Self-as-Subject and Experiential Ownership

Caleb Liang

In what follows, I investigate the distinction between the sense of self-as-object and the sense of self-as-subject, and propose an account that is different from Shoemaker's immunity principle. I suggest that this distinction can be elucidated by examining two types of self-experience: the sense of *body ownership* and the sense of *experiential ownership*. The former concerns self-as-object: whether a body part or a full body belongs to me. The latter concerns self-as-subject: whether I represent myself as the unique subject of experience. A key point is that misrepresentation can occur not only in the sense of body ownership but also in the sense of experiential ownership. Then I examine the most relevant neuroscientific accounts of the sense of self-as-subject, including Damasio's account of the core-self, Panksepp's affective neuroscience, neural synchrony, and the subcortical-cortical midline structures. I argue that none of these successfully explains the neural basis of the sense of self-as-subject. In order to make progress, I suggest, the first step is to look for and then to study the various conditions in which one can pursue the "Wittgenstein Question".

Keywords
Body ownership | Core-self | Experiential ownership | Immunity principle | Neural synchrony | Self-as-object | Self-as-subject

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1 Introduction

This paper investigates a central form of self-consciousness from an interdisciplinary perspective: *the sense of self-as-subject*.[1] How philosophers understand this form of consciousness has been influenced by two ideas. One is Wittgenstein's distinction between "I"-as-object and "I"-as-subject. In the Blue Book (1958), he says that: "there is no question of recognizing a person when I say I have toothache. To ask 'are you sure it is *you* who have pains?' would be nonsensical". The other is Shoemaker's immunity principle. Developing Wittgenstein's distinction, Shoemaker (1968) argues that we are "immune to error through misidentification relative to the first-person pronouns (IEM)". Many consider IEM to be solely addressing semantic

1 Here I will focus on the minimal sense of self-as-subject, which means that the sense of self-as-subject does not require exercising conceptual capacities and can be transient. It is contrasted with the "narrative self" or "autobiographical self", which involves episodic memory and persists through time (Gallagher 2000).

or conceptual issues. But for philosophers of mind, it decisively sets apart two types of self-consciousness. When one is conscious of oneself-as-object, error is always possible; however, when one is conscious of oneself-as-subject, a particular sort of mistake about *who* the subject is becomes impossible.

The first goal of this paper is to propose an alternative explication of the sense of self-as-object and the sense of self-as-subject. I aim to provide an account that is both phenomenologically precise and empirically useful. The distinction, I will suggest, can be better understood as two types of self-experience: a sense of body ownership and a sense of experiential ownership. I will argue that sometimes it makes perfect sense to ask a subject "are you sure it is *you* who feels pain?" For brevity, I will call this type of question the "Wittgenstein Question". I will also argue that IEM, or at least some versions of it, faces counterexamples from empirical research. The second goal of this paper is to examine empirical accounts related to the sense of self-as-subject. There are currently many neuroscience programs devoted to self-consciousness, and recently some researchers claim to have explained the neural mechanisms of the sense of self-as-subject. Investigating these programs will reveal how philosophy can contribute to neuroscience in understanding this target phenomenon.

I discuss the sense of body ownership in section 2, and explain how it helps to clarify the sense of self-as-object. Section 3 introduces the notion of experiential ownership. I use this notion to specify what it is like to experience the self-as-subject. A crucial claim is that *being* the subject of an experience does not imply experiencing oneself *as* the subject of experience. If this is correct, at least some forms of IEM fail. Consequently, if we want to talk about a sense of self-as-subject we need more empirical studies. Section 4 examines Damasio's account of the core-self and Panksepp's affective neuroscience. Both claim to explain the neural basis of the sense of self-as-subject, but I argue that they only address the sense of self-as-object. In section 5, I criticize two proposals that some neuroscientists use for explaining the sense of self-as-subject: neural synchrony and subcortical-cortical midline structures (SCMS). The overall positive lesson we can take from these accounts will be presented in the final section.

2 Body ownership and self-as-object

The sense of body ownership concerns whether a body part or a whole body is experienced as belonging to me. For example, I am now typing this paper with two hands, and I have a sense that the two hands are mine. To clarify this concept of self-experience, three distinctions will be very useful. One is between the *fact* of body ownership and the *sense* of body ownership (Dokic 2003; de Vignemont 2011). The former is a biological fact about the anatomical structures of one's body. The latter is a conscious experience of the fact of body ownership. As the syndrome of somatoparaphrenia indicates, these two aspects are dissociable. A prominent feature of somatoparaphrenia is that patients deny that parts of their body, e.g., a hand, belongs to them (Vallar & Ronchi 2009). Their sense of body ownership fails to match up with the facts —namely, that that the hand is theirs.

In healthy subjects, the sense of body ownership can also be mistaken. In the rubber hand illusion (RHI), participants experience a fake hand as belonging to them. The set-up is simple: The subject's own hand is blocked from view. The subject sees a rubber hand in front of her, clearly distinct from her own real hand. The experimenter uses paint brushes to touch the real hand and the rubber hand either synchronously or asynchronously (Botvinick & Cohen 1998; Tsakiris & Haggard 2005). In the synchronous condition, many subjects report that they feel as though they are being touched on the rubber hand rather than on their real hand. More interestingly, many subjects feel as if the rubber hand were their own hand.[2]

Another form of misrepresentation involves the full body—an illusion that induces some interesting aspects of out-of-body experience

2 Proprioceptive drift is another aspect frequently associated with RHI: many subjects judge (by proprioception) their real hand as being located closer to the rubber hand, rather than as where it really is. But Rohde et al. (2011) have recently shown that this aspect can be dissociated from the feeling of the rubber hand as one's own.

(OBE) (Lenggenhager et al. 2007).[3] In experiments of this type, the subject wears a three-dimensional head-mounted display (HMD), and a stereo camera stands two meters behind her. The scenes registered by the camera are transmitted to the HMD such that the subject sees the back of his virtual body in front of her. Then the subject's back is stroked either synchronously or asynchronously with the virtual body. In the synchronous condition, many subjects feel as if the virtual body were their own.[4]

The second distinction is between the first-personal sense and third-personal sense of body ownership. In daily experience, the sense of body ownership is often first-personal as well as pre-reflective (Legrand 2007, 2010). That is, by proprioception and somatosensation, I can experience the body as mine *from the inside* without watching it or reflecting upon it (de Vignemont 2012). Consider simple activities such as walking. When I talk to someone while walking, my attention can be fully absorbed in the conversation. In this case, I don't pay any attention to my leg movements. Still, due to the firing patterns of muscle spindles in my legs, I implicitly experience that my legs take turns entering into the stance phase (touching the ground) and the swing phase (leaving the ground) to move my body forward. In contrast, the sense of body ownership can sometimes be third-personal and reflective. When looking at a monitor in an airport showing the image of my body, I may wonder whether the body that I see is mine. In this case, instead of experiencing it *from the inside*, I consider my body from the third-person point of view. That is, the body is treated as the object of visual experience, attention, or reflection.[5] In the rest of this paper, I will use "the sense of body ownership" to indicate the first-personal sense of the term.[6]

These two distinctions have been suggested before. But now I want to propose a third distinction to help elucidate what we mean when we talk about the sense of self-as-object. This third distinction refers to the difference between a sense of body ownership and a sense of self *as a physical body*.[7] The former relates to questions like "Is this my hand?" and "Is that body mine?", whereas the latter concerns issues such as "What am I?" and "Am I a physical object?" This distinction marks two notions of bodily self-consciousness: experiencing a body part or a full body as one's *own*, on the one hand, and being conscious of oneself *as* a physical body on the other. Conceptually, the sense of *having* a body and the sense of *being* a body are different notions.[8] However, they are closely related *experientially*. I suggest that experien-

3 Cf. Ehrsson (2007) for a different OBE experiment.

4 The relationship between body-part and whole-body representations for body ownership is a controversial issue. Clearly they are not the same. The issue is: are they fundamentally different? Or is the difference only a matter of degree? As an anonymous reviewer points out, during the rubber-hand illusion, one's self-location and global body ownership are unaffected. However, during full-body illusions these aspects are affected and misrepresented because they concern the whole-body. Some researchers might therefore think that there exist some fundamental differences between body-part and whole-body representations for body ownership. One can also reasonably hypothesize that the neural mechanisms that are responsible for hand ownership do not need to involve brain regions that process leg or trunk representations. However, in my opinion more interdisciplinary studies would be required to really solve this issue. My current position is that, regarding the sense of body ownership, the difference between body-part and whole-body representations is a matter of degree. First, conceptually speaking, there doesn't seem to be a sharp distinction between body-part and whole-body representations. Second, if we consider the experimental set-ups of the rubber hand illusion and of the full-body illusions (either Lenggenhager's version or Ehrsson's), the differences between them seem to be a matter of degree as well. Of course, these are not arguments yet. I have recently designed a set of experiments precisely to deal with this issue, and I hope to be able to say something about it soon.

5 Are there borderline cases between the first-personal and the third-personal experiences of one's own body? I think so. For example, to use the above example again, if one of my legs suddenly hurts a little bit, I may be able to continue my conversation without disruption, but I have to pay attention to proprioception in order to walk normally. In this case, I submit, the distinction between the first-personal and the third-personal senses of body ownership is not sharp. However, this will not affect my proposal below regarding the relationship between the sense of full-body ownership and the sense of self-as-object.

6 Both the first-personal and the third-personal senses of body ownership are involved in RHI and OBE. On the one hand, the fake hand or the virtual body that the subject sees is the object of visual awareness, which is experienced as standing apart from their visual perspective. In addition, by filling in the questionnaires after the experiment, the subject makes explicit judgments about body ownership. This is the third-personal sense of body ownership. On the other hand, during the experiment, the synchronous touch and proprioception causes the subject to feel as if "it is my body that is being touched". This is the first-personal sense of body ownership, which can be indirectly measured by skin conductance response (SCR). In RHI and OBE, both the third-personal and the first-personal senses of body ownership are prone to misrepresentation.

7 Here, "physical body" is broadly construed such that it can refer not only to a physical object but also to a biological organism or a flesh-and-blood person.

8 A Cartesian dualist might say that, although I experience a particular body as mine, I fundamentally conceive of myself *as* a thinking being rather than as a physical body. For the purpose of this paper, we can set Cartesianism aside.

cing ownership of a full body provides a sense of self as a physical body. When I engage in daily activities, there is not only a sense that this body is mine but also a sense that I *am* a physical body. Consider ordinary experiences like eating, running, bleeding, standing behind a desk, etc. These experiences involve a sense of body ownership, i.e. what it is like to *have* a body. But I also experience what it is like to *be* something that is eating, running, bleeding, etc. That is, I have a sense about *what* I am, or a sense of myself as a physical body that is doing these things.

I suggest that the sense of full-body ownership helps us to understand the sense of self-as-physical-body.[9] The sense of self-as-physical-body, in turn, helps us to specify what it means to be conscious of the self-as-object.[10] When I experience these hands as mine, there is a sense in which I am implicitly aware of myself *as* a physical body such that these two hands *are parts of me*. The proposal here is that I am conscious of myself-*as-object* when I am conscious of myself as a physical body. This holds not only in cases where I take myself as an object of vision or attention, such as seeing myself in a mirror. It holds even when I experience myself as a body from the first person perspective.[11]

Let me draw some remarks made by Wittgenstein to support this proposal. Consider his examples of "I"-as-object: "My arm is broken", "I have grown six inches", "I have a bump on my forehead" (1958, p. 67). These examples clearly refer to the speaker's body. This fits my suggestion that consciousness of self-as-object can be understood as consciousness of self-as-physical-body—I have the sense that I am a body that has a broken arm or that has grown six inches. Now consider his examples of "I"-as-subject: "*I* see so-and-so", "*I* try to lift my arm", "*I* have toothache" (1958, pp. 66–67). As indicated by his own italicization, the use of "I"-as-subject is about *who* the perceiver, agent, or the subject is. But notice that these examples refer to the speaker's body *as well*. What does this tell us? My interpretation is that it implies that the idea of *who the subject is* should not be regarded as the same as the idea of *what* does the perceiving, lifting, or undergoes toothache. The sense of self-as-subject is not equivalent to the sense of self-as-physical-body.

Towards the end of The Blue Book, Wittgenstein makes two important remarks. First, "we can perfectly well adopt the expression "this body feels pain", and we shall then, just as usual, tell it to go to the doctor, to lie down, and even to remember that when the last time it had pains they were over in a day" (1958, p. 73).[12] His point is that we should not construe the thing that suffers pain as a Cartesian immaterial ego. The notion of body in the expression

9 The idea is that we know how to conduct empirical research in order to study the sense of full-body ownership which, as Blanke and Metzinger suggest, is connected with the following features: (i) the global sense of identification with a physical body as a whole (self-identification); (ii) the sense of being situated in a specific place (self-location); and (iii) the sense of possessing "a point of projection functioning as its origin in sensory and mental processing (weak 1PP)" (2009, pp. 7–8). Together, these features characterize what Blanke and Metzinger call minimal phenomenal selfhood (MPS), defined as "the conscious experience of being a self" (2009, p. 7). It is my view that these three features articulate what it is like to be a self *as a physical body*. In this regard, the sense of full-body ownership helps us to understand the sense of self-as-physical-body. Also, thanks to the recent findings of the RHI and the OBE experiments, we have now better ideas regarding how misrepresentation may occur in the sense of body ownership. This, in turn, suggests that the sense of self-as-physical-body can involve misrepresentation as well.

10 In my account, "the sense of self-as-physical-body" serves as a conceptual bridge between "the sense of full-body ownership" and the "sense of self-as-object". Experientially, the sense of full-body ownership and the sense of self-as-physical-body are closely related. I deliberately leave open whether these two notions denote the same or different experiences. I think more interdisciplinary work will be required to fix this issue.

11 My proposal here is very different from what might be called the Pre-reflective Account of self-consciousness (Legrand 2006, 2007, 2010, 2011; Gallagher 2005; Zahavi 2005). According to this account, self and body are constitutively tied together, and body can provide a sense of self-as-subject, i.e., one can experience one's body-*as-subject*. Pre-reflectively experiencing the self as a physical body would correspond to the sense of body-as-subject rather than as-object. The difference between my view and this account centers on whether the notion of object in "self-as-object" is construed as a physical body or as an "intentional object of consciousness". I contend that the sense of self-as-subject is different from the sense of body-as-subject. Experiencing the self as the subject of experiences is not the same as experiencing the self as a perceiving or acting body. I address these issues in another paper.

12 Just before this, Wittgenstein says: "Let us now ask: 'Can a human body have pain?' One is inclined to say: 'How can the body have pain? The body in itself is something dead; a body isn't conscious!' And here again it is as though we looked into the nature of pain and saw that it lies in its nature that a material object can't have it. And it is as though we saw that what has pain must be an entity of a different nature from that of a material object; that, in fact, it must be of a mental nature. But to say that the ego is mental is like saying that the number 3 is of a mental or an immaterial nature, when we recognize that the numeral '3' isn't used as a sign for a physical object" (1958, p.73).

'this body feels pain' can perfectly well refer to a physical object, i.e. to a person or to a biological organism that can consciously feel pain. Wittgenstein states this point from the third-person perspective. But there is no reason why this point cannot be formulated from the first-person perspective. That is, by "this body" I can refer to myself. As I suggested above, I can experience my body *from the inside*. Someone else can tell me to go to the doctor or to lie down, etc. In this case, I can be aware of myself as *having* a body that is in pain (a sense of body ownership), and I can have a sense of myself *as* a body that is in pain (the sense of self-as-physical-body).

This brings us to Wittgenstein's second remark: "The kernel of our proposition that that which has pains or sees or thinks is of a mental nature is only that the word 'I' in 'I have pains' does not denote a particular body, for we can't substitute for 'I' a description of a body" (1958, pp. 73–74). My interpretation of this remark is that, even when it is my body that is in pain, there remains a difference between saying "I have pains" and saying "this particular body feels pain". When Wittgenstein says that "the word 'I' in 'I have pains' does not denote a particular body", this remark can apply to the speaker's body considered *from the first-person perspective*. The reason why we can't substitute for "I" a description of a body is *not* because my body has to be described from the third-person point of view or that it has to be treated as an intentional object of consciousness. Rather, the reason we can't substitute for "I" a description of a body is that the "I" in "I have pains" captures the sense of *who* feels pains, while "a particular body" captures the sense of *what* feels pains. This difference, then, marks two different types of self-consciousness. In the former case, I am conscious of myself as the subject of pain experience. In the latter case, I am conscious of myself *as the body* that feels pain. I do not mean that this is the only possible interpretation of Wittgenstein's remarks. My claim is that it is a plausible interpretation, according to which the sense of self as subject of experience is distinct from the sense of self as a physical body, even when the body is characterized from the first-person perspective.

So far I have suggested an empirical approach to understanding the sense of self-as-object. The sense of full-body ownership provides theoretical and experiential grounds for understanding the sense of self-as-physical-body, which, in turn, helps to explicate the sense of self-as-object. This means that we can understand consciousness of self-as-object by studying the sense of full-body ownership. This fits Wittgenstein's and Shoemaker's assertions that the "I"-as object allows misrepresentation. The main advantage of my approach, however, lies in the fact that we know how to conduct empirical research on the sense of self-as-object. Now, in cognitive neuroscience there are plenty of exciting studies on full-body illusions and their neural mechanisms (Lenggenhager et al. 2007; Petkova & Ehrsson 2008; Ehrsson 2007; Ehrsson 2012; Ionta et al. 2011; Blanke 2012; Serino et al. 2013). A philosophical account will certainly benefit from looking at these. But what about the sense of self-as-subject? In the next section, I will appeal to the notion of experiential ownership in order to capture this basic form of self-consciousness.

3 Experiential ownership and self-as-subject

The sense of experiential ownership is not about ownership of body parts or a whole body, but about whether I represent myself as the unique *subject* of experience. As I am typing, for example, I do not only experience tactile sensations in my fingers. I also have a sense that I am the one who is having these tactile sensations. This corresponds to Wittgenstein's assertion: "To ask 'are you sure it is you who have pains?' would be nonsensical." In this section, I will (1) illustrate that the sense of experiential ownership is different from the sense of body ownership; and (2) draw two distinctions to explicate the sense of experiential ownership. I will then (3) describe some varieties of the immunity principle (IEM); and (4) provide two counterexamples against two major forms of

IEM. We will see that, *pace* Wittgenstein and Shoemaker, we need another way of articulating the distinction between the sense of self-as-object and the sense of self-as-subject.

Moro et al. (2004) describe two patients with somatoparaphrenia. These patients suffered not only from somatoparaphrenia but also from hemispatial neglect and tactile extinction. They denied ownership of their left hand, in which they had no sensation, and their left visual field was lost. So far, we might think that these cases involve only misrepresentation of body ownership. But there is more. When the researcher moved the patients' left hand to the right-hand side so that they could see it, their tactile sensation was restored. But despite representing themselves as the subjects who felt the sensations, the two patients still denied the ownership of their left hands (2004, p. 440–441). This shows that it is possible to have the sense of experiential ownership without the sense of body ownership. The two types of self-experience are conceptually and empirically dissociable.

To clarify the notion of experiential ownership, let me begin with the point that every phenomenal state has a *what*-component and a *who*-component. The *what*-component includes the representational content and the phenomenal character of that state. The *who*-component ties the *what*-component to a unique subject. The basic assumption here is that every phenomenal state has one and only one subject. The sense of experiential ownership is exclusively about the *who*-component—it concerns whether one experiences oneself as the subject of a phenomenal state. I will now draw two distinctions to further clarify this point.

The first distinction is between the *fact* of experiential ownership and the *sense* of experiential ownership. When a subject experiences a phenomenal state, there exists a *fact* that he is the subject of that state. This fact of experiential ownership is constitutive of every conscious experience—i.e. every experience has a unique subject. For every conscious experience, we can ask "Who is the subject of that experience?" and there exists a fact of the matter. For example, right now it is me, not you, who is experiencing lower-back pain. The fact of experiential ownership is objective in that it refers to a biological fact about whether a subject undergoes a phenomenal state.

When a subject experiences herself *as* the unique subject of a phenomenal state, she has the *sense* of experiential ownership, i.e. she experiences herself as the subject of that state. This aspect is captured by the Wittgenstein Question: "Are you sure it is you *who* has pains?" When a subject answers this question, she relies on her sense of experiential ownership. When I have a tactile sensation, I experience *what it is like for me* to undergo that sensation. The *what-it-is-like* aspect, i.e., the phenomenal character, belongs to the *what*-component. The *for-me* aspect refers to the subjective sense that I am the one who is having the sensation.[13]

The fact of experiential ownership and the sense of experiential ownership are two different aspects of experiential ownership: the *factual* aspect and the *subjective* aspect. These are not numerically different states or events that can be detached from a phenomenal state. Rather, they are two ways of characterizing the *who*-component of that state. The factual aspect addresses whether a subject experiences a phenomenal state; the subjective aspect concerns whether the subject is conscious of the factual aspect. But many philosophers do not see that these two aspects are not the same. To sustain this distinction, I will later argue that the factual aspect of experiential ownership can be misrepresented, which means that sometimes the Wittgenstein Question can be perfectly intelligible. Misrepresentation, as I shall explain, happens when the subjective aspect fails to match the factual aspect of experiential ownership.

The second distinction is between the first-personal sense and third-personal sense of experiential ownership. Suppose I experience a phenomenal state—say, lower-back pain. Not only do I experience the phenomenal character of the pain but also, *in the very same experience,* I have the sense that it is *me* who is experiencing that particular pain. This sense of

13 For other views about the *for-me* aspect, cf. Kriegel (2009) and Legrand (2007).

experiential ownership is first-personal, since it is part of the pain experience rather than resulting from a separate act of reflection. I experience a sense of experiential ownership by experiencing the pain without requiring any further attention or introspection.

Now suppose I participate in an experiment where several subjects receive tactile stimulations in a random order and everyone is simultaneously scanned with fMRI equipment.[14] Later, using the fMRI data on my somatosensory cortex, I can judge whether it was me who experienced a particular stimulation a few minutes ago. In this case, the sense of experiential ownership is considered from the third-person point of view, where the sense of experiential ownership is the content of a further judgment or reflection rather than an integral part of the respective phenomenal states.

I suggest that the sense of self-as-subject is captured by the first-personal sense of experiential ownership. Being conscious of oneself-as-subject just *is* to experience oneself as the subject of a phenomenal state. This implies that the sense of self-as-subject is exclusively about the *who*-component of a phenomenal state—no parts of the *what*-component belong to it. The sense of self-as-subject concerns whether I experience myself as the subject of a phenomenal state and nothing else. For the rest of this paper, I will use the term "the sense of experiential ownership" strictly in the first-personal sense.

Can one's sense of self-as-subject go wrong? Following Wittgenstein and Shoemaker, most philosophers believe that the answer to this question is negative. According to Shoemaker, "in being aware that one feels pain one is, tautologically, aware, not simply that the attribute *feel(s) pain* is instantiated, but that it is instantiated *in oneself*" (1968, pp. 563–564; emphases in original). Hence, when I consciously feel a sensation, I *cannot be wrong* about whether it is me who feels it. This immunity (IEM) is widely considered to be a conceptual truth.[15]

I want to argue, however, that both Shoemaker and Wittgenstein are wrong. IEM is not a conceptual truth, and sometimes it makes perfect sense to ask the Wittgenstein Question —namely, "Are you sure it is you who is having a so-and-so experience?" Using my own terms, I will argue that the *sense* of experiential ownership can misrepresent the *fact* of experiential ownership. First, let me briefly mention some varieties of IEM. (1) Pryor (1999) distinguishes between *de re* misidentification and *which-object* misidentification.[16] *De re* misidentification is false identification of two particular objects. It occurs when a mental state that a is F involves an assumption that $a = b$, but in fact $a \neq b$. For example, when looking in the mirror, I misidentify someone else as myself (Pryor 1999, p. 276). A mental state enjoys *de re* immunity just in case it is not possible for the state to be in error through *de re* misidentification. In the case of *which-object* misidentification, one makes an existential generalization that there is something that is F based on suitable grounds, but misidentifies *which thing* is F (Pryor 1999, p. 281). For example, when listening to a symphony orchestra, I can tell that one of the trumpet players is slightly out of tune, but I misidentify which one it is. A mental state enjoys *which-object* immunity just in case it is not possible for the state to be in error through *which-object* misidentification. (2) De Vignemont (2012) recently distinguished bodily immunity from mental immunity. Mental immunity concerns whether certain self-ascriptions of mental states, including thoughts, judgments, or sensations, etc., enjoy IEM. By contrast, bodily immunity is not about mental states but about bodily properties. It concerns whether certain self-ascriptions of bodily states enjoy IEM, e.g. "my legs are crossed".[17]

14 The method used here is called hyperscanning; cf. Montague et al. (2002).

15 Also, when specifying the "I"-as-subject, Shoemaker remarks that "not every self-ascription could be grounded on an identification of a presented object as oneself" (1968, p. 561). Because identification of the self requires that when ascribing a mental state to oneself, e.g. "a is F", one needs to demonstrate both "b is F" and "a = b." But "b is F" would in turn require both "c is F" and "b = c", and hence generates an infinite regress. This, Shoemaker argues, shows that the sense of self-as-subject must be identification-free.

16 Although disputed (Coliva 2006), many still consider this distinction useful.

17 Other varieties of IEM have been proposed in the literature. For example, Shoemaker (1968) distinguishes between circumstantial and absolute immunity, and between *de facto* and logical immunity (Shoemaker 1970; cf. also Coliva 2006). Pryor (1999) distinguishes between relative and absolute immunity. The former refers to im-

My target is a form of mental immunity that I call *experiential* immunity. *Experiential* immunity concerns phenomenal experiences. It is a form of *relative* immunity—that is, it is relative to first-personal access to phenomenal states, such as introspection, somatosensation, proprioception, etc. Experiential immunity is then the phenomenon that, when I am aware of a phenomenal state through first-personal access, I cannot be wrong about whether it is me who feels it. Experiential immunity can be construed as *de re* or *which-object* immunity. In the following section, I present counterexamples against both versions of experiential immunity. This will show that the sense of self-as-subject can be erroneous.

Bottini et al. (2002) describe a somatoparaphrenia patient ("FB") who has lost tactile sensation in her left hand and insists that her left hand belongs to her niece. They conducted the following tests on the patient, each involving several trials: (i) FB was blindfolded and told by the researcher that her left hand would be touched. Then the researcher actually touched the dorsal surface of her left hand. The result was that FB always reported feeling no sensation. (ii) FB was again blindfolded and was told that her *niece's* hand would be touched. The result in this case was that, when the researcher touched the dorsal surface of her left hand, surprisingly, FB reported feeling the touch.[18] The relevance of this case to IEM lies in the fact that, since FB was blindfolded during these tests, she relied on internal and first-personal access (e.g., introspection, somatosensation, proprioception) to determine whether or not she felt the touch. The perplexity lies in the difference between tests (i) and (ii). For the researcher, the only difference between the two was the verbal cues given to FB before touching her hand. The remaining conditions were the same. But for FB, the difference was dramatic. Why is it that FB felt nothing when she expected that she herself would be touched, but felt the sensations when she expected that her niece would be touched? What is the best description of this strange phenomenology?

My view is that, during test (ii), FB misrepresented her tactile sensations as belonging to someone else, namely her niece. For the sake of argument, Shoemaker and I can agree on the following claims: (1) for every phenomenal state there must be a subject who experiences it; (2) every phenomenal state is in principle available to first-personal access (Shoemaker 1996); (3) every phenomenal state is experienced by the one who has first-personal access to that state. The crucial point is that (1)–(3) do not imply that (4) every phenomenal state is, from the first-person point of view, *represented as* experienced by the one who has first-personal access to that state. In FB's case, (4) fails. FB fails to represent from her first-person perspective that she is the owner of the sensations. During test (ii), the factual aspect of her experiential ownership of the tactile sensations was intact when she was told that her niece would be touched, i.e., she was indeed the one who felt the tactile sensations. What went wrong was her sense of experiential ownership. Although FB felt the sensations, she misrepresented this fact as it being her niece who felt them.[19] This shows that it is empirically possible for a subject, while being aware of a phenomenal state via a first-personal

munity relative to certain rational grounds G, and the latter immunity by every possible ground. Regarding judgments and beliefs, Coliva (2006) suggests a distinction between immunity relative to the subject's own rational grounds and immunity relative to background presuppositions.

18 Test (ii) was conducted for four sessions, and FB reported feeling touches in 70%, 70%, 100%, and 80% of the trials respectively. As Bottini et al. observe: "her tactile imperceptions dramatically recovered" (2002, p. 251). To test if FB was just guessing, she was again blindfolded and told that her right hand (which is normal) would be touched. But actually the researcher did not touch her right hand. The result was that FB never reported feeling sensations—i.e., she passed the catch trials.

19 Shoemaker describes IEM as follows: 'The statement 'I feel pain' is not subject to error through misidentification relative to 'I': it cannot happen that I am mistaken in saying 'I feel pain' because, although I do know of someone that feels pain, I am mistaken in thinking that person to be myself' (1968, p. 557). Based on this description, some might insist that the self-ascriptions involved in IEM must be propositional in form, i.e. judgments, beliefs or statements. However, I contend that this restriction is unnecessary. What is crucial for IEM is that the self-ascriptions are based on first-personal grounds such as introspection, somatosensation, and proprioception, etc. As Bottini et al. have stated: "The patient was blindfolded and instructed to say 'yes' when she felt a touch and 'no' when she did not feel any touch" (2002, p. 251). So when FB said "yes" during test (ii), there is no reason why this wouldn't count as a self-ascription. Applying Shoemaker's description to FB's case: I am mistaken in reporting 'yes' during test (ii) because, although I do know of someone that feels the sensations (via first-personal access), I am mistaken in my thinking about who that person is. Shoemaker's IEM can be violated.

method, to commit a *de re* error regarding who the subject of that state is. Hence, *de re* immunity fails. Using my own terms, the sense of experiential ownership can misrepresent the fact of experiential ownership.[20]

The second case against Shoemaker's IEM is the "body swap illusion" (Petkova & Ehrsson 2008, figure 6). This involves agentive experience—I experience myself as someone who is doing something. In an experiment, subjects wore a head-mounted display (HMD), and stood face-to-face with the experimenter, who wore two closed-circuit television (CCTV) cameras. The images registered by the CCTV cameras were transmitted concurrently to the subjects' HMD, such that through the HMD the subjects saw their own body facing themselves. Both the subjects and the experimenter extended their right hands, took hold, and then squeezed synchronously for two minutes. Twenty college students participated in this experiment. The authors describe their phenomenology: "after the experiment, several of the participants spontaneously remarked: 'I was shaking hands with myself!'" (2008, p. 5)

This strange phenomenology indicates that the subjects' agentive experience was mistaken. It was the experimenter who was shaking their hands, not the subjects themselves. Again, Shoemaker and I can agree that: (1) for every agentive experience there must be a subject who experiences it; (2) every agentive experience is in principle available to first-personal access; and (3) every agentive experience is experienced by the subject who has first-personal access to it. However, (1)–(3) together do not imply that: (4) every agentive experience is, from the first-person perspective, *represented as* experienced by the subject who in fact has first-personal access to it. In this case, *which-object* immunity fails because (4) was violated by those who experienced the strange phenomenology in the body swap illusion. They were aware that there was someone having the agentive experience of squeezing their hands, but they misrepresented themselves as the subject of that experience.[21]

As such, it is possible for the subject of a given conscious experience, while being aware of that experience via a first-personal standpoint, to be mistaken about who the subject is.[22] Thus Wittgenstein is wrong: it would make perfect sense to ask FB and the body-swap subjects: 'Are you sure that it is *you* who is having a so-and-so experience?' And Shoemaker is wrong, too: experiential immunity is violated both in FB's case and in the body-swap illusion. One's sense self-as-subject can be mistaken—that is, the sense of experiential ownership can misrepresent the fact of experiential ownership. Therefore, since both the sense of self-as-object and the sense of self-as-subject can involve misrepresentation, Shoemaker's IEM fails to distinguish between them.[23]

20 One might object that the mistake that FB made was about the judgment of experiential ownership, not the sense of experiential ownership. My reply is that since FB was blindfolded, her report was based on first-personal grounds, i.e. on introspection. In addition, FB passed the catch trials mentioned in. As Bottini et al. have stated, FB "did not show any other sign of mental deterioration on the Mini Mental State Examination" (2002, p. 251). Therefore, no evidence suggests that her reports were unreliable. These considerations support the idea that the mistake was FB's sense of experiential ownership rather than her judgment. For other objections and responses, cf. Lane & Liang (2011).

21 Again, one might wonder whether the misrepresentation in this case was about the judgment rather than about the sense of experiential ownership. My reply is that since the subjects were normal college students, their reportability was not in question. So it is plausible to assume that their reports that "I was shaking hands with myself" were based on their subjective phenomenology, and more specifically on their sense of experiential ownership. Hence it was their sense of experiential ownership that committed misrepresentation.

22 There are at least two other (possible) cases of misrepresentation of the sense of experiential ownership. One is *voice ownership*: an illusion in which a stranger's voice, when presented as the auditory concomitant of a participant's own speech, is perceived as a modified version of one's own voice. "It felt as if the voice I heard was my voice" (Zeng et al. 2011). The other is *perception ownership*: A twenty-three-year-old male (DP) suffered from right inferior temporal hypometabolism (Zahn et al. 2008). The authors of a study on this male described his sensations as follows: "It appeared to him that he was able to see everything normally, but that he did not immediately recognize that he was the one who perceives and that he needed a second step to become aware that he himself was the one who perceives the object."

23 Let me briefly compare my position with other views. First, following Shoemaker, Coliva (2000) states that "If a subject is introspectively aware of pain, this just means that she is feeling pain […] it is a matter of *conceptual truth* that if a subject is introspectively aware of a certain mental state, then she herself is having it and, therefore, that *mental state is her own*" (my emphasis). In contrast to Coliva, my account rejects IEM as a conceptual truth. From the fact that a subject experiences a mental state it does not necessarily follow that the subject represents herself as the one who experiences that state. I take the possibility of misrepresentation to be an important feature of the sense of experiential ownership.
Second, Legrand (2007) emphasizes that consciousness of self-as-subject is pre-reflective, meaning that it is not an object of intentional consciousness. She says that the self-as-subject "is neither an external object (for example, it is not my body that I can observe in

I propose that this distinction can be made clearer by looking again at the sense of body ownership and the sense of experiential ownership. As I suggested in the last section, the sense of self-as-object can be understood in terms of a sense of self-as-physical-body which, in turn, can be understood via a sense of full-body ownership. Hence, when one experiences full-body ownership, one is conscious of oneself-as-object. In this section, I have suggested that we take an empirical approach to understanding the sense of self-as-subject. We can understand the consciousness of self-as-subject by studying the sense of experiential ownership.[24] In the next two sections, I examine some of the most relevant empirical accounts about the sense of self-as-subject. I argue that none of them are satisfactory. The reasons for this will be valuable when we consider where to go from here.

4 Core-self and affective-self

For animals, many biological values, such as finding food and shelter, avoiding predators, etc., have to do *homeostasis*—namely maintaining overall physiological states within the range required for survival (Damasio 1999, 2010; Panksepp 1998, 2005). To explain this, both Damasio and Panksepp propose that the brain has distinctive emotion systems and self-systems (the "proto-self" and the "core-self"). These inter-connected systems regulate homeostasis by integrating external information from perception with internal information from the body.[25] Despite their differences, Damasio and Panksepp share the following views: (1) emotions and homeostasis play essential roles in explaining how the sense of self is generated in the brain; (2) the key brain areas related to the self involve not only cortical but also sub-cortical regions, especially the brain stem possessed by both humans and many animals; (3) those brain areas are crucial, because multifarious types of neural information are integrated in those regions and provide representations of the whole body; (4) both Damasio and Panksepp believe that their accounts explain not only the sense of self-as-object but also the sense of self-as-subject. In the following I elucidate these points and then examine whether their goals are achieved.

According to Damasio, animal brains have what he calls the proto-self system, which is "a dynamic collection of integrated neural processes, centered on the representation of the living body" (2010, p. 9). The neural processes of

the mirror) nor an internal object […] I am simply looking outside at the external world, and within this single act of consciousness I pre-reflectively experience myself-as-subject" (2007). I agree that the sense of self-as-subject is often implicit rather than explicit. But Legrand's view neglects the distinction that I draw between the fact and the sense of experiential ownership. This is indicated by the fact of her embracing IEM. The fact of experiential ownership can be secured simply by looking outside at the external world, but whether one's sense of experiential ownership is correct is another issue.

24 What is the relationship between the sense of body ownership and the sense of experiential ownership? The short answer is that the former presupposes the latter, but a full treatment would require another paper. Here, let me draw on Metzinger's Self-model Theory of Subjectivity (2003, 2008) to briefly address this issue. According to this theory, PMIR (phenomenal model of the intentionality relation) is a phenomenal experience that represents the relation between a subject and an object component. For example, I take a bite of an apple. The PMIR contains a subject component (I), a relation component (tasting), and an object component (the apple). But I want to propose a revised version of PMIR. Since the PMIR is a complex phenomenal property experienced by a subject, it would sometimes be legitimate to ask who is experiencing this particular PMIR. Does the subject attribute the sense of experiential ownership of this PMIR to him or herself? My proposal is that PMIR consists of three components: (1) the sense of experiential ownership; (2) intentional relations; and (3) an object component. On this view, PMIR already involves the sense of experiential ownership as the subject component, which is distinct from intentional relations and the object component. This revised version of PMIR helps to unpack the phenomenological structures of the sense of body ownership as follows. The subject component is served by the sense of experiential ownership. The object component can be one of the following: my hand, a rubber hand, someone else's leg, my whole-body, or a virtual body, etc. The intentional relations include vision, touch, proprioception, location, motion, introspective awareness, affective feelings, and so on. Four quick remarks are relevant here. First, the sense of body ownership is itself a phenomenal state, about which (2) and (3) specify the *what*-component. The *who*-component of the sense of body ownership is characterized by (1) the sense of experiential ownership. Hence, the sense of body ownership presupposes the sense of experiential ownership. Second, it is (1) and (2) that generate the sense that (3) is part of my body. Third, the difference between the sense of body-part ownership and the sense of full-body ownership lies in (3), while (1) and (2) may remain the same. Finally, based on my proposal in section 1, the sense of self-as-physical-body can be understood in terms of the following structure of PMIR: (1) the sense of experiential ownership; (2) intentional relations; and (3) a whole body. And the sense of self-as-object can be understood in terms of the same structure of PMIR as well.

25 Both Damasio and Panksepp distinguish between emotions and their neural substrates, on the one hand, and feelings (Damasio) or affective feelings (Panksepp), on the other. Emotions refer to innate patterns of neural and physiological responses to environmental events. Feelings (or affective feelings) refer to phenomenal consciousness of emotions (Damasio 1999, p. 42, p. 55; Damasio 2010, pp. 108–110; Panksepp 1998, pp. 48–49; Panksepp 2005, p. 32). The emotion-systems closely interact with the self-systems to regulate and manage homeostasis.

this system represent "moment by moment, the most stable aspects of the organism's physical structure", on the one hand, and "the externally directed sensory portals", on the other (2010, p. 190). This generates *primordial feelings* that "reflect the current state of the body" and "provide a direct experience of one's own living body, wordless, unadorned, and connected to nothing but sheer existence" (2010, p. 21, p. 185). The proto-self system and primordial feelings account only for the sense of self-as-object (2010, p. 9, p. 202). The sense of self-as-subject is generated when an animal interacts with the environment such that a neural representation of the interaction is generated in the brain (2010, pp. 9–10, p. 91, p. 202). By interacting with external objects, the current state of the body and the proto-self system are modified. This modification activates the core-self system, which enhances attention to external objects and "engenders a sense of ownership" (2010, pp. 202–203). This is closely related to the sense of experiential ownership discussed above. It is part of what Damasio calls *core consciousness*, which "displays [...] moment by moment, that you rather than anyone else are doing the reading and the understanding of the text" (1999, p. 10).

Damasio's key idea is that the brain produces not only first-order representations of external objects and of the body (2010, p. 76, p. 84, pp. 91–97), but also *second-order representations* of the relationship between objects and the organism (1999, pp. 169–170; 2010, pp. 71–72, p. 181). These are "the source of the sense of the self in the act of knowing" (1999, p. 169). When the core-self is *felt* (1999, p. 172), i.e. when the second-order representations become conscious states (2010, p. 248), core consciousness emerges. This includes a minimal sense of self-as-subject, a transient sense that "it is you [...] doing the seeing" (1999, p. 169; cf. 2010, p. 168), or the sense that I am the subject of current experiences (cf. 2010, p. 185, p. 203, p. 209). As we can see, this account is highly relevant to our current investigation.

Damasio emphasizes that the most crucial neural structures related to the proto-self and the core-self systems are found in the subcortical regions, especially the brain stem (2010, p. 195, p. 205).[26] They include, among others, the nucleus tractus solitarius (NTS), the parabrachial nucleus (PBN), the periaqueductal gray (PAG), the hypothalamus, and the superior colliculus (2010, pp. 98–99, pp. 191–192; 1999, pp. 180–183). Why are these neural structures so critical for the core-self and core consciousness? According to Damasio, core consciousness results from *integration* of interoceptive, proprioceptive, and exteroceptive information, which produces second-order representations (2010, p. 76, p. 97, pp. 190–196, p. 199, p. 203, pp. 206–209). The brain areas just mentioned receive input from many other regions, which process information about external objects and internal bodily conditions (2010, p. 78, p. 80, pp. 84–85, p. 94, pp. 99–100, pp. 207–209). Thus it is in these areas that integration is thought to take place. Integration in those areas constitutes core consciousness because they provide neural representations of the organism's *whole body* (2010, p. 68, pp. 94–97, p. 209, pp. 244–245), and the integration is implemented by neural synchrony in the gamma range (2010, p. 20, pp. 86–87).

Panksepp points out seven basic innate emotion-systems in mammals: seeking, rage, fear, lust, care, panic, and play.[27] These emotion-systems generate affective feelings, which characterize how animals respond to environmental challenges. Panksepp & Northoff (2009) also postulate that the proto- and core-self systems monitor and regulate homeostasis. The proto-self is 'the most ancient form of coherent body representation', and the core-self gives rise to "affective consciousness".[28] Both systems are

26 For Damasio, the cortical areas that are important for the core self include insular and somatosensory cortices (2010, pp. 205–209).

27 According to Panksepp, emotions and affective feelings are internally generated by neuronal mechanisms to respond to life-challenging events. The neural systems of emotions compute and monitor homeostasis by evaluating an organism's adaptation to the environment. Each emotion system refers to a specific neural network, mainly in the subcortical areas.

28 Panksepp and Northoff prefer to use the expressions "proto-SELF" and "core-SELF" to emphasize neural mechanisms rather than mental phenomena, but this emphasis need not concern us here. They describe the relation between core-SELF and affective consciousness as follows: "What is subjectively experienced here is the relation of one's body to the incentives in the environment as well as internally generated emotional arousals—the core-SELF thus enables the organism to access this relation in terms of subjective experience, e.g., a primitive form of phenomenal consciousness, which at this level is essentially affective" (2009, p. 196).

causally mediated by what they call affective *self-related processing*, which integrates interoceptive information from the body and exteroceptive stimuli from the environment. The main mechanism that underlies this processing is a subcortical-cortical midline system (SCMS) (2009, p. 197). The subcortical parts of this network include "the Periaqueductal gray (PAG), the superior colliculi (SC), and the adjacent mesencephalic locomotor region (MLR), as well as preoptic areas, the hypothalamus, and dorsomedial thalamus (DMT)" (2009, p. 201). On the superior colliculi (SC) and the periaqueductal gray (PAG), they tell us that:

> The colliculi and the PAG are among the most richly connected areas of the brain; both receive afferents from several exteroceptive sensory regions (occipital, auditory, somatosensory, gustatory, and olfactory cortex) and, at the same time, afferents from other interoceptive subcortical regions. In addition, the PAG and the colliculi are connected with the cortical midline structures (CMS). (2009, p. 201)

Like Damasio, Panksepp and Northoff believe that the SC and the PAG play important roles in instigating the core-self system because they are the central areas where exteroceptive sensory information and interoceptive bodily information are integrated. They suggest that, due to anatomical convergence and neural synchronizations within the SCMS, "an archaic scheme of the *entire body* may be constituted in brain regions as low as the medial brainstem" (2009, p. 202; my emphasis).

Panksepp and Northoff claim that their theory explains what philosophers call the 'experiential self' and the 'primitive form of selfhood' (2009, p. 209). Self-related processing "intrinsically integrates affectivity, appropriateness and belongingness, and the phenomenal dimension of mineness into the *ownership of experience*" (2009, p. 199; my emphasis). This comes very close to the sense of experiential ownership that I discussed above. They consider self-related processing by the SCMS to be the mechanism not only of affective consciousness but also of the sense of self-as-subject.

In sum, Damasio, Panksepp and Northoff suggest that the sense of self-as-subject can be explained by full-body representations implemented by neural synchrony or by the SCMS. Now the key issue is: Do their accounts really specify the neural mechanisms that produce the sense of self-as-subject? Or do they specify only the mechanisms of the sense of self-as-object, i.e., of consciousness of oneself as a physical body interacting with the world? I argue that they address only the sense of self-as-object; they do not really provide a genuine account of the sense of self-as-subject.[29] Below I raise this theoretical issue; empirical arguments will follow in the next section.

Damasio claims that core consciousness is constituted by a second-order neural representation of the relation between animal and the environment. But this seems to require more explanation. Yet an explanation is not really provided by Damasio. I can agree that, for the sense of self-as-object, one must not only represent the external world, but also the body. But we cannot assume that the same account will automatically apply to the sense of self-as-subject. The problem with Damasio's account is that the theoretical link between full-body representation and the sense of self-as-subject is lacking. And Panksepp and Northoff's account is afflicted with the same defect. It might be that full-body representations are part of the biological conditions *necessary* for generating the sense of self-as-subject. But since they are also necessary for the sense of body ownership and the sense of self-as-object, it is far from obvious whether they are *sufficient* for the sense of self-as-subject. Let me elaborate.

Consider the full-body illusion mentioned in section 1. According to Blanke & Metzinger (2009), this illusion contains three central features related to self-consciousness. The first is *self-identification*. When the subjects experienced OBE during the experiment, "they felt as if the virtual body was their own" (2009, p. 12). We can see that this feature turns on the ques-

29 Cf. Legrand (2007) for a slightly different criticism of Damasio.

tion "Is that body mine?" rather than "Am I the one who is having this experience?" So self-identification is about the sense of full-body ownership rather than the sense of experiential ownership. The second feature is *self-location*, which concerns "where my body is located in space and time". Again, this is about the spatiotemporal position of the body rather than the sense of experiential ownership. Blanke and Metzinger call the third feature a *weak first-person perspective*, defined as a geometrical point of projection and nothing more (2009, p. 8). So construed, even a camera could possess such a perspective. Hence, this feature does not specify the sense of self-as-subject, either.

The point is that, in the OBE experiment, the sense of experiential ownership is not in question and hence not measured. This means that explanations of the mechanisms of full-body representation or the sense of body ownership do not necessarily apply to the sense of experiential ownership. As such, self-related processing can help explain full-body representation *without* explaining the sense of self-as-subject. Damasio, Panksepp and Northoff neglect the theoretical gap between full-body representation and the sense of self-as-subject, hence their accounts do not really explain the sense of self-as-subject. They suggest that the sense of self-as-subject results from integration by neural synchrony in the brain stem or the SCMS. But it remains unexplained why and how this could be so. To investigate these worries, I examine in the next section the two major proposals by neuroscientists regarding the mechanisms of the sense of self-as-subject: neural synchrony and processing in the SCMS.

5 Neural synchrony and subcortical-cortical midline structures

Neurons in different brain regions may exhibit rhythmic firing patterns. This is called neural oscillation, the frequency of which can be recorded by an electroencephalogram (EEG). When a group of neurons fire together with the same oscillation pattern, they are in *synchrony*. Neural synchrony is considered to be a central mechanism of many cognitive functions. In the case of conscious perception, multifarious types of visual information are processed in different brain regions, which need to be combined in order to produce coherent percepts. Many researchers suggest that transient synchronization in the visual system provides such a binding mechanism (Engel & Singer 2001; Singer 2004; Singer 2007; Koch 2004). In addition to vision, synchronization in the beta and gamma ranges is also found in the olfactory, auditory, and somatosensory systems, as well as in other brain areas that influence (or are influenced by) perception, such as the pre-frontal cortex, the motor cortex, and the hippocampus (Singer 2007).

However, if this is all there is to neural synchrony, it would not explain the sense of self-as-subject at all. What we are looking for is not the mechanism that explains what I consciously perceive, but the mechanism that produces the sense that I, rather than someone else, am the subject of these perceptions.[30] Thus, information integration by neural synchrony may explain the content of consciousness without explaining the sense of experiential ownership, i.e., it explains *what* one experiences rather than *who* the subject of that experience is. In the following I consider three recent developments that connect neural synchrony more closely with self-consciousness.

(1) Uhlhaas et al. (2009) recently suggested that there are high correlations between disorders of self-consciousness and abnormalities in neural synchrony. Symptoms of schizophrenia, epilepsy, autism, Alzheimer's disease, and Parkinson's disease are related to dysfunctions of synchronization. For example, correlations have been suggested between reduced or abnormal alpha- or gamma-band oscillations, on the one hand, and impaired visual binding, auditory hallucination in schizophrenia, and impaired linguistic and auditory performance in autism, on the other. The problem is that the sense of experiential ownership is not itself targeted in these studies. Researchers measured how abnormal neural synchrony relates to impaired cognitive performance, tather than to who the subject of the experience is.

30 The sense of experiential ownership is not studied in Singer's work on neural synchrony at all.

(2) Lou et al. (2010) used transcranial magnetic stimulation (TMS) to show that a medial paralimbic network is crucial for minimal self-consciousness.[31] This network may "bind conscious experiences with different degrees of self-reference through synchrony of high frequency oscillations" (2010, p. 185). They tested three conditions that represent different degrees of self-reference: maximal ("Self"), intermediate ("Franz"), and minimal ("Syl"). In each condition a set of adjectives were sequentially presented on a screen.[32] In the "Self" condition, the subject's task was to make personal judgments concerning how well each adjective fitted him or herself. However, none of these conditions are about the sense of experiential ownership. Whether it was "I" who looked at the screen and made the judgments was not in question. Hence, the sense of self-as-subject was not measured by the reported patterns of synchronization.

(3) Kanayama et al. (2009) used EEG to investigate the rubber hand illusion (RHI), and found high correlation between the visual-tactile integration process and gamma-band synchrony in the parietal cortex. The stronger the subjects experienced the illusion, the higher the synchrony was. The authors suggested that RHI is caused by gamma band synchrony. In addition, a study of the full-body illusion by Lenggenhager et al. (2011) found high correlation between alpha-band oscillations in the sensorimotor cortex and the medial prefrontal cortex, on the one hand, and subjects feeling themselves to be located in space, on the other. Unfortunately, these studies do not really tell us about the sense of self-as-subject. In these experiments, what was misrepresented was the sense of ownership of a body part or a whole body. Whether "I" was the one who was experiencing the illusions was not in question. The synchronization reported by these studies can help explain the sense of body ownership, but not the sense of self-as-subject.

31 Lou et al. (2010) suggest that this network includes the anterior cingulate, medial prefrontal and posterior cingulate, and the medial parietal cortices, connected via the thalamus.

32 In the 'Franz' condition, the subject judged how well each adjective fitted a well-known German football star Franz Beckenbauer. In the ''Syl'' condition, the subject's task was to decide whether each of the different sets of adjectives had an even or odd number of syllables.

As far as I know, no empirical study on neural synchrony really targets the sense of self-as-subject. We cannot explain the sense of experiential ownership simply by describing the mechanisms of content of conscious perception, cognitive deficits, or body ownership. The lesson here is that we need first to ascertain that the neural information being integrated by synchrony is *about* the sense of self-as-subject, and not just about representation of the organism's bodily condition. Unless we know exactly how the integrating processes bring about that one represents oneself as the subject of phenomenal or conscious states, we cannot say that the mechanisms of the sense of self-as-subject have been found. As I will suggest below, the key here is to identify the right research question. And this is where philosophy can make contributions to neuroscience.

The second proposal regarding the mechanisms of the sense of self-as-subject, suggested by Panksepp & Northoff (2009), is self-related processing implemented in the subcortical-cortical midline system (SCMS). This mechanism is notably related to the so-called resting state and the default mode network. Researchers have found that some brain areas are highly activated in the resting state, i.e. when the subject is not actively engaging with its environment (e.g. lying quietly in a scanner with eyes closed but awake) (Raichle et al. 2001). Interestingly, the activations decrease significantly when the subject performs tasks that involve focusing on the external world. These brain areas constitute what is now called the default mode network.

How one should interpret the neural activities in the resting state and the default mode network, and how they relate to self-consciousness, are controversial issues. For example, Gillihan & Farah (2005) point out that different research programs on the self employ divergent methodologies and implicate a wide range of brain areas. Putting all the data together, we do not obtain a specific or unitary picture, because pretty much the entire brain is involved in processing the sense of self. This and other criticisms suggest that we should be

cautious when interpreting the alleged empirical evidence about the sense of self-as-subject.[33]

Still, many researchers maintain that resting state activities and the default mode network are closely related to the self (cf. Gusnard 2005; D'Argembeau et al. 2007). Northoff et al. (2006) reviewed a vast number of imaging studies, and compared the processing of what they call self-related tasks and non-self-related tasks.[34] They found that the data indicate the same group of brain areas, including "the medial orbital prefrontal cortex (MOFC), the ventromedial prefrontal cortex (VMPFC), the sub/pre- and supragenual anterior cingulate cortex (PACC, SACC), the dorsomedial prefrontal cortex (DMPFC), the medial parietal cortex (MPC), the posterior cingulated cortex (PCC), and the retrosplenial cortex (RSC)" (2006, pp. 441–442). These areas constitute the cortical midline structures (CMS), i.e. the cortical parts of the SCMS. Compared with non-self-related tasks, when subjects perform self-related tasks their CMS reveal high activation across all domains (2006, p. 450). The authors suggest that the CMS correspond to the default mode network,[35] and that neural activity in the CMS constitutes "an experiential self that mediates ownership of experience" (2006, p. 441). "Ownership", they claim, "describes the sense that I am the one who is undergoing an experience" (2006, p. 448), which makes this account directly relevant to our investigation.

Legrand & Ruby (2009) argue against Northoff et al. that the CMS are at most self-related, i.e. related to the self only to some extent, but not *self-specific*, i.e., not specific enough to capture the sense of self-as-subject.[36] Partly because of this criticism, but more because of new findings by his own group, Northoff's view has changed significantly in recent times. First, Qin et al. (2010) recently studied the CMS in patients who are in a vegetative state. Surprisingly, by showing the patients their own names, various regions in their CMS were activated. Assuming that vegetative patients have lost the capacity to experience themselves as subjects, this finding undermines Northoff's previous claim that the CMS constitutes an "experiential self that mediates ownership of experience." In fact, Northoff now agrees that the neural processing in the CMS is at most a necessary condition for the experiential self.[37]

Second, after conducting a meta-analysis on eighty-seven imaging studies covering 1433 participants, Qin & Northoff (2011) suggest that self-related processing involves far fewer areas in the CMS. It is the perigenual anterior cingulate cortex (PACC), rather than the medial prefrontal cortex (MPFC) or posterior cingulate cortex (PCC), that is specifically involved in self-processing. This indicates that they have become more cautious about interpreting data. However, they still maintain that there exists a strong connection between the PACC and the sense of self. They argue that "our sense of self may result from a specific kind of interaction between resting state activity and stimulus-induced activity, i.e., rest–stimulus interaction, within the midline regions" (2011, p. 1221). That is, a narrower network *within* the CMS is not just necessary but indeed sufficient for "generating our sense of the self" (2011, p. 1222). I will comment on this last claim below.

Whether or not Qin and Northoff take their notion of "sense of self" to include the sense of

33 Another criticism is that, when the subject is interacting with the world, the neural activity in the default mode network is not totally extinguished. Some studies show that it is "reorganized in response to the working memory task" (Fransson 2006). Others have suggested that it could "function to support exploratory monitoring of the external environment when focused attention is relaxed" (Buckner et al. 2008).

34 Many of these studies used a "judgment paradigm". Subjects made explicit evaluative judgments about first- vs. third-person perspectives, own vs. others' judgments, self vs. others' decisions, own vs. others' personality traits, etc. The domains that Northoff et al. (2006) reviewed include verbal, spatial, memory, emotional, facial, agency, ownership of movements, and social tasks.

35 CMS show a high level of neural activity during the resting state. Non-self-referential tasks elicit large signal decreases in the CMS (Northoff et al. 2006, p. 450).

36 Legrand and Ruby indicated that the CMS are involved not only in self-related tasks, but also in several cognitive tasks that are not related to self-consciousness at all. For example, their review showed that some areas in the CMS are activated in others' mind reading, inductive and deductive reasoning, resting state, and memory recall. Moreover, these areas are "sometimes more activated for the self than for others and sometimes more activated for others than for self" (Legrand & Ruby 2009, p. 258).

37 Northoff et al. tell us that "the neural mechanisms underlying SRP [self-related processing] may only be considered a necessary condition which is not sufficient by itself to constitute a self with its self-specific contents" (2011, p. 55).

self-as-subject, I argue that their meta-analysis does not capture the sense of self-as-subject. They describe the operational criteria as follows: "the specificity of the self (e.g. hearing one's own name, seeing one's own face) was tested and compared across familiar (using stimuli from personally known people) and other (non-self–non-familiar, i.e. strangers and widely-known figures) conditions" (2011, p. 1211). The tasks in the "self condition" include "trait adjective judgment, retrieval of personality traits, face recognition, body recognition, personal thinking, name perception, autobiographical memory, own feeling, self-administered pain, person perspective tasks and agency tasks" (2011, p. 1224). All these tasks are about participants making judgments about whether a certain property may be suitably attributed to themselves. From the first-person point of view, the participants are judging whether the contents of the stimuli accurately characterize themselves. But again, whether "I" am the one who is experiencing the stimuli and making the judgments is really not in question, and hence not reflected in the data. Once again, the sense of self-as-subject is not measured by Qin and Northoff's most recent study.

I conclude that Damasio, Panksepp, and Northoff have all failed to explain the mechanisms of the sense of self-as-subject. A theoretical gap exists between neural synchrony and the SCMS, on the one hand, and the sense of self-as-subject, on the other. But it is important to see exactly where the shortcoming is. It is not that neural synchrony and the SCMS are completely irrelevant to the sense of self-as-subject. Rather, the failure is that why and how they are relevant have not really been explained. This is because the neuroscientists have not clarified and captured the sense of self-as-subject well enough, such that they over-interpret data and make unjustified claims about this target phenomenon. In this regard, my proposals in sections 2 and 3 have provided the required clarification.

6 Conclusion

I have suggested that the sense of self-as-subject can be explicated by examining the sense of experiential ownership, which is distinct from the sense of body ownership. Having a conscious experience secures only the fact of experiential ownership, not the sense of experiential ownership. This provides a reinterpretation of the distinction between the sense of self-as-object and the sense of self-as-subject. I elucidated the sense of self-as-object by looking at the sense of body ownership, and the sense of self-as-subject by examining the sense of experiential ownership. It became clear that both can misrepresent. The possibility of misrepresentation makes the sense of self-as-subject open to empirical as well as philosophical investigations. It is important to investigate how misrepresentation of the sense of experiential ownership is generated. This requires us to identify the right research question—which, I suggest, is precisely the Wittgenstein Question. When examining pathological cases or conducting experiments, researchers should ask their subjects questions like: "Are you sure it is you who is feeling your niece's sensations?" or "Are you sure it is you who is shaking your own hand?" Then psychophysical and fMRI experiments can be developed to study the subjects' responses. As such, to move forward, the first step is to look for and then to study the various conditions about which one can pursue the Wittgenstein Question.

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