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Mood migration: How enfacing a smile makes you happier

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ABSTRACT

People tend to perceive the face of another person more as their own if own and other face are stroked in synchrony—the enfacement illusion. We conceptually replicated the enfacement illusion in a virtual reality environment, in which participants could control the movements of a virtual face by moving and touching their own face. We then used this virtual enfacement illusion to study whether enfacing a virtual face would also involve adopting the emotion that this face is expressing. As predicted, participants adopted the expressed emotion, as indicated by higher valence scores and better performance in a mood-sensitive divergent-thinking task when facing a happy virtual face, if the virtual face moved in synchrony with their own head movements. This suggests that impact on or control over another person's facial movements invite "mood migration" from the person one identifies with to oneself.

1. Introduction

One commonly has no problem telling one's own body from that of another person—an ability that is commonly thought to rely on more or less continuous self-representations (De Vignemont, 2010; Gallagher, 2000; Jeannerod, 2003). Interestingly, however, recent findings suggest that self-representation is quite malleable. For example, synchronously stroking a person's real hand and a rubber hand lying in front of her has been shown to be sufficient to induce the illusion that the rubber hand has become part of one's own body (Botvinick & Cohen, 1998; Ehrsson, Spence, & Passingham, 2004). Ownership illusions of that sort have numerous behavioral implications, including increased interpersonal cooperation, and liking of the owned body part or of others (e.g., Hove & Risen, 2009; Sebanz, Bekkering, & Knoblich, 2006; Wiltermuth & Heath, 2009), suggesting that ownership illusions are associated with the blurring between representations of self and other.

Body ownership has been investigated by means of various paradigms but the rubber hand illusion (RHI) paradigm is by far the most widely used. The findings obtained with this paradigm suggest that multisensory integration (of felt stroking of one's real hand and seen stroking of the rubber hand) can induce a sense of ownership. Interestingly for our present purposes, ownership illusions can also be induced by means of virtual reality. If people operate a virtual hand shown on a screen (e.g., by means of a data glove), synchrony between real movements and virtual-hand movements creates or increases the illusion that the virtual hand is a part of the person's body—the virtual hand illusion (VHI; Ma & Hommel, 2013; Slater, Perez-Marcos, Ehrsson, & Sanchez-Vives, 2008). The VHI and the RHI share many characteristics and demonstrate the same basic illusion, but they also differ in interesting ways. For instance, a direct comparison of a virtual version of the rubber-hand and the virtual-hand design (Ma & Hommel, 2015a) revealed that ownership and agency are more related to each other in the dynamic virtual-hand than the static rubber-hand design. Considering that the virtual hand setup is much more representative of real-world situations, this suggests that ownership and agency might be closer related than theoretical considerations based on static designs have implied (e.g. Tsakiris, Schütz-Bosbach, & Gallagher, 2007).

Recent studies successfully extended the rubber-hand-like ownership illusion to human faces. While traditional research on face-based self-recognition focuses on permanent visual features of the face (e.g., Keenan, Wheeler, Gallup, & Pascual-Leone, 2000; Zahavi & Roepstorff, 2011), self-recognition studies modeled according to the rubber-hand logic have demonstrated contributions from multisensory matching (e.g., Tsakiris, 2008). In fact, watching the face of another person while that face and one's own face are stroked synchronously induces the illusion of "owning" the other face—the so-called enfacement illusion (e.g., Paladino, Mazzurega, Pavani, & Schubert, 2010; Sforza, Bufalari,

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Haggard, & Aglioti, 2010; Tajadura-Jiménez, Lorusso, & Tsakiris, 2013; Tsakiris, 2008). Enfacement effects of that sort suggest that multisensory integration of visual, tactile, and proprioceptive signals is associated with, or contributes to blurring self-other boundaries. Interestingly, the enfacement illusion has been shown to affect performance in a self-recognition task, but not the recognition of the other face, confirming that the illusion is related to the representation of one's own face (Tajadura-Jiménez, Grehl, & Tsakiris, 2012). As for the rubber-hand case, enfacement effects have also been shown to correlate with marked differences in (social) cognition, including conformity behavior, social inference, and self-other integration (Mazzurega, Pavani, Paladino, & Schubert, 2011; Paladino et al., 2010).

2. Aims of present study

The first aim of our study was methodological in nature and essential for our second, more theoretical aim. While the synchronous-stroking technique has been very successful in elucidating various aspects of perceived body ownership, the stroking procedure itself is not particularly natural or ecologically valid. This makes it rather unlikely that spontaneous feelings of ownership outside of the psychological laboratory are really based on processes that are fully captured in stroking studies (Ma & Hommel, 2015a). We were therefore interested to see whether, and to what degree stroking-based enfacement effects can be (conceptually) replicated in a virtual-reality design.

At first sight, a successful replication may seem very likely, given the results of recent studies that have replicated the RHI in virtual reality setups (Slater et al., 2008). Notably, virtual reality allows to integrate visual, proprioceptive, and tactile feedback, and offers the advantage to assess whether and to what extent visuomotor correlations may contribute to ownership illusions. Interestingly enough, in the above-mentioned study (Ma & Hommel, 2015a) in which we compared a virtual version of the rubber hand setup with a virtual-hand setup, we found that synchrony-induced ownership illusion was stronger when visuotactile synchronous stimulation and visuomotor synchrony were combined (as it was in the virtual-hand setup) than when only visuotactile stimulation was manipulated (as it was in the virtual version of the rubber hand setup). This provides evidence suggesting that ownership illusions are more pronounced when multiple informational sources can be integrated: continuously moving one's hand together with the seen virtual hand and having simulated contact with another object creates a multiplicity of data points that can be correlated to calculate the degree of intermodal matching (cf. Ma & Hommel, 2015a). Accordingly, in the present study we decided to implement a similar experimental design as in the virtual-hand setup of Ma and Hommel (2015a) in order to maximize the chance of eliciting a virtual enfacement illusion.

To this end, we presented participants with virtual faces the movements of which they could either control directly/synchronously (i.e., with no noticeable delay between their own head movements and the movements of the virtual face) or with a noticeable delay/asynchronously. Participants were also asked to touch their own face with their own hand and view the (synchronous or asynchronous) touch on the virtual face by a virtual ball on corresponding facial locations. We hypothesized that the tendency to perceive the virtual face as part of one's own body would be significantly more pronounced in the synchronous condition.

The second, more theoretical aim of our study was to see whether enfacing/perceiving ownership for another face is accompanied by adopting the emotions that this other face is expressing. To test that possibility, we presented some participants with neutral virtual faces and other participants with smiling virtual faces. This manipulation was crossed with the synchrony manipulation, so that one group of participants could control the movements of a neutral face directly in one condition and with a noticeable delay in another, while another group of participants could control the movements of a happy face directly in one condition and with a noticeable delay in another.

We considered two theoretical approaches that differ with respect to the specific conditions under which emotions are likely to be adopted. First, there is considerable evidence that people tend to imitate the facial expressions they are exposed to. For instance, when confronted with emotional facial expressions, people tend to spontaneously and rapidly react with distinct facial reactions (as for instance detected via electromyography) that mirror the observed one, even without conscious awareness of the emotional facial expression (e.g., Dimberg & Thunberg, 1998; Dimberg, Thunberg, & Elmehed, 2000). Imitating a facial expression in turn tends to induce the expressed emotion in the imitator (e.g., Strack, Martin, & Stepper, 1988), which is in line with the assumption that facial muscle activity is a prerequisite for the occurrence of emotional experience (e.g., Buck, 1980). According to this approach, one would expect that being exposed to a happy face might induce a more positive mood, perhaps by means of automatic imitation—we will refer to this prediction as the "mirroring hypothesis". Note that this prediction does not consider synchrony as a relevant factor, which means that being confronted with a smiling face would be expected to improve mood to the same degree in synchronous and asynchronous conditions.

Second, we considered a hypothesis that was motivated by recent successful attempts to apply the theory of event coding (TEC; Hommel, 2009; Hommel, Müsseler, Aschersleben, & Prinz, 2001), which originally was formulated to explain interactions between perception and action, to social phenomena. TEC assumes that perceived and produced events (i.e., perceptions and actions) are cognitively represented in a common format, namely, as integrated networks of sensorimotor feature codes (so-called event files; see Hommel, 2004). Feature codes represent the distal features of both perceived events, such as the color or shape of a visual object, and self-generated events (i.e., actions), such as the location targeted by a pointing movement or the sound produced by pressing a piano key. In addition to these feature codes, event files have been shown to also include information about the goal an event was associated with Waszak, Hommel, and Allport (2003) and the affective state it was accompanied by Lavender and Hommel (2007). Hence, event files can be assumed to comprise codes of all features of a given event, which are integrated and bound. The codes bound into an event file are retrieved as a whole (in a pattern-completion fashion), at least if they are related to the task goal (Memelink & Hommel, 2013), when one of the features of a given event is encountered—be it while perceiving an event or while planning and acting (Kühn, Keizer, Colzato, Rombouts, & Hommel, 2011).

TEC does not distinguish between social and nonsocial events, which implies that people represent themselves and others – be them other individuals or objects – in basically the same way. As with object perception, where multiple objects can be perceived separately or grouped into comprehensive units, depending on the emphasis on discriminative vs. shared features, people may thus represent themselves as separate from, or as part of another person or group (Hommel, Colzato, & Van Den Wildenberg, 2009). This assumption fits with claims that people's self-construal is dynamic and sensitive to situational and cultural biases (Kühnen & Oyserman, 2002), and findings suggesting that situational factors impact the degree of self-other discrimination in joint task settings (Colzato, de Bruijn, & Hommel, 2012). Even more interesting for present purposes, the possible malleability