Multisensory Integration, Dissociation and Self-Concept Clarity

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Thesis declaration form

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Overview

Conditions marked with high levels of dissociation continue to be very difficult to treat effectively. As with other mental health difficulties, the field of interoception offers new lines of inquiry to better understand mechanisms underlying dissociative symptoms. This thesis explores the relationship between multisensory integration, dissociative symptoms and self-concept.

Part 1 is a critical narrative review informed by a systematic search for intervention studies investigating effects on dissociation. A range of clinical, interoception and neurobiological literature is synthesized to offer a novel perspective on therapeutic mechanisms of change. Findings build on the fundamental role interoception plays in emotional regulation. Bodily self-awareness and sensory processing are both linked to change processes in trauma-focused, cognitive-behavioural, mindfulness-based and psychodynamically informed therapies.

Part 2 investigates the relationship between embodied integration and self-concept integration. A novel virtual-reality experiment manipulating multisensory integration shows how sensitivity to sensory delay and susceptibility to dissociative symptoms relates to self-concept clarity. Findings from a control group are compared to two clinical groups: individuals meeting clinical threshold for depersonalisation derealisation disorder and those presenting with difficulties in line with borderline personality disorder. Potential implications related to how the minimal self may be related to the narrative self are also considered.

Part 3 is a critical reflection on the motivations to research this area, and a selection of interesting issues related to conducting the study. Topics include the integration of mental health and physical health and involving service-users in mental health science research seeking to innovate. Wider implications for future research and clinical practice are also discussed.

Impact Statement

Dissociation is transdiagnostic and related to increased risk and chronicity of mental illness. Acute levels of dissociative symptoms are present in the most intractable of difficulties. It is a symptom that is currently largely overlooked and its significance in condition maintenance is not being addressed in treatment with as much rigour as it could be. Together with the parent study, the project supports the scientific endeavour to link interoception and sensory processing to dissociation and mental health more broadly. Specifically, the empirical findings elucidate the significant relationship between disrupted body-based regulation and higher-order metacognitive beliefs. This is a particular area that is less developed in the interoception literature. Clinically, it invites practitioners to consider the role of body-based techniques in addressing self-concept disruption.

The empirical paper looks directly at the relationship between minimal self and narrative self, and signposts to a self-organising motivational drive for coherence. This is a concept that is only very lightly touched on in the literature to date. It builds a case for future studies to marry experimental methods from both social cognition and interoception. The translational research trajectory benefits greatly from including clinical groups in the early stages of innovation, and the project demonstrates different types of partnerships that offer an effective approach to recruiting those with clinical symptoms, or on treatment pathways.

The literature review consolidates a broad plethora of clinical and neuroscience insights to provide a unique understanding of therapeutic change. The findings highlight many possible future research questions regarding the treatment of dissociation. By threading interoception through multiple modalities, the review demonstrates that the domain of interoceptive self-regulation is potentially a common active ingredient that demands more attention from researchers and practitioners. By presenting the emerging role of interoception across many mechanisms of change, including higher-order cognition and intersubjectivity, the review suggests that by raising the importance of both dissociation and interoception, wider treatment outcomes could be enhanced.

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Part 1: Literature Review

Interoceptive Pathways to Integration: A Narrative Review Comparing Treatments for Dissociation

Abstract

Dissociation is potentially more pervasive than current research or clinical practice acknowledges. Relatedly, there is scant research homing in on the precise mechanisms of improving dissociation. Dissociation increases clinical severity and risk so the gap in knowledge and treatment provision requires innovation. Ever expanding evidence continues to show that interoception is fundamental to emotions and chronic dissociation is commonly implicated in emotional dysregulation. The aim of this review is to elucidate unexplored mechanisms of change through the lens of interoception, in the hope that this will deepen our understanding of treating dissociation, and encourage novel paths of treatment development. A brief review of dissociation, interoception and their overlap is provided. This is followed by an evaluation of the possible mechanisms of therapeutic change through the lens of interoception. Primarily, the literature highlights the potential importance of improving multisensory integration in the treatment of dissociation, and provides possible mechanisms underpinning the conventional strategies including “grounding” skills. More specifically, the function of increasing present moment awareness (both internally and externally) may be a key change process. Directly, this may enhance attentional control and fear habituation. Indirectly, this may support cognitive reappraisal, memory reconsolidation, self-referential awareness and intersubjectivity. The true significance of basic coping strategies and their full potential may not be fully realised, and there could be widespread benefits to elevating the importance of embodiment and mindfulness-based coping strategies. This review also warrants further testing and developing of interoception-based interventions for dissociation.

Background

1.1 Dissociative Symptoms and Disorders

Dissociation refers to a breakdown of psychological and perceptual processes and the term has been used to describe a varied but interrelated list of both pathological and normal symptoms (Brown, 2006). This disconnection effects embodiment, sensory experience, perception of the immediate environment, self-processing, memory, and identity (Dell, 2006; Sierra et al., 2005). Two categories of dissociation have been proposed: detachment (where experiences have a *sense of separation* rather than being immersive) and compartmentalisation (where there is a *clear separation* between sensory-motor experience and perception) (Holmes et al., 2005).

Dissociative disorders include depersonalisation derealisation disorder (DDD), dissociative amnesia, dissociative identity disorder (DID) and dissociative subtype of post-traumatic disorder (PTSD+DS). Reflecting "compartmentalisation" type of dissociation, functional neurological disorders are categorised as dissociative disorders in the ICD-11 (World Health Organisation, 2019). Beyond defined dissociative disorders, dissociation may in fact be ubiquitous to psychopathology (Lyssenko et al., 2018), with particularly high rates in post-traumatic stress disorder (PTSD), borderline personality disorder (BPD), and eating disorders. Not only is dissociation a hallmark of particularly acute and difficult treatment conditions such as DID, it is relevant to managing clinical risk, as dissociation has a highly significant relationship with suicide attempts and self-injury (Calati et al., 2017; Gonzalez Vazquez et al., 2020; Kolek et al., 2019).

Despite its clinical importance, there is limited consensus on dissociation's aetiology (e.g. Bailey & Brand, 2017; Loewenstein, 2018; Lynn et al., 2019) and no dominant model for intervention. In terms of therapeutic change, there is a longstanding debate as to whether dissociation is a contraindication for treatment or not (e.g. Bae et al., 2016; Kleindienst et al., 2016; Murray et al., 2022). There are surprisingly few studies where dissociation is an outcome variable, and even less where it as a primary outcome of interest. One review of randomised-control trials (Aujoulat et al.,

2024) and a review taking a more inclusive approach (Burback, Forner, et al., 2024) indicate reduction in dissociation is possible. Both reviews found a highly heterogenous range of treatment modalities, and effect sizes ranged from small to large.

To develop more precise and consistently effective treatments, back-translation of interventions can provide new insights on therapeutic change. The exploration of common processes in psychotherapy is highly complex (Cuijpers et al., 2019) and not yet attempted for dissociation specifically. The overall aim for this review is to apply contemporary affective neuroscience, namely interoception, to elucidate unexplored mechanisms of change, encourage new paths of treatment development and develop testable hypotheses. Firstly, a brief overview of the alignment between dissociation and interoceptive integration are given including theoretical, neurobiological and empirical connections. Treatment studies are then evaluated through this lens, providing mechanistic links between therapeutic processes and interoception in the reduction of dissociation.

1.2 Interoception and Mental Health

Interoception describes the multi-faceted process by which the nervous system senses, monitors and integrates internal signals, in order to regulate the body and maintain homeostasis (Khalsa et al., 2018). Physiological feedback maps the state of the body, and these neural representations provide the basis of subjective feelings, including emotions (Craig, 2008). There is now strong evidence to support the intrinsic link between interoception and emotion (Critchley & Garfinkel, 2017), thus interoception is beginning to be recognised as a crucial dimension of mental health (Paulus & Stein, 2010; Quadt et al., 2018). Interoception could provide a pathway to understanding biomarkers of psychopathologies (Khalsa & Lapidus, 2016), expanding how we conceptualise and treat mental illness.

To extrapolate how interoception may contribute to the development, maintenance, and recovery from mental health problems, it is necessary to delineate the different dimensions in interoception, from the raw sensation through to beliefs about one's body connection. A multidimensional framework of interoception outlines eight levels of processing (Nord & Garfinkel,

2022; Suksasilp & Garfinkel, 2022). Each domain may have varying significance across mental health difficulties, including dissociation and dissociative disorders (see Table 1 for examples of associations between interoception and psychological measures in mental health).

Table 1

Dimensions of Interoception, Clinical Relevance, and Association with Dissociation

Interoceptive Dimension	Clinical Relevance	Dissociation Association
Interoception neural processing	Melancholic depression, corresponds with a disconnection between interoceptive networks and attentional network (Hyett et al., 2015)	Dorsal anterior cingulate cortex activity is the most reliable neurobiological signature of dissociative symptoms (Cavicchioli et al., 2023) and plays primary role in determining salience of interoceptive signals (Medford & Critchley, 2010).
Nature of afferent signals	Dysregulated afferent thermosensory signals are associated with affective disorders included depression (Raison et al., 2015).	A bias towards attenuating interoceptive signals may contribute to depersonalisation symptoms (Saini et al., 2022).
Preconscious impact of afferent signals	Reduced heart rate recovery following psychological stress is associated with cognitive-affective symptoms of depression (Gordon et al., 2012)	Dissociative experiences are preceded by enhanced activation in amygdala, insula and left thalamus at a pre-conscious level, signifying emotional numbing (Felmingham et al., 2008).
Interoceptive attention	Social anxiety is associated with increased internal sensorimotor attentional bias (Mansell et al., 2003)	DDD is associated with blunted heartbeat-evoked potentials during a heartbeat detection task suggesting potential difficulty in interoceptive attention (Schulz et al., 2015)
Interoception accuracy	Reduced interoceptive accuracy is present in functional neurological disorders (Wolters et al., 2022)	Dissociative disorders are associated with lower interoceptive accuracy (Schäflein et al., 2018).
Interoceptive insight	Secondary care mental health service-users demonstrated a greater discrepancy between interoceptive accuracy and	Interoceptive insight was a stronger predictor of dissociation in patients with functional neurological

	confidence scores (Critchley et al., 2023).	seizures than anxiety and depression (Koreki et al., 2020).
Interoception attribution/appraisal	Catastrophic appraisals of interoceptive signals are central to panic disorder (Clark et al., 1997).	Individuals with DDD make significantly different attributions of physical sensations than healthy controls and those with an anxiety disorder (Hunter et al., 2014).
Interoception self-report and beliefs	Low body-trusting is related to suicidality (Hielscher & Zopf, 2021).	Increased interoceptive awareness is associated with reduced dissociative tendency (D'Antoni et al., 2022).

Altered interoception features in conscious perceptions and cognitions that are central to select mental disorders (e.g. panic disorder). Interoceptive regulation may also underpin mental state in a very broad sense across the entire hierarchy of perception. Pre-conscious impact of afferent signals influences affect, and metacognitive beliefs regarding one's body connectedness are closely associated with emotional regulation capabilities. The variability observed in mental disorders begs the question: what role does interoception have in recovery? Each interoceptive domain may be modifiable (Nord & Garfinkel, 2022) and interoception-based interventions have been found effective in improving symptomology in anxiety, eating disorders, psychosomatic disorders and addiction (Khoury et al., 2018).

No studies have tested specific interoception-based interventions on dissociation; however preliminary studies are connecting alterations in interoceptive domains to different components of dissociation.

1.3 Dissociation and Interoception

1.3.1 Conceptual and Theoretical Overlap

One of the first theories of dissociation posed by Pierre Janet in the early nineteenth century, described an apparent split in consciousness, where emotions, memories, and behaviours appeared dis-integrated (van der Hart & Horst, 1989). Conversely, robust first person selfhood is the result of

preconscious integration of interoceptive and exteroceptive signals (Tsakiris, 2017). Modern neuro-imaging data is starting to show that dissociation is in fact a disorder of integration (Scalabrini et al., 2020). A meta-analysis of fMRI studies on dissociative symptoms found that altered response across the emotional regulatory network (e.g. hippocampus, amygdala and insula) correspond with avoidance and inhibition of affect, as well as disrupted integration of physiological and higher order processing (Cavicchioli et al., 2023).

The threat detection (Mobbs et al., 2009) and defence cascade models (Kozlowska et al. 2015) explain dissociation as an evolutionarily defence response to inescapable threat to avoid overwhelm and further harm. The fronto-limbic inhibitory model of depersonalisation (Sierra & Berrios, 1998) explains how prefrontal cortex inhibits activity in the amygdala (responsible for emotional responses) and the anterior cingulate cortex (ACC, associated with vigilant attention), and anterior insula (hub of multisensory integration), leading to emotional numbing and disconnection from internal and environmental cues. This dominance of the prefrontal cortex may be associated with high rates of rumination and perseverant thinking in depersonalisation disorder (Quigley et al., 2024). Importantly, the ACC and anterior insula both play central roles in interoception (Taylor et al., 2009) and form the salience network, monitoring and responding to incoming signals.

New theories of depersonalisation centre around predictive processing models of interoception. Predictive processing is an influential computational framework for understanding how the brain may perceive information (Clark, 2013). These models state that the agent generates top-down predictions based on existing beliefs (priors); these are met with raw sensations, leading to prediction errors, which go on to update priors. Priors vary in precision (how confident we are in its accuracy), and prediction errors are prescribed precision-weighting (how salient errors are and whether priors update in response to them). The agent is motivated to minimise uncertainty by increasing accuracy of predictions and managing precision-weighting. A predictive processing concept that is particularly relevant to interoception and emotion is active inference (Seth & Friston, 2016). This is a strategy of taking *action* to minimise uncertainty, for example autonomic responses

or cognitive action. It is thought that many mental disorders are indicative of failures in active inference (Paulus et al., 2019). Depersonalisation may be the result of aberrant salience of interoceptive signals, and instead of effective active inference providing an immersive first person perspective, individuals feel decentred from processing (Ciaunica et al., 2022). To enhance predictability, metacognitive beliefs that the self is *not* in control may develop, perpetuating predictions of disconnection. Alternatively, imprecise interoceptive predictions arise from previous intense experiences where threat was felt as inescapable. This leads to prediction errors with low precision-weighting, and therefore downregulated leading to a disembodied state (Saini et al., 2022).

1.3.2 Empirical Evidence Linking Dissociation and Interoception

A recent review mapped different domains of interoception against clusters of dissociative symptoms (Woelk & Garfinkel, 2024). The same grouping of symptoms are used to guide our evaluation. The authors drew on a range of factor analyses (Briere et al., 2005; Dell, 2006; Sierra et al., 2005) as well as the transdiagnostic domain-based framework Research Domain Criteria to outline symptom clusters: 1) reduced self-representation (i.e. depersonalisation), 2) impaired self-other/self-world differentiation (i.e. derealisation), 3) altered emotional experience, and 4) altered subjective recall. There is emerging empirical evidence that interoception and sensory processing may underly each of these four clusters of symptoms.

Interoceptive integration is thought to provide the foundation for moment-to-moment subjectivity, also referred to as “minimal self” (Gallagher, 2000). In dissociation, first-person perspective is disrupted as a result of reduced self-representation. Embodiment, or bodily (self-) consciousness, is the product of multisensory integration of proprioceptive, exteroceptive and interoceptive signals (Blanke, 2012). Recent findings showed that delaying visual cues, so they are misaligned with tactile cues, induces feelings of disembodiment and the effect is enhanced for those with higher rates of trait dissociation (Moffatt et al., 2025). A robust self depends on a robust boundary between ourselves and others and to the world (Simantov et al., 2021). Rudimentary self-other distinction is evident in somatosensory and interoceptive processing of self-touch and other-

touch (Boehme et al., 2019). Low-level self-other processing is disrupted in depersonalisation disorder (Chiu et al., 2016), and this is reflected in anomalous and distressing disconnection with others and the world (Ciaunica et al., 2023).

Emotional overmodulation is thought to characterise dissociative subtype of PTSD (Lanius et al., 2012). A meta-analysis found that dissociation predicted rumination, worry, nonacceptance, avoidance and thought suppression, yet interestingly, it was not related to self-reported emotional suppression (Cavicchioli et al., 2021). A closer look at depersonalisation systems illustrates higher sympathetic arousal, and attenuated autonomic responses to emotional stimuli (Horn et al., 2020). Taken together, depersonalisation may result in altered, as opposed to reduced, emotional experience. Disconnection to the body may underly this dysregulation. Fear and threat processing is influenced by cardiac signals through baroreceptor activation (Critchley & Garfinkel, 2015) and interoceptive accuracy may enable adaptive reappraisal and in turn, the downregulation of affect (Füstös et al., 2013). Signifying the intrinsic relationship between affect and interoception, both monitoring your heartbeat and engaging in emotional experiences activates the anterior insula and ACC (Zaki et al., 2012).

The last cluster of symptoms regards altered memory processing. Dissociation and depersonalisation is associated with worse immediate visual and verbal recall, but not delayed recall, implying deficits are in the early stages of perception (Fani et al., 2019; Guralnik et al., 2007). At the same time, those who dissociate recall sad memories more accurately and vividly than happy ones (Duman & Tekcan, 2022). A recent review concluded that both objective measures (i.e. interoceptive accuracy) and self-reported interoception beliefs are associated with memory and learning, but more research is needed (Werner & Schandry, 2024).

In terms of shared neural correlates, the right anterior insula is reliably associated with interoception and subjective emotional experience (Zaki et al., 2012) and is commonly shown to have reduced activity in dissociative symptoms (Roydeva & Reinders, 2021). Two reviews (Cavicchioli et al., 2023; Roydeva & Reinders, 2021) concluded increased activity in the dorsal ACC is the most

reliable neurobiological signature of dissociative symptoms across multiple disorders. Together with the anterior insula, the ACC detects salience of interoceptive and exteroceptive signals (Medford & Critchley, 2010), and transforms interoceptive signals into subjective emotion and pain (Simmons et al., 2013).

Evidence directly linking clinical dissociation with interoceptive processing is surfacing. Heartbeat-evoked potentials were reduced for those with DDD during a heartbeat detection task compared to controls, indicating reduced cortical representation and a potential difficulty In attending to interoceptive signals (Schulz et al., 2015). Research looking at objective psychophysiological measures (e.g. Heartbeat-evoked potentials, heart-rate variability and cortisol levels) suggest deficits in afferent and efferent signalling in BPD (Back & Bertsch, 2020), and patients with dissociative disorders also show lower interoceptive accuracy (Schäflein et al., 2018). When people with PTSD anticipate a shift in affective stimulus, they show reduced activation in the right anterior insula, indicating impaired interoceptive modulation (Simmons et al., 2009). Finally, the role of dissociation in psychosis is beginning to be acknowledged too (Longden et al., 2020) and initial findings suggest that failures in interoceptive and exteroceptive signals could account for both positive and negative symptoms (Yao & Thakkar, 2022).

Treatment Studies

A number of reviews find treatment effects on dissociation to be positive but underwhelming (Atchley & Bedford, 2021; Bloomfield et al., 2020; Burback, Forner, et al., 2024; Gaskell et al., 2023; Wang et al., 2024). Based on these reviews, we will discuss interventions within the following most researched modalities: trauma-focused therapy; dissociation focused cognitive-behavioural therapy (CBT); mindfulness-based and body-oriented interventions; and psychodynamic and attachment-informed approaches. Table 2 maps potential therapeutic processes of changes across our four clusters of dissociative symptoms.

Table 2

Change Processes, Symptoms Targeted, and Interoception Domain

Change process	Therapy modality	Dissociative symptoms	Interoception domain
Fear habituation and emotional regulation	Trauma-focused Mindfulness Psychodynamic	Altered emotional experience	*Directly:* afferent signal strength; accuracy; neural representation; interoceptive attribution; attention interoceptive insight *Indirectly*: preconscious impact of afferent signals; self-report interoceptive beliefs
Memory reconsolidation	Trauma-focused Psychodynamic	Altered subjective memory recall	*Directly/indirectly:* neural representation; interoceptive attribution; accuracy
Cognitive appraisal	All	Altered emotional experience	*Directly:* interoceptive attribution; neural representations *Indirectly:* preconscious impact of afferent signals; self-report interoceptive beliefs
Attentional control	Mindfulness Trauma-focused CBT for dissociation / DDD	Reduced self-representation; impaired self-other / self-world; differentiation; altered subjective memory recall; altered emotional experience	*Directly:* interoceptive attention; nature of afferent signals *Indirectly:* interoceptive accuracy; neural representation; interoceptive attribution; preconscious impact of afferent signals; interoceptive insight; self-report interoceptive beliefs
Body and present-moment awareness	Mindfulness	reduced self-representation; altered emotional experience	*Directly:* interoceptive attention; afferent signal strength; neural representations; interoceptive insight *Indirectly:* Interoceptive attribution; preconscious impact of afferent signals; self-report interoceptive beliefs
Self-referential awareness	Mindfulness CBT for dissociation / DDD	Reduced self-representation; altered emotional experience; disrupted subjective memory recall	*Indirectly:* interoceptive attribution; preconscious impact of afferent signals; afferent signal strength; self-report interoceptive beliefs; interoceptive insight

Intersubjectivity	Psychodynamic Mindfulness	Reduced self-representation; impaired self-other / self-world differentiation; altered emotional experience	*Directly:* interoceptive attention; Interoceptive attribution; neural representations *Indirectly:* preconscious impact of afferent signals; self-report interoceptive beliefs

2.1 Trauma-Focused Therapy

2.1.1 Review of Treatment Studies

The only place dissociation is mentioned in the National Institute for Health and Care Excellence (2018) guidelines, is in treatment recommendations for PTSD, reflecting the widely accepted association between trauma and dissociation. This emphasis is reflected in the research literature. Some conceptualise PTSD as a dissociative disorder, with or without pathological depersonalisation (Nijenhuis, 2017). Historically, the focus of intervention research has been whether trauma-focused therapy is as effective for people with significant dissociation (e.g. Schiavone et, al., 2018). There is less research on the effectiveness of treatment on dissociation specifically, nonetheless, the evidence so far suggests that trauma therapy has a small-moderate effect (Atchley & Bedford, 2021).

All trauma-focused therapy involves activating trauma memories by bringing them to mind, but different protocols vary in terms of emphasis. Prolonged exposure therapy focusses on imaginal exposure to trauma memories and in-vivo exposure (e.g. avoided places, sounds, smells). A sample of 284 female veterans with PTSD +DS experienced a significant decrease in dissociation following prolonged exposure despite no particular adaptations (Wolf et al., 2016). Narrative exposure therapy prioritises memory exposure and aims to expand on narrative detail. This approach effectively reduced dissociation, amongst those with comorbid PTSD and BPD (Pabst et al., 2014; Steuwe et al., 2016), and those with PTSD alongside a severe mental illness (Mauritz et al., 2020).

Cognitive therapies (e.g. trauma-focused CBT (TF-CBT)) also involves exposure, however in this approach, autobiographical memories are elaborated with context and memory "updates" (i.e. "*what I now know*"). These therapies also seek to reappraise catastrophic interpretations and drop

maladaptive behavioural or cognitive coping strategies (Ehlers & Clark, 2000). TF-CBT and cognitive processing improved dissociation amongst patients with a history of childhood abuse (Chard, 2005a; Cohen et al., 2005), however elsewhere, no changes were observed (McDonagh et al., 2005).

Eye-movement desensitisation reprocessing therapy (EMDR) is another exposure-based intervention that has been shown to be just as effective for PTSD as TF-CBT (Mavranezouli et al., 2020). EMDR involves recalling key qualities of trauma memories, whilst focusing on the therapist's finger moving from left to right, or alternative bilateral stimulation such as tapping the body. EMDR reduces dissociation scores too (Gonzalez-Vazquez et al., 2018; Slotema et al., 2019), and its effects on dissociation are comparable to other CBT based approaches (Boterhoven de Haan et al., 2020; Molero-Zafra et al., 2024; Rothbaum et al., 2005). One study found no effect on dissociation, however the study excluded high dissociation scores (Burback, Yap, et al., 2024).

2.1.1 Stabilisation and Phase-Based Approaches

Several studies test the effectiveness of stabilisation phase prior to trauma-focused intervention. The International Society for the Study of Trauma and Dissociation Guidelines for treating DID recommend a three-phase model (Chu et al., 2011). The principle is also applied to individuals with complex trauma histories (APA, 2024). It is argued that this approach reduces drop-out and prevents the negative effects of dissociation on exposure. Stabilisation aims to establish objective and relational safety, and to build skills that support emotional regulation.

Dissociation and other PTSD symptoms did improve following phased-based methods, according to one randomised-control trial, however, these improvements were not noticeable until after the trauma-focused phase (Wigard et al., 2024). Dissociation was not improved by delivering a structured stabilisation phase prior to Imaging Rescripting (Raabe et al., 2022) or EMDR (Vliet et al., 2024). On the other hand, a 104-person trial established that it depends on the baseline dissociation scores (Cloitre et al., 2012). Whilst stabilisation had no additive effect for those with low dissociation, it did enhance both outcomes for those with high dissociation rates. At the 6-month follow-up, individuals without stabilisation returned to baseline levels, but those who completed both

components, saw sustained decline in dissociation. Dialectical behaviour therapy is a standalone treatment originally developed for BPD and has four skills-based components: mindfulness, emotional regulation, distress tolerance and interpersonal effectiveness. It has been shown that dialectical behavioural therapy with either exposure or cognitive trauma therapy is more effective for decreasing dissociation than either on their own (Bohus et al., 2020; Harned et al., 2014).

2.1.2 Mechanisms of Change

Exposure-focused treatments are rooted in classical conditioning and the emotional processing theory of PTSD (Rauch & Foa, 2006). The core aim is to overcome ongoing sense of threat with fear habituation. It is posited that fear structures link stimulus, response and meaning and over-generalised rigid meanings (e.g. "*I am inherently incapable*" or "*the world is dangerous*") make it hard to update these structures with new or corrective information. Prolonged exposure involves repeatedly recalling the memory at an optimum state of arousal, to allow for these meanings to be updated (Hembree et al., 2003). The cognitive theory of PTSD builds on this concept of over-generalised meanings and elevates the importance of maladaptive appraisal of both the event, and traumatic sequelae (Ehlers & Clark, 2000). This model also assumes that elaborating memory with more context (e.g. time, location, explanatory factors) is required for past experiences to be stored as long-term memories. These cognitive-affective theories also align with the dual-processing model (Brewin et al., 1996) which identifies automatically accessed sensory representation and linguistically accessed contextual representations as unintegrated in PTSD.

For EMDR, bilateral stimulation demands dual attention. Whether exposure is the active mechanism, or bilateral stimulation is additive, remains controversial (Novo Navarro et al., 2018). Nonetheless, additional eye movement is associated with increased effectiveness of exposure therapy, and reduced emotional valence of memories (Lee & Cuijpers, 2013). In line with the dual processing model (Brewin et al., 1996), dual attention increases accessibility of contextual associations. Another theory is the orienting response model which states that eye movements trigger investigatory reflex allowing subsequent relaxation in response to signs of safety (Armstrong

& Vaughan, 1996). De-arousal and the positive valence allows negative memories to be conditioned with benign stimulus and an approach orientation, as opposed to threat stimulus and avoidance responses (MacCulloch & Feldman, 1996). It is notable that there is far less emphasis on repeated "re-living" the event or developing a more detailed narrative and yet it is an effective PTSD treatment. The protocol also involves mindful awareness of trauma-related symptoms (e.g. physiological sensations) and cognitive restructuring (Lee et al., 2006).

In terms of trait dissociation, within the context of PTSD, it is conceptualised as a trauma-response, so the reduction of dissociation is presumed to be a secondary consequence of reduction in PTSD symptoms.

2.1.2.1 Interoception, Exposure and Fear Habituation

Given that trauma therapy is the application of fear habituation (Craske et al., 2014), attending to internal sensations of arousal are actually central to the process. To date, interoception has only been identified as relevant to panic treatment where interoceptive attention is formulated as a key maintenance factor. It has been acknowledged that interoceptive dysregulation could be central to fear learning and fear extinction (Joshi et al., 2023), however there is a gap in research looking at different dimensions of interoception (e.g. accuracy or attention) in fear extinction (Werner & Schandry, 2024).

At the level of afferent signals, traumatic experiences overwhelm somatic sensory processing with acutely salient afferent signals. Post trauma, habitual hyperarousal and hypo-arousal response to sensory signals leads to chronic miscommunication between the mind and body (Kearney & Lanius, 2022). Fear habituation involves the reprocessing of sensory representations so that afferent signals of fear are tolerated and contextualised. When a phobic image is presented at cardiac systole (heart contraction) subjective symptoms reduce more than when the image is presented at diastole (heart relaxation) (Watson et al., 2019) demonstrating that salient physiological sensations mediate fear habituation. Behavioural avoidance also reduced more in the group who saw the image in time with the either systole or diastole compared to those who saw it presented at random timings. This

implies the coupling of self-relevant representations (i.e. one's heartbeat) and the target for habituation has an impact across the hierarchy of agentic action. Both these mechanisms may be disadvantaged by dissociative attenuation of arousal.

Within these frameworks, hypo-arousal seen in peri-traumatic dissociation obstructs encoding preventing the creation of verbally accessible memories (Brewin et al., 1996), and ongoing trait dissociation blocks both fear habituation and memory integration post-trauma. Therefore, the key consideration within CBT is encouraging optimum arousal so that fear desensitisation is possible. Coping strategies, referred to as "grounding", or "reality-focussing", are taught to counteract both acute arousal and dissociative symptoms (Kennedy et al., 2013; Kennerley, 1996). Grounding targets afferent signals (by using touch, pressure, vision etc.). This improves attention, accuracy and attribution of internal and external signals. Grounding also provides exteroceptive sensory feedback which contributes to bodily self-consciousness (Park & Blanke, 2019; Salvato et al., 2020).

At a neural processing level, different insula subregion functional connectivity patterns distinguishes between PTSD and PTSD+DS (Harricharan et al., 2020) but both types exhibit reduced connectivity between the insula and sensorimotor processing areas emphasising the role of disrupted multisensory integration. PTSD+DS also displays reduced connection between anterior insula and primary visual cortex, suggesting that depersonalisation and derealisation moderates the salience of visual cues. We are not aware of studies demonstrating neural correlates of improvements in PTSD+DS however, findings related to PTSD further support the importance of interoception. Successful PTSD treatment (including CBT, EMDR, and mindfulness amongst others), is associated with reduced activity in the amygdala and insula, and increased activity in dorsal ACC and hippocampus (Aupperle et al., 2013; Malejko et al., 2017; Szeszko & Yehuda, 2019) implying a change in the monitoring and responding to internal signals. Following prolonged exposure there were increases in connectivity between the amygdala and insula, between the insula and posterior ventromedial prefrontal cortex, and reduced connectivity to frontoparietal control regions (Fonzo et

al., 2021). These shifts suggest changes in affective processing, emotional regulation and cognitive control may be mediated by activity in the interoceptive hub.

EMDR may also improve body to brain communication by moderating the salience of afferent signals. Researchers analysed brain-heart interplay (BHI) by combining autonomic measure and neural response data. Connectivity from the heart to the brain increased in participants following EMDR (Malandrone et al., 2024). This may be due to increases in parasympathetic vagal tone and decreases in heart rate that follow directly after saccadic eye movements begin (Sack et al., 2008). Bilateral eye movements have also been shown to reduce strength of emotional response, including bodily sensations (Barrowcliff et al., 2004). Eye movement during exposure increased connectivity between right supplementary eye field and both right anterior insula, and dorsal lateral prefrontal cortex for those with PTSD, compared to controls (Harricharan et al., 2019). Trait and state dissociative symptoms reduced this connectivity for those with PTSD+DS indicating that integration between interoception and higher order processing is potentially modulated by a reduction in visual salience and attentional control.

2.1.2.2 Interoception and Memory Reconsolidation

Memory reconsolidation, a presumed change mechanism in TF-CBT, describes the process of retrieving and revising or reprocessing memories, so that they are stored in a more stable form in long-term memory. The influence of emotion on memory is well established, so we can predict that interoception plays a role. Hyperarousal allows sensory input to dominate, and memories cannot be updated. Conversely, downregulated sensory processing as in dissociation, also prevents memory updating (Harricharan et al., 2019). According to the multiple trace theory whenever a memory is recollected it is in a “fragile form”, where adaptive reappraisals and new emotional experiences can be absorbed into the structure (Lane et al., 2015). The crucial role of emotional arousal in therapeutic change set out by Lane and colleagues, can be interpreted as the crucial role of interoception. Whether an original memory can be reconsolidated, or simply new associations are

made, is beyond the scope of this current discussion, however, in either case, new representations of subjective feelings require body-awareness, interoceptive attribution or appraisal.

Emotional arousal (synonymous with afferent salience), versus emotional valence (determined by interoceptive appraisal and attribution) may have dissociable effects on memory. High heart-beat perception has been shown to predict enhanced recall of both positive and negative features of emotive images, but not of neutral features (Pollatos & Schandry, 2008) and heart signals may both influence fear processing and enhance fear memories (Critchley & Garfinkel, 2015). A meta-analysis concluded that high-moderate arousal increases accuracy, at the same time, negative and positive valence actually reduces accuracy, compared to neutral valence (Pereira et al., 2023). Higher subjective arousal has more of an influence on attention towards salient stimuli, than valence (Sutherland & Mather, 2018), suggesting that strength of afferent signals has an effect on memory encoding. Implicit memory may also be affected by afferent signals. Words shown at systole, were less likely to be remembered than those shown at diastole, but people with high interoceptive accuracy demonstrated a smaller difference between the two (Garfinkel et. al., 2013). Therefore, having more precise interoceptive feedback improved memory. Taken together, afferent signals have a preconscious impact on encoding, and interoceptive accuracy (i.e. perception) also improves memory accuracy.

Being excited, scared, relaxed or bored all effect how fast and slow time passes (Wittmann, 2013), and the insula has been identified as locus of time perception (Craig, 2009), suggesting interoception may be central to the passing of time. Very little exists on this topic, however acute depersonalisation has been shown to have a great impact on time perception (Zaytseva et al., 2015) and altered emotional experience is a core feature of depersonalisation. Dissociation causes individuals to lose track of time and severe episodes lead to significant gaps in memory. Out-of-body experiences leads to less detailed autobiographical memory (Bergourignan et al, 2014), indicating that linguistic component of memory depends upon embodiment. This aligns with associations between peri-traumatic dissociation and memory fragmentation (Huntjens et al., 2013). The

interplay between interoception, affect, time perception and memory is unexplored in the literature, however it does echo the clinical evidence that moderate arousal levels support the linguistic processing that enables memories to be perceived as in the past.

Interoception may have an interesting role in intrusive memories present in PTSD. The default mode network (DMN) is active in self-referential thinking, the central executive control network (CEN) is associated with task-focussed attention, and the salience network (SN) monitors for relevant signals and enables the switch between networks. The anterior insula detects salient signals and facilitates this switch, thus it is critical to attentional control (Sridharan et al., 2008). The nature of trauma "memories", where sensory details are dissociated from the past and are experienced in the present moment, may be the result of hyperconnectivity between the SN and DMN (Kearney & Lanius, 2024). When memory is consolidated, the authors observe that it is possible to recall a memory, whilst present body awareness distinguishes between past and present. The altered functional connectivity of the insula and wider SN including the amygdala is associated with reexperiencing (Mickleborough et al., 2011), indicating the potential role of the insula in both intrusive trauma memories and episodic memories (Kearney & Lanius, 2024). Indeed, increased anterior insula signalling to the DMN and CEN after trauma treatment correlates with reduction in reexperiencing following memory exposure (Leroy et al., 2022).

Finally, a dominant assumption is that narrative detail and coherence integrates intrusive trauma memory and this in turn leads to reduction in symptomology, including dissociation. One paper has shown that degree of fragmentation in the narrative after prolonged exposure, did not predict therapy outcome (Bedard-Gilligan et al., 2017). The authors propose that making sense of experiences is more important than narrative detail. This might explain why EMDR (and other modalities) are effective, where the narrative fragmentation is not especially targeted. High interoceptive awareness predicts positive autobiographical memories, not specificity or vividness (Messina et al., 2022). This speaks to the adaptive bias towards positive memories and recalling events in a positive light (Conway & Pleydell-Pearce, 2000). The association between interoception

and memory may therefore also be a broader correlation under the umbrella of adaptive emotional regulation.

2.1.3 Summary of trauma-focused therapy

PTSD and its dissociative subtype are defined by sensory dysregulation. Effective treatment could be supporting the integration of multisensory signals, through fear habituation and regulation of the autonomic nervous system. Dissociation impedes memory consolidation, and conversely, body connectedness could aid the laying down of integrated long-term memories. A handful of studies have demonstrated that interoception and dissociation improve concurrently, however no studies have investigated interoceptive awareness as a mediator (Leech et al., 2024). Overall, we may hypothesise that improving interoception and multisensory integration is an important therapeutic mediator in effective trauma treatment, particularly for those who have high dissociative symptoms. This could be tested by using interoception measures in clinical trials and testing the effects of including comprehensive interoception-based intervention that go beyond introductory grounding skills.

2.2 Dissociation-Focused Cognitive Behavioural Therapy

2.2.1 Review of Treatment Studies

In contrast to CBT for PTSD, where the primary target is cognitive memory, and dissociative symptoms are believed to reduce once the memory is rescripted, there are a small selection of studies applying a CBT model of DDD and dissociative symptoms. The protocol focusses on targeting catastrophic beliefs about dissociative symptoms, attentional biases, rumination, behavioural coping strategies and anxiety management (Hunter et al., 2003). In a pilot sample, 66% no longer met the DDD clinical threshold by the end of treatment (Hunter et al., 2003). Compared to waitlist control, the intervention resulted in a medium effect on DDD symptoms (Hunter et al., 2023). The same protocol has been found effective in three other studies (Farrelly et al., 2016; Flückiger et al., 2021; Mohajerin et al., 2020).

Dissociation-focused CBT reduced symptoms in a group of people with PTSD+DS, and this change was associated with reduced PTSD symptoms, reduced negative beliefs about dissociation (Vancappel, Chavigny, et al., 2024). The authors note that, given PTSD symptoms also reduced, this suggests that building emotional regulation skills (including dissociative responses) may support trauma reprocessing without the need for exposure. The protocol largely focusses on improving self-regulation through emotional awareness and cognitive reappraisal.

A recent review concluded that not only is there a robust relationship between dissociation and positive symptoms in psychosis, that it may be most helpful to design interventions that target dissociation when treating patients with psychosis (Longden et al., 2020). A case series of 16 individuals with auditory hallucinations, high rates of dissociation, as well as PTSD symptoms completed 24 sessions of CBT, where sessions 5-14 were dedicated to coping with dissociation (e.g. grounding, distress tolerance and perceived controllability) (Varese et al., 2021). Both dissociation and psychosis symptoms reduced by end of treatment with large effects, and improvement was maintained at 6 month follow up.

2.2.2 Mechanisms of change

The cognitive conceptualisation of panic disorder has informed the recently developed CBT model of DDD. Within this framework dissociative experiences are normal transient responses that some people are more vulnerable to, and it is the catastrophic cognitive appraisal and subsequent coping strategies that contribute to chronic symptoms (Hunter et al., 2003). Reducing attention towards symptoms, cognitive reappraisal, and other positive emotional coping strategies are thought to break maintenance cycles. Studies testing CBT for dissociation more broadly describe similar techniques with a focus on emotional regulation. There is no module of interoceptive exposure in this protocol, as in the protocol for panic disorder, although there is a module on “reality focussing” (Kennerley, 1996) and attention training which includes “internal attention”. This highlights a critical opportunity to explore the role of interoceptive and exteroceptive integration in this intervention more precisely.

2.2.2.1 Interoception and Symptom Monitoring

As in CBT for panic, there is an assumption that interoceptive attention, or monitoring for the feared symptoms, leads to a heightened awareness of these aversive symptoms, and perpetuates them. Symptom-focussed attention led to increased DDD symptoms in DDD group (in Paired Associate Task but not the Dot Probe Task) (Hunter et al., 2014). Internal (mental arithmetic) and external (listening) focus tasks designed to be cognitively demanding and potentially stressful, led to a decrease in DDD symptoms in the DDD group, conversely, these tasks increased DDD symptoms in anxiety group and control group. This can be interpreted as evidence that symptom monitoring prevention (i.e. moving attention away from interoceptive signals) decreases symptoms. Additionally, it may be demonstrating the therapeutic benefit of concentrated goal-directed attention and exteroceptive processing on DDD.

Interoceptive exposure is not a formal module, although methods to trigger depersonalisation have been shown to be successful in habituation and reduction of symptoms (Dockery, 2015). The role of afferent signals and neural interoceptive processing in fear habituation apply here too although the neural correlates of CBT for dissociation or DDD are not known. Nonetheless, increased connectivity between the amygdala and interoceptive hub has been reliably indicated following the comparable CBT for panic protocol (Kircher et al., 2013).

2.2.2.2 Interoception and Cognitive Appraisal

Cognitive appraisal has since been shown to be the most influential psychological factors in dissociative experiences (Černis et al., 2022). Qualitative exploration of naturalistic coping strategies led to the conclusion that cognitive appraisals play a key role for patients (Vancappel et al., 2022; Vancappel & El-Hage, 2023). Comparing DDD to anxiety and healthy groups, DDD group more often attributed a range of symptoms to brain dysfunction, compared to those with anxiety. On the other hand, those in the anxiety group attributed symptoms to physical illness more (Hunter et al., 2014). Interestingly, this suggests higher order beliefs which mirror the neurobiological models where

anxiety is marked with stronger and noisier signals from the body, versus DDD being associated with a downregulation of bodily signals.

In CBT for DDD, interoceptive attribution may be invariably targeted through the explicit cognitive appraisal of disembodiment (e.g. "*this is transitory*"). Similarly, interoceptive appraisal or attribution may update whether they are targeted directly or not. In panic treatment, cognitive reappraisal of internal signals and interoceptive exposure were found comparably effective for panic disorder, and both interventions led to reduction in catastrophic beliefs (Arntz, 2002). Improving interoceptive regulation may therefore affect higher order beliefs with or without conscious cognitive effort.

Accurate heart beat detection is associated with an implicit measure of sense of agency (Koreki et al., 2022). Clinically, interoceptive accuracy is reduced in schizophrenia, however the more accurate this group is, the more likely they are to experience delusions of grandiosity (Ardizzi et al., 2016). This shows how the embodied processes that create sense of control can inform self-compensatory cognitions in those who are vulnerable to delusions. An important aspect of the active inference account of depersonalisation, is the impact of aberrant precision control on metacognitive feelings (e.g. lack of agency) (Ciaunica et al., 2022). The theory sits in parallel with the notion that the valence of metacognitive feelings (e.g. feeling of agency, feeling of coherence, disorientation) are the result of interoceptive inference (for a discussion see Fernández Velasco & Loev, 2025). These affective states may generate priors (e.g. "*I'm not in control*") which direct cognitions and behaviours that align in order to minimise uncertainty. This raises novel hypotheses about the role of interoceptive inference in the outcomes of CBT more broadly.

2.2.3 Summary of dissociation focused CBT

Learning to shift attention as opposed to monitoring for anomalous perception, or attending to rumination, may indirectly improve interoception. Habituating to the triggers of depersonalisation and the symptoms themselves may feasibly adjust interoceptive processing. The reattribution of bodily disconnection may be included in treatment, and overtime this may imbue metacognitive

feelings of agency and control. Whether cognitive behavioural approaches lead to neurobiological changes would require fMRI and psychophysiological methods.

2.3 Mindfulness-Based and Body-Oriented Interventions

2.3.1 Review of Treatment Studies

Mindfulness describes an innate capacity to notice "what is" without interpretation or interference. Mindfulness-based approaches are Western secular translations of a collection of ancient Eastern meditative practices which in their simplest forms, target attention (Williams & Kabat-Zinn, 2013). Various exercises aim to increase present moment awareness and develop a nonjudgmental attitude to any phenomena that emerges in consciousness, including physiological sensations, external sensory inputs, thoughts and emotions. Multiple psychotherapeutic models now incorporate mindfulness and are most consistently associated with positive effects on depression, pain and addictions (Goldberg et al., 2018). A number of papers have started to draw the links between dissociation and mindfulness (Forner B.A., 2019; Zerubavel & Messman-Moore, 2015).

A recent systematic review found that mindfulness-based therapies (MBT) had a generally positive effect on dissociation, although there were some mixed results (Burback, Forner, et al., 2024). MBT in a small sample led to decreases in frequency and severity of seizures for those with functional seizure disorder (Baslet et al., 2020), although dissociation changes were not significant. Interventions with a more explicit body-oriented approach, used focused attention on the body and often incorporate touch or movement with the qualities of mindfulness. Whilst there are no systematic reviews of body and movement based interventions for dissociation, it is notable that they are moderately effective (g = 56) at reducing trauma symptomology in PTSD (van de Kamp et al., 2019). Yoga (a practice that combines physical postures, breath-focus and mindfulness, and a component of standardised MBT) reduces dissociation in chronic PTSD (Price et al., 2017) and body dissociation in women with history of substance misuse (Willy-Gravley et al., 2021). Eighteen months after an RCT comparing yoga with more conventional PTSD treatment, regularity of yoga practice

predicted both PTSD and dissociation scores (Rhodes et al., 2016). Dance and body awareness exercises also reduce DDD symptoms (Millman et al., 2023).

Practicing with sensory feedback could be effective for treating dissociation. For those with PTSD and significant trauma histories, vibrations and sound neurofeedback during breath-focused mindfulness, led to greater and more significant reductions in dissociation compared to without feedback (Fani et al., 2023). Mindful-awareness in body orienting therapy is a treatment that involves psychoeducation, body-focused mindfulness combined with massage. The treatment has been found effective in decreasing both dissociation and substance use compared to treatment as usual (Price et al., 2012).

2.3.2 Mechanisms of Change

Buddhist texts are at the roots of mindfulness, and these set out awareness practices, aimed at three realisations. 1) experience is impermanent, 2) habitual reactions lead to suffering and 3) the self is not a separate entity (Grabovac et al., 2011). Whilst these practices were not developed for treating pathologies, there are two broad assumed therapeutic mechanisms: attentional and attitudinal change (increasing acceptance and compassion) (Grabovac et al., 2011). Dissociation and mindfulness contrast on some shared dimensions, including presence versus detachment and connectedness versus fragmentation (Zerubavel & Messman-Moore, 2015). MBT is thought to improve self-regulation, through increased body awareness, attention regulation, emotional regulation and changes in self-perception (Hölzel et al., 2011). These factors provide compelling theoretical justification for mindfulness as a treatment for dissociation (Zerubavel & Messman-Moore, 2015). In support of this, a cross-sectional study of 90 patients with PTSD established an indirect negative relationship between trait mindfulness and dissociation via attentional difficulties and non-acceptance (Vancappel, Hingray, et al., 2024).

Interoception has been proposed as a fundamental process to the core changes seen in mindfulness (Gibson, 2019) and MBT is in fact one of the most common approaches used to target interoceptive measures (Heim et al., 2023).

2.3.2.1 Interoception and Attentional Control

Focused attention and open monitoring involved in MBT programmes have distinct phenomenological qualities and engage different attentional processes (Lutz et al., 2015). The ability to orientate and shift attention towards positive or neutral objects is vital to emotional regulation (Wadlinger & Isaacowitz, 2011). In order to maintain homeostasis, salient or aversive internal sensations demand attention, therefore monitoring prediction errors and updating internal models is predicated on attentional control (Seth, 2013). The salience network orchestrates our attention, and this includes our interoception hub, the insula and ACC, as well as the amygdala. The anterior insula acts as an internal sensor, communicating with the posterior insula to inform autonomic regulation, and the ACC to trigger a behavioural response (Menon & Uddin, 2010). Attention towards depersonalisation symptoms as discussed above may be predicated on attentional control. PTSD+DS has increased SN connectivity with regions of the brain responsible for episodic memory, and decreased communication between the SN and primary visual cortex (Nicholson et al., 2020). This suggests salience detection and attentional control is a key factor for chronic dissociation.

In terms of focused attention practices, breath-focused meditation modulates interoceptive processing via neuromodulation of the vagus nerve, regulation of the sympathetic nervous system and improved attentional control (Weng et al., 2021). Body-focused mindfulness also activates attentional neural networks in the parietal and prefrontal structures (Dickenson et al., 2013). Repeated redirection of attention may drive changes but improved body awareness may support more accurate somatosensory salience detection, and thus attentional control (Kerr et al., 2013). Unreliable internal signals, are thought to lead to overall downregulation of interoceptive signals (Saini et al., 2022). It logically follows that breath or body-focussed attention may overcome depersonalisation symptoms. Few dismantling studies exist, although mindfulness-based cognitive therapy increased attentional control in participants with BPD and had small improvements in mindfulness and dissociation (Sachse et al., 2011).

Open monitoring (or “choiceless awareness”) describes observing objects as they arise into awareness without attending to them. This may improve meta-awareness of mind-wandering (Ruimi et al., 2023) and this being aware of distraction may also correlate with activity in the salience network (Lutz et al., 2015). During divided attention tasks, DDD has an implicit preference for sensory (i.e. colour) over verbal information which presents as distractibility and emotionally avoidant information processing (Simeon et al., 2023). At the same time, highly dissociative individuals showed reduced connectivity between the insula and amygdala during trauma-associated stimuli, and reduced performance in immediate visual memory possibly influenced by lower attention (Fani et al., 2019). Becoming consciously aware of distractions and controlling attention towards the present moment could be therapeutic, however there are cautionary notes which are discussed below.

2.3.2.2 Interoception, Body and Present-Moment Awareness

Increased activity in the interoceptive network is one of the most robust observations following MBT (Young et al., 2018), and it is evident that body awareness and conscious presence emerges from activity in the insula and ACC (Seth et al., 2012). If mindfulness increases interoceptive weighting and minimises interoceptive prediction errors, this may increase sense of presence and agency (N. Farb et al., 2015). The stability of selfhood depends upon adaptive predictive processing of interoception, proprioception and exteroceptive information (Seth & Friston, 2016), and each channel may need some careful attention in the treatment of dissociation.

Body-oriented interventions highlight the importance of multisensory integration and the role of exteroceptive feedback. An intervention which involved mindful awareness during touch reduced dissociation (C. J. Price et al., 2012). This approach also increased insula–prefrontal connectivity, which correlated with increased self-report interoceptive awareness (Price et al., 2023). Common grounding exercises involve attending to your five senses, and those with acute dissociation require more intense sensory feedback (e.g. cold water, stamping feet, loud music, strong smells). A meta review of fMRI studies concluded that mindfulness, touch and interoception share functional

convergence as all three had neural correlates in the insula cortex (Casals-Gutiérrez & Abbey, 2020). Collectively, these findings speak to the effectiveness of targeting both bottom-up afferent signals (i.e. through touch) and top-down processing (i.e. through mindfulness).

Interoceptive attention activates different regions of the insula: the dorsal mid-insula related to somatosensory system, and the ventral mid-insula which is coupled with regions of the brain associated with self-regulation of autonomic responses and body-representations (Simmons et al., 2013). Exteroceptive attention activates the right dorsal anterior insula which is coupled with region of the right anterior prefrontal cortex associated with attention and cognitive control, and a region that is hyperactive in dissociation (Roydeva & Reinders, 2021). Exteroceptive signals have been shown to trigger multisensory integration in the insula (Koeppel et al., 2020). Indeed, heart-beat detection accuracy was actually highest when participants received exteroceptive feedback (auditory) as opposed to interoceptive (García-Cordero et al., 2017). Subsequently, incorporating multisensory feedback whilst focussing attention on interoception may be particularly significant when treating dissociation, where there is chronic downregulation of interoception and higher distractibility.

Breath-focused mindfulness with vibrational feedback showed higher interoceptive awareness, sustained attention, and amygdala-hippocampus connectivity than tasks without neurofeedback amongst women with a history of trauma (Fani et al., 2023). In the feedback condition, reduced dissociation, and improved autonomic regulation both corresponded with improved interoceptive awareness. Haptic feedback was shown to improve multiple stages of information processing, including sustained attention, perceptual sensitivity as well as decision-making and reaction speed (Zhang et al., 2016). A small study tested the effects of dance exercises and body awareness exercises on DDD (Millman et al., 2023). Both dance and body awareness reduced depersonalisation scores. Dance (but not body awareness) increased mindfulness in the DDD group, and body awareness (but not dance) increased mindfulness in the control group. Dance may be providing both proprioceptive feedback and more salient visceral sensations. So where

healthy controls benefit from attending to internal signals alone, for DDD, interoceptive, exteroceptive and proprioceptive signals, may be optimal.

2.3.2.3 Interoception and Emotional Acceptance

Mindfulness also targets experiential avoidance and negative evaluations by learning to be with what is and accept what arises, rather than attempting to change its contents (Crane, 2017). MBT may target experiential avoidance in dissociative disorders (Baslet et al., 2017) and increasing acceptance of emotional arousal and dissociative symptoms themselves may be a key change process (Zerubavel & Messman-Moore, 2015). Mindfulness teaches individuals to observe negative feelings until they dissipate, and so the neurobiological correlates of fear extinction overlap with those that change following mindfulness (Hölzel et al., 2011). Thus, the role of interoception in fear habituation apply here too.

Attribution and appraisal of interoceptive signals contribute to psychopathologies (N. A. S. Farb & Logie, 2018). Open monitoring reduces connectivity between the insula and the prefrontal cortex (N. A. S. Farb et al., 2007), demonstrating that simply paying attention even without appraisal reduces evaluative thinking (N. A. S. Farb & Logie, 2018). After an MBT course, increases in mindfulness correlated with decreased dissociation (D'Antoni et al., 2022). Mindfulness was also related to less worrying about bodily signals and regulating distress by attending to the body.

2.3.2.4 Interoception and Self-Referential Awareness

A key feature of mindfulness is the experience of de-centring from thoughts, emotions and self-representations observing them as transient mental events. Changes in self-referential processing may be a primary therapeutic benefit, and is associated with altered functioning in the DMN (Boyd et al., 2018; Lin et al., 2018). Aberrant DMN connectivity predicts PTSD+DS (Nicholson et. al., 2020) and hyperactivity in the prefrontal cortex, a region of the DMN, is a consistent biomarker for pathological dissociation (Roydeva & Reinders, 2021). Conversely, both novice and expert meditators demonstrated reduction in medial prefrontal cortex associated with more narrative self-reference and increase in areas of the brain associated with experiential self-reference, including the

insula (Farb et al., 2007). This suggests that with increased body connection, comes reduced self-referential thinking.

The reduction in rumination is likely to benefit those with high rates of dissociation, as it is has a significant association with negative self-referential coping strategies such as rumination (Cavicchioli et al., 2021). However, the subsequent changes in self-perception that can emerge following continued non-attachment practices, may also relax body boundaries and expand field of awareness (Hanley et al., 2020), which could exacerbate the detached decentred self in DDD. Adverse reactions including episodes of depersonalisation are possible (Van Dam et al., 2018) more often after intensive meditation. Not only is harm-reduction paramount, interoception may be important to understanding the mechanisms of such reactions. For example, those who experience dissociation may find both environmental and body-focused mindfulness that restore multisensory integration is a pre-requisite to experience the benefits of de-centring thoughts.

Experience of transcending the sense of self as a fixed object is considered an enlightened experience in meditators, but decentred experience is associated with distress in depersonalisation symptoms (Deane et al., 2020). Deane and colleagues consider this paradox through the lens of predictive processing, proposing that failures in active inference are interpreted as a loss in allostatic control, causing the lack of agency, whereas in meditation, it is experienced as a positive voluntary process. Higher rates of negative thinking and "deconstructive" forms of meditation (e.g. Vipassana which focusses *only* internally) correlates with negative mediative experiences (Schlosser et al., 2019). This highlights the importance of the attitudinal components (acceptance and compassion) in therapeutic interventions. The cognitive components of interoception-based interventions are indeed influential factors in positive mental health outcomes (Heim et al., 2023). Whilst mindfulness may reduce detachment, absorption and compartmentalisation seen in dissociation, this may be incumbent on adaptive metacognitive appraisal (Zerubavel & Messman-Moore, 2015). The metacognitive appraisal of being in control may therefore be protective against adverse responses, and an emphasis on embodiment practices may cultivate such beliefs.

2.3.3 Summary of Mindfulness-Based Interventions

Mindfulness may target multiple dimensions of interoception that cause improvements in dissociative symptoms. Initially enhanced attention, precision, and increased neural representation may increase embodiment. Practicing non-reactivity and non-judgement, could influence preconscious impact of afferent signals (i.e. reduce the aversive and 'alien' nature of signals). Caution is needed when considering mindfulness-based interventions, however as opposed to dissociation being a contraindication, more precise understanding of the different components of mindfulness and how they influence self-processing may highlight possible benefits specific to this group. For example, both noninterference with phenomena and conscious positive appraisals of the self, may be particularly important in enhancing a sense of agency and positive self-beliefs when treating depersonalisation symptoms. In addition, our findings suggest that dismantling studies might find body-focused mindfulness, mindful movement (i.e. proprioception), exteroceptive focus have independent and combined effects on dissociative symptoms.

2.4 Psychodynamic and Attachment-Informed Therapy

2.4.1 Review of Treatment Studies

Psychodynamic therapy is principally concerned with bringing unconscious processes into awareness in a non-directive manner (Lemma, 2015). Early relational experiences, and consequent attachment strategies are thought to establish self-other dynamics, and they emerge in the therapeutic relationship. The therapist achieves therapeutic outcomes by observing how the client responds to them, and how they feel towards the client (transference and countertransference). Affect and narrative are a primary focus. Within this school of thought, dissociation is a self-protective unconscious defence against unintegrated painful experiences or parts of the self that are imbued with unbearable emotions (F. N. Busch et al., 2021).

Psychodynamic therapy reduced dissociative symptoms amongst people with dissociative disorders (Damsa et al., 2014) and six clinical studies on DID treatment also observed positive results (Yeates et al., 2024). Psychodynamically-focused integrative treatment reduced dissociation (Lampe

et al., 2014; Sachsse et al., 2006) however body-oriented techniques and trauma-focused therapy could have been attributed. Treatment for people with BPD diagnoses, had a statistically significant effect on dissociation over 12 months, where treatment as usual did not (Gregory et al., 2008). A review concluded that between 25% and 67% of patients with dissociative functional seizures reported being seizure-free following psychodynamic and psychoanalytical therapy (Lanzillotti et al., 2021). Eighteen people with dissociative seizures experienced reduced symptoms after only three sessions (Malda Castillo et al., 2022).

Mentalising capacity - the ability to psychologically distinguish between thoughts and emotions of self and of others - is determined by early attachment experiences (Fonagy & Target, 1997). Mentalisation-based therapy aims to bolster self-awareness through reflexivity skills and curiosity in internal worlds (Bateman & Fonagy, 2004). A 12-month intervention targeting mentalising did result is some improvements in dissociation amongst those with BPD diagnoses, however levels were still high and results did not significantly differ to dialectical behavioural therapy (Barnicot & Crawford, 2019).

Other relational interventions that have improved dissociation include cognitive analytic therapy, interpersonal therapy, and internal family systems (IFS) (Burback, Forner, et al., 2024). IFS reflects a long-standing psychoanalytic idea of multiplicity of the self, and defences, but is rooted in family systems therapy which emphasises interactions between roles. Internal “parts” (subpersonalities) are invited to engage in new relating dynamics. Ninety percent of a pilot study (17 individuals with PTSD) no longer met the diagnostic criteria, and there were large improvements in dissociation (Hodgdon et al., 2022).

2.4.2 Mechanisms of Change

Earlier psychodynamic theories of depersonalisation state it represents “intrapsychic conflict within the ego” where dissociation is a defence against anxieties caused by self-representations that conflict with the ideal self (Frances, Sacks, and Aronoff, 1977). The intrinsic link between attachment theory and the psychodynamic model (Shaver & Mikulincer, 2005) is pertinent to pathological

dissociation. If the caregiver was unpredictable, or in extreme cases, was a source of danger, normative dissociation becomes a chronic coping strategy in order to keep the caregiver close (to ensure survival) and to numb the painful emotion (Liotti, 2006). Psychodynamic therapy aims to bring unconscious dynamics established in childhood, into awareness, it is then possible to have a reparative self-other experience with the therapist, process unbearable emotions, and build a more coherent adaptive autobiographical narrative (Lemma, 2015).

It is important to mention an influential theory, structural dissociation of personality (Putnam, 1997; Van Der Hart et al., 2004) which assumes that trauma can cause a 'split' in the self. One part continues to operate in the current time and place, and other parts may still be stuck in the time of the trauma. Dissociative symptoms are thought to subside once past emotional experiences are integrated and discrepancies between self and ideal self are resolved. In DID, treatment involves the different parts speaking to one another to integrate, although this is somewhat controversial due to the potential risks of solidifying the identities making them more fixed (Maxwell et al., 2018).

2.4.2.1 Interoception and Affect

Affect, and the schemas of meaning that give way to emotion, are of utmost importance in psychodynamic approaches. As already discussed, there is an increasingly widespread acceptance of the role of interoception processing in both direct experience of affect and conceptual labelling of these experiences (Barrett, 2017; Craig, 2008). The implications discussed regarding other therapy types apply here too. Qualitative feedback following therapy suggested that increased emotional awareness, including antecedents and triggers of functional neurological disorders allowed individuals to manage their emotions and illicit some control over seizures (Malda Castillo et al., 2022). In a meta-analysis of psychotherapy for BPD, intervention had a medium effect on dissociation, and affective instability saw a very large change indicating this as a first order change (Rameckers et al., 2021). This demonstrates the primary mechanistic role of affect regulation in dissociation reduction, and the effectiveness of psychodynamic approaches in achieving this.

There was a small but significant reduction in dissociation reduction following dynamic deconstructive psychotherapy for BPD (Goldman & Gregory, 2010). Developing a narrative for interpersonal events and naming the associated emotions had a stronger correlation with dissociation improvements compared to moderating other-representation and increasing mentalisation flexibility. Although, this was a small sub-group of a larger randomised controlled trial, it describes a parallel to the functional role of meaning and narrative in reducing dissociation in TF-CBT. The valence of a feeling depends on how we make sense of it. Interoception contributes to the arousal and valence of a felt experience, and this may be recruited in the re-telling of stories. Making sense of experience activates different regions of the dorsal medial prefrontal cortex and ACC which coalesce to simultaneously appraise of emotional conflicts and attend to interoceptive signals of arousal (Etkin et al., 2011).

2.4.2.2 Interception and Intersubjectivity

Psychodynamic therapy assumes emotional experience is a function of relational dynamics. Transference and countertransference refer to intersubjectivity observed, experienced, and interpreted by the therapist and are tools to understand the self and other representations. Somatic countertransference refers to instances of a therapist noticing pre-symbolic feelings such as mood shifts, or tiredness, alertness or nauseousness, and it is thought to be more prevalent when patients have difficulty differentiation from the other (Lemma, 2015). Effective psychodynamic therapy may therefore be targeting the body-based self-other differentiation emerges in early infancy (Gallagher & Meltzoff, 1996).

Body connection seems to support adaptive self-other relating. Interoceptive accuracy predicts stability of self-other differentiation, when empathising (Palmer & Tsakiris, 2018). Conversely, stress (a proxy for physiological arousal) leads to increased alignment with other's emotions, in both behavioural and neurobiological measures for individuals with BPD (Luyten et al., 2021). This might be because dissociation erodes self-other distinction (Adler et al., 2016). For example, plasticity of body boundaries in BPD was predicted by dissociative rates (Bekrater-Bodmann

et al., 2016). Studies investigating whether minimal self-other distinction is a mechanism of change are yet to emerge. Interestingly, oxytocin does increase cognitive self-other distinction (Tomova et al., 2019) and it has been hypothesised that oxytocin may be a biomarker of change in psychotherapy (Zilcha-Mano et al., 2020).

Caregivers may mentalise interoception within the child and thus instil the ability to self-regulate (Fotopoulou & Tsakiris, 2017). The authors propose that exteroceptive and proprioceptive signals through connection (e.g. touch, pointing, mirroring expressions) enables an infant's interoception, and then self-other distinction follows. Correspondingly, interoceptive inference may play a key role in the ability to mentalise (Ondobaka et al., 2017). In this way the psychodynamic therapist may be a secure attachment figure through which maladaptive interoceptive inference is corrected (Duquette & Ainley, 2019). Visceral effects of autonomic responses could be echoes of early self-other representations established in infancy. The therapist attunes to these and supports the patient to become conscious of priors and establish greater self-other distinction. Presumably, this would allow for an increase of awareness to the triggers of dissociation, and eventually, this might moderate preconscious appraisal of affective arousal as aversive (Cavicchioli et al., 2023), allowing for prediction errors to be updated. This process would result in reduced dissociative defences.

2.4.3 Summary of Psychodynamic and Attachment-Based Therapy

Psychodynamic-based approaches are focused on felt emotion and self-other relating, as such, interoception attention and attribution may be recruited and moderated indirectly through emotional enquiry. Through a process of making the client aware of both implicit and explicit beliefs they hold about the self and the other, self-other distinction and mentalising are targeted. It has been proposed that interoceptive priors and the preconscious impact of signals could be moderated as result of updated preconscious internal models. This is a complex interplay between physiological and psychological self-processing that is yet to be investigated.

Conclusion

Increasing the focus on dissociative symptoms could enhance treatment for many clinical presentations. As interoception is a complex multidimensional process that integrates across the regulatory systems, it may play a variable role in many of the key change processes in the psychotherapy. This review has illustrated that dissociation may reduce via emotional regulation mechanisms that depend on interoception functions such-as attentional control, body awareness, arousal management, self-other differentiation and metacognitive self-beliefs. Mindfulness-based therapies appear to offer some striking connections with clusters of dissociative symptoms and should be explored further as an adjunct to enrich other therapeutic modalities. Echoing the long history of teaching grounding to cope with dissociation, preliminary findings shine a light on the role of exteroceptive augmentation of mindfulness interventions.

Future research should aim to unearth how multisensory integration contributes to dissociative symptoms, and in turn, how integration processing can be modulated. If the importance of interoception is appreciated, this alone may restructure existing methods. For example, increasing psychoeducation on interoception, and ensuring grounding or mindful breathing skills are regularly practiced throughout treatment. Finally, the findings provide robust rationale for more studies testing the efficacy and acceptability of body-based therapies for dissociation.

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Part 2: Empirical Paper

Integrating the Self: Sensory Processing, Dissociation and Self-Concept Clarity

Abstract

There is scant research investigating the connection between the embodied self and psychological self. Disruption at both levels often co-occur in mental health conditions so it is of clinical interest. This study investigated the relationship between embodied integration, dissociation and self-concept coherence. To explore diagnostic variability, a control group was compared to individuals who met threshold for depersonalisation derealisation disorder (DDD) and those who presented with borderline personality disorder (BPD) symptoms. Surveys provided data on self-concept clarity, trait dissociation, and covariates anxiety and depression. A novel mixed-reality task that induces multisensory (dis)integration effectively stimulates states of depersonalisation and derealisation. Using this experiment, we captured embodied integration, by measuring sensitivity to sensory mismatch, state dissociation, and self-other distinction. Self-concept clarity predicted trait dissociation (N = 152, r =-.61, p <.001), and state dissociation (N = 96, f^2 = 0.27, p <.001). Stability of self also predicted sensitivity to sensory mismatch when touched by others (N = 98, r = -.19, p = .029). DDD and BPD symptoms were associated with decreased sensitivity to sensory delays, and higher susceptibility to state dissociation. Despite predicted differences, the two groups did not statistically differ on either level of self-experience. Finally, in terms of self-other distinction, this was not associated with self-concept clarity. Expected aberrant self-other processing in the DDD and BPD groups was observed, however our study was underpowered for these effects to reach statistical significance. In conclusion, metacognitive beliefs about identity coherence predicted multisensory integration and dissociative phenomenology. Thus, the organising principle of coherence may be a primary process linking the bodily self to the psychological self. Future research might test causal relationships and explore treatment innovations that leverage the connection between dissociation and self-concept difficulties.

Background

A commonality across all forms of mental distress is an undermining or attacking of the sense of self. This can range from mood states that block self-fulfilling behaviour, to unstable or incoherent identity, through to profound breakdown of self-consciousness. Psychological therapies tend to deal with the content of the self-concept. Negative self-schemas that are contradictory or unacceptable are targeted, but the phenomenological felt sense of self is largely neglected (Brewin, 2023). A self-experience that continues to be under-acknowledged is the dissociated self. Dissociation is a transdiagnostic symptom (Černis et al., 2021; Lyssenko et al., 2018) and is a predictor of poorer disorder progression, recurrent hospitalisation, and higher suicidality (Boyer et al., 2022). Understanding how dissociation varies across diagnoses and comorbidities is of key research importance (Sar & Ross, 2022). Identity disturbance also can co-occur with dissociative symptoms. One of the earliest theories explaining the link described a process of (dis)integration (van der Hart & Horst, 1989). The precise relationship between these two levels of self-awareness is rarely investigated experimentally, but unpacking potential mechanisms could provide innovative approaches to understanding and treating self- disturbances.

1.1 The Narrative Self and Self-Concept Clarity

Our 'narrative self' (Gallagher, 2000) is a collection of memories and cognitions that feel continuous over time and aligned in nature. Exactly what we recognise as us adapts over a lifetime following events, transitions and environmental change (Demo, 1992) but we strive for self-continuity (Sedikides et al., 2022). Making sense of these experiences and telling stories restructures this narrative self in the face of conflicting and challenging experiences. Misalignment between actual and ideal self creates discomfort and is associated with common mental health difficulties (Higgins et al., 1985). Self-differentiation, (having contrasting identities across social roles) is also associated with higher rates of emotional difficulties (Bigler et al., 2001; Donahue et al., 1993).

Stability seems to be achieved partly by processing congruent self-related information and resisting incongruent information (Markus, 1977). In the face of socially challenging events, subtle

transitory malleability is observed, indicating how an individual "changes" over time in response to context (Markus & Kunda, 1986). Despite this plasticity, self-concept coherence (high correlation and connection between self-representations) is more important than plurality (Campbell et al., 2003). The subjective metacognitive perception that self-schemas are coherent and part of one whole, can be measured by the Self-concept clarity (SCC) questionnaire (Campbell et al., 1996). SCC predicts psychological adjustment (Bigler et al., 2001), contributes to the quality of relationships (Lewandowski et al., 2010) and increases resilience in the face of contextual uncertainty (Alessandri et al., 2021). SCC also mediates the relationship between adverse childhood experiences and multiple adult mental health measures (Wong et al., 2019).

1.2 The Minimal Self and Multisensory Integration

The narrative self incorporates semantic autobiographical concepts and is distinguishable from the minimal self – our moment-to-moment phenomenology (Gallagher, 2000). Coherence and stability of selfhood depends upon efficient multisensory integration of both interoceptive and exteroceptive signals (Blanke, 2012; Tsakiris, 2017). Multisensory integration is the process of sensory inputs being emphasised, attenuated and bound by the brain and nervous system to maintain a coherent perception of the world (Alais et al., 2010). During intentional action, misaligned signals are overridden, providing the illusion of synchrony across senses - this is called the intentional binding effect and underlies a sense of agency (Moore & Obhi, 2012). Interoception refers to the signalling, processing and representation of internal bodily signals. Attenuation of these self-produced signals supports sense of coherence. Intentional binding effect correlates with interoceptive accuracy indicating that interoception, as well as proprioceptive and exteroceptive signals during movement, contribute to self-agency (Koreki et al., 2022).

The development of a singular self depends on low level embodied self-other distinction and this depends upon constant discrimination between internal and external sensory signals (Simantov et al., 2021). Self-other boundaries and body ownership are thought to be malleable. Illusory supernumerary embodiment tasks manipulate multisensory information to induce the perception

that a rubber hand, a virtual body, or virtual face is incorporated into one's own bodily self. In the classic experimental paradigm, the rubber-hand illusion (RHI) (Botvinick & Cohen, 1998), the individual sees a rubber hand being stroked at the same time as they feel their arm being stroked out of sight. The brain's sensory integration process over-rides conflict with internal working models and adopts the rubber hand. This influences not only subjective embodiment (Longo et al., 2008) but also autonomic responses such as histamine production (Barnsley et al., 2011). Enhancing cardiac feedback during the RHI increases the strength of the illusion, supporting the combined role of interoception and exteroception in body ownership (Suzuki et al., 2013). The experimental effect also demonstrates the function of synchronous and coherent signals in producing body ownership and body agency (Tsakiris, 2017).

As evidence mounts that our phenomenological sense of "being" is embodied, the question remains: is the "I" connected to "me" and if so, how? The process of unity and coherence may provide some answers.

1.3 Clinical Evidence of Co-Occurring Self-Disturbance and Dissociation

The antithesis of a unified and stable self is seen in the phenomenon of dissociation. Dissociation is a multifaceted phenomenon that could include disconnection from thoughts, memories, the environment, and the body (Černis et al., 2018). Dissociation and self-disturbance often co-occur. Disorders characterised by profoundly disturbed identity drew attention in late 19th century research leading to the term dissociation first being used (Dorahy, 2022). Many of these earlier cases would now be diagnosed as dissociative identity disorder (DID), where there are multiple self-states or 'alters'. The co-existence of the two difficulties can also be tracked in the ICD-11 diagnosis of Complex PTSD (Mohammadi et al., 2024) and schizophrenia (Klaunig et al., 2018; Schäfer et al., 2018). Diagnostic criteria for borderline personality disorder (BPD) includes "identity disturbance" indicated by unstable sense of self (American Psychiatric Association [APA], 2022), and rates of dissociation are very high (Dell, 2022). Empirically, BPD has been associated with less self-other differentiation and more complex, less integrated self-descriptions (Beeney et al., 2016). Whilst

pathological issues with identity are not a diagnostic criteria for DDD, depersonalisation symptoms are associated with self-reported lack of identity (L. Quigley et al., 2024).

Building on previous observational evidence (Chiu et al., 2017; Lassri et al., 2023), and clinical evidence of the link between SCC and dissociation, the first aim of this study is to investigate the correlation between the two constructs. We will also look at the variability across two clinical groups that have high rates of dissociation but vary in terms of self-concept disturbances: DDD and BPD and compare these to a control group with low level of dissociative symptoms. Depression and anxiety are reliably correlated with stability of the self (Cicero, 2017; Zheng et al., 2023) and affect regulation is central to cognitive models of dissociation (Vancappel & El-Hage, 2023) therefore the influence of these will be controlled for. The following hypotheses will be tested:

Hypotheses 1: Association Between Self-Concept Clarity on Trait Dissociation

H1a: There will be an inverse relationship between dissociation and SCC.

H1b: When controlling for age, sex, anxiety and depression scores, there will still be a significant relationship between dissociation and SCC.

H1c: SCC will be lowest in BPD, followed by DDD. SCC will be highest amongst those with low trait dissociation.

H1d: When controlling for trait dissociation and anxiety and depression, SCC will vary between BPD and control and between BPD and DDD, but it will not vary between the control group and DDD.

1.4 Integrating the Minimal Self and Narrative Self

Developmental theories attempt to explain how the trajectory of self-other differentiation from birth, may be one bridge between the embodied minimal self and psychological narrative self. A rudimentary self-other distinction - the ability to determine when sensory signals are internal, versus external - is evident in newborns (Gallagher & Meltzoff, 1996). This implicit differentiation may lay

the foundations for pre-reflective self- and other representations informed by parent-child relating (Monti et al., 2022).

From an attachment perspective, affect regulation (intrinsically linked with interoception (Feldman et al., 2024)) is entwined with the development of internal models of the self and others. As the infant's self-regulation is wholly dependent on the parent, they learn self- and other representations that increase their chances of survival. When the caregiver is abusive or traumatised themselves, dissociation is an adaptive response to cope with "disorganised attachment" (Liotti, 2006). Normative dissociative processes may defend self-organisation from contradictory information (e.g. scary caregiver; parental apathy to infant's pain). Studies have shown that parent's affect expression and communication in early childhood accounts for markedly large variability in dissociative symptoms in adolescence (Ogawa et al., 1997) and adulthood (Dutra et al., 2009). Chronic attachment difficulties can lead to a more active pathological dissociation, blocking the development of a coherent self (Carlson, et al., 2008). Drawing these theories together, inadequate affect regulation leads to inaccurate and inconsistent body sensations (poor interoception), making the individual susceptible to fragmented self-awareness; and unpredictable or threatening attachment experiences disrupt adaptive self-other differentiation and prevent distinct self-states from integrating (Schimmenti & Caretti, 2016). The most acute examples of this are seen in severe dissociative disorders.

1.5 Embodied Integration in Dissociative Disorders

Depersonalisation is the aspect of dissociation that refers to the feeling that first-person experiences are not happening to "me". This could be the result of aberrant somatosensory attenuation (Ciaunica et al., 2022). To compensate, an over-active higher-order self-awareness emerges and self-agency fades. Another potential mechanism, linked to the defence cascade theory of dissociation (Kozlowska et al., 2015) proposes that imprecise predictions of internal threat signals, leads to chronic downregulation of interoceptive signals and this causes disembodiment (Saini et al.,

2022). Both outline a critical role for multisensory integration in dissociative self-processing, which have been supported by empirical evidence.

Experiments investigating multisensory integration often involve the manipulation of self and other-related stimuli. Disorders with high rates of dissociation have been shown to alter experimental effects and thus are associated with altered self-other processing. High levels of depersonalisation has been related with diminished mirroring effect during self-related events (Adler et al., 2016) and reduced integration of self-related visuo-tactile stimuli (Farmer et al., 2020). Current BPD diagnosis increased the vividness of the rubber-hand illusion, and dissociation also influenced the degree of plasticity reported (Bekrater-Bodmann et al., 2016). Finally, whereas PTSD reduced the strength of the RHI illusion, PTSD+DS shows highly variable responses (Rabellino et al., 2018).

1.6 Embodied Integration and Self-Concept Integration

Embodiment illusions have enabled empirical evidence for the relationship between minimal (bodily) self and narrative (conceptual) self, although they are rare. Studies in this area have emphasised the idea that manipulated embodiment leads to internalising others' experiences and behaviours. For example, virtual body ownership illusions have increased empathy (Barbot & Kaufman, 2020) and caused adoption of another's attributes (Banakou et al., 2013). Exploring whether stability of self-concept relates to stability of the body has garnered negligible attention.

Two studies have investigated the relationship between self-concept coherence and embodied integration. In a healthy sample, fMRI showed distinction between self-touch and other-touch in somatosensory and socio-cognitive regions of the brain, and this distinction arose at the spinal cord level (Boehme et al., 2019). Higher SCC also correlated with increased self-other differentiation in the left anterior cingulate cortex and left insula (regions of the interoception network (Craig, 2009)). Another study has shown that SCC predicts the plasticity of body ownership (Krol et al., 2020). Researchers showed that those with lower self-coherence were more susceptible to the RHI in the asynchronous condition (when no illusion is expected) and experienced a stronger body-swap illusion. Prior out-of-body experiences also predicted stronger body illusions but only in

the control condition (Braithwaite et al., 2017). Together, these studies suggest that an unstable sense of identity and dissociative experiences at trait level lead to more malleable body boundaries, particularly in the unmanipulated state.

1.7 Manipulating Embodied Integration

Whilst the body illusions explore body ownership, a new mixed-reality method has been developed that manipulates the phenomenology of embodiment by essentially inversing the manipulation (Roel Lesur et al., 2020). The participant sees their arm being stroked through a virtual reality headset linked to a webcam. The visual feedback from the webcam is delayed so that there is a temporal visuo-tactile mismatch for the participant. In this paradigm, delay sensitivity refers to whether an individual detects asynchronous tactile and visual stimuli at shorter or longer delay times. Sensitivity is a proxy measure for temporal binding windows – the window of time different incoming sensory modalities may be combined to be perceived as products of the same event. For example, lower delay sensitivity indicates wider temporal binding windows. This would imply integration of multisensory stimuli is achieved even when there is high temporal incongruence between the different sensory inputs. Those who reported asynchronous sensory input at shorter delays (implying a higher sensitivity to multisensory disruption) were more prone to reporting disembodiment (Roel Lesur et al., 2020).

A subsequent study found that trait dissociation positively predicted the strength of induced disembodiment (Moffat et al., 2025). Participants who reported higher trait dissociation experienced stronger induced disembodiment and were more sensitive to multisensory disruption during self-touch. In addition, higher trait dissociation was associated with less distinct cardiac signature between self and other-touch. Dissociation was therefore associated with less multisensory integration and reduced self-other distinction at level of afferent signals and pre-conscious response.

Building on the findings that SCC influences the RHI (Krol et al., 2020), the second aim for this study is to test whether people who have a less coherent sense of self are more prone to embodied (dis)integration and more susceptible to induced dissociation. This will be indicated by sensitivity to

multisensory disruption and reported state dissociation. Body illusion experiments have demonstrated differing effects in different clinical presentations. By exploring any variability between those self-reporting DDD and individuals who experience symptoms in line with a BPD diagnosis (referred to BPD group henceforth), we hope to understand any differences between how these phenomena operate across diagnoses. The following hypotheses will be tested:

Hypotheses 2: Influence of Self-Concept Clarity on State Dissociation and Delay Sensitivity

H2a: As SCC decreases, feelings of state dissociation during sensory delay will increase.

H2b: Participants with low SCC will be more likely to experience dissociation without sensory delay than people with high SCC.

H2c: When controlling for trait dissociation, SCC will have a nonsignificant effect on state dissociation.

H2d: SCC will vary the association between the groups and state dissociation.

H2e: As SCC decreases, sensitivity to sensory mismatch will increase, demonstrated by shorter temporal binding windows.

H2f: When controlling for trait dissociation, SCC will have a nonsignificant effect on delay sensitivity.

H2g: SCC will vary the association between the groups and delay sensitivity.

A robust and coherent self depends upon self-other distinction. Both high trait dissociation (Moffat et al., 2025) and low SCC (Boehme et al., 2019) have been associated with diminished self-other distinction. Self-disturbance is diagnostically critical to BPD, and it has been associated with reduced psychological self-other distinction (Beeney et al., 2016) and increased bodily self-plasticity (Bekrater-Bodmann et al., 2016). Therefore, the third aim is to investigate the influence of SCC and clinical symptoms on self-other processing.

Hypotheses 3: Influence of Self-Concept Clarity on Self-Other Distinction

H3a: As SCC decreases, the difference between state dissociation during self and other-touch will decrease.

H3b: The difference between state dissociation during self and other-touch following sensory delay will be lowest amongst BPD, followed by DDD and the control group will demonstrate the strongest self-other distinction.

H3c: Participants with low SCC will be more sensitive to sensory delay during self-touch.

H3d: As SCC decreases, the difference between delay sensitivity during self and other-touch will decrease.

H3e: The difference between delay sensitivity during self and other-touch will be lowest amongst BPD, followed by DDD and the control group will demonstrate the strongest self-other distinction.

Methods

2.1 Participants

A total sample size of 152 was recruited via three referral pathways for both the current study and an attached study investigating nociception and dissociation (for similar procedure see (Edwards et al., 2001). This sample was analysed for the cross-sectional hypotheses 1a-1d. The initial planned sample size for the experimental study was 120. This was based on previous studies and feasibility. Post-hoc sensitivity analyses of nonsignificant effects in planned analyses indicated where the sample was adequately powered to detect statistically significant effects.

The control group was recruited via from UCL's Psychology and Language Sciences Subject Pool (SONA), and other standard UCL participant recruitment channels. The DDD Group was recruited via charity partner Unreal UK. Final assignment depended on scoring in the Cambridge Depersonalisation Scale (CDS) (Sierra & Berrios, 2000). The control group all scored below 50 in the CDS (Female = 29, Male = 11, mean age = 29.7, *SD* = 10.80). The DDD group all scored above 90 in

the CDS (Female = 33, Male = 10, mean age = 29.7, *SD* = 9.58). The BPD group was recruited via a research partner Probing Social Exchanges. Individuals were either referred to that project from clinics or self-referred on the basis of BPD diagnosis or experiencing problems in line with the diagnostic criteria, (Female = 15, Male = 7, mean age = 33.8, *SD* = 9.93). In terms of key exclusion criteria for the experimental study, participants had to have normal or corrected-to-normal eyesight, and anyone with a cardiac pacemaker, a history of seizures or recurrent fainting were excluded.

The total experimental dataset *N* = 104 excludes those who took part in the attached nociception tasks only. One individual in the control group showed adverse reaction to the task. Participants that either experienced technical difficulties or terminated early due to discomfort were excluded from experimental data analyses. Appropriate steps were taken as per the risk assessment and ethics application following adverse reactions or discomfort. Individuals who scored moderately high in CDS scale (50-90) were excluded to avoid skewing the control data. This also provided the more balanced groups for cross-sectional group comparisons (H1c and H1d). Once all exclusions and missing data was accounted for, the final experimental sample analysed was *N* = 97.

Ethical approval for this study was obtained from the UCL High-Risk Research (25987/001), and all procedures conform to the principles of the Declaration of Helsinki. The recruitment and testing of the BPD group was approved by the Research Ethics Committee for Wales 3 and Health Research Authority (12/WA/0283).

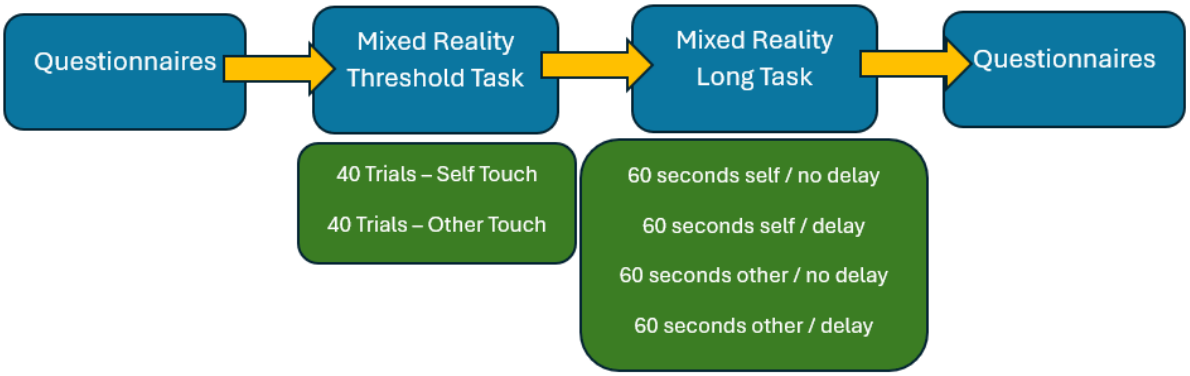
2.2 General Procedure

The control and DDD group completed the CDS and provided demographics information as part of the screening process. These groups provided informed consent form on site. The BPD group provided consent as part of their onboarding to the Probing Social Exchanges project. Due to individuals on this pathway reaching us via participation in a clinical intervention and a larger research study, referrals received additional communication to ensure informed consent at each step. Extra care was taken to apply trauma-informed principles to testing. During the testing session,

all participants completed a block of questionnaires, followed by the mixed-reality task then a second block of questionnaires. The order of questionnaires was randomised.

Figure 1

Diagram flow of protocol.



Note. Source of touch in The Threshold Task was counterbalanced, and order of the conditions was randomised for The Long Task. Visual Analog Scale (VAS) questions were answered after every trial in the Threshold Task and provided measures of sensitivity to multisensory delay. VAS questions were answered after each of the four condition levels in the Long Task and this provided measures of state dissociation.

2.3 Materials and measures

The mixed-reality task was programmed with Unity 2023.1. The task was administered via Oculus Quest 2 virtual-reality headset with a 360-degree fisheye camera mounted on the front. The participant viewed the video feed of their first-person perspective visual field through the headset. Participants were sat on a chair with their arms relaxed on the arm rests or desk. During each trial, the arm was stroked with a paint brush, either by the participant (Self-touch) or by the experimenter (other-touch). The stroke was unidirectional to their non-dominant arm and around 3cm per second, based on the optimal speed for activating unmyelinated C-tactile afferents associated with pleasant comforting touch (Crucianelli et al., 2022). In both tasks, following the video feed, participants viewed visual analogue scale questions which they answered by moving their head/eye line to move the cursor.

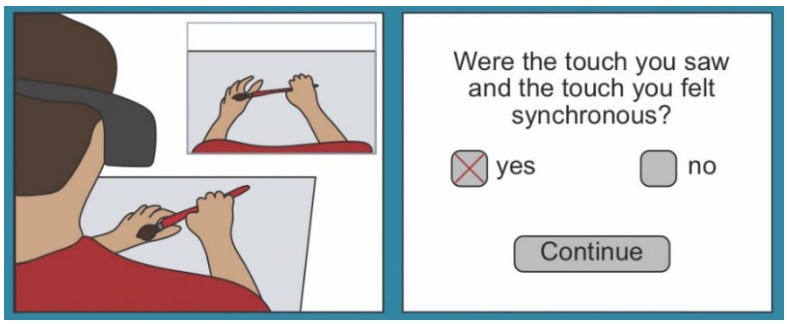
2.3.1 Mixed-Reality - Threshold task

Embodied Integration: Sensitivity To Sensory Mismatch. The threshold task tested the participants sensitivity to visual input delay. Participants would receive the video feed through the headset, and they would see their arm being stroked twice, before they answered the VAS questions. The order of the two conditions (self/other) was counterbalanced. There were 10 different delay times (between 0-594 milliseconds), each repeated four times, and randomised across 40 trials in each condition. Participants were provided a short break in between self and other conditions. 80 trials were completed in total.

After each trial, participants responded to the forced choice (yes or no) question "*It felt as if the touch/movement I saw and felt was synchronous (in time)*". This provided the data to calculate the estimated point of subjective equality (PSE). The PSE is the length of delay at which participants were equally likely to state the visual input was delayed or not delayed (Roel 2020,2021). This tells us the width of the individual's temporal binding window, which is the length of time an individual starts to notice multisensory delay. The PSE calculation methods are detailed in *Data and Statistical Analysis.*

Figure 2

Illustration of Self-Touch Condition.



Note. Adapted from (Roel Lesur et al., 2021). Experimental set up for the self-touch condition. Participant viewed their arm through the VR headset, stroked their arm twice, unidirectionally from the elbow crease to the wrist. Three VAS questions are viewed and answered through the headset. Only the VAS analysed in the current paper is pictured.

2.3.2 Mixed Reality - Long task

Embodied Integration: State Dissociation. The long task gathered subjective disembodiment and derealisation across four 60 second trials. This was a repeated measures design with two factors, video feedback delay (delay/no-delay), and source of stroke (self/other). The order of the four conditions was counterbalanced.

The delay conditions delayed the video feedback by 1000 milliseconds. After each trial, participants had to provide ratings to VAS questions ranging from "Strongly Disagree" to "Strongly Agree". There were two statements on Body Disownership (e.g. "S*ometimes I felt alienated from my body*"), two on Deafference (e.g. *"Sometimes I felt as if my body was numb*"), two on Embodiment *(e.g. "Sometimes I felt as if the body I saw was my own*"), and two on Derealisation (e.g. *"Sometimes I felt* a*s if my surroundings felt detached or unreal*"). The questions are based on the psychometric for disembodiment developed for this procedure (Roel Lesur et al., 2020) and derealisation questions have been added. Embodiment scores were reversed, and each pair of answers were averaged for a subscale score for Body Ownership, Deafference, Embodiment and Derealisation. A composite score for *state dissociation* was computed by calculating the mean of the four subscale scores. This then gave a state dissociation value for each of the four levels: no-delay/self-touch; delay/self-touch; no-delay/other-touch; delay/other-touch.

Embodied Integration: Self-Other Distinction. Self-other distinction was captured via both PSE values in self and other conditions in the threshold task and also state dissociation scores in self and other conditions of the long task. The difference in PSE between the two conditions, and difference in state dissociation between were calculated and this provided a "self-other" distinction value for simple bivariate correlational analyses. For H3a and H3c, the outcome values in the two conditions were compared using analysis of variance tests.

2.3.3 Questionnaires

RedCAP (Research Electronic Data Capture) captured screening data including CDS responses and demographics and securely stored in the Data Safe Haven. Qualtrics (https://www.qualtrics.com, Proto, UT) was used to collect the anonymised responses to the other questionnaires, the order was randomised for each participant.

Self-Concept Integration. Self-concept clarity (SCC, Campbell et al., 1996) measures the metacognitive belief that one has a clearly defined and integrated psychological sense of self you recognise as 'you'. Likert scale responses to 12 statements, (e.g. "*Sometimes I think I know other people better than I know myself"*) are summed for total score. Average scores are ≈ 30-40 (SCC, Campbell et al., 1996). This is a validated measure of a coherent self-concept (DeMarree & Bobrowski, 2017). Data from our sample showed high internal consistency (α = 0.90). Age (Lodi-Smith et al., 2017) and sex (Cicero, 2020) has a small effect on SCC.

Trait Dissociation. Dissociative Experiences Scale (DES, Berstein & Putnam, 1986) has 28 items capturing symptoms (e.g. "*Sometimes people have the experience of being in a familiar place but finding it strange and unfamiliar*") that may indicate dissociative disorders. Participants provide a percentage of the time that they experience each of these symptoms. The DES focusses on psychological disconnection, and captures normative experiences, rather than being a diagnostic. Percentages were converted into numbers for analysis and internal consistency was high (α = 0.96). Clinically significant scoring is 30 and above (Leavitt, 1999). The most widely used scale is the DES, and it is the broadest measure of dissociation, therefore it was used as our primary measure for key hypotheses.

Depersonalisation Derealisation Disorder. The Cambridge Depersonalisation Scale (CDS, Sierra & Berrios, 2000) is a 29-item scale that more precisely assesses for Depersonalisation Derealisation Disorder, (e.g. "*When I weep or laugh, I do not seem to feel any emotions at all*" and "*My surroundings feel detached or unreal, as if there were a veil between me and the outside*

world"). Responses on frequency and duration are given, and the total score is summed. Suggested clinical cut-off is 70. The CDS scale was used to assign individuals to control and DDD groups.

Anxiety and Depression. Anxiety and depression correlated with SCC (Cicero, 2017) so their influence on the relationship between dissociation and SCC will be controlled for. Public Health Questionnaire 8 (Kroenke et al., 2009) is the most widely used clinical assessment for major depressive disorder. The sub-scales from the State-trait Anxiety Inventory (Spielberger et al., 1983) will be our measure for trait anxiety and for state anxiety . Recognising the role of stress in state dissociation, state anxiety will be controlled for to isolate any independent effects of SCC on experimental effects.

2.4 Data and Statistical Analysis

PSE values were calculated using R package, quickpsy (Linares, & López-Moliner, 2016). This fitted a Gaussian cumulative psychometric function to average proportions of synchrony judgements at each time delay, for self-touch and other-touch conditions. The average PSE was then estimated. The max delay was 594ms plus 120ms of intrinsic system delay. Seven cases had a projected PSE above the max delay between 1000ms and undefined extreme value. Due to having two clinical groups, and the paradigm being relatively novel, these were assumed to be of theoretical interest and were included. To capture real variation in the data, whilst preventing outlier impact on hypothesis testing, we capped all extreme PSE to 1000ms. Anyone with negative PSE values (N=12) were kept as this indicates individuals who tended to report a delay, even when there was no manipulated delay, leading to projected PSE values below zero. Ten cases had extreme negative values, and these were replaced with the lower limit, -1000ms.

Statistical analysis was performed with IBM SPSS Statistics (Version 27). The alpha level was set at 0.05. Predictor variables in multiple regression tests and covariates in ANOVA models were mean-centred. Data were visually inspected for normality using Q-Q plots and histograms. Simple linear regression, multiple regression and analysis of covariance tests (ANOVA) were run to test our hypotheses. Assumptions for parametric tests were met unless stated otherwise. Where appropriate,

a bias-corrected and accelerated (BCa) bootstrap was used to estimate the confidence interval, to adjust for possible biases including unequal group sizes, outliers and skewness. These analyses were based on 1000 bootstrap resamples. Where ANOVA results were significant, post hoc comparisons were conducted. Bonferroni corrections were applied to planned comparisons and post-hoc tests.

Post-hoc sensitivity analyses indicated that our sample was underpowered to detect small effects in some of our planned analyses, possibly due to unbalanced groups, variability and outliers within the groups. Therefore the descriptives and interaction plots were also reported to elucidate possible true effects or clinically significant findings (Loftus, 1996; Visentin et al., 2020).

Results

3.1 Hypotheses 1: Cross-Sectional Data

3.1.1 Association Between Self-Concept Clarity and Trait Dissociation

A simple regression with SCC as the dependent variable was conducted. SCC (*M* = 33.67, SD = 10.27) was significantly negatively related to trait dissociation (*M* =24.70, *SD* = 20.29), *r* = -.61, 95% CI [-.695, -.510], *p* <.001. As trait dissociation increased, SCC decreased, supporting hypothesis 1a.

To understand the unique contribution of dissociation to SCC, a hierarchical linear multiple regression was performed. Based on the literature age, gender, anxiety and depression were expected to have a relationship with SCC so they were entered into the model first, and dissociation was entered in the second step. The first model significantly predicted SCC, 54.9% variation in SCC, R^2 = .55, *F* (4,147) = 44.66, *p* = <.001 and the second model was also significant, R^2 = .57, *F* (1,146) = 39.26, *p* = .004. In this sample, age and gender had a nonsignificant influence on SCC, but trait anxiety and depression significantly predicted SCC. When trait dissociation was entered, it was accountable for 2.5% unique variation. Trait anxiety remained significant; however depression lost its significance, indicating that dissociation accounted for the relationship between depression and SCC. This analysis indicates that hypothesis 1b was supported, in that the relationship between SCC and trait dissociation is not wholly explained by anxiety or depression.

Table 3

Linear Model of Predictors of Self-Concept Clarity

		b	*95% CI*	*SE*	β	*p*
Model 1	(Constant)	51.217	[44.81, 57.63]	3.24		<.001
	Age	.093	[-.028, .214]	0.06	.088	.130
	Gender	1.809	[-.993, 4.61]	1.42	.074	.204
	Trait Anxiety	-.372	[-.507, -.237]	0.07	-.493	<.001
	Depression	-.439	[-.719, -.158]	0.14	-.280	.002
Model 2	(Constant)	51.071	[44.82, 57.32]	3.16		<.001
	Age	.110	[-.008, .229]	0.06	.104	.068
	Gender	1.313	[-1.44, 4.01]	1.39	.053	.348
	Trait Anxiety	-.347	[-.480, -.215]	0.07	-.461	<.001
	Depression	-.216	[-.528, 0.96]	0.16	-.138	.173
	Dissociation [a]	-.118	[-197, -038]	0.04	-.232	.004

Note. N = 152. CI = confidence interval. Significant coefficients p <0.05 are in bold.

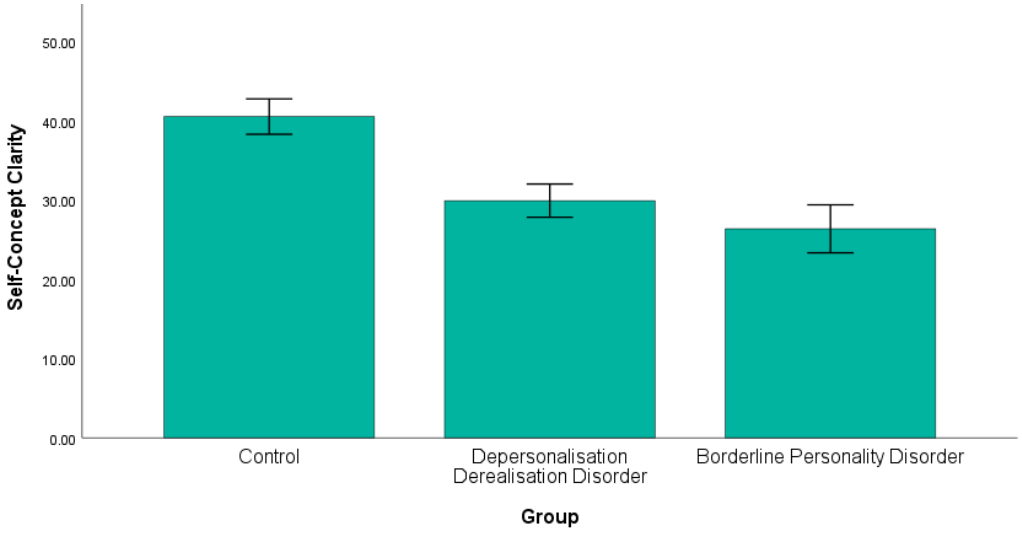
[a] Dissociative Experiences Scale

3.1.2 Differences in Self-Concept Clarity Between Groups

As disturbed self-concept is a diagnostic criterion for BPD, but not for DDD, it was hypothesised that SCC would be lowest in the BPD group, followed by DDD and then the control group. This hypothesis was partially supported. A one-way analysis of variance (ANOVA) revealed that SCC in the DDD and BPD group was statistically different to the control group, N = 107, F (2, 150) = 36.24, p <.001, η^2 = 0.33. Planned contrasts showed that the clinical groups were significantly lower in SCC, t(150) = -8.47, p < .001, but there was no significant difference between the DDD group and BPD group, t(150) = -1.79, p = .076. On the other hand, there was a significant linear trend F (1,150) = 66.50, p < .001. Suggesting, SCC was indeed lower in the BPD group compared the DDD group however the difference was not statistically significant (Figure 3).

Figure 3

Mean Self-Concept Clarity Across Groups



Note. *N* = 107. Error Bars 95% confidence interval.

It was hypothesised that when anxiety, depression and dissociation were controlled for, there would be no difference in SCC between the control and DDD, but that SCC would still be statistically different in the BPD group. The assumption of homogeneity regression slopes was violated so a multiple regression with interaction terms was conducted. To avoid type I errors when looking at group differences, the smaller experimental sample, (with more balanced group sizes) was analysed, *N* = 107.

Firstly, when dissociation, anxiety and depression were controlled for, the model significantly predicted SCC, R^2 = .54, *F* (5,101) = 26.02, *p* < .001, however group allocation (DDD, *p* = .66 and BPD, *p* = .73), no longer was responsible for the differences in SCC. Depression was also a nonsignificant predictor of SCC, *p* =.239. This indicates that trait anxiety β = -.455, *t* = -4.034, *p* < .001, and trait dissociation β = -.231, *t* = -2.20, *p* = .03, accounted for the differences in SCC for the sample as a whole. This partially supports the hypothesis, however these predictors also accounted for SCC scores in the BPD group, contrary to our prediction.

When the interaction terms were entered into the model, it was no longer significant overall, R^2 = .57, *F* (11,95) = 13.59, *p* = .08. Multicollinearity was high for DES and severe for the interaction terms. This would be expected for these variables and may hide true effects. DDD x anxiety interaction was statistically significant, β = .310, *t* = 1.809, *p* < .001, and the BPD x

dissociation interaction was just under significance level, β = .510, *t* = 1.913, *p* = .06, implying SCC levels may depend on trait anxiety scores in the DDD group and may depend on dissociation levels for the BPD group. However, the multicollinearity levels indicated high instability, therefore conclusions cannot be drawn. See Table 4 for intercorrelations indicating that self-concept clarity, trait dissociation, anxiety and depression are all closely interconnected.

Table 4

Summary of Intercorrelations Between Variables

	1	2	3	4	5	6
1: Self-Concept Clarity						
2: Control	.57**					
3: DDD [a]	-.23*	-.63**				
4: BPD [b]	-.39**	-.42**	-.44**			
5: Dissociation [c]	-.61**	-.71**	.38**	.38**		
6: Trait Anxiety [d]	-.71**	-.70**	.34**	.41**	.60**	
7: Depression [e]	-.66**	-.72**	.40**	.36**	.72**	.78**

Note. N = 107. [a] Depersonalisation Derealisation Disorder Group; [b] Borderline Personality Disorder Group; [c] Dissociative Experiences Scale; [d] Trait Anxiety subscale from the State-trait Anxiety Inventory; [e] Public Health Questionnaire 8; *significant at the 0.05 level; ** significant at the 0.01 level

3.2 Experimental Data

3.2.1 Hypotheses 2: Influence of Self-Concept Clarity on Embodied Integration

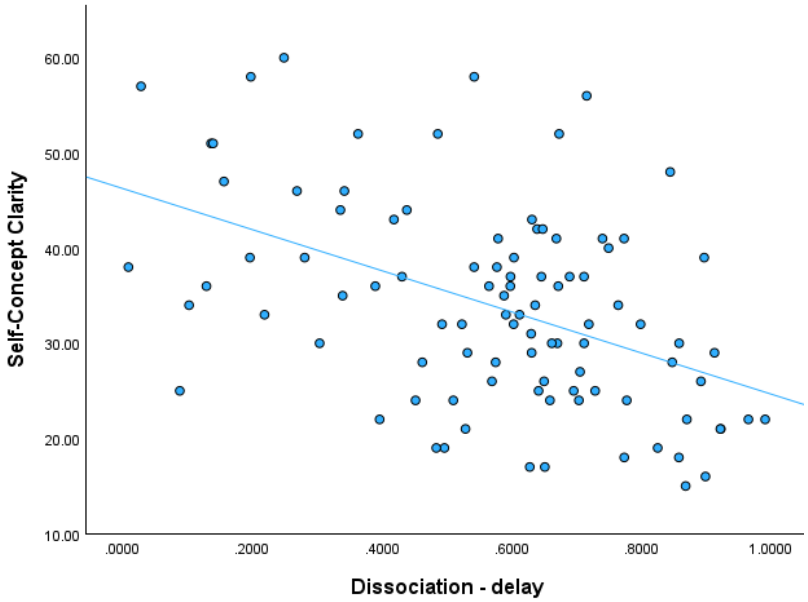
3.2.1.1 State Dissociation. First, a paired sample t-test (*N* = 96) confirmed that the 1 second delay led to increased state dissociation *t*(*M* = .575, *SE* = .02) compared to when there was no visual delay *t*(*M* = .370, *SE* = .03). This difference was significant *t*(96) = -10.91, *p* <.001, 95% BCa CI [-.242, -.168] and it represented a large effect of *d* = 0.87, consistent with previous studies using the same paradigm (Moffatt et al., 2025; Roel Lesur et al., 2020, 2021).

During the long task conditions with a 1 second delay, there was a moderate correlation between SCC and state dissociation, *r* = -.47, 95% CI [-.625, -.275], *p* < .001 (Figure 3). As SCC decreased, state dissociation increased, supporting our hypothesis 2a. During the no-delay condition, moderate correlation was also indicated, *r* = -.44, 95% CI [-.603, -.268], *p* < .001. Investigating the

dissociation subscales across all four conditions, Embodiment and Derealisation were both non-normally distributed. Bootstrapped correlations indicated that SCC had significant relationships with Embodiment, r = -.31, 95% CI [-.119, -.468], p < .001, Body Ownership r = -.49, 95% CI [-.638, -.319], p < .001 and Deafference, r = -.45, 95% CI [-.621, -.261], p < .001, and Derealisation, r = -.47, 95% CI [-.620, -.304], p < .001.

Figure 4

Correlation Between Self-Concept Clarity and State Dissociation During Delay



To test hypothesis 2b, A repeated measures ANCOVA was conducted with the within-subject conditions (No Delay and Delay), SCC as the covariate. There was a significant main effect of delay condition on state dissociation, F(1, 94) = 117.81, p < .001, and a main effect of SCC, F(1, 94) = 30.49, p < .001. The interaction between SCC and delay was nonsignificant, F(1, 94) = .002, p = .97. This partially supported our hypothesis showing that SCC influences dissociation during no delay, however, when SCC is a continuous variable, its influence is statistically significant in both conditions.

To understand the unique contribution of SCC on state dissociation and test hypothesis 2c, a multiple regression with the other key variable of interest, DES, was conducted. SCC predicted state

dissociation, R^2 = .22, F (1,94) = 26.22, p <.001 (Cohen's f^2 = 0.27) when DES was entered, the model was still statistically significant, R^2 = .29, F (1, 93) = 18.98, p =.003. With SCC as the only predictor, SCC explained 21.8% of the variance in state dissociation. In the second model, SCC only explained 3.8% of the variance. Trait dissociation explained a proportion of the relationship between SCC and induced dissociation. This suggests that the two variables may be closely intertwined however they are not wholly intrinsic to one another, as predicted. When state anxiety was also controlled, the model remained significant, R^2 = .38, F (1,92) = 18.96, p <.001. As seen in Table 5, state anxiety is found to account for the effect of SCC and trait dissociation.

Table 5

Linear Model of Predictors of State Dissociation

		b	***SE***	***β***	***p***
Model 1	(Constant)	.578	0.02		<.001
	Self-concept-clarity	-.010	0.002	-.467	<.001
Model 2	(Constant)	.573	0.02		<.001
	Self-concept-clarity	-.005	0.002	-.250	.03
	Trait dissociation [a]	.004	0.001	.345	.003
Model 3	(Constant)	.574	0.02		<.001
	Self-concept-clarity	-.004	0.002	-.165	.13
	Trait dissociation [a]	.002	0.001	.180	.12
	State anxiety	.007	0.002	.379	<.001

Note. N = 96. Significant coefficients p <0.05 are in bold.

[a] Dissociative Experiences Scale

To test hypothesis 2d, several analyses were completed. Firstly, the difference in state dissociation between the three groups was investigated (N = 96). The homogeneity of variance assumption was violated therefore Welch's ANOVA was conducted and a statistically significant difference between the groups was indicated, Welch's F(2, 44.68) = 13.66, p <.001, η^2 = 0.23 . Post-hoc comparisons using Games-Howell test showed that the control group had lower state dissociation (N = 38, M = .440, SD = .24) than the DDD group (N = 39, M = .682, SD = .16), p < .001, and the BPD group (N = 19, M = .626, SD = .22), p = .015. There was no significant difference between the DDD and BPD group, p = .59.

Next, the effect of delayed visual input was compared between the groups. A repeated measures ANOVA with delay as the within-subjects factor showed a nonsignificant delay x group interaction F(2, 93) = 2.32, p = 104, η_p^2 = 0.05 with a small to moderate effect size Cohen's f = 0.17. Visual inspection of plots (see figure 5) indicates that BPD were potentially more likely to experience dissociation when there was no delay than the control group. However, the two groups showed a similar increase in dissociation during delay. In contrast, the DDD group showed less of a difference during delayed visual input, compared to no delay.

To explore the role of SCC, a one-way ANCOVA was conducted. There was a statistically significant difference in state dissociation between groups, whilst controlling for SCC, $F(1, 90) = 6.02$, p = .004. However, the variance attributed to group reduced from 23.4% to 11.8%. The main effect of SCC on state dissociation was also found to be significant $F(1, 90) = 9.16$, p = .003. The interaction between group and SCC was not significant, $F(2, 90) = .348$, p = .71. This indicates that SCC may account for or mediate the differences in state dissociation between the groups, however its influence on state dissociation was consistent across groups. Pairwise comparisons with Bonferroni adjustment, showed when SCC was held constant, there was a statistically significant difference between control (M = .493, SE = .036) and DDD (M = .660, SD = .032), p = .002, but not between control and BPD (M = .565, SD = .05), p = .84. There was also a nonsignificant difference between the DDD and BPD group, p = .28. Therefore differences in SCC between control and BPD groups, and between DDD and BPD, accounts for the differences in induced dissociation. Whereas the effect of DDD on state dissociation still held. This partially supported our predictions.

To isolate the relationship between SCC and state dissociation, trait dissociation and state anxiety were included in the model. When DES was added to the model, SCC still had a significant main effect, $F(1, 91) = 5.14$, p = .026, η^2 = .053, and the effect of DES on state dissociation only just fell below significance, $F(1, 91) = 3.73$, p = .057. When SCC and state anxiety were entered into the model, differences between groups was no longer statistically significant, $F(2, 90) = 1.91$, p = .15. SCC

had a significant influence, $F(1, 90) = 5.48$, $p = .021$, $\eta^2 = .057$, but state anxiety had a larger and more significant influence $F(1, 90) = 12.26$, $p < .001$, $\eta^2 = .12$.

3.2.1.2 Delay Sensitivity. The mean PSE ($N = 98$) across both self and other conditions violated assumption of normality which may have been due to the number of outliers ($N = 16$), therefore BaC bootstrapped confidence intervals were applied to a Pearson's correlation. There was a significant small to moderate correlation between SCC and mean PSE during other-touch, $r = -.19$, 95% BCa CI [-.370, -.008], $p = .029$. This shows that contrary to predictions of hypothesis 2e, as SCC increased, sensitivity to sensory mismatch increased. The correlation between SCC and PSE during self-touch was nonsignificant, $r = -.11$, $p = .14$. An exploratory correlation was run to investigate the relationship between trait dissociation and PSE to compare the findings. No association was found in the self-condition, $r = .00$, p = .50, but a significant relationship was observed in the other condition, $r = .20$, $p = .03$, indicating that as dissociation increased, sensitivity to mismatch reduced when touched about another. When trait dissociation was controlled for in a multiple regression, SCC no longer significantly predicted delay sensitivity in the other condition, $R^2 = .049$ $F(2,96) = 2.456$, $p = .091$ in support of hypothesis 2f.

Next, to test hypothesis 2g, we compared the three groups, the control ($N = 40$, $M = 163.68$), DDD group ($N = 38$, $M = 319$) and BPD group ($N = 19$, $M = 272.63$). Due to unequal group sizes and violations of normality, Welch's ANOVA was conducted to look at initial group differences. There was no statistical difference in PSE across the groups Welch's $F(2, 44.68) = 2.09$, $p = .135$, with Cohen's $f = 0.21$. A post hoc sensitivity analysis confirmed an effect size of $d = 0.32$ was required to be detected. To complete the analysis, a one-way ANCOVA was conducted to explore the influence of SCC and bootstrapping with 1,000 resamples was applied to handle violations. Despite the significant bivariate correlation between SCC and PSE, the adjusted effect of SCC was nonsignificant $F(1,91) = 0.63$, $p = .426$ and the interaction between group and SCC was nonsignificant, $F(2, 91) = 1.25$, $p = .290$. This suggests that group differences could potentially explain the overall correlation between SCC and mean PSE, however the study was underpowered to detect group differences.

3.2.2 Hypotheses 3: Self-Other Distinction and Self-Concept Clarity

Self-Other Distinction in State Dissociation. State dissociation during self-touch (*M* = .464, *SD* = .22) was lower than during other-touch (*M* = .481, *SD* = .22). A one-tailed paired sample t-test confirmed the distinction was statistically significant, M_d = -.017, *t*(96) = -1.677, *p* =.05, 95% CI [-.037, .003] with effect size Cohen's *d* = 0.17. There was a nonsignificant Person's correlation between SCC and self-other distinction in state dissociation, *r* =-.027, 95% CI [-1.00, .142] *p* = .40. Therefore, SCC did not influence the degree state dissociation experienced in self, versus other conditions, contrary to our hypothesis 3a. However, a post-hoc sensitivity analysis confirmed that the study was underpowered to detect significant correlations *r* < 0.25.

In order to test hypothesis 3b, a three-way repeated measures ANOVA investigated the data from the long task, with delay and self-other conditions as the two within-subject factors, and state dissociation as the outcome variable. Homogeneity of variance was violated for the delay/other condition. The difference between self/other conditions did not significantly differ between groups, *F*(2, 93) = .017, *p* = .98. The test confirmed there was a significant main effect of delay on state dissociation, *F*(1, 93) = 118.9, *p* < .001, η_p^2 = 0.56, with Cohen's *f* = 1.11. The condition did not have a significant effect *F*(1, 93) = 2.37, *p* = .13, η_p^2 = 0.025 (Cohen's *f* = 0.12), and there was a nonsignificant delay x condition interaction *F*(2, 93) = 2.36, *p* = .128, η_p^2 = 0.025, (Cohen's *f* = 0.12). The delay x condition x group interaction was nonsignificant, *F*(2, 93) = .695, *p* = .50, η_p^2 = 0.015, Cohen's *f* = 0.12.

Visual inspection of the mean scores (Table 6) and interaction plots (Figure 5) showed that whilst there was a clear distinction between self and other conditions and a lack of interaction in the control group, a delay x condition interaction may be present in both clinical groups, with a potentially stronger interaction in the BPD group. Both the DDD group and BPD group showed a larger difference between no delay and delay trials during self-touch, than during other-touch. During delay trials, the DDD group experienced no difference in dissociation in self or other-touch. Whereas the BPD group experienced slightly more dissociation in the self-touch during delay

compared to other-touch, although this difference may be negligible. Both the smaller sample size and larger variation in the BPD group may have prevented the small interaction effect sizes from reaching significance. A sensitivity analysis confirmed the sample was underpowered to detect any effect size smaller than $f = 0.28$ in this test.

Table 6

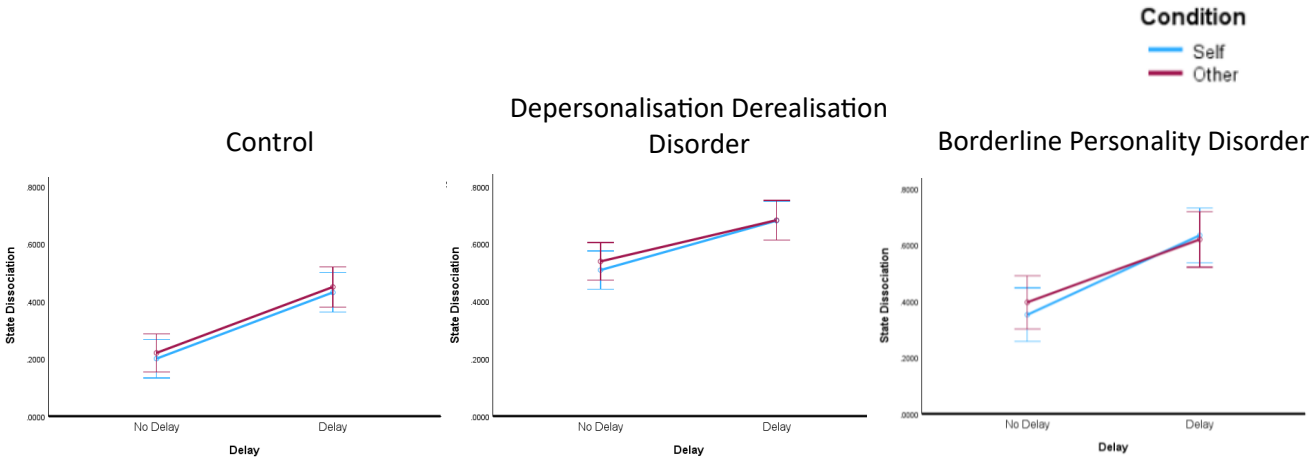
Mean State Dissociation in Each Condition Across the Three Groups

		N	*Mean*	*SD*
Self - No Delay	Control	38	.200	.189
	DDD Group [a]	39	.509	.235
	BPD Group [b]	19	.352	.187
Self - Delay	Control	38	.431	.240
	DDD Group [a]	39	.681	.178
	BPD Group [b]	19	.633	.226
Other – No Delay	Control	38	.220	.194
	DDD Group [a]	39	.539	.211
	BPD Group [b]	19	.400	.221
Other - Delay	Control	38	.450	.251
	DDD Group [a]	39	.683	.167
	BPD Group [b]	19	.619	.235

Note. [a] Depersonalisation Derealisation Disorder Group; [b] Borderline Personality Disorder Group

Figure 5

The Relationship Between State Dissociation and Delay in the Three Groups: Control, DDD and BPD



Note. $N = 96$. Error Bars 95% confidence interval.

Self-Other Distinction in Sensitivity to Sensory Mismatch. PSE ($N = 97$) during self-touch ($M = 264.36$, $SD = 316.14$) was higher than PSE during other-touch ($M = 227.28$, $SD = 492.54$) indicating

participants were more sensitive during other-touch than self-touch (see Table 6 for mean values across the three groups). Due to violation of normality and homogeneity of variance assumptions, a Wilcoxon signed rank test was conducted and this confirmed a nonsignificant difference between the three groups Z = -1.766, p = .076, r = -.18 (Cohen's d_z = 0.37). A post-hoc sensitivity analysis indicated that our study was sufficiently powered to detect a significant difference of this size. To compete the analysis and test hypothesis 3c, a one-way repeated measures ANCOVA with touch source as the within subjects factor was conducted. This confirmed that SCC did not interact with condition F(1, 95) = 1.406, p =.239, therefore sensitivity to delay was not higher for those with low SCC during self-touch compared to other-touch.

In contrast to hypothesis 3d, there was a small nonsignificant correlation between SCC and self-other distinction in sensitivity to mismatch , r = .12, 95% BCa CI[-.077, .309], p =.119.

Table 7

Mean Point of Subjective Equality in Self and Other Conditions Across the Three Groups

		N	*Mean*	*SD*
Self-Touch	Control	40	235.40	391.54
	DDD Group [a]	38	275.96	180.56
	BPD Group [b]	19	302.15	360.86
Other-touch	Control	40	91.75	590.60
	DDD Group [a]	38	362.03	337.27
	BPD Group [b]	19	243.11	473.69

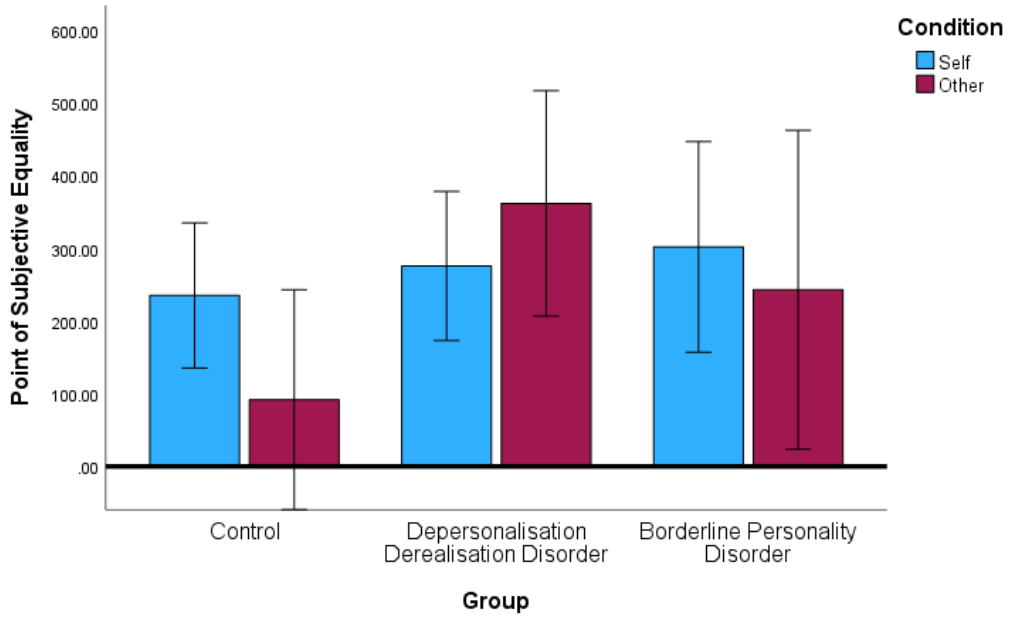
Note. [a] Depersonalisation Derealisation Disorder Group; [b] Borderline Personality Disorder Group

A two-way repeated measures ANOVA was conducted to examine the effects of self-other condition on PSE across the three groups, testing hypothesis 3d. Assumptions of normality and homogeneity of variance were violated. There was a nonsignificant main effect of self-other condition, F(1,96) = .395, p = 53, and nonsignificant main effect of group, F(2,96) = 2.335, p = 10. The group x condition interaction was also nonsignificant, F(1,96) = 2.211, p = 12. A visual inspection of the data confirmed that the difference between self and other PSE was smallest for the BPD group,

followed by the DDD group and the largest self-other difference was in the control group, however the 95% confidence intervals highlight the issues in variability (see Figure 6).

Figure 6

Mean Point of Subjective Equality During Self and Other-touch Across Three Groups



Note. N = 97. Error Bars 95% confidence interval.

Discussion

Developmental theories argue that dissociative states, and the disconnected self are both the result of poor integration, however the tools to test these theories experimentally have only recently come into existence. Self-concept coherence is a construct that allows us to explore fragmentary sense of self, its relation to dissociation, and clinical presentations. Firstly, we confirmed that integration of the psychological self is related to day-to-day dissociative experiences. Our cross-sectional data also indicated the important impact of negative affect in self-concept stability. Our investigation is one of a handful of experimental studies demonstrating a direct relationship between the bodily self and psychological self, and how this relationship fluctuates between clinical conditions. Our clinical groups both showed decreased SCC, and also demonstrated aberrant

multisensory integration compared to the control group. Disrupted self-processing was indicated in both clinical groups, however analyses were not statistically significant. Our findings do not provide evidence of causality, or developmental trajectory of either dissociation or disturbed self-concept. However, we offer potential possible mechanisms that may bridge minimal 'I' and narrative 'me' within the specific context of healing fragmented selves, and future avenues of research to explore.

4.1 Hypotheses 1: Self-Concept Clarity is Related to Trait Dissociation

Echoing previous findings (Chiu et al., 2017; Evans et al., 2015; Holm & Thomsen, 2018), we showed that high rates of dissociation predicts a lower self-concept clarity. This indicates that the metacognitive belief one is a singular coherent self, is associated with disconnected perceptual fragmentation. When comparing SCC across the three groups, there was a significant linear trend, supporting our hypothesis that SCC would be lowest in the BPD group and highest in the control group.

There is an established association between SCC and mental health symptoms (Cicero, 2017), and our findings emphasise the enmeshed and nuanced relationship between dissociation, anxiety, low mood and self-concept. Trait anxiety and depression both predicted SCC, however dissociation explained the influence of depression on self-coherence. Our analysis implies that dissociation has a key role to play in the disrupted self-experiences considered central to major depressive disorder (Pyszczynski & Greenberg, 1987). Evidence, including a meta-analysis, suggests that the State-Trait Anxiety Index (Spielberger, 1983) actually assesses negative affect and is strongly correlated with both depression and anxiety (Bados et al., 2010; Knowles & Olatunji, 2020). Therefore our findings may indicate the important role of negative affect in self-disturbance more broadly, rather than anxiety specifically.

According to our findings self-concept coherence is comparable in both DDD and BPD, but descriptives suggested that our BPD group did have both highest dissociation and lowest SCC. In contrast to our hypothesis, when anxiety, depression and dissociation were controlled for, there was no main effect of BPD on SCC. Those with BPD symptoms show increased compartmentalisation, and

negative self-representations have enhanced importance (Vater et al., 2015). These self-evaluations play a central role in the difficulties within BPD (Winter et al., 2017). The difference in clinical self-disturbance could be attributed to higher implicit self-esteem, less vulnerability to "frontal" behaviours and increased harm avoidance in DDD (Hedrick & Berlin, 2012), resulting in more protective, self-coherent behaviours. The SCC scale may therefore capture the conflictual nature of the self, experienced in BPD, and the lack of self, experienced in DDD (L. Quigley et al., 2024) but not distinguish between this nuance. Findings could be due to unequal group sizes and group allocation methods. Self-referral (for the DDD group) could feasibly have led to individuals in the DDD group that also experienced symptoms similar to BPD.

When controlling for anxiety, depression and dissociation, there were no differences between the groups' levels of SCC. On the one hand this informs us that emotional dysregulation and dissociation account for group differences. However when interaction terms were entered, the model was no longer significant and in addition, we found high multicollinearity. Therefore, we cannot interpret the degree to which these measures individually contribute to SCC for each group. Unknown variables may also be contributing to the lack of significance and instability.

4.2 Hypotheses 2: Self-Concept Clarity Predicts Embodied Integration

4.2.1 Susceptibility to Dissociation Following Sensory Mismatch.

Those reporting lower self-concept clarity were more susceptible to dissociative states during visual delay supporting our hypothesis that embodied integration would correlate with self-concept integration. This is consistent with one other study exploring the effect of SCC on body consciousness (Krol et al., 2020). Where SCC had a small-medium effect on embodying a prosthetic arm, SCC had a medium-large effect on state dissociation. The effect was comparable whether visuo-tactile signals were synchronous or asynchronous. Again, this reflected previous findings (Krol et al., 2020). However whilst the RHI may be effective for individuals with high and low SCC, induced dissociation was variable according to stability of the self whether embodiment was manipulated or not.

The psychometric used in our study (Roel Lesur et al., 2020), was developed on the notion that ownership of an external body is likely distinct to disembodiment of one's own body (de Vignemont, 2011). The plasticity that is unveiled by the RHI is thought to confirm the relative dominance for visual signals, and top-down bodily self-representations that maintain the feeling of a coherent bodily self (Tsakiris & Haggard, 2005). The current experiment challenges the robustness of processing, and by doing so, it elucidates the degree to which someone's self-representation is more fragile and vulnerable to dis-integration. Thus, the vagueness of self-concept may be more strongly associated with disconnection to one's body, than readiness to adopt other bodies.

When current stress levels were controlled for, this accounted for the effect of both SCC and trait dissociation on the experimentally induced disembodiment. In real terms, this is understandable as current state is likely to have a stronger influence than a trait measure, however this finding highlights the role of stress in experimental manipulation of sensory input and might explain the larger effect size. Dissociating from one's body is closely associated with stress-responses (Schauer & Elbert, 2010; Stiglmayr et al., 2008) where ownership of supernumerary bodies may not be. The data could be illustrating the close association between vulnerability to anxiety and vulnerability to dissociative states. This finding supports the cognitive behavioural model for dissociation, as affect sensitivity and intolerance have been shown to be primary drivers of dissociative experiences (Černis et al., 2022).

When trait dissociation was controlled, the proportion of variance explained by SCC decreased substantially, suggesting the two constructs are intertwined but SCC maintains some influence independent of trait dissociation. Self-concept integration explained differences in state dissociation between controls and BPD, however clinical levels of depersonalisation and derealisation symptoms had an independent effect on dissociative responses. Self-concept clarity therefore plays a stronger role in subjective disembodiment for both controls and those with BPD symptoms, and DDD symptoms account for variance in state dissociation independent of SCC.

4.2.2 Delay Sensitivity and Multisensory Integration

Multisensory integration was demonstrated via sensitivity to delayed visual stimuli. Assuming an inverse relationship between SCC and trait dissociation, and based on previous findings where trait dissociation predicted increased sensitivity to delays (Moffatt et al., 2025), we hypothesised that higher levels of SCC would be associated with lower sensitivity to sensory mismatch. Conversely, we found that as self-concept clarity decreased, sensitivity significantly decreased during other-touch, but the correlation was nonsignificant during self-touch. One interpretation is that an incoherent sense of self results in increased detection and integration of conflict from external sources. This could be taken as over-compensatory integration to increase a sense of agency when an individual has stronger beliefs around lack of control or agency. Our two clinical groups demonstrated larger temporal binding windows than our control group, however these differences were not statistically significant either. Our sample was underpowered for small effect sizes, so true effects regarding group differences, and SCC's influence on self-touch may be undetectable.

Diagnoses associated with self-concept disturbances have been shown to have decreased sensitivity to sensory mismatch. Those with BPD and schizophrenia are less sensitive to manipulated multisensory delays (Franck et al., 2001; Rossetti et al., 2022; Stevens et al., 2004). The RHI has been shown to be stronger for those with BPD despite judgement of synchrony between seen and felt touch, being no different to healthy controls (Bekrater-Bodmann et al., 2016). Delays and sensitivity to delay had a reduced influence on body ownership and body agency in schizophrenia compared to healthy participants, therefore higher-order conceptual biases towards feeling disconnected may have led to anomalous bodily experiences (Rossetti et al., 2022).

We did not analyse the relationship between sensitivity and state dissociation, however observationally, a similar pattern emerged in our study. Higher disembodiment rates were observed in BPD and DDD than in the control group, regardless of enhanced sensory integration, pointing to higher-order processing as a possible causal factor (e.g. "*unexpected sensory feedback is due to me*

not being in control"). Again this aligns with the cognitive behavioural model of depersonalisation (Hunter et al., 2014), and could be interpreted as evidence for the primary role of self-beliefs and cognitive appraisals in dissociation (Černis et al., 2022).

4.3 Hypotheses 3: Self-Other Distinction in Clinical Presentations

Our third set of hypotheses aimed to show SCC's role in self-other distinction, which we found some very tentative support for. Firstly, when looking at the whole sample, sensitivity to visual delay was significantly enhanced during other-touch and individuals were less sensitive to sensory mismatch during self-touch, however, group differences are important here. Descriptives provided possible evidence of altered self-other distinction in the two clinical groups. In line with our prediction, the BPD group elicited the smallest distinction between self and other when detecting delays, followed by the DDD group, and the then the control. During 1000ms visual delay, the control group felt higher rates of dissociation during other-touch than during self-touch. However for the clinical groups, who had lower SCC scores, the difference between self and other was diminished. There was no self-other difference in disembodiment for the DDD group during visuo-tactile delay. The difference between self and other reduced for the BPD group too, however, there may have been a slight reversal. The noise from afferent signals during self-touch may cause further disconnection from the body in the BPD group with lowest self-concept clarity, and highest rates of dissociation.

Despite lack of statistical significance, the pattern of data in our DDD group replicated previous findings in healthy samples, (Moffatt et al., 2025; Roel Lesur et al., 2021; van Kemenade et al., 2016) and showed increased sensitivity to visual delays during self-touch. Although temporal binding windows were larger in DDD, this bias towards self-signals is indicative of hypervigilance towards possible depersonalisation symptoms (Hunter et al., 2014). This evidence conflicts with the interoception downregulation model of depersonalisation symptoms (Saini et al., 2022) and speaks more to the salience of aberrant internal signals which are attenuated in healthy individuals, and inferred as anomalous in DDD (Ciaunica et al., 2022). Conflicting and inconclusive findings is not

surprising given the complex multi-faceted components of dissociation. For example, when delineated, depersonalisation is associated with attenuating salient internal signals, whereas derealisation is associated with attenuating salient external cues (Dewe et al., 2018). Differences in self-other processing also mirrors diminished psychological self-other differentiation seen in BPD (De Meulemeester et al., 2021). Mentalising has been shown to be most difficult for those with BPD diagnosis when the task involved extracting other's points of views from their own (Colle et al., 2019). Social cognition in DDD is less studied, however we may hypothesise the shared interoceptive processing difficulties across DDD and BPD interact differently with other genetic and developmental factors, causing distinguishable disorder trajectories.

4.3 Implications and Future Research

Our study demonstrated a correlational relationship between self and body integration. It would be possible to test the effect of manipulating sensory integration on the clarity of self-concept by conducted a subsequent behavioural self-differentiation task (e.g. Chiu et al., 2017). Conversely, researchers may manipulate self-concept stability by using a discrepant feedback activity (e.g. (Brotzeller et al., 2025; Elder et al., 2023)) prior to undertaking the mixed-reality task. These designs would test whether momentary challenge to coherence at body or psychological level influences the robustness of the other. This could provide justification for increasing bodily integration to improve psychology integration and vice versa.

As discussed, the effect on state dissociation could be interpreted as the result of both altered pre-conscious sensory perception and top-down expectations. It would be of clinical importance to test this interpretation by incorporating cognitive measures. Negative cognitive appraisals and attributions of dissociation are strongly connected to dissociation (Černis et al., 2022; Hunter et al., 2014). Broader negative self-beliefs such as low self-efficacy both precede depersonalisation (Ciaunica et al., 2022), and is caused by dissociation (Černis et al., 2022; Thompson-Hollands et al., 2017). Indeed, we have shown that the self-belief related to fragmentary identity is also closely associated with dissociative symptoms. As well as testing the relative effects of

cognitive appraisals and self-beliefs on dissociation, the paradigm could offer novel in-session exposure. For example, patients might practice cognitive reappraisal used in CBT for DDD (Hunter et al., 2023), whilst experiencing multisensory mismatch.

Self-regulation and coping styles may underly both dissociation with self-concept coherence, rather than one causing the other. People who are susceptible to dissociation, including those with BPD (Daros & Williams, 2019), engage in high levels of rumination and perseverative thinking (Cavicchioli et al., 2021; Černis et al., 2022). It has been proposed that disrupted embodied self-processing in DDD is compensated with hyper-reflexivity (Ciaunica et al., 2022). Introspection also plays a key role in the malleability of the self-concept (Brotzeller et al., 2025). The more individuals ruminated on negative social feedback the more their self-concept changed in response. It would be possible to include measures on ruminative coping styles to explore its association with susceptibility to disembodiment. Alternatively, researchers may investigate self-reflexive thinking as a mechanism, by incorporating it into the design.

In terms of intervention, dissociative experiences do reduce following psychological therapy (Burback et al., 2024). Correspondingly, the RHI reduces amongst those with BPD diagnosis when in remission, indicating that level of distress influences multisensory integration and body plasticity (Bekrater-Bodmann et al., 2016). The evidence that sensory processing is associated with dissociation, provides objective mechanisms that may drive the effectiveness of “grounding” skills (Kennedy et al., 2013) which involve attending to different senses. It also unearths possible mechanisms of change underlying body-based approaches that have shown to be effective for disorders that present with dissociative and self-concept disturbances (e.g. Galbusera et al., 2019; Price et al., 2012; van de Kamp et al., 2019). Looking to improving outcomes, biofeedback in body awareness interventions (Fani et al., 2023; Krempel & Martin, 2023) may be enhancing the salience of afferent signals in a way that could be particularly beneficial for those with dissociative tendencies.

Finally, a critical method of integration in the narrative self, is of course – narrative. Autobiographical memory informs and reinforces our sense of identity (Prebble et al., 2013) but a coherent narrative maintains unity despite complexities and discrepancies (Gallagher, 2023). Disruption in memory is considered a core facet of dissociation (Ellickson-Larew et al., 2020) and there is empirical evidence of out-of-body experiences influencing the accuracy and specificity of episodic memory (Bergouignan et al., 2014). If the body is the apparent constant that carries us through times, locations, relationships, roles, and is the channel by which we act out our self-concept (Gallagher, 2023), the potential bidirectional role of self-narrative and embodiment is an area for investigation.

4.4 Limitations and Considerations

A number of limitations need to be kept in mind when drawing conclusions from these findings. As already stated, our sample was underpowered to detect small effect sizes in a selection of our analyses, therefore we reported and discussed observations that were not statistically significant in the current sample. One cause of this was challenges in recruitment of the BPD group. There was large variability in the control and BPD group, which challenges reliability. It would be important to confirm these findings with a larger sample.

The sensitivity to delay data raised interesting questions. The negative PSE values and extreme values were assumed to carry significance due to our sample meeting clinical thresholds and the paradigm being novel. Negative PSE values are projections based on biased responses where delays were detected on trials even when there was none. This could have been showing that intrinsic delay (~120ms) was detectable to those with very sensitive to mismatch. A possible explanation for extremely high PSE could be genuinely large temporal binding windows or adaptation following prolonged exposure to visuo-tactile delay (Ho et al., 2015). There are some challenges to interpreting these values as true effects.

These outliers predominantly emerged in the control group and the BPD group. Biased responses in the control group could be attributed to disengagement. Experimenter observations of

the BPD group noted whilst this group was highly engaged, a select number of participants made explicit comments about the strangeness of the task, and a few appeared restless. This could have led to noisy data, explaining the poor fit and raises queries on the reliability of the sensitivity data. Based on previous findings, we might assume that cases with a negative value in one condition (i.e. self-touch) might correspondingly show very low PSE in the second condition, however for a large proportion of outliers, there was a comparatively high positive PSE in the second condition. Whether a distinction between self and other this large is possible, would need to be investigated further.

State dissociation varied in the no-delay trials and scores during synchronous stroking was higher for the DDD and BPD groups compared to the control. This may be related to the view through the VR headset. Seeing one's body through a wide-angle perspective distortion of the webcam, with colour and definition different to real-life could feel strange to someone vulnerable to anomalous perceptions in the everyday. Previous use of this task found that susceptibility to anomalous perception significantly predicted disembodiment (Moffatt et al., 2025). Furthermore, a new measure of dissociation found that a "felt sense of anomaly" is consistent across all dimensions of the diverse range of dissociative experiences (Černis et al., 2018). Relatedly, hypnotisability has been identified as a key confound in the RHI (Lush et al., 2020; Slater & Ehrsson, 2022) and a correlate of dissociation proneness (Lynn et al., 2022). These are of theoretical interest, and do not discount the effect demonstrated here, however future studies may wish to delineate the role of sensory mismatch from these other factors.

4.5 Conclusion

Dissociation and identity disruption co-occurs to varying degrees, but even within complex emotional needs or borderline personality disorder where these difficulties are marked, their connection is rarely explored. Firstly, we showed that self-concept integration has a moderate correlation with day-to-day dissociative symptoms. We replicated previous findings (Moffatt et al., 2025; Roel Lesur et al., 2021) that inducing a multisensory (dis)integration results in subjective feelings of disembodiment and derealisation. In addition, identity stability was associated with both

sensitivity to delay when touched by others and delay-induced dissociative responses. State dissociation levels were not statistically different between DDD and BPD, however, where self-concept coherence explained the differences in dissociation between the control group and BPD, DDD had a small independent influence. Our findings suggest that bottom-up afferent signals are less salient in DDD and BPD, yet anomalous feelings of disconnection are more likely for both groups. We also observed predicted patterns of altered self-other processing in DDD and BPD although further sufficiently powered studies would need to confirm the significance of these effects. Furthermore, our data suggests that negative affect plays a very important functional role both at a trait and state level. More research would be needed to unpack differential influences of dissociation, emotional dysregulation and other factors such as attachment style or self-other differentiation on self-concept clarity.

Future studies are needed to determine causality however our findings imply embodied processes may influence dissociation via aberrant salience of signals and top-down beliefs for healthy, and clinical groups. Treatment for either dissociation or disrupted self-concept may benefit from more emphasis on embodied processes and beliefs regarding the self. Finally, investigating symptomology here has indicated that the link between the minimal and narrative self may lie within the motivational drive for coherence and integration, and disruption at the embodiment level, may have a cascading effect on higher order self-organisation.

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Part 3: Critical Appraisal

1.1 Topic Selection

Although psychologists have worked in physical health since 1970s, the previous Long Term Plan (NHS England, 2019) acknowledged more explicitly the importance of integrating physical and mental health services, across primary and secondary mental health care. There were a few key drivers behand this strategic focus. A third of people with physical illnesses meet criteria for a mental health concern, individuals with severe mental illness have shorter life expectancy, and there are consistently poor outcomes for those with medically unexplained illnesses (Attoe et al., 2018). Working within primary care, I saw directly the challenges of services trying to treat each individual part of a person, with multiple interconnected problems. From an individual perspective, I employ heuristics that assume connectedness and systems thinking. As a result, the relative absence of the body in clinical psychology training and practice strikes me. The research project was a chance to provide some more technical clout to my general assumptions around interconnectedness.

The physical-mental integration in clinical training and in services is currently being achieved by using psychological intervention to reduce distress for people with physical illnesses, improve physical health outcomes and by addressing barriers to healthcare for those with severe mental illnesses. There is less discussion on how the bodily experience is a dimensional component of mental health. The mounting evidence linking interoceptive measures to mental illness (Tsakiris & Critchley, 2016), and the theories explaining the association (e.g. constructed theory of emotion (Barrett, 2017)) suggest that our understanding of emotional dysregulation needs to be revitalised.

In terms of research, the absence of sensory processing in the Research Domain Criteria is an unfortunate gap that will hopefully be eventually addressed (Harrison et al., 2019). It is observable in clinical work that people with psychological distress become divorced from their bodily needs (thirst, hunger, sleep) whilst becoming a prisoner to their thoughts. Despite the general acknowledgement of the connection between physical and mental health, the body has not been brought into treatment. Although diet, sleep, exercise is lightly touched on at preliminary stages of primary care, as a trainee, I had wondered about the void of in-depth discussion of these factors on mental health

with patients. For example, the positive effects of physical exercise on mental health (Rethorst et al., 2009; Singh et al., 2023) seem to be applied in public health but it is not yet incorporated into specialist mental health intervention. I wondered if this was due to the lack of understanding or appreciation of precisely *why* movement helps.

CBT models focus on both explicit and implicit maintenance cycles at the level of behaviour and cognition. Basic psychoeducation encourages curiosity in how emotions feel in the body, and this rationalises breathing, relaxation and grounding techniques. A recent qualitative study showed that this is positively received, and there may be a strong wish for clinicians to enquire more into physical symptoms (Hickman et al., 2025). My own experience to date have shown me the destigmatising and often empowering effect talking about the nervous system has on individuals seeking help. Neuroscience behind even just the cornerstone strategies in CBT could improve formulation, tailor intervention as well as increase expectancy effects in patients (De Raedt, 2020). For me, there is huge potential for clinical psychologists to hone their practice by being reasonably versed in incorporating knowledge on the biological underpinnings of a person's psychological wellbeing and distress.

The research project was an opportunity gain a deeper understanding on one possible mechanism connecting our physical state to our psychological experience. My ambitions led me to approach Professor Sarah Garfinkel, and the topic of dissociation was a fortuitous opportunity that came from the lab. Dissociation was not a symptom I had worked closely with but unbeknownst to me, it was a perfect fit for my wider interests.

1.2 Study

1.2.1 Recruitment and Testing

The partnership with a well-established research programme meant that it was possible to recruit individuals on a clinical treatment pathway. The need for NHS ethics meant there was a delay to testing the third group. Additionally, the actual pace of referrals was not realised until the ethics application had been accepted which meant the third group was always unlikely to meet the sample size of 40. This reduces the likelihood of publication and obviously influences reliability of analyses.

Fortunately, this study sits within a lab and wider partnership that is motivated to complete the sample. This provided direct experience of the time and resources it takes to complete research with clinical groups. On the other hand, the partnership with the charity Unreal led to recruitment rate comparable to the control group, which confirms that working with specialist charities can be very effective. The partnership with a long-standing research programme also demonstrated a relatively efficient approach to recruiting people on a clinical pathway to non-clinical research.

The process highlighted the topic of co-production and involving service-users at the start of innovation. In terms of the study itself, in the perfect circumstances co-production would be incorporated but this is not possible for doctorate research projects that have limited funding and short time-frames. More broadly, co-production in innovation is increasing but it is certainly not the norm and has a number of complexities and nuances (Sangill et al., 2019; Veldmeijer et al., 2023). Even this small project which had convenient partnerships saw the challenges to recruiting clinical groups. However, individuals with symptomology were clearly highly engaged and enthusiastic, which certainly incentivised me as a researcher. If one takes a longer-term view and considers the potential upsides (research questions informed by real-world difficulties, treatments that are designed with accessibility built in etc.) then involving patients throughout the research cycle (e.g. Hardy et al., 2018) will be more efficient and impactful in the long run.

I observed the direct value of including those with symptoms in the research of fundamental processes. The rare cases where individuals had to terminate testing due to discomfort, provide some of the most striking evidence for the role of sensory processing in either dissociative or anomalous perception. Obviously these insights are unlikely to make it to publication, and it made me reflect on the iterative process of scientific progress with clinical groups particularly, where data may not be reliable for analysis but has potential to inform future studies. One notable example was a person stating, "*things don't feel real*", and having to terminate. The individual expressed some distress in response to the discomfort during the task and said in passing: "*because I'm never in control".* To me this really put a spotlight on the direct impact of disrupted sensory processing on

negative metacognitive beliefs and feelings about the self. In addition, a few comments were made about the delays by those in the DDD and BPD group. In some cases describing derealisation but finding it curious or laughing. Qualitative research uncovers both subjective perception and metacognitive feelings that characterises phenomenology of depersonalisation (Černis et al., 2020; Ciaunica et al., 2021), and these anecdotal exchanges indicates the role of sensory conflict on such a feeling. Taken together, observations support the statistical findings that the key research thesis posed by the creator of the protocol (Roel Lesur et al., 2020) is of high clinical importance for dissociation. This is very exciting for the field, and in order to capture the full spectrum of the effect, study designs might want to explore options that make it feasible for people who find the effect strong to finish the task (e.g. less trials, more breaks, the role of encouragement etc.).

1.2.2 Analysing and Interpreting Results

There were a few issues in the data that were new challenges for me. The perception of subjective equality values were difficult to assess as to what was unreliable and what were true extreme effects. The large proportion of outliers and lack of manipulation check meant that it was not a straightforward decision of exclusion. In some ways this was valuable because it required deeper thought as to the nature of the measure of delay sensitivity, however it does mean that the analyses had to be very tentative. From an individual perspective, the variable was outside of my frame of reference, and unidirectional delay, is also not the conventional use of this measure. In addition I was grappling with what I observed as an experimenter. It was a good insight on how innovations in science evolve, including interpreting and understanding novel measures and the different sources of biases in new paradigms.

A number of assumptions were violated throughout the statistical tests, and at times it was challenging to decide whether conventional steps needed to be followed or not. In terms of finding guidance, I often found contradictory advice, and I understand working with clinical samples can mean that pragmatic approaches are more appropriate. For example, I was debating between using linear mixed models instead of continuing with repeated measures ANOVA, ultimately both provided

almost identical results and so the guidance to be pragmatic was probably accurate. The process made me aware of the potential depth of understanding in statistical testing, however I have to rely on conceptual explanations, and this leads to outsourcing decisions to some degree (following guidance: if X is true then I do Y), rather than feeling confident in deeper statistical or mathematical knowledge.

I decided to report and discuss nonsignificant results based on a few reasons. The descriptives and plots indicated my hypotheses were largely accurate for the self-other distinction relationships, but findings were nonsignificant. On the one hand, this is partly due to not setting up the study so I was not able to run an a priori power analysis for small effects, however it could also be due to the variability within groups, and smaller BPD group. Either way, the use of null hypothesis testing and reporting significant results only, is being challenged (Montero et al., 2023; Szucs & Ioannidis, 2017) and the importance of practical significance is undervalued but potentially very important for clinical topics (Page, 2014; Peeters, 2016). This is not to say that the design could not be improved to avoid the limitations stated. Nonetheless, this gave me direct experience of seeing possible real world differences that may not meet conventional statistical standards and made me reflect on widespread implications this could have on many unreported findings.

1.3 Understanding Mechanisms Underlying Dissociation

Dissociation is partially addressed in different therapy modalities but as discussed in the literature review it is generally conceptualised as a coping strategy and a sign of emotional dysregulation. What this project has indicated to me is that its significance in the development of and recovery from mental illness is overlooked, making it a critical gap that has widespread public health consequences (Boyer et al., 2022). Dissociation's transdiagnostic nature (Ellickson-Larew et al., 2020) raises questions about its role in the severity of many disorders (Justo et al., 2018; Kolek et al., 2019; Panisch et al., 2023) not just those commonly associated with the symptom. A network analysis showed that dissociation is less likely a response to distress and rather, distress intolerance results from dissociation (Černis et al., 2021). The same study showed that dissociation had a more

marked influence on psychotic experiences. The relative lack of research interest suggests that there is much more we do not know about its function and the potential for improving health outcomes if we addressed it more comprehensively.

One reflection is that self-coherence is so ubiquitous to wellbeing, that in ill-health it is nebulous and inadvertently overlooked, as demonstrated by the background research completed and literature review. The role of interoception in laying the foundations for higher order cognitive self-concepts is speculated on in the field (Fotopoulou & Tsakiris, 2017; Tsakiris, 2017). Theories of how dissociation is linked to identity disruption (e.g. Schimmenti & Caretti, 2016) illustrate how early interactions with caregivers, interoception, emotional regulation and self/other representations coalesce. There is a scarcity of research testing the precise relationship between minimal self and narrative self and considering self-structure as opposed to self-content may offer promising lines of enquiry. Integration is a concept applied to the organisation of multisensory inputs that promotes stable perception and thus selfhood (Blanke, 2012). In psychology, it is surprisingly ignored. Self-concept coherence is somewhat considered in the personality literature (Markus & Kunda, 1986.). In clinical perspectives, the interest in fragmented self-concept has strongest ties with psychodynamic schools of thought. One application of "integration" refers to reconciling polarised good self-representations and "split-off" bad self-representations to develop a more realistic, and therefore robust, self-concept. In cognitive-behavioural approaches, self-concepts (or self-beliefs) are addressed to some degree, but the focus is again on the content, and particularly its valence. Overall, affirmative self-beliefs are the goal. Self-coherence – or lack of - may well be spoken to within the therapeutic dialogue, and indirectly targeted, but it is not necessarily explicitly emphasized in the mechanisms of change.

A few very interesting studies have tested adapted reinforcement learning models to demonstrate how self-concept coherence is maintained via bias to positive information of the self (J. Elder et al., 2022). Neural correlates were also explored, and activation in the ventromedial prefrontal cortex correlated with the selective attenuation of social feedback and propagation with

past information (J. J. Elder et al., 2023). It has been proposed that the ventromedial prefrontal cortex, associated with self-referential processing (Uddin et al., 2007), produces self-in-context models that might integrate self-related information from multiple brain networks (Koban et al., 2021). This current study has made a modest attempt to demonstrate that the integration of bodily and psychology self is in fact related potentially via shared organising principles. The paradigm itself offers a wide range of exciting opportunities to test theories and investigate if higher order self-processing does in fact depend upon the integrity of multisensory processing. In mental illness, BPD is consistently associated with negative self-representations (e.g. Vater et al., 2015) and when provided with social feedback, those with the diagnosis are just as likely to integrate negative feedback, where healthy controls only adapted self-evaluations in response to positive feedback (Korn et al., 2016). In terms of informing treatment, it would be interesting to understand if dissociation interacted with the lack of positivity bias, and if reducing dissociation contributed to self-referential processing or not. Currently dissociation is often considered a maladaptive emotional regulation strategy, however social cognition studies of this kind would justify more concerted effort to treat dissociation directly.

1.4 Understanding Mechanisms Underlying Treatment

The literature review brought me to the wider debate in clinical psychology on shared or specific processes in therapeutic change. Interoception and dissociation is particularly synergistic with transdiagnostic domain-based framework, the Research Domain Criteria. This research framework sets out to investigate the physiological systems and mechanisms underpinning mental illness (Insel et al., 2010). The exploration of common mechanisms of change in psychotherapy (Gibbons et al., 2009; Wampold, 2015) echo the systems and process-based Research Domain Criteria. The search for active ingredients in psychotherapy is highly complex as mediation testing is not sufficient and temporality must be investigated (Cuijpers et al., 2019). Taking depression as an example, new theories of change, refined research methods are needed (Lemmens et al., 2016). A number of recommendations have been made on how best to conduct mechanism of change

research that will improve outcomes for patients (Salkovskis et al., 2023). I would argue that psychotherapy would be greatly improved by also incorporating neuroscience (De Raedt, 2020; Goodwin et al., 2018), and that includes when investigating mechanisms of change.

The literature review may argue for investigating interoception as a mechanism of change. Yet, investigating the premise of "active ingredient" research it became evident that careful consideration is required regarding impact and cost benefit of researching therapeutic mechanisms of change. One compelling position points out that the length and cost of dismantling studies may not be as justified, however their value can be assured through careful design, for example incorporating individual differences into theories of change (Lorenzo-Luaces, 2023; Lorenzo-Luaces & DeRubeis, 2018). One argument the authors make is that real-world implementation and dissemination is detached from strict active ingredient research and this must be considered for research impact. Applying these authors' recommendations, interoception and dissociation may be individual differences that interact with treatment factors. If that was the case, one possible outcome could be assessing interoception and dissociation before choosing treatment.

Psychotherapy effectiveness ranges dramatically, but it is widely acknowledged that standardised CBT successfully reduces symptoms for 50% of patients (e.g. Jarrett & Vittengl, 2015). For BPD, psychotherapy typically has small effects compared to control interventions (Cristea et al., 2017). Developing interoception-based interventions should focus on effectively reducing symptomology, acknowledging that the precise mechanism can remain elusive without preventing good outcomes. Again, reflecting on points made about diversifying participant groups, and understanding effective dissemination of treatment (Lorenzo-Luaces, 2023; Lorenzo-Luaces & DeRubeis, 2018), this new frontier of mental health science has the opportunity to accelerate impact for patients, by designing treatments with inclusivity and accessibility in mind.

A promising qualitative study gathering patient experiences has captured the anecdotal clinical observations that physical symptoms are an aspect of mental health problems (Hickman et al., 2025). This may have been a relatively small study, but it speaks volumes, and the field could

benefit from more patient voice projects. We may find individuals have very complex and rich bodily experiences that they themselves have never thought of as part of their mental health state. A similar story may be told regarding dissociative symptoms and their interaction with treatment interventions across multiple disorders.

1.5 Final Reflection

Overall, the combined experience of studying fundamental processes and working on a project that is novel in a few different ways was a hugely valuable experience as a trainee in clinical psychology. For effective and efficient innovation, collaboration across disciplines needs to continue to grow. Whilst interdisciplinary projects do exist on the clinical psychology doctorate, I wonder if more collaboration outside of core clinical psychology with other mental health sciences could reach their full potential with opportunities to learn and apply interdisciplinary frameworks (Tobi & Kampen, 2018).

One broader motivation to study in this area was observing the growing public rhetoric around trauma and its impact on the body across popular science and wellness content. In line with this, demand for body-based interventions (a heterogenous field of therapy) is rising, but it is yet to build an robust evidence base that fulfils conventional standards, although efforts are being made (Kuhfuß et al., 2021; Rosendahl et al., 2021). We seem to be at an interesting moment in time where decades of robust scientific methods are demonstrating the role of interoception, and public interest in preconscious body-based symptoms is running in parallel. At the same time, our profession maintains healthy scepticism of the holistic traditions or approaches that body-based therapies tend to reside. I was interested in the intersection of these three worlds. Mindfulness-based therapy is providing a clinical home for interoception, and this is undoubtedly an approach that has also faced scepticism but now features in the NICE guidelines for treating depression (NICE, 2022). I am certainly curious to see how science and experiential practices may meet, and how our profession responds to this in the future.

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Appendix A - Parent Study and Individual Contribution

Parent Study and Individual Contribution.

This study was part of larger PhD project, 'Dissociative Symptoms and Interoceptive Integration Study' managed by PhD student Sascha Woelk. The study was designed and underway when I joined. I developed my own research question and hypotheses, and added the primary measure, Self-concept Clarity Scale (Campbell et al., 1996). The ethical applications were completed by the wider team, and the recruitment partners were also established prior to me joining the project.

Testing sessions involved the virtual reality experiment, collecting electrocardiographic activity, electromyographic activity, electrodermal activity, and beat-to-beat systolic and diastolic blood pressure, and also conducting the skin stimulation task needed for the attached PhD study investigating nociception. The majority of the control and DDD group data collection was completed prior to my joining the day-to-day testing. I ran testing sessions for a small proportion of participants in the control and DDD group through July-September. To support the team, I collected data for additional participants taking part in the nociception task only, in October-November 2024. I trained a colleague to take over this data collection. I ran testing sessions for the BPD Group and have trained the same colleague in the mixed-reality task for them to collect data with the BPD group independently since April 2025.

In collaboration with my colleagues at the Probing Social Exchanges project, I was responsible for planning and managing the referral process from the Probing Social Exchanges project to the 'Dissociation Symptoms and Interoceptive Integration Study'. This involved follow-up phone calls, to secure the participants. The colleague running the testing sessions and the Probing Social Exchanges team refer to me for queries regarding exclusion criteria and suitability concerns. Anything beyond my knowledge is ran past the clinical advisor to the project.

The PhD student computed the point of subjective equality values. I completed the data analyses detailed in this paper and write-up independently.

Appendix B - Ethics Approval

RESEARCH AND INNOVATION SERVICES

20th October 2023

Professor Sarah Garfinkel
Institute of Cognitive Neuroscience
UCL

Cc:
Sascha Woelk
Professor Anthony David

Dear Professor Garfinkel

Notification of Ethical Approval
Project ID/Title: 25987/001: Dissociative symptoms and interoceptive integration

I am very pleased to confirm in my capacity as Chair of the UCL Research Ethics Committee that your study has been ethically approved by the UCL REC until **30th September 2026.**

Ethical approval is subject to the following conditions:

Notification of Amendments to the Research
Please seek Chair's approval for proposed amendments (to include extensions to the duration of the project) to the research for which this approval has been given. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing an 'Amendment Approval Request Form'
https://www.ucl.ac.uk/research-ethics/responsibilities-after-approval

Adverse Event Reporting – Serious and Non-Serious
It is your responsibility to report to the REC any unanticipated problems or adverse events involving risks to participants or others. The REC should be notified of all serious adverse events via the Research Ethics Service (ethics@ucl.ac.uk) immediately after the incident occurs. Where the adverse incident is unexpected and serious, the Chair will decide whether the study should be terminated pending the opinion of an independent expert.

For non-serious adverse events, the Chair should again be notified via the Research Ethics Service within ten days of the incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Chair will confirm that the incident is non-serious and report to the REC at the next meeting. The final view of the REC will be communicated to you.

Final Report
At the end of the data collection element of your research we ask that you submit a very brief report (1-2 paragraphs will suffice) which includes issues relating to the ethical implications of the research i.e., any issues obtaining consent, participants withdrawing from the research, confidentiality, protection of participants from physical and mental harm etc.

Research Ethics Service
Research and Innovation Services
University College London
ethics@ucl.ac.uk
www.ucl.ac.uk/research-ethics/

In addition, please:

- ensure that you follow all relevant guidance as laid out in UCL's Code of Conduct for Research;
- note that you are required to adhere to all research data/records management and storage procedures agreed as part of your application. This will be expected even after completion of the study.

With best wishes for the research.

Yours sincerely

Professor Sarah Edwards
Chair, UCL Research Ethics Committee

Research Ethics Service
Research and Innovation Services
University College London
ethics@ucl.ac.uk
www.ucl.ac.uk/research-ethics/

Ymchwil Iechyd a Gofal Cymru
Health and Care Research Wales

Ariennir gan Lywodraeth Cymru
Funded by Welsh Government

Wales Research Ethics Committee 3
Cardiff

Please note: This is the favourable opinion of the REC only and does not allow the amendment to be implemented at NHS sites in England until the outcome of the HRA assessment has been confirmed.

18 March 2024

Professor Peter Fonagy
HoD, Department of Clinical
Educational and Health Psychology
UCL, Gower Street
London
WC1N 3BG

Dear Professor Fonagy

Study title:	**Probing Social Exchanges – A Computational Neuroscience Approach to the Understanding of Borderline and Anti-Social Personality Disorder**
REC reference:	**12/WA/0283**
Amendment number:	**Substantial Amendment 15**
Amendment date:	**12 September 2023**
IRAS project ID:	**103075**

The above amendment was reviewed at the meeting of the Sub-Committee held on 11 March 2024 by the Sub-Committee in correspondence.

Ethical opinion

The members of the Committee taking part in the review gave a favourable ethical opinion of the amendment on the basis described in the notice of amendment form and supporting documentation.

Approved documents

The documents reviewed and approved at the meeting were:

Document	*Version*	*Date*
Completed Amendment Tool [Substantial Amendment 15_authorised_tool]	1	12 September 2023
GP/consultant information sheets or letters [Clinician Info Sheet, Remote Study, MBTi, Tracked]	4.2	12 September 2023
GP/consultant information sheets or letters [Clinician Info Sheet, Remote Study, MBTi, Clean]	4.2	12 September 2023
GP/consultant information sheets or letters [Clinician Info Sheet, Remote Study, Tracked]	4.1	12 September 2023
GP/consultant information sheets or letters [Clinician Info Sheet, Remote Study, Clean]	4.1	12 September 2023

Letter from sponsor [Sponsorship Approval]	1	09 February 2024
Other [Amendment Tool Supplement Change 4]	1	12 September 2023
Other [Debrief Sheet, Remote Study, Tracked]	2.1	12 September 2023
Other [Debrief Sheet, Remote Study, Clean]	2.1	12 September 2023
Participant consent form [Participant Consent Form_v1.6.1_12.09.2023_Remote Study_Tracked_noCA]	1.6.1	12 September 2023
Participant consent form [Participant Consent Form_v1.6.2_12.09..2023_Remote Study_MBTi stream_Tracked_noCA]	1.6.2	12 September 2023
Participant information sheet (PIS) [Participant information sheet_v1.9.1_12.09.2023_RemoteStudy_Controls_Tracked_noCA]	1.9.1	12 September 2023
Participant information sheet (PIS) [articipant information sheet_v1.9.1_12.09.2023_RemoteStudy_Patients_Tracked_noCA]	1.9.1	12 September 2023
Participant information sheet (PIS) [Participant information sheet_v1.9.2_12.09.2023_RemoteStudy_Patients_MBTi stream_Tracked_noCA]	1.9.2	12 September 2023
Research protocol or project proposal [Research Protocol Clean]	1.12	12 September 2023
Research protocol or project proposal [Research Protocol Tracked]	1.12	12 September 2023
Validated questionnaire [Invalidating Childhood Experiences Scale (ICES)]	1	12 September 2023
Validated questionnaire [Working Alliance Inventory, Short Revisited (WAI-SR)]	1	12 September 2023
Validated questionnaire [Social Network Analysis Questionnaire (SNA)]	1	12 September 2023
Validated questionnaire [Social Network Analysis Questionnaire (SNA)]	1	12 September 2023
Validated questionnaire [Questionnairs for opt-in in person tasks]	1	12 September 2023
Validated questionnaire [Post Traumatic Sexuality Scale (PTSEX)]	1	12 September 2023
Validated questionnaire [Perceived Positive Appraisal Style Scale (PASS)]	1	12 September 2023
Validated questionnaire [Interpersonal Reactivity Index (IRI)]	1	12 September 2023
Validated questionnaire [International Trauma Questionnaire (ITQ)]	1	12 September 2023
Validated questionnaire [Failures in Mentalization of Trauma (FMTQ)]	1	12 August 2023
Validated questionnaire [Defense Mechanisms Rating Scale (DMRS)]	1	12 September 2023
Validated questionnaire [Cambridge Depersonalization Scale (CDS)]	1	12 September 2023
Validated questionnaire [Anxiety-Symptoms-Questionnaire (BAI)]	1	12 September 2023

Membership of the Committee

The members of the Committee who took part in the review are listed on the attached sheet.

Working with NHS Care Organisations

Sponsors should ensure that they notify the R&D office for the relevant NHS care organisation of this amendment in line with the terms detailed in the categorisation email issued by the lead nation for the study.

Amendments related to COVID-19

We will update your research summary for the above study on the research summaries section of our website. During this public health emergency, it is vital that everyone can promptly identify all relevant research related to COVID-19 that is taking place globally. If you have not already done so, please register your study on a public registry as soon as possible and provide the HRA with the registration detail, which will be posted alongside other information relating to your project.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

HRA Learning

We are pleased to welcome researchers and research staff to our HRA Learning Events and online learning opportunities– see details at: https://www.hra.nhs.uk/planning-and-improving-research/learning/

IRAS Project ID - 103075:	**Please quote this number on all correspondence**

Yours sincerely

[redacted]

PP Miss Joanne Love
Dr Kath Clarke
Chair

E-mail: [redacted]

Enclosures: *List of names and professions of members who took part in the review*

Copy to: *Dr David Wilson*

Wales REC 3

Attendance at Sub-Committee of the REC meeting on 11 March 2024

Committee Members:

Name	*Profession*	*Present*	*Notes*
Dr Kath Clarke	Head of Quality	Yes	Chaired meeting
Dr Simone Cuff	Lecturer in Biomedicine	Yes	

Also in attendance:

Name	*Position (or reason for attending)*
Miss Joanne Love	Approvals Administrator (minuted meeting)

Appendix C – Communications For Recruitment

PARTICIPATE in NEUROSCIENCE RESEARCH
focused on DISSOCIATIVE SYMPTOMS

Dissociation is a way that the mind copes with too much stress, such as during traumatic events. If you dissociate you may feel detached from yourself or the world around you.

We would like understand the role that bodily signals play in dissociation.

What to expect?

- Complete the short screening survey (5 min).
- If eligible, you will be invited to a testing session near Russel Square.
- During the testing session (2-3 hrs), you will complete a virtual-reality task and a task involving electrical skin stimulation while we monitor your heart rate, blood pressure, muscle activity and skin conductance.

Compensation

You will receive £30 or 2 credits for your time (2 hrs total)

Participants must be aged 18-64

Interested?

Scan the QR code and complete the short 5 min screening survey

This study has been approved by the UCL Research Ethics Committee 25987/001

You can contact the research team, if you have any questions:

[redacted]

UCL

UCL Cognitive Neuroscience

Leverhulme Doctoral Training Programme for the Ecological Study of the Brain (ECOLOGICAL BRAIN DTP)

Email template for study invitation

The template here was used for control group and individuals who came via Unreal recruitment partner. An adapted version was used for the third group referred via Probing Social Exchanges, to reflect their referral pathway experience.

Dear «Name»,

Thank you for your interest in taking part in our study "The role of bodily signals in how we perceive ourselves and the world around us".

We would like to invite you to sign up for an in-person testing session.

What does the study involve?
During the in-person testing session, you will complete two computerised psychological tasks, while we monitor your bodily signals (heartrate, skin conductance, beat-to-beat systolic and diastolic blood pressure) non-invasively (electrocardiogram [ECG], skin conductance unit, and beat-to-beat blood pressure cuffs). The first task will involve wearing a virtual-reality headset, while receiving gentle brushstrokes on your arm. The second task will involve receiving non-harmful electric skin stimulation that may be unpleasant but not painful. You will also be asked to complete a series of questionnaires about your thoughts, behaviour, feelings, mental health, and current medications. There are no serious risks from performing the computerised tasks or from the equipment for measuring bodily signals or from the mild electric skin stimulation.

What are the benefits of taking part?
You will be reimbursed £37-45 for your time spent on-site (i.e. £15/hour for a study duration of approximately 2.5-3 hours total). Alternatively, if you are a UCL student you can also opt to receive 2 credits for your participation.

How do I book a testing slot?
Please book onto a testing slot via our testing slot booking page.

Testing will take place at the UCL Institute of Cognitive Neuroscience https://bit.ly/41frgxM.

Where can I get more information?
More detailed information can be found on our Participant Information Sheet.
We will also ask for your consent at the start of the testing session, for which a sample form can be found here.

If you have any further questions about the study please get in touch with the study coordinator Sascha Woelk at

Thank you for supporting our research,
Sascha Woelk
PhD Student

Appendix D - Information Sheets and Consent Forms

Participant Information Sheet For Adults

UCL Research Ethics Committee Approval ID Number: 25987/001

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET

Title of Study: Dissociative symptoms and interoceptive integration
(The role of bodily signals in how we perceive ourselves and the world around us)

Department: Institute of Cognitive Neuroscience, UCL

Name and Contact Details of the Researcher(s):
Sascha Woelk
Institute of Cognitive Neuroscience Alexandra House
17 Queen Square
London WC1N 3AZ
[redacted]

Name and Contact Details of the Principal Researcher:
Prof Sarah Garfinkel
Institute of Cognitive Neuroscience Alexandra House
17 Queen Square
London WC1N 3AZ
[redacted]

1. **Invitation Paragraph**
   You are being invited to participate in a research project. Before you consent to participate in the study, it is important that you understand why the research is being undertaken and what participation will involve. Please take time to read the information and feel free to ask the if there is anything that is unclear or that you would like more information about. Take time to decide whether you wish to participate or not. Thank you.

2. **What is the project's purpose?**
   Many people may experience dissociation (dissociate) during their life. If you dissociate, you may feel disconnected from yourself and the world around you. For example, you may feel detached from your body or feel as though the world around you is unreal. Common examples when this can happen are when we are sleep-deprived or when we drink too many caffeinated beverages. Experiences of dissociation can last for a short time (minutes or hours) or for much longer (weeks or months).

   In this study, we aim to better understand how bodily responses to touch, discomfort, and emotional material interact with our self-image, and how this changes with different levels of dissociation. For this purpose, we employ a virtual reality task that help us understand how you experience the world around you; as well as a task involving mild electrical stimulation of the skin, which helps us to understand how your body processes sensory experiences. The tasks are described in more detail on the next pages.

3. **Why have I been chosen?**
To take part you must be aged 18–64 with normal or corrected-to-normal vision. If you are aged 17 or under, aged 65+ or have impaired eyesight despite wearing glasses/contact lenses, you are not eligible for this study. Participants who have a cardiac pacemaker, a history of seizures, or a history of frequent or recurrent fainting (i.e. having fainted 3 or more times in the past 2 years) cannot participate either.

We aim to include a maximum of 120 individuals in this study. Participants are shortlisted for in-person testing based on age, sex, and scores on the screening questions, which measure dissociation traits and related mental health aspects. We will include a range of people with different scores on the pre-screening questions because we want to include individuals with various levels of dissociation in our study.

4. **Do I have to take part?**
It is up to you to decide whether or not to take part. If you decide to take part, you will be given a copy of this Information Sheet and you will be asked to sign a Consent Form. You can withdraw at any time without giving a reason and without it affecting any benefits that you are entitled to. If you withdraw at any point during the study you will be paid for the full duration of the study as advertised (i.e. 2 hrs) or for your time spent at the in-person testing session (whichever is longer), either in terms of course credits or financial compensation. If you would like to withdraw, please alert the researcher. If you decide to withdraw you will be asked what you wish to happen to the data you have provided up that point.

5. **What will happen to me if I take part?**

<u>Online registration and screening</u>
When you register to participate in the study, you will be asked to complete a short screening questionnaire (lasting 3 mins).

<u>Online questionnaires</u>
Before the in-person testing session, you will have the opportunity to answer a set of questionnaires online. This is entirely optional. Alternatively, you can complete all questionnaires during the in-person testing session.

<u>In-person testing</u>
If you are shortlisted (based on age, sex, and responses on the screening form) and decide you would like to proceed with the study, we will ask you to attend an in-person testing session. The testing session lasts approximately 2 - 3 hours, including a 5-10 minute break.

During the in-person testing session, we will monitor your bodily signals (heartrate, skin conductance, beat-to-beat systolic and diastolic blood pressure) while you complete two computerised psychological tasks. You will also be asked to complete a series of questionnaires about your thoughts, behaviour, feelings, mental health and current medications.

In detail, the in-person testing session involves the following:

Informed consent

At the start of the in-person testing session you will be provided with the Participants Information Sheet (this sheet). After reading the Information Sheet, you will be invited to sign a Consent Form if you would like to participate.

Equipment setup

In order to record your bodily signals, the researcher will attach non-invasive equipment to measure your bodily signals (heartrate, skin conductance [a measure that can determine sweat response of the skin], beat-to-beat systolic and diastolic blood pressure, and electromyographic activity [muscle contraction] of the upper arm) at the start of the in-person testing session. The equipment will be attached to your fingers, wrist, upper arm and chest. For the task with the mild electric skin stimulation, another similar device will be attached to your forearm. For the task with the virtual-reality headset, we will ask you to put on the headset yourself and assist you, if needed. The equipment looks similar to the images below.

Heartbeat (ECG) sensor

Electrode for delivering electric skin simulation

Skin conductance sensors

Beat-to-beat blood pressure sensor

Electromyography sensors (muscle activity)

Virtual-reality headset

Tasks

During the first task you will be wearing a virtual-reality headset, that is connected to a webcam, so that you see the world from your regular first-person perspective, but through the webcam. The picture may sometimes be slightly delayed. During the experiment, we will ask you to look at your arm, while your arm is being stroked gently with a brush. At times, the experimenter will

stroke your arm with the brush, and at times we will ask you to stroke your own arm with the brush. You will also answer a short set of questions, regarding the experience.

During the second task you will receive mild electric skin stimulation while you will be asked to simply look at a fixation cross, displayed on the computer screen. The skin stimulation is not harmful. It will be unpleasant but tolerable, similar to a rubber band being snapped against the skin. People differ in their sensitivity to the skin stimulation. Therefore, before the task, the researcher will check with you to make sure the skin stimulation is not too strong for you. The electrical skin stimulation used in this study will be delivered through an electrode placed on the wrist. The skin stimulation will be delivered by a machine designed for routine human use, which is safeguarded to not deliver electric stimulation above safe and ethically acceptable levels. This technique has been used in hundreds of individuals within our research institute with no harmful effects.

The order of the tasks in the experiment may differ from the order in which they are described here.

Questionnaires
You will be asked to complete a series of questionnaires about your thoughts, behaviour, feelings, mental health, dissociative experiences, and current medications.

Data to be recorded
We will record your questionnaire responses, responses on the task, and bodily signals.

We will record the following personal data:

- Email address
- First name
- Age
- Sex

We will record the following special category personal data:

- Names of medications you are currently taking for psychiatric or cardiovascular conditions
- Self-reported diagnostic mental health status

You can withdraw your data at any point up to 8 weeks from today's date. After this point, your data may have already been processed in anonymised form and entered into statistical analyses together with other participants' data. You will still be able to request deletion of any personally identifiable information that we may hold after 8 weeks from today's date (for example, in the case where you requested for us to keep your data in order to inform you about future studies, or send you a copy of the research report).

Future studies
Please indicate on the Consent Form if you would like to be contacted about future research participation opportunities.

6. What are the possible disadvantages and risks of taking part?
The questionnaires contain questions about your emotions and mental health, which some people may find distressing. If any of these questions make you distressed, you may withdraw from the study at any point without giving a reason. If you are concerned about your mental

health, please contact the research team, who will be glad to put you in contact with experts on site who are available to chat with you confidentially about your concerns. Alternatively, you may prefer to contact one of the following mental health organisations who provide expert support:

Samaritans
Email: joe@samaritans.org
Tel: 116 123

Mind
Email: info@mind.org.uk
Tel: 0300 123 3393

If you would like to find out more about dissociation, you can find more information on the website of the charity Mind: https://www.mind.org.uk/information-support/types-of-mental-health-problems/dissociation-and-dissociative-disorders/about-dissociation/

Virtual reality can induce motion sickness in some individuals. Possible symptoms include dizziness, nausea, and light-headedness. In addition, using a virtual reality headset may trigger seizures or fainting in a small number of people. To minimize this risk, people with a history of seizures or frequent/recurrent fainting cannot participate. We ask that you alert the researcher should you feel dizzy, nauseous, funny or strange during the in-person testing session.

The skin stimulation may be unpleasant and uncomfortable, but they will not be painful and have no long-term effects.

There is a risk of tripping over equipment cables. To mitigate this risk, please remain seated while the electrodes are attached to you. If you need to stand (e.g. to go to the toilet), please alert the researcher who will safely remove the equipment.

We remind you that if at any point you wish to withdraw from the study, you are free to do so without giving a reason why or without penalty.

7. **What are the possible benefits of taking part?**
You will aid in much-needed research on features of dissociation. You will also be reimbursed at a rate of £15 per hour (£30-45 total for the full duration of the study) for your time on site, plus £7.50 for completing the set of online questionnaires prior to the in-person testing session. If you are a student at UCL you may also be able to choose to receive 2-3 credits (i.e. 1 credit per hour) instead of financial compensation.

8. **What if something goes wrong?**
If you have any complaints about the project or the researchers' behaviour, in the first instance you can contact the principal researcher running this project on s.garfinkel@ucl.ac.uk. If you feel your complaint has not been handled to your satisfaction you can contact the Chair of the UCL Research Ethics Committee on ethics@ucl.ac.uk.

9. **Will my taking part in this project be kept confidential?**
All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications. As part of routine research practice, we will collect personal data, including: email address, first name, age, sex, current medications, and mental health diagnostic status. Identifiable data will only be accessible by the core research team and will not be published.

10. **Limits to confidentiality**

Please note that confidentiality will be maintained as far as it is possible, unless during the testing session the researcher hears anything which makes them worried that someone might be in danger of harm, in which case they might have to inform relevant agencies of this. We would inform you of any decisions that might limit your confidentiality.

11. What will happen to the results of the research project?

The results will be published through standard scientific outlets, for example in academic journals, talks, and conference posters. If you are participating in a project run by a student, data may be included in the final submitted report, for example an undergraduate or Masters dissertation, or a PhD thesis. All personal identifiers will be removed before any publications and conclusions will be made based on all participants' data combined not data from individual participants.

If you wish to be given a copy of the report summarising the findings from this research, please provide us with your email when asked to do so on the Consent Form. Your email address will be stored separately from all other data.

Screening data will be stored separately from all other study data. Screening data will be deleted on a rolling basis at least bimonthly. If you indicate on the Consent Form that you would like to be invited to follow-up studies for this project, your screening data will be retained for up to 5 years. This data will be stored separately from all other data.

Your testing session data will be stored on the secure UCL servers for up to 10 years, where it will only be accessible by the core research team. Following publication of any resulting papers, all personal identifiers will be removed from the data. Your de-identified study data may be archived online as "open data" for up to 10 years. "Open data" means the data could be downloaded by anyone with an internet connection and used for any purpose.

12. Local Data Protection Privacy Notice

Notice:

The controller for this project will be University College London (UCL). The UCL Data Protection Officer provides oversight of UCL activities involving the processing of personal data.

Name and Contact Details of the UCL Data Protection Officer: Alexandra Potts and can be contacted at data-protection@ucl.ac.uk

This 'local' privacy notice sets out the information that applies to this particular study. Further information on how UCL uses participant information can be found in our 'general' privacy notice:

For participants in research studies, click here

The information that is required to be provided to participants under data protection legislation (GDPR and DPA 2018) is provided across both the 'local' and 'general' privacy notices.

The categories of personal data used will be as follows:
Email address
First name
Age

Sex
Names of medications you are currently taking for psychiatric or cardiovascular conditions
Self-reported mental health diagnostic status
History of seizures (if applicable)
History of fainting (if applicable)

The lawful basis for processing your personal data will be *"performance of a task in the public interest"*.

The lawful basis used to process special category personal data will be for *"scientific and historical research or statistical purposes"*.

Your personal data will be processed so long as it is required for the research project (up to 10 years). We will de-identify (pseudonymise) the personal data you provide. We will minimise the processing of personal data wherever possible.

If you are concerned about how your personal data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at data-protection@ucl.ac.uk. If you remain unsatisfied you may wish to contact the Information Commissioner's Office (ICO). Contact details, and details of data subject rights, are available on the ICO website at: https://ico.org.uk/for-organisations/data-protection-reform/overview-of-the-gdpr/individuals-rights/

13. Who is organising and funding the research?

This research is being organised by the Clinical and Affective Neuroscience group at the UCL Institute of Cognitive Neuroscience. The research is funded by Doctoral Training Programme for the Ecological Study of the Brain.

14. Contact for further information

If you would like to know more information about the study, please contact the researcher or Principal Investigator using the contact details at the top of this Information Sheet.

Thank you for reading this information sheet and for considering to take part in this research study.

CONSENT FORM FOR ADULTS IN RESEARCH STUDIES

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Title of Study: Dissociative symptoms and interoceptive integration
(The role of bodily signals in how we perceive ourselves and the world around us)

Department: Institute of Cognitive Neuroscience, UCL

Name and Contact Details of the Researcher(s):
Sascha Woelk
Institute of Cognitive Neuroscience
Alexandra House
17 Queen Square
London WC1N 3AZ
[redacted]

Name and Contact Details of the Principal Researcher:
Prof Sarah Garfinkel
Institute of Cognitive Neuroscience
Alexandra House
17 Queen Square
London WC1N 3AZ
[redacted]

Name and Contact Details of the UCL Data Protection Officer:
Contact Alexandra Potts on data-protection@ucl.ac.uk

This study has been approved by the UCL Research Ethics Committee: Project ID number 25987/001

Thank you for considering taking part in this research. The person organising the research must explain the project to you before you agree to take part. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

I confirm that I understand that by ticking/initialling each box below I am consenting to this element of the study. I understand that it will be assumed that unticked/initialled boxes means that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study.

N.B. The following will be displayed as a computer-based form. Participants will click the tick box to indicate consent

		Tick Box
1.	I confirm that I have read and understood the Information Sheet for the above study. I have had an opportunity to consider the information and what will be expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction.	
2.	I understand that I will be able to withdraw my data up to 8 weeks from today's date.	

3.	I voluntarily consent to participate in the study. I understand that my personal information (email address, first name, age, sex) and special category personal information (details of current medications, self-reported mental health diagnostic status) will be used for the purposes explained to me. I understand that according to data protection legislation, 'public task' will be the lawful basis for processing my personal data, and that 'scientific and historical research or statistical purposes' will be the lawful basis for processing my special category personal data.	
4.	I understand that confidentiality will be respected unless there are compelling and legitimate reasons for this to be breached. If this was the case we would inform you of any decision that might limit your confidentiality. I understand that my data gathered in this study will be stored anonymously or pseudonymously, and securely. It will not be possible to identify me in any publications.	
5.	I understand that my information may be subject to review by responsible individuals from the University for monitoring and audit purposes.	
6.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason and without being negatively impacted. I understand that if I decide to withdraw, any data I have provided up to that point will be deleted unless I agree otherwise.	
7.	I understand the potential risks of participating and the support that will be available to me should I become distressed during the course of the research.	
8.	I understand that, while I will not directly benefit from this study, the research has potential benefits for the scientific community.	
9.	I understand that the data will not be made available to any commercial organisations but is solely the responsibility of the researcher(s) undertaking this study.	
10.	I understand that I will not benefit financially from this study or from any possible outcome it may result in in the future.	
11.	I understand that I will be compensated for the portion of time spent in the study (if applicable) or fully compensated if I choose to withdraw.	
12.	I agree that my anonymised research data may be published online as 'open data' to be used by others for future research. I understand that no one will be able to identify me when this data is shared. I understand that once the anonymised data is shared online, it will not be possible to delete it and anyone with an internet connection will be able to access it.	
13.	I understand that the information I have submitted will be published as a report.	
14.	I wish to receive a copy of the report.	Y/N
	If yes, a box to enter their email address will appear on the screen	
15.	I hereby confirm that I understand the inclusion criteria as detailed in the Information Sheet and explained to me by the researcher.	
16.	I hereby confirm that: (a) I understand the exclusion criteria as detailed in the Information Sheet and explained to me by the researcher; and (b) I do not fall under the exclusion criteria.	
17.	I am aware of who I should contact if I wish to lodge a complaint.	
18.	I voluntarily agree to take part in this study.	

We may invite participants to participate in future studies about dissociation. If you wish the research team to retain your screening data (email address, age, sex, responses to screening questions) for up to 5 years so that you can be contacted in the future to participate in follow up studies, please tick the appropriate box below. Otherwise, your screening data will be deleted.

	Yes, I would be happy to be contacted in this way	
	No, I would not like to be contacted	

The following will be input in boxes on the screen:

Name of participant	Date	Signature

Understanding the Social Brain in Healthy Volunteers and People with Psychological Difficulties-MBTi stream

This study has been approved by the Research Ethics Committee for Wales (Project ID Number): 12/WA/0283.

We would like to invite you to participate in this research project.

You are being invited to take part in a research study. You should only participate if you want to. Before you decide whether to take part, this sheet will give you some more information about why the study is being carried out, what you would be asked to do if you decide to take part, and how the study will be conducted. Please take some time to read this sheet, and to discuss it with other people if you wish. You are also very welcome to ask any further questions about the study, or if you find anything on this sheet unclear.

Why is this study being done?

With the proposed project we plan to investigate the social brain and social behaviour of people suffering from personality disorders or similar traits and compare them with healthy control participants. Only little is known about the neurobiology and cognition of Borderline and Antisocial Personality Disorders and how patients experience themselves in their social world and groups (including therapy groups). Our study design will address some of these. This will hopefully allow us to gain a better understanding of the disorders and to develop more informed and effective treatments from which clients will benefit.

Why have you been invited to take part?

You have been invited to take part in the study because you have recently been assessed by a clinician at one of the clinical services currently collaborating with the research team.

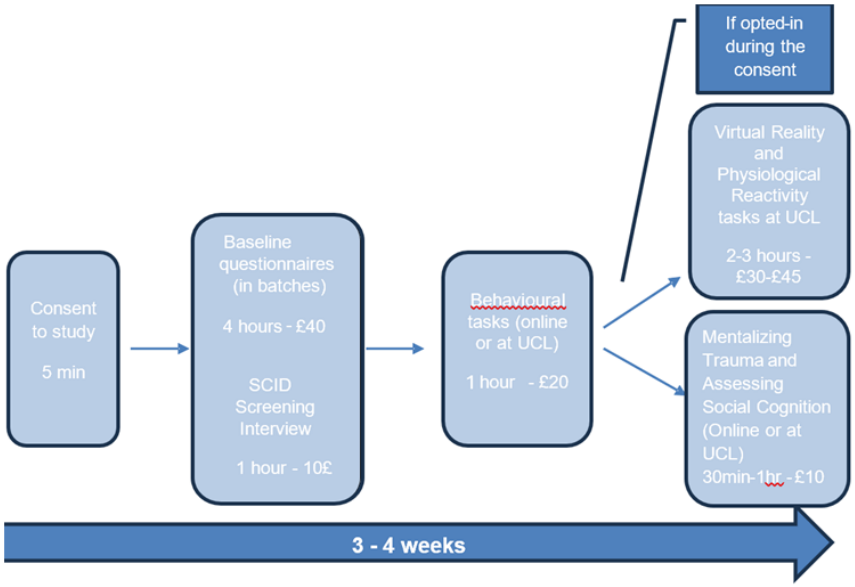
Do I have to take part?

No. Taking part in the study is entirely voluntary. It is your choice whether or not you would like to participate. Deciding not to take part in the study will not affect the care you receive from services either now or in the future. If you do decide to participate, you will be given this information sheet to keep, and you will later be asked to fill in an online consent form stating that you wish to take part. If you do give consent to take part in the study, you are still free to leave the study at any point, without giving a reason. This will not affect the care you are currently receiving, or will receive in the future. If you leave, any information that we have already collected from you will be destroyed.

What will happen if I decide to take part?

This study is an online study, meaning you do not have to travel anywhere if you don't want to and can complete all tasks from home. However, if you prefer, we can arrange for you to visit our research centre at UCL in Central London and complete the study in person. One optional study component requires you to attend in person. If you wish to take part in the study, then you can get in touch with the research team or provide your contact details so that we can arrange a time to discuss the study in more detail. If you agree to participate in this study, you will be asked to complete the following components:

Study overview (see additional diagrams below):



1. **An online consent form.** If you agree to participate, the first step will be to log into your online POD account and complete a consent form that states you have understood all the information about the study, have had a chance to ask questions and are happy to participate. The researcher will send you your unique, anonymized POD login details. If you decide to attend the study in person, you will complete this consent form on paper and we will ask you to provide signed consent if you are happy to participate.

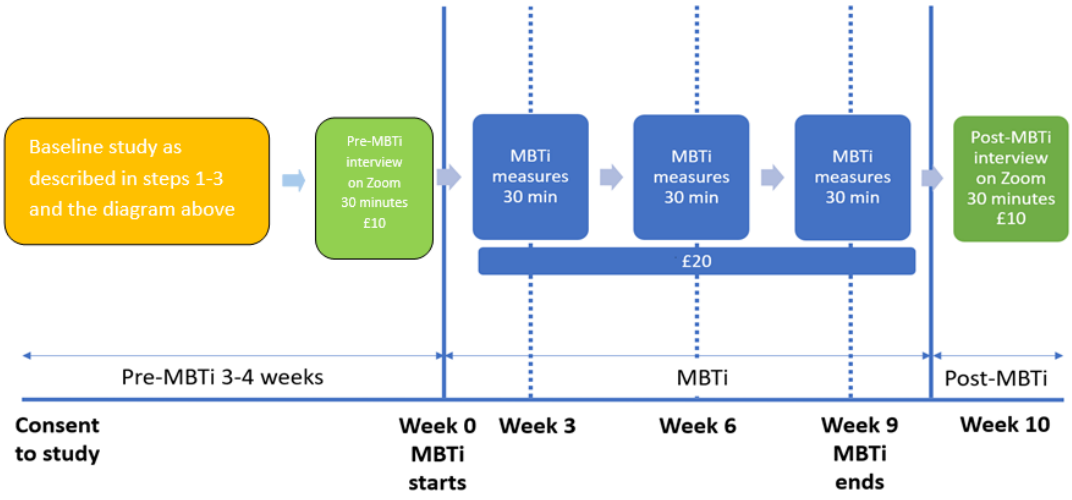
2. **Self-report questionnaires** asking about personality/character traits, childhood and upbringing experiences, other life experiences, your general mental and physical health. These questionnaires will always be completed online on POD, but you can let the researcher know if you need support.

    - A description of each questionnaire can be found at the end of this information sheet. If you are interested, you can have a look through this to decide if you are happy with these questionnaires or if you have any questions you would like to ask the research team. In case there are questionnaires you would prefer not to answer, that is okay. You can still participate and let the researcher know which questionnaire you would like to skip.

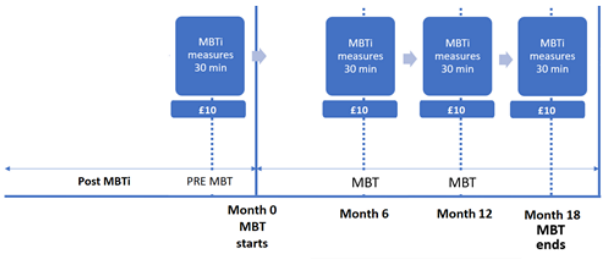
    - These questionnaires will be made available to you on POD. The researcher will control the number of questionnaires that are available to you so that you do not become overwhelmed. Once you complete the first part of the questionnaires, the researcher will make the next part available.

    - Altogether, the questionnaires should take about 3-4 hours. You do not have to complete them all at once, you can split this up in any way that is convenient for you. All questionnaires should be completed within 2 weeks of starting the study (and a few will be done during and after the MBTi group is completed). During that process you will also have a SCID II which is a psychiatric interview that takes approximately 30 to 60 minutes to complete. This will be conducted online via the recorded video call.

3. **Behavioural computer tasks** called the Trust game and the Intentions task. These games will be completed online on your computer or laptop, or if you prefer, in person with a researcher at UCL.
    - Please let the researcher know if you do not have available a laptop or computer.
    - For all games, the instructions will be sent to you by the researcher and you will have an opportunity to discuss these. It is important that you understand the instructions.
    - For all games, you will be responding to either written cues or videos on the screen using a keyboard and a mouse. You will be playing with virtual partners. The games are similar to simple computer games.
    - The Trust and the Intentions games should each take about 20-30 minutes to play.
4. **MBTi evaluation component.** If you take part in the MBTi psychoeducation group and/or the 18-month MBT programme as part of your treatment, you will be invited to complete a few questionnaires and an interview.
    - **During your MBTi psychoeducation:** The questionnaires will take about 20-30 minutes each time, and you will be asked to answer them after the 3rd, after the 6th and after the final session of MBTi. You might also be invited to take part in a 30 minute interview before and after the MBTi process.



    - **During your 18-month MBT treatment programme:** If you go on to complete the 18-month MBT treatment programme, then you will be invited to complete the same questionnaires again before you start the treatment programme, and 6 and 12 months, and once the treatment programme is complete. You can still participate in the study even if you are not yet sure whether you will do the 18-month programme.



5. **Optional opt-in component 1**: the Mentalizing Trauma and Assessing Social Cognition component. This involves two online tasks, and you will be either watching or reading cues about human interactions and then answering some multiple choice questions about that (e.g., how did this person feel?). This component will take about 30 minutes to 1 hour, and it will be important that you can complete both tasks in one sitting.

6. **Optional opt-in component 2:** the Dissociative Symptoms and Interoception component. It is only possible to participate in this component if you can attend an in-person testing appointment at the research centre at UCL in Central London. Please read the following description carefully:

    - Research shows that dissociative experiences are common across many mental health conditions. In this study, we aim to better understand how bodily responses to touch and discomfort interact with our thoughts, feelings and life experiences, and how this changes with different levels of dissociation.

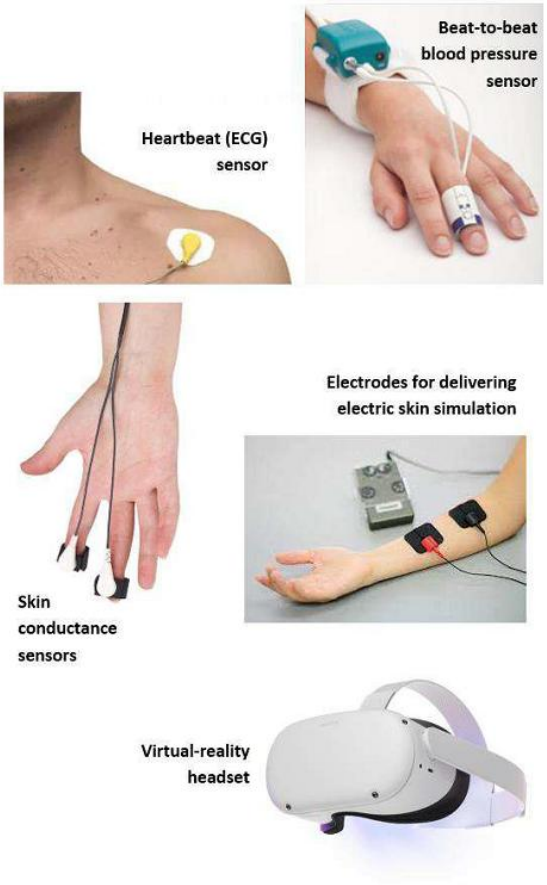
    - If you have a cardiac pacemaker you **cannot** participate. If you have a history of seizures and/or recurrent/frequent fainting (i.e. having fainted 3 or more times within the past two years) you **cannot** participate.

    - We will record the names of medications you are currently taking for psychiatric or cardiovascular conditions.

    - **Task Process**: The testing session lasts approximately 2-3 hours, including a 5-10 minute break. During the in-person testing session, we will monitor your bodily signals (heartrate, skin conductance, beat-to-beat systolic and diastolic blood pressure) while you complete two computerised psychological tasks. You will also be asked to complete a series of questionnaires about your thoughts, behaviour, feelings, mental health and current medications. Participants will have the opportunity to complete a subset of these questionnaires online prior to the in-person testing session, to reduce the length of the in-person testing session. In detail, the in-person testing session involves the following:

    - **Equipment setup**: In order to record your bodily signals, the researcher will attach non-invasive equipment to measure your bodily signals (heartrate, skin conductance, beat-to-beat systolic, diastolic blood pressure, and muscle contraction of the upper arm) at the start of the in-person testing session. The equipment will be attached to your fingers, upper arm, rib cage , and just below the shoulder. For the task with the mild electric skin stimulation, another similar device will be attached to your wrist. For the task with the virtual-reality headset, we will ask you to put on the headset yourself and assist you, if needed. The equipment looks similar to the images below.

    - **Questionnaires** You will be asked to complete a series of questionnaires about your thoughts, behaviour, feelings, mental health, dissociative experiences, and current medications. A description of each questionnaire can be found at the end of this information sheet.



7. **Study completion & debriefing**. Once you have completed the study, or in case you decide to withdraw at any point, the researcher will provide you with some debriefing information. The researcher will also ask you to provide your bank account details so that an online bank transfer for your participation payment can be made. You can withdraw at any time without penalty. In this event, you will be compensated for the full duration of the study as advertised or for the time they attended (whichever longer).

No part of the study is compulsory and there will be separate consent sections for each part of the study.

We do encourage you to discuss these details with the research team in order to make sure that you fully understand them and that your concerns and questions can be addressed.

What are the possible disadvantages and risks of taking part?

There are no major risks in participating. Some people may find it upsetting to answer questions about their personal experiences. At the end of this information sheet you will find a description of all the questionnaires. These descriptions can help you decide whether you would like to participate in this study. Of course, if you decide to participate, you can skip a questionnaire or a specific question in case you are worried that it might be upsetting. Please feel free to discuss this with the researcher at any point. We will support you if you become upset. A specific Risk and Safety protocol for this study has been

developed. You will be given time at the end of the study (or at the moment of study withdrawal) to be fully debriefed with a member of the research team and provided with information on crisis phone numbers. The debriefing sheet also contains a self-guided relaxation exercise and some mindfulness techniques. Your personal therapist will also be aware of your participation in the study and able to support you should you find discussing your experiences difficult. Should you feel overwhelmed or acutely distressed during or at the end of the assessments, we you will be appropriately looked after by an experienced clinician. You can also contact the Samaritans help line for free from any phone by dialling 116 123.

If you opt in to taking part in the optional Virtual Reality and Physiological Responsivity component, the following applies:

Virtual reality can induce motion sickness in some individuals. Possible symptoms include dizziness, nausea, and light-headedness. In addition, using a virtual reality headset may trigger seizures or fainting in a small number of people. To minimize this risk, people with a history of seizures or frequent/recurrent fainting cannot participate.

To minimise any risk, we ask that you alert the researcher should you feel dizzy, nauseous, funny or strange during the in-person testing session so that we can take a break if needed. In addition, the entire task will be performed seated in a chair with arm rests and the area will be kept clear of sharp objects. The skin stimulation may be unpleasant and uncomfortable, but they will not be painful and have no long-term effects. There is a risk of tripping over equipment cables. To mitigate this risk, please remain seated while the electrodes are attached to you. If you need to stand (e.g. to go to the toilet), please alert the researcher who will safely remove the equipment.

What are the possible benefits of taking part?

You may find it interesting to complete these tasks and the information gathered during this study will also help to inform our understanding of treatment for Personality Disorders, which will hopefully be a step towards helping improve interventions in the future.

Will I be paid for taking part in the study?

As an acknowledgement of your time, we will be offering you £40 for completing all self-report questionnaires, £10 for completing the SCID assessment interview, £20 for completing the computerised tasks, £10 for completing the optional opt-in component 1, and £30-£45 for completing the optional opt-in component 2. Therefore, the total reimbursement for completing the full baseline study will be up to £125. You can also win some additional money (up to £5) on the computer tasks.

If you complete the MBTi evaluation component, you will receive an additional £20 for the MBTi questionnaires, £20 for the MBTi interviews, and £10 per completion of the long-term follow-up MBT questionnaires. This will be paid to you via an online bank transfer at the end of the study (you will receive the payment for the MBTi questionnaires with the full study payment, and the payment for the long-term follow-up MBT questionnaires will be made immediately after each time point has been completed). In case you decide to withdraw or drop out of the study, you will be reimbursed for your time spent on anything completed so far. If you decide to attend the research appointment in person, you will be reimbursed for your travel costs as long as you can provide a receipt for them.

Who will know you are taking part in the study?

We will inform your personal therapist if you have been recruited via these services. We may inform your GP of your participation in this study, but information collected during all stages of the study will be kept strictly confidential. All information will only be viewed by members of the research teams at University College London and Virginia Tech University in

the US. However, if through the course of the study it was found that you are at immediate risk of harm to yourself or others, this information will be shared with your therapist or GP and, if necessary, emergency services.

Your consent form will be kept in a separate location from all your other data, ensuring that this remains anonymous. All data will be stored in secure locations whereby a participant ID will be assigned to your data, non-identifiable personal information and the results of your tasks will be recorded on computers or flash drives which are password protected.

The data from this study will be stored in accordance with the UCL and NHS Data Protection and Records Management policies.

Your study data and any information will be treated as strictly confidential and handled in accordance with the provisions of the UK General Data Protection Regulation (UK GDPR).

Will my taking part in this project be kept confidential?

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any ensuing reports or publications.

If you are concerned about how your personal data is being processed, or if you would like to contact us about your rights, please contact UCL in the first instance at data-protection@ucl.ac.uk.

What will happen to the results of the research study?

The results will be written up in the form of reports to be submitted to scientific journals or presented at conferences. You will not be identifiable from these results. On completion and if you request it you will be sent a report of the study.

What if there is a problem?

Every care will be taken in the course of this study.

If you wish to complain, or have any concerns about any aspect of the way you have been approached or treated by members of staff you may have experienced due to your participation in the research, National Health Service or UCL complaints mechanisms are available to you. Please ask your research doctor if you would like more information on this.

In the unlikely event that you are harmed by taking part in this study, compensation may be available to you. If you suspect that the harm is the result of the Sponsor's (University College London) or the hospital's negligence then you may be able to claim compensation. After discussing with your research doctor, please make the claim in writing to the Prof Fonagy who is the Chief Investigator for the research and is based at UCL, Research Department of Clinical, Educational and Health Psychology, 26 Bedford Way, London, WC1H 0AP. The Chief Investigator will then pass the claim to the Sponsor's Insurers, via the Sponsor's office. You may have to bear the costs of the legal action initially, and you should consult a lawyer about this

Who has reviewed this study?

This study has been reviewed by the **REC for Wales 12/WA/0283**

Contact Details

If you wish to contact the research team to discuss any of the information further or any concerns you have about the study, then please do so by getting in touch with the members of the research team listed below:

If you feel that we have not addressed your questions adequately or if you have any concerns about the conduct of the research team, then please contact my supervisor Dr. Janet Feigenbaum (Strategic and Clinical Lead for Personality Disorder Services, North East London NHS Foundation Trust and Senior Lecturer, Research Department of Clinical, Educational and Health Psychology, UCL) on 07957 919 961or by email at janet.feigenbaum@nhs.net.

Janet Feigenbaum, PhD Research Department of Clinical, Educational and Health Psychology General Office, Room 436, 4th Floor 1-19 Torrington Place, London, WC1E 7HB; Telephone: 07957 919 961	Tobias Nolte MD, tobias.nolteMD@annafreud.org Wellcome Trust Centre for Neuroimaging & Research Department of Clinical, Educational and Health Psychology 12 Queen Square, London WC1N 3BG

Thank you very much for taking the time to read this information sheet.

Questionnaire Descriptions

The below provides a description of the self-report questionnaires that are part of the study. If, based on this description, you are concerned that a specific questionnaire might make you feel upset, please let your researcher know and this questionnaire can then be skipped. We do not want to make you feel upset in any way. In case you decide to go ahead with all questionnaires and unexpectedly find that a question is upsetting you, then the questionnaire can be abandoned at that stage as well.

It is important to keep in mind that all questionnaires are answered on scales. Therefore, some items may not apply to you at all, or you do not experience certain things a lot, and other items might apply to you a lot, or you experience certain things often. This will vary for every person. The questionnaires cover a wide range of topics. It is also important to know that they are not used for any diagnostic purpose, nor can we make any clinically relevant judgments based on your responses. They simply provide an overview of yourself based on your answers. All your answers will be kept strictly anonymously and confidentially.

Once you start working through these questionnaires, we will make them available to you in smaller portions so that it is not overwhelming. We also encourage you to take as many breaks as you'd like so that you do not feel fatigued or stressed.

Questionnaire	Brief Description
Main Study	
Brief Symptom Inventory (BSI)	This questionnaire contains a list of problems people sometimes report, including both physical and mental health symptoms. Examples include "Nervousness or shakiness inside" and "Feeling hopeless about the future". It asks you to indicate how much each of these problems has caused you distress in the past 7 days on a scale from Not at All to Extremely.
Antisocial Process Screening Device (APSD)	This questionnaire is a screening questionnaire for the presence of antisocial, impulsive or self-enhancing behaviours. Examples include "You lie easily and skilfully" and "You do risky and dangerous things". It asks you to choose how much these items describe you on a scale from Not at all true to Definitely true.

Personality Assessment Inventory – Borderline subscale (PAI-BOR)	This questionnaire assesses four domains of personality: affective instability, identity problems, interpersonal problems, and self-harm. Examples include "My mood can shift quite easily" and "I can't handle separation from those close to me very well". It asks you to choose how true each statement is for you, on a scale from False to Very True.
Inventory of Interpersonal Problems (IIP32)	This questionnaire is focused on your interpersonal relationships, or your relationships with other people. It will ask about recent experiences with other people and whether you have had any difficulties relating to other people. Examples include "It is hard for me to confront people with problems that come up" and "I am overly generous to other people". You will answer the questions on a scale from Not at all to Extremely.
Self-Report Psychopathy Scale (Levenson SRPS)	This questionnaire will ask you about your empathy levels and your emotions towards other people. It will also ask you about your lifestyle preferences. Examples include "For me, what's right is whatever I can get away with" and "Love is overrated". You will be asked to answer on a scale from Strongly Disagree to Strongly Agree.
Beck Depression Inventory (BDI-II)	This questionnaire will ask you about the presence and severity of depression symptoms. Examples include "Loss of pleasure" and "Crying", and you will be asked to answer how often individual symptoms occurred within the past 14 days.
Assessment of significant losses	This questionnaire will ask you if you have experienced any significant losses and/or separations of meaningful individuals during your childhood (from parents/siblings/close family members/close friends).
Schizotypal personality questionnaire (SPQ)	This questionnaire will ask you about a list of experiences some people sometimes have. Some of these experiences may be rather unusual. Examples include "Have you had experiences with the supernatural?" and "Some people think that I am a bizarre person". You will be asked to choose between Yes and No for each item.
Drug & Alcohol Use Questionnaire (DASI)	This questionnaire will ask you about your use of alcohol, nicotine and other substances. It will also ask you about the presence of a history of self-harm. The items will be answered on a scale from Never to Every day or nearly every day.
Standardized Assessment of Personality, Abbreviated Scale (SAPAS)	This short questionnaire will ask you about some common personality traits and preferences. An example includes "In general, do you trust other people". You are asked to choose from Yes or No, based on what is mostly true for yourself.
Childhood Trauma Questionnaire (CTQ)	This questionnaire will ask you about your childhood experiences, and whether there were any occurrences of trauma, including physical, sexual and emotional. Examples include "People in my family said hurtful or insulting things to me" and "Someone tried to touch me in a sexual way or tried to make me touch them". You will be asked to answer on a scale from Never True to

	Very Often True.
Dissociative Experience Scale (DES)	This questionnaire will ask you about every-day experiences you might have had in your life, specifically focusing on your memory, your identity, your awareness and your thoughts. Examples include "Some people find that they have no memory for some important events in their lives (for example, a wedding or graduation)" and "Some people sometimes have the experience of feeling that their body does not belong to them". You will be asked to answer on a scale of 0% to 100%, depending on how often you have these experiences.
PTSD Checklist (PCL-S)	This questionnaire will ask you about the presence of an unusually stressful or traumatic experience in your life in the past 4 weeks, and if this is not the case, you can also consider an experience from any time in the past. You will be asked to indicate how much this experience is affecting various parts of your thoughts, feelings and behaviours today. Examples include "Repeated, disturbing dreams of stressful experience" and "Trouble falling or staying asleep". You will be asked to answer on a scale from Not at All to Extremely.
Paranoid Thoughts Scale (GPTS)	This questionnaire asks you about thoughts and feelings you may have had towards others in the past month. Examples include "People talking about me behind my back" and "I was sure someone wanted to harm me". You will be asked to answer on a scale from Not at all to Totally.
Barratt Impulsiveness Scale (BIS-11)	This questionnaire will ask you about your planning and decision-making preferences and whether you have impulsive or non-impulsive tendencies. Examples include "I do things without thinking" and "I am restless at the theatre or in lectures". You will be asked to answer on a scale from Never to Almost Always/Always.
Other As Shamer (OAS)	This questionnaire explores your expectations and thoughts about how others see or judge you. You will be asked to respond to statements describing feelings or experiences about how you may feel other people see you. Examples include "I think that other people look down on me" and "Others see me as fragile". You will answer on a scale from Never to Almost Always.
Reflective Functioning Questionnaire (RFQ)	This questionnaire will ask you about your own thoughts and feelings as well as how you think about others' thoughts and feelings. Examples include "I don't always know why I do what I do" and "My intuition about a person is hardly ever wrong". You will be answering on a scale from Strongly disagree to Strongly agree.
Experiences in Close Relationships (ECR-R)	This questionnaire assesses your attachment preferences when you are in a close or romantic relationship. It can also be answered based on imagining yourself in a close relationship, if you are currently not in one. Examples include "I rarely worry about my partner leaving me" and "I don't feel comfortable

	opening up to a romantic partner". You will be asked to answer on a scale from Strongly disagree to Strongly agree.
The OPD structure questionnaire (OPD-SQ)	This questionnaire assesses your personality structure. You will be shown a series of character description of people and be asked to indicate how much these statements reflect you. Examples include "I find it difficult to be aware of my feelings" and "I find it easy to get into contact with other people". You will be answering on a scale from Fully disagree to Fully agree.
Agency questionnaire (AFI)	This questionnaire measures your sense of authorship/self-congruence, your sense of control over your actions and your interest taking. Examples include "I strongly identify with the things that I do" and "I often pressure myself". You will be asked to answer on a scale from Not at all true to Completely true.
Difficulties in Emotion Regulation Scale (DERS)	This questionnaire is about any difficulties in emotion regulation, including awareness and understanding of emotions, acceptance of emotions, the ability to engage in goal-directed behaviour and refrain from impulsive behaviour when experiencing negative emotions. Examples include "I care about what I am feeling" and "When I'm upset, I feel weak". You will answer on a scale from Almost Never to Almost Always.
Personality Assessment Inventory – Antisocial Subscale (PAI-AS)	This questionnaire assesses the tendency for impulsive and antisocial behaviour, as well as thoughts and emotions about others. Examples include "I like to drive fast" and "I've done some things which aren't exactly legal". You will be asked to answer on a scale from False to Very True.
Life History of Aggression (LHA)	This questionnaire will ask about the presence, frequency and severity of a range of aggressive behaviours throughout the lifetime. Examples include "Get into verbal fights or arguments with other people" and "Had difficulties with the law or police which resulted in a warning". You will be asked to indicate how often these behaviours have happened on a scale from Never to Happened so many times I can't count.
Pathological Narcissism Inventory (PNI)	This questionnaire will ask about your view of yourself and your rights. Examples include "I get mad when people don't notice all that I do for them" and "Everybody likes to hear my stories". You will be asked to answer on a scale from Not at all like me to Very much like me.
Depressive Experiences Questionnaire (DEQ)	This questionnaire will ask you about experiences with depressive symptoms, self-esteem and self-criticism, and your dependency on others. Examples include "I feel I am always making full use of my potential" and "Often I feel I have disappointed others". You will be asked to answer on a scale from Strongly Agree to Strongly Disagree.
Additional Epistemic Trust Scale (aka Epistemic Trust,	This questionnaire is very similar to the above ETS but it adds other questions that expand on the above by asking about more generic situations. Examples

Mistrust, and Credulity Questionnaire) (ETMCQ)	include "I often feel that people do not understand what I want or need" and "I have often taken bad advice from the wrong people". You will be asked to answer on a scale from Strongly Disagree to Strongly Agree.
Bullying Experiences Questionnaire (BEQ)	This questionnaire asks about the presence, frequency and severity of bullying experiences in childhood and adolescence. These experiences can range from interpersonal bullying to cyberbullying, with or without physical elements. You will be asked to answer whether you had an experience of a particular type of bullying, and if you have, further questions about the impact of this bullying experience will be asked. Examples include "I was excluded from social events" and "I was touched in a way that made me feel uncomfortable".
Mentalization Questionnaire (MZQ)	This questionnaire assesses different elements of mentalizing or thinking about your own feelings and other people's feelings. Examples include "Talking about feelings would mean they become more and more powerful". You will be answering on a scale from I Disagree to I Agree.
Experience of Time Alone Scale (ETAS)	This questionnaire measures your experience of and reaction to spending time alone and loneliness. Examples include "When I am alone, I enjoy pampering and doing nice things for myself" and "I feel hopeless about my future when I am alone". You will be asked to answer on a scale from Not at all to A great deal.
Personality Inventory for DSM-5, Brief (PID-5-BF)	This questionnaire will ask more questions about your personality traits and characteristics and what you are usually like as a person. Examples include "I worry about almost everything" and "I am easily distracted". You will be asked to answer on a scale from Very False/Often False to Very True/Often True.
Certainty about Mental States Questionnaire (CAMSQ)	This questionnaire will ask you to reflect on your own thoughts, feelings and behaviours. Examples include "I understand why certain things make me happy" and "I know how a person feels when I look at their face". You will be asked to answer on a scale from Never to Always.
Social Media Use Questionnaire (SMUQ)	This short questionnaire asks about your social media use. Examples include "I enjoy spending time on social media platforms" and "I spend more time than I should on social media platforms". You will be asked to answer on a scale from Agree to Disagree.
Perceived Positive Appraisal Style Scale, content- and process-focused subscales (PASS)	This questionnaire will ask you to reflect on how you react and feel about stressful situations. Examples include "I think that there is a solution for every problem" and I "think that I have to accept the situation." You will be asked to answer on a scale from Never to Almost Always.

Invalidating Childhood Environment Scale (ICE)	This questionnaire will ask you to assess negative interactions you had with your mother and father when growing up. Examples include "My parents would understand and help me if I couldn't do something straight away" and "When I was anxious, my parents ignored this". You will be asked to answer on a scale from Never to All The Time.
Post Traumatic Sexuality Scale (PT-SEX)	This questionnaire will ask you about uncomfortable reactions you might experience during sexual activity. Examples include "I feel very tense during sex" or "I have a hard time concentrating during sex". You will be asked to answer on a scale from Not At All to Extremely.
Defence Mechanism Rating Scale (DMRS)	This self-report measure will prompt you to reflect on defence mechanisms that you might employ in challenging situations. The examples include "Did you take an active role in solving problems when they arose?" or "Did you perceive others as 'all good' or 'all bad'?" You will be asked to answer on a scale from Not At All to Very Often/Much.
Failure to Mentalize Trauma Questionnaire (FTMCQ)	This questionnaire is about adverse relationships you may have experienced in your life. They include situations and relationships during which you experienced strong negative emotions (such as feeling betrayed, hurt, abandoned, used, disrespected, frightened or overwhelmed). An example includes: "I was treated badly but I deserved it." You will be asked to answer on a scale from Strongly Disagree to Strongly Agree.
Social Network Analysis Questionnaire (SNA)	This questionnaire will ask you to assess the quality of the relationship you have with a helping professional (e.g. your therapist) and someone from your private life. Example includes: "How reliable is this person?" and "How likely are you to go to this person when you have difficulties?". You will be asked to answer on a scale from Never to Always.
Shamed and Ashamedness Scale (SAS)	This questionnaire will ask you to think about how you experience yourself versus how you think other people experience you. Examples include "I think other people can notice my flaws" and "I get very self-conscious when I am around other people". You will be asked to answer on a scale from Not At All to A Lot.
International Trauma Questionnaire (ITQ)	This questionnaire will ask you about reactions and feelings related to past trauma. Examples include "Having powerful images or memories that sometimes come into your mind in which you feel the experience is happening again in the here and now?" You will be asked to answer on a scale from Not at All to Extremely.
Interpersonal Reactivity	This questionnaire assesses how you relate and react to others. Examples

Index (IRI)	include "When I see someone being taken advantage of, I feel kind of protective towards them." or "I really get involved with the feelings of the characters in a novel.". You will be asked to answer on a scale from Does Not Describe Me Well to Does Describe Me Well.
Psychological Emptiness Scale (PES)	This questionnaire asses the feelings of emotional numbness in your life, and a feeling of a lack of direction. For example, you are going to be asked how often you "Felt indifferent to anything that goes on around you" or "Felt incapable of doing anything right. You will be asked to answer on a scale from Never to All the Time.
MBTi evaluation component	
MBTi Attitudes and Knowledge Questionnaire	This questionnaire will ask you to think about your understanding of, attitudes towards and skills surrounding the BPD diagnosis and the MBTi psychoeducational group. You will be asked to answer on a scale from Strongly Disagree to Strongly Agree.
Helping Alliance Questionnaire Revised (HAQ-II)	This questionnaire will ask you to reflect about your relationship with the MBTi group facilitator. Examples include "I like the facilitator as a person" and "The facilitator and I have meaningful exchanges". You will be asked to answer on a scale from Strongly Disagree to Strongly Agree.
Working Alliance Inventory, Short Revised (WAI-SR)	This questionnaire asks you to reflect on the experiences you might have with your therapy or therapist. Examples include "I feel that he/she appreciates me." Or "I feel that the things I do in therapy will help me to accomplish the changes that I want." You will be asked to answer on a scale from Always to Seldom.
If you opt into the optional component 2 (Virtual Reality and Physiological Responsivity) you will also be asked to complete the following questionnaires:	
Cambridge Depersonalisation Scale (CDS)	This questionnaire describes strange and 'funny' experiences that people may have in their daily life. Examples include: "Parts of my body feel as if they didn't belong to me". You will be asked how frequent the experience occurs on a scale from Never to All The Time, as well as how long does the experience last on scale from A Few Seconds to More Than A Week.
Somatoform Dissociation Questionnaire (SDQ-20)	This questionnaire asks about different physical symptoms or body experiences, which you either may have had briefly or for a longer time. Examples include "I have pain while urinating" and "I cannot see for a while". You will be asked to answer on a scale from Not at All to Extremely.
Edinburgh Handedness	This short questionnaire will ask you which hand you prefer to use during

Inventory – Short Form (EHI-Short Form)	common daily activities such as writing or toothbrushing. You will be asked to indicate whether you mostly use right or left hand.
State-trait Anxiety Inventory (STAI)	This self-report measure will ask you to indicate your levels of anxiety. Examples include: "I feel secure" or "I am presently worrying over possible misfortunes". You will be asked to answer on a scale from Not at All to Very Much So.
Toronto Alexithymia Scale (TAS-20)	This self-report measure assesses the difficulty in identifying and describing emotions. Examples include: "I am able to describe my feelings easily" and "When I am upset, I don't know if I am sad, frightened, or angry". You will be asked to answer on a scale from Strongly Disagree to Strongly Agree.
Perth Emotional Reactivity Scale (PERS)	This questionnaire will ask you to consider how you react to either positive or negative emotions. Examples include: "I tend to get happy very easily." Or "When I'm upset, it takes me quite a while to snap out of it." You will be asked to answer on a scale from Very Unlike Me to Very Like Me.
Beck Cognitive Insight Scale (BCIS)	This self-report measure will ask you to assess your confidence and ability to reflect on interpretations of life experiences you might have. Examples include "I have jumped to conclusions too fast." Or "At times, I have misunderstood other people's attitudes towards me." You will be asked to answer on a scale from Do Not Agree At All to Completely Agree.
Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2)	This questionnaire will ask you to reflect on how in tune you are with your bodily sensations. Examples include: "I notice when I am uncomfortable in my body." And "I try to ignore pain." You will be asked to answer on a scale from Never to Always.
Beck Anxiety Inventory (BAI)	This self-report questionnaire will ask you how you experience the feeling on anxiety on both physical and mental level. Examples include: "Feeling of choking" or "Unable to relax". You will be asked to answer on a scale from Not At All to Severely.
Self-Concept Clarity Scale (SCCS)	This self-report measure will ask you about the clarity you have about yourself and your self-concept. Examples include "My beliefs about myself often conflict with one another" or "I seldom experience conflict between different aspects of my personality". You will be asked to answer on a scale from Strongly Disagree to Strongly Agree.
Patient Health Questionnaire (PHQ-8)	This questionnaire will ask you whether you experience common symptoms associated with depressive mood. Examples include "Poor appetite or overeating" or "Feeling down, depressed or hopeless". You will be asked to

Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research.

Project Title:

Understanding the Social Brain in Healthy Volunteers and People with Psychological Difficulties.

This study has been approved by the Research Ethics Committee for Wales (Project ID): 12/WA/0283.

Thank you for your interest in taking part in this research. Before you agree to take part, the person organising the research must explain the project to you.

If you have any questions arising from the Information Sheet (version 1.10.2, dated 02/07/2024) or explanation already given to you, please ask the researcher before you to decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

Please tick the following statements if you agree with them:

1. I have read the notes written above and the Information sheet dated 02/07/2024, version 1.10.2, and understand what the study involves and what is expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction.
2. I understand that if I decide at any time that I no longer wish to take part in this project, I can notify the researchers involved and withdraw immediately.
3. I understand that this study can be completed online or in person and that I will be contacted by the researcher via telephone, email or text message. I understand that I will be responsible for completing the study according to the instructions of the researcher.
4. I understand that part of my participation will be audio-recorded (the SCID interview) and I consent to the anonymous use of this material as part of the project.
5. I agree to participate in the following components listed in the study overview of the information sheet.
    a. Self-report questionnaires, about 4 hours completed online.
    b. Behavioural computer tasks components (2 computerised tasks), about 1 hour completed online or in person.
    c. MBTi evaluation component (questionnaires and interview), about 4 hours completed online over the span of my participation in the MBTi psychoeducation group, and an additional 4 hours completed over the span of my participation in the 18-month MBT treatment (if I go forward with this programme).
6. I would like to opt-in to take part in the Mentalizing Trauma and Assessing Social Cognition component, which requires me to complete both tasks in one sitting that will take between 30 minutes and 1 hour either online or in person.
7. I would like to opt-in to take part in the Dissociative Symptoms and Interoception component. I understand that this will require in person attendance for testing at the UCL research centre in Central London and I am able to travel there. I understand that it involves several parts, including tasks and

additional questionnaires (about 2-3hours). I understand that further consent to the below points is required if I wish to take part in this component:

a. I understand the potential risks of participating and the support that will be available to me should I become distressed during the course of the research.
b. I understand the exclusion criteria (specifically, I do not have a cardiac pacemaker, I do not have a history of seizures, I do not have a history of frequent/recurrent fainting) and they have been explained by the researcher.
c. I do not fall under the exclusion criteria.

8. In case I get invited to complete the MBTi evaluation interview, which forms part of the MBTi evaluation component, I understand that this will be completed via video call. It has been made clear to me that my participation (or my wish not to participate) in this interview will not affect my treatment in any way. I understand that this interview on my experience of the psychoeducation group will be recorded on safe devices and only be used for research purposes. I understand that it will be transcribed in an anonymized way, stored encrypted and securely, and that the audio recording will be deleted.
9. I consent to the processing of my personal information for the purposes of this research study.
10. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the UK General Data Protection Regulation (UK GDPR).
11. I agree that my anonymous data may be used by others for future research. I am assured that the confidentiality of my personal data will be upheld through the anonymous identifiers.
12. I understand that the information I have submitted will be published as a report and that I can request a copy. Confidentiality and anonymity will be maintained, and it will not be possible to identify me from any publications.
13. I agree that some of the study data will be shared with the collaborating laboratory at Virginia Tech University in the USA and SOMA Analytics. I understand that data shared with Virginia Tech University would no longer be subject to EEA data protection laws but that this data will be anonymised and no identifiable personal information will be shared or transferred.
14. I understand that relevant sections of my medical notes and data collected during my clinical assessment (including the clinical outcome data) and during the study from me may be looked at by individuals from the research team, my clinician, or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.
15. I agree that the research team might re-contact me in case that additional data has to be obtained.
16. I agree that I can be contacted after the end of this study about possible future research and follow-up with the research team and related groups.
17. I agree that my GP can be told that I am participating in this study.
    GP name:
    GP surgery:
    GP address:
18. I agree that the research project named above has explained to me to my satisfaction and I agree to take part in this study.

Thank you for your help.

By completing and returning this form, you are giving us your consent that the personal information you provide will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.

Appendix E - Questionnaires

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