



# More of myself: Manipulating interoceptive awareness by heightened attention to bodily and narrative aspects of the self



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## ABSTRACT

Psychology distinguishes between a bodily and a narrative self. Within neuroscience, models of the bodily self are based on exteroceptive sensorimotor processes or on the integration of interoceptive sensations. Recent research has revealed interactions between interoceptive and exteroceptive processing of self-related information, for example that mirror self-observation can improve interoceptive awareness. Using heartbeat perception, we measured the effect on interoceptive awareness of two experimental manipulations, designed to heighten attention to bodily and narrative aspects of the self. Participants gazed at a photograph of their own face or at self-relevant words. In both experimental conditions interoceptive awareness was significantly increased, compared to baseline. Results show that attention to narrative aspects of self, previously regarded as relying on higher-order processes, has an effect similar to self-face stimuli in improving interoceptive awareness. Our findings extend the previously observed interaction between the bodily self and interoception to more abstract amodal representations of the self.

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## 1. Introduction

Although few subjects are more central to human experience than ‘the self’, there has been a lack of consensus on definitions and means of operationalising the self within philosophy, psychology and neuroscience (Gallagher, 2000; Neisser, 2006; Strawson, 1999). The distinction between a bodily and narrative self, first proposed by William James, continues to structure the debate (James, 1890).

The narrative or autobiographical self, which encompasses stored knowledge of the individual's past experience and anticipated future, has often been treated within psychology as if it were an amodal, abstract symbolic structure (Gallagher, 2000), although a recent taxonomy proposes that the narrative self is grounded in bodily self processes acting upon autobiographical memories (Damasio, 2010). By contrast, in neuroscience, models of the material or bodily self have been largely based on multisensory integration. For example, the exteroceptive senses of touch and vision are crucial to body ownership. Thus in the ‘rubber hand illusion’ (Botvinick & Cohen, 1998) synchronous stroking of a visible rubber hand and the participant's own hidden hand produces the illusion of ownership of the fake hand. Similarly, the integration of efferent, re-afferent and ex-afferent sensorimotor signals provides our sense of personal agency over our own actions (Blakemore, Wolpert, & Frith, 2002), which may be disrupted in disorders such as schizophrenia.

The interoceptive senses (Cameron, 2002; Vaitl & Schandry, 1995; Ádám, 2010) are also fundamental to the self. ‘Interoception’ is defined as “the afferent information arising from within the body that affects the cognition, or behaviour of an organism, with or without awareness” (Cameron, 2002, p. 271). It has been proposed that our basic feelings of existence

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are underpinned by continuous brainstem mapping of homeostatic information about the interoceptive state of the body (Damasio, 2010), while conscious selfhood is potentially based on the re-representation and integration of interoceptive signals in insular cortex (Craig, 2010). 'Interoceptive awareness' differs between individuals and is usually assessed behaviourally by a cardiac awareness task (Schandry, 1981; Whitehead & Drescher, 1980). Such tests correlate with sensitivity to other interoceptive systems, such as visceral or respiratory awareness (Harver, Katkin, & Bloch, 1993; Herbert, Muth, Pollatos, & Herbert, 2012; Whitehead & Drescher, 1980).

Although theoretical analyses have tended to treat interoceptive and exteroceptive aspects of the bodily self as separate sensory systems, recent research has shown that they are interdependent. The eerie phenomenology of the rubber hand illusion depends upon interoceptive processes in the autonomic nervous system (Ehrsson, Wiech, Weiskopf, Dolan, & Passingham, 2007). As the illusion takes hold, the skin temperature of the hidden hand falls (Moseley et al., 2008) while histamine reactivity in the concealed hand rises (Barnsley et al., 2012), as if the exteroceptive stimulation causes the autonomic nervous system to no longer treat the hand as fully part of the body. Given that the most basic definition of self is "what the immune system identifies as belonging to the body" (Damasio, 2003), in the rubber hand illusion there is an apparently blurring of what the autonomic system regards as a true body part. That interoceptive and exteroceptive processes interact in forming the sense of bodily self is further illustrated by research showing that the extent to which individuals experience the rubber hand illusion depends on their interoceptive awareness. Thus people who are more accurately aware of their internal body signals, are less prone to both the rubber hand illusion (Tsakiris, Tajadura-Jiménez, & Costantini, 2011) and the 'enfacement illusion' (Tajadura-Jiménez, Longo, Coleman, & Tsakiris, 2012; Tajadura-Jiménez & Tsakiris, *in press*), implying that individuals with low interoceptive awareness might have a more malleable mental representation of the self in response to exteroceptive signals.

Interoceptive awareness has generally been considered a robust trait variable because experimental attempts to manipulate it have often been ineffective (Fairclough & Goodwin, 2007; Khalsa et al., 2008; Stevens et al., 2011). However, two studies show that interoceptive awareness, measured by heartbeat tasks, can be improved through mirror self-observation. In an early paper by Weisz, Bálazs, and Ádám (1988), the mere presence of a mirror was reported to have improved performance in one measure of cardiac awareness, although not in another. Recently, Ainley, Tajadura-Jiménez, Fotopoulou, and Tsakiris (2012) found that gazing into a mirror significantly improved the accuracy of heartbeat perception in individuals who had initially low interoceptive awareness. A third study (Maister & Tsakiris, *in press*) has recently demonstrated that looking at a photograph of their own face improves the interoceptive awareness of individuals who have below-median interoceptive awareness in the baseline (a blank screen). No such improvement was found when participants gazed at a similar photograph of a gender- and age-matched stranger. These findings can be interpreted with respect to the 'perceptual accuracy hypothesis' in self-focus research (Silvia & Gendolla, 2001), which proposes that any type of self-focused attention improves an individual's accuracy in judging not only somatic but also cognitive aspects of the self.

Given the importance of interoception to the sense of bodily self, the motivation for the current study was therefore to investigate whether the processing of self-related narrative information can bring about improvements in people's conscious awareness of their internal bodily selves, analogous to the improvements in interoceptive awareness that are induced by the processing of physical representations of the bodily self. In this experiment, following the results of Ainley et al. (2012) and Maister and Tsakiris (*in press*), and in accordance with the perceptual accuracy hypothesis, it was hypothesised that any manipulation leading to increased self-awareness, focusing on either the bodily or narrative aspects of the self, would feed-back to increased accuracy in the individual's awareness of internal bodily states. In a 'sceptical review' of the literature, Silvia and Gendolla (2001) have criticised much of the evidence for the perceptual accuracy hypothesis on methodological grounds. They stipulate that a valid test of this hypothesis (with regard to interoception) must compare self-reported internal perception (i.e. counted heartbeats, in our experiment) against an objective standard (i.e. recorded heartbeats), without introducing confounding changes in physiological variables such as heart rate. Our experiment was designed to fulfil these requirements.

We investigated the effect on interoceptive awareness of two experimental manipulations of self-focus. Using stimuli frequently employed in self-focus research (Fejfar & Hoyle, 2000), we contrasted a condition in which participants gazed at a photograph of their own face ('the bodily self condition') with another in which they looked at a set of self-relevant words ('the narrative self condition'). The baseline (control) condition was looking at a blank screen. Interoceptive awareness was measured using a well-validated heartbeat perception task (Schandry, 1981), which has good test-retest reliability (Mussgay, Klinkenberg, & Rüdell, 1999; Pollatos, Traut-Mattausch, Schroeder, & Schandry, 2007) and is sensitive to individual differences (Domschke, Stevens, Pfleiderer, & Gerlach, 2010; Dunn et al., 2010; Ehlers & Breuer, 1992). Gender and change in heart rate were recorded, as these are commonly reported confounds of cardiac awareness tasks (Knapp-Kline & Kline, 2005; Ring & Brener, 1992). Our participants were students, to avoid introducing the potential confound of age (Khalsa, Rudrauf, & Tranel, 2009). It was hypothesised (following the results of Ainley et al., 2012) that interoceptive awareness would be increased by observation of the participant's own photographed face, given that recognition of one's face in a mirror and in a still photograph employ similar cortical networks (Butler, Mattingley, Cunningham, & Suddendorf, 2012). Following the perceptual accuracy hypothesis, it was also expected that self-relevant words, which enhance attention to narrative aspects of the self, would have a similar effect. It was anticipated, as in Ainley et al. (2012), that significant effects would be concentrated amongst participants who had low interoceptive awareness in the baseline condition.

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