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The depersonalized brain: New evidence supporting a distinction between depersonalization and derealization from discrete patterns of autonomic suppression observed in a non-clinical sample

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ABSTRACT

Depersonalization and Derealization are characterised by feelings of detachment from one's bodily self/surroundings and a general emotional numbness. We explored predisposition to trait-based experiences of depersonalization/derealization-type experiences and autonomic arousal toward simulated body-threats, which were delivered to the participant's own body (i.e. *Self*) and when observed being delivered to another individual (i.e. *Other*). Ninety participants took part in an "Implied Body-Threat Illusion" task (Dewe, Watson, & Braithwaite, 2016) and autonomic arousal was recorded via standardised skin conductance responses and finger temperature. Autonomic suppression in response to threats delivered to the Self correlated with increases in trait-based depersonalization-type experiences. In contrast, autonomic suppression for threats delivered to Others correlated with trait-based derealization-like experiences. Body-temperature and anticipatory arousal did not correlate reliably with predisposition to depersonalization- or derealization-type experiences. The theoretical implications of these findings are discussed in terms of a fronto-limbic autonomic suppression mechanism.

1. Introduction

During typical daily life, our experience of our bodily self is coherent and stable. We enjoy a firm feeling of embodiment with the conscious perceiving "self" located in its physical moorings. Such stable self-awareness is dependent on a multitude of multisensory processes, acting in concert to maintain a coherent sense of embodiment. Embodiment is a fundamental aspect of self-consciousness and underpins the notion that we are active cognizing agents, distinct from our environment and present in the here and now (Blanke & Metzinger, 2009; Ehrsson, 2012; Gallagher, 2000; Myachykov, Scheepers, Fischer, & Kessler, 2014).

A growing body of evidence suggests that the neurocognitive processes underlying stable embodiment can breakdown, leading to striking distortions in self-consciousness (Blanke, 2012; Blanke et al., 2005; Blanke & Arzy, 2005; Braithwaite, Broglia, & Watson, 2014; Braithwaite, Watson, & Dewe, 2017; Brugger, 2002; Lenggenhager, Tadi, Metzinger, & Blanke, 2007; Lenggenhager, Mouthon & Blanke, 2009; Seth, 2009, 2013; Seth, Suzuki, & Critchley, 2012). What is even more compelling is that such distortions are now known to occur spontaneously or can be artificially induced in non-clinical groups (Aderibigbe, Bloch, & Walker, 2001; Botvinick & Cohen, 1998; Braithwaite et al., 2017, 2014, 2013; Braithwaite, Samson, Apperly, Broglia & Hulleman, 2011; Ehrsson, 2007; Ehrsson,

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Holmes, & Passingham, 2005; Ehrsson, Spence, & Passingham, 2004; Hunter, Sierra, & David, 2004; Michal et al., 2009; see also Kessler & Braithwaite, 2016; Sierra, 2009). The emerging picture is one in which people can be placed on a continuum representing their predisposition to experiencing an aberration in self-consciousness (Johns & van Os, 2001; Verdoux & van Os, 2002; van Os, Hanssen, Bijl & Ravelli, 2000). Importantly, the presence of such experiences, in non-clinical groups, can provide crucial insights not only into the nature of aberrant experiences and those who experience them, but also more fundamental aspects of human self-consciousness.

In its clinical expression, depersonalization is characterised by a severe and profound disruption in self-awareness that can include aberrant bodily experiences and a subjective emotional "numbing" (Sierra, 2009; Sierra & David, 2011). Individuals often describe feelings of remoteness, of being detached or estranged from their bodies, a reduction in the sense of ownership or "presence" (i.e. of being in the here and now) and a flattening of affect (Medford, 2012; Medford, Sierra, Baker & David, 2005; Sierra, 2009; Sierra & Berrios, 1998, 2001; Sierra & David, 2011).

The overarching disorder of depersonalization subsumes two components, namely depersonalization (DP) itself which pertains to an unreality of the "self", and derealization (DR) which relates to an unreality of one's surroundings (Medford, 2012; Medford et al., 2005; Sierra, 2009; Sierra & David, 2011). Therefore, DP and DR can be seen as a kind of bias, with DP directed towards internal body-states and DR directed away from one's surroundings. Both depersonalization and derealization experiences (DP/DR) are examples of what happens when multisensory integration breaks down, with profound implications for self-consciousness (Sierra, 2009; Sierra & Berrios, 2001; Sierra & David, 2011; see also Medford et al., 2005; Seth et al., 2012).

While DP and DR experiences typically co-occur, there is some evidence to suggest that they are separate but possibly interconnected entities reflecting diverse neurocognitive underpinnings (though this remains a matter of debate: Sierra, Lopera, Lambert, Phillips, & David, 2002; see also Lambert, Senior, Fewtrell, Phillips, & David, 2001; Rosen, 1955, Sierra, 2009). However, DP/DR experiences are predominantly referred to as "depersonalization" and clinically classified as "depersonalization/derealization disorder" by the DSM-V (APA: American Psychiatric Association, 2013) or "depersonalization-derealization" syndrome by the ICD-10 (WHO, 1992). DP/DR-type experiences are also prevalent in the general population and thought to exist along a continuum of symptom severity, with an estimated lifetime prevalence rate of between 23 and 74% (Aderibigbe et al., 2001; Hunter et al., 2004; Dewe, Watson, & Braitheaite, 2016; Sierra, 2009).

Previous research has found that depersonalized patients show suppressed autonomic arousal to aversive stimuli in the form of reduced skin conductance responses (SCRs: Giesbrecht, Merckelbach, van Oorsouw, & Simeon, 2010; Sierra, Senior, et al., 2002; Sierra, Senior, Phillips, & David, 2006), and inhibited neural activity in brain regions associated with translating emotion into feeling states - areas such as the anterior insula and amygdala (Lemche et al., 2007, 2008; Medford et al., 2006; Phillips et al., 2001). More recently, suppressed SCRs toward simulated threats delivered to the participant's own physical body have been observed in non-clinical populations (Dewe et al., 2016). Consistent with the view of an autonomic suppression, depersonalized patients have also been shown to exhibit a reduced empathy for others (Lawrence et al., 2007), which is perhaps unsurprising, given that in order to infer the cognitive and emotional states of others (empathetic response), one must rely on coherent self-related processing and internal feeling states (Decety & Grèzes, 2006; Decety & Jackson, 2004; Decety & Lamm, 2006; Preston & de Waal, 2002; Singer & Lamm, 2009).

It has been argued that both the anterior insula (AI) and anterior cingulate cortex (ACC) play crucial roles in self-representation of internal bodily states and subjective emotional experience (Craig, 2002, 2003, 2009; Critchley, 2005; Critchley, Wiens, Rotshtein, Ohman, & Dolan, 2004). Consistent with this, coactivation in these regions has been associated with the perception of emotion expressed by others; for example when observing facial expressions (Adolphs, Tranel, Damasio, & Damasio, 1994, 1995; Botvinick et al., 2005; Jackson, Brunet, Meltzoff, & Decety, 2006; Jackson, Meltzoff, & Decety, 2005; Lamm, Batson, & Decety, 2007; Saarela et al., 2007). Moreover, this coactivation has been found when observing painful stimuli (such as electric shocks) delivered to other individuals (Morrison, Lloyd, Di Pellegrino, & Roberts, 2004; Singer et al., 2004; see Jackson, Rainville, & Decety, 2006 for review), and for evaluative functions of pain experience, such as anticipation (Drabant et al., 2011; Hutchison, Davis, Lozano, Tasker, & Dostrovsky, 1999; Seifert et al., 2013; see also Medford & Critchley, 2010; Price, 2000).

1.1. Neurobiological accounts: Threshold theory

The dominant theoretical account proposed to explain these experiences argues for a dysfunctional fronto-limbic network. By this account, networks in the right ventro-lateral pre-frontal cortex (rVLPFC) become inappropriately triggered and suppress structures responsible for translating emotion into conscious feeling states (i.e., the anterior insula and amygdaloid regions: Sierra & Berrios, 1998; see also Jay, Sierra, Van den Eynde, Rothwell, & David, 2014; Lemche et al., 2007, 2008; Medford et al., 2006; Phillips & Sierra, 2003; Phillips et al., 2001). As a net consequence, conscious feeling states are prevented from colouring the typical integration between perception and cognition resulting in attenuated emotional experience, subjective feelings of "unreality" and profound alterations in self-consciousness.

Essentially, the threshold model proposes the existence of two stages of processing: (i) mechanisms responsible for detecting and processing aversive stimuli, which initiates/serves as a "trigger" for suppression, and; (ii) mechanisms responsible for implementing the actual suppression of autonomic responses once an aversive stimulus has been detected. These processes are thought to become triggered when a certain "threshold" of anxiety or fear is crossed; and are intended to ensure adaptive behaviour during situations with disabling levels of anxiety, stress and fear. By this account, DP and DR occur due to an anxiety-triggered inhibitory response, which may occur due to the initial detection mechanism triggering the suppression too readily, or a lower threshold in the neurocognitive processes that facilitate conscious feeling states. As a result, these early processes may "over-estimate" the intensity of