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A Self for the Body

Frederique de Vignemont

Abstract:

What grounds the experience of our body as our own? Can we rationally doubt that this is our own body when we feel sensations in it? Here, I show how recent empirical evidence can shed light on issues on the body and the self, such as the grounds of the sense of body ownership and the immunity to error through misidentification of bodily self-ascriptions. In particular, I discuss how bodily illusions (e.g., the Rubber Hand Illusion), bodily disruptions (e.g., somatoparaphrenia) and the multimodal nature of bodily self-knowledge challenge a classic view of ownership and immunity that puts bodily sensations at its core.

Key words: Bodily sensations; body schema; body ownership; immunity to error; multimodality; Rubber Hand Illusion; self; somatoparaphrenia

The body has always elicited strong opinions, either pro (e.g., Spinoza, Nietzsche, Merleau-Ponty) or against (e.g., Plato, Descartes). Does the body imprison and deceive the soul, distracting it from the acquisition of knowledge? Or does it ground our existence? In more contemporary terms, could we be a disembodied brain in a vat or is embodiment constitutive of the faculties of the mind? Surprisingly, in most discussions, little time is spent in analysing what it is like to be embodied, and in particular in relation to self-awareness. Here, I shall describe various philosophical perspectives on the relation of the body and the self. I shall then focus on its psychological and epistemological aspects and raise two main questions. First, what grounds the sense of body ownership (i.e. experiencing one's body as one's own)? Second, what guarantees the immunity to error through misidentification of bodily self-ascriptions (i.e. no possible rational doubt that one's body is one's own)? A traditional method in philosophy consists in appealing to thought experiments to solve this type of questions, but I shall show how recent scientific experiments can challenge our classic assumptions on the role of bodily sensations for the sense of body ownership and for bodily immunity.

1. The body and the self: A panorama

In the short story *The Notary's nose*, Edmond About (1862) described the tribulations of a notary who gets his nose cut off and who buys a new nose from a poor water-carrier and successfully grafts a bit of his arm skin. Yet, the new nose behaves as if it were still a part of the donor's body. When the water-carrier drinks too much, the notary's nose is red; when he starves, it dwindles away; when he loses his arm from which the graft was made, the nose drops off altogether. This tale from the nineteenth century highlights a number of major questions about the relation of the body and the

self that are still open nowadays. What makes a nose one's own? Can one sell or buy a nose? Is the nose constitutive of a person? What grounds the notary's experience of the new nose as his own? And can he doubt that it is his own nose? Those questions are only a few examples of a wide range of issues about the body and the self from ontological, moral, psychological and epistemological perspectives that I shall quickly overview with the help of a few key questions each time.

1.1 Ontological issues

Is the self to the body merely what a captain is to his ship? Or is it more, and if so, what? The Cartesian view assumes that the self is purely mental. The captain may as well command another ship for all that matters. However, one may argue that the body grounds the self, or that it anchors and individuates the self through time, thus guaranteeing personal identity. One may even go a step further and posit a relation of identity between the body and the self. Those questions aim at determining what the body is for the self. Alternatively, one may ask which body has this specific relation to the self. In other words, we talk of our own body, but how to individuate it? As we shall see later, it has been proposed that one's own body is the body where one feels sensations, but one may as well claim that it is the body we care for and/or the body we directly control.

Sample of ontological questions:

- Am I a body or do I own a body?
- Is the self bodily?
- What role does the body play for personal identity?
- Which body is mine?

1.2 Ethical and legal issues

Biomedical research is booming. Crucial to all of this is the ability to obtain, store and use parts of the human body taken from living individuals. These developments raise major issues concerning the moral and legal status of what one may call human biological materials. The general context of analysis is that the human body cannot be treated as a simple object upon which one has property rights, let alone as a mere instrument. Though everyone agrees on the complexity of the moral and legal status of the body, the views vary. In the line of the Habeas Corpus Act (1675), the subject has full authority and unrestricted property rights over her body. Alternatively, in the line of the Roman law and the model of the Divine Right of Kings, the State owns the body and decides its fate in order to protect the society and the citizens, whereas the subject is the mere 'usufruct' of her body.

Sample of ethical and legal questions:

- Can the body be owned? Can one have property rights upon human body parts?
- If so, who owns the human body?
- Does the moral and legal status of the body vary whether it is the living body or the body after death, or whether it refers to separated tissues or human fluids (e.g., semen, saliva, blood)?
- Can the body be commercialized like any object?

1.3 Psychological issues

Our biological body directly strikes us as belonging to us. We are aware of our biological body as our own. But do we merely believe it or do we feel it? According to the deflationary conception of the sense of body ownership, there may be only judgements of ownership, with no corresponding feeling of ownership. On the

contrary, according to the inflationary conception, there is something it is like to experience our body as our own that goes beyond the mere experience of bodily properties. Our body is manifested to us in a more primitive form than beliefs or judgments, in the form of an immediate or pre-reflective awareness of body ownership. But if there is such feeling of body ownership, what grounds it?

Sample of psychological questions:

- Is there a positive phenomenology of 'myself'?
- Is the sense of ownership similar for internal organs, face and limbs?
- What is the functional role of the sense of ownership?
- How is the sense of ownership related to (a) bodily sensations, (b) action, and (c) emotion?
- Can one feel body ownership towards any object besides one's biological body, no matter its shape and its location?
- Can one feel disownership towards one's biological body? And if so, is the sense of disownership the mere result of the lack of sense of ownership?

1.4 Epistemological issues

The self-ascription of a property is said to be immune to error through misidentification relative to the first-person (hereafter IEM) if one cannot be mistaken about the person who instantiates the property, namely oneself, when one has gained information about the property in the appropriate way. For instance, if I think that I am anxious because I feel anxious, my thought is IEM because introspection gives a privileged inner access to my own mental life that I do not have for other people's mental life. But if I think that I am anxious because my psychoanalyst told me so, my thought is not IEM. Indeed, the psychoanalyst may have confused me with another

patient, who is the person suffering from anxiety. One can be mistaken about the psychological property one ascribes to oneself, but one cannot be mistaken about the person who instantiates the psychological property. Most accounts of immunity to error through misidentification have focused on self-ascriptions of mental states (Shoemaker 1968; Wright 1998; McGinn 1983; Peacocke 1999; Pryor 1999). But is immunity an epistemic property restricted to a certain class of psychological self-ascriptions or does it apply as well to self-ascriptions of bodily properties? By bodily self-ascriptions, I do not mean the ascription of bodily sensations. Bodily sensations are mental states, like emotions, beliefs or desires. By bodily ascription, I mean the ascription of bodily properties (e.g. body size, weight, posture, etc.).

Sample of epistemological questions:

- Are bodily self-ascriptions IEM?
- What are the appropriate grounds that can secure bodily immunity?
- Do self-ascriptions of bodily properties display the same type of immunity as self-ascriptions of mental states?
- Does bodily immunity reveal the bodily nature of the self?

To conclude, questions about the body and the self have long been considered to be beyond reach of experimental studies. This is true of some of them, but these last ten years, research in cognitive science has yielded a vast array of exciting discoveries and provocative hypotheses about bodily awareness and self-awareness. Here, I shall illustrate how the dialog between philosophy and cognitive science can be fruitful, and thus for both domains. On the one hand, confrontation with empirical findings sheds new light on long-standing conceptual issues about the body and the self, helps philosophers to forge and sharpen new conceptual frameworks for the investigation of

bodily self-awareness, and raises new philosophical puzzles. However, empirical results provide only partial or indirect replies to questions raised in philosophy. Philosophical theories and conceptual tools are thus needed for the perspicuous interpretation of empirical data and their systematization.

2. Bodily sensations and bodily ownership

One strategy to answer some of the questions outlined above is to compare experiences of one's own body and experiences of other people's bodies. The underlying assumption is that what is specific to the experiences of one's own body - whether it is the specific way one perceives it, one affectively reacts to what happens to it, or one controls it - may indicate which body is one's own and which body one experiences as one's own. Here, I shall limit myself to analyse the different types of perceptual experiences of one's body and of other bodies.

We have a privileged internal access to our own body that we do not have for other bodies. Unlike other physical objects, our body is experienced not only from the outside (e.g., vision), but also from the inside (e.g., bodily sensations). We do not feel bodily sensations in other bodies than our own, whereas we see many bodies. A traditional conception of bodily ownership thus relates bodily sensations and body ownership at various levels:

- (a) At the ontological level of body ownership (e.g., Locke 1689): One's own body consists in the body in which one feels sensations.
- (b) At the psychological level of the sense of body ownership (e.g., Brewer 1995; Cassam 1997; Dokic 2003; Martin 1995; Bermudez 1998): The body that one experiences as one's own is the body that one experiences from the inside.

- (c) At the level of the epistemic properties of judgments of body ownership (e.g., Evans 1982, Brewer 1995; Cassam 1997; Bermudez 1998): Bodily self-ascriptions are IEM if they are grounded in bodily experiences.

Here, I shall leave aside the ontological view to focus on the others. On the psychological view, the sense of body ownership is grounded in bodily experiences such as the sense of pressure, the sense of posture and the sense of balance (i.e. body senses). There are two ways to interpret this theory. According to the informational account, bodily experiences ground the sense of ownership because the body senses are characterized by a privileged informational/causal link to one's body, and to no other bodies. For example, I cannot have access to the posture of another body through proprioception. The body that one experiences as one's own is the body from which one receives internal information (e.g. through proprioception). Alternatively, according to the spatial account, what grounds the sense of ownership is not the fact that one has access to the bodily property from the inside, but that one localizes the bodily property within the spatial representation of one's own body. When I feel a bodily sensation, I do not feel it in one body as opposed to another body. I feel it in my own body. The body that one experiences as one's own is the body in which one spatially ascribes sensations.¹ On both accounts, vision is disqualified as a possible ground of the sense of ownership. As Brewer (1995) says, the visual body, that is, the body from the outside, does not bear the "stamp of ownership". On the one hand, vision carries information about more than one's own body. On the other hand, the property can be localized outside the representation of the boundaries of one's body. When one sees a red spot on one's hand, one sees it on one hand as opposed to many other hands.

The dichotomy between two types of perceptual experiences, either from the inside or from the outside, is also at the core of the epistemological view, which claims that the two types of perceptual experiences lead to two classes of bodily judgments with distinct epistemic properties. In particular, bodily self-ascriptions based on bodily experiences are said to be IEM because bodily experiences give a privileged inner access to one's bodily states. For instance, on the basis of proprioception, I may be mistaken about my bodily posture (e.g., my legs are not crossed), but I cannot rationally doubt that those are my legs that I feel crossed. Proprioceptive experiences suffice to justify bodily self-ascriptions such that no intermediary process of self-identification is required. The judgment “my legs are crossed” is not grounded in the judgment “those legs are crossed” and in the identification “those legs are mine”. By contrast, as noted by Wittgenstein (1958), I can see an arm broken, but this does not entitle me to directly conclude that my own arm is broken. It might be another person's arm that is intermingled with mine. I may be mistaken about whose arm is broken because I can see my arm, as well as many other arms. There is a gap between visually knowing that a body is F and visually knowing that it is my own body that is F, a gap that needs to be fulfilled with the help of self-identification.

To conclude, there seems to be a dichotomy between two well-defined types of perceptual experiences of one's body, from the inside and from the outside, with distinct psychological properties (stamp of ownership or not) and distinct epistemic properties (bodily immunity or not). I shall now refine this view in the light of empirical phenomena. In section 3, I shall show how the analysis of some disorders and illusions of bodily self-awareness contributes in our understanding of the relation between bodily experiences and the sense of body ownership. In section 4, I shall revise the dichotomy between the perception of the body from the inside and from the

outside in the light of pervasive multimodal effects, and assess their consequences for bodily immunity. I shall not go into the details each time,ⁱⁱ but rather sketch how cognitive science can improve our understanding of the sense of body ownership and bodily immunity.

3. The grounds of the sense of ownership

3.1 This is my hand

Can one experience ownership towards an object extraneous to one's biological body? The reply is yes, as shown by a bodily illusion recently discovered, the Rubber Hand Illusion (hereafter, RHI). The RHI has become the main experimental design to artificially manipulate the sense of body ownership in healthy individuals. Participants sit with their arm resting on a table, hidden behind a screen, while looking at a fake hand presented in front of them. An experimenter then simultaneously strokes with two paintbrushes both the participants' biological hand and the fake hand. The illusion is fourfold: (i) participants feel as if they were touched on the rubber hand; (ii) they feel as if the rubber hand were their own hand; (iii) they mislocalize their hand in the direction of the rubber hand (i.e. proprioceptive drift); (iv) they emotionally react when the rubber hand is threatened or hurt as if it were their own hand that was in danger. Although there are some disagreements about the correct interpretation of the RHI, one may conclude that one can experience an object as one's own despite the fact that is not spatially connected with one's biological body and that one knows that it is a mere rubber hand:

“I found myself looking at the dummy hand thinking it was actually my own.” In Botvinick and Cohen (1998, 756)

Hence, it seems that an object that is only seen can bear the stamp of ownership. This result questions the relation between bodily sensations and the sense of ownership. More particularly, I shall argue that the RHI refutes the informational account of ownership, but not the spatial account. One can indeed explain the sense of ownership of the rubber hand in terms of the spatial content that assigns a specific location to the bodily property within a representation of the space of one's body.

In the RHI, participants do not receive tactile information from the rubber hand (i.e. they do not have tactile receptors on the rubber hand that convey tactile signals to the brain), but from their biological hand that is touched in synchrony. Hence, it is not necessary to receive information from the inside (e.g. through the sense of pressure) to experience a body part as one's own. Yet, we are not entitled to conclude on the sole basis of these results that the sense of ownership is completely independent of bodily experiences and that it is grounded in a further mechanism, still to be determined. What is interesting in the RHI is that the participants assign the sensation of pressure to the rubber hand, and not the biological hand. The sense of ownership of the rubber hand is thus compatible with the spatial account. If the sense of body ownership is indeed grounded in the spatial ascription of bodily experiences, it is then of no surprise that participants experience the rubber hand as their own. Nonetheless, the RHI brings a new insight on the spatial account of the sense of ownership. In particular, it reveals that pressure is localized within a spatial representation of the body that is based not only on touch, but also on vision. One needs thus to refine the spatial account of the sense of ownership to take into account the multimodality of the representation of the body space. I shall come back later to it.

3.2 This is not my hand

Not only can we experience as our own an extraneous object, but we can also experience our own body as alien. Although the sense of body ownership may appear as a given, various psychiatric or neurological conditions indeed highlight the possibility of losing the sense of ownership of one's body. For example, patients suffering from the psychiatric disorder of depersonalization experience a general alteration of their relation to the self, as revealed by anomalous bodily experiences, emotional numbing, sensation of alienation from surroundings and anomalous subjective recall (Sierra et al. 2005).

“I don't know who I am, of course I am **** but I feel like a robot, like I am listening to someone else talking, like I am looking at myself from the outside, but it is not another voice or body, it is mine, it is me, it just doesn't feel like it.” In Baker et al. (2003, 432)

In particular, patients often feel as if their body did not belong to them or as if it had disappeared, leading them to compulsively touch their body and pour hot water on it to reassure themselves of their bodily existence. Similarly, following brain lesion or epileptic seizure, patients with somatoparaphrenia (also sometimes called asomatognosia or alien hand sign) deny ownership of one of their limbs so that they can even attribute it to another individual (Vallar and Ronchi 2009).

“Examiner: Whose arm is this? AR: It's not mine. Ex: Whose is it? AR: It's my mother's. Ex: How on earth does it happen to be there? AR: I don't know. I found it in my bed. Ex: How long has it been there? AR: Since the first day. Feel, it's warmer than mine. The other day too, when the weather was colder, it was warmer than mine. Ex: So, where is your left arm? AR: It's under there (indefinite gesture forwards) (...) Look, it's queer, but

that's how it is. Just fancy finding your son's arm in your bed" In Bisiach et al. (1991, 1030)

Whereas patients with depersonalization are aware that their bodily alienation is just an illusion, patients with somatoparaphrenia are convinced that the limb does not belong to them and they maintain their delusional belief despite correction: "Feinberg: Suppose I told you this was your hand? Mirna: I wouldn't believe you." (Feinberg et al. 2005, 104). However, it is with Body integrity identity disorder (BIID) that the experience of disownership leads to the most extreme and tragic consequences. Patients with BIID feel the overwhelming desire to be amputated of one(s) of their perfectly healthy limbs, partly because they experience this limb as alien (First 2005; Bayne and Levy 2005; Brang et al. 2008). Some actually perform self-amputation, going as far as lying under a train, building a homemade guillotine, or freezing their legs in dry ice.

"I don't understand where it comes from or what it is. I just don't want legs. Inside I feel that my legs don't belong to me, they shouldn't be there. At best my legs seem extraneous. I would almost say as if they're not part of me although I feel them, I see them, I know they are..." Corrine (in "Complete Obsession," BBC, 17th February, 2000)

To conclude, although counterintuitive, one can feel disownership towards one's biological body. But it may not be so surprising. Anybody can indeed sometimes wake up during the night with a 'sleeping' arm that almost feels alien. The lack of bodily sensations in the arm accounts for the lack of ownership feelings. This explanation reveals the importance of bodily experiences for the sense of ownership, and one may generalize it to the listed disownership syndromes: patients would not

experience their hand as their own because they would no longer receive information about their 'alien' hand from the inside.ⁱⁱⁱ

However, the reality is more complex. On the one hand, the deprivation of bodily sensations does not always lead to the lack of ownership feeling. In a study with normal subjects who have been locally anaesthetized, only 5 out of 36 subjects denied the ownership of their limb (Paqueron et al. 2003). On the other hand, disownership feelings are not always associated with the lack of bodily experiences. The patients described above are not always numb or anaesthetized in their 'alien' limb. For example, when somatoparaphrenic patients are touched with a paintbrush or pinpricked, they can feel the touch or the pinprick (Melzack 1990; Moro et al. 2004; Bottini, et al. 2002). Yet, they fail to experience the hand that they feel being touched as their own. In other words, the body that we feel may always be our own in our actual world, but it does not follow that we always experience it as our own.

In a nutshell, patients have access from the inside to the properties of their 'alien' body part, and yet, this does not suffice to elicit ownership feelings. The informational account of the sense of ownership is invalidated. But do disownership syndromes refute as well the spatial account? At first sight, it may seem so. Indeed, the patients localize the touch on their 'alien' hand. Hence, the spatial representation of their body still includes the 'alien' hand, and yet their hand feels alien. It is not as if they reported that they felt the touch, but they did not know where. However, disownership syndromes may not be a fatal objection against the spatial account if there are several types of body representation, and only one of them grounds the sense of ownership. I shall briefly develop this argument here.

Arguably, one single type of body representation cannot suffice to account for the diversity of bodily aspects (e.g. semantic, emotional, spatial, motor, tactile, visual,

proprioceptive, etc.) and the variety of bodily disorders (e.g. autotopagnosia, phantom limb, somatoparaphrenia, anorexia nervosa, body-specific aphasia, personal neglect, etc). In particular, one may distinguish between the representation of bodily information exploited for action (i.e. body schema) and the representation of bodily information used by perception (i.e. body image) (Paillard 1999; Gallagher 2005; de Vignemont 2010a). If there are several types of body representations, then the 'alien' hand can be represented at one level, but not at another. Furthermore, one may suggest that it is the impaired body representation that is responsible for the lack of ownership. A careful study of somatoparaphrenia can thus help us to determine which body representation is disrupted, and eventually which body representation grounds the sense of ownership.

I shall not go into the detail here, but some evidence points towards a disruption of the body schema in somatoparaphrenia. Interestingly, most somatoparaphrenic patients are either paralyzed or suffer from the anarchic hand syndrome (they cannot control their 'alien' hand). For example, a patient during epileptic seizure felt his leg as alien and immediately fell. One possible interpretation is that his leg was no longer represented within his body schema, which led the patient both to fall and to feel that the leg did not belong to him (Elson and Schaüble 2004). I propose that the sensorimotor body representation that carries information about the long-term properties of one's own body necessary for action is at the source of the sense of ownership. Roughly speaking, the body that you represent for acting is the body that you experience as your own. In somatoparaphrenia, the 'alien' limb is no longer represented within this sensorimotor representation of the body space, preventing thus the touch to be localized on the hand at the sensorimotor level, and the hand to feel as one's own. Hence, one can account for the lack of sense of ownership of one's hand in

terms of the spatial ascription that assigns a specific location to the bodily property within a sensorimotor representation of the space of one's body.

To conclude, the analysis of illusory and disrupted ownership experiences has deepened our understanding of the relation between bodily experiences and the sense of ownership. In a nutshell, the sense of body ownership can be at odds with the body that one experiences from the inside. I have shown that the Rubber Hand Illusion and somatoparaphrenia argue against the informational account of the sense of ownership. Yet, they can fit within the framework of the spatial account. Nonetheless, further arguments and details need to be provided if one wants to make a case for the spatial account of the sense of ownership. One needs to develop a theory of the spatial ascription of bodily experiences, which takes into account the role of vision and action in shaping the representation of the bodily space. It is only if one takes into account the recent empirical literature on body representations that one can offer a full-fledged theory of bodily space and the sense of body ownership.

4. The grounds of bodily immunity

I shall approach now the link between bodily experiences and ownership at the epistemological level and analyse the various ways empirical phenomena could enrich our understanding of immunity to error through misidentification before focusing on the issue of multimodal bodily self-knowledge.

First, in order to question the hypothesis of immunity to error, one may look at recent technological developments and prospects that challenge the very idea that one is connected only to one's biological body. Patients that are fully paralysed can play ping-pong on a computer screen. Artists like Stellarc can incorporate a prosthetic third arm that moves at will. What used to be mere thought experiments may become soon

reality. The anatomical constraints that secure the causal chain between bodily experiences and one's body might be overridden in the future if, for instance, one's brain is connected to another individual's body. One would then directly experience from the inside another's bodily states and postures. If so, knowing that the arms are crossed via proprioception would no longer guarantee that those are one's arms that are crossed. In this futuristic scenario, bodily self-ascriptions grounded in bodily experiences are not IEM.

A second way to empirically address the issue of bodily immunity is to look for bodily misidentification in judgments that are grounded in bodily experiences. If such cases exist, then bodily self-ascriptions are not IEM. One may suggest for instance that the RHI and somatoparaphrenia constitute such cases (e.g., Mizumoto and Ishikawa 2005). In both cases, one misidentifies whose hand it is, whether one self-attributes an external hand or attributes one's own hand to another individual. However, not any case of misidentification can falsify the hypothesis of immunity to error, and in particular nor the RHI nor somatoparaphrenia can challenge the fact that bodily experiences guarantee bodily immunity. The hypothesis of bodily immunity claims that if the ownership judgment derives from the appropriate way of gaining information about the bodily property, namely, the senses of posture, balance and pressure, then it is IEM. But the way of gaining bodily knowledge is not appropriate in the RHI. Indeed, it is vision that gives the information that the bodily property is instantiated, not proprioception or touch. That is why the RHI is characterized in terms of *visual* capture of touch and proprioception. And in this case, vision does not guarantee bodily immunity. As for somatoparaphrenia, the patients have the appropriate grounds that guarantee the immunity of bodily self-ascriptions (e.g., they have tactile experiences), if self-ascriptions were to be made. But the mere presence

of appropriate grounds does not suffice to guarantee that one does make those self-ascriptions. Roughly, it is not because one has plenty of good reasons to believe that *p* that one believes that *p*. And it is not because one does not believe that *p* that one does not have the good reasons for believing that *p*. Hence, the patients may have the appropriate grounds to make the judgment that this is one's own hand, but that does not necessarily imply that one makes such judgment. And the fact that they do not make the ownership judgment does not challenge the validity of the grounds. The patients may indeed have other reasons that they take to defeat their grounds. Hence, somatoparaphrenia and the RHI have no relevance for bodily immunity.

Finally, the maybe most interesting and promising way to empirically address bodily immunity is to focus on the grounds of bodily self-knowledge. One important move in the discussion of immunity to error has been to acknowledge that immunity does not apply to propositions *per se*, but to thoughts made upon specific grounds. In principle, any self-ascription can be IEM if the subject has gained information about the property in the appropriate way. This allows not only psychological self-ascriptions, but also bodily self-ascriptions to be IEM. But what are the appropriate grounds that secure bodily immunity? It is generally assumed that the body senses (e.g., touch, proprioception and the sense of balance) guarantee bodily immunity. However, recent empirical findings have shown that the normal way of gaining bodily self-knowledge is not via the body senses *per se*, but rather via the integration of body senses with vision. Bodily self-knowledge is primarily multimodal. But if bodily self-ascriptions are grounded not only in proprioception, which secures bodily immunity, but also in vision, which is not supposed to secure bodily immunity, then are bodily self-ascriptions still IEM?

For a long time, most research on perception has studied each sensory modality in isolation. However, not only do we experience the world through various senses at the same time, but those senses also interact together. Then information from one modality impact another such that it reorganizes its perceptual experience. Plurimodal integration can imply the resolution of conflicts between the different kinds of information, and it can even sometimes lead to perceptual illusions. For example, in the ventriloquism effect, the absence of seen lip-movement alters the apparent location of speech sounds. Cross-modal effects can be found between all modalities. In particular, vision, proprioception and touch can mutually interfere. For the sake of this paper, I shall present a single example.

When people view their hand through optical prisms that shift the direction of light rays by a constant angle, they experience a conflict between the seen and the felt position of their hand. After a certain time of adaptation, people no longer make two distinct judgments on the position of their hand, respectively grounded in vision and in proprioception. Rather, they report *seeing* and *feeling* their hand somewhere between the two positions where the hand is perceived on the basis of vision only and proprioception only. Furthermore, the hand is usually localized closer to the visually perceived position than to the proprioceptively perceived position (Welch and Warren 1986). Prisms highlight the integration of the two information channels because there is an artificial conflict. But many bodily judgments in everyday life result from multimodal integration. The boundary between body senses and external senses is permeable. It may be hard to quantify the extent of multimodality, but recent evidence shows that what you can see when you are four-year old influences how you feel touch twenty years later, even if you are now blind (Röder et al. 2004). Furthermore, even in the absence of online visual inputs, visual imagery, whether as visual memory

or visual prediction, can still impact your proprioceptive experiences (Smeets et al. 2006). As Bermudez (1998, 141) noted, “it is in fact very rare that we have modality-specific perceptions”, and the perception of one's body is no exception.

The major influence of vision on bodily experiences is not accidental. It has a strong adaptative value. On the one hand, most of the time vision is more reliable than proprioception at determining spatial information. Combining visual information to proprioceptive information thus increases the accuracy of bodily self-knowledge. On the other hand, our body navigates in and interacts with the external world, which is given to us mainly through vision. In order to grasp the glass in front of me, I need to locate my hand relative to the glass in the environment where there can be obstacles to avoid. The body is embedded in its environment, and the perception of the body from the inside needs to be remapped within the external frame of reference provided by vision to interact with the environment.

What are the epistemological implications of multimodality for bodily immunity? In other words, are bodily self-ascriptions based on multimodal grounds IEM? As I shall argue, the involvement of vision does not necessarily 'contaminate' bodily self-ascriptions, and thus for two reasons. First, contrary to what is generally assumed, vision can sometimes guarantee bodily immunity. Second, even if vision does not guarantee bodily immunity, the integration between vision and proprioception does not involve an identification component, and thus lead to judgments that are IEM.

Most examples in the literature appeal to indirect vision of one's body in mirrors to disqualify vision. For example, Ernst Mach famously reported that one day, he stepped in a bus and noticed a man that looks like a shabby pedagogue, while he was actually seeing himself in a large mirror at the far end of the bus. But there are some circumstances when one directly sees one's body and one cannot doubt that this is

one's own body that one sees.^{iv} Whether vision guarantees bodily immunity or not depends on the visuo-spatial perspective (i.e. angle and distance at which the body is seen). If you see a body far away in the middle of a forest, it is highly unlikely that this body is your own. But if you see a nose by closing one eye and looking down at a very close distance, it cannot be anybody else's nose than your own. This is due to the fact that the representation of the body from this specific visuo-spatial perspective is self-specific. Put another way, it is anatomically impossible that it could be another individual's nose that you could see from this angle at this distance. Hence, one should not automatically disqualify vision as a valid ground for bodily immunity.

Still, there are some cases - actually most cases - where vision does not guarantee bodily immunity. For instance, when I see my hand on the table, it could be as well another's hand. And if this visual information is integrated with proprioceptive information about the location of my hand, then my judgment "my hand is on the table" is based on mixed grounds, only partially IEM. If we defend the view that bodily self-ascriptions are IEM if and only if they are exclusively based on grounds that guarantee bodily immunity, then my judgment is not IEM. But there is no principle that commits us to defend this strong view of bodily immunity. Rather, we need to understand the basic mechanisms of multisensory integration if we want to assess the immunity of visuo-proprioceptive judgments. In particular, we need to determine if multimodal integration involves self-identification. Indeed, it is only if there is identification of the subject that there can be errors through misidentification relative to the subject.

For two sensory signals to be integrated, they need to be assigned to the same individual (i.e. assumption of unity, cf. Welch and Warren 1986). What is thus required is to select the relevant sensory signals that come from a common source,

and to segregate them from those that come from a different source. In other words, it is not adaptative for the perceptual system to integrate proprioceptive information about one's hand with visual information about another's hand. Rather, it needs to make sure that both types of information are about the same hand in order to increase reliability of the perceptual judgment. The question then is whether the assumption of unity requires self-identification.

On one interpretation, one would need first to identify whose hand one is seeing before integrating the visual information with the proprioceptive information. If so, visuo-proprioceptive integration would be identification-dependent. This interpretation, however, is misleading. Multimodal integration does not require that the subject feels that her hand is F, sees that x is F, judges that x is her hand, and integrates what she feels with what she sees. On the one hand, multimodal integration occurs very early on in the perceptual process, at a stage where raw modality-specific sensory signals are not available to the subject. Rather than identification, one may talk of a subpersonal process of assignment (Deneve and Pouget 2004). On the other hand, there is no need to first identify the source to determine that the sensory signals come from the same source. It suffices to compare the sensory signals themselves, and the information they carry. For example, if they occur at the same time and carry information about the same location within the same frame of reference, then it is likely that they carry information about the same individual. The reliability of the assumption of unity depends on the number of properties that are congruent across the sensory signals. Hence, the visual system does not have to identify the seen body as one's own body. Rather, the properties of the seen body are compared with the properties of the felt body (e.g. location, posture) and if they are similar enough, then

the visual and proprioceptive signals are melted into a multimodal perceptual experience of one's hand.

Under normal circumstances, the process of assignment to a common source is reliable. The fact of the matter is that we do not integrate visual information from other people's bodies with proprioceptive information from our own body, except in some artificially induced bodily illusions. This does not mean, however, that the assignment process is infallible. It may happen that visual information about a rubber hand is integrated with proprioceptive information about one's hand because visual information is mistakenly assigned to the same hand as proprioceptive information. Consequently, there can be errors. But they are not errors through misidentification.

To conclude, one should not accept the classical dichotomy between immunity-preserving body senses and vulnerable vision. Nor should one assume the exclusive thesis such as only the judgments that are exclusively grounded in body senses are immune to error. Rather, I propose to extend the list of grounds appropriate for bodily IEM to include visual experiences of the body from a self-specific perspective and bodily experiences resulting from the integration of vision and body senses. Only sensory signals assigned to a common source are indeed integrated together, and the assignment to a common source results from a subpersonal comparative process that does not depend on self-identification. Consequently, bodily immunity is preserved in integration-based bodily self-ascriptions. It might happen that the assignment process fails, but this cannot be assimilated to an error through misidentification relative to the first-person.

Conclusion

In this paper, I opened new avenues of dialogue between philosophers and scientists working on the body and the self. In particular, I discussed how recent empirical evidence, on topics such as the Rubber Hand Illusion, somatoparaphrenia and the multimodal nature of bodily self-knowledge, can help philosophers to revise and refine a classic view of ownership and immunity that puts bodily sensations at its core.

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ⁱ Arguably, the specific type of spatial content that characterizes bodily experiences ultimately derives from the privileged informational/causal relation between the body senses and one's body.

ⁱⁱ For a detailed account of the sense of ownership, see de Vignemont 2007; 2010b. For a detailed account of bodily immunity, see de Vignemont forthcoming.

ⁱⁱⁱ Furthermore, one may suggest that the urge to touch their body found in some patients reveals that tactile experiences ground the sense of ownership and through feeling touch, they can recover the experience of their body as their own.

^{iv} In addition, some visual experiences of the external world can guarantee bodily immunity. See Evans 1982, Bermudez 1998 and de Vignemont 2011a for more details.