BASIC RESEARCH ARTICLE

Sleep, trauma, fantasy and cognition in dissociative identity disorder, post-traumatic stress disorder and healthy controls: a replication and extension study

Lora Dimitrova [ID][a,b]*, Vinuri Fernando [ID][a,b]*, Eline M. Vissia[c], Ellert R. S. Nijenhuis [ID][d], Nel Draijer[e] and Antje A. T. S. Reinders[f]

[a]Department of Psychosis Studies, Institute of Psychiatry, King's College London, London, UK; [b]Department of Psychiatry, Amsterdam UMC, location VUMC, VU University Amsterdam, Amsterdam, the Netherlands; [c]Heelzorg, Centre for Psychotrauma, Zwolle, The Netherlands; [d]Clienia Littenheid AG, Private Clinic for Psychiatry and Psychotherapy, Littenheid, Switzerland; [e]Department of Psychiatry, VU University Medical Center, Amsterdam, The Netherlands; [f]Department of Psychological Medicine, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, UK

ABSTRACT

Background: Two aetiology models for dissociative identity disorder (DID) have been proposed, namely a childhood Trauma Model and an iatrogenic or Fantasy model. A recent study indicated that sleep disturbances underlie dissociative symptomatology.

Objective: Our current study aims to test whether this finding can be replicated in an independent sample and to investigate if this finding still holds after correcting for childhood and adult traumatization. An experimental working memory task is included to investigate how sleep disturbance, traumatization, dissociation, and fantasy proneness impact cognitive functioning.

Methods: Three groups of participants were included – individuals with DID, individuals with post-traumatic stress disorder (PTSD), and matched healthy controls. Sleep disturbances were measured and compared between the groups along with measures of childhood and adult traumatization, psychoform and somatoform [psychological and somatic] dissociative symptoms, and fantasy proneness. Cognitive capacity was assessed using a working memory task.

Results: When controlled for traumatic experiences, sleep disturbances did not predict dissociative symptoms. When controlled for sleep disturbance and fantasy proneness, childhood traumatization did predict dissociative symptoms. Psychoform dissociative symptoms correlated with traumatic experiences more than with fantasy proneness. Working memory performance was similar among the participating groups. Propensity to fantasy did not discriminate individuals with DID and PTSD, and was a weak predictor of dissociative symptoms.

Conclusion: Whereas DID and PTSD are associated with sleep disturbances, these features do not statistically predict dissociative symptoms in these disorders when traumatic experiences are taken into account. Fantasy proneness is not excessive in DID and PTSD. Hence, we found no evidence that sleep disturbances, propensity to fantasy and abnormal working memory capacity explain dissociative symptoms in DID and PTSD. In sum, the relationship between sleep and dissociative symptoms disappeared when potentially traumatizing events were controlled for.

Sueño, trauma, fantasía y cognición en el trastorno de identidad disociativo, trastorno de estrés postraumático y controles sanos. Un estudio de replicación y extensión

Antecedentes: Se han propuesto dos modelos etiológicos para el trastorno de identidad disociativo (TID), a saber, un modelo de trauma infantil y un modelo iatrogénico o de fantasía. Un estudio reciente indicó que las alteraciones del sueño subyacen en la sintomatología disociativa

Objetivo: Nuestro actual estudio tiene como objetivo evaluar si este hallazgo se puede replicar en una muestra independiente e investigar si este hallazgo aún se mantiene después de corregir la traumatización en niños y adultos. Se incluye una tarea experimental de memoria de trabajo para investigar cómo la alteración del sueño, la traumatización, la disociación y la propensión a la fantasía afectan el funcionamiento cognitivo.

Métodos: Se incluyeron tres grupos de participantes: individuos con TID, individuos con trastorno de estrés postraumático (TEPT) y controles sanos pareados. Las alteraciones del sueño se midieron y compararon entre los grupos junto con medidas de traumatización

HIGHLIGHTS
• Sleep disturbances do not predict pathological dissociation when controlling for traumatisation.
• Cognitive performance similar in individuals with dissociative identity disorder, post-traumatic stress disorder and healthy controls.
• Findings support a trauma model of dissociative symptoms.

CONTACT Antje A. T. S. Reinders ✉ a.a.t.s.reinders@gmail.com 🖅 Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience (IoPPN), King's College London, De Crespigny Park, London SE5 8AF, UK

*These authors contributed equally to this work
🅑 Supplemental data for this article can be accessed here.

infantil y adulta, síntomas disociativos psicomorfos y somatomorfos [psicológicos y somáticos] y propensión a la fantasía. La capacidad cognitiva se evaluó mediante una tarea de memoria de trabajo

Resultados: Cuando se controlaron las experiencias traumáticas, los trastornos del sueño no predijeron síntomas disociativos. Cuando se controlaron las alteraciones del sueño y la propensión a la fantasía, la traumatización infantil predijo los síntomas disociativos. Los síntomas disociativos psicomorfos se correlacionan más con las experiencias traumáticas que con la propensión a la fantasía. El rendimiento de la memoria de trabajo fue similar entre los grupos participantes. La propensión a la fantasía no discriminaba a los individuos con TID y TEPT, y era un predictor débil de síntomas disociativos

Conclusión: Mientras que el TID y el TEPT están asociados con trastornos del sueño, estas características no predicen estadísticamente los síntomas disociativos en estos trastornos cuando se tienen en cuenta las experiencias traumáticas. La propensión a la fantasía no es excesiva en DID y PTSD. Por lo tanto, no encontramos evidencia de que los trastornos del sueño, la propensión a la fantasía y la capacidad anormal de la memoria de trabajo expliquen los síntomas disociativos en el TID y el TEPT. En resumen, la relación entre el sueño y los síntomas disociativos desapareció cuando se controlaron los eventos potencialmente traumáticos.

分离性身份障碍，创伤后应激障碍和健康对照者的睡眠、创伤、幻想和认知：一项重复和拓展研究

背景：两种分离性身份障碍（DID）的病因模型已被提出，即童年创伤模型和医源性或幻想模型。最近的一项研究表明，睡眠障碍是分离症状的基础。

目标：我们当前的研究旨在考查该发现是否可以在独立样本中复制，并研究在校正儿童和成人创伤后是否仍然成立。实验性的工作记忆任务被纳入，以研究睡眠障碍、创伤、分离和幻想倾向如何影响认知功能。

方法：纳入三组参与者——患有DID的个体，患有创伤后应激障碍（PTSD）的个体以及匹配的健康对照组。测量并比较组间的睡眠障碍，以及童年和成人期创伤、心理形式和躯体形式（心理和躯体）的分离症状及幻想倾向。使用工作记忆任务评估认知能力。

结果：当控制创伤经历时，睡眠障碍并不能预测分离症状。当控制睡眠障碍和幻想倾向时，童年创伤确实可以预测分离症状。心理形式的分离症状与创伤经历的相关性大于与幻想倾向的相关性。各参与组的工作记忆表现相似。幻想倾向并不能区分DID和PTSD组个体，并且是分离症状的弱预测因子。

结论：尽管DID和PTSD与睡眠障碍有关，但当考虑了创伤经历时，这些特征在统计学上无法预测这些障碍的分离症状。在DID和PTSD中，幻想倾向并不过度。因此，我们没有发现证据表明睡眠障碍、幻想倾向和异常的工作记忆能力可以解释DID和PTSD中的分离症状。总之，控制了潜在的创伤事件后，睡眠与分离症状之间的关系就消失了。

1. Introduction

According to the DSM-5 dissociative identity disorder (DID) is characterized by having two or more distinct dissociative personality states in conjunction with the failure to integrate memory, consciousness and identity (American Psychiatric Association, 2013). Each of these personality states is characterized by a way of thinking about the environment and the self, resulting in fluctuating perceptions which may impair normal cognitive functioning. Three core features present in DID are, among others, 'dissociative amnesia', that is the inability to recall key personal information, 'absorption'/imaginative escape and 'depersonalisation/derealisation' (American Psychiatric Association, 2013). Despite the prevalence rates being similar to those seen in schizophrenia (Sar, 2011; Sar et al., 2007), DID remains under-researched and cognitive functioning mediating these three core features remain unknown.

DID is also under-diagnosed and the most disputed of psychiatric disorders (Reinders et al., 2019). Whether its aetiology is trauma-related, as described in a Trauma Model (TM) (Dalenberg et al., 2012), or related to fantasy proneness, which is referred to as the Fantasy Model (FM) (Dalenberg et al., 2012) (also known as the

Sociocognitive model (Spanos, 1994)), is an ongoing debate (Brand et al., 2016; Dalenberg et al., 2012, 2014; Lynn et al., 2014; Merckelbach, Lynn, & Lilienfeld, n.d.; Vissia et al., 2016). The TM for DID explains dissociation and identity fragmentation as a reaction to early and prolonged traumatizing experiences (Brand et al., 2016; Vissia et al., 2016). Consistent with this DID is associated with chronic emotional neglect, emotional abuse, physical abuse and neglect and/or sexual abuse starting in early childhood (Brand et al., 2009; Chalavi et al., 2015a, 2015b; Hornstein & Putnam, 1992; Kluft, 1996; Nijenhuis, 2015). Furthermore, the presence of dissociative symptoms is highly contingent on childhood trauma history (Frewen, Brown, & Lanius, 2016). However, self-reported rates of trauma may be underreported due to knowingly withheld information to avoid painful recollection (Koutstaal, Schacter, Johnson, Angell, & Gross, 1998), or unknowingly withheld due to dissociative processes (Brand et al., 2018).

The FM posits that individuals with severe dissociative symptoms score high on fantasy proneness measures and report more cognitive impairments (Merckelbach, Muris, & Rassin, 1999). Consequently, individuals would be left with a cognitive vulnerability

to iatrogenesis and this process distorts memory reports of traumatization (Loftus & Ketcham, 1994; McNally, 2003). However, neurobiological research has failed to support this model, showing that high fantasy prone healthy controls instructed and motivated to simulate DID were not able to enact brain activation patterns and physiological activation of individuals with DID (Reinders, Willemsen, Vos, den Boer, & Nijenhuis, 2012; Schlumpf et al., 2013, 2014). Research on cognitive functioning, dissociative symptoms and DID has produced conflicting results: some studies (Dorahy, 2001) on memory and dissociative disorders showed potential deficits in working memory of DID individuals, while several other studies documented that dissociation was linked to better task-performance in working memory tasks accompanied by increased brain activation (Elzinga et al., 2007; Swick, Cayton, Ashley, & Turken, 2017; Veltman et al., 2005). Consequently, research requires further replication and validation. (McNutt, 2014).

Dissociative symptoms have been hypothetically linked to sleep-wake cycles in which 'dreamlike mentation conquers the waking state' (Van Der Kloet, Merckelbach, Giesbrecht, & Lynn, 2012, p. 167), producing memory failures and driving dissociative experiences. It has also been proposed that sleep disturbances (such as hypnagogic hallucinations, nightmares, waking dreams and lucid dreams) are causally related to dissociative symptoms and cognitive failures (Van Der Kloet et al., 2012). Hence, sleep disturbances might undermine cognitive efficiency by reducing attention control and memory, whilst fuelling 'imaginative mentation' (Van Der Kloet et al., 2012, p. 167). This thought raised the idea that sleep disturbances are a 'necessary and sufficient antecedent' for DID (Van Der Kloet et al., 2012, p. 167).

In contrast, the TM maintains that these sleep disturbances may be a consequence of dissociative symptoms and actual traumatization, for example, due to nightmares. Van Heugten – van der Kloet, Huntjens, Giesbrecht, & Merckelbach (2014) explored the hypothesis that sleep predicts dissociative symptoms in a group of individuals with DID, a group with PTSD, and a healthy control group on the basis of an earlier study conducted in a non-clinical insomnia group (Van Der Kloet et al., 2013). Results showed that although DID and PTSD individuals did not differ in any respect, except for the severity of dissociative symptoms, a high score for unusual sleep experiences was the best statistical predictor of belonging to the DID group; the PTSD group was differentiated by markedly lower cognitive performance. Additionally, fantasy proneness, cognitive impairments, and sleep disturbances scores were higher in both diagnosed groups (DID and PTSD) when compared to those of healthy controls. The authors stated that the idea that DID is strongly

related to PTSD fits well with their findings. Although traumatization might have been the common factor, this was unfortunately not studied despite its possible link to sleep disturbances (Brand et al., 2016; Van Der Kloet et al., 2013). Of note, the authors of the original study offered the suggestion of adding measures of traumatic experiences as a future direction of study.

Therefore, several aspects of the study by van Heugten – van der Kloet et al. (2014) require further investigation and replication (McNutt, 2014). Firstly, no trauma measure was included and it was therefore not possible to test a trauma-sleep-dissociation relationship. Secondly, the use of an experimental measure of cognitive capacity, instead of a self-report measure, would have been more suitable, as the authors also mention themselves (van Heugten – van der Kloet et al., 2014, p. 3). Thirdly, it would be of interest to study amnesia, absorption, and depersonalization/derealization, the three core features of psychogenic dissociation, and somatoform dissociation in relation to cognitive functioning and sleep deprivation in DID. Finally, the correlation analyses in the original study (van Heugten – van der Kloet et al., 2014) might be prone to methodological error because the analyses were performed across diagnosed groups and controls. Such analyses can lead to inflated results and spurious outcomes for the diagnosed groups (Dalenberg et al., 2012).

The current study aimed to investigate whether previous findings can be replicated in a larger independent and carefully diagnosed sample of individuals with DID, a PTSD sample, and a healthy control group, while extending the study by including measures of traumatization and an experimental measure of working memory. Therefore, this study allows for the investigating of the relationship between dissociation and sleep, trauma, fantasy, and cognitive performance. We hypothesized that (i) when correlation analyses are run within DID and PTSD groups only, to avoid spurious effects, sleep disturbances and fantasy proneness correlate less than traumatic experiences with dissociative symptoms, (ii) sleep disturbances do not predict dissociative symptoms when controlling for traumatic experiences, but traumatic experiences do predict dissociative symptom severity better than sleep disturbances or fantasy proneness, and that (iii) working memory performance in individuals with DID and PTSD is similar but worse from performance in healthy controls.

2. Methods

2.1. Design and participants

The questionnaire data were obtained as part of a larger study (Chalavi et al., 2015a, 2015b; Vissia et al., 2016). Only female participants volunteered to participate, and

data of three groups were included: individuals with DID (n = 17), individuals with PTSD (n = 16), and healthy controls (HC) (n = 16). Inclusion age of all three groups was 18–65 years. Other requirements were Dutch as the native language and ability to give informed consent according to Dutch legal regulations. Individuals with DID were recruited in the Netherlands by clinicians at treatment settings. The diagnosis was confirmed by ERSN and/or ND using the Structured Clinical Interview for DSM-IV Dissociative Disorders (SCID-D) (Boon & Draijer, 1993). If permission for video recording was given, the SCID-D interview was recorded, enabling an assessment of the interview by a second reviewer when necessary. The data from the DID participants' most prominent neutral personality state (NPS) (van der Hart, Nijenhuis, & Steele, 2006), also known as 'Apparently Normal Personality' (van der Hart et al., 2006), was included from all of the questionnaires and the N-Back task. This was for purpose of replicating the study by van Heugten – van der Kloet et al. (2014). For the group of individuals with PTSD, the diagnosis was confirmed by the researchers using the Clinician-Administered PTSD Scale (CAPS) Dutch translation according to the DSM-5 criteria (American Psychiatric Association, 2013). Sixteen healthy control (HC) participants were recruited through leaflets, advertisements in newspapers, use of posters, and by word of mouth. Both PTSD and HC groups we carefully matched to the DID group for age, gender and level of education. The HC group was not told that they would serve as a control group for DID. Additional exclusion criteria for HC were: a high score of (psychoform/ somatoform) dissociative symptoms (evaluated with the DES and SDQ-20, respectively), psychiatric disorder in the past or at present, or a high score on the TEC. All participants gave informed written consent in accordance with the Declaration of Helsinki and as dictated by ethics approval which was obtained from the Medical Ethical Committees of UMCG (Reference number: METC2008.211) and the AMC (Reference number: MEC09/155).

2.2. Questionnaires and tasks

All participants completed self-report questionnaires for trauma, dissociative symptoms, sleep deprivation and fantasy proneness. The Dissociative Experiences Scale (DES) (Bernstein & Putnam, 1986; Carlson & Putnam, 1986) assesses the severity of psychoform dissociative symptoms. The Traumatic Experiences Checklist (TEC) assesses 25 types of adverse experiences, their duration, and the age at occurrence or onset. The Dutch version of the Childhood Trauma Questionnaire (CTQ) (Bernstein et al., 1994, 2003), the 'Jeugd Trauma Vragenlijst' (JTV) (Arntz & Wessel, 1996), evaluates the frequency of childhood maltreatment (physical, emotional, sexual abuse and physical, emotional neglect). The Iowa Sleep

Experience Survey (ISES) (Watson, 2001) assesses sleep disturbances. The Creative Experience Questionnaire (CEQ) (Merckelbach, Horselenberg, & Muris, 2001) measures developmental antecedents of fantasy proneness, involvement in fantasy and daydreaming, and consequences of daydreaming.

All groups also completed a working memory task, namely the N-back task. The N-back task measures working memory capacity (Kirchner, 1958) through reaction times to a condition-specific instruction. Individuals viewed single capital letters presented onto a screen followed one after the other. They were instructed to respond by pressing a key, when the projected letter was the same as the one before (1-back), the same as the letter preceding the last shown letter (2-back), and the same as the preceding last two shown letters (3-back). Individuals were also required to respond to the letter X when presented on screen (0-back/baseline). A condition-specific instruction was shown each time a new trial block started. Each block consisted of 14 stimuli, with six targets. For each condition, three blocks were presented. Each condition was presented three times, in a pseudo-randomized order, resulting in a total of 12 blocks of each 14 stimuli. Total duration of the task is approximately 7 min. The DID group had three participants who were unable to take part in the N-back task and one participant with missing values for the CTQ assessment, hence data of 14 DID participants for the N-back task and 16 for the CTQ were included in the current analyses.

2.3. Statistical analysis

The first and second hypotheses were tested using the questionnaire measures and one-way analysis of variance (ANOVA). Nonparametric Kruskal–Wallis tests and (post-hoc) Mann–Whitney tests were added because the data did not meet the assumption of normal distribution or heterogeneity of variance. As part of the ANOVA, Bonferroni post-hoc correction was applied. Effect sizes were calculated using Eta squared values by computing the Chi-Square and dividing that by n-1. Pearson's partial correlation analyses were performed twice controlling for level of education: the first analysis included only the diagnosed samples to avoid spurious effects, whereas the second analysis included the total sample to reproduce the analyses method of the original paper (for extended analyses specifying the DES in terms of absorption, amnesia and depersonalization/ derealization, the Somatoform dissociation questionnaire [SDQ] see Part A of the Supplementary materials in Tables S1 and S2. CEQ item-specific correlation analyses with these measures of dissociation are provided in Part B of the Supplementary materials).

Multiple linear regression analyses were applied to analyse predictability of traumatic experiences and sleep deprivation on dissociative symptoms. The

main analysis was run on diagnosed individuals (DID and PTSD) to avoid spurious outcomes from including the healthy control sample. The multivariate regression was between measures of dissociative symptoms and the predictor variables traumatic experiences (TEC and CTQ total scores), sleep disturbances (ISES) and fantasy proneness (CEQ) (see Part C of Supplementary materials for sample size estimates).

For the third hypothesis, investigating working memory performance on the N-back task, we used one-way ANOVA repeated measures in a between-subject design of group (DID, PTSD, and HC), condition (0-back, 1-back, 2-back and 3-back) and the Group x Condition. Furthermore, multiple linear regression analysis was carried out concerning reaction time (RT) and correct responses (CR). The regression involved examining the cumulative effect of all traumatization (TEC and CTQ total scores), sleep (ISES) dissociative symptoms (DES) and fantasy measures (CEQ) on RT and CR.

3. Results

3.1. Summary of the main data

Table 1 displays the descriptive statistics for all questionnaires, that is dissociative symptoms (DES), traumatic experiences (TEC and CTQ), sleep disturbances (ISES) and fantasy proneness (CEQ). Somatoform and psychoform dissociative symptoms were highest in the DID group compared to PTSD and HC. Eta squared values indicated that 76% of DES score variance was explained by the groups. The CTQ (traumatic experiences) mirrored this pattern with 64% of variance explained by the groups, while the TEC (idem) indicated 80% of explained variance, whereby highest traumatic experiences score was found in the DID group for both CTQ and TEC. ISES (sleep measures) explained 46% of variance. Post-hoc analyses for the ISES showed that the DID and PTSD groups did not differ, but both groups differed significantly from the healthy controls (all $p < .001$). Similarly, fantasy proneness (CEQ) did not differ significantly between the DID and PTSD groups, but differed significantly between DID and HC ($p = .004$) and PTSD and HC ($p = .006$). However, the fantasy proneness variance explained by groups was only 22%.

3.2. Analysis

3.2.1. Hypothesis (i): correlating sleep, dissociative symptoms and traumatic experiences

When only including the DID and PTSD groups, and not the HC group, the Pearson's partial correlation analysis between sleep measures and measures

Table 1. Demographics, descriptive statistics and ANOVA analyses.

	Mean (SD)			ANOVA/Kruskal Wallis			Post-hoc (Mann Whitney)		
	DID (n = 17)	PTSD (n = 16)	HC (n = 16)	Statistic	η²	Sig. (2-tailed)	DID vs. HC	DID vs. PTSD	PTSD vs. HC
Demographics									
Age (years)	43.88 (9.86)	40.80 (12.10)	43.59 (11.68)	$F_{(3.61)} = 0.382$		n.s			
Education (years)	14.88 (0.99)	14.94 (0.85)	15.25 (0.58)	$F_{(3.61)} = 0.415$		n.s			
DES total	54.41 (16.18)	22.18 (13.83)	5.49 (3.46)	$H_{(2)} = 36.44**$	76%	$p < .001$	$U = 272, Z = 4.90, p < .001$	$U = 18, Z = 4.25, p < .001$	$U = 23, Z = 3.96, p < .001$
TEC total	17.53 (4.08)	11.06 (4.01)	2 (1.93)	$H_{(2)} = 38.35**$	64%	$p < .001$	$U = 272, Z = 4.92, p < .001$	$U = 25.00, Z = 4.02, p < .001$	$U = 5, Z = 4.66, p < .001$
CTQ total	88.25 (18.62)[a]	60.94 (22.70)	35.94 (8.22)	$H_{(2)} = 30.21**$	80%	$p < .001$	$U = 256, Z = 4.83, p < .001$	$U = 41.5, Z = 3.26, p = .001$	$U = 35.5, Z = 3.49, p < .001$
ISES total	64.94 (18.27)	57.38 (17.31)	33.25 (12.64)	$H_{(2)} = 21.89**$	46%	$p < .001$	$U = 21.5, Z = 4.13, p < .001$	n.s	$U = 29, Z = 3.73, p < .001$
CEQ	9.71 (5.93)	7.81 (3.51)	3.81 (3.12)	$H_{(2)} = 10.52*$	22%	$p = .005$	$U = 57.5, Z = 2.84, p = .004$	n.s	$U = 56.50, Z = 2.72, p = .006$

DID = Dissociative Identity Disorder; PTSD = Posttraumatic Stress Disorder; HC = Healthy Controls; DES = Dissociative Experiences Scale; TEC = Trauma Experience Checklist; CTQ = Childhood Trauma Questionnaire; ISES = Iowa Sleep Experiences Survey; CEQ = Creative Experiences Questionnaire; n.s. = not significant; [a] = DID (n = 16) * = $p ≤ .05$; ** = $p ≤ .001$.

Table 2. Pearson's partial correlation results.

	DES total	TEC	CTQ	ISES	CEQ
A: Without healthy control group n = 33 (DID n = 17, PTSD n = 16)					
DES total	____	____	____	____	____
TEC total	.664**	____	____	____	____
CTQ total[a]	.651**	.628**	____	____	____
ISES total	.246	.236	-.040	____	____
CEQ	.387*	.302^	.225	.467*	____
B: With healthy control group n = 49 (DID n = 17, PTSD n = 16, HC n = 16)					
DES100	____	____	____	____	____
TEC total	.811**	____	____	____	____
CTQ total[a]	.792**	.808**	____	____	____
ISES total	.561**	.599**	.396*	____	____
CEQ	.561**	.543**	.457**	.656**	____

DID = Dissociative Identity Disorder; PTSD = Posttraumatic Stress Disorder; HC = healthy controls; DES = Dissociative Experiences Scale; Absp = Absorption; Amn = Amnesia; DpDr = Depersonalization Derealization; TEC = Trauma Experience Checklist; CTQ = Childhood Trauma Questionnaire; ISES = Iowa Sleep Experiences Survey; CEQ = Creative Experiences Questionnaire; Subscales of subsequent questionnaires presented in italics; [a] = DID (n = 16); * = $p \leq .05$; ** = $p \leq .001$; ^ = $0.05 < p \leq 0.1$.

of dissociative symptoms did not give any significant results (see Table 2, part A). As presented in Table 2 part A, the correlations between traumatic experiences and dissociative symptoms were much stronger for both for TEC ($r = .664$, $p < .01$) and CTQ ($r = .651$, $p < .001$), than those of dissociative symptoms and fantasy proneness ($r = .387$, $p < .05$), while correlations with sleep deprivation were not significant. When HC were included in the analyses, sleep deprivation resulted in a significant positive association with dissociative symptoms ($r = .561$, $p < .001$) (see Table 2, part B; Figure 1), while the correlation strength of the CEQ was increased ($r = .561$, $p < .001$).

3.2.2. Hypothesis (ii): predicting dissociative symptoms: traumatic experiences versus sleep disturbances

The multiple regression analysis including measures of sleep disturbances (ISES), traumatic experiences (TEC and CTQ total) and fantasy proneness (CEQ) showed that sleep disturbances and fantasy proneness are weaker predictor variables for dissociation symptoms than traumatic experiences in DID and PTSD individuals (results including all three groups of participants are provided in the supplementary materials, Table S1). When including childhood or adult traumatic experiences (CTQ and TEC, respectively) as a predictor variable of dissociative
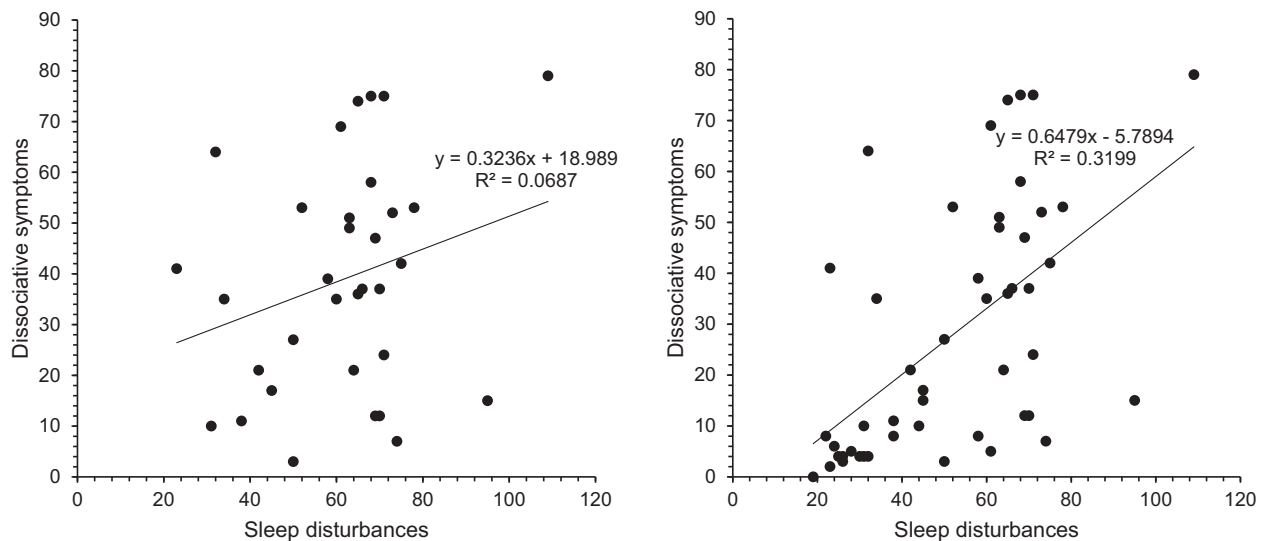
Figure 1. Correlation analyses between dissociative symptoms (DES total) and sleep disturbances (ISES total). The first scatter graph presents the relationship including only DID and PTSD participants. A moderate positive association with a weak effect size of 7% is presented (not significant), which indicates that as sleep disturbances increase, dissociative symptoms increase weakly, meaning sleep disturbances are a weak predictor of dissociative symptoms. The second scatter graph presents a correlation analysis between dissociative symptoms (DES total) and sleep disturbances (ISES total) including all participant groups (DID, PTSD and HC) ($p \leq$ 001). A strong positive association with a moderate effect size of 32% is presented, which indicates that as sleep disturbances increase, dissociative symptoms increase moderately. It is found that the inclusion of healthy controls, skews the correlation, strengthening the relationship, which increases the effect of sleep on dissociative symptoms significantly.

Table 3. Multiple linear regression analyses between dissociation measures (DES total, Absorption, Amnesia, Depersonalization/Derealization) and traumatic experiences (CTQ and TEC), sleep disturbances (ISES) and fantasy proneness (CEQ) measures in DID and PTSD.

Variable	B	SE B	β	R^2
DES total				
CTQ total[a]	.36	.15	.41*	.58
TEC total	1.42	.73	.33^	
ISES total	.14	.18	.12	
CEQ	.66	.64	.15	
Absorption				
CTQ total[a]	.51	.18	.54*	.46
TEC total	−.00	.89	.00	
ISES total	.24	.22	.19	
CEQ	1.04	.78	.22	
Amnesia				
CTQ total[a]	.24	.20	.24	.38
TEC total	1.82	1.01	.37^	
ISES total	.16	.25	.12	
CEQ	.30	.88	.06	
Depersonalization/Derealization				
CTQ total[a]	.63	.18	.58*	.59
TEC total	1.09	.89	.21	
ISES total	.22	.22	.15	
CEQ	.27	.78	.05	

DES = Dissociative Experiences Scale; TEC = Trauma Experience Checklist; ISES = Iowa Sleep Experiences Survey; CTQ = Childhood Trauma Questionnaire; CEQ = Creative Experiences Questionnaire; B = B value; SE B = Standard error of B; β = beta value; [a] = DID (n = 16); * = $p \leq .05$; ** = $p \leq .001$; ^ = $0.05 < p \leq 0.1$.

symptoms, we found greater coefficients of effect than sleep disturbances and fantasy proneness in predicting dissociative symptoms (see Table 3). Childhood traumatic experiences in particular were the most significant predictor variable for dissociative symptoms.

3.2.3. Hypothesis (iii): cognitive performance

Testing whether dissociation, traumatization or sleep disturbances predicted performance on the N-back working memory task did not yield a significant main effect (Table 4). The main effect of condition over DID, PTSD and HC participants revealed that increased task load coincided with a significant increase of reaction time (RT), while the correct responses (CR) decreased significantly ($F(2.39, 102.95) = 37.77$, $p < .001$). The Interaction

Group x Condition was not significant for either RT or CR, hence task performance was similar over all three groups. We did not find significant results when testing whether dissociative symptoms, traumatic experiences, sleep quality and fantasy predicted working memory performance in terms of RT or CR.

4. Discussion and conclusion

The current study investigated the relationship between dissociative symptoms, sleep disturbance, traumatic events, fantasy proneness, and working memory performance. Our most important finding is that sleep disturbances did not predict dissociative symptoms when controlling for traumatic experiences. This finding supports a trauma model of dissociative symptoms. Further, traumatic experiences predicted dissociative symptoms better than either sleep disturbances or fantasy proneness. This finding is therefore at odds with a fantasy model. Another important finding is that we did not find superior or inferior working memory capacity in individuals with DID or individuals with PTSD as compared to HC.

One of the aims of the current study was to replicate findings of a study by van Heugten – van der Kloet et al. (2014). When including the DID and PTSD groups and not the healthy control group to avoid spurious effects, our results show a much lower sleep deprivation-dissociative symptoms correlation than the previous study, which reported a large and significant correlation (van Heugten – van der Kloet et al., 2014). Importantly, our findings are within the range reported by a large review of sleep-dissociation studies (Van Der Kloet et al., 2012), whereas the sleep deprivation-dissociative symptoms correlation of the study by van Heugten – van der Kloet et al. (2014) seems to be an outlier. Interestingly, when including the HC group to mimic the design of the previous study, we did replicate the highly significant finding for the sleep deprivation-dissociation association. The combined findings are in line

Table 4. Mean scores (Standard deviation) of N-back task in three groups: DID, PTSD and HC and repeated ANOVA analyses.

	DID (n = 14)	PTSD (n = 16)	HC (n = 16)	Repeated measures ANOVA	
				Statistic	Sig. (2-tailed)
Reaction time (milliseconds)					
0-back	461.93 (90.24)	437.69 (51.27)	444.25 (68.13)	**Main effect group**	
				F(2,43) = 0.133	n.s.
1-back	513.93 (98.13)	495.94 (103.02)	472.69 (163.15)	**Main effect condition**	
2-back	607.64 (112.99)	602.13 (131.79)	625.69 (159.85)	F(2.39, 102.95) = 37.77	< .001
3-back	614.14 (143.11)	591.69 (117.92)	619.31 (156.66)	**Interaction group x condition**	
				F(4.79, 102.951) = 0.40	n.s.
Correct responses					
0-back	9 (0.00)	9 (0.00)	9 (0.00)	**Main effect group**	
				F(2,43) = 0.562	n.s.
1-back	8.93 (0.27)	8.88 (0.34)	8.88 (0.34)	**Main effect condition**	
2-back	8.43 (0.65)	8.13 (1.20)	8.50 (0.97)	F(1.80, 77.19) = 39.97	< .001
3-back	7.36 (1.22)	7.13 (.1.78)	7.44 (1.09)	**Interaction group x condition**	
				F(3.59, 77.19) = 0.25	n.s.

DID = dissociative identity disorder; PTSD = post = traumatic stress disorder; HC = healthy controls.

with our hypothesis that the original results were based on a spurious effect due to the inclusion of an HC group.

Regarding sleep disturbances, we did not find a difference between the DID and PTSD groups, yet we found a significant outcome when including HC participants. Regarding fantasy proneness, we found that it is a weak predictor of dissociative symptoms, which contrasts to the view put forward by the FM and Van Der Kloet et al. (2012). According to the FM, fantasy proneness mean scores across groups were expected to be higher than those of the traumatization measures, which was in fact, the opposite. Furthermore, it was expected to observe a difference between DID and PTSD samples, with higher mean scores for DID individuals, to suggest a causal effect of fantasy proneness on DID. We did not find any differences between the two diagnosed samples for levels of fantasy proneness, yet, similar to sleep disturbances, there were significant outcomes when the DID and PTSD individuals were compared to healthy controls. As described in the previous paragraph, correlation analyses showed an increase in strength of the effects of sleep disturbances and fantasy proneness on psychoform and somatoform dissociation when healthy control participants are included. Taking these three findings together, we propose that fantasy proneness and sleep disturbances are factors influenced by introducing the HC sample, and are not significant in predicting DID symptomatology. It would therefore have been preferable to introduce another psychiatric diagnosis for the comparison group, such as a group of depressive patients or personality disorder patients.

When accounting for the effects of trauma, sleep disturbances and fantasy proneness lost all predictive strength on DID symptomatology. This leads us to conclude that trauma is causally related to dissociation, and that the outcomes of Van Der Kloet et al. (2012), suggesting sleep disturbances in combination with fantasy proneness to be the cause of DID, are inconsistent. Childhood traumatic events are linked with nightmares and dissociative experiences (Agargun et al., 2003). Hence, a relationship between sleep experiences and dissociative symptoms can be explained by traumatic experiences that cause sleep disturbances such as nightmares, hyperarousal and sleep avoidance (Ohayon, Shapiro, Ohayon, & Shapiro, 2000) in individuals with DID or PTSD, resulting in heightened dissociative symptoms as a by-product and vice-versa (Brand et al., 2018; Koffel & Watson, 2009). Our results show a strong effect of traumatic experiences on DID symptomatology, even when controlling the effect of sleep disturbances. Hence, sleep disturbances, although present in traumatized individuals, cannot be considered the cause of dissociative symptoms.

Regarding cognition, we found similar working memory capacity in DID, PTSD, and healthy controls, which is in contrast to findings of previous studies (Elzinga et al., 2007; Rossini, Schwartz, & Braun, 1996; Simeon et al., 2009). One explanation is that individuals with dissociative disorders may have found ways to compensate for cognitive deficits that make these hard to detect (Brewin, Ma, & Colson, 2013). Another explanation is that the inconsistency in findings across studies might be explained by the fact that other studies did not control for the type of personality state of the individuals with DID participating in the research, which is an important limitation. By specifically including a neutral personality state (NPS) the current study controlled for the dissociative personality state participating in the research paradigm, which is a strength of the current study. However, it would be of interest for future studies to include trauma-related personality states as well, and study personality-state-dependent working memory performance in DID (Dorahy, Irwin, & Middleton, 2004).

Some differences in variables included in the replication versus the original study are worth noting. The original study (van Heugten – van der Kloet et al., 2014) incorporated two sleep measures: the ISES and Pittsburgh Sleep Quality Inventory (PSQI). Whilst the ISES assessed for content of the sleep disturbance (for example, nightmares), the PSQI measured for the quality of sleep (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Our replication is in this aspect only partial because we only included the ISES, which is the most widely used sleep measure for dissociation research (Watson, 2001). Nevertheless, it will be of interest to include measures of quality of sleep in future studies. Furthermore, we choose to use multiple linear regression instead of binary logistic regression to predict group membership. The aim of van Heugten – van der Kloet et al. (2014) was to investigate how cognitive failures, fantasy proneness and sleep are related to dissociative symptoms. This aim translates to examining which measures best predict dissociative symptoms, not group membership, which is best done using multiple linear regression on the variables of dissociation obtained from the patient groups. Our control sample consisted of non-traumatized, non-dissociative healthy controls, who, per inclusion criteria, do not have dissociative symptoms and dissociation can therefore not be predicted in this group. With these two differences, we ensured the reliability of our findings regarding which measure best predicts dissociative symptoms. Another limitation of the present study is the relative low number of participants. It can be argued that especially the N-back is underpowered, but the sample size of the original study was even lower. For future studies, we would recommend to include a non-pathological traumatized control group which has experienced both childhood and adulthood

traumatic events, but is free from dissociative experiences or PTSD symptoms. The present study could not inconclusively determine whether traumatization, sleep disturbances or fantasy proneness were responsible for PTSD group membership, so an inclusion of a traumatized healthy control sample could inform on this relationship. It is important to note our use of a cross-sectional design. We propose that future research would benefit from a mediation model approach to assess whether sleep disturbances or fantasy proneness play a causal role in dissociation as mediators of trauma. However, an improvement over the original study is that in the current study, the DID participants were diagnosed by two expert clinical psychologists using the SCID-D and false positives were excluded. Another strength of our study is that it followed the future directions that the authors of the original study indicated: adding measures of traumatic experiences and replacement of the Cognitive Failure Questionnaire (CFQ) with an experimental measure to assess working memory capacity. The retrospective assessment of traumatic experiences using self-report can be seen as an almost unavoidable limitation.

The current study shows that traumatization is the most important predictor of dissociation in individuals with DID and we assume that sleep disturbances are likely to be related to nightmares due to traumatic childhood experiences. A diagnosis of DID is still controversial (Reinders et al., 2019). When an individual presents with severe dissociative symptoms as well as sleeping problems, we recommend to check for nightmares and investigate the origin of sleep disturbances and to explore a trauma-related disorder, such as DID. This is important because individuals with DID can spend years in the mental health system before being correctly diagnosed (Brand et al., 2016). An earlier diagnosis can therefore prevent personal suffering and personal and societal costs, especially because younger DID individuals appear to respond more rapidly to treatment than adults (Myrick et al., 2012). Although we included 17 individuals with DID instead of 12 in the original study of van Heugten – van der Kloet et al. (2014), we ensured the inclusion of only individuals with genuine DID and not with imitative DID (Draijer & Boon, 1999) by using DID-expert clinicians for the diagnosis (see for an in depth discussion (Brand et al., 2016)). Although our findings fit our hypotheses we still need to be cautious due to the relative small sample size and high chance for type–II errors. It is therefore recommended that future studies include larger sample sizes.

This study verifies the need to focus DID treatment on managing the effect of traumatization. This is important because there is contrasting research concerning the aetiology of the disorder, which can prevent an accurate diagnosis and treatment. Hence, the current study provides evidence for targeting traumatization as a key predictor of dissociation in individuals with DID. The costs of under-diagnosing DID are high, not only for the individual patients, but also for their residing support system and society as a whole (Reinders et al., 2019). Sleep disturbances are an indicator of mental health suffering (Anderson & Bradley, 2013), but we propose that in DID sleep disturbances are likely to occur as a symptom due to the resurfacing of traumatic childhood experiences, not as causation of DID.

In conclusion, the current findings do not fit the hypotheses that sleep disturbances or fantasy proneness cause DID, or that DID involves working memory deficits. However, our findings are consistent with the hypothesis that chronic traumatic experiences have a major role in the aetiology of DID. Our results do not support the idea that DID is a fantasy construct.

Acknowledgments

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

ORCID

Lora Dimitrova http://orcid.org/0000-0002-0862-3515
Vinuri Fernando http://orcid.org/0000-0001-8035-9475
Ellert R. S. Nijenhuis http://orcid.org/0000-0003-4710-474X

References

Agargun, M. Y., Kara, H., Özer, Ö. A., Selvi, Y., Kiran, Ü., & Kiran, S. (2003). Nightmares and dissociative experiences: The key role of childhood traumatic events. *Psychiatry and Clinical Neurosciences*, 57, 139–145.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders, 5th edition (DSM-5). *The Diagnostic and Statistical Manual of Mental Disorders 4th Ed TR*, 280. doi:10.1176/appi.books.9780890425596.744053

Anderson, K. N., & Bradley, A. J. (2013). Sleep disturbance in mental health problems and neurodegenerative disease. *Nature and Science of Sleep*, 5, 61–75.

Arntz, A., & Wessel, I. (1996). *Jeugd trauma vragenlijst* [Dutch version of the childhood trauma questionnaire]. Maastricht, the Netherlands: Arntz & Wessel.

Bernstein, D. P., Fink, L., Handelsman, L., Foote, J., Lovejoy, M., Wenzel, K., … Ruggiero, J. (1994). Initial reliability and validity of a new retrospective measure of child abuse and neglect. *The American Journal of Psychiatry*, 151.

Bernstein, D. P., Stein, J. A., Newcomb, M. D., Walker, E., Pogge, D., Ahluvalia, T., … Zule, W. (2003). Development and validation of a brief screening version of the childhood trauma questionnaire. *Child Abuse & Neglect*, 27, 169–190.

Bernstein, E. M., & Putnam, F. W. (1986). Development, reliability, and validity of a dissociation Scale. *The Journal of Nervous and Mental Disease*, 174, 115–167.

Boon, S., & Draijer, N. (1993). Multiple personality disorder in The Netherlands: A clinical investigation of 71 patients. *The American Journal of Psychiatry*, 150, 489–494.

Brand, B., Dalenberg, C., Frewen, P., Loewenstein, R., Schielke, H., Brams, J., & Spiegel, D. (2018). Trauma-Related dissociation is no fantasy: Addressing the errors of omission and commission in Merckelbach and Patihis. *Psychological Injury and Law*, 11, 377–393.

Brand, B. L., Classen, C. C., Lanins, R., Loewenstein, R. J., McNary, S. W., Pain, C., & Putnam, F. (2009). A naturalistic study of dissociative identity disorder and dissociative disorder not otherwise specified patients treated by community clinicians. *Psychological Trauma: Theory, Research, Practice, and Policy*, 1, 153–171.

Brand, B. L., Sar, V., Stavropoulos, P., Krüger, C., Korzekwa, M., Martínez-Taboas, A., & Middleton, W. (2016). Separating fact from fiction. *Harvard Review of Psychiatry*, 24, 257–270.

Brand, B. L., Vissia, E. M., Chalavi, S., Nijenhuis, E. R. S., Webermann, A. R., Draijer, N., & Reinders, A. A. T. S. (2016). DID is trauma based: Further evidence supporting the trauma model of DID. *Acta Psychiatrica Scandinavica*, 134, 560–563.

Brewin, C. R., Ma, B. Y. T., & Colson, J. (2013). Effects of experimentally induced dissociation on attention and memory. *Consciousness and Cognition*, 22, 315–323.

Buysse, D. J., Reynolds, C. F., 3rd, Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28, 193–213.

Bernstein, E. M., & Putnam, F. W. (1986). Development, reliability and validity of a dissociation scale. *The Journal of Nervous and Mental Disease*, 174(12), 727–735.

Chalavi, S., Vissia, E. M., Giesen, M. E., Nijenhuis, E. R. S., Draijer, N., Barker, G. J., & Reinders, A. A. T. S. (2015a). Similar cortical but not subcortical gray matter abnormalities in women with posttraumatic stress disorder with versus without dissociative identity disorder. *Psychiatry Research: Neuroimaging*, 231, 308–319.

Chalavi, S., Vissia, E. M., Giesen, M. E., Nijenhuis, E. R. S., Draijer, N., Cole, J. H., … Reinders, A. A. T. S. (2015b). Abnormal hippocampal morphology in dissociative identity disorder and post-traumatic stress disorder correlates with childhood trauma and dissociative symptoms. *Human Brain Mapping*, 36, 1692–1704.

Dalenberg, C. J., Brand, B. L., Gleaves, D. H., Dorahy, M. J., Loewenstein, R. J., Cardeña, E., & Spiegel, D. (2012). Evaluation of the evidence for the trauma and fantasy models of dissociation. *Psychological Bulletin*, 138, 550–588.

Dalenberg, C. J., Brand, B. L., Loewenstein, R. J., Gleaves, D. H., Dorahy, M. J., Cardeña, E., & Spiegel, D. (2014). Reality versus fantasy: Reply to Lynn et al. (2014). *Psychological Bulletin*, 140, 911–920.

Dorahy, M. J. (2001). Dissociative identity disorder and memory dysfunction: The current state of experimental research and its future directions. *Clinical Psychology Review*, 21, 771–795.

Dorahy, M. J., Irwin, H. J., & Middleton, W. (2004). Assessing markers of working memory function in dissociative identity disorder using neutral stimuli: A comparison with clinical and general population samples. *Australian & New Zealand Journal of Psychiatry*, 38, 47–55.

Draijer, N., & Boon, S. (1999). The imitation of dissociative identity disorder: Patients at risk, therapists at risk. *The Journal of Psychiatry & Law*, 27, 423–458.

Elzinga, B. M., Ardon, A. M., Heijnis, M. K., De Ruiter, M. B., Van Dyck, R., & Veltman, D. J. (2007). Neural correlates of enhanced working-memory performance in dissociative disorder: A functional MRI study. *Psychological Medicine*, 37, 235–245.

Frewen, P. A., Brown, M. F. D., & Lanius, R. A. (2017). Trauma-related altered states of consciousness (TRASC) in an online community sample: Further support for the 4-D model of trauma-related dissociation. *Psychology of Consciousness: Theory, Research, and Practice*, 4, 92–114.

Hornstein, N. L., & Putnam, F. W. (1992). Clinical phenomenology of child and adolescent dissociative disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, 31, 1077–1085.

Kirchner, W. K. (1958). Age differences in short-term retention of rapidly changing information. *Journal of Experimental Psychology*, 55, 352–358.

Kluft, R. P. (1996). Treating the traumatic memories of patients with dissociative identity disorder. *The American Journal of Psychiatry*, 153, 103–110.

Koffel, E., & Watson, D. (2009). Unusual sleep experiences, dissociation, and schizotypy: Evidence for a common domain. *Clinical Psychology Review*, 29, 548–559.

Koutstaal, W., Schacter, D. L., Johnson, M. K., Angell, K. E., & Gross, M. S. (1998). Post-event review in older and younger adults: Improving memory accessibility of complex everyday events. *Psychology and Aging*, 13, 277–296.

Loftus, E., & Ketcham, K. (1994). *The myth of repressed memory: False memories and allegations of sexual abuse*. New York: St. Martin's Press.

Lynn, S. J., Lilienfeld, S. O., Mcnally, R. J., Loftus, E. F., Bruck, M., Garry, M., … Malaktaris, A. (2014). The trauma model of dissociation: Inconvenient truths and stubborn fictions. *Comment on Dalenberg Et Al. (2012)*, 140, 896–910.

McNally, R. J. (2003). *Remembering trauma*. Cambridge, MA: The Belknap Press of Harvard University Press.

McNutt, M. (2014). Reproducibility. *Science (80-)*, 343, 229.

Merckelbach, H., Horselenberg, R., & Muris, P. (2001). The Creative Experiences Questionnaire (CEQ): A brief self-report measure of fantasy proneness. *Personality and Individual Differences*, 31, 987–995.

Merckelbach, H., Lynn, S. J., & Lilienfeld, S. O. (n.d.). Vissia and co-workers claim that DID is trauma-based. But how strong is their evidence? DID is trauma based : Further evidence supporting the trauma model of DID. *Acta Psychiatrica Scandinavica*, 559–560. doi:10.1111/acps.12642

Merckelbach, H., Muris, P., & Rassin, E. (1999). Fantasy proneness and cognitive failures as correlates of dissociative experiences. *Personality and Individual Differences*, 26, 961–967.

Myrick, A., Brand, B., McNary, S., Classen, C., Lanius, R., Loewenstein, R., & Putnam, F. W. (2012). An exploration of young adults' progress in treatment for dissociative disorder. *Journal of Trauma & Dissociation*, 13, 582–595.

Nijenhuis, E. R. S. (2015). *The trinity of trauma: Ignorance, fragility, and control: The evolving concept of trauma/The concept and facts of dissociation in trauma*. Göttingen: Vandenhoeck & Ruprecht.

Ohayon, M. M., Shapiro, C. M., Ohayon, M. M., & Shapiro, C. M. (2000). Sleep disturbances and psychiatric disorders associated with posttraumatic stress disorder in the general population. *Comprehensive Psychiatry*, 41, 469–478.

Reinders, A. A. T. S., Marquand, A. F., Schlumpf, Y. R., Chalavi, S., Vissia, E. M., Nijenhuis, E. R. S., & Veltman, D. J. (2019). Aiding the diagnosis of dissociative identity disorder: Pattern recognition study of brain biomarkers. *The British Journal of Psychiatry: The Journal of Mental Science*, 215, 536–544.

Reinders, A. A. T. S., Willemsen, A. T. M., Vos, H. P. J., den Boer, J. A., & Nijenhuis, E. R. S. (2012). Fact or factitious? a psychobiological study of authentic and simulated dissociative identity States. *PLoS One*, 7, e39279.

Rossini, E., Schwartz, D., & Braun, B. (1996). Intellectual functioning of inpatients with dissociative identity disorder and dissociative disorder not otherwise specified. Cognitive and neuropsychological aspects. *The Journal of Nervous and Mental Disease*, 184, 289–294.

Sar, V. (2011). Epidemiology of dissociative disorders: An overview. *Epidemiology Research International*, 1, 1–8.

Sar, V., Koyuncu, A., Ozturk, E., Yargic, L. I., Kundakci, T., Yazici, A., & Aksüt, D. (2007). Dissociative disorders in the psychiatric emergency ward. *General Hospital Psychiatry*, 29, 45–50.

Schlumpf, Y. R., Nijenhuis, E. R. S., Chalavi, S., Weder, E. V., Zimmermann, E., Luechinger, R., … Jäncke, L. (2013). Dissociative part-dependent biopsychosocial reactions to backward masked angry and neutral faces: An fMRI study of dissociative identity disorder. *NeuroImage: Clinical*, 3, 54–64.

Schlumpf, Y. R., Reinders, A. A. T. S., Nijenhuis, E. R. S., Luechinger, R., Van Osch, M. J. P., & Jäncke, L. (2014). Dissociative part-dependent resting-state activity in dissociative identity disorder: A controlled fMRI perfusion study. *PLoS One*, 9, 1–15.

Simeon, D., Guralnik, O., Hazlett, E. A., Spiegel-Cohen, J., Hollander, E., & Buchsbaum, M. S. (2009). Feeling unreal: A PET study of depersonalization disorder. *American Journal of Psychiatry*, 157, 1782–1788.

Spanos, N. (1994). Multiple identity enactments and multiple personality disorder: A sociocognitive perspective. *Psychological Bulletin*, 116, 143–165.

Swick, D., Cayton, J., Ashley, V., & Turken, A. U. (2017). Dissociation between working memory performance and proactive interference control in post-traumatic stress disorder. *Neuropsychologia*, 96, 111–121.

van Der Hart, O., Nijenhuis, E. R. S., & Steele, K. (2006). *The haunted self : Structural dissociation and the treatment of chronic traumatization*. New York: W.W. Norton.

Van Der Kloet, D., Giesbrecht, T., Franck, E., Van Gastel, A., De Volder, I., Van Den Eede, F., & Merckelbach, H. (2013). Dissociative symptoms and sleep parameters - An all-night polysomnography study in patients with insomnia. *Comprehensive Psychiatry*, 54, 658–664.

Van Der Kloet, D., Merckelbach, H., Giesbrecht, T., & Lynn, S. J. (2012). Fragmented sleep, fragmented mind: The role of sleep in dissociative symptoms. *Perspectives on Psychological Science*, 7, 159–175.

van Heugten – van der Kloet, D., Huntjens, R., Giesbrecht, T., & Merckelbach, H. (2014). Self-reported sleep disturbances in patients with dissociative identity disorder and post-traumatic stress disorder and how they relate to cognitive failures and fantasy proneness. *Frontiers In Psychiatry / Frontiers Research Foundation*, 5, 19.

Veltman, D. J., de Ruiter, M. B., Rombouts, S. A. R. B., Lazeron, R. H. C., Barkhof, F., Van Dyck, R., … Hans Phaf, R. (2005). Neurophysiological correlates of increased verbal working memory in high-dissociative participants: A functional MRI study. *Psychological Medicine*, 35, 175–185.

Vissia, E. M., Giesen, M. E., Chalavi, S., Nijenhuis, E. R. S., Draijer, N., Brand, B. L., & Reinders, A. A. T. S. (2016). Is it trauma- or fantasy-based? Comparing dissociative identity disorder, post-traumatic stress disorder, simulators, and controls. *Acta Psychiatrica Scandinavica*, 134, 111–128.

Watson, D. (2001). Dissociations of the night: Individual differences in sleep-related experiences and their relation to dissociation and schizotypy. *Journal of Abnormal Psychology*, 110, 526–535.