Dissociation and sleep in dissociative seizures: An exploration.

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Chapter 1

Measuring dissociation in a dissociative seizure population: a systematic review of studies measuring dissociation over time

Prepared in accordance with the author requirements for Epilepsy & Behaviour

https://www-sciencedirect-com.ezproxy2.lib.gla.ac.uk/journal/epilepsy-and-behavior/publish/guide-for-authors

1.1 Abstract

Background: This review aims to characterise outcome measures and subscales used to assess dissociation in dissociative seizure (DS) populations and whether they capture changes over time or after interventions.

Methods: Studies published in English, peer-reviewed, with adult DS populations (16+ years) and at least one dissociation measure assessed at two or more time points were included. Case reports and single-case experimental designs were excluded. Searches were conducted on Medline, Embase, and PsycINFO on 25th August 2024. Study quality was assessed using Kmet (2004), and results were synthesised narratively.

Results: Ten studies were included in the final review (four cohort studies, two randomized control trials and four within-subjects intervention studies), with a total sample of 240 participants. Participants all had a diagnosis of DS, with a proportion reported as having co-morbid epilepsy.

Synthesis of results: The Dissociative Experiences Scale (DES, Carlson & Putnam, 1993), was the most used measure, used in five studies. Common dissociative features measured included: amnesic symptoms, absorption, depersonalization and derealization. No single measure captured all relevant aspects of dissociation. One cohort study that was plausibly expected to see a change in dissociation scores reported a partial change in scores over time. Two intervention studies reported a change in dissociation scores following cognitive behavioural therapy-based interventions, one of which was plausibly expected to report a change, whilst it was unclear for the other. Several studies that were plausibly expected to report a change in dissociation scores did not report a change.

Discussion: Across the studies included, there was considerable heterogeneity in study design, results and quality; therefore, the certainty of conclusions drawn is limited. Results varied across both cohort and intervention studies, indicating a complex relationship between dissociation and seizure frequency. More research is needed to determine the role of dissociation in DS, and into how best to measure it.

Funding and registration: This review was registered with PROSPERO (ref. CRD42024545066).

1.2 Introduction

Dissociative seizures (DS) are paroxysmal events that can manifest as a range of symptoms, typically including altered states of consciousness, involuntary movements and sensations that can resemble epileptic seizures but are not accompanied by the underlying neurobiological changes that characterize epilepsy (Oto & Reuber, 2014). They are also known as non-epileptic attack disorder (NEAD), and psychogenic non-epileptic seizures (PNES, Ertan et al., 2022). A study completed in the United Kingdom found that the incidence of DS was 4.09/100,000, with DS comprising 8-12% of presentations to specialized 'first-seizure' clinics (Duncan et al., 2011). The condition is associated with poor outcomes, with those diagnosed experiencing difficulties maintaining employment, social obligations and having a lower quality of life (Walther et al., 2020). Due to difficulties in discerning the condition from epileptic seizures, patients typically experience long waits to receive a diagnosis (Bodde et al., 2009), which in turn incurs large economic costs due to more frequent healthcare service use and longer periods of unemployment due to the seizures remaining uncontrolled (Magee et al., 2014).

Despite the prevalence and impact of DS, aspects of the condition remain poorly understood, reflecting its complexity. Historically, DS have been considered to be psychological in their origin (Brown & Reuber, 2016b) and psychological models conceptualising the condition have been proposed as a result (e.g. Baslet, 2011; Bowman, 2006; Brown & Reuber, 2016). However, recent studies have begun to investigate the neurophysiological markers of DS and have found evidence of structural and functional neurological differences, although it is unclear whether these differences are causal or consequential (Ding et al., 2013). Taken altogether, the evidence base for DS suggests that it arises from a complex interplay of biological, social and psychological factors (Asadi-Pooya et al., 2021).

One such factor found to be linked to DS is pathological dissociation. Dissociation can be defined as a transient, involuntary disruption to the ability to integrate conscious experience, which can impact memory, sensations, behaviour and bodily control (Ertan et al., 2022; World Health Organisation, 2019). Dissociation occurs on a continuum, from non-pathological to pathological (Cardeña, 1994). Symptoms of non-pathological dissociation can include imaginative states such as daydreaming, or absorption in activities

that lead to a loss in awareness of time passing, such as when reading a book (Holmes et al., 2005). Common pathological symptoms of dissociation can include depersonalisation (often described as the feeling of not being in one's body), derealization (described as the sensation that things are not real), amnesic dissociation (where one struggles to recall episodic memories) and somatoform symptoms (e.g. involuntary movements) or sensory (e.g. altered senses; Campbell et al., 2023; Vancappel & El-Hage, 2023). Pathological symptoms of dissociation have been hypothesised to occur as a protective mechanism in response to a traumatic event or intense emotional state (Ertan et al., 2022).

A range of measures are currently used to assess dissociation within a DS population. These measures typically assess trait dissociation, where one experiences enduring differences in the level and severity of dissociation felt (Salmon et al., 2023). The measures used assess different aspects of trait dissociation; some measure psychological elements such as depersonalisation and derealisation, whilst others measure somatoform manifestations of dissociation. A recent review assessed the psychometric properties and methodological quality of measures of dissociation (Wainipitapong et al., 2025). The review found that of the 44 measures identified, no single measure currently assesses all aspects of dissociation comprehensively. This review did not consider longitudinal or repeated measurement of dissociation.

Dissociation and DS share theoretical commonality in that they are both conceptualised as repeated, temporary disruptions to the ability to integrate conscious experiences and can share symptomatology, for example, some forms of DS can be classified as somatoform dissociation (Koreki et al., 2020). However, given the variation in dissociative phenomena and DS presentations, the two do not always co-occur. It is possible to experience DS without scoring highly on dissociation measures and vice versa (Campbell et al., 2023).

Studies have found that those with DS score more highly on measures of dissociation assessing depersonalisation, derealisation and amnestic dissociation than those with epilepsy, comorbid epilepsy and DS and healthy controls (O'Brien et al., 2015; Prueter et al., 2002; Reuber, Pukrop, et al., 2003). Higher levels of somatoform dissociation have also been found in a DS population, compared to an epilepsy population and healthy controls (Lally et al., 2010; van der Kruijs et al., 2012).

An exploratory study by Hingray et al. (2022) revealed three possible profile groups in the DS population, where the average dissociation score varied according to which profile a

patient belonged to. Participants who disclosed childhood trauma scored within the pathological range on dissociation measures, compared to participants with no trauma history, or cumulative lifetime trauma. This indicates that dissociation in a DS population may be impacted by individual differences (Hingray et al., 2022).

Pick et al. (2017) investigated the relationship between dissociative symptoms, seizure symptoms and emotional distress in people with DS compared to healthy controls. The study found that the DS population reported significantly higher scores than healthy controls in both psychological and somatoform dissociative symptoms and that seizure symptoms correlated positively with derealisation, identity dissociation and depersonalisation (Pick et al., 2017). Following this, it appears that there is a sizeable evidence base for DS being considered through a dissociative lens.

In addition to various aspects of dissociation being measured, findings across studies using the same measure to assess dissociation in this population vary. In a recent systematic review, Campbell et al. (2023) found that some studies using the Dissociative Experiences Scale (DES, Carlson & Putnam, 1993) reported that DS populations generated some of the highest scores on this scale, compared to other functional neurological samples (e.g. Mousa et al., 2021), but that this was not a consistent finding, as some studies reported low DES scores (e.g. Jungilligens et al., 2020). The diversity of measures used and the inconsistency of scores on measures of dissociation between studies indicates that more work must be done in this area to examine the relationship between pathological dissociation and DS.

Accompanying high levels of dissociation being found in a DS population, studies have also investigated a link between dissociative symptoms and seizure frequency. Campbell et al. (2023) listed five studies which reported statistically significant positive associations between seizure frequency and dissociation scores across a range of measures (Bodde et al., 2007; Kuyk et al., 2008; Martino et al., 2021; O'Brien et al., 2015; Walther et al., 2019). These findings indicate the importance of considering dissociation in the management and any intervention in DS.

Although the literature has long argued that dissociation has a role in DS (Bowman, 2006), the use of the term 'Dissociative Seizures' as opposed to previously used names is a more recent development. In a recent, large-scale randomised controlled trial, Goldstein et al. (2020) stated that the term gave clinicians a mechanism that can be discussed with patients. Given the recent increase in the use of this term, it is important to investigate the

relationship between dissociation and DS broadly, rather than relying on tools that only measure certain aspects of dissociation. Additionally, the variation in measures used to assess dissociation in DS, the inconsistency across levels of dissociation found and the link between dissociation and seizure frequency, it is important to ensure that the methods used to assess dissociation in this population are valid, reliable and sensitive to detect clinically meaningful changes. Recently, efforts have been invested in establishing consistent outcome measure sets across mental and physical health conditions, with the aim of improving the quality of data collected from studies (Pick et al., 2020). With an increase in both the number and quality of experimental studies in DS, outcome measurement must be optimized to facilitate the comparison of different treatment modalities in this population (Pick et al., 2020).

This review aims to explore whether the outcome measures currently used to assess dissociation in dissociative seizure populations capture change in symptoms over time.

Primary question:

- Do currently used outcome measures assessing dissociation in a DS population capture changes in dissociation in this population?

Secondary questions:

- Which outcome measures are used to measure dissociation in a DS population?
- What dissociative features are found on these measures in a DS population?
- Do these measures capture a change in dissociation in a DS population following an intervention?
- Do these measures capture a change in dissociation in a DS population over time?

1.3 Method

1.3.1 Protocol registration and review methods

This review's protocol was registered on PROSPERO on 3rd September 2024 (ref. CRD42024545066), accessible at https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=545066. PRISMA

standards for the reporting of systematic reviews informed its method and reporting (Page et al., 2021).

1.3.2 Search and Study Selection

Searches were conducted using the OVID platform. Three electronic databases were searched: MEDLINE(R) ALL 1946 to August 2024, Embase 1947- August 2024 and PsycINFO 1806 – August 2024, with titles, abstracts and keyword fields searched to obtain all relevant studies. All searches were conducted on 25th August 2024. Search terms included alternative names for DS, dissociation and outcome measures e.g. Functional seizure*, non?epileptic attack, Depersonali*, Dereali*, scale*, method*. See Appendix 1.3 for the full search terms used. Studies were included if they used a measure of dissociation in a DS population, on at least two different time points.

1.3.3 Inclusion and Exclusion Criteria

Papers were included if they met all of the following criteria:

- Published in English.
- Published in a peer-reviewed journal.
- Studies conducted with an adult (16 years+) DS population.
- Studies with at least one measure of dissociation.
- Dissociation measure used on a minimum of two different time points.

Papers were further excluded if they met any of the following criteria:

- Case reports, single case experimental designs (SCEDs).

1.3.4 Study screening

Initially, 2,078 articles were identified across the three databases. Search results were then exported into Rayyan for processing (Ouzzani et al., 2016). Rayyan's AI-powered algorithm highlighted 866 possible duplicates, manually reviewed for inclusion/exclusion by SA. 538 articles were excluded as true duplicates, leaving 1540 articles for screening. Titles and abstracts were screened for reference to a DS population by its various names (Psychogenic Seizures, Non-epileptic attack disorder etc.), followed by other inclusion/exclusion criteria. This left 24 articles for full-text review, which were retrieved and assessed for inclusion by SA. 14 articles were excluded, see Figure 1.1 PRISMA flow diagram for reasons, leaving 10 papers in the final sample. 21% of the articles were screened for inclusion in the final sample by CC, with the two reviewers working

independently. The inter-rater percentage agreement was calculated to be 99.33%, with discrepancies discussed until an agreement was reached.

1.3.5 Data extraction

Data were extracted from full-text papers by SA into a pre-defined table populated with variables of interest. If the data required was missing from the included papers, study investigators were contacted via email. Data extracted from included studies were: Author, Year, Study type, DS sample size, DS population characteristics, method of DS diagnosis, Control group details (if any), dissociation measure used (incl. exact version if translated and/or if additional questions were added), the time points at which questionnaires were collected, the scores on measures at each time point, what other measures were included, intervention related metadata and relevant statistical information reported.

1.3.6 Quality appraisal

The quality of studies included in this review was determined using the Standard Quality Assessment Criteria for Evaluating Primary Research Papers from a Variety of Fields (QualSys, Kmet, 2004), see Appendix 1.4, following the criteria for the assessment of quantitative papers. This tool was selected as it applies to a wide range of study methodologies. It is comprised of 14 multiple-choice questions where the quality of a paper is rated against aspects such as study design, sample size, appropriateness of statistical methods and quality of the reporting of the results, to assess the internal validity of studies rated. A score is then derived for each paper based on the answers to the questions, with the options being: Yes = 2, Partial = 1, No and N/A = 0. The authors of the tool noted that a conservative cut-off score of 0.75 and a liberal cut-off score of 0.55 for the inclusion of a study in a review were agreed upon by 64% and 73% of raters, respectively. The liberal cut-off score was used to determine the inclusion of studies in this review. Both reviewers reviewed the papers included in the full-text review, calibrating their ratings using 2 papers, and independently rating the remaining 8. Scores were then compared using a two-way ANOVA. The intra-class correlation was determined to be 0.99 ($F(9,9) = 108$, $p < 0.0001$, CI: 0.96-0.99), indicating good agreement.

1.3.7 Method of Synthesis

Data were synthesised according to Synthesis Without Meta-analysis guidance (SWiM, Campbell et al., 2020). Papers were initially split into two groups by study type, with one group comprised of cohort studies and one group comprised of experimental studies, to separate the manipulation of variables. This was in line with the review protocol. The study

samples were categorised into ‘confirmed DS only’, ‘Mixed DS and Epilepsy’ and ‘unconfirmed DS only’, as those with comorbid epilepsy and DS can present differently to a DS-only population (Kuyk et al., 2003). The time points at which the studies measured dissociation were categorised into three groups: ‘Baseline & Long-term Follow-up’, for cohort studies where the outcome measure assessment occurred over a year after the initial measurement point, ‘Pre & Post-intervention’ for when the assessment occurred before and after an intervention, and ‘Pre, Post & follow-up’ for studies where there was a follow-up assessment using outcome measures >6 months after the intervention was completed. Intervention characteristics were categorised by whether it was an individual or group intervention, long-term (over 12 weeks), intermediate-term (6-12 weeks) or short-term (less than 6 weeks) and by the frequency of sessions. Intervention components were also detailed, see Table 1.3 for details.

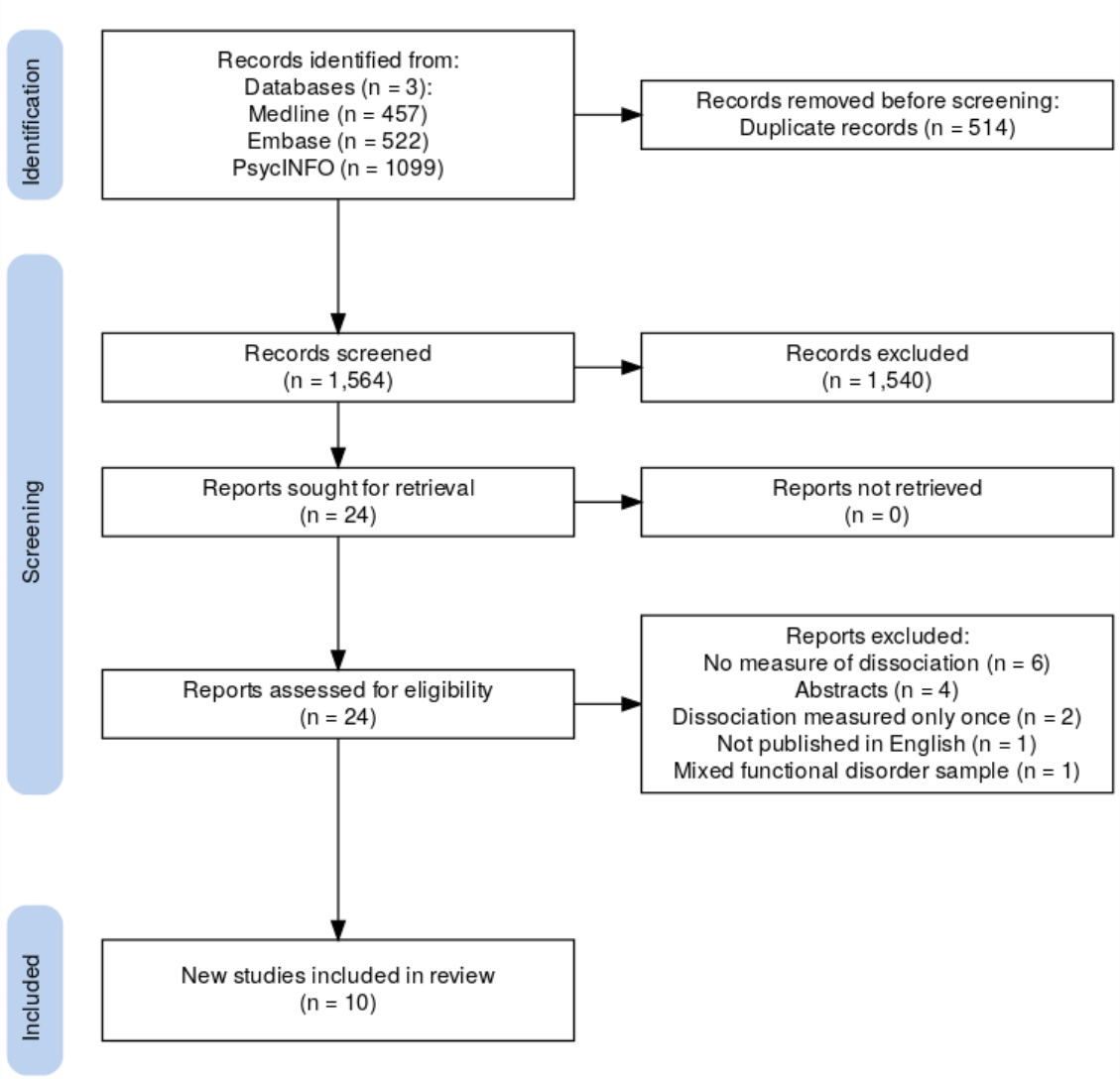
Effect sizes and direction were collected, if possible, as well as other relevant statistics such as p values, to assess change in dissociation scores. To consider whether a change in dissociation scores or lack thereof reported by the studies may be due to measurement sensitivity or other factors, subjective judgments were made regarding whether change could plausibly be expected. To support these subjective judgments, reported changes to DS presentation were collected for all studies. For cohort studies, information about the point of entry to the study was collected (e.g. as a recent diagnosis may result in a change in symptoms, Bodde et al., 2009), and for intervention studies, information about the intervention and whether it may impact dissociation was collected (e.g. did it directly address dissociation or a treatment target closely associated with it?). This information was then collated with the study quality rating and available psychometric data for the measures to make an overall judgment as to whether change could plausibly be expected. Given that studies differed in sample size, time points measures, statistical tests used, study designs, outcome measures collected and other aspects, a narrative synthesis was used to synthesise results. Irrespective of the risk of bias in each study, studies were given equal weight in the reporting for findings in the synthesis given the small sample size and the variability in study characteristics.

The heterogeneity of studies was investigated informally as it was not possible to investigate this statistically, given the limited data reported in the studies. A table of study characteristics is presented and discussed, followed by two comparing tables grouped by

study type (cohort/experimental). Finally, a table detailing the outcome of the quality appraisal tool is presented to assess the quality of studies included in the review.

Figure 1.1

PRISMA flow diagram of included studies



1.4 Results

1.4.1 Study characteristics

Study design varied across the ten studies included. Four of the studies were observational cohort studies (Bodde et al., 2007; Gagny et al., 2021; Grenevald et al., 2021; Villagrán et al., 2022), two studies were randomised controlled trials (La France et al., 2014; Senf-Beckenbach et al., 2022). and the remaining four were within-subjects intervention studies with no control group (Kuyk et al., 2008; Metin et al., 2013; Sarudiansky et al., 2020; Zaroff et al., 2004).

The participants involved in the studies all had a diagnosis of DS, confirmed by video-EEG. Six of the studies indicated explicitly that they excluded participants from participating in the study if they had a comorbid diagnosis of epilepsy (Bodde et al., 2007; Kuyk et al., 2008; LaFrance et al., 2014; Sarudiansky et al., 2020; Senf-Beckenbach et al., 2022; Villagrán et al., 2022), two studies indicated that they had a mixed sample of participants concurrently diagnosed with DS and epilepsy (Gagny et al., 2021; Grenevald et al., 2021) and two other studies did not specify whether that was an exclusion criterion (Zaroff et al., 2004; Metin et al., 2013).

The number of participants included in each study varied considerably with the smallest sample size being 10 at baseline (Zaroff et al., 2004), whilst the largest sample size included was 107 at baseline, which was drawn upon by two studies (Gagny et al., 2021; Grenevald et al., 2021). The ten studies had a combined sample size of 240 participants in their data analysis, with 179 participants identifying as female. The weighted mean age of participants across the included studies was calculated to be 33.5 years. None of the studies reported ethnicity data for their participants.

The time points at which the dissociation measures were collected varied considerably across the studies. Two papers reporting on the linked cohort data set measured dissociation at baseline and then at a maximum of 24 months (Gagny et al., 2021; Grenevald et al., 2021), whilst a further two cohort studies collected measures at baseline and then at follow-up spanning a period of several years later (Bodde et al., 2007; Villagrán et al., 2022). Most intervention studies collected measures at baseline and then post-intervention, however, intervention length varied across the studies. The shortest intervention time was one and a half months (Sarudiansky et al., 2020) and the longest intervention time lasted as long as six months (Kuyk et al., 2008). Two intervention studies also collected outcome measure data at a further six months post-intervention (Kuyk et al., 2008; Senf-Beckenbach et al., 2022).

See Table 1 in Appendix 1.1 for further details regarding the study characteristics.

1.4.2 Quality appraisal

The quality of the included studies was appraised using the QualSys tool for quantitative studies (Kmet, 2004). The average score for observational cohort studies was 0.88, whilst the average score for within-subjects intervention studies was 0.77. Of the cohort studies, Villagrán et al. (2022) had the highest rating, scoring 0.91; whilst the remaining three studies all scored 0.86 (Bodde et al., 2007; Gagny et al., 2021; Grenevald et al., 2021). The experimental studies were rated as having greater variation in their quality, with LaFrance et al. (2014) receiving the highest rating of 0.92, and Metin et al. (2013) receiving the lowest rating of 0.64.

Despite some studies reporting significant results, they all reported being underpowered due to their small sample sizes, with only one study referencing a power calculation (Senf-Beckenbach et al., 2022). Two of the experimental studies included a control group (LaFrance et al., 2014; Senf-Beckenbach et al., 2022), whilst four did not (Kuyk et al., 2008; Metin et al., 2013; Sarudiansky et al., 2020; Zaroff et al., 2004). Studies varied in their reporting of how participants were identified to be recruited to the study, with four studies receiving a full score on this point (Bodde et al., 2007; LaFrance et al., 2014; Sarudiansky et al., 2020; Villagrán et al., 2022). Six of the studies included attempted to control for confounding via the use of multivariate statistical methods (Bodde et al., 2007; Gagny et al., 2021; Grenevald et al., 2021; LaFrance et al., 2014; Senf-Beckenbach et al., 2022; Villagrán et al., 2022), whilst four studies did not refer to confounding (Kuyk et al., 2008; Metin et al., 2013; Sarudiansky et al., 2020; Zaroff et al., 2004).

1.4.3 Outcome measures used and dissociative features measured.

1.4.3.1 Outcome measures

Various outcome measures were used across the ten studies. The most commonly used measure was the Dissociative Experiences Scale (DES, Carlson & Putnam, 1993), used in five of the included studies (Gagny et al., 2021; Grenevald et al., 2021; LaFrance et al., 2014; Metin et al., 2013; Villagrán et al., 2022). This is a 28-item self-report measure that measures trait dissociation and produces a total score between 0-100, with higher scores indicating greater dissociative phenomena experienced. Sarudiansky et al. (2020) used a modified version of the DES, translated to Spanish called the DES-M (Montes et al., 2011). This was described as an 18-item self-report measure that assesses dissociation across similar domains to the DES.

Table 1.1

Quality appraisal scores

	Bodde et al. (2007)	Gagny et al. (2021)	Grenevald et al. (2021)	Villagran et al. (2022)	Kuyk et al. (2008)	LaFrance et al. (2014)	Metin et al. (2013)	Sarudiansky et al. (2020)	Senf-Beckenbach et al. (2022)	Zaroff et al. (2004)
1. Question/objective sufficiently described?	Partial	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Yes	Yes
2. Study design evident and appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3. Method of subject/comparison group selection or source of information/input variables described and appropriate?	Yes	Partial	Partial	Yes	Partial	Yes	Partial	Yes	Partial	No
4. Subject (and comparison group, if applicable) characteristics sufficiently described?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5. If interventional and random allocation was possible, was it described?	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A	Yes	N/A
6. If interventional and blinding of investigators was possible, was it reported?	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A	No	N/A

7. If interventional and blinding of subjects was possible, was it reported?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	N/A
8. Outcome and (if applicable) exposure measure(s) well defined and robust to measurement / misclassification bias? Means of assessment reported?	Yes	Yes	Yes	Yes	Partial	Partial	Partial	Yes	Yes	Partial
9. Sample size appropriate?	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial	Partial
10. Analytic methods described/justified and appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes
11. Some estimate of variance is reported for the main results?	Partial	Yes	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Partial
12. Controlled for confounding?	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No
13. Results reported in sufficient detail?	Yes	Partial	Yes	Yes	Yes	Yes	Partial	Yes	Yes	Yes
14. Conclusions supported by the results?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes
Total Score:	0.86	0.86	0.86	0.91	0.77	0.92	0.64	0.86	0.75	0.68

Villagrán et al. (2022) also measured dissociation using the Somatoform Dissociation Questionnaire (SDQ-20, Nijenhuis et al., 1996). This is a 20-item self-report questionnaire that assesses somatoform dissociation. Two studies (Bodde et al., 2007; Kuyk et al., 2008) used the Dissociation Questionnaire (DISQ, Vanderlinden et al., 1991), which is a Dutch 63-item, self-report questionnaire developed from several English language dissociation measures e.g. the DES. Senf-Beckenbach et al. (2022) measured dissociation using the German Fragebogen zu dissoziativen Symptomen-20 (FDS-20, Freyberger et al., 1998), a 20-item self-report questionnaire based on the DES. Finally, Zaroff et al. (2004) measured dissociation using the Curious Experiences Survey (CES, Goldberg, 1999), a 31-item self-report measure, also developed from the DES.

1.4.3.2 Dissociative features measured

The measures used to measure dissociation in the studies included in this review measured a variety of dissociative phenomena. See table 1.2 below.

Table 1.2

Dissociative features that were measured by each measure. Abbreviation: DES – Dissociative Experiences Scale, DIS-Q – Dissociation Questionnaire, SDQ-20 – Somatoform Dissociation Questionnaire-20, FDS-20 - Fragebogen zu dissoziativen Symptomen-20, CES - Curious Experiences Survey

		Dissociative features measured					
Measure	Included in:	Depersonalisation	Derealisation	Amnesic Symptoms	Absorption	Self-control	Somatoform Dissociation
DES	Gagny et al. (2021); Grenevald et al. (2021); LaFrance et al. (2014); Metin et al. (2013); Villagrán et al. (2022)	✓	✓	✓	✓		
DES-M	Sarudiansky et al. (2020)	✓	✓	✓	✓		
DISQ	Bodde et al. (2007); Kuyk et al. (2008)	✓		✓	✓	✓	
SDQ-20	Villagrán et al. (2022)						✓
FDS-20	Senf-Beckenbach et al. (2022)	✓	✓	✓	✓		
CES	Zaroff et al. (2004)	✓		✓	✓		

1.4.4 Change in dissociation scores within longitudinal & intervention studies

1.4.4.1 Cohort studies

Data not reported in the studies but relevant to this review were requested from authors. Of the four cohort studies, the two studies with the linked dataset (Gagny et al., 2021; Grenevald et al., 2021) did not provide the scores on the dissociation measures at follow-up. Therefore, any change in the scores could not be determined. Bodde et al. (2007) found a change in dissociation scores on some subscales, with d1 - identity confusion and depersonalisation (p = 0.01) and d2 - self-control showing a statistically significant reduction ($p \leq 0.0001$). The sample in this study experienced a reduction in DS ($p \leq 0.001$), with ten patients (45%) classifying themselves as seizure-free or having occasional seizures annually (Bodde et al., 2007). Villagrán et al. (2022) found no statistically significant change in dissociation scores as measured by either the DES or the SDQ-20, when measured at a mean follow-up duration of 71 months. This study reported that 39% of the sample were seizure-free at follow-up, with 82% reporting a 50% reduction in seizures (Villagrán et al., 2022). See Table 1.2 for details. Both studies had a sample of DS with no comorbid epilepsy and measured outcomes several years later. Villagrán et al. (2022) received a quality score of 0.91, whilst Bodde et al. (2007) received a score of 0.86.

1.4.4.2 Following an intervention

Six studies contributed to the synthesis as to whether dissociation was measured to change following intervention in a dissociative seizure population (Kuyk et al., 2008; LaFrance et al., 2014; Metin et al., 2013; Sarudiansky et al., 2020; Senf-Beckenbach et al., 2022; Zaroff et al., 2004). Study quality was typically lower in the interventional study group than in the cohort study group and was as follows: Kuyk et al. (2008) = 0.77, LaFrance et al. (2014) = 0.92, Metin et al. (2013) = 0.64, Sarudiansky et al. (2020) = 0.86, Senf-Beckenbach et al. (2022) = 0.75, and Zaroff et al. (2004) = 0.68. Trends in the studies receiving a lower quality score included insufficient detail regarding the recruitment of participants to the study, insufficient sample size to power the studies adequately, poorly defined outcome measures and a lack of reporting as to whether confounding variables were accounted for.

Four studies found no significant change between dissociation scores measured at baseline and post-intervention (Metin et al., 2013; Sarudiansky et al., 2020; Senf-Beckenbach et al., 2022; Zaroff et al., 2004). These studies had a mix of samples in which the sample was confirmed to be a DS-only sample and in which it was not specified whether the sample had DS-only or

whether they may have had comorbid epilepsy. Of note, Metin et al. (2013) reported a significant decrease in seizure frequency across the duration of the intervention, and at follow-up ($\chi 2(7, N = 9) = 36.18, p \leq .0001$). Out of 9 participants, 6 were seizure-free at follow-up, and all participants had a >50% reduction in seizure frequency. Zaroff et al. (2004) reported mixed results for their participants, with 3 of 7 participants achieving seizure cessation prior to the commencement of their intervention, and a further 2 reported a decrease in seizure frequency post-intervention. Sarudiansky et al. (2020) and Senf-Beckenbach et al. (2022) reported no significant decrease in seizure frequency.

The interventions consisted of weekly group sessions, except for Sarudiansky et al. (2020), where the intervention was bimonthly. The interventions provided in these groups were largely psychoeducational. Dissociation was measured using different measures in each study. The interventions investigated by Sarudiansky et al. (2020) and Senf-Beckenbach et al. (2022) included psychoeducation on dissociation. No reference to dissociation was mentioned as part of the intervention investigated by Metin et al. (2013), and Zaroff et al. (2004).

Two studies found a significant change between dissociation scores measured at baseline and post-intervention (Kuyk et al., 2008; LaFrance et al., 2014). Kuyk et al. (2008) found a statistically significant reduction in dissociation scores when baseline scores were compared to post-intervention scores ($z = -1.99, p = 0.05$) and follow-up scores ($z = -2.59, p=0.01$). This study reported a significant reduction in seizures post-intervention ($z = -2.33, p = 0.02$), with 6 out of 22 participants reporting that they were seizure-free. However, the study received a quality score of 0.77 so the findings should be considered with caution. LaFrance et al. (2014) found a statistically significant change in dissociation scores for the CBT-informed psychotherapy group (mean difference = -4.9, $d = -1.2, p < 0.001$). No significant differences were found between scores on dissociation measures in the other groups included in the trial. No significant change in seizure frequency was found in the CBT-ip group. Kuyk et al. (2008) and LaFrance et al. (2014) both provided interventions where there were some individualised sessions, and the interventions included cognitive behavioural therapy elements. Kuyk et al. (2008) referred to the intervention under investigation in their study as having included trauma treatment, but no direct reference to dissociation was made. No reference to dissociation was mentioned as part of the intervention investigated by LaFrance et al. (2014).

Table 1.3

Dissociative measures used and any changes captured on them in the cohort studies. Abbreviations: V-EEG – Video Electroencephalograph, DIS-Q – Dissociation Questionnaire, DES – Dissociation Experiences Scale, SDQ-20 – Somatoform Dissociation Questionnaire-20, PNES – Psychogenic Non-Epileptic Seizures, D1 – identity confusion and depersonalization, D2 – self-control, D3 – amnestic and dissociation features, D4 – concentration 'absorption' of environmental features, ES – Effect Size.

Study	Population	Type	Time points measured	Outcome measure	Means (SD)		Available statistics	Change plausibly expected?	Change in scores reported?
Bodde et al. (2007)	V-EEG diagnosed DS, no epilepsy	Cohort	Baseline & Long-term follow-up	DIS-Q	D1 pre: 1.62 (0.77) D2 pre 2.29 (0.59) D3 pre 2.14 (0.70) D4 pre 1.89 (0.57)	D2 post: 1.25 (0.40) D2 post 1.61 (0.56) D3 post 1.72 (0.83) D4 post 1.60 (0.61)	p = .01. ES not reported, could not be calculated. p = .000. ES not reported, could not be calculated. p = .007. ES not reported, could not be calculated. *P = .098.* ES not reported, could not be calculated.	Yes: a change in seizure frequency was noted and participants were newly diagnosed.	Partial
Gagny et al. (2021)	V-EEG diagnosed DS & Epilepsy	Cohort	Baseline & Long-term follow-up	DES	Not reported		Not reported	Unclear: no data on changes in DS presentation or other relevant metrics given.	No data

Greneval d et al. (2021)	V-EEG diagnosed DS & Epilepsy	Cohort	Baseline & Long-term follow-up	DES	Not reported		Not reported	Unclear: no data on changes in DS presentation or other relevant metrics given.	No data
Villigran, Lund, Duncan & Lossuis (2022)	V-EEG diagnosed DS, no epilepsy	Cohort	Baseline & Long-term follow-up	DES, SDQ-20	SDQ Seizure free = 30.6, (6.7) DES Seizure Free 13.5 (11.2)	SDQ PNES = 32.7 (9.6) DES PNES 16.6 (10.9)	p = 0.41. d = 0.25* p = 0.33. d = 0.28*	Yes: change in seizure frequency noted and follow-up was 4+ years	No

* Effect sizes calculated from summary data and are between groups, not within group.

Table 1.4

Dissociative measures used and any changes captured on them in the intervention studies. Abbreviations: V-EEG – Video Electroencephalograph, DIS-Q – Dissociation Questionnaire, DES – Dissociation Experiences Scale, FDS-20 - Fragebogen zu dissoziativen Symptomen-20, CES - Curious Experiences Survey, CBT – Cognitive Behavioural Therapy, CBT-ip – Psychotherapy Informed Cognitive Behavioural Therapy, Sert – Sertraline, TAU – Treatment As Usual, PNES – Psychogenic Non-Epileptic Seizures, ES – Effect Size

Study	Population	Type	Time points measured	Outcome measure	Intervention format	Intervention Length	Intervention Frequency	Intervention Features	Means (SD)	Available statistics	Change plausibly expected?	Change in scores reported?
Kuyk et al. (2008)	V-EEG diagnosed DS	Intervention	Pre, post + follow up	DIS-Q	Mixed - individual and group	Long term	Unclear	CBT, Psychotherapy, Psychomotor, Creative, Rational Emotive, Behavioural, Assertiveness Training, Family therapy	Pre 1.86 (0.37) Post 1.69 (0.42) Follow-up 1.48 (0.17)	Pre vs post z = -1.99, p = 0.05 Post vs follow-up z = -0.80, p = 0.42 Pre vs follow-up z = -2.59, p = 0.01	Yes: change in seizure frequency noted and intervention included elements that had previously been linked with reduced dissociation.	Yes
LaFrance et al. (2014)	V-EEG diagnosed DS	Intervention	Pre and post intervention	DES	Individual	Intermediate term	Weekly	Psychotherapy	CBT-ip mean difference [MD] = -4.9 (4.1) CBT-ip & Sert. MD =2.1 (11.1) Sert. MD = -2.0 (8.3) TAU MD = -2.1 (9.4)	d = 1.12, p < .001 d = -0.2, p > 1 d = -0.2, p > 1 d = -0.2, p > 1	Unclear: no change in seizure frequency reported and no details on intervention targets were given.	Partial
Metin et al. (2013)	V-EEG diagnosed DS	Intervention	Pre and post intervention	DES	Group	Intermediate term	Weekly	Psychoeducation, Psychotherapy, Behavioural	Not reported	Not reported	Yes: change in seizure frequency noted, and intervention included elements that had previously been	No

											linked with reduced dissociation.	
Sarudiansky et al. (2020)	V-EEG diagnosed DS	Intervention	Pre and post intervention	DES-M	Group	Short term	Bimonthly	Psychoeducation	Pre = 46. 83 (15.58) Post = 41.75 (14.65)	z = -0.79, p = 0.43.	No: no change in seizure frequency reported and intervention did not target dissociation.	No
Senf-Beckenback et al. (2022)	V-EEG diagnosed DS	Intervention	Pre, post + follow up	FDS-20	Group	Intermediate term	Weekly	Psychoeducation, mindfulness	Control pre 23.2 (16.8) Control post 22.2 (15.7) Control follow-up 16.8 (10.8) Intervention pre 26.1 (16.3) Intervention post 21.2 (12.8) Intervention follow-up 19.8 (10.9)	η^2 = 0.05, p = 0.15	Yes: intervention indirectly targeted dissociation	No
Zaroff et al. (2004)	V-EEG diagnosed DS	Intervention	Pre and post intervention	CES	Group	Intermediate term	Weekly	Psychoeducation	Pre 68.29 (18.84) Post 53.57 (29.67)	t = 2.59, p = 0.04	Yes: intervention indirectly targeted dissociation	No

1.4.4.3 Plausible change

Four out of the six studies (Metin et al., 2013; Senf-Beckenbach et al., 2022; Villagrán et al., 2022; Zaroff et al., 2004) classified as plausibly expecting change did not find a significant decrease in dissociation scores. The remaining two studies did report a significant decrease in dissociation scores (Bodde et al., 2007; Kuyk et al., 2008). One study (LaFrance et al., 2014) that could not be classified due to limited information, found a significant decrease in dissociation scores for one of their experimental groups.

1.5 Discussion

This systematic review aimed to characterize the outcome measures used to assess dissociation in a DS population and identify trends in dissociative features measured. It also examined whether these measures capture changes in dissociation over time and following interventions. Ten papers met inclusion criteria, comprising four cohort studies, two RCTs, and four interventional studies without control groups. The studies varied in outcome measures, dissociation changes, time points measured, design, sample diagnoses, interventions administered, and quality, limiting conclusions on measure sensitivity to dissociative symptom change.

A key finding was that several outcome measures are currently used to assess change in dissociation in a DS population. The most commonly used measure was the Dissociative Experiences Scale (DES, Carlson & Putnam, 1993), consistent with previous reviews (e.g. Campbell et al., 2023; Cassady & Baslet, 2023). However, it is not standardised in a DS population. The studies included in this review did not report on their justification for their choice of dissociation measure over others available. It remains unclear as to why this measure is the most selected. Three out of the ten studies included reported subscale scores on derealization, depersonalisation and amnesic symptoms. Future research should report the outcomes of dissociation measures and subscale scores more consistently so that dissociation in this population may be explored further.

Within the cohort studies, only one out of the four included studies reported partial changes in dissociation scores, alongside reduced seizure frequency when using the DIS-Q (Bodde et al., 2007). This study was of high quality, and was categorised as plausibly expecting change in dissociation scores. In contrast, Villagrán et al. (2022) found no significant dissociation changes using DES and SDQ-20, despite a similar seizure-free sample

proportion at follow-up. Villagrán et al.(2022) received a higher study quality rating than Bodde et al. (2007), and was also categorised as plausibly expecting change. It may be that the DES and SDQ-20 are less sensitive to changes in dissociation over time.

Two out of six intervention studies reported reduced dissociation scores. Kuyk et al. (2008) found significant reductions in dissociation as measured by the DIS-Q following cognitive behavioural therapy (CBT) delivered as a mix of individual and group sessions (Kuyk et al., 2008). LaFrance et al. (2014) also found significant reductions in dissociation scores for the CBT-informed psychotherapy group who received individualised sessions, as measured by the DES. Other studies, primarily psychoeducational interventions, reported no significant dissociation changes. These findings align with previous reviews, identifying CBT as an effective therapy for DS (Moro et al., 2024).

Due to the small number and heterogeneity of studies, it remains unclear whether dissociation measure sensitivity, intervention modality, or both influenced these findings. The three intervention studies (Metin et al., 2013; Senf-Beckenbach et al., 2022; Zaroff et al., 2004) that were classified as plausibly expecting change on measures of dissociation all deployed new interventions that were previously untested in this population and were of lower study quality. Two of the studies (Senf-Beckenbach et al., 2022; Zaroff et al., 2004) also used dissociation measures, which are not commonly used in this population. It is, therefore, difficult to conclude as to whether the lack of change was due to measurement insensitivity or methodological issues with the study design, or a combination. Gaskell et al. (2024) found that treatment modality was not a moderating variable for outcomes, suggesting perhaps that the DIS-Q and DES may be more sensitive to changes in dissociation following an intervention than other measures. Given the lack of trends in whether change was found on dissociation measures following on from whether a study was classified as plausibly expecting it, it remains difficult to make firm conclusions as to the sensitivity of dissociation measures used to assess dissociation in a DS population,

1.5.1 Methodological Considerations

Only a small number of studies have investigated dissociation over multiple time points within a DS population, limiting the certainty of any conclusions drawn. Within the studies, there is also high heterogeneity across numerous factors, making comparisons difficult. All studies included in this review referred to inadequate statistical power. This was referred to in a general sense, rather than regarding specific measures, so the extent to which this

impacted the detection of changes in dissociative phenomena is not clear. . This made it difficult to ascertain whether a lack of change measured on dissociation measures was due to a lack of sensitivity in the measures or the study design itself. Future research should consider undertaking power calculations when designing studies, to ensure that any effects between or within subjects can be detected.

This review found a complex relationship between dissociation changes and seizure frequency, with no consistent trend. This contrasts with Campbell et al.'s (2023) review, where several studies found positive correlations between the two variables. Differences in dissociation measures, sample characteristics, study design, and psychopathology may explain these discrepancies. One difference may also be differences in the underlying psychopathology of the study samples. Reuber et al. (2003) reported that an association between dissociation scores and DS outcomes became non-significant when psychopathology was controlled for. A previous review by Brown & Reuber (2016a) has therefore called for the inclusion of a psychiatric control group when investigating the relationship between these variables. Future studies may wish to consider this, given recent suggestions of dissociation having a mechanistic link in DS (Cassady & Baslet, 2023).

1.5.2 Clinical and research implications

This review found that most measures used to assess dissociation longitudinally in a DS population looked at general dissociation, and this is consistent with a recent review of such measures (Wainipitapong et al., 2025). This ‘general’ classification refers to dissociation measures that typically assess depersonalisation, derealisation, amnestic and absorption symptoms. However, these are not the only types of dissociative symptoms. Other forms of dissociation relevant to DS exist, e.g. somatoform dissociation (Koreki et al., 2020). With regard to clinical implications, clinicians may wish to consider the use of dissociation measures that measure different types of dissociative phenomena when measuring dissociation in a DS population, as there is yet to be an established consensus on which measures are best. Wainipitapong et al. (2025) found the most robust levels of evidence for the DES which measures general dissociation and the SDQ-20 which measures somatoform dissociation. Clinicians may wish to develop a more comprehensive measure based on the DES, with additional items capturing somatoform dissociation taken from the SDQ-20 and items measuring self-control from the DIS-Q. This would ensure that there are no aspects of dissociative phenomena missed clinically and build evidence for establishing a gold standard measure. Clinicians may also wish to consider the

measurement of psychopathology in this population alongside dissociative measures, to determine which variables are priority targets for interventions.

Future research should aim to develop standardised measures of dissociation, to allow for increased comparability across studies so that its nature and relationship to seizure frequency can be determined. Researchers may also wish to consider the measurement of trauma history and ethnicity when designing studies, as both are known to impact presentation and levels of dissociation.

1.5.3 Review limitations

As with any piece of work, this review is not without its limitations. Best practice guidance regarding the undertaking of a systematic review encourages the use of two reviewers for screening, data extraction and quality appraisal to aid in the reliability of information synthesised (Higgins et al., 2024), however, due to resource constraints, this was not possible for this review. Papers not published in English were also excluded for the same reason, leading to the potential exclusion of relevant articles. Best practice guidelines also encourage the use of synthesis methods such as a meta-analysis (Higgins et al., 2024), however, this was not possible due to insufficient information reported and the large heterogeneity across the studies.

1.6 Conclusion

This review aimed to characterise the outcome measures used to investigate changes in dissociation in a DS population both over time and following an intervention. A small number of studies were found to have investigated this, largely as secondary measures. The review found that there was heterogeneity across many aspects of study design, quality and findings. Therefore, it was difficult to draw any conclusions with certainty.

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Chapter 2

A brief CBT-based sleep intervention for individuals under investigation for dissociative seizures: a single-case experimental design.

Prepared in accordance with the author requirements for Epilepsy & Behaviour and SCRIBE guidelines (Tate et al., 2017)

https://www-sciencedirect-com.ezproxy2.lib.gla.ac.uk/journal/epilepsy-and-behavior/publish/guide-for-authors

Plain Language Summary

Title

Investigating the impact of a brief psychological intervention for sleep on individuals being investigated for dissociative seizures.

Background

Dissociative seizures (DS), also called psychogenic non-epileptic seizures or non-epileptic attack disorder, are events that can involve temporary changes in consciousness, behaviour and movement. They are like epileptic seizures but are not caused by changes in brain activity. It is thought that DS result from a mix of psychological, social and biological factors. People with DS often report high levels of dissociation, meaning their sense of self, thoughts and memories are disrupted. There is evidence to suggest a link between dissociation and more frequent DS. Poor sleep, which is common in DS, may also make dissociative symptoms worse.

Treating sleep difficulties in those with DS may improve sleep, which may in turn reduce dissociative symptoms. This study aimed to investigate whether two sessions of a brief psychological intervention called Cognitive Behavioural Therapy for Insomnia (bCBTi) would effectively treat sleep difficulties in people being investigated for DS, and whether that would lead to a reduction in symptoms of dissociation, anxiety, and low mood, and an improvement in quality of life.

Aims and Questions

The aims and research questions of the study were:

1) Does bCBTi improve sleep difficulties for people under investigation for DS and as measured by a wearable movement tracker.
2) Does bCBTi reduce symptoms of dissociation, anxiety and low mood and improve quality of life for people under investigation for DS?
3) Is bCBTi an acceptable intervention to deliver to inpatients?

Methods

Participants: Three adults admitted to the William Quarrier Scottish Epilepsy Centre for investigation of possible DS were identified as meeting study criteria of reporting sleep

difficulties and not having any difficulties that would stop them from participating, like a significant learning disability.

Design of the study: Participants were asked to fill in two short surveys every day, assessing their sleep and dissociative symptoms and wear a movement tracker called an Actiwatch. After an initial baseline phase, participants had their first bCBTi session, followed by the second approximately a week later. They continued to complete the surveys and wear the Actiwatch every day to see if there was a change in their scores when they began the intervention. Participants were also asked to complete more detailed surveys on their dissociative symptoms, sleep difficulties, mood, levels of anxiety and quality of life before and after the study, to see if any changes took place.

Main Findings and Conclusions

Following the intervention, no consistent pattern of improvement was found in the sleep difficulties reported by the participants or measured by the Actiwatches. It may be that the time we measured to see whether there were any changes following the intervention was too short. Further research should seek to investigate this further. No pattern of improvement was found on the surveys measuring dissociative symptoms, mood, levels of anxiety or quality of life.

2.1 Abstract

Introduction: Dissociative seizures (DS) are events similar to epileptic seizures but without underlying changes in neural electrical activity which can be highly disabling. It is established that (i) dissociative symptoms beyond seizures are common in DS; (ii) poor sleep can exacerbate dissociative symptoms, and (iii) those with DS commonly experience poor sleep. This study investigated whether brief Cognitive Behavioural Therapy for insomnia (bCBTi) improved sleep and dissociative experiences in inpatients under investigation for DS.

Research Questions: Does bCBTi improve subjective and objective sleep difficulties, dissociative symptoms, quality of life, mood and anxiety in those under investigation for DS?

Design: The study utilised a non-concurrent, two-phase, multiple baseline single case experimental design (SCED). Participants were randomised to one of three baseline conditions.

Methods: Participants were adult inpatients admitted for the diagnostic clarification of events potentially indicative of DS, who also reported poor sleep. They underwent two sessions of bCBTi delivered by a clinical psychologist. They completed a sleep diary and a measure of state dissociation daily and wore an actigraphy watch throughout the study, before and after two bCBTi sessions. Self-report measures capturing trait dissociation, anxiety, mood, sleep quality, and quality of life were completed pre and post-intervention.

Results: No pattern of improvement on dissociative, sleep or psychiatric measures was found following the intervention. Possible reasons include the length of measurement post-intervention.

Conclusions: Future research should investigate the mechanisms behind sleep difficulties in a DS population, so effective treatments may be developed.

Keywords: Dissociative Seizures; Psychogenic Non-epileptic Seizures; Sleep; Insomnia; Single Case Experimental Design; Dissociation; Cognitive Behavioural Therapy

2.2 Introduction

Dissociative seizures (DS) are complex events involving paroxysmal changes in behavior, manifesting as sensory, motor, emotional symptoms, and changes in consciousness (Oto & Reuber, 2014). These events resemble epileptic seizures but are not caused by abnormal electrical brain activity (Brown & Reuber, 2016a). DS can co-occur with epilepsy; a 2018 meta-analysis found that 22% of those with DS also had epilepsy, while 12% of those with epilepsy had DS (Kutlubaev et al., 2018). DS arise from an interplay of psychological, biological, and social factors (Asadi-Pooya et al., 2021).

The Integrative Cognitive Model (ICM, Brown & Reuber, 2016b) proposes that DS result from a previously learnt 'rogue' mental representation of seizures (a 'seizure scaffold') becoming preconsciously activated by internal or external triggers. This scaffold develops unconsciously over time from experiences of seizures (occurring in oneself or witnessed in others), poor health and loss of consciousness (Brown & Reuber, 2016b). In early DS onset, heightened arousal impairs the ability to inhibit automatic processing, increasing vulnerability to the activation of rogue representations (Reuber & Brown, 2017). This increase in arousal occurs in conjunction with a preconscious prediction that a seizure is likely, thereby making the seizure scaffold the most salient hypothesis. This triggers the DS, which may lead to a reduction in one's level of arousal. An association develops, DS may then be experienced in anticipation of a trigger rather than experiencing it (Brown & Reuber, 2016b).

Brown & Reuber's (2016) conceptualisation has similarities with pathological dissociation, which can represent a transient disruption to one's ability to integrate conscious experience, therefore impacting one's behavioural, memory, bodily control and sensations (Ertan et al., 2022; World Health Organisation, 2019). Pathological dissociation includes: 'compartmentalisation', a temporary inability to control mental processes or actions that are ordinarily under one's control (Brown, 2002a, 2004; Cardena, 1994) and 'detachment', encompassing feelings of derealisation and depersonalisation (Holmes et al., 2005).

Evidence links DS with dissociation. A systematic review (Campbell et al., 2023) found dissociation levels in the 'severe' range in DS patients, which was associated with both seizure frequency and severity of seizure symptoms. The strongest evidence was found for depersonalisation, derealisation, and amnesic symptoms occurring alongside DS, with mixed findings for somatoform dissociative symptoms and perceptual alteration. A narrative review of the literature identified dissociation as a key mechanism underlying DS (Cassady & Baslet, 2023).

Poor sleep exacerbates dissociative symptoms. Watson (2001) hypothesised that sleep-wake disruptions cause sleep phenomena to intrude into daytime consciousness, triggering dissociation. Supporting this, Giesbrecht et al. (2007) found that undergraduate students deprived of a single night's sleep reported a 4.45-fold increase in dissociative symptoms. In a longitudinal study, van der Kloet et al. (2012) found that improving sleep hygiene reduced dissociative symptoms in inpatients with mixed psychiatric diagnoses.

Sleep difficulties are common in DS. Vanek et al. (2021) noted subjective reports of reduced sleep length, difficulties falling asleep, and correlations between sleep and seizure frequency, though objective measures yielded mixed results. In another study, actigraphy data showed DS patients had more awakenings, longer wakefulness after sleep onset, and lower sleep efficiency than controls. While DS patients reported higher dissociation, no link was found between sleep difficulties and next-day state dissociation (Mousa et al., 2021). Given DS's dissociative nature and its link with poor sleep, we hypothesise that improving sleep may reduce dissociation and DS.

Cognitive Behavioural Therapy for Insomnia (CBTi) has a robust evidence base for treating sleep difficulties (van Straten et al., 2018). Even abbreviated CBTi administered in 2-4 sessions can be efficacious, so long as strategies such as sleep restriction, sleep-specific cognitive restructuring, and stimulus control are retained (Bishop et al., 2021). Pigeon et al. (2019) administered four sessions of bCBTi to primary care patients with insomnia and comorbid Post Traumatic Stress Disorder (PTSD) and found a large effect size for insomnia severity, and a small effect size for PTSD. A secondary analysis revealed that most treatment effects occurred after two sessions, suggesting that two sessions were sufficient to reduce insomnia severity (Bishop et al., 2021). Two sessions

of group bCBTi have also been found to be effective in decreasing sleep onset latency, increasing objective sleep efficiency, and leading to a reduction of hypnotic use at 6-month follow-up (Harada et al., 2015). This study examined the impact of bCBTi on sleep, DS, and related outcomes in an inpatient setting.

Aims and Research Questions

The aim of the current study was to determine whether bCBTi improves sleep and dissociative experiences in an inpatient population under investigation for DS and comorbid insomnia. The research questions were:

1) Does bCBTi improve subjective and objective sleep difficulties in those under investigation for DS?
2) Does bCBTi reduce subjective dissociative experiences in those under investigation for DS?
3) Does bCBTi result in other improvements in QoL, mood and anxiety?
4) Is bCBTi an acceptable intervention to deliver within an inpatient setting?

It was hypothesised that if the intervention were successful, a reduction in sleep difficulties would reduce dissociative symptoms for participants with DS. It was further hypothesised that this sleep improvement would improve other psychiatric comorbidities.

2.3 Method

2.3.1 Design

The Single-Case Reporting guideline In BEhavioural interventions (SCRIBE; Tate et al., 2016) was used to guide study write-up, with the Single-Case Intervention Research Design Standards (Kratochwill et al., 2021) used to develop the study design. The study utilised a non-concurrent AB multiple baseline single case experimental design (SCED). It included two phases, a baseline phase, and an interventional phase. Phases were determined *a priori*, where the interventional phase was triggered based on the participant completing the required number of days in the baseline phase. Although a replication of the baseline conditions across participants was originally planned, this was not completed due to difficulties arising during recruitment. Due to a change in clinician availability, the number of days between each intervention session had to be increased

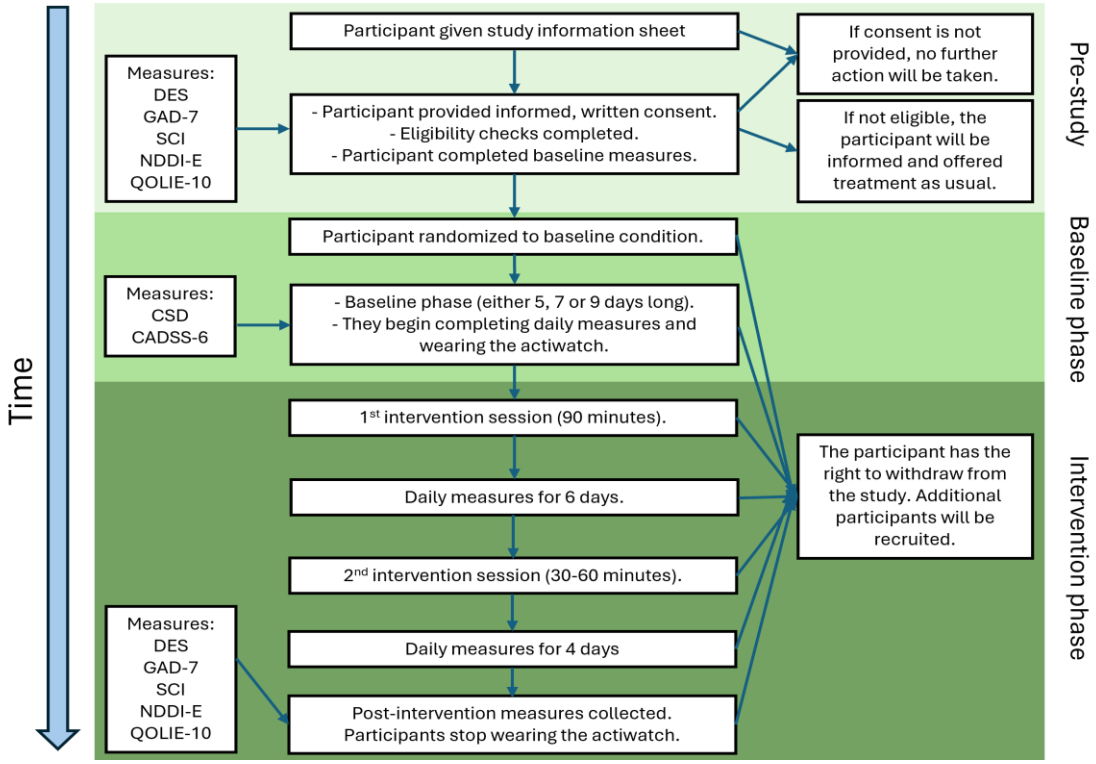
from what was stated in the protocol, but this was then kept consistent across participants. See results for details regarding an adverse event unrelated to the study that arose for one participant.

Participants were randomised to one of three baseline conditions using www.randomizer.org (Urbaniak & Plous, 2013), which had durations of five, seven or nine days. These lengths were selected to balance the need for establishing a reliable baseline given variable sleep changes each night (Ford et al., 2022), and the limited inpatient admission time to enable the completion of the entire study. The lengths exceed the minimum data points per phase specified within design standards (Kratochwill et al., 2013). Due to the nature of the study, blinding of participants and investigators was not possible. A diagram of the intended research procedures is included below (Figure 1), with further explanation and details of necessary procedural changes from the protocol to follow.

Key: DES = Dissociative Experiences Scale, GAD-7 = Generalised Anxiety Disorder-7, SCI = Sleep

Figure 2.1

Overview of research procedures



Conditions Indicator, NDDIE-E = Neurological Disorders Depression Inventory for Epilepsy – English version, QOLIE-10 = Quality of Life in Epilepsy-10, CSD = Consensus Sleep Diary, CADSS-6 = Clinician Administered Dissociation Symptom Scale-6.

2.3.2 Participants

2.3.2.1 Selection criteria

Participants were adult inpatients at the William Quarrier Scottish Epilepsy Centre (WQSEC) in Glasgow, Scotland, undergoing diagnostic or additional seizure assessment with DS as a potential or confirmed diagnosis. The centre typically admits patients under investigation for DS for 2-4 weeks, where they are monitored continuously with the aim of capturing seizure activity. Each patient had a private ensuite room, with shared living and dining areas. Patients' time during the day was unstructured. Potential participants were initially identified by the WQSEC clinical nurse specialist (CNS) prior to admission. The CNS contacted all individuals admitted to the centre where there was an indication that some seizures could be dissociative and asked them two screening questions, taken from Kraepelien et al. (2021), about the quality of their sleep. If sleep difficulties were identified, the CNS requested verbal consent for a research team member to contact the potential participant to provide them with the study information sheet. Once admitted, if the participants indicated that they wished to participate, a meeting was arranged with the principal researcher to assess the remaining eligibility criteria, obtain informed consent and complete the remaining baseline measures.

Participants were required to meet the following inclusion criteria:

- 18 years or older.
- Able to speak and read English.
- Self-reported sleep disturbance, scoring ≤16 on the Sleep Conditions Indicator (SCI).
- Compelling evidence that at least some of a participant's seizures are likely to be dissociative, based on at least one of the following:
    1) Opinion of the referring consultant, WQSEC consultant, or WQSEC CNS, based on:
        - Direct witnessing of seizure(s)
        - Review of video footage
        - Semiology as suggested by reliable patient or family history.
    2) EEG assessment showing seizures without correlated EEG change.

Participants were excluded if they met any of the following criteria:

- Active and significant mental health problems and/or moderate to severe learning disabilities (IQ score of ≤50).
- Lack of mental capacity to consent to participation.
- Already participating in another research project.

The study chose to include participants under investigation for DS rather than those with a confirmed diagnosis as their period of admission to the centre provided a consistent, controlled environment for the trial of a sleep intervention. The admission period meant that the study had to begin promptly and could not wait until a diagnosis was made, as a definitive diagnosis would result in discharge. From an ethical standpoint, the literature shows a broad evidence base for CBTi, including its effectiveness for those with epilepsy (e.g. Mouchati et al., 2024) . Consequently, it was deemed to be of potential benefit and unlikely to cause harm if participants went on to receive a diagnosis of epilepsy.

2.3.2.2 Participant characteristics

Between February and December 2024, the CNS identified ten potential participants and expressed interest in participating. During the initial meeting with the researcher, four participants were identified as meeting the criteria for exclusion. Two individuals did not meet the criteria of <16 on the SCI, and two individuals were excluded due to indications that they had a significant learning disability. A further three participants met the criteria for participation and began but did not complete the study. Participant A participated in the study as an outpatient following an abbreviated admission, but contact was lost following the first intervention session, and no data were collected. The centre identified participant B as solely having epileptic seizures and subsequently withdrew from the study prior to the intervention. Participant C withdrew prior to the intervention due to early discharge from the centre. For ethical reasons, both participants were offered the remaining intervention sessions without the additional obligations associated with the study, but these were declined.

Three participants completed the study, and their demographics are as follows:

Participant 1 was a white Scottish male in his early 30s admitted to the WQSEC for investigation of events indicative of DS. Participant 1 was living with his partner and children and had been employed in a skilled trade occupation prior to the onset of events. Participant 1 was not taking any medication during the time he participated in the study.

Participant 2 was a white Scottish female in her 50s who had previous diagnoses of both epilepsy and DS. She was admitted to clarify the nature of new events. Participant 2 was married, lived with her husband, and was a mother. She was previously employed in a sales and customer service occupation. Participant 2 was taking the following medication during her participation in the study: Brivaracetam, Lansoprazole, Ramipril, Naproxen, Gabapentin, and Dihydrocodeine. Participant 2 had a history of depression and post-traumatic stress disorder, for which she previously received psychological intervention.

Participant 3 was a white Scottish male in his 50s admitted for investigation of events consistent with DS. Participant 3 lived with his wife and was a father and grandfather. He was previously employed in a variety of occupations, including as a process, plant, and machine operative and in sales and customer service. Participant 3 had a history of mood disorders, alcohol dependency and trauma.

2.3.3 Ethical approval and registration

Ethical approval was obtained from the West of Scotland Research Ethics Committee, on 23rd February 2024, ref: 24/WS/001. Management approval was obtained from WQSEC on 4th December 2023. This study was registered on https://clinicaltrials.gov/ on 11th of October, 2023, ref: NCT06145971.

2.3.4 Measures and Materials

Demographic information was collected from participant medical records, with written consent. DS frequency whilst participating in the study was assessed using data collected by the WQSEC and self-report from the participants, if they completed a portion of the study from home.

2.3.4.1 Pre and post-intervention measures:

The Dissociative Experiences Scale-II (DES-II) was used to measure dissociation (Carlson & Putnam, 1993). This is a self-report, 28-item questionnaire that measures the percentage of time (0-100%) that various dissociative phenomena are experienced. The presence of a dissociative disorder is indicated by scores of ≥30, out of a total of 100. The DES-II has high internal consistency (α = .95, Carlson & Putnam, 1993) and acceptable test-retest reliability (α = .89, Arzoumanian et al., 2023). The DES-II is widely used in a DS population and studies have found that those with DS score highly on it (Campbell et al., 2023).

The self-report Sleep Conditions Indicator (Espie et al., 2014) was used to assess sleep difficulties subjectively. This questionnaire has eight items, each with a 5-point Likert scale that evaluates sleep across dimensions such as quality of sleep, duration of sleep difficulties and their impact. The possible presence of insomnia is indicated by scores ≤16, out of a total score of 32. The questionnaire was found to have robust internal consistency (α = .86) and convergent validity with existing sleep measures (Espie et al., 2014).

Symptoms of anxiety were measured using the Generalised Anxiety Disorder-7 (GAD-7, Spitzer et al., 2006). This self-report, 7-item questionnaire assesses anxiety using a 4-point Likert scale assessing symptoms such as worry and physical symptoms of anxiety. Scores >5 indicate the presence of anxiety, out of a total score of 21 (Spitzer et al., 2006). The GAD-7 has high internal consistency (α = .92) and good convergent and discriminant validity when used in a DS population (Goldstein et al., 2023).

Quality of life was measured using the Quality of Life in Epilepsy Inventory 10-item (QOLIE-10, Cramer et al., 1996). This 10-item, self-report questionnaire measures aspects of quality of life such as social functioning, emotional well-being and seizure worry, with a total score of 51. Lower scores denote better quality of life. The QOLIE-10 has been used in DS populations (Jones et al., 2016).

Depression was measured using the Neurological Disorders Depression Inventory for Epilepsy (NDDI-E, Friedman et al., 2009). This is a 6-item, self-report measure that

assesses symptoms of depression using a 4-point Likert scale where scores over 15, out of a total of 24, indicate the presence of depression (Friedman et al., 2009). It has high internal consistency (α = .87), specificity, and sensitivity to detecting depression in a DS population (Williams & Bagary, 2012).

The SCI, GAD-7, NDDIE and QOLIE-10 were all selected as they were measures currently used by the WQSEC to reduce the burden on participants.

2.3.4.2 Daily measures:

The Consensus Sleep Diary (CSD, Carney et al., 2012) was selected as the daily subjective measure of sleep. The CSD captures the following metrics: sleep efficiency (SE), total sleep time (TST), and nightly sleep onset latency (SOL) amongst other information. The CSD has good discriminant validity and usability in clinical settings (Maich et al., 2018). It was selected as it has been used successfully with a DS population (Mousa et al., 2021).

Sleep was objectively measured using actigraphy data collected via Axivity AX3 devices, worn on the participants' wrists for the duration of the study. Actigraphy is a valid measure of sleep, with high accuracy and sensitivity when measuring TST and Wakefulness After Sleep Onset (WASO, Marino et al., 2013). It was selected as the objective sleep measure as polysomnography was not available. Actigraphy devices measure movement, light and temperature, with the data collected allowing for the determination of periods of wakefulness or sleep during the night. They were configured via the Open Movement GUI (OMGUI, V1.0.0.43, Guan et al., 2019) at a sampling frequency of 100 hz ± 8g for participants 1 and 2 and 50 hz ± 8g for participant 3. The sampling frequency was intended to be 50 hz ± 8g for all participants, but it was set at 100 hz for two participants due to human error.

Dissociation was measured using the Clinician-Administered Dissociative States Scale-6 (CADSS-6; Rodrigues et al., 2021), which is a 6-item self-report questionnaire that measures dissociation across the following three domains: depersonalisation, derealisation, and amnesia.

The CADSS-6 correlated highly (*rs* = .93) with the original CADSS (Bremner et al., 1998, Rodrigues et al., 2021), which has been used with DS populations before (e.g. Akyuz et al., 2004).

2.3.4.3 Intervention

The intervention comprised two sessions of bCBTi with a clinical psychologist, administered weekly. It was developed in line with guidelines for the minimum elements required for a bCBTi intervention to be effective (Espie et al., 2022). The first session was the main session, where the psychologist formulated the participant's sleep difficulties, provided psychoeducation on sleep hygiene and instructed them in the behavioural intervention of sleep restriction. The following session included a cognitive component - cognitive restructuring - as well as a review of their progress with sleep restriction. See Appendix 2.7 for the intervention manual, which was adhered to across the participants. Session attendance was recorded for analysis of treatment feasibility.

2.3.4.4 Procedural Fidelity

Procedural fidelity was evaluated in the baseline phase by checking the percentage completion of daily measures, and the quality control graphs provided by the actigraphy analysis to ensure that participants wore the Actiwatch in the evenings. Procedural fidelity was ensured during the intervention phase by the same clinician administering the intervention to all three participants, using the intervention manual. It was evaluated by recording whether participants attended the intervention sessions.

2.3.5 Analysis

Accelerometery data was processed in its binary format (.cwa) in Rstudio (v.2024.09.1+394 "Cranberry Hibiscus", 2024) using R (v4.4.2) and the GGIR package (van Hees et al., 2024). The data underwent autocalibration, and no errors were apparent.

Missing values were handled using mean substitution, this method was selected in line with the available guidance (Aydin, 2024). Visual analysis was used to determine whether the bCBTi had an impact on CADSS-6 scores and sleep outcomes, using the steps outlined in the Visual Aid Implying an Objective Rule approach (VAIOR, Manolov & Vannest, 2019). SE, TST, WASO and Sleep Onset Latency (SOL) from the CDS and

actigraphy alongside CADSS-6 scores were formatted into text files according to guidance and were uploaded to https://manolov.shinyapps.io/TrendMAD/ to complete the analysis. Given that this intervention was previously untested in this population, all data points from the intervention phase were considered to determine whether there was an effect (Manolov & Vannest, 2023).

Statistical analysis of the daily measures used the Tau-U method (Parker et al., 2011), to conduct pairwise comparisons to measure the percentage of non-overlapping data between baseline and intervention phases. Tau-U allows the analysis of data trends, both between and within phases (Brossart et al., 2018), does not rely on data conforming to the assumptions of parametric tests and controls for trends in baseline effectively (Parker et al., 2011). Measure scores were inputted into the Tau-U calculator at https://singlecaseresearch.org/calculators/tau-u/. Baseline trend correction was applied if baseline Tau was ≥ 0.40, ≤ -0.40 or $p \leq 0.05$, as used in Parker et al. (2011). Tau-U measures of effect were interpreted using the recommendations of Vannest & Ninci (2015), where values of ≤ 0.20 are categorised as a small effect, values of 0.20-0.60 are categorised as a moderate effect, values of 0.60-0.80 are categorised as a large effect, whilst values ≥ 0.80 are categorised as a very large effect.

To analyse the effects of bCBTi on pre and post-intervention measures, reliable change index (RCI) scores were calculated using the Jacobson & Truax method (Jacobson & Truax, 1991). This method assesses whether a change in scores on a measure between two time points is 'reliable' or 'clinically significant', beyond that of fluctuations in scores due to measurement error (Guhn et al., 2014). A threshold of $Z = \pm 1.96$, corresponding to a 95% confidence level was used. RCIs were produced using the Reliable & Clinical Change Generator (Devilly, 2005). Test-retest reliability and standard deviation figures were taken from the following papers: DES (Frischholz et al., 1990), SCI (Espie et al., 2018), GAD-7 (Spitzer et al., 2006), NDDI-E (Caller et al., 2016; Gilliam et al., 2006) and QOLIE-10 (Cramer et al., 1996; Tolchin et al., 2019).

2.4 Results

For each participant, their study sequence and any adverse events are reported, followed by the visual and Tau-U analysis results for the CADSS-6, subjective and objective Sleep Efficiency (SE) and Total Sleep Time (TST). Following this, reliable change index scores are presented for the pre and post-intervention measures. See Appendix 2.9 for additional results.

Table 2.1

Mean (SD) scores on daily measure metrics.

	Participant 1		Participant 2		Participant 3	
	Baseline Mean (SD)	Intervention Mean (SD)	Baseline Mean (SD)	Intervention Mean (SD)	Baseline Mean (SD)	Intervention Mean (SD)
CADSS-6*	0 (0)	0 (0)	9.00 (1.15)	9.64 (3.09)	9.57 (3.06)	7.44 (1.41)
Subjective SE†	82.39 (4.49)	73.46 (9.15)	84.19 (14.38)	98.85 (0.48)	67.17 (9.79)	71.60 (9.60)
Subjective TST‡	397.00 (59.43)	352.27 (63.28)	348.00 (82.56)	386.92 (87.76)	495.00 (66.84)	566.67 (101.78)
Subjective WASO‡	43.11 (14.66)	99.09 (47.78)	13.00 (12.27)	0 (0)	19.29 (8.31)	21.67 (14.45)
Subjective SOL‡	31.11 (14.01)	21.82 (8.30)	3.80 (5.89)	1.33 (1.09)	95.71 (26.99)	83.33 (39.22)
Objective SE†	76.41 (4.12)	76.56 (3.34)	72.78 (24.69)	76.97 (10.63)	88.50 (3.55)	85.89 (3.98)
Objective TST⁋	7.52 (0.90)	7.31 (0.95)	5.01 (2.41)	4.21 (1.76)	9.54 (0.54)	9.51 (0.40)
Objective WASO⁋	1.57 (0.37)	1.50 (0.33)	0.43 (0.29)	0.50 (0.56)	0.71 (0.20)	0.98 (0.15)
Objective SOL§	23.48 (0.55)	23.79 (0.62)	25.82 (1.81)	26.62 (3.28)	23.37 (0.48)	23.32 (0.49)

Key: * = total score, † = percentage, ‡ = total minutes, ⁋ = hours, § = time in hours since 12am previous night. CADSS-6 = Clinician Administered Dissociative Symptoms Scale-6, SE = Sleep Efficacy, TST = Total Sleep Time. WASO = Wakefulness After Sleep Onset, SOL = Sleep Onset Latency.

2.3.1 Participant 1

Participant 1 was allocated to the 9-day baseline condition. He completed the study, attending both intervention sessions held 5 days apart, and was discharged home on day 16 of the study, where he completed the remaining 5 days from home. Participant 1 returned to the centre upon study completion to complete post-intervention measures. No seizure events were captured during his stay at the WQSEC, therefore no DS diagnosis was made. The sampling rate of the Actiwatch resulted in an abbreviated data collection period for this participant, with 5 days captured after the first intervention session was delivered, compared to the planned 11 days.

2.3.1.1 CADSS-6

Participant 1 reported no dissociative symptoms on the CADSS-6 for the duration of the intervention. As a result, visual and Tau-U analyses were not conducted for this measure.

2.3.1.2 Subjective Sleep measures

Sleep Efficacy (SE): Visual analysis of SE using VAIOR (Manolov & Vannest, 2023), revealed that on 11 out of 11 days (100%), Participant 1's scores during the intervention phase (phase B) were below the baseline (phase A) variability band. Therefore, the criterion for the intervention resulting in an improvement in SE was not met. Tau-U analysis, used to determine the change in SE, revealed a moderate, statistically significant negative effect, *Tau-U* = -.62, *p* = 0.02, *90% CI* [-1, -0.18]. This indicates that Participant 1's subjective SE worsened during phase B.

Total Sleep Time (TST): Visual analysis of TST found that on 8 out of 11 days (72.72%), Participant 1's scores were below the phase A variability band, therefore, the criterion for an improvement in TST was not met. Tau-U analysis revealed a moderate, negative effect, *Tau-U* = -.45, *p* = 0.08, *90% CI* [-0.89, -0.02]. This indicated that Participant 1's TST was reduced during phase B. However, this was not statistically significant.

2.3.1.3 Objective Sleep measures

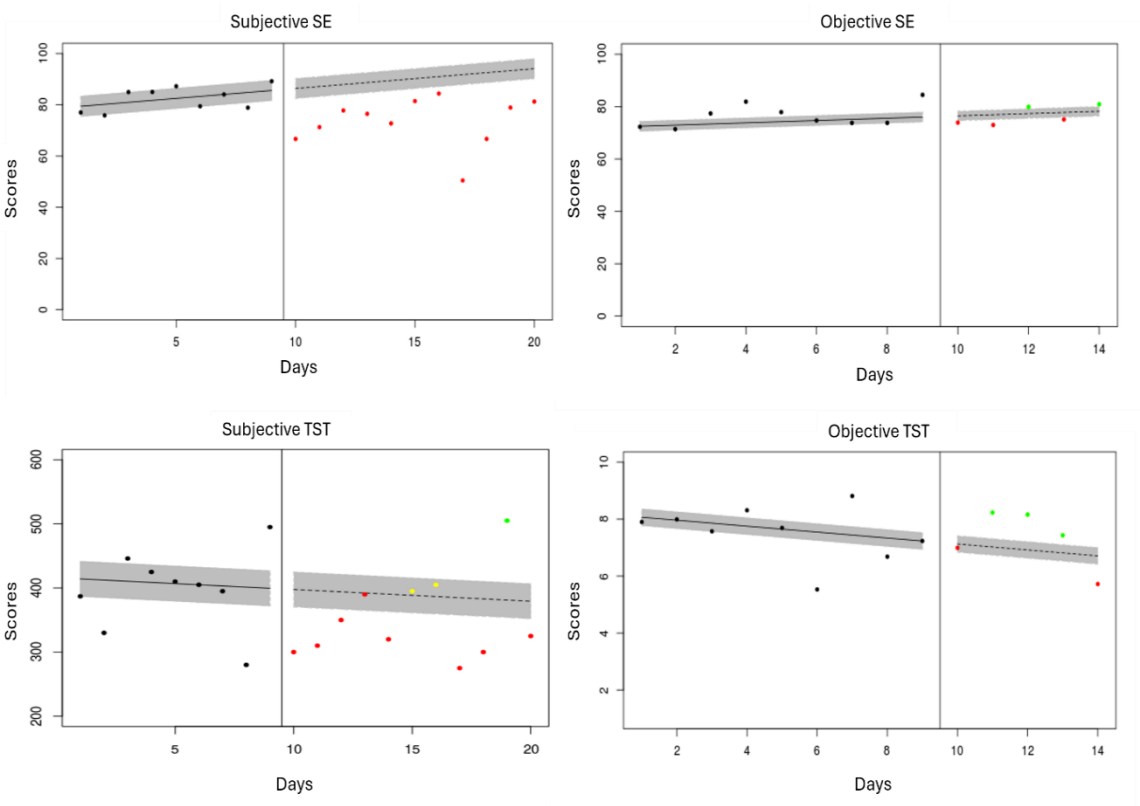
SE: Visual analysis of SE found that on 2 out of 5 days (40%), Participant 1's scores were above the phase A variability band. However, this was insufficient for the criterion for overall improvement to be met. Tau-U analysis revealed a small, positive effect, *Tau-*

U = .11, *p* = 0.74, *90% CI* [-0.44, 0.66]. This indicated that Participant 1's SE increased slightly during phase B. However, this was not statistically significant.

TST: Visual analysis of TST found that on 3 out of 5 days (60%), Participant 1's scores were above the phase A variability band. However, this was insufficient for the criterion for overall improvement to be met. Tau-U analysis revealed a small, negative effect, *Tau-U* = -.11, *p* = 0.74, *90% CI* [-0.66, 0.44]. This indicated that Participant 1's TST decreased slightly during phase B. However, this was not statistically significant.

Figure. 2.2

Participant 1's subjective and objective SE and TST.



2.3.1.4 Reliable Change

Reliable change analysis of participant 1's pre and post-intervention measures revealed that his scores on the SCI decreased by 8 points, representing a reliable change. All other changes in scores were in the range of measurement error, see details in table 2.2 below.

Table 2.2

Participant 1's reliable change scores

	Pre score	Post score	Difference	Critical Value	Reliable Change?
Dissociative Experiences Scale	2.5	1.79	-0.71	10.39	No
Generalised Anxiety Disorder-7	16	15	1	5.37	No
Neurological Disorders Depression Inventory for Epilepsy	15	15	0	4.68	No
Quality Of Life In Epilepsy-10	26	30	4	16.02	No
Sleep Conditions Indication	16	8	-8	6.57	Yes (decrease)

Overall, there was no improvement for participant 1 following the intervention. Subjective measures indicated a worsening of sleep difficulties, however, this was not reflected in the objective sleep measures. No change was found across the psychiatric measures.

2.3.2 Participant 2

Participant 2 was allocated to the 5-day baseline condition. Two focal epileptic seizures were captured during Participant 2's stay at the WQSEC, confirming that the events were epileptic in nature. She requested to remain a participant and completed the study as her previous diagnosis of DS meant that she continued to meet the inclusion criteria, . Participant 2 attended both intervention sessions held 6 days apart, due to a change in clinician availability. Participant 2 was discharged from the centre on day 14 of the study, where she completed the remaining 3 days from home. The sampling rate of the Actiwatch resulted in an abbreviated data collection period for this participant. An adverse event unrelated to the study arose for participant 2, where she was unable to meet the principal researcher at the planned end of the study day. Participant 2 then experienced emergent social and physical health difficulties unrelated to the study. As a

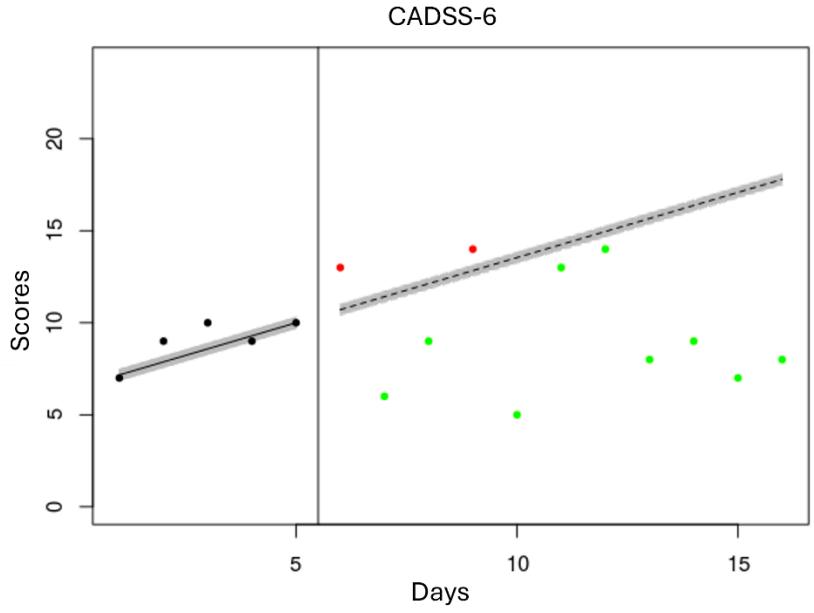
result, the post-intervention measures were not completed until 3 weeks after they were due.

2.3.2.1 CADSS-6

Visual analysis revealed that on 9 out of 11 days (81.81%), participant 2's CADSS-6 scores during the intervention phase (phase B) were below the baseline (phase A) variability band, meeting the criteria for an overall improvement in daily dissociation scores during phase B. The first score in phase B was above the phase A variability band, therefore the criteria for immediate improvement was not met. Tau-U analysis used to determine the change in scores between phase A and phase B was completed, with baseline trend correction. It revealed a small effect, *Tau-U* = -.15, *p* = 0.65, *90% CI* [-0.67, 0.38], however, this was not statistically significant.

Figure 2.3

Participant 2's CADSS-6 scores



2.3.2.2. Subjective Sleep measures

SE: Visual analysis of participant 2's scores revealed variability in phase A, leading to a wide variability band that accelerated sharply, beyond the maximum score possible (100%). As a result, the online calculator erroneously determined that the criterion for improvement was not met when it was. Tau-U analysis with baseline trend correction

confirmed this, revealing a very large, positive effect, *Tau-U* = .87, $p \leq 0.01$, *90% CI* [0.35, 1]. This indicated that participant 2's SE increased significantly during phase B.

TST: Visual analysis of participant 2's TST revealed large variability in scores across both phases. A decelerating TST in phase A led to a downward trend projection, resulting in all phase B scores being above the variability band. This indicates that the criterion for improvement is met, however, this should be interpreted with caution due to the variability in the data. Tau-U analysis revealed a moderate, positive effect, *Tau-U* = .25, $p = 0.43$, *90% CI* [-0.27, 0.77]. This indicated that participant 2's TST increased during phase B, however, this was not statistically significant.

2.3.2.3 Objective Sleep measures

SE: Visual analysis revealed that on 10 out of 10 days (100%), participant 2's scores were below the phase A variability band. This led to the criterion for an overall improvement not being met. Tau-U analysis with baseline trend correction revealed a moderate, negative effect, *Tau-U* = -.22, $p = 0.50$, *90% CI* [-0.76, 0.32]. This indicated that participant 2's SE decreased during phase B, however, this was not statistically significant.

TST: Visual analysis revealed that on 10 out of 10 days (100%), participant 2's scores were below the phase A variability band. This led to the criterion for overall improvement not being met. Tau-U analysis with baseline trend correction revealed a small, negative effect, *Tau-U* = -.36, $p = 0.27$, *90% CI* [-0.90, 0.18]. This indicated that participant 2's TST decreased during phase B, however, this was not statistically significant.

2.3.2.4 Reliable Change

Reliable change analysis of participant 2's pre and post-intervention measures revealed that her scores on the SCI increased by 8 points, representing a reliable improvement. All other changes in scores were in the range of measurement error, see details in table 2.3 below.

Figure 2.4

Participant 2's subjective and objective SE and TST.

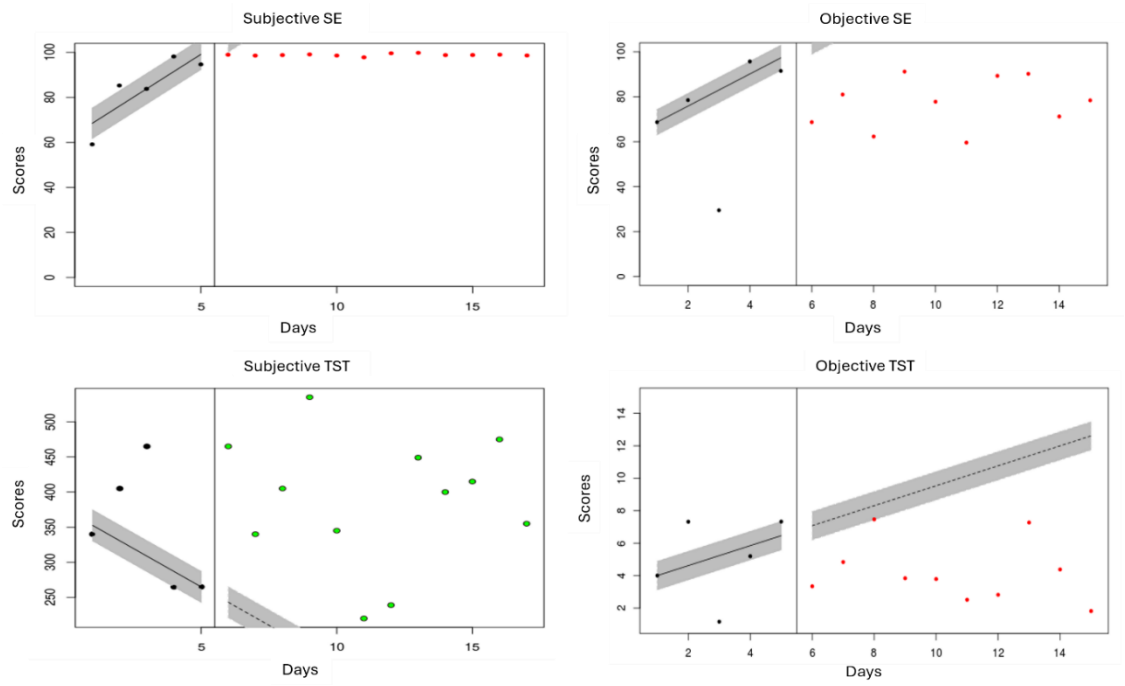


Table 2.3

Participant 2's reliable change scores

	Pre score	Post score	Difference	Critical Value	Reliable Change?
Dissociative Experiences Scale	38	48	10	10.39	No
Generalised Anxiety Disorder-7	17	14	-3	5.37	No
Neurological Disorders Depression Inventory for Epilepsy	19	20	1	4.68	No
Quality Of Life In Epilepsy-10	38	40	2	16.02	No
Sleep Conditions Indicator	9	18	9	6.57	Yes (improvement)

Overall, there was an improvement for participant 2 on subjective sleep measures following the intervention. However, this was not reflected in the objective measures. No further change was found across the psychiatric measures.

2.3.3 Participant 3

Participant 3 was allocated to the 7-day baseline condition. One non-epileptic epileptic seizure was captured by video EEG during his time as an inpatient, therefore, he received a diagnosis of DS. He completed the study, attending both intervention sessions held six days apart. He was discharged from the centre earlier than planned meaning he completed four days post-intervention rather than seven as planned.

2.3.3.1 CADSS-6

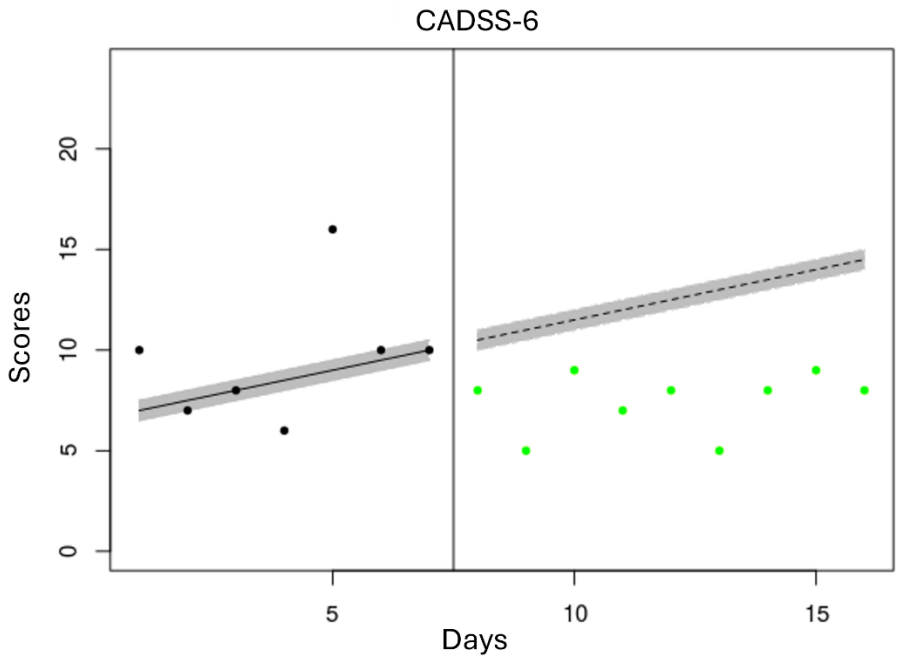
Visual analysis revealed that on 9 out of 9 days (100%), participant 3's CADSS-6 scores during the intervention phase (phase B) were below the baseline (phase A) variability band, meeting the criteria for immediate, progressive and overall improvement in daily dissociation scores during phase B. Tau-U analysis used to determine the change in scores between phase A and phase B with baseline trend correction revealed a small effect, *Tau-U* = .19, *p* = 0.55, *90% CI* [-0.331, 0.712]. However, this was not statistically significant.

2.3.3.2. Subjective Sleep measures

SE: Visual analysis revealed that on 1 out of 9 days (11.11%), participant 3's score was above the phase A variability band. This led to the criterion for overall improvement not being met. Tau-U analysis revealed a moderate, positive effect, *Tau-U* = .24, *p* = 0.43, *90% CI* [-0.26, 0.73]. This indicated that participant 3's SE increased during phase B, however, this was not statistically significant.

Figure 2.5

Participant 3's CADSS-6 scores



TST: Visual analysis revealed that on 7 out of 9 days (77.77%), participant 3's scores were above the phase A variability band. The criteria for immediate and overall improvements were not met. However, the results indicate that the criterion for progressive improvement over phase B was met. Tau-U analysis revealed a moderate, positive effect, *Tau-U* = .44, *p* = 0.14, *90% CI* [-0.05, 0.94]. This indicated that participant 3's TST increased during phase B, however, this was not statistically significant.

2.3.3.3. Objective Sleep measures

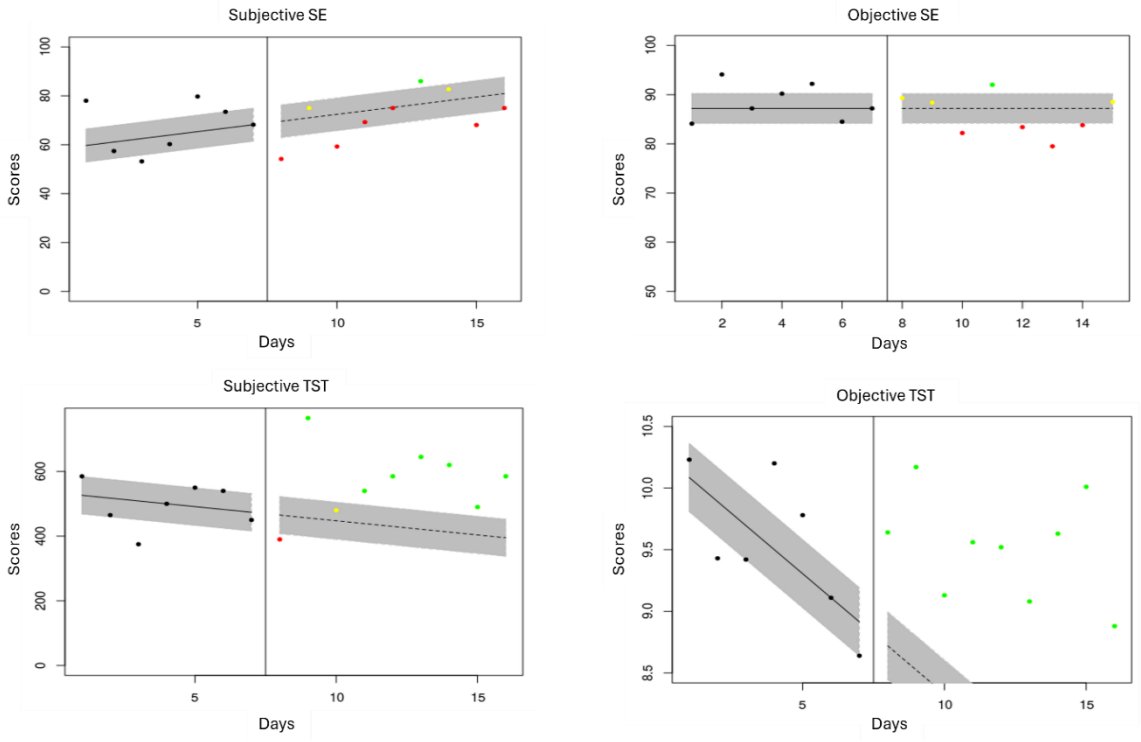
SE: Visual analysis revealed that on 1 out of 6 days (16.67%), participant 3's scores were above the phase A variability band. As a result, the criterion for improvement was not met. Tau-U analysis revealed a moderate, negative effect, *Tau-U* = -.39, *p* = 0.20, *90% CI* [-0.90, 0.12]. This indicated that participant 3's SE decreased during phase B, however, this was not statistically significant.

TST: Visual analysis indicated that on 9 out of 9 days (100%), participant 3's scores were above the phase A variability band. This led to the online calculator indicating that

the criterion for improvement had been met. However, this should be interpreted with caution as there was large variability in participant 3's scores. Tau-U analysis with baseline trend correction revealed a small, positive effect, *Tau-U* = .16, *p* = 0.60, *90% CI* [-0.34, 0.65]. This indicated that participant 3's TST increased slightly during phase B, however, this was not statistically significant.

Figure 2.6

Participant 3's subjective and objective SE and TST.



2.3.3.4 Reliable Change

Reliable change analysis of participant 3's pre and post-intervention measures revealed that his scores on the DES increased by 12 points, his scores on the GAD-7 decreased by 14 points and his scores on the NDDI-E decreased by 7 points, all representing a reliable change. The remaining changes in scores were in range of being because of measurement error, see details in table 2.4 below.

Table 2.4

Participant 3's reliable change scores

	Pre score	Post score	Difference	Critical Value	Reliable Change?
Dissociative Experiences Scale	42	54	12	10.39	Yes (deterioration)
Generalised Anxiety Disorder-7	19	5	-14	5.37	Yes
Neurological Disorders Depression Inventory for Epilepsy	22	15	-7	4.68	Yes
Quality Of Life In Epilepsy-10	42	28	-14	16.02	No
Sleep Conditions Indication	14	15	1	6.57	No

Overall, there was no improvement for participant 3 in sleep measures following the intervention. An increase in dissociative symptoms was found, alongside an improvement in depressive and anxiety symptoms.

2.3.4 Acceptability of intervention

All three participants attended both intervention sessions and completed almost all the daily measures (participant 2 did not complete the CADSS-6 on one of the days), both of which suggest good acceptability of both the intervention and study design in an inpatient context. Qualitative feedback from participants regarding the intervention was not formally sought, but anecdotally, participants 2 and 3 reported to the researcher that they felt benefit from it. No participants reported any detrimental impact of the intervention. One outpatient appointment was not attended, and outpatient appointments offered to participants no longer eligible or discharged early were not taken up, suggesting that the intervention may be of less interest in an outpatient context.

2.5. Discussion

This study aimed to determine whether bCBTi improved sleep on subjective and objective measures in individuals under investigation for DS. It also aimed to determine whether improving sleep would improve subjectively reported dissociative symptoms and other psychosocial outcomes (mood, anxiety, quality of life). Finally, it aimed to determine whether bCBTi was an acceptable intervention to deliver within an inpatient setting.

2.4.1 Summary of findings

Sleep measures: There was no clear pattern of improvement following the intervention. Participant 1 reported a significant decrease in SE, but this was not corroborated by SE results measured by actigraphy. Reliable change analysis also revealed a significant decrease in participant 1's subjective SCI score. Participant 1 may have been experiencing an abnormally high period of sleep disturbance during his participation, as he reported environmental disruptions in the CSD. For participant 2, a significant improvement in SE was found on the subjective sleep measure, supported by a significant improvement on the SCI. However, this was not corroborated by actigraphy data, and no further significant changes were found across other sleep metrics. Participant 2's subjective sense of sleep improvement may be due to expectation rather than objective improvements. For participant 3, a progressive improvement was found for subjective TST, but this was not significant when Tau-u analysis was conducted. No other sleep metrics changed significantly, and no reliable change was found in his SCI scores.

There may be several reasons for the lack of improvement. Firstly, participants were not sleeping in their usual environments, potentially increasing sleep disruption and/or difficulty maintaining good sleep hygiene. Participant 1 anecdotally reported this. Secondly, although all participants attended both intervention sessions, adherence to intervention recommendations was not measured. It is unclear whether participants implemented the behavioural and cognitive changes required for intervention effectiveness (Espie et al., 2022). Additionally, a longer post-intervention measurement period may have been required. Bishop et al. (2021) found a significant effect of bCBTi a week after the second session, suggesting a longer measurement period may have

captured improvement. The period selected matched historic inpatient admission lengths to ensure environmental consistency. Future research may consider whether factors hinder the effectiveness of interventions in this population or whether participants prioritised other concerns over improving sleep.

Dissociation measures: For participant 2, who was historically diagnosed with DS and participant 3, who was recently diagnosed with DS, levels of dissociation were high, in line with the literature (Campbell et al., 2023; Cassady & Baslet, 2023). For participants 2 and 3, visual analysis indicated an improvement in state dissociation scores, but this was not statistically significant when analysed following baseline trend correction using Tau-U. The lack of significant change in state dissociation is unsurprising, given the absence of an improvement in sleep. No reliable change in trait dissociation was found, corroborating findings in state dissociation. Participant 3's trait dissociation scores reliably increased. It may be that this change in score reflects a genuine increase in dissociation caused by participating in the intervention, or other factors relating to their stay as an inpatient during the study period. However, we think other factors may also have been influential. Specifically, this participant completed post-intervention measures over the telephone due to his early discharge as opposed to completing them in person which may have led to him appearing more open to sharing his experiences. He also seemed much more decisive about his responses, and it is possible that this reflected a change in his reflective capacity following the alleviation of uncertainty regarding the nature of his seizure events.

Other measures: Participant 3 was the only participant with a reliable change in anxiety and depression measures. This may be due to receiving a DS diagnosis, which is recognised as a therapeutic intervention (LaFrance et al., 2013); however, the evidence is correlational. Future research may wish to investigate the relationship between diagnosis and mood changes.

The lack of reliable change across other measures may reflect the ineffectiveness of the intervention in improving sleep. Given that no pattern of improvement in sleep was identified, a lack of change across psychiatric measures is unsurprising. Additionally, the measures may not be sensitive to short-term change. Most selected measures (except for

the NDDI-E and GAD-7; Goldstein et al., 2023; Williams & Bagary, 2012) have not been standardised in this population despite widespread use. Normative data for reliable change scores were based on different populations with varying time gaps between measurements. Every effort was made to select measures used in DS populations with similar time gaps, but gaps in the literature limited this.

Acceptability of intervention and study design

The 100% attendance rate suggests the intervention was acceptable. Anecdotally, participants 2 and 3 expressed benefits, and no participants reported harm. The high completion rate of daily measures suggests that SCEDs may be viable for inpatients with DS. However, difficulties in retaining/contacting participants post-discharge should be considered in future studies.

2.4.2 Limitations

This SCED has limitations. Replication of all baseline conditions was planned to increase demonstrations of intervention effect but was not possible due to recruitment challenges. However, including three baseline conditions ensured minimum design standards were met (Kratochwill et al., 2021). An additional limitation is that only one participant was actively experiencing DS during the study, despite careful consideration of the inclusion criteria to ensure that the likelihood of a subsequent DS diagnosis/active DS was high. Changes found may reflect underlying differences in patient profiles rather than the intervention. Two participants were discharged earlier than planned and completed part of the study from home, introducing contextual bias. Adherence to intervention recommendations was not assessed, which future research should consider

2.4.3 Applicability of findings

The bCBTi intervention failed to produce treatment effects in a sample under investigation for DS, making it difficult to recommend for sleep difficulties in this population. Sleep remains a viable target for intervention within this population, further research may usefully examine the causes and maintaining factors behind sleep difficulties to determine effective treatments. The 100% attendance rate and daily measures indicate that SCEDs are a viable research design for use in an inpatient population undergoing investigation for DS. While this intervention was ineffective, SCEDs may be useful for assessing other interventions.

2.6 Conclusion

This SCED investigated whether bCBTi would improve subjective and objective sleep measures in those under investigation for DS, and whether this would improve dissociative symptoms, mood, anxiety and quality of life. No clear pattern of improvement emerged. Reasons such as sleeping environment, adherence, and post-intervention measurement length were considered. The impact that treating sleep difficulties may have on dissociative symptoms and other psychiatric outcomes remains unanswered. Future research should investigate sleep difficulties in a DS population to develop effective treatments.

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Appendices

Appendix 1.1: Characteristics of included studies

Table 1

Demographic characteristics of included studies

Study	Country	Context	Study Design	Study aim	Sample characteristics
Bodde et al. (2007)	The Netherlands	Not reported	Observational Cohort	To investigate factors associated with the long-term prognosis of DS.	N = 22 Mean Age (SD): 30.4 (10.7) Female gender, N (%): 19 (86.4) Maximum educational level, N (%): Primary school: 3 (13.7) Lower secondary school: 9 (40.9) Secondary school: 9 (40.9) Higher education: 1 (4.5) Demographic characteristics, N (%): Living with parents 7 (31.8), Single 1 (4.5), Married/living together 9 (40.9), Divorced and single 4 (18.3), Divorced and new partner 1 (4.5) Age at seizure onset, Mean (SD): 23.2 (12.5) Age at diagnosis, Mean (SD): 30.4 (10.7) Seizure frequency at diagnosis, N (%): Seizure-free 0 (0), Yearly 1 (4.5), Monthly 5 (22.7), Weekly 7 (31.8), Daily 9 (41.0)
Gagny et al. (2021)	France	Outpatients from the following neurology departments: Dijon, Nancy, Reims & Tours	Observational Cohort	To identify explicative factors of QoL in patients with DS at the time of diagnosis and to seek factors linked to the positive evolution of the QoL during follow-up.	N = 107 Mean Age: 33.7 Female gender, N (%): 81 (75.7) Intellectual Functioning ≤ 70, N (%): 24 (22.4) Education in years, Mean: 11.3 Employment, n (%): Employed 40 (37.4) DS frequency per month, Mean: 21.7 Experience of at least one traumatic event, N (%): 89 (83.2)
Grenevald et al. (2021)	France	Outpatients from the following neurology departments: Dijon, Nancy, Reims & Tours	Observational Cohort	To investigate predictive factors in the evolution of seizure frequency during follow-up.	N = 85 (of the 107 sample used in Gagny et al., 2021) Mean Age: 34 Female gender, N (%): 62 (72.9) Intellectual Functioning ≤ 70, N (%): 19 (22.4) Employed, N (%): 30 (35.3) Living in couple, N (%): 51 (60) Trauma during Lifetime, N (%): 47 (53.4)

					No trauma, N (%): 12 (13.6) Emotional abuse, N (%): 47 (53.4) Sexual abuse, N (%): 48 (54.5)
Villigran et al. (2022)	Norway	Outpatients from the Norwegian Epilepsy Centre	Observational Cohort	To investigate clinical outcomes in DS patients and possible associations between parenting and attachment styles along with demographic clinical and neuropsychiatric factors.	N= 53 Mean Age (SD): 32.1 (13.4) Female gender, N (%): 45 (84.9) Age at DS onset in years, mean (SD): 25.6 (11.7) Diagnostic delay in years, mean (SD): 5.6 (9.1) Psychiatric history for anxiety or depression, n (%): 32 (60.4) Marital Status, Mean (SD): Married/partner 23 (43.4), Single/separated 30 (56.6) Education in years, Mean (SD): 13.1 (2.7) Employment, n (%): Employed/student 23 (43.3), Unemployed 25 (47.2) DS frequency per month, Mean (SD): 21.9 (61.8) Trauma history, (n = 52), n (%): Emotional trauma 37 (71.2), Sexual trauma 20 (38.5), Bodily threat 36 (69.2), Any trauma 45 (84.9)
Kuyk et al. (2008)	The Netherlands	Inpatients admitted to the Epilepsy Institute of the Netherlands Foundation	Within-subjects intervention	To evaluate whether a multidisciplinary treatment program has an impact on seizure frequency, health-related quality of life (HRQOL), anxiety, depression, coping and dissociation in a DS sample.	N = 22 Mean Age (SD): 30.6 (10.8) Female gender, N (%): 17 (77.3) Marital status (%): Single 59.1, Married/living together 40.9 Occupation (%): Housekeeping 9.1, Employment 54.5, Disability pension/welfare 27.3, Other 9.1 Education (%): Primary education 13.6, Secondary education 72.8, Higher education 13.6 Age at onset seizures (years) Mean (SD): 23.9 (11.3) Duration of seizures (years) Mean (SD): 6.7 (7.2)
LaFrance et al. (2014)	United States	Outpatients from Rhode Island Hospital, University of Standford and University of Cincinnati	Randomised controlled trial	To evaluate CBT-informed psychotherapy as a treatment for those with DS compared to other treatment modalities.	Group (N): CBT-ip (9), CBT-ip w. Sert. (9), Sert (9), TAU (7) Group age mean (SD): CBT-ip 37.9 (11.5), CBT-ip w. Sert. 39.1 (13.2), Sert. 39.7 (11.7), TAU 41.6 (8.3) Group Female N (%): CBT-ip 7 (77.8), CBT-ip w. Sert 9 (100), Sert. 8 (88.8), TAU 7 (100) Group education mean (SD): CBT-ip 15.4 (3.9), CBT-ip w. Sert 15.7 (2.4), Sert. 13.0 (1.9),

					TAU 16.0 (3.6) Group currently employed, N (%): CBT-ip 2 (22.2), CBT-ip w. Sert. 6 (66.7), Sert. 2 (22.2), TAU 2 (28.6) Group currently married, N (%): CBT-ip 4 (44.4), CBT-ip w. Sert. 6 (66.7), Sert. 4 (44.4), TAU 2 (28.6) Group mean age at DS onset (SD): CBT-ip 33.6 (10.7), CBT-ip w. Sert. 36.7 (13.9), Sert. 33.2 (11.9), TAU 39.1 (7.7) Group mean time in years from DS onset to diagnosis (SD): CBT-ip 3.7 (4.6), CBT-ip w. Sert. 1.4 (1.3), Sert. 5.6 (5.6), TAU 2.2 (3.4) Group history of trauma or abuse, N(%): CBT-ip 7 (77.8), CBT-ip w. Sert. 6 (66.7), Sert. 7 (77.8), TAU 6 (85.7)
Metin et al. (2013)	Turkey	Not reported	Within-subjects Intervention	To assess the effect of an intervention covering a range of themes such as psychoeducation on seizures and coping strategies on seizure frequency and neuropsychiatric outcomes in a DS population.	N = 9 Mean Age: 22.5 Female gender, N (%): 10 (83.3) Education, N: Elementary school graduates 4, High school graduates 5 Marital Status, N: Married 4, Single 5 Comorbidities, N: Depression 6, Post-traumatic stress disorder 2, Dysthymic disorder 1, Generalised anxiety disorder 1, Pathological mourning 1
Sarudiansky et al. (2020)	Argentina	Inpatients admitted to the video-electroencephalograph (V-EEG) units at the Epilepsy Center at the Ramos Mejía General Hospital and the Neurosciences Service at the Hospital “El Cruce - Dr. Néstor Carlos Kirchner.”	Within-subjects intervention	To examine the effect of a three-session group psychoeducational intervention and patients with DS in an Argentinian public hospital.	N = 12 Mean Age (SD): 30.8 (14.2) Female gender, N (%): 10 (83.3) Co-habitants in patient’s home, N (%): Parents 7 (58.3), Spouse 4 (33.3), Child 1 (8.3) Occupation, N (%): Student 6 (50), Unemployed 4 (33.3), Employee 2 (16.7) Education complete, N (%): Elementary 2 (25), Incomplete High school 7 (58.3), Trade school 1 (8.3), Incomplete University 1 (8.3) Reported trauma, N (%): Physical/Sexual abuse/child abuse 9 (75), Serious illness 6 (50),

					Accident/disaster 7 (58.3), Other 4 (33.3)
Senf-Beckenback et al. (2022)	Germany	Outpatients from Charité University Berlin	Randomised controlled trial	To evaluate the effect of the treatment program CORDIS on seizure severity and level of dissociation in a DS sample.	Group (N): CORDIS (22), SHG (20) Group age mean (SD): CORDIS 36.6 (12.1), SHG 32.8 (13.2) Group Female N (%): CORDIS 19 (86.4), SHG 12 (60) Group education mean years (SD): CORDIS 11.8 (1.6), SHG 11.2 (1.6) Group duration of disease mean (SD): CORDIS 6.5 (6.7), SHG 10.7 (10.4) Group Childhood Trauma Questionnaire total score mean (SD): CORDIS 53.3 (15.5), SHG 54.2 (23.7)
Zaroff et al. (2004)	United States	Outpatients from the Comprehensive Epilepsy Centre at New York University Medical Centre	Within-subjects	To examine the effect of a group Psychoeducation regime on seizure frequency and psychiatric symptoms in a DS sample.	N = 10 Mean Age (SD): 35.7, 12.9 Female gender, N (%): 6 (60) Education yrs mean (SD): 13.4 (3.6) Trauma during Lifetime, N (%): 5 (50) Sexual abuse (N): 5

Appendix 1.2: PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page 6
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	Page 87
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Pages 8-11
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Page 11
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Page 12
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Page 12
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Pages 88-90
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Pages 12-13
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Pages 13, 21
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Page 13
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Page 13
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Page 13
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Page 23-26
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Page 13-15
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Pages 13-15

Section and Topic	Item #	Checklist item	Location where item is reported
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Pages 13-15
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Pages 14-15
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Page 15
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Page 17
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Page 12, 15
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Page 15
Study characteristics	17	Cite each included study and present its characteristics.	Pages 15-16, 80-83
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Pages 18-19
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Pages 23-26
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Pages 15-27
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Pages 21-22, 27
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Page 27-28
	23b	Discuss any limitations of the evidence included in the review.	Pages 29-30
	23c	Discuss any limitations of the review processes used.	Page 30

Section and Topic	Item #	Checklist item	Location where item is reported
	23d	Discuss implications of the results for practice, policy, and future research.	Pages 29-30
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Page 11
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Page 11
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	N/A
Competing interests	26	Declare any competing interests of review authors.	N/A
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

Appendix 1.3: PRISMA Checklist for Abstracts

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	Yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	Yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	Yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	Yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	Yes
Synthesis of results	6	Specify the methods used to present and synthesise results.	Yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	Yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	Yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	Yes
Interpretation	10	Provide a general interpretation of the results and important implications.	Yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	Yes
Registration	12	Provide the register name and registration number.	Yes

Appendix 1.4: Search Strategy

Database: Medliner

1. exp Psychogenic Nonepileptic Seizures/
2. (Non?epileptic attack disorder OR Dissociative seizure* OR Functional seizure* OR hysterical seizure* OR psychogenic non?epileptic seizure* OR non?epileptic attack OR non?epileptic seizure* OR psychogenic seizure* OR nonepileptic OR PNES OR NES OR NEAD OR Somatoform Disorders OR Psychophysiologic Disorders).ti,ab
3. 1 or 2
4. exp Dissociative Disorders/
5. (Dissociat* OR Depersonali* OR Dereali* OR Detachment OR Compartmentali*ation OR Hysteri* OR absorption OR multiple personalit* OR identity alteration* OR somatoform dissociat* OR Conversion disorder).ti,ab
6. 4 OR 5
7. exp Outcome Assessment, Health Care/
8. (outcome* OR measurement instrument OR assessment OR scale* OR questionnaire* OR inventor* OR checklist* OR symptom measure* OR instrumentation* OR method* OR Validation Studies OR Comparative Study OR psychometrics OR psychometr* OR outcome assessment OR outcome assessment OR outcome measure* OR measure* OR findings OR result* OR test* OR Dissociative Experiences Scale OR DES OR Multiscale Dissociation Inventory OR MDI OR Somatoform Dissociation Questionnaire OR SDQ-20 OR Dissociation Questionnaire OR DIS-Q OR Clinician-Administered Dissociative States Scale OR CADSS OR Childhood Trauma Checklist).ti,ab
9. 7 OR 8
10. 3 and 6 and 9

Database: Embase

11. exp nonepileptic seizure/
12. (non?epileptic attack disorder OR conversion seizure* OR dissociative seizure* OR hysterical seizure* OR non?epileptic attack disorder OR non epileptic seizure* OR paroxysmal event* OR PNES OR psychogenic non epileptic

event* OR psychogenic non?epileptic seizure* OR psychogenic seizure* OR functional seizure* OR NEAD).ti,ab

13. 11 OR 12
14. exp dissociation/
15. (Dissociat* OR Depersonali* OR Dereali* OR Detachment OR Compartmentali*ation OR Hysteri* OR absorption OR multiple personalit* OR identity alteration* OR somatoform dissociat* OR Conversion disorder).ti,ab
16. 14 OR 15
17. exp treatment outcome/
18. (outcome* OR measurement instrument OR assessment OR scale* OR questionnaire* OR inventor* OR checklist* OR symptom measure* OR instrumentation* OR method* OR Validation Studies OR Comparative Study OR psychometrics OR psychometr* OR outcome assessment OR outcome assessment OR outcome measure* OR measure* OR findings OR result* OR test* OR Dissociative Experiences Scale OR DES OR Multiscale Dissociation Inventory OR MDI OR Somatoform Dissociation Questionnaire OR SDQ-20 OR Dissociation Questionnaire OR DIS-Q OR Clinician-Administered Dissociative States Scale OR CADSS OR Childhood Trauma Checklist).ti,ab
19. 17 OR 18
20. 13 AND 16 AND 19

Database: PsycINFO

21. exp somatoform disorders/
22. (Non?epileptic attack disorder OR conversion seizure* OR dissociative seizure* OR hysterical seizure* OR non?epileptic attack disorder OR non epileptic seizure* OR paroxysmal event* OR PNES OR psychogenic non epileptic event* OR psychogenic non?epileptic seizure* OR psychogenic seizure* OR functional seizure* OR NEAD).ti,ab
23. 21 OR 22
24. exp dissociation/
25. (Dissociat* OR Depersonali* OR Dereali* OR Detachment OR Compartmentali*ation OR Hysteri* OR absorption OR multiple personalit* OR identity alteration* OR somatoform dissociat* OR Conversion disorder).ti,ab

26. 24 OR 25

27. exp treatment outcome/

28. (outcome* OR measurement instrument OR assessment OR scale* OR questionnaire* OR inventor* OR checklist* OR symptom measure* OR instrumentation* OR method* OR Validation Studies OR Comparative Study OR psychometrics OR psychometr* OR outcome assessment OR outcome assessment OR outcome measure* OR measure* OR findings OR result* OR test* OR Dissociative Experiences Scale OR DES OR Multiscale Dissociation Inventory OR MDI OR Somatoform Dissociation Questionnaire OR SDQ-20 OR Dissociation Questionnaire OR DIS-Q OR Clinician-Administered Dissociative States Scale OR CADSS OR Childhood Trauma Checklist).ti,ab

29. 27 OR 28

23 AND 26 AND 29

Appendix 1.5: QualSys Tool

https://doi.org/10.7939/R37M04F16

Appendix 2.1: SCRIBE Checklist

The Single-Case Reporting guideline In BEhavioural interventions (SCRIBE) 2016 Checklist

Item number	Topic	Item description	Notes
TITLE and ABSTRACT			
1	Title	Identify the research as a single-case experimental design in the title	Page 42
2	Abstract	Summarise the research question, population, design, methods including intervention/s (independent variable/s) and target behaviour/s and any other outcome/s (dependent variable/s), results, and conclusions	Page 45
INTRODUCTION			
3	Scientific background	Describe the scientific background to identify issue/s under analysis, current scientific knowledge, and gaps in that knowledge base	Pages 46-48
4	Aims	State the purpose/aims of the study, research question/s, and, if applicable, hypotheses	Page 48
METHODS			
	DESIGN		
5	Design	Identify the design (e.g., withdrawal/reversal, multiple-baseline, alternating-treatments, changing-criterion, some combination thereof, or adaptive design) and describe the phases and phase sequence (whether determined *a priori* or data-driven) and, if applicable, criteria for phase change	Page 38
6	Procedural changes	Describe any procedural changes that occurred during the course of the investigation after the start of the study	Pages 48, 58, 60, 64
7	Replication	Describe any planned replication	Page 48
8	Randomisation	State whether randomisation was used, and if so, describe the randomisation method and the elements of the study that were randomized	Page 49
9	Blinding	State whether blinding/masking was used, and if so, describe who was blinded/masked	Page 49
	PARTICIPANT/S or UNIT/S		
10	Selection criteria	State the inclusion and exclusion criteria, if applicable, and the method of recruitment	Pages 50-51
11	Participant characteristics	For each participant, describe the demographic characteristics and clinical (or other) features relevant to the research question, such that anonymity is ensured	Pgs. 51-52, 57-67, 104-108
	CONTEXT		
12	Setting	Describe characteristics of the setting and location where the study was conducted	Page 50
	APPROVALS		
13	Ethics	State whether ethics approval was obtained and indicate if and how informed consent and/or assent were obtained	Pages 51-52
	MEASURES and MATERIALS		
14	Measures	Operationally define all target behaviours and outcome measures, describe reliability and validity, state how they were selected, and how and when they were measured	Pages 52-55
15	Equipment	Clearly describe any equipment and/or materials (e.g., technological aids, biofeedback, computer programs, intervention manuals or other material resources) used to measure target behaviour/s and other outcome/s or deliver the interventions	Pages 54-55, 102
	INTERVENTIONS		
16	Intervention	Describe intervention and control condition in each phase, including how and when they were actually administered, with as much detail as possible to facilitate attempts at replication	Page 55, 102
17	Procedural fidelity	Describe how procedural fidelity was evaluated in each phase	Page 55
	ANALYSIS		
18	Analyses	Describe and justify all methods used to analyse data	Pages 55-56
RESULTS			
19	Sequence completed	For each participant, report the sequence actually completed, including the number of trials for each session for each case. For participant/s who did not complete, state when they stopped and the reasons	Pages 58, 60, 64
20	Outcomes and estimation	For each participant, report results, including raw data, for each target behaviour and other outcome/s	Pages 57-67
21	Adverse events	State whether or not any adverse events occurred for any participant and the phase in which they occurred	Page 58, 60, 64
DISCUSSION			
22	Interpretation	Summarise findings and interpret the results in the context of current evidence	Pages 68-70
23	Limitations	Discuss limitations, addressing sources of potential bias and imprecision	Page 70
24	Applicability	Discuss applicability and implications of the study findings	Page 70
DOCUMENTATION			
25	Protocol	If available, state where a study protocol can be accessed	Page 93
26	Funding	Identify source/s of funding and other support; describe the role of funders	N/A

Appendix 2.2: MRP Proposal

https://osf.io/bnwz2

Appendix 2.3: Ethical Approval

REMOVED FOR CONFIDENTIALITY REASONS

Appendix 2.4: WQSEC Management Approval

REMOVED FOR CONFIDENTIALITY REASONS

Appendix 2.5: Participant Information Sheet

https://osf.io/3q6rc

Appendix 2.6: Consent Form

https://osf.io/feu52

Appendix 2.7: Intervention Manual

https://osf.io/rvkwt

Appendix 2.8: Screening Questions

1. How satisfied/dissatisfied are you with your current sleep pattern?

0 Very satisfied
1 Satisfied
2 Moderately satisfied
3 Dissatisfied
4 Very dissatisfied

2. To what extent do you consider your sleep problem to interfere with your daily functioning (e.g. daytime fatigue, mood, ability to function at work/daily chores, concentration, memory, mood, etc.)?

0 Not at all
1 A Little
2 Somewhat
3 Much
4 Very much

If potential participants score above 5 points, they can be sent the information sheet.

From:

Kraepelien, M., Blom, K., Forsell, E., Hentati Isacsson, N., Bjurner, P., Morin, C. M., Jernelöv, S., & Kaldo, V. (2021). A very brief self-report scale for measuring insomnia severity using two items from the Insomnia Severity Index—Development and validation in a clinical population. *Sleep Medicine, 81*, 365–374. https://doi.org/10.1016/j.sleep.2021.03.003

Appendix 2.9: Additional Results

Here are the visual analysis and Tau-U results for the WASO and SOL metrics across both the subjective (CSD) and objective (Actigraphy) sleep measures for each participant.

Participant 1:

Subjective:

Wakefulness After Sleep Onset (WASO): Visual analysis revealed that on 11 out of 11 days, (100%), participant 1's scores were above the phase A variability band. Therefore, the criterion for improvement was not met. Tau-U analysis revealed a very large, statistically significant positive effect, *Tau-U* = .92, $p \leq 0.01$, *90% CI* [0.48, 1]. This indicated that participant 1's WASO increased significantly during phase B.

Sleep Onset Latency (SOL): Visual analysis revealed that on 11 out of 11 days, (100%) participant 1's scores were above the phase Ooh A variability band. Therefore, the criterion for improvement was not met. Tau-U analysis with baseline trend correction revealed a moderate, negative effect, *Tau-U* = -.20, *p* = 0.45, *90% CI* [-0.06, 0.24]. This indicates that participant 1's SOL decreased slightly during phase B. However, this was not statistically significant.

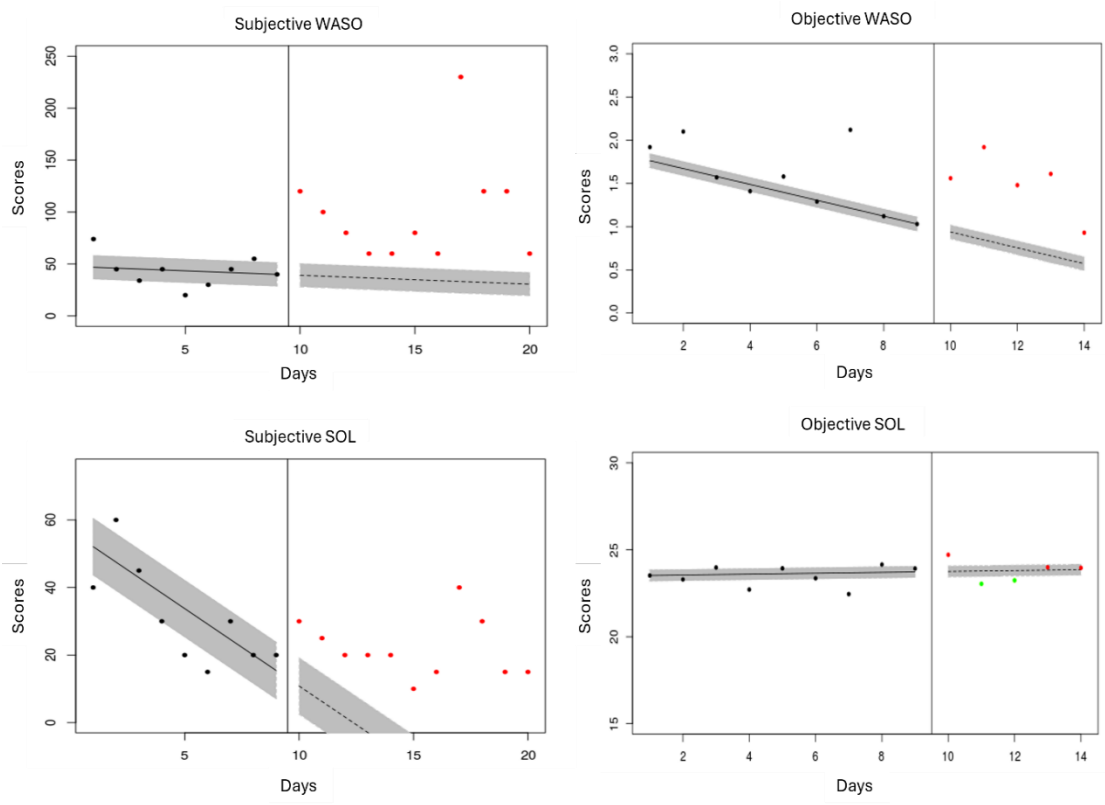
Objective:

WASO: visual analysis revealed that on five out of five days. (100%) participant 1 scores were above the phase A variability band. Therefore, the criterion for improvement was not met. Tau-U analysis with baseline trend correction revealed a moderate, positive effect, *Tau-U* = .31, *p* = 0.35, *90% CI* [-0.24, 0.86]. This indicated that participant 1's WASO increased during phase B. However, this was not statistically significant.

SOL: Visual analysis revealed that on 2 out of 5 days (40%), participant 1's scores were below the phase A variability band. However, this was not sufficient for the criterion for improvement to be met. Tau-U analysis revealed a moderate, positive effect, *Tau-U* = .24, *p* = 0.46, *90% CI* [-0.30, 0.79]. This indicated that participant 1's SOL increased during phase B. However, this was not statistically significant.

Figure 1

Participant 1's subjective and objective WASO and SOL.



Participant 2:

Subjective:

WASO: Visual analysis revealed a sharp decline in participant 2's WASO in phase A, leading to a sharp deceleration in the phase A variability band which projected scores to drop into negative numbers. The program, therefore, indicated that the criterion for improvement was not met when a floor effect had been achieved for participant 2. Tau-U analysis revealed a large, negative effect, *Tau-U* = -.60, *p* = 0.06, *90% CI* [-1, -0.08]. This indicated that participant 2's WASO increased during phase B, however, this was not statistically significant.

SOL: Visual analysis revealed little variation in participant 2's SOL, with scores remaining stable across both phases. Participant 2 reported little difficulty with SOL, and this remained the case in the intervention phase; therefore, the criterion for improvement was not met. Tau-U analysis with baseline trend correction revealed a moderate, negative effect, *Tau-U* = -.20, *p* = 0.53, *90% CI* [-0.72, 0.32]. This indicated that participant 2's SOL decreased during phase B, however, this was not statistically significant.

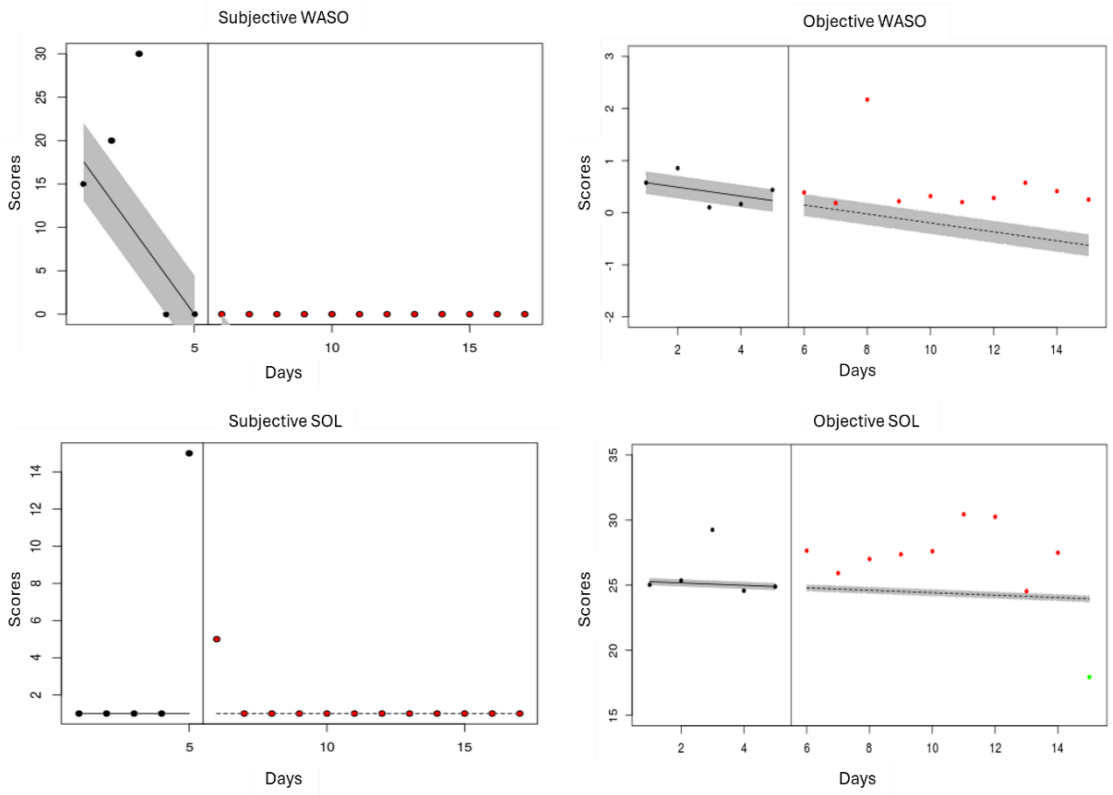
Objective:

WASO: visual analysis revealed that on ten out of ten days. (100%) participant 2's scores were above the phase A variability band. Therefore, the criterion for improvement was not met. Tau-U analysis revealed a small, negative effect, *Tau-U* = -.04, *p* = 0.90, *90% CI* [-0.58, 0.50]. This indicated that participant 2's WASO decreased very slightly during phase B, however, this was not statistically significant.

SOL: Visual analysis revealed that on 1 out of 10 days (10%), participant 2's scores were below the phase A variability band, indicating that the criterion for improvement was not met. Tau-U analysis revealed a moderate, positive effect, *Tau-U* = .36, *p* = 0.27, *90% CI* [-0.18, 0.90]. This indicated that participant 2's SOL increased during phase B, however, this was not statistically significant.

Figure 2

Participant 2's subjective and objective WASO and SOL



Participant 3:

Subjective:

WASO: The visual analysis revealed that on 7 out of 9 days (78%), participant 3scores were below the phase A variability band, therefore, the criterion for a progressive improvement was met. The criterion for overall improvement was not met as the 3rd score in phase B was above the phase A variability band. Tau-U analysis revealed a small, negative effect, *Tau-U* = -.11, *p* = 0.71, *90% CI* [-0.60, 0.38]. This indicated that participant 3's WASO decreased slightly during phase B, however, this was not statistically significant.

SOL: Visual analysis revealed large variability in participant 3's scores both in phase A and phase B. On 2 out of 9 days (22%), participant 3's scores fell below the phase A variability Band. Therefore, the criterion for improvement was not met. Tau-U analysis revealed a moderate, negative effect, *Tau-U* = -.21, *p* = 0.49, *90% CI* [-0.70, 0.29]. This indicated that participant 3's SOL decreased during phase B, however, this was not statistically significant.

Objective:

WASO: Visual analysis revealed that on 1 out of 8 days (13%), participant 3's scores were below the phase A variability band. Therefore, the criterion for improvement was not met. Tau-U analysis revealed a very large, statistically significant positive effect, *Tau-U* = .71, *p* = 0.02, *90% CI* [0.21, 1]. This indicated that participant 3's WASO increased during phase B.

SOL: Visual analysis revealed that on 9 out of 9 days (100%), participant 3's scores were below the phase A variability band. Therefore, the criterion for improvement was met. Tau-U analysis with baseline trend correction revealed a moderate, negative effect, *Tau-U* = -.25, *p* = 0.42, *90% CI* [-0.76, 0.26]. This indicated that participant 3's SOL decreased during phase B, however, this was not statistically significant.

Figure 3

Participant 3's subjective and objective WASO and SOL