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Detached and distracted: ERP correlates of altered attentional function in depersonalisation

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ABSTRACT

Depersonalisation (DP) is a psychological condition marked by feelings of disembodiment. In everyday life, it is frequently associated with concentration problems. The present study used visual event-related potentials (ERPs) in a Posner-type spatial cueing task with valid, invalid and spatially neutral cues to delineate the potential neurophysiological correlates of these concentration problems. Altered attentional functioning at early, sensory stages was found in DP patients but not in anxiety- and depression-matched psychosomatic patients without DP. Specifically, DP was associated with decreased suppression of stimuli at unattended locations, shown as absent processing costs for invalidly versus neutrally cued stimuli over P1 (135–150 ms). Attentional benefits at N1, and all attentional effects at later, cognitive processing stages (P2-N2, P3) were similar in both groups. We propose that this insufficient early suppression of unattended stimuli may result from atypical sensory gain control in DP.

1. Introduction

Depersonalisation and derealisation are aspects of a psychological condition that is characterised by feelings of detachment from one's own self and body and/or from one's surroundings (e.g., Michal et al., 2007; Simeon, 2004). For example, one might have the experience of being an outside observer to one's own thoughts, feelings, sensations and body (depersonalisation) or experience other people or objects as unreal, dreamlike, lifeless or as if through a fog (derealisation). In depersonalisation (DP) reality testing remains intact (e.g., Simeon, 2004).

Experiences like these can occur in healthy adults under conditions of stress or fatigue (Simeon, 2004; Trueman, 1984) or as a symptom of a mental disorder (e.g. panic disorder, post-traumatic stress disorder). When symptoms of DP are persistent, they may indicate the presence of depersonalisation-derealisation disorder, which causes clinically significant distress or impairments (Spiegel et al., 2011; American Psychiatric Association, 2013). The prevalence of DP in the general population is around 1–2% with both genders equally affected (Hunter, Sierra, & David, 2004; Lee, Kwok, Hunter, Richards, & David, 2012; Simeon, 2004). The onset of the disorder is usually before age 25, and the symptoms often become chronic (Baker et al., 2003; Simeon, Knutelska, Nelson, & Guralnik, 2003).

One of the most frequent complaints in patients with DP is difficulties with concentration (Lambert, Senior, Fewtrell, Phillips, & David, 2001; Hunter, Phillips, Chalder, Sierra, & David, 2003; American Psychiatric Association, 2013). Indeed, standard neuropsychological tests suggest that DP is marked by broad alterations of the attentional and perceptual systems (Guralnik, Schmeidler, & Simeon, 2000; Guralnik, Giesbrecht, Knutelska, Sirroff, & Simeon, 2007). Specifically, DP was associated with slower processing speed, impaired perceptual organisation, vulnerability to distracting stimuli, and impairments in immediate recall of verbal or visual information. A more recent study provided further evidence for reduced capacity to suppress stress-related physiological arousal (Lemche et al., 2016

Selective attention is a higher cortical function necessary to deal with the constant stream of information arising from our body and the physical world around us, in line with the current needs of our organism and the pressures that the external world places on us. Because of its limited processing resources, the brain has to focus on behaviourally relevant information, while ignoring the rest; a process referred to as selective attention (e.g., Posner, Snyder, & Davidson, 1980; Hillyard, Vogel, & Luck, 1998).

A common and well established method to investigate selective attentional mechanisms is the spatial cueing paradigm (Posner & Cohen,

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1984). In a recent study (Adler et al., 2014), we used this paradigm to investigate the behavioural mechanisms of spatial-selective attention in DP. We manipulated attentional demand by asking DP patients and healthy controls to perform an easy detection task and a more difficult discrimination task. In both tasks, targets (Gabor patches) were presented in the left or right hemifield, and participants were asked to respond to all of them (detection task) or only certain ones (discrimination task). We measured covert attentional selection by comparing response times to validly predicted targets (targets at the location indicated by a preceding central cue) with response times to invalidly predicted targets (targets at the non-indicated location). This overall attention-directing effect was smaller for DP patients than for healthy controls in the more difficult discrimination task only. The inclusion of neutrally predicted targets (targets preceded by non-informative cues) in this study allowed us to measure the contribution of costs (differences between invalidly and neutrally cued trials) and benefits (differences between validly and neutrally cued trials) to the overall attention-directing effect. We found that, in the discrimination task, the DP group experienced fewer attentional costs (i.e., less slowing of response times in invalid compared to neutral trials) but the same benefits as healthy controls. These findings show that DP is associated with altered mechanisms of spatial attention, and particularly with a weaker suppression of events at unexpected locations under conditions of increased attentional demand. This may lead to increased distractibility, which may be the source of the concentration difficulties reported by DP patients in daily life. As we compared DP patients with healthy controls, it remains unclear, however, to what extent the attentional effect is specific to DP rather than explained by mental illness itself.

To this end, the present study used a control group of psychosomatic patients without clinically significant DP symptoms, but similar average levels of anxiety and depression. We employed a variant of the discrimination task and spatial cueing paradigm used by Adler et al. (2014), and investigated the underlying neural mechanisms of selective attention in DP with electroencephalography (EEG). Visual stimuli evoke cortical event-related potentials (ERPs), which consist of typical components (P1, N1, P2, N2, P3). The sequence of these ERP components reflects the sequence of neural processes triggered by the stimulus (Luck, Woodman, & Vogel, 2000). Early sensory processes (P1, N1) are followed by later cognitive stages (P2, N2, P3), which research has related to processes of decision making and response selection.

We hypothesised that DP patients would demonstrate fewer attentional costs than controls, both in response times and in ERPs. The central question of the present study was whether these effects occur on a cognitive level of information processing (mirrored in the P2, N2, and P3 components of the ERP) or are already observable at the level of sensory processing (i.e., at earlier stages of neuronal processing as mirrored in the P1 and N1 components). The latter might be expected because previous ERPs studies of DP symptoms (disembodiment and emotional numbing) observed effects at earlier rather than later processing stages (Quaedflieg, Giesbrecht, Meijer, Merckelbach, de Jong, Thorsteinsson et al., 2013; Adler, Schabinger, Michal, Beutel, & Gillmeister, 2016). For early, sensory ERPs, previous studies have also shown that attentional costs are reflected over P1, while attentional benefits are reflected over N1 (e.g., Hillyard & Anllo-Vento, 1998; Luck & Hillyard, 1995; Rüsseler & Münte, 2005). We therefore expected to see reduced attentional suppression over P1 in DP compared to control patients.

2. Materials and methods

2.1. Participants

The total sample consisted of 28 psychosomatic patients, recruited from the Department of Psychosomatic Medicine and Psychotherapy of the University Medical Center Mainz. Psychosomatic patients presented with a variety of psychological conditions (e.g., depression, anxiety, somatoform disorders). All participants completed the German versions of the Cambridge Depersonalization Scale (CDS; Sierra & Berrios, 2000; German version CDS-d: Michal et al., 2004), the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996; German version: Hautzinger, Keller, & Kühner, 2006) and the State and Trait Anxiety Inventory (STAI; Laux, Glanzmann, Schaffner, & Spielberger, 1981). Excluded from this study were patients with an emotionally unstable personality disorder, a lifetime history of any psychotic disorder, current substance abuse or neurological disease. With regard to the individual extent of DP symptoms as measured by the CDS-d, the participants were assigned to one of two groups. One group (N = 14) encompassed patients with a CDS-d score ≥ 65, i.e. with clinically relevant DP symptoms (Michal et al., 2004). On average, the reported age of onset of DP was 17.21 ± 4.58 years (range: 12–25 years); these participants constituted the DP patient group. The second group (N = 14) did not have clinically relevant DP symptoms (CDS-d score < 65); these patients constituted the Control patient group. Both groups were balanced for symptoms of depression and anxiety (see Table 1).

Table 1
Sample characteristics with results of *t*-tests for continuous variables, chi-square tests for categorical variables and Mann-Whitney-U test for ordinal variables.

	DP patients (n = 14) Mean (SE)	Control patients (n = 14) Mean (SE)	Statistical comparison
Gender (male)	10 (71.4%)	10 (71.4%)	
Age (years)	26.07 (1.62)	26.93 (1.28)	p = .681
Level of education	2.29 (0.19)	2.79 (0.11)	p = .085
DP score (CDS-d)	162.07 (12.84)	13.00 (2.18)	p < .001
Depression score (BDI-II)	22.36 (2.03)	21.64 (2.62)	p = .831
Anxiety score (STAI-Trait)	53.50 (2.18)	58.21 (1.75)	p = .103

Notes: Level of education = mean highest level achieved, where 1 = lower secondary education (Hauptschule), 2 = intermediate secondary education (Realschule), and 3 = higher secondary education (Abitur); CDS-d = Cambridge Depersonalisation Scale, BDI-II = Beck Depression Inventory-II, STAI-Trait = State-Trait-Anxiety-Inventory (Trait).

In addition, all patients were receiving psychotherapeutic treatment at the time of participation in this study. Seven DP patients were additionally being treated with antidepressants (in one case supplemented by an anticonvulsive drug). Within the Control patients group, six patients were being treated with antidepressants (in one case supplemented by an anticonvulsive drug).

All patients had normal or corrected-to-normal vision. The study was approved by the ethics committee of the Statutory Medical Board of the State of Rhineland-Palatinate (Germany) and was conducted in accordance with the Declaration of Helsinki. Each participant gave written informed consent prior to the study and received a honorarium of 45 € for their participation.

2.2. Stimuli and materials

For stimulation we used Presentation (Neurobehavioral Systems, Berkeley, USA). The experiment was presented visually on a computer screen (EIZO ColorEdge CG223W, display size 22") with a visual angle of α = 33.07° (viewing distance: 80 cm). All stimuli were presented in white colour on a black background. Both the fixation cross and the spatial cue were depicted centrally, and were both less than 1° of horizontal and vertical visual angle. Cues were defined as arrows, which pointed to the left (<), to the right (>) or in both directions (< >). Event stimuli emerged 6.44° left or right of the fixation cross (measured from the fixation cross to the centre of the event stimulus).Targets were white ellipses (1.4° horizontal x 1° vertical visual angle) while non-