Merging second-person and first-person neuroscience

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Abstract: Schilbach et al. contrast second-person and third-person approaches to social neuroscience. We discuss relations between second-person and *first*-person approaches, arguing that they cannot be studied in isolation. *Contingency* is central for converging first- and second-person approaches. Studies of embodiment show how contingencies scaffold first-person perspective and how the transition from a third- to a second-person perspective fundamentally involves first-person contributions.

Main text

In developing their framework for second-person neuroscience, Schilbach and colleagues contrast their approach with what they consider third-person approaches, widespread in cognition and social neuroscience, in which participants simply observe (but do not interact with) others. Surprisingly, Schilbach et al. have less to say about the converse relation, between their second-person neuroscience and *first*-person approaches. Recent research has provided rich descriptions of the first-person experience of embodiment, the role of sensory and motor signals in forming such experiences, and their subsequent effects on cognition and behaviour. Here, we will discuss points of potential convergence between first- and second-person approaches and argue that the two cannot be approached in isolation from each other.

First, the key factor differentiating second-person from third-person approaches on Schilbach et al.'s view is *contingency*. Second-person others respond contingently to an observer's actions, whereas third-person others do not. Intriguingly, this idea of

contingency is also central to recent approaches to studying first-person experiences of embodiment (for reviews see Longo & Haggard 2012; Tsakiris 2010). In the case of first-person experience, this plays out at both the perceptual and motoric levels. In terms of perception, our somatic experiences (e.g., of touch, pain, or position sense) are contingently related to our experiences in other sensory modalities (e.g., visual, auditory, or vestibular sensations). For example, my tactile experiences as I reach to pick up my coffee mug are exactly temporally and spatially congruent with my visual experience of seeing my hand grip the mug. This visual-tactile match is a strong cue that the hand I see is *my* hand, and can be manipulated to produce perceptual illusions of embodiments such as the rubber hand illusion (Botvinick & Cohen 1998), full-body illusions (Lenggenhager et al. 2007), or the body-swap illusion (Petkova & Ehrsson 2008). In the rubber hand illusion, for example, vision of touch applied to a prosthetic hand in temporal and spatial synchrony with felt touch on one's own hand creates the compelling illusion that the rubber hand actually is one's hand (the sense of *body ownership*) and corresponding proprioceptive biases (Botvinick & Cohen 1998; Longo et al. 2008; Tsakiris & Haggard 2005).

Contingency in first-person approaches also plays out in terms of action. The actions of our body are contingently related to our intentions. When I form an intention to lift my arm, it is *my* arm that lifts. The contingent relation between efferent motor commands and visual and proprioceptive feedback strongly influences our first-person experience of our body, over and above matches between vision and proprioception alone. This is another strong cue for body ownership, and creates an additional sense of

agency over one's body (i.e., the feeling that I am in control of my body). Recent results have demonstrated that ownership and agency are distinct and separable components of the experience of embodiment (Longo et al. 2008) and have distinct functional consequences on behaviour (Kammers et al. 2009; Longo & Haggard 2009; Tsakiris et al. 2006) and separable neural correlates (Tsakiris et al. 2010). Thus, contingency, both of perception and action, plays a critical role in structuring first-person experiences of our own body.

As Schilbach and colleagues point out, however, contingency also plays a fundamental role in differentiating our second-person experiences of immediate others from third-person experiences of more distant others. This raises a critical question: What differentiates contingent relations specifying first-person experiences from those specifying second-person experiences? This is an important question for future research, about which we can only speculate here. We wish to propose, however, that first-person experiences may be primary and possibly even necessary prerequisites for second-person experiences. For example, first- and second-person contingency differ in terms of their immediacy, both temporally and logically. When I form an intention to act, my own action follows immediately, whereas your response comes later. Any instance of contingency specifying second-person relations thus follows the sequence: *Intention* → *My Action* → *Your Action*, where the first arrow indicates the contingent relation specifying a first-person experience and the second arrow indicates the contingent relation specifying a second-person experience. The second-person contingency cannot exist without the first-person contingency, because the sequence: *Intention* → *Your*

Action would not indicate that I am *interacting* with you (a second-person relationship), but would rather indicate that I *am* you (a first-person relationship).

Related to the preceding argument is the possibility that embodied interactions may alter self-other boundaries, which suggests that the transition from a third- to a second-person perspective may fundamentally involve, but also affect, first-person representations. This possibility has been explored by extending the known role of multisensory integration from body-awareness to self-other boundaries. In the "enfacement illusion" (Sforza et al. 2010; Tsakiris 2008), participants see someone else's face being touched at the same time as their own face, creating a situation that resembles the experience of looking at oneself into the mirror, albeit the "mirror reflection" of one's face is replaced by another individual. Synchronous interpersonal multisensory stimulation (IMS) between the two faces changes self-face recognition, as the other's face is perceived to be more similar to one's own face (Tajadura-Jimenez et al. 2012). Interestingly, and of particular relevance for our understanding of the second-person perspective, IMS also influences social cognition processes of inference and conformity (Paladino et al. 2010). Such findings support a model of first-person perspective according to which our sense of self is plastically affected by multisensory information as it becomes available during self-other interactions. Shared multisensory experiences might explain how the "I" comes to be identified with "me," allowing this "me" to be represented as an object for others, as well as for one's self.

Together, these considerations suggest that there are important points of connection between the first- and second-person perspectives, meaning that neither can be investigated in isolation from the other. In particular, it will be critical for future research to investigate how contingency alters both the relation of the self to its "self" or body (first-person neuroscience), and the relation of the self to the other (second-person neuroscience).

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