Personality and Individual Differences 202 (2023) 111952

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Psychological trauma, mood and social isolation do not explain elevated dissociation in functional neurological disorder (FND)

S.R. Blanco [a,b,*], S. Mitra [a], C.J. Howard [a], A.L. Sumich [a,c]

[a] Nottingham Trent University, 50 Shakespeare Street, Nottingham NG1 4FQ, UK
[b] Psychology Division, Bishop Grosseteste University, Lincoln, United Kingdom
[c] Auckland University of Technology, North Shore Campus Northcote, Auckland 1142, New Zealand

ARTICLE INFO

Keywords:
Dissociation
Functional Neurological Disorder
Psychological trauma
Anxiety
Depression
Social isolation

ABSTRACT

Functional Neurological Disorder (FND) results in altered motor, sensory and cognitive function in the absence of evident organic disease. It often co-occurs alongside dissociative disorders and dissociation has been found to be high in patients across FND subtypes (particularly in those with Non-Epileptic Attack Disorder; NEADs). However, the presence of dissociation in FND is varied and there are contradictory definitions and suggestions for elevated levels. Here, three studies show that dissociation is a prominent, defining feature of people with FND compared to those who are healthy or have other, similar long-term health conditions, and that this heightened dissociation is not explained by a history of trauma (study 1, $N = 121$), mood (study 2, $N = 589$) and is not associated with social isolation/social exclusion (study 3, $N = 542$). As dissociation appeared to occur in FND in the absence of the usual contributing factors, and as higher levels of dissociation were associated with increased disability and illness impacts, understanding its role is of fundamental importance to developing our understanding of FND. These findings have further applications, beyond the theoretical, in clinical settings and in research; the implications for further research are discussed.

1. Introduction

In Functional Neurological Disorder (FND), motor and sensory symptoms (including seizures, movement disorders, loss or reduced sensory functions amongst others) occur in the absence of identifiable organic disorder or neurological disease (American Psychiatric Association, 2013). FND can be accompanied by severe pain and chronic symptoms, which have considerable impact on patients' quality of life and psychosocial functioning, resulting in significant health and social care costs (Carson et al., 2011). Biopsychosocial frameworks acknowledge a wide variety of predisposing, precipitating and perpetuating influences which can contribute toward FND, and the maintenance of symptoms (McKee et al., 2018; Reuber, 2009) though the degrees to which they do and the influence of these on symptoms and illness outcomes is widely disputed. Research is expanding, yet the mechanisms underlying FND remain little understood and whilst models are continuing to evolve there is no one favored theoretical framework. Nonetheless, models have begun to diverge from simplistic trauma-centered models and advocate distortions in (and disruptions to) usually integrated higher-order cognitive processes i.e., sensory or motor processing (Brown, 2004; Edwards et al., 2012; Van den Bergh et al., 2017). Accumulating evidence implicates dissociation (Kozlowska, 2017), atypical sensory processing (Brown et al., 2007; Pick et al., 2017) and altered processing of sensory-motor signals (Edwards et al., 2012; Van den Bergh et al., 2017) in the development and maintenance of FND. Some subtypes of FND also show atypical emotional function (Pick et al., 2019) or prominent alexithymia (the inability to identify one's own feelings; Demartini et al., 2016; Steffen et al., 2015), and it is often considered that FND has a co-occurrence with mood disorders (Brown and Reuber, 2016; Pick et al., 2016). However, little is understood about the potential underlying mechanisms for FND, nor the relationships between them, and current models fail to account for all symptoms and varying degrees of severity; continued research in this field is essential for advancing knowledge of the condition.

Dissociation has long been considered as underpinning FND (since the work Janet, 1907) and remains upheld by the World Health Organization's (World Health Organization, 2018) classification which defines FND as “dissociative neurological symptom disorder”. On-the-

Abbreviations: FND, Functional Neurological Disorder.

* Corresponding author at: 50 Shakespeare Street, Nottingham NG1 4FQ, UK.
E-mail address: stephanie.blanco@ntu.ac.uk (S.R. Blanco).

https://doi.org/10.1016/j.paid.2022.111952
Received 1 December 2021; Received in revised form 14 October 2022; Accepted 18 October 2022
Available online 5 November 2022

other-hand, DSM-5, has adopted "functional neurological symptom disorder", categorised in somatic symptom disorders. Dissociation refers to a pathological process of disconnection in which sensory awareness is altered or there is a loss of typical integration of mental processes, including sensorimotor functions, emotions, memories, awareness, movement, thoughts and affect (World Health Organisation, 1992). Subtypes of dissociation may include *detachment*, an altered state of consciousness in which there is separation from the self (*depersonalisation*), or the world (*derealisation*) and *compartmentalizing*, an inability to deliberately control actions or cognitive processes that would normally be amenable to such control (Holmes et al., 2005). Biopsychosocial frameworks acknowledge dissociation as a predisposing factor for FND (McKee et al., 2018), rather than a symptom or precipitating factor, which the current set of studies aims to explore.

The role of dissociation in FND is in part supported by the co-occurrence of FND with other dissociative disorders (e.g., dissociative identity, dissociative amnesia), which may reflect shared risk factors (e.g., traumatic life events, hypnotic susceptibility) and/or biological mechanisms (Brown et al., 2007). Moreover, in self-report scales, individuals with FND show higher psychological (Goldstein and Mellers, 2006; Perez et al., 2018; Reuber et al., 2003; Şar et al., 2004) and somatoform (Brown et al., 2013; Pick et al., 2017; Sar et al., 2009) dissociation, particularly in non-epileptic attack disorder (NEADs) subtypes (Prueter et al., 2002) to a similar degree as in borderline personality disorder and post-traumatic stress disorder (PTSD; see meta-analysis by Lyssenko et al., 2018). Further evidence for dissociation in FND comes from findings that normal muscle power or changes in the frequency or character of tremors are observed when an individual with FND is distracted from the movement (Carson et al., 2015; Daum et al., 2015). Hoover's tests are commonly used as positive diagnostic tools with high specificity for FND (McWhirter et al., 2011), suggesting issues with distorted attention across the patient group. Recently, studies have found that reduced interoceptive awareness is associated with increased dissociation in NEADs (Yogarajah et al., 2019) and FND (Pick et al., 2020), which could account for clinical observations of sensory disturbances and loss of sense of internal bodily changes. Thus, dissociation appears to be a common feature across FNDs, though research has yet to establish this or the potential causes of heightened dissociation in FND (for example if this is a symptom of the illness or a result of other mechanisms such as mood or trauma).

Interpretation of elevated dissociation in FNDs is varied, with several contradictory suggestions (Nijenhuis and van der Hart, 2011). For example, Myers et al. (2019) and Williams et al. (2020) interpret positive symptoms of dissociation as being formed through the conversion of intrusive traumatic memories, comparable to the symptoms' presence in psychological disorders, (e.g., PTSD; Myers et al., 2019). Many authors suggest that the presence of traumatic experiences mediates this relationship with dissociation, leading to increased susceptibility to the development of FND (Diez et al., 2020; Levita et al., 2020; Wieder and Terhune, 2019). However, the DSM-5 changed its criteria, removing the need for psychological precipitating events owing to limited and inconsistent evidence; many patients report physical (rather than psychological) traumatic events at the onset of symptom development (Pareés et al., 2014). For example, there are reports of infections and other physical injuries, in the absence of any known psychological trauma, preceding the onset of FND, though physical traumas can elicit an emotional response too. Whilst the DSM-5 is considered to be a diagnostic nosology, and the subjective nature of its various diagnostic categories is widely accepted, other diagnostic manuals including the ICD-11 (World Health Organization, 2018) have endorsed similar changes owing to the expanding evidence base and the need to positively differentiate FND from other disorders (Nicholson et al., 2020). Nevertheless, dissociation remains high within the patient group. Thus, dissociation might be considered as an autonomous symptom in FND, and whether it is exacerbated by traumatic experiences remains unclear.

In Edwards et al. (2012)'s prevailing model, FND is framed as arising from distortions between top-down and bottom-up processing, implicating dissociation in the separation of (normally integrated) executive control functions. This model is analogous to mechanisms proposed to underpin some symptoms of ADHD (Mattfeld et al., 2016) and certain positive symptoms in schizophrenia (Akbey et al., 2019; Sumich et al., 2018, 2008). Whilst such diagnoses are subject to discussions of validity themselves in the absence of biomarkers (much like FND) and are highly subjective, the models here might explain the role of dissociation as an autonomous symptom. However, the origins of dissociation remain unclear and little is understood about the relationship between dissociation via usual ACES (including mood, life events, trauma) or the role of potential protective factors like social support. Further, an increased understanding of the factors that contribute toward functional impairments could allow for the progression and advancement of theoretical models and treatment options for FND.

Through online cross-sectional research, the current three-study project aims to establish whether dissociation is a prominent feature in FND (a finding which could distinguish it from other, similar long-term conditions) and to identify whether usual explanatory factors (mood, a history of trauma or social isolation) can adequately explain levels of dissociation in FND. More specifically, the association between implicated triggers for FND and the presence of dissociation is investigated, with four primary aims: i) to assess whether dissociation is a prominent feature in FND (Study 1,2,3); ii) to test relationships between a history of trauma and the presence of dissociation (Study 1); iii) to test relationships between mood (anxiety, depression and stress) and the presence of dissociation (Study 2), and (iv) to test whether dissociation might be associated with social isolation, common in FND (Study 3). To address the first research aim, study 1 compared dissociation scores between those with FND and healthy controls and studies 2 and 3 compared dissociation scores between those with FND, healthy controls and those with other long-term disorders. To address the second aim, study 1 measured levels of trauma and dissociation in those with FND and in comparison, to a healthy control group. To address the third aim, study 2 measured the relationships between mood scores (anxiety, depression and stress) and explored the relationship between these to dissociation in a cohort of those with FND and in comparison to both a healthy control group and a long-term conditions group. To address the fourth aim, study 3 measured social isolation and explored the relationship between this and dissociation in an FND group, a healthy control group and a long-term conditions group.

1.1. Hypotheses

- Those with FND will show higher levels of dissociation that the two control groups (Healthy control and LTD) and those in the long-term conditions group will show higher dissociation levels than those in the healthy control group;
- Dissociation will correlate with dissociation in both the FND and Healthy control group and this will result in positive correlations in both groups between dissociation and trauma;
- Scores for anxiety, depression and stress will positively correlate with dissociation scores in each of the three groups (FND, Healthy and LTD) and mood scores will be higher for those in the FND group than the healthy and LTD groups;
- Levels of social isolation will positively correlate with dissociation in each of the three groups (FND, Healthy and LTD) and self-reported social isolation scores will be higher for those with FND.

2. Methods

2.1. Ethics

Ethical approval for the following studies was provided by the University's College Research Degrees Committee (CRDC). Standards and practices of research were followed as outlined by the British

Table 1
Test statistics for FND and Control groups for anxiety, depression, life events, total self-reported dissociation (and each of the four subscales of dissociation; Study 1).

Variable	*M*		*SD*		*F*	*95 % CI*	*p*
	FND	Control	FND	Control			
Anxiety	16.77	14.49	3.51	3.39	16.75	[0.0252, 0.1820]	<0.001
Depression	16.02	13.26	3.56	3.29	24.77	[0.0492, 0.2269]	<0.001
Life events	1.06	1.39	11.73	9.93	3.59	[0.0000, 0.0819]	0.064
Total dissociation	10.14	5.97	4.11	2.10	54.55	[0.1422, 0.3504]	<0.001
Depersonalization/decentralisation	2.93	1.47	1.21	0.71	71.96	[0.1925, 0.4038]	<0.001
Gaps	3.22	1.94	1.25	0.92	48.83	[0.1247, 0.3304]	<0.001
Sensory dissociation	1.92	1.23	1.02	0.43	25.26	[0.0507, 0.2295]	<0.001
Re-experiencing	2.06	1.32	1.15	0.47	23.49	[0.0452, 0.2202]	<0.001

Psychological Society (BPS), especially guidelines pertaining to online mediated research (British Psychological Society, 2013).

2.2. Design

The current project comprises three online cross-sectional studies in three volunteer (unpaid) cohorts. Participants with FND were recruited through advertisements with charitable organisations and support groups. Controls (healthy participants with no pre-existing mental or physical health conditions) were recruited through existing online platforms and snowballing. In studies 2 and 3, a long-term disability group (LTD) formed an additional control. LTD had conditions characterized by similar physical impairments to those with FND, which had lasted for >6 months. To recruit the LTD group, several support groups who supported people with conditions including Multiple Sclerosis, Elher-Danlos Syndrome, Epilepsy, Chronic Fatigue Syndrome and Fibromyalgia, advertised the study link. Much of the sample consisted of UK participants, the demographic variables for each cohort are provided in the studies below. All participants were over the age of 18 and reported being fluent in English language. Whilst additional demographic information would have added to the strength of the data collected, additional data regarding demographics (including SES, education and employment status) proved challenging to collect and analyse robustly and thus are not described within the manuscript. Data were collected using an online survey collection platform (Qualtrics) and an anonymous link was distributed to participants. Results were analysed using IBM SPSS V.24.

2.3. Power & sample size

Given that the proportion of missing data is directly attributed to the quality of statistical inferences, these three studies removed participants from the analysis if they had >10 % missing data (whilst not a commonly applied rule Bennett (2001) states that statistical analysis is more likely to be biased beyond this threshold). Given the equal importance of sample size and quality of the data, a priori power analysis was conducted using using G*Power version 3.1.9.7 (Faul et al., 2007), which generates minimum sample size requirements based on effect size, error probability, degrees of freedom, number of groups and covariates. Results indicated the required sample size to achieve 80 % power for detecting a medium effect, at a significance criterion of $\boldsymbol{a} = 0.05$, was $N = 225$ for MANOVA global effects. G*Power suggested we would need a minimum of 55 participants per group in an independent samples *t*-test. Minimum recommended sample sizes were exceeded in all studies (post data removal, based on missing values). Effect sizes were calculated by Eta Squared and interpreted based upon Cohen's (1988) cut-off values and confidence intervals have been reported at 95 %.

3. Study 1

3.1. Aim

Study 1 aimed to assess whether dissociation is higher in those with FND, relative to healthy controls and if dissociation scores hold a relationship with adverse life experiences.

3.2. Participants

Participants (67.03 % UK residents) with FND ($N = 121$; 14 males, 107 females) and healthy controls ($N = 64$, 10 males, 54 females) were aged 18–72 years (entire group *M*age = 37.23, *SD* = 12.09; FND participants' *M*age = 38.35, *SD* = 10.88; Controls *M*age = 35.11, *SD* = 13.94).

3.3. Procedure

Participants completed an online self-report survey with questions on demographics (i.e., health status, age, sex and country of residence), and psychometrics (assessment of anxiety, depression, dissociation and life events).

3.4. Self-report scales

3.4.1. Anxiety

Anxiety was measured using a 10-item (5 negatively scored) subscale from Jackson's Personality Inventory-Revised (JPI-R; Jackson, 1994). Responses were scored on a true-false scale with scores ranging from 10 (low anxiety) to 20 (high anxiety), with high scores indicating higher anxiety. The scale was selected due to its short form, good reliability and psychometric properties (Cronbach's Alpha = 0.87).

3.4.2. Depression

Depression was assessed using a 10-item (3 negatively scored) subscale from the Revised NEO Personality Inventory (NEO-PI-R; Costa and McCrae, 2008). Responses were scored on a true-false scale with a total score range from 10 (low depression) to 20 (high depression). The scale has good psychometric properties and good reliability (Cronbach's = 0.88).

3.4.3. Dissociation

Dissociation was measured using the 20-item Dissociative Symptoms Scale (DSS; Carlson et al., 2018). Examinations of misperceptions, cognitions and behaviours were measured across four subscales, i) distortions in perceptions of the self/surroundings (decentralisation/depersonalisation), ii) experiences of gaps in awareness/memory, iii) sensory misperceptions and iv) trauma-related re-experiencing. The mean of each of the subscales is summed to create an overall dissociation score, where high scores equate to higher levels of dissociation. The authors reported the reliability of the scale to be 0.82 (as measured by Cronbach's alpha) with good properties when considered as a whole or product of subscales and with high re-test reliability.

Table 2
Pearson's correlation coefficients for dissociation, anxiety, depression and life events for the healthy control and FND group (Study 1).

Group	Variable	Dissociation	Anxiety	Depression	Life events
Dissociation					
Control	Anxiety	0.130			
	Depression	0.165	0.728**		
	Life events	0.457*	−0.058	−0.115	
FND	Anxiety	−0.004			
	Depression	−0.014	0.877**		
	Life events	0.072	−0.079	0.125	

Note: significant indicated by * $p < .05$. ** $p < .01$.

3.4.4. Life events

The Davidson Trauma Scale (DTS; Davidson et al., 2002) was used to measure the impact of life events and presence of negative, traumatic experiences. This 17-item scale measures life events on a 5-point frequency and severity scale with scores ranging from 0 (no impact) to 68 (high impact). The scale assesses a range of life events and is robustly tested across multiple populations with good reliability (Cronbach's alpha = 0.86).

3.5. Statistical analysis

Preliminary analyses were performed to assess the assumptions of normality, linearity, homogeneity of variance-covariance matrices and multicollinearity. No scale, or subscale was excluded because of data not being normally distributed (see Appendix A). MANOVA was used to compare scores between the *Groups* (FND and Healthy) on anxiety, depression, dissociation and life events. Pearson's Correlations tested for the relationship between dissociation, anxiety, depression and life events. Fisher's *Z*-tests were computed to compare the magnitude of these correlations between the FND and Healthy groups.

4. Results Study 1

Table 1 shows the descriptive statistics, *F*-values and significance for the groups for anxiety, depression, life-events and dissociation (total dissociation and the four subscales). A statistically significant MAOVA effect was obtained, Pillais' Trace = 0.35, $F(4, 162) = 21.70$, $p < .001$. Significantly higher scores were seen in the FND group relative to healthy controls for anxiety ($F(1, 165) = 16.75$, $p < .001$, $\eta^2 = 0.092$, moderate effect size) and depression ($F(1, 165) = 24.77$, $p < .001$, $\eta^2 = 0.131$, moderate effect size). There was no significant differences between FND and controls life-events, $F(1, 165) = 3.59$, $p = .064$, $\eta^2 = 0.021$, small effect. Compared to controls, FND showed higher mean and greater standard deviation for dissociation and the difference in total dissociation scores was significant, $F(1,17) = 54.55$, $p < .001$, $\eta^2 = 0.248$, large effect,. Univariate analyses of the subscales of dissociated showed effects of *Group* in all four subscales showed this effect was present for all four subscales with FND scoring significantly higher in all subscales: Decentralisation/depersonalisation ($F(1, 165) = 71.96$, $p < .001$, $\eta^2 = 0.30$); Gaps ($F(1, 165) = 48.83$, $p < .001$, $\eta^2 = 0.228$); sensory experiences ($F(1, 165) = 25.26$, $p < .001$, $\eta^2 = 0.13$; and re-experiencing ($F(1, 165) = 23.49$, $p < .001$, $= 0.05$, $\eta^2 = 0.13$).

Table 2 shows the Pearson's correlation coefficients for Anxiety, Depression, Life Events and Dissociation, separated by *Group*. In the healthy control group, there was a moderately strong, positive correlation between dissociation and life-events, $r = 0.616$, $p = .040$, 95 % CI [0.00, 0.08], but not between dissociation and anxiety ($p = .650$) nor between dissociation and depression ($p = .204$). In the FND group the relationship between dissociation and life-events was not significant ($p = .450$). No other significant correlations were found within the data.

To ascertain whether the magnitude of the correlations between the psychometric measures differed significantly between the two groups (FND and Healthy), two Fisher's *z*–Tests for multiple independent samples were conducted, followed by independent comparisons of correlation coefficients (using Fisher's z transformations where appropriate). Results revealed that the strength of the correlation between *Dissociation* and *Life Events* for those with FND ($z = 0.07$) and healthy controls ($z = 0.49$) were significantly different, $x^2(2) = 2.67$, $p = .008$, with this correlation being greater in the Healthy control group. The magnitude of the effect between *Anxiety* and *Depression* was significantly greater for the FND group ($z = 1.36$) than the Healthy Group, $z = 0.92$; $x^2(2) = 2.78$, $p = .005$.

4.1. Summary study 1

The results of Study 1 show that dissociation in individuals with FND is higher than in people without FND. This is the case across all the measured sub-facets of dissociation (derealization, gaps, sensory and re-experiences). Although participants with FND scored higher for anxiety and depression, they did not report significantly more adverse life-events, suggesting that they do not experience more trauma than those without FND. Unlike in the non-FND group, dissociation was not correlated with trauma in those with FND. Elevated dissociation scores were also unrelated to mood scores in the FND group. Thus, current results do not support an association between dissociation in FND and mood or psychological trauma. The comparison here was with a healthy (non-FND) sample, so it is not clear from these results whether this pattern of dissociation is unique to FND or a result of long-term chronic illness. Study 2 further investigated comparisons with other long-term health disorders (LTD).

5. Method Study 2

5.1. Aim

This study aimed to explore dissociation levels between those with FND, those with other long-term conditions and relatively healthy participants to make direct illness comparisons. Study 2 aimed to explore whether levels of dissociation differed between the three groups and if dissociation held a relationship with mood, impact of illness and/or levels of disability.

5.2. Participants

Participants ($N = 589$; 79 males, 4 gender fluid; 18–79 years $M = 37.04$, SD = 12.42) were recruited. Twenty-one participants were removed from the subsequent analysis due to missing data (>10 %) or for being outliers (with scores exceeding the critical value obtained via examination of Manhalonobis distance scores, see Appendix A, and examination of individual responses appearing indicative of abnormal responding from the populations which these cases were sampled from). The final cohort comprised, FND participants ($N = 277$; 24 males, *Mage* = 39.22, *SD* = 11.93), controls ($N = 202$; 49 males, *Mage* = 32.73, *SD* = 11.95) and a long-term disability control group (LTD; $N = 89$; 6 males, *Mag* = 40.35, *SD* = 11.95).

5.3. Self-report scales

All participants provided demographic information and completed Dissociation and mood self-report measures. Those in FND and LTD groups were asked to complete 3 additional scales in assessing impact of health (Impact of Illness and a Disability scale).

5.4. Scales completed by all groups

5.4.1. Dissociation

Dissociation was measured using the 20-item Dissociative Symptoms Scale (DSS; Carlson et al., 2018) as previously described in Study 1.

Table 3
Means, standard deviations, Cronbach's alpha and significant values of each of the tested variables for the three groups (Study 2).

Variables	FND		LTD		Controls		∝	f Statistic	95 % CI	p
	M	SD	*M*	SD	*M*	SD				
Anxiety	29.30	9.21	27.75	9.26	21.49	9.29	0.80	45.70	[0.0977, 0.2065]	**<0.001**
Depression	30.38	12.73	31.08	13.88	24.46	9.78	0.94	14.26	[0.0199, 0.0928]	**<0.001**
Stress	32.02	10.12	32/84	10.12	25.78	8.20	0.85	24.92	[0.0458, 0.1364]	**<0.001**
Dissociation (overall)	9.35	3.59	7.62	2.78	6.09	2.23	0.88	57.09	[0.1238, 0.2372]	**<0.001**
Decentralisation/depersonalization	2.77	1.12	2.20	1.12	1.14	0.61	–	95.49	[0.2070, 0.3279]	**<0.001**
Gaps	2.93	1.18	2.51	1.08	2.03	1.00	–	85.52	[0.1861, 0.3059]	**<0.001**
Sensory experiences	1.84	0.90	1.38	0.56	1.25	0.46	–	37.63	[0.0766, 0.1788]	**<0.001**
Re-experiencing	1.76	0.93	1.52	0.55	1.35	0.50	–	15.88	[0.0234, 0.0985]	**<0.001**

Note: In rows, interactions have been detailed along with relevant significant values. '-' has been used to represent where data was not available i.e. when testing was not conducted as it was not applicable to the interaction or when this test was not conducted.

Table 4
Correlations between dissociation scales, impact of illness and levels of disability separated by Group (Study 2).

Group	Variables	Anxiety	Depression	Stress	Impact of illness	Levels of disability	Dissociation (total)	Deper/ Dereal	Gaps	Sensory	*Re*-exp.
FND	Anxiety										
	Depression	0.689**									
	Stress	0.722**	0.724**								
	Impact of illness	0.379**	0.385**	0.278**							
	Levels of disability	0.300**	0.237**	0.252**	0.616**						
	Dissociation (total)	0.611**	0.604**	0.597**	0.449**	0.450**					
	Deper/dereal	0.516**	0.518**	0.511**	0.436**	0.439**	0.886**				
	Gaps	0.519**	0.530**	0.501**	0.440**	0.393**	0.898**	0.750**			
	Sensory	0.529**	0.478**	0.453**	0.339**	0.419**	0.857**	0.651**	0.691**		
	Re-exp.	0.567**	0.572**	0.613**	0.361**	0.301**	0.823**	0.621**	0.617**	0.695**	
LTD	Anxiety										
	Depression	0.683**									
	Stress	0.659**	0.882**								
	Impact of illness	0.455**	0.600**	0.547**							
	Levels of disability	0.455**	0.338**	0.285*	0.412**						
	Dissociation (total)	0.634**	0.600**	0.684**	0.456**	0.290**					
	Deper/dereal	0.594**	0.575**	0.666**	0.453**	0.363**	0.929**				
	Gaps	0.447**	0.555**	0.644**	0.453**	0.105	0.897**	0.761**			
	Sensory	0.573**	0.190	0.237*	0.138	0.282*	0.715**	0.572**	0.506**		
	Re-exp.	0.632**	0.674**	0.704**	0.423**	0.296**	0.825**	0.744**	628**	0.532**	
Healthy	Anxiety										
	Depression	0.617**									
	Stress	0.722**	0.718**								
	Impact of illness	–	–	–	–						
	Levels of disability	–	–	–	–	–					
	Dissociation (total)	0.794**	0.658**	0.662**	–	–					
	deper/dereal	0.805**	0.615**	0.642**	–	–	0.852**				
	Gaps	0.681**	0.639**	0.594**	–	–	0.913**	0.585**			
	Sensory	0.434**	0.358**	0.360**	–	–	0.759**	0.557**	0.585**		
	Re-exp.	0.699**	0.542**	0.609**	–	–	0.868**	0.729**	0.706**	0.589**	

** Highlights that correlation is significant at the 0.01 level.
* Indicates significance at the 0.05 level.

5.4.2. Mood

The Depression, Anxiety and Stress scale (DASS-21; Lovibond and Lovibond, 1995) is a 21-item scale (7-items each for depression, anxiety and stress). Scores on each of the subscales ranged from 0 (none) to 3 (usually/always). The scale assesses dysphoric mood states including self-depreciation, lack of interest, hopelessness, arousal states and emotional liability to stressors across the subscales. Summed scores were generated and multiplied by two to match the authors' recommendations. The scale has good psychometric properties (Cronbach's alpha = 0.80).

5.4.3. Additional scales completed by FND and LTD groups

5.4.3.1. Impact of illness. The impact of illness scale (Klimidis et al., 2001) was also used to measure impact of illness for FND and LTD groups. The 9-item scale is measured on a 4-point Likert scale from 0 (not at all) to (3) fully, giving potential scores of 0 (no impact) to 27 (strong impact). The scale measures the degree that any illness interferes with key roles and responsibilities associated with daily life, for example "To what extent has your capacity to carry out routine chores, been reduced?". This scale had good reliability measures (Cronbach's alpha = 0.93).

5.4.3.2. Disability scale. An adapted version of The Guy's Neurological

Table 5
Means, standard deviations, Cronbach's alpha and significant values of each of the tested variables for the three groups (Study 3).

Variables	FND		LTD		Controls		∝	f Statistic	95 % CI	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*				
Anhedonia	64.49	12.46	69.02	10.45	70.19	9.05	**0.88**	12.70	[0.0182, 0.0948]	**<0.001**
Anxiety	10.32	5.57	9.40	4.77	7.37	5.54	**0.93**	13.13	[0.0193, 0.0969]	**<0.001**
Depression	14.33	13.64	21.81	12.12	25.27	10.64	**0.94**	34.64	[0.0775, 0.1874]	**<0.001**
Social isolation	5.70	2.08	6.39	1.94	6.75	1.99	**0.83**	11.68	[0.0157, 0.0896]	**<0.001**
Social support	8.43	2.34	8.86	2.29	9.45	2.03	**0.71**	8.88	[0.0092, 0.0747]	**<0.001**
Stress	7.98	5.83	6.10	4.71	3.73	4.23	**0.93**	30.26	[0.0662, 0.1721]	**<0.001**
Dissociation (Total)	66.64	25.9	56.64	21.76	48.86	20.73	**0.96**	24.82	[0.0505, 0.1495]	**<0.001**
Disengagement	15.74	5.19	14.12	5.29	12.43	4.81	–	17.45	[0.0305, 0.1176]	**<0.001**
Identity	7.52	4.52	6.88	3.63	6.89	3.98	–	1.27	[0.0000, 0.0236]	0.281
Emotional	11.41	6.20	10.36	5.93	8.28	4.95	–	12.88	[0.0186, 0.0957]	**<0.001**
Memory	11.53	5.55	9.18	4.62	7.49	3.82	–	30.52	[0.0662, 0.1720]	**<0.001**
Depersonalisation	9.96	5.60	7.73	3.68	6.65	3.54	–	23.89	[0.0479, 0.1456]	**<0.001**
Derealisation	10.48	5.45	8.37	4.59	7.11	4.11	–	21.03	[0.0401, 0.1335]	**<0.001**

Note: Cronbach's alpha scores under the '∝' columns are bolded if deemed to be >0.7 and thus show good internal reliability. Significance is listed under 'p' column with sign and significant effects are bolded. In rows, interactions have been detailed along with relevant significant values. '-' has been used to represent where data was not available i.e. when testing was not conducted as it was not applicable to the interaction or when this test was not conducted.

Table 6
Correlations between dissociation, anhedonia, anxiety, stress, depression, social isolation and social support in the FND, LTD and Healthy Groups (Study 3).

Group	Variables	Anhedonia	Anxiety	Stress	Depression	Social isolation	Social support	Dissociation
FND	Anhedonia							
	Anxiety	−0.134						
	Stress	−0.125	0.809**					
	Depression	−0.329**	0.704**	0.724**				
	Social Isolation	−0.024	0.467**	0.437**	0.529**			
	Social Support	0.155*	−0.229**	−2.56*	−0.343**	−0.207**		
	Dissociation	−0.261**	0.617**	0.663**	0.687**	0.275**	−0.365**	
LTD	Anhedonia							
	Anxiety	−0.009						
	Stress	0.116	0.752**					
	Depression	−0.126	0.693**	0.592**				
	Social Isolation	0.013	0.301**	0.338**	0.352**			
	Social Support	0.127	−0.245**	−0.175*	−0.386**	−0.293**		
	Dissociation	−0.102	0.514**	0.531**	0.586**	0.259**	−0.358**	
Healthy	Anhedonia							
	Anxiety	−0.054						
	Stress	0.015	0.733**					
	Depression	0.052	0.710**	0.615**				
	Social Isolation	0.008	0.470**	0.393**	0.512**			
	Social Support	0.106	−0.272**	−0.245**	−0.396**	−0.278**		
	Dissociation	0.139	0.462**	0.679**	0.582**	0.329**	−0.277**	

** Highlights that correlation is significant at the 0.001 level.

Disability Scale (GNDS; Sharrack and Hughes, 1999) was used to measure levels of disability within the FND and other illness control group. Whilst the scale was designed for MS, at the time of data collection for this study, there were no published scales to measure disability in FND. The GNDS has demonstrated good reliability, re-test reliability and validity over the phone and through self-administration, Cronbach's = 0.96 (Rossier and Wade, 2002). The adapted scale had a total of 9-items measuring cognitive, visual, bladder, bowel, sexual, speech and motor impairments with high scores indicating high levels of disability. This scale showed good psychometric properties when used online in the current sample (Cronbach's alpha = 0.90).

5.4.3.3. Statistical analysis. Following preliminary analysis to ensure data assumptions were met, Multivariate analysis (MANOVA) were carried out to compare scores between the FND, LTD and Healthy control groups for anxiety, depression, stress and dissociation. Further analyses of variance explored illness effects (impact of illness and levels of disability) and Pearson's correlations were used to investigate relationships with dissociation. Fisher's *Z*-tests were computed to explore the magnitude of these correlations between the FND, LTD and Healthy groups.

6. Results Study 2

Table 3 shows the descriptive statistics, F/t values and significance for the groups for mood and dissociation.

There was a significant effect of *Group* on anxiety ($F(2, 510) = 45.70$, $p < .001$, $\eta^2 = 0.15$, large effect), depression ($F(2, 510) = 14.26$, $p < .001$, $\eta^2 = 0.05$, large effect size), and stress ($F(2, 512) = 24.92$, $p < .001$, $\eta^2 = 0.09$, moderate effect size). Post-hoc comparisons (using Turkey HSD) indicated higher scores in FND than controls for anxiety ($p = .006$), depression ($p = .001$) and stress ($p = .001$). The LTD group also showed significantly higher scores than controls for anxiety ($p = .001$), depression ($p = .001$) and stress ($p = .001$). There were no significant differences between the FND and LTD groups for anxiety ($p = .323$), depression ($p = .887$) and stress ($p = .778$).

There was an effect of *Group* on dissociation, $F(2, 516) = 57.09$, $p < .001$; $\eta^2 = 0.18$. Post-hoc comparisons (using Turkey HSD) indicated higher dissociation in FND than LTD and control ($p = .001$) groups. The LTD group had higher dissociation than controls ($p = .001$) Univariate analyses of subscales showed effects of *Group* in all subscales Decentralisation/depersonalisation ($F(2, 516) = 95.49$, $p < .001$, $\eta^2 = 0.27$, large effect); Gaps ($F(2, 518) = 85.52$, $p < .001$, $\eta^2 = 0.25$); sensory

experiences ($F(2, 518) = 37.63$, $p < .001$, $\eta^2 = 0.13$, moderate effect size); and re-experiencing ($F(2,5\ 18) = 15.88$, $p < .001$, $\eta^2 = 0.06$, small effect). In all cases, post-hoc comparisons indicated higher scores in FND than LTD (Decentralisation/depersonalisation $p < .001$; Gaps $p = .008$; Sensory $p < .001$; *Re*-experiencing $p = .034$). FND also scored higher than Healthy controls, in all cases (Decentralisation $p < .001$; Gaps $p < .001$; Sensory $p < .001$; Re-experiencing $p < .001$).

6.1. Effects of illness

Higher scores were seen in the FND group ($\overline{M}\ M = 26.51$, $SD = 4.98$) relative to the LTD group ($M = 25.12$, $SD = 5.18$) for impact of illness $F(1, 357) = 4.96$, $p = .027$, $\eta^2 = 0.026$, small effect. Higher scores were also seen in the FND Group ($M = 22.30$, $SD = 5.01$) than the LTD group ($M = 19.14$, $SD = 5.50$) for levels of disability, $F(1, 342) = 23.48$, $p < .001$, $\eta^2 = 0.08$, moderate effect size.

Table 4 shows the Pearson's correlation coefficients for impact of illness, levels of disability and dissociation for each group. Correlations with mood were not significant, replicating the findings of study 1. There was a strong, positive correlation between disability levels and impact of illness in the FND group, $r = 0.616$, $n = 349$, $p < .001$, 95 % CI [0.55, 0.68]. There were moderately strong, positive correlations between dissociation and impact of illness, $r = 0.449$, $N = 349$, $p < .001$, 95 % CI [0.36, 0.53] and dissociation and levels of disability, $r = 0.450$, $n = 349$, $p < .001$, 95 % CI [0.37, 0.53]. Subscales for dissociation were correlated with impact of illness and levels of disability.

To ascertain the magnitude of the correlations for impact of illness measures between the FND and LTD Groups, three Fisher's *z*-tests for independent samples were conducted. Results revealed that the strength of the correlation between impact of illness and levels of disability for those with FND ($z = 0.67$) and LTD ($z = 0.41$) were significantly different, $x^2(2) = 2.27$, $p = .023$. The correlations between dissociation and impact of illness ($p = .943$) and dissociation and levels of disability ($p = .132$) did not significantly differ between the two groups.

6.2. Summary study 2

Whilst those with FND scored higher on mood measures (anxiety, depression and stress) than healthy controls (mimicking the results from Study 1), they did not score significantly higher on these measures when compared to the LTD group. This suggests that high anxiety, depression and stress may not be specific to those with FND, rather it could result from living with a long-term chronic illness and associated changes in quality of life, self or economic status and/or shared underpinning biological mechanisms of long-term ill health, such as inflammation. The FND group did however report significantly higher impact of illness and greater levels of disability than the LTD group. Elevated levels of dissociation were found for the FND group relative to both the healthy and LTD groups. This suggests that dissociation may be a prominent feature of FND that distinguishes the condition from other long-term illnesses, especially as dissociation is also associated with the impact of illness and increased disability in the FND group. However, social and environmental factors (e.g., social isolation) are also known to increase dissociation in interaction with biological drivers (Nijenhuis and van der Hart, 2011). Moreover, living with a long-term condition or disability can increase risk for social isolation/exclusion (Guilcher et al., 2021; O'Grady et al., 2004), impacting self-concept and/or social support (Dalenberg and Carlson, 2012). Therefore, in study 3 we assessed the relationship between social isolation and dissociation between FND, LTD and healthy groups.

7. Methods Study 3

7.1. Aim

Social isolation/exclusion is often experienced by those with long-term chronic illnesses (Cacioppo and Hawkley, 2003; Dalenberg and Carlson, 2012). However, it is unclear whether this relates to Dissociation in FND. Studies 1 and 2 did not show a relationship with adverse life-events or mood and dissociation in FND, however given such high levels of dissociation in the patient group this could represent a detachment of emotion for the participants rendering self-report of emotions difficult. The current study thus explored the relationship between dissociation and social isolation during COVID-19 restrictions between three groups: FND, LTD and healthy controls. In addition, dissociation was explored with reference to Anhedonia, as this emotional detachment could account for an inability to self-identify and therefore report mood scores in the FND cohort. The study used different scales to those previously tested to ensure that results were not reliant upon specific psychometric measures.

7.2. Participants

Participants ($N = 542$; 158 males, 382 females, 2 gender fluid) took part in an online questionnaire. Eighty-two participants were removed from the subsequent analysis as they had >10 % data missing or were deemed to be outliers in preliminary analysis (11 cases had a score exceeding the critical value obtained via Manhalonobis distances and after examination of individual cases by response pattern these cases were removed, see Appendix A for additional clarity). The final sample comprised FND participants ($N = 163$; $Mage = 43.41$, $SD = 12.79$), healthy controls ($N = 202$; $Mage = 35.11$, $SD = 14.17$) with no long-term or physical health conditions and a long-term disability control group (LTD; $N = 129$; $Mage = 37.51$, $SD = 12.52$) were recruited using the same methods as study 2.

7.3. Self-report scales

7.3.1. Anhedonia

Anhedonia was measured using the 17-item Dimensional Anhedonia Rating Scale (DARS; Rizvi et al., 2015). Responses across four subscales, on a 5-point rating system, were averaged to create a total anhedonia score. The scale considers assessment of anhedonia across areas such as interest, motivation, effort and pleasure and showed good reliability (Cronbach's alpha = 0.88).

7.3.2. Anxiety & stress

Anxiety and Stress were measured using subscales from The Depression Anxiety Stress Scale (DASS-21; Lovibond and Lovibond, 1995), described in Study 2.

7.3.3. Depression

Depression was assessed using The Beck's Depression Inventory (BDI-II) which contains 21 items on a 4-point scale from 0 (symptom absent) to 3 (severe symptoms). Affective, cognitive, somatic and vegetative symptoms are assessed, reflecting the DSM-IV criteria for major depression (Steer et al., 2000). Scoring was computed as per the scales recommendations with scores ranging from 0 to 63 and high scores indicating greater symptom severity. In non-clinical populations, scores above 20 indicate depression. The internal consistency was very good (Cronbach's alpha = 0.94).

7.3.4. Dissociation

Briere et al. (2005)'s Multiscale Dissociation Inventory (MDI) was used to assess dissociation across 6 subscales; Disengagement, Identity, Emotional, Memory, Depersonalisation and Derealisation. The 30-item scale also generates a total dissociation score. The scale asks people to

consider how often they find themselves in particular circumstances or feeling dissociative tendencies e.g., "Feeling like you don't belong in your body". The scale showed good psychometric properties and good internal consistency (Cronbach's alpha = 0.96).

7.3.5. Social isolation

The Social Isolation Scale (Cotten et al., 2017) was used to measure the extent of participant's social isolation during COVID-19 restrictions. The 3-item scale rates items on a 5-item scale with high responses indicative of high levels of social support. The scale showed good psychometric properties (Cronbach's alpha = 0.83).

7.3.6. Social support

Using the OSLO Social Support Scale-3 (Meltzer, 2003), participants answered multiple-choice structured items on a 3-item scale. The sum of the scores ranges from 3 to 14 with high values indicative of strong levels of social support, the median score of 10 indicates moderate social support. The scale showed good psychometric properties and good reliability (Cronbach's alpha = 0.71).

7.4. Procedure

Data for this study was collected between April – June 2020 at a time when large sections of the population were forced to limit social interaction and travel due to the COVID-19 pandemic. This provided an opportunity to study social isolation and its relationship with dissociation in FND, using a unique social situation in which people, regardless of health status, experienced similar restrictions to social movement. After providing informed consent, participants provided demographic information and answered a battery of psychological self-report measures before being debriefed.

7.5. Statistical analysis

Preliminary analyses (see Power & Sample Size) were performed to ensure no violation of the assumptions of normality, homogeneity of variance-covariance matrices and multicollinearity. Outliers were removed from the data, but no other serious violations were noted. MANOVA's were used to compare the mean scores of the FND, LTD and Healthy control groups for anhedonia, anxiety, stress, depression, socialization and social support. Pearson's correlations tested the relationship between these variables in each group and Fisher's *z*-tests were computed to compare the magnitude of these correlations.

8. Results Study 3

Table 6 shows the descriptive statistics, inferential statistics and significance for the groups for anhedonia, anxiety, depression, dissociation, social isolation and social support.

There was a significant effect of *Group* for Anhedonia ($F(2, 457) = 12.70$, $p < .001$, $\eta^2 = 0.05$, small effect), Anxiety ($F(2, 457) = 13.13$, $p < .001$, $\eta^2 = 0.05$, small effect), Depression ($F(2, 457) = 34.64$, $p < .001$, $\eta^2 = 0.13$, moderate effect) and Stress ($F(2, 457) = 30.53$, $p < .001$, $\eta^2 = 0.12$, moderate effect). Compared to healthy controls, the FND group showed significantly lower scores for anhedonia ($p < .001$), anxiety ($p < .001$) and depression ($p < .001$). The FND group has significantly higher stress scores than healthy controls ($p < .001$). In comparison to the LTD group, the FND group showed significantly lower scores for anhedonia ($p = .001$) and depression ($p < .001$). The FND group showed significantly higher scores than the LTD group for stress ($p < .001$). There were no significant differences between the FND and LTD group for anxiety ($p = .308$).

8.1. Dissociation

There was also a significant difference in dissociation scores between the three groups, $F(2, 457) = 24.82$, $p < .001$, $\eta^2 = 0.098$, moderate effect. Significantly higher mean scores were seen in the FND group than the LTD group ($p = .001$) and the healthy control group ($p < .001$). The mean score of the LTD group was also significantly higher than the mean score for the healthy control group ($p = .011$), however the greatest difference was between the FND and Control groups (*Meandif* = 17.78, $p < .001$).

Further analysis showed this effect was present for most of the 6 subscales of dissociation: the FND group scored significantly higher than the LTD group for Disengagement ($p = .019$), Memory ($p < .001$), Depersonalisation ($p < .001$) and Derealisation ($p = .001$). The FND group also scored significantly higher than healthy controls for Disengagement ($p < .001$), Emotional ($p < .001$), Memory ($p < .001$), Depersonalisation ($p < .001$) and Derealisation ($p = .001$). The LTD group showed significantly higher scores than healthy controls for Disengagement ($p = .014$), Emotional ($p < .001$), Memory ($p = .007$), Depersonalisation ($p = .009$). The subscale Identity did not show any statistically significant differences between the groups; there were no other noteworthy significant interactions.

8.2. Social isolation and social support

There was a significant effect for *Group* for social isolation, $F(2,457) = 11.68$, $p < .001$, $\eta^2 = 0.05$ and social support, $F(2,457) = 8.88$, $p < .001$, $\eta^2 = 0.04$. Post-hoc tests showed lower scores for social isolation in the FND group compared to the Healthy group ($p < .001$) and lower scores in the FND group compared to the LTD group ($p = .009$). LTD and healthy group ($p = .297$) showed no significant difference in social isolation scores. Significantly lower scores were reported by the FND group in social support compared to the healthy control group ($p < .001$). There were no significant differences in social support between the FND and LTD group ($p = .226$) or between the LTD and healthy group ($p = .06$).

8.3. Relationships to dissociation

Table 6 shows the Pearson's Correlation Coefficients for Anhedonia, Anxiety, Depression, Stress, Dissociation, Social Support and Social Isolation separated by *Group*. In those with FND, Dissociation showed statistically significant, weak, negative correlations with Anhedonia ($p = .001$, 95 % CI [−0.405, −0.117]) and Social Support ($p < .001$, 95 % CI [−0.50, −0.23]). There were strong positive correlations in the FND group with Dissociation for Anxiety ($p < .001$, 95 % CI [0.52, 0.71]), Stress, ($p < .001$, 95 % CI [0.58, 0.75]) and Depression ($p < .001$, 95 % CI [0.61, 0.77]). A weak, positive correlation was found between Dissociation and Social Isolation ($p < .001$, 95 % CI [0.13, 0.41]). A similar pattern of results is seen in both the LTD and Healthy groups with Dissociation showing strong positive correlations with Anxiety ($p < .001$), Stress ($p < .001$), and Depression ($p < .001$). Both groups showed a weak negative correlation between Dissociation and Social Support ($p < .001$) and a weak positive correlation between Dissociation and Social Isolation ($p < .001$). Correlations between Anhedonia and Dissociation in the LTD and Healthy groups were not significant.

To ascertain whether the magnitude of the correlations between the psychometric measures differed significantly between the three groups (FND, LTD and Healthy), 6 Fisher's *z*-Tests for multiple independent samples were conducted, followed by independent comparisons of correlation coefficients (using Fisher's *z* transformations where appropriate). Results revealed that the strength of the correlation between *Dissociation* and *Anhedonia* was significantly different between the FND ($z = -0.27$), LTD ($z = -0.10$) and Healthy ($z = 0.14$) Groups [$x^2(3) = 15.04$, $p = .001$]. The magnitude of difference was not significant for *Dissociation* and the following: *Anxiety* ($p = .112$), *Depression* ($p = .195$), *Stress* ($p = .095$), *Social Anxiety* ($p = .760$) or *Social Support* ($p = .590$).

8.4. Summary Study 3

When we compare FND to others (with or without long-term conditions) who are being subjected to the kinds of social isolation that often accompanies FND, we still find elevated dissociation in people with FND. This suggests that elevated dissociation in FND is likely not attributable to the social isolation the patients endure as a result of their chronic illness. It is worth noting that the FND group reported less anhedonia than the other two groups, which might indicate a prior habituation with the isolation conditions that affected the other groups more strongly.

9. General discussion

The present three-study, cross-sectional project aimed to establish the relationship between dissociation and FND and explore several factors implicated in the development of dissociation, that could influence this relationship. Specifically, we measured i) comparisons in dissociation between healthy controls and those with other chronic illnesses (all studies); ii) relationships between adverse life-events and dissociation (study 1); iii) relationships between social isolation and dissociation (study 3); and iv) the relationship with dissociation and mood (stress, anxiety and depression; all studies).

The findings from all 3 studies support elevated dissociation in FND relative to both controls and those with other long-term illness, on most subscales (Derealisation, Memory/gaps, Emotional, Disengagement and Depersonalization) but not on those focusing on identity. However, the findings do not support a relationship between dissociation and trauma, dissociation and mood or dissociation and social isolation in FND. This suggests that elevated dissociation may be particularly prominent in FND and greater than in other similar chronic illnesses; thus, corroborating previous assertions that dissociative tendencies are a significant difficulty for those diagnosed with FND (Brown et al., 2007; Pick et al., 2017). For example, those with FND are also known to have greater susceptibility to dissociation induction in laboratory studies (Perez et al., 2018) and are susceptible to both detachment and compartmentalization phenomena (Brown et al., 2007; Holmes et al., 2005). Such findings help to identify main areas of dysfunction in FND, with implications for focusing interventions and future research. Understanding dissociation in FND could be valuable in refining treatment options and increasing focus on overcoming dissociation, in combination with grounding and body or emotion focused techniques, such as eye movement desensitization and reprocessing (EMDR; Cope, 2020) and mindfulness-based therapies (Baslet et al., 2020). Whilst the effectiveness of EMDR and mindfulness-based theories are not without controversy (see Herbert et al., 2000) further studies should investigate their effectiveness at reducing dissociation in FND and potential effectiveness at reduction of symptoms as a result.

Whilst the typical relationship between dissociation and adverse life experiences was seen in the control group, it was absent in the FND group (study 1). Thus, current findings do not support a link between adverse life events and dissociation in FND. Nevertheless, some studies have found relationships between dissociation and adverse life-events or trauma in FND (Brown et al., 2007; Nicholson et al., 2016) and adverse early life-events have been found to be higher in those with FND when compared to healthy controls (see Ludwig et al., 2018 for review).The discrepancy between previous findings and our own could reflect differing methodologies and sample acquisition; we recruited participants through advertisements on FND support groups whereas prior literature more heavily relies upon patients in either neurological or psychiatric clinics or meta-analyses. Alternatively, disruption to the typical dissociation-ACEs relationship in FND might reflect a reluctance to report adverse life-events due to a sensitivity/awareness of stigma. However, this alternative explanation is somewhat speculative and will need to be more specifically explored in further studies. Thus, based on the current results, we argue that high dissociation scores in FND do not have a relationship with adverse life-experiences. Future research should explore the extent to which adverse life events increases susceptibility to developing FND across symptom subtypes.

Study 2 investigated whether dissociation in FND is associated with being chronically ill (and concomitant life changes) or a product of mood. Our findings suggest dissociation in FND is higher than both healthy controls and those with other long-term health conditions whose symptoms mimic FND. Thus, high dissociation scores appear to be a key feature in FND, and more prominent than in conditions with similar symptoms. Given the high variability of dissociation in the FND group, it is possible that dissociation may be particularly associated with certain subtypes, such as NEADS (Goldstein and Mellers, 2006); NEADs is also associated with raised dissociation compared to those with epilepsy (Myers et al., 2019). Identification of such FND subtypes, characterized by dissociation, might have implications for tailoring treatment for FND. Dissociation was associated with higher disability scores and could reflect generally higher disability and impairment to quality of life than those with other organic disorders (Carson et al., 2011).

In the current data there was no association between dissociation and social isolation in FND. Moreover, even during global social isolation (Study 3 was conducted during the COVID-19 pandemic), FND participants maintained higher dissociation than both control groups. This is particularly interesting as it could be argued that those with FND may be more accustomed to social isolation and restrictions to their movement, as a result of the unpredictability of symptoms and reduced quality of life. This might explain why those with FND also reported lower depression, than in studies 1 and 2 and compared to healthy and LTD controls, despite reporting less social support. Those with FND and long-term other conditions reported higher anxiety, although this might reflect a lack of access to medical or support care for their conditions during “lockdown”. Given these findings, we would recommend that future research continues to explore the importance of dissociation in FND. Further, given the lack of evidence here to support that elevated dissociation is a product of usual triggering factors (mood, adverse life-experiences and social isolation) it should be considered if dissociation in FND is a symptom of the illness which may distinguish it from other similar conditions and what, if any, biopsychosocial mechanisms trigger such elevated levels.

This series of studies is not without its limitations, namely the use of self-report measurements of psychological constructs collected remotely with individuals self-identifying their health status. At the time of data collection, methods of online screening of FND were limited and thus participants with FND were asked to confirm that they had i) been given the diagnosis of FND from a neurologist and ii) had experienced symptoms for >6 months. Those with other Long-term conditions (control group) were asked to provide similar information as well as naming health conditions. The presence of comorbid physical and mental health diagnosis, and the use of medications, may influence the findings in the FND group. However, symptom pure groups are unlikely in this condition and given that the studies here repeatedly demonstrate high dissociation, this influence seems unlikely. Future studies should however also aim to explore if dissociation subtypes and levels, influence symptoms in FND and illness outcomes. However, despite these limitations and across different and large samples of patients with FND this pattern of elevated dissociation remains and warrants further exploration and incorporation into theoretical models and the provision of treatment.

9.1. Conclusion

The current study repeatedly demonstrates raised dissociation in FND, relative to healthy individuals and those with other long-term chronic health conditions. Understanding mechanisms underpinning dissociation in FND would have implications for development of etiological models and may be key to the disorder in general. Based on the present findings, dissociation in FND does not appear to be associated

with adverse life events or mood (stress, anxiety and depression) or psychosocial adversity (social isolation). Dissociation was however associated with increased levels of disability and anhedonia in those with FND, but not in those with other long-term conditions. Future studies should look toward identifying any biological correlates of dissociation in FND.

CRediT authorship contribution statement

Stephanie-Roxanne Blanco: Conceptualisation, Methodology, Software, Formal Analysis, Investigation, Data Curation, Writing – Original Draft, Visualisation Preparation **Suvo Mitra:** Conceptualisation, Writing – Review and Editing, Supervision **Christina J Howard:** Writing – Review and Editing, Supervision **Alex L Sumich:** Writing – Review and Editing, Supervision, Project Administration.

Data availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Acknowledgements

We would like to thank FND Action, FND Dimensions and FND Hope UK for their assistance with advertising this study to their members, and for all participants for their involvement in these studies.

Funding

This sutdy did not recieve a grant but the project was supported by Nottingham Trent University through indirect funding and conducted over the course of a number of years as part of the lead authors studies (as an undergraduate, masters and PhD student).

Appendix A

A.1. Statistical assumption tests

A.1.1. Multivariate outliers

To screen for multivariate outliers amongst the variables in each of the three studies, Mahalonobis distance scores were generated from multiple regression analyses. Mahalanobis distance follows a Chi-square (x^2) distribution, in which the degrees of freedom are equivalent to the number of independent variables in the model (Tabachnick et al., 2007). In study 1, there were 4 degrees of freedom, which equated to a critical Chi-Square value of 18.47 (at $a = 0.001$). The test revealed three cases with a distance score exceeding this critical value and examination of the cases revealed that individual response patterns across variables was not sufficiently abnormal to indicate illegitimate respondents nor did they seem unrepresentative of the population from which they were drawn. Further examination of the parameter estimates excluded from the model confirmed this indicating that no cases had a large influence on the regression parameters and as such these three cases were retrained.

In study 2, there were 6 degrees of freedom, which equated to a critical Chi-Square value of 22.46 (at $a = 0.001$). Mahalonbis distance tests indicated five cases with a distance score exceeding this critical value. After examination of the cases by individual response pattern across the variables and parameter estimates, which were excluded from the model, these cases indicated that responses were sufficiently abnormal and had a large influence on the regression parameters. Thus, these five cases were considered outliers and excluded from the analysis.

In study 3, there were 7 degrees of freedom, which equated to a critical Chi-Square value of 24.32 (at $a = 0.001$). Mahalonbis-distance tests indicated eleven cases with a distance score exceeding this critical value. After examination of the individual cases by response pattern and parameter estimates, these cases were deemed to be abnormal from the populations which they were drawn from. Thus, given this and their sufficiently large influence on the regression parameters, these eleven cases were excluded from the subsequent analyses.

A.2. Normality

A.2.1. Study 1

The normality of variables in study 1 (Anxiety, Depression, Life Events and Dissociation) was assessed. The Shapiro-Wilk test indicated that the scores were not normally distributed for Anxiety [$W(184) = 0.879$, $p \leq 0.001$], Depression [$W(179) = 0.888$, $p \leq 0.001$], Life Events [$W(173) = 0.923$, $p \leq 0.001$] or Dissociation [$W(185) = 0.905$, $p \leq 0.001$]. However, given the large sample size (>30) this violation was not considered to be problematic. Skewness and kurtosis values were between −2 to +2 for each of the scales and subscales suggesting that data were normally distributed (Table 1).

A.2.2. Study 2

Normality of variables in study 2 (Anxiety, Depression, Dissociation, Impact of Illness, Levels of Disability and Stress) were assessed. Again the Shapiro-Wilk test indicated a violation of the assumption of normality for all variables; Anxiety [$W(513) = 0.942$, $p \leq 0.001$], Depression [$W(513) = 0.902$, $p \leq 0.001$], Dissociation [$W(513) = 0.907$, $p \leq 0.001$], Impact of Illness [$W(359) = 0.982$, $p \leq 0.001$], Levels of Disability [$W(344) = 0.990$, $p \leq 0.001$] and Stress [$W(513) = 0.967$, $p \leq 0.001$]. However, again given the large sample size and the robustness of MANOVA, this violation was not considered to be problematic. Skewness and Kurtosis values were between −2 to +2 for each of the scales and subscales (Table 3).

A.2.3. Study 3

Normality of variables was assessed in study 3 for all variables. Again the Shapiro-Wilk test indicated a violation for the assumption of normality for all variables with $p < .001$; Anhedonia [$W(460) = 0.952$, $p \leq 0.001$], Anxiety [$W(460) = 0.969$, $p \leq 0.001$], Depression [$W(459) = 0.966$, $p \leq 0.001$], Dissociation [$W(459) = 0.880$, $p \leq 0.001$], Social Isolation [$W(458) = 0.906$, $p \leq 0.001$], Social Support [$W(460) = 0.975$, $p \leq 0.001$] and Stress [$W(460) = 0.905$, $p \leq 0.001$]. Skewness and Kurtosis remained between −2 to +2 for all variables (Table 5).

A.3. Homogeneity of variance-covariance matrices

To protect against inflating Type 1 error MANOVAs with follow up ANOVAs and post-hoc comparisons were applied. Pearson correlations performed between the dependent variables, showed correlations to be mostly within the moderate range (i.e., 0.20–0.60; Meyers et al., 2016). As can be seen in Table 2 (study 1) Table 4 (study 2) and Table 6 (study 3) a meaningful pattern of correlations was observed amongst most of the dependent variables validating the appropriateness of the us of MANOVA in these studies. Additionally, Box's M value for study 2 of 98.605 ($p = .007$), Box's M value for study 3 of 133.411 ($p = .009$) was interpreted as being non-significant. Thus, the covariance matrices between the groups were assumed to be equal for the purposes of the MANOVA in studies 1 and 2. Study 1's Box's M value of 17.89 ($p = .003$) presumably as a result of the larger gap between sample sizes and smaller sample of this study. For Study 1, Pillai's trace statistics were used and reported to compensate for this potential violation of the assumption, as reported in the results section.

Prior to conducting follow-up ANOVAs, the homogeneity of variance assumption was tested for all subscales of Dissociation in each study. Based on a series of Levene's F tests, the homogeneity of variance assumption was considered satisfied ($p < .05$). However, there were two instances where this was not the case; in Study 3 Levene's F test

suggested that the variances associated with the dissociation subscales Identity and Depersonalisation were not homogeneous. An examination of the standard deviations revealed that none of the largest standard deviations (Table 5) revealed that none of the largest standard deviations were more than four times the size of the smallest, suggesting that the ANOVA would be robust enough to handle this (Howell, 2012).

A.4. Multicollinearity

Tolerance and VIF were used to assess multicollinearity in each of the three studies and Durbin-Watson statistics were examined to assess for the assumption of independent errors which explores serial correlations and tests whether adjacent residuals were correlated. Tolerances were deemed accepted of a value >0.1, VIF values <10 and Durbin-Watson values between 0 and 4 (with values closest to 2 indicating uncorrelated nature of residuals). In study 1, tests to see if the data met the assumption of collinearity (using Dissociation as the outcome variable) indicated that multicollinearity was not a concern [*Anxiety,* Tolerance = 0.280, VIF =3.58; *Depression*, Tolerance = 0.280, VIF = 3.57; *Life Events*, Tolerance = 0.990, VIF = 1.01]. Study 1 data also met the assumption of independent errors [*Durbin-Watson value* = 1.53]. In study 2, tests indicated that multicollinearity was not a concern [*Anxiety,* Tolerance = 0.431, VIF = 2.32; *Depression*, Tolerance = 0.346, VIF = 2.89; *Stress*, Tolerance = 0.359, VIF = 2.79; *Impact of Illness*, Tolerance = 0.547, VIF = 1.83; *Levels of Disability*, Tolerance = 0.60, VIF = 1.67]. Data from Study 2 also met the assumptions of independent errors [*Durbin-Watson value* = 1.88]. Tests also indicated that multicollinearity was not a concern for study 3 data [*Anhedonia,* Tolerance = 0.928, VIF = 1.07; *Anxiety,* Tolerance = 0.338, VIF = 2.96; *Depression*, Tolerance = 0.363, VIF = 2.75; *Social Isolation*, Tolerance = 0.708, VIF = 1.41; *Social Support*, Tolerance = 0.817, VIF = 1.23; *Stress*, Tolerance = 0.356, VIF = 2.81]. Study 3 data also met the assumption of independent errors [*Durbin-Watson value* = 1.95].

References

Akbey, Z. Y., Yildiz, M., & Gündüz, N. (2019). Is there any association between childhood traumatic experiences, dissociation and psychotic symptoms in schziophrenic Patients? *Psychiatry Investig., 16*(5), 346.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®). American Psychiatric Pub.*.

Baslet, G., Ehlert, A., Oser, M., & Dworetzky, B. A. (2020). Mindfulness-based therapy for psychogenic nonepileptic seizures. *Epilepsy Behav., 103*, Article 106534.

Bennett, D. A. (2001). How can I deal with missing data in my study? *Aust. N. Z, 25*(5), 464–469.

Briere, J., Weathers, F. W., & Runtz, M. (2005). Is dissociation a multidimensional construct? Data from the multiscale dissociation inventory. *Journal of Traumatic Stress: Official Publication of the International Society for Traumatic Stress Studies, 18*(3), 221–231.

British Psychological Society. (2013). *Ethics guidelines for internet-mediated research*. The British Psychological Society.

Brown, R. J. (2004). Psychological mechanisms of medically unexplained symptoms: an integrative conceptual model. *Psychol. Bull., 130*(5), 793–812.

Brown, R. J., & Reuber, M. (2016). Psychological and psychiatric aspects of psychogenic non-epileptic seizures (PNES): a systematic review. *Clin. Psychol. Rev., 45*, 157–182. https://doi.org/10.1016/j.cpr.2016.01.003

Brown, R. J., Cardeña, E., Nijenhuis, E., Sar, V., Hart, O., & v. de.. (2007). Should conversion disorder be reclassified as a dissociative disorder in DSM-V? *Psychosomatics, 48*(5), 369–378. https://doi.org/10.1176/appi.psy.48.5.369

Brown, R. J., Bouska, J. F., Frow, A., Kirkby, A., Baker, G. A., Kemp, S., Burness, C., & Reuber, M. (2013). Emotional dysregulation, alexithymia, and attachment in psychogenic nonepileptic seizures. *Epilepsy Behav., 29*(1), 178–183.

Cacioppo, J. T., & Hawkley, L. C. (2003). Social isolation and health, with an emphasis on underlying mechanisms. *Perspect. Biol. Med., 46*(3x), S39–S52. https://doi.org/10.1353/pbm.2003.0063

Carlson, E. B., Waelde, L. C., Palmieri, P. A., Macia, K. S., Smith, S. R., & McDade-Montez, E. (2018). Development and validation of the dissociative symptoms scale. *Assessment, 25*(1), 84–98. https://doi.org/10.1177/1073191116645904

Carson, A., Stone, J., Hibberd, C., Murray, G., Duncan, R., & Coleman, R. (2011). Disability, distress and unemployment in neurology outpatients with symptoms 'unexplained by organic disease'. *J. Neurol. Neurosurg. Psychiatry, 82*(7), 810–813. https://doi.org/10.1136/jnnp.2010.220640

Carson, A. J., Stone, J., Hansen, C. H., Duncan, R., Cavanagh, J., Matthews, K., Murray, G., & Sharpe, M. (2015). Somatic symptom count scores do not identify patients with symptoms unexplained by disease: a prospective cohort study of neurology outpatients. *J. Neurol. Neurosurg. Psychiatry, 86*(3), 295–301. https://doi.org/10.1136/jnnp-2014-308234

Cohen, S. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan, & S. Oskamp (Eds.), *The social psychology of health* (pp. 31–67). Sage Publications Inc.

Cope, S. R. (2020). EMDR as an adjunctive psychological therapy for patients with functional neurological disorder: Illustrative case examples. *Journal of EMDR Practice and Research, 14*(2), 76–89. https://doi.org/10.1891/emdr-d-20-00008

Costa, P. T., & McCrae, R. R. (2008). *The Revised NEO Personality Inventory (NEO-PI-R). The SAGE Handbook of Personality Theory and Assessment: Volume 2 — Personality Measurement and Testing*, 179–198. https://doi.org/10.4135/9781849200479.n9

Cotten, S. R., Anderson, W. A., & McCullough, B. M. (2017). *Social Isolation Scale.*. https://doi.org/10.1037/t62081-000

Dalenberg, C., & Carlson, E. B. (2012). Dissociation in posttraumatic stress disorder part II: how theoretical models fit the empirical evidence and recommendations for modifying the diagnostic criteria for PTSD. *Psychol. Trauma Theory Res. Pract. Policy, 4*(6), 551–559. https://doi.org/10.1037/a0027900

Daum, C., Gheorghita, F., Spatola, M., Stojanova, V., Medlin, F., Vingerhoets, F., Berney, A., Gholam-Rezaee, M., Maccaferri, G. E., Hubschmid, M., & Aybek, S. (2015). Interobserver agreement and validity of bedside 'positive signs' for functional weakness, sensory and gait disorders in conversion disorder: a pilot study. *J. Neurol. Neurosurg. Psychiatry, 86*(4), 425–430. https://doi.org/10.1136/jnnp-2013-307381

Davidson, J. R. T., Tharwani, H. M., & Connor, K. M. (2002). Davidson trauma scale (DTS): normative scores in the general population and effect sizes in placebo-controlled SSRI trials. *Depression and Anxiety, 15*(2), 75–78. https://doi.org/10.1002/da.10021

Demartini, B., Ricciardi, L., Crucianelli, L., Fotopoulou, A., & Edwards, M. J. (2016). Sense of body ownership in patients affected by functional motor symptoms (conversion disorder). *Conscious. Cogn., 39*, 70–76. https://doi.org/10.1016/j.concog.2015.11.005

Diez, I., Larson, A. G., Nakhate, V., Dunn, E. C., Fricchione, G. L., Nicholson, T. R., Sepulcre, J., & Perez, D. L. (2020). Early-life trauma endophenotypes and brain circuit–gene expression relationships in functional neurological (conversion) disorder. *Mol. Psychiatry*, 1–12.

Edwards, M. J., Adams, R. A., Brown, H., Parees, I., & Friston, K. J. (2012). A bayesian account of 'hysteria'. *Brain, 135*(11), 3495–3512. https://doi.org/10.1093/brain/aws129

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav. Res. Methods, 39*, 175–191. https://doi.org/10.3758/BF03193146

Goldstein, L. H., & Mellers, J. D. C. (2006). Ictal symptoms of anxiety, avoidance behaviour, and dissociation in patients with dissociative seizures. *J. Neurol. Neurosurg. Psychiatry, 77*(5), 616–621. https://doi.org/10.1136/jnnp.2005.066878

Guilcher, S. J. T., Catharine Craven, B., Bassett-Gunter, R. L., Cimino, S. R., & Hitzig, S. L. (2021). An examination of objective social disconnectedness and perceived social isolation among persons with spinal cord injury/dysfunction: A descriptive cross-sectional study. *Disab. Rehabil., 43*(1), 69–75. https://doi.org/10.1080/09638288.2019.1616328

Herbert, J. D., Lilienfeld, S. O., Lohr, J. M., Montgomery, R. W. T., O'Donohue, W., Rosen, G. M., & Tolin, D. F. (2000). Science and pseudoscience in the development of eye movement desensitization and reprocessing: Implications for clinical psychology. *Clinical Psychology Review, 20*(8), 945–971.

Holmes, E. A., Brown, R. J., Mansell, W., Fearon, R. P., Hunter, E. C., Frasquilho, F., & Oakley, D. A. (2005). Are there two qualitatively distinct forms of dissociation? A review and some clinical implications. *Clin. Psychol. Rev., 25*(1), 1–23. https://doi.org/10.1016/j.cpr.2004.08.006

Howell, D. C. (2012). *Statistical Methods for Psychology*. Cengage Learning.

Jackson, D. N. (1994). Jackson personality inventory-revised. *Sigma Assessment Systems, Research Psychologists Press Division.*. https://doi.org/10.4135/9781412952644.n232

Janet, P. (1907). *The major symptoms of hysteria: Fifteen lectures given in the medical school of*. Harvard University. Macmillan.

Klimidis, S., Minas, I. H., & Yamamoto, K. (2001). Impact of illness scale: reliability, validity, and cross-cultural utility. *Compr. Psychiatry, 42*(5), 416–423. https://doi.org/10.1053/comp.2001.26266

Kozlowska, K. (2017). A stress-system model for functional neurological symptoms. *J. Neurol. Sci., 383*, 151–152. https://doi.org/10.1016/j.jns.2017.10.044

Levita, L., Mayberry, E., Mehmood, A., & Reuber, M. (2020). Evaluation of LiNES: A new measure of trauma, negative affect, and relationship insecurity over the life span in persons with FND. *J. Neuropsychiatry Clin. Neurosci., 32*(1), 43–49. https://doi.org/10.1176/appi.neuropsych.19050121

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: comparison of the depression anxiety stress scales (DASS) with the beck depression and anxiety inventories. *Behav. Res. Ther., 33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-u

Ludwig, L., Pasman, J., Nicholson, T., Aybek, S., David, A., & Tuck, S. (2018). Stressful life events and maltreatment in conversion (functional neurological) disorder: Systematic review and meta-analysis of case-control studies. *Lancet Psychiatry, 5*(4), 307–320. https://doi.org/10.1016/s2215-0366(18)30051-8

Lyssenko, L., Schmahl, C., Bockhacker, L., Vonderlin, R., Bohus, M., & Kleindienst, N. (2018). Dissociation in psychiatric disorders: a meta-analysis of studies using the dissociative experiences scale. *Am. J. Psychiatry, 175*(1), 37–46. https://doi.org/10.1176/appi.ajp.2017.17010025

Mattfeld, A. T., Whitfield-Gabrieli, S., Biederman, J., Spencer, T., Brown, A., Fried, R., & Gabrieli, J. D. (2016). Dissociation of working memory impairments and attention-

deficit/hyperactivity disorder in the brain. *NeuroImage: Clinical, 10*, 274–282. https://doi.org/10.1016/j.nicl.2015.12.003

McKee, K., Glass, S., Adams, C., Stephen, C. D., King, F., Parlman, K.Kontos, N., … (2018). The inpatient assessment and management of motor functional neurological disorders: an interdisciplinary perspective. *Psychosomatics, 59*(4), 358–368. https://doi.org/10.1016/j.psym.2017.12.006

McWhirter, L., Stone, J., Sandercock, P., & Whiteley, W. (2011). Hoover's sign for the diagnosis of functional weakness: a prospective unblinded cohort study in patients with suspected stroke. *J. Psychosomatic Res., 71*(6), 384–386. https://doi.org/10.1016/j.jpsychores.2011.09.003

Meltzer, H. (2003). *Oslo Social Support Scale-3 [Database record]. Retrieved from PsycTESTS*. https://doi.org/10.1037/t75682-000

Meyers, L. S., Gamst, G., & Guarino, A. J. (2016). *Applied multivariate research: Design and interpretation*. Sage publications.

Myers, L., Trobliger, R., Bortnik, K., Zeng, R., Saal, E., & Lancman, M. (2019). Psychological trauma, somatization, dissociation, and psychiatric comorbidities in patients with psychogenic nonepileptic seizures compared with those in patients with intractable partial epilepsy. *Epilepsy & Behavior, 92*, 108–113. https://doi.org/10.1016/j.yebeh.2018.12.027. Nicholson, T. R., Aybek, S., Craig, T., Harris, T., Wojcik, W., David, A. S., & Kanaan, R. A. (2016). Life events and escape in conversion disorder. Psychological medicine, 46(12), 2617-2626. doi:10.1017/s0033291716000714.

Nicholson, T., Carson, A., Edwards, M., Goldstein, L., Hallett, M., Mildon, B., et al. (2020). Outcome measures for functional neurological disorder: a review of the theoretical complexities. *J. Neuropsychiatry Clin. Neurosci., 32*(1), 33–42. https://doi.org/10.1176/appi.neuropsych.19060128

Nicholson, T. R., Aybek, S., Craig, T., Harris, T., Wojcik, W., David, A. S., & Kanaan, R. A. (2016). Life events and escape in conversion disorder. *Psychol. Med., 46*(12), 2617–2626.

Nijenhuis, E. R., & van der Hart, O. (2011). Dissociation in trauma: a new definition and comparison with previous formulations. *J. Trauma Dissociation, 12*(4), 416–445. https://doi.org/10.1080/15299732.2011.570592

O'grady, A., Pleasence, P., Balmer, N. J., Buck, A., & Genn, H. (2004). Disability, social exclusion and the consequential experience of justiciable problems. *Disability Soc., 19*(), 259–272.

Pareés, I., Kojovic, M., Pires, C., Rubio-Agusti, I., Saifee, T. A., Sadnicka, A., Kassavetis, P., Macerollo, A., Bhatia, K. P., Carson, A., Stone, J., & Edwards, M. J. (2014). Physical precipitating factors in functional movement disorders. *J. Neurol. Sci., 338*(1–2), 174–177. https://doi.org/10.1016/j.jns.2013.12.046

Perez, D. L., Matin, N., Williams, B., Tanev, K., Makris, N., LaFrance, W. C., Jr., & Dickerson, B. C. (2018). Cortical thickness alterations linked to somatoform and psychological dissociation in functional neurological disorders: Cortical thickness alterations. *Hum. Brain Mapp., 39*(1), 428–439. https://doi.org/10.1002/hbm.23853

Pick, S., Mellers, J. D., & Goldstein, L. H. (2016). Emotion and dissociative seizures: a phenomenological analysis of patients' perspectives. *Epilepsy & Behav., 56*, 5–14.

Pick, S., Mellers, J. D. C., & Goldstein, L. H. (2017). Dissociation in patients with dissociative seizures: relationships with trauma and seizure symptoms. *Psychol. Med., 47*(7), 1215–1229.

Pick, S., Goldstein, L. H., Perez, D. L., & Nicholson, T. R. (2019). Emotional processing in functional neurological disorder: a review, biopsychosocial model and research agenda. *J. Neurol. Neurosurg. Psychiatry, 90*(6), 704–711.

Pick, S., Rojas-Aguiluz, M., Butler, M., Mulrenan, H., Nicholson, T. R., & Goldstein, L. H. (2020). Dissociation and interoception in functional neurological disorder. *Cog. Neuropsychiatry, 25*(4), 294–311.

Prueter, C., Schultz-Venrath, U., & Rimpau, W. (2002). Dissociative and associated psychopathological symptoms in patients with epilepsy, pseudoseizures, and both seizure forms. *Epilepsia, 43*(2), 188–192.

Reuber, M. (2009). The etiology of psychogenic non-epileptic seizures: toward a biopsychosocial model. *Neurol. Clin., 27*(4), 909–924.

Reuber, M., House, A. O., Pukrop, R., Bauer, J., & Elger, C. E. (2003). Somatization, dissociation and general psychopathology in patients with psychogenic non-epileptic seizures. *Epilepsy Res., 57*(2–3), 159–167.

Rizvi, S. J., Quilty, L. C., Sproule, B. A., Cyriac, A., Bagby, R. M., & Kennedy, S. H. (2015). Development and validation of the dimensional anhedonia rating scale (DARS) in a community sample and individuals with major depression. *Psychiatry Res., 229*(1–2), 109–119.

Rossier, P., & Wade, D. T. (2002). The Guy's neurological disability scale in patients with multiple sclerosis: a clinical evaluation of its reliability and validity. *Clin. Rehabil., 16*(1), 75–95.

Şar, V., Akyüz, G., Kundakçı, T., Kızıltan, E., & Doğan, O. (2004). Childhood trauma, dissociation, and psychiatric comorbidity in patients with conversion disorder. *Am. J. Psychiatry, 161*(12), 2271–2276.

Sar, V., Islam, S., & Öztürk, E. (2009). Childhood emotional abuse and dissociation in patients with conversion symptoms. *Psychiatry Clin. Neurosci., 63*(5), 670–677.

Sharrack, B., & Hughes, R. A. (1999). The guy's neurological disability scale (GNDS): a new disability measure for multiple sclerosis. *Mult. Scler. J., 5*(4), 223–233.

Steer, R. A., Rissmiller, D. J., & Beck, A. T. (2000). Use of the beck depression inventory-II with depressed geriatric inpatients. *Behav. Res. Ther., 38*(3), 311–318.

Steffen, A., Fiess, J., Schmidt, R., & Rockstroh, B. (2015). "That pulled the rug out from under my feet!"–adverse experiences and altered emotion processing in patients with functional neurological symptoms compared to healthy comparison subjects. *BMC Psychiatry, 15*(1), 1–9.

Sumich, A., Kumari, V., Gordon, E., Tunstall, N., & Brammer, M. (2008). Event-related potential correlates of paranormal ideation and unusual experiences. *Cortex, 44*(10), 1342–1352.

Sumich, A., Anderson, J. D., Howard, C. J., Heym, N., Castro, A., Baker, J., & Belmonte, M. K. (2018). Reduction in lower-alpha power during ganzfeld flicker stimulation is associated with the production of imagery and trait positive schizotypy. *Neuropsychologia, 121*, 79–87.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007), *5. Using Multivariate Statistics*. Boston: Pearson.

Van den Bergh, O., Witthöft, M., Petersen, S., & Brown, R. J. (2017). Symptoms and the body: taking the inferential leap. *Neurosci. Biobehav. Rev., 74*, 185–203.

Wieder, L., & Terhune, D. B. (2019). Trauma and anxious attachment influence the relationship between suggestibility and dissociation: a moderated-moderation analysis. *Cogn. Neuropsychiatry, 24*(3), 191–207.

Williams, I. A., Reuber, M., & Levita, L. (2020). Interoception and stress in patients with functional neurological symptom disorder. *Cogn. Neuropsychiatry*, 1–20.

World Health Organisation. (1992). *The ICD-10 classification of mental and behavioural disorders: Clinical descriptions and diagnostic guidelines.*.

World Health Organization. (2018). *International statistical classification of diseases and related health problems (11th ed.)*. https://icd.who.int/en.

Yogarajah, M., Koreki, A., Agrawal, N., Cope, S., Eilon, T., Van Praag, C. G., Garfkinel, S., Critchley, H., Mula, M., & Edwards, M. (2019). *17 State and trait interoception is disrupted in functional seizures*.