotion | Items 27, 60, 169 and 196 | Cronbach’s α = .688 |
| Example: ‘Very strong feelings (e.g. fear, or anger, or emotional pain and hurt) that suddenly go away.’ | Example: ‘Your mood changing rapidly without any reason.’ |
All statistical analyses were carried out using SPSS version 25. Analyses were performed as outlined in previous methodology (Brown & Frewen, 2017; Frewen et al., 2014; Frewen & Lanius, 2014b). The first hypothesis regarding the relationship between TRASC/NWC and childhood abuse was investigated by examining bivariate correlations. For the second hypothesis, logistical regressions were performed with CDD comorbidity as a dichotomous outcome and TRASC/NWC variables as predictors, while age and general psychopathology were included as nuisance parameters. To investigate the third hypothesis, we performed within-subjects analyses of variance, with dimension (four levels: time, thought, body and emotion) and form of consciousness (two levels: NWC and TRASC) as factors. Significant results were followed by post-hoc comparisons, using Bonferroni-corrected levels of significance. The fourth hypothesis was tested by calculating intercorrelations between TRASC/NWC scores across dimensions, and comparing these through conversion to z-scores (Fisher transformation). Finally, for the fifth hypothesis we performed hierarchical regressions with other measures of dissociation as dependent variables and alternating stepwise order of TRASC and NWC as predictors. Since MID items were used to calculate TRASC/NWC scores, DES and SDQ were used as dependent variables.

3. Results

3.1. Sample characteristics

Descriptive statistics and group differences between patients with and without comorbid CDD are reported in Table 2. The CDD group was more likely to report a history of inpatient treatment and comorbid psychotic symptoms, as assessed by MINI, and general psychopathology, as assessed by SCL-90. A strong association was found between severe suicidality scores on MINI and CDD comorbidity. Few differences were observed in the level of reported childhood abuse, except for experiences of emotional neglect. The group with comorbid CDD was also significantly younger, by a mean of 4.4 years (SD = 10.36).

3.2. Hypotheses

Hypothesis 1. Experiences of TRASC will be specifically related to a self-reported history of childhood abuse

Examining bivariate correlations between TRASC/NWC and CTQ scores, mean NWC symptoms were not significantly related to self-reported childhood abuse, while mean TRASC symptoms were correlated with CTQ total score \( r = .253 \), \( p = .005 \) and CTQ sexual abuse \( r = .295 \), \( p = .001 \). Further investigating correlations between CTQ subscales and TRASC/NWC scores across dimensions (Table 3), a significant association between sexual abuse and symptoms of TRASC was replicated across all dimensions. Only NWC symptoms of the body dimension were significantly correlated with any CTQ subscales.

Hypothesis 2. Comorbid dissociative disorder will be specifically associated with higher endorsement of experiences of TRASC, not NWC distress

Patients with comorbid CDD endorsed both NWC and TRASC symptoms to a greater degree than patients without comorbid CDD across all four dimensions (Figure 1). Results from logistic regression analyses are shown in Table 4. Consistent with predictions, TRASC symptoms significantly predicted CDD comorbidity across all four dimensions, while controlling for group differences in age and general psychopathology. Scores on NWC distress were not significant as predictors.

Hypothesis 3. Experiences of TRASC will be less frequently endorsed than distress associated with NWC

Mean symptom endorsement for each dimension of TRASC and NWC compared in patients with and without CDD can be seen in Figure 1. Within the whole sample, both form of consciousness \( F(1,135) = 397.987, p < .001, \eta^2 = .747 \) and dimension of consciousness \( F(3,405) = 37.004, p < .001, \eta^2 = .215 \) emerged with significant main effects, with a form X dimension interaction \( F(3,405) = 82.598, p < .001, \eta^2 = .169 \). This indicates that although form of consciousness (NWC vs TRASC) predicts endorsement with a large effect size, this association varies across dimensions. Follow-up paired t-tests comparing NWC and TRASC on all dimensions were all significant at the < .001 level, with effect sizes ranging from 0.544 to 1.143 in the predicted direction (NWC > TRASC). Performing the same analyses in subsamples with and without comorbid CDD largely replicated these results (see supplementary material).

Hypothesis 4. Experiences of TRASC will be less intercorrelated than experiences of NWC

Intercorrelations between the four different dimensions of TRASC and NWC can be seen in Figure 2. Contrary to predictions, TRASC subscales generally had higher intercorrelations (\( Mr = .612, SDr = .046 \)) than NWC subscales (\( Mr = .489, SDr = .108 \)).
Table 2. Sample characteristics and clinical comorbidity.

|                          | PTSD with CDD* (N = 46) | PTSD without CDD* (N = 96) | Difference between groups |
|--------------------------|--------------------------|-----------------------------|--------------------------|
| Age (years)              | 36.1 (10.4)              | 40.5 (9.7)                  | 2.442 (138), p = .016*   |
| Gender, male             | 4.3%                     | 14.6%                       | χ² = 3.259, p = .716     |
| Married or partner       | 52.4%                    | 43.9%                       | χ² = 0.802, p = .371     |
| College-level education  | 46.3%                    | 45.7%                       | χ² = 0.005, p = .945     |
| GSI                      | 1.95 (0.661)             | 1.66 (0.664)                | t(118) = −2.252, p = .026*|
| MINI number of comorbid axis-I disorders | 5.2 (2.3)               | 4.5 (2.3)                   | t(135) = −1.783, p = .077 |
| MINI any depressive disorder (present or lifetime) | 90.7%                   | 91.5%                       | χ² = 0.023, p = .879     |
| MINI any bipolar disorder (present or lifetime) | 23.3%                   | 19.1%                       | χ² = 0.306, p = .580     |
| MINI severe suicidality (scored above 2) | 72.1%                   | 20.2%                       | χ² = 34.26, p < .001**   |
| MINI any anxiety disorder (present or lifetime) | 88.4%                   | 85.1%                       | χ² = 0.263, p = .608     |
| MINI substance abuse     | 11.6%                    | 13.8%                       | χ² = 0.125, p = .723     |
| MINI any psychotic disorder (present or lifetime) | 30.2%                   | 13.8%                       | χ² = 5.162, p = .022**   |
| MINI any eating disorder | 18.6%                    | 8.5%                        | χ² = 2.914, p = .088     |
| SCID-II number of comorbid axis-II disorders | .907 (1.06)             | .904 (1.06)                 | t(135) = −.14, p = .702  |
| SCID-II borderline personality disorder | 14%                     | 12.8%                       | χ² = 0.035, p = .849     |
| Inpatient treatment ever | 74.3%                    | 46.5%                       | χ² = 7.345, p = .007**   |
| Inpatient treatment last year | 35.3%                   | 18.3%                       | χ² = 3.656, p = .056     |
| Work incapacity          | 80.5%                    | 75%                         | χ² = 0.459, p = .498     |
| CTQ total                | 77.29 (20.235)           | 71.15 (18.057)              | t(120) = −1.704, p = .091|
| CTQ – Emotional abuse    | 17.85 (5.332)            | 17.63 (5.458)               | t(120) = −0.216, p = .830|
| CTQ – Physical abuse     | 12.05 (6.253)            | 10.40 (5.647)               | t(120) = −1.473, p = .143|
| CTQ – Sexual abuse       | 16.7 (7.11)              | 14.47 (7.27)                | t(119) = −1.223, p = .224|
| CTQ – Emotional neglect  | 19.49 (4.879)            | 17.44 (5.153)               | t(120) = −2.106, p = .037|
| CTQ – Physical neglect   | 11.73 (5.301)            | 11.38 (4.931)               | t(120) = −0.360, p = .719|
| MID mean score           | 42.13 (17.486)           | 21.74 (15.318)              | t(140) = −7.083, p < .001**|
| SDQ-20                   | 40.667 (12.249)          | 30.900 (9.057)              | t(101) = −4.545, p < .001**|
| DES total                | 42.785 (19.822)          | 18.912 (16.387)             | t(103) = −6.519, p < .001**|

*Data are shown as mean (SD) or percentages. PTSD, post-traumatic stress disorder; CDD, complex dissociative disorder; GSI, Global Severity Index; MINI, Mini-International Neuropsychiatric Interview; SCID-II, Structured Clinical Interview for DSM-IV Axis II Personality Disorders; CTQ, Childhood Trauma Questionnaire; MID, Multidimensional Inventory of Dissociation; SDQ, Somatoform Dissociation Questionnaire; DES, Dissociative Experiences Scale. *p < .05, **p < .01.

Table 3. Correlations between dimensions of trauma-related altered states of consciousness (TRASC) or normal waking consciousness (NWC), and measures of dissociation and childhood abuse.

|                      | DES | SDQ | CTQ – total | EA | PA | SA | EN | PN |
|----------------------|-----|-----|-------------|----|----|----|----|----|
| TRASC – Time         | .731** | .678** | .178* | .127 | .165 | .271** | −.017 | .006 |
| NWC – Time           | .566** | .338* | .127 | .157 | .015 | .099 | .121 | .042 |
| TRASC – Thought      | .662** | .608** | .139 | .094 | .091 | .233** | .034 | −.075 |
| NWC – Thought        | .515** | .409** | .047 | −.052 | −.049 | .054 | −.100 | −.057 |
| TRASC – Body         | .777** | .787** | .230* | .146 | .162 | .280** | .072 | .095 |
| NWC – Body           | .548** | .44** | .267** | .208* | .169 | .244** | .140 | .115 |
| TRASC – Emotion      | .801** | .718** | .327** | .225* | .269* | .213* | .189* | .182* |
| NWC – Emotion        | .546** | .364** | .033 | .057 | .108 | .043 | .047 | −.073 |

DES, Dissociative Experiences Scale; SDQ, Somatoform Dissociation Questionnaire; CTQ, Childhood Trauma Questionnaire; EA, emotional abuse; PA, physical abuse; SA, sexual abuse; EN, emotional neglect; PN, physical neglect. All forms of childhood abuse were measured with the CTQ.

*p < .05, **p < .01.

Hypothesis 5. Experiences of TRASC will be more strongly related to other measures of dissociation than experiences of NWC.

As reported in Table 3, both NWC and TRASC across all dimensions were significantly correlated with other measures of dissociation. NWC distress failed to significantly incrementally predict scores on DES beyond TRASC scores (ΔR² = .009, total R² = .763, ΔF change = 3.681, p = .058), but slightly improved the model for SDQ (ΔR² = .018, total R² = .684, ΔF change = 5.742, p = .018). By contrast, symptoms of TRASC incrementally improved predictions for DES (ΔR² = .273, ΔF = 117.57, p < .001) and SDQ (ΔR² = .428, ΔF = 135.35, p < .001) beyond symptoms of NWC, supporting the hypothesis. These results were largely replicated in both subsamples when analysed separately (see supplementary material).
4. Discussion

The results of this study found general support for the predictions of the 4-D model of dissociation (Frewen & Lanius, 2015). The theoretical distinction between reactions that are inherently dissociative (TRASC) and those that may remain part of normal waking consciousness (NWC) revealed predicted endorsement rates and correlations with other measures of dissociation across the sample of patients with PTSD with and without comorbid CDD. The separation of these two constructs was supported, even when measured in a highly traumatized sample and using only items from an inventory designed to assess pathological dissociation. These results replicate findings from previous investigations in patients with PTSD (Frewen et al., 2014; Frewen & Lanius, 2014b) and bipolar disorder (BPD) (Frewen et al., 2014), acutely traumatized individuals (Frewen et al., 2015), and online (Frewen et al., 2017; Tzannidakis & Frewen, 2015) and student samples (Brown & Frewen, 2017; Frewen & Lanius, 2014b). The focus on TRASC, defined as non-self-referential alterations of consciousness, therefore, in our opinion, represents a promising narrowing and delineation of the term dissociation.

The results also represent a noteworthy expansion of previous empirical support for the 4-D model in that the predictions are supported in the sample with comorbid CDD, and the finding that experiences of TRASC specifically predicted CDD membership beyond PTSD status and levels of general

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**Figure 1.** Mean symptom endorsement for each dimension of trauma-related altered states of consciousness (TRASC) and normal waking consciousness (NWC) compared in patients with and without complex dissociative disorder (CDD).

*p < .05, **p < .01.

**Table 4.** Logistic regressions predicting a comorbidity of complex dissociative disorder.

| Dimension | β (SE) | OR | χ² (df) | Model r² (Nagelkerke) |
|-----------|--------|----|---------|-----------------------|
| Mean      | TASC   | .758 (.218)** | 2.133 | 22.902 (114)** .250 |
|           | NWC    | .042 (.157)  | 0.959 | 0.075                 |
| Time      | TASC   | .233 (.112)** | 1.263 | 6.360 (112)* .138   |
|           | NWC    | .039 (.094)  | 1.040 |                      |
| Thought   | TASC   | .353 (.115)** | 1.424 | 12.091 (114)** .165 |
|           | NWC    | .010 (.094)  | 1.010 |                      |
| Body      | TASC   | .393 (.125)** | 1.482 | 14.284 (111)** .215 |
|           | NWC    | .022 (.078)  | 1.022 |                      |
| Emotion   | TASC   | .526 (.145)** | 1.446 | 25.419 (114)** .275 |
|           | NWC    | .144 (.100)  | 1.155 |                      |

TRASC, trauma-related altered states of consciousness; NWC, normal waking consciousness. Age and Global Severity Index were included as parameters. *p < .05, **p < .01.
psychopathology. It is worth noting that although the 4-D model aims to describe pathological dissociation, it does not specifically address the diagnostic criteria of CDD (e.g. amnesia and identity alterations). As such, the items used to operationalize TRASC in this study do not measure presumed core symptoms of CDD, such as significant time loss, dissociative fugue or the presence of alters/parts of the personality. As previously noted, the 4-D model holds that experiences of TRASC do not occur exclusively within the context of identity fragmentation. This is evident in the present study, as PTSD patients without CDD comorbidity also endorsed having experiences of TRASC, albeit to a lesser degree than those with CDD comorbidity. This supports the 4-D model as a framework for understanding dissociation across different clinical presentations with different levels of psychopathology and trauma exposure.

We did not find support for the prediction that experiences of TRASC would be less intercorrelated than experiences of NWC, replicating the findings from a previous investigation in patients with BPD (Frewen et al., 2014), but contrasting with findings from samples with less pronounced psychopathology. This might point to dissociation forming a more unidimensional structure, across the four dimensions, in more clinically severe and trauma-affected samples. It is conceivable that experiences of TRASC are experienced as isolated or transient phenomena for less severely traumatized individuals, but are more pervasive across the dimensions of conscious awareness in those affected by severe childhood trauma. People with DID for instance, with distinct dissociative identity states, can typically experience a full range of dissociative phenomena simultaneously. However, the original prediction of the 4-D model regarding symptom intercorrelations refers to state-dependent assessment, that is, as taking place during discrete moments in time, which remains to be investigated.

As in previous investigations of the model in trauma-affected samples, the relationship between dissociation and trauma history was more complex than predicted, with only sexual abuse emerging as a consistent correlate of TRASC. This is in line with a recent meta-analytic review (Vonderlin et al., 2018) that also found CSA to be especially strongly related to dissociation, when compared to neglect and emotional abuse. CSA has also been identified as a potent risk factor for auditory hallucinations (Bentall et al., 2014), which are conceptualized as a symptom of TRASC in the 4-D model. Furthermore, higher reporting of childhood emotional neglect emerged as the only significant difference between patients with and without CDD comorbidity. Although physical abuse and sexual abuse are mostly hypothesized as etiological factors in the development of CDD (Brand & Frewen, 2017; Dalenberg et al., 2012), this may point to a role of experiences of emotional neglect in the development of CDD comorbidity. For example, DePrince, Huntjens, and Dorahy (2015) found alienating appraisals (i.e. 'I am

| NWC Time | NWC Thought | NWC Body | NWC Emotion | TRASC Time | TRASC Thought | TRASC Body | TRASC Emotion |
|----------|-------------|----------|-------------|------------|--------------|-----------|---------------|
| NWC Time | .616        | .481     | .432        | .533       | .419         | .436      | .469          |
| NWC Thought | .442      | .619     | .536        | .536       | .453         | .419      |               |
| NWC Body | .347        | .578     | .433        | .493       | .415         |           |               |
| NWC Emotion | .496      | .526     | .417        | .476       |             |           |               |
| TRASC Time | .6         | .616     | .59         |           |             |           |               |
| TRASC Thought | .625      | .554     |             |           |             |           |               |
| TRASC Body |           | .692     |             |           |             |           |               |

Figure 2. Intercorrelations between the four different dimensions of trauma-related altered states of consciousness (TRASC) and normal waking consciousness (NWC). All correlations are significant at $p < .001$. 

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disconnected from people’, ‘I feel lonely’) to distinguish patients with DID from those with PTSD, perhaps reflecting disturbances in the sense of self and others related to experiences of neglect.

It should be noted as a limitation that information on trauma history in this study was based on retrospective reporting, so possible recall bias may influence group differences. The measurement used did not provide detailed information related to the abuse, such as age of onset, number of events or relation to perpetrator. Also, as childhood abuse was an inclusion criterion for the study, the general level of abuse reported was very high. This makes it difficult to differentiate between groups and identify strong effects.

The implications drawn from this study must be further interpreted with caution owing to several other limitations. As in most previous investigations of the 4-D model, the operationalization of the constructs was based on a measure that was not originally designed to capture this specific model. Therefore, some constructs were less well represented in the MID and based on few or single items. The study was also based entirely on self-reports of dissociative symptoms, measured at a single time-point, and thus future research should examine the possibility of using observer-based data and repeated measurements. In addition, the sample in this investigation consisted entirely of help-seeking patients with PTSD and histories of childhood abuse, with the large majority being female. Generalizing the findings to men and less trauma-affected populations should be done cautiously. Finally, the study did not differentiate between PTSD patients with and without a dissociative subtype (Lanius et al., 2012, 2010). The dissociative subtype has been shown to be especially prevalent in PTSD patients with histories of childhood abuse, and it is therefore probable that a substantial proportion of patients in this sample would fulfill criteria for DPTSD. Future research should differentiate between PTSD and DPTSD patients, as this subgroup will probably confound results.

In spite of these limitations, this study expands on the empirical support for the 4-D model as a promising theory for understanding trauma-related reactions and disorders. Lanius (2015) further outlines how the model could guide treatment for trauma-affected patients, as TRASC of different dimensions of consciousness may require different treatments, something that future clinical studies could investigate. Studies on the impact of dissociation on treatment show inconsistent results, with some studies finding dissociation to predict poorer response (Bae, Kim, & Park, 2016; Kleindienst et al., 2016) while others fail to find such an effect (Minnen & Harned, 2012; Zoet, Wagenmans, van Minnen, & de Jongh, 2018). Heterogeneity in how dissociation is measured and conceptualized may influence the results, making it important to investigate whether experiences of TRASC affect treatment outcome; such an evaluation is planned for the present randomized controlled trial. Finally, the 4-D model can inform the limited literature on treatment of CDDs. Although psychotherapeutic treatment of these disorders has been shown to be beneficial (Brand et al., 2012), little is known about specific interventions and change mechanisms. Interventions aimed at symptoms of TRASC, as well as the proposed underlying non-self referential processing, may have promise for this patient group.

Disclosure statement

No potential conflict of interest was reported by the authors.

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