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The first-person in pain

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Human's experience of pain is strictly dependent from the way we represent the body itself and from the sense that it is *my* body that is undergoing a certain experience (i.e., body ownership). (Pia et al., 2013)

The very idea of feeling a pain in a limb which does not seem to be ours is difficult to frame, perhaps unintelligible. (Dokic, 2003, p. 325)

There is an intuitive sense in which pain is deeply connected to self-awareness. One might, for instance, report how one feels extremely self-aware when one is in deep pain, as if the rest of the world ceased to exist. Pain, or at least the expectation of pain, is also commonly used to test our intuitions in debates about personal identity. The underlying assumption is that one fears pain for the person one identifies with. Imagine that you are told that you will be tortured tomorrow but beforehand you will undergo a series of psychological changes, including completely new memories coming from another person. If you are still afraid despite these psychological changes, then one might conclude that you identify yourself with your body in this situation (Williams, 1970). The relationship between pain and the first-person has also been addressed in epistemology. When I feel pain, there is no doubt that I am the person feeling pain. Pain self-ascriptions are then said to be immune to error through misidentification relative to the first-person (Shoemaker, 1968).

But there are often two occurrences of the first-person in pain statements: one occurrence referring to the subject of the painful experience (*I feel pain*) and one to the body part in which the pain is felt (in *my hand*). Corresponding to these two occurrences, there are two phenomena: the subjectivity of pain (what it feels like *for me* to be in pain) and the sense of bodily ownership (the awareness of the *body* in pain *as one's own*). In this chapter, I shall focus on the latter and investigate to what extent the localization of pain depends on what one experiences as one's own. Dokic (2003) claims that one cannot conceive feeling pain in a part of the body that feels as alien (see also Martin, 1995 and Bain, 2003).¹ But why does it seem so? And is it really impossible to feel pain in an 'alien' body?

In the first section of this paper, I will consider several explanations of the apparent link between the sense of bodily ownership and pain. In particular, I will discuss in what manner pain differs from other bodily sensations in its relation to the sense of bodily ownership. In the second section, I will discuss whether the localization of pain tracks, so to speak, what one experiences as one's own. In light of borderline cases of ownership, I will argue that the sense of bodily ownership may be a sufficient condition to localize pain in a specific body part, but not a necessary one. In the last section, I will finally assess the implications of those findings for our understanding of pain in relation to threat, to the body and to the self.

1. The roots of the ownership intuition

¹ It is important here to distinguish between pain *per se* and *vicarious* pain (Vignemont and Jacob, 2011). Pain is vicarious if it is caused by another person being in pain and it is isomorphic to the other person's state, but to some extent only. When I claim that I feel your pain, I am only reporting my vicarious state of pain and this cannot be taken as a counterexample to Dokic's claim.

There are two ways to analyse the relationship between pain and the sense of bodily ownership. One can start either from the analysis of the sense of ownership or from the analysis of pain. In the former case, it has been suggested that one necessarily feels one's body as one's own when one feels bodily sensations, including pain. In the latter case, it has been suggested that one can localize pain in a part of the body only if one feels this body part as one's own. Hence, it seems that either bodily sensations, including pain, are necessary for the sense of ownership or the sense of ownership is necessary for pain. It follows from both views that pain and the sense of bodily ownership are inseparable.

1.1 The deflationary conception of ownership

A limb or a sensation counts as apparently belonging to one's body simply by being felt. (Martin, 1992, p. 202)

Martin's claim is not that the body that belongs to me is the body in which I feel sensations. He makes no ontological commitment. Rather, he analyses the sense of bodily ownership, that is, the awareness of a body as belonging to me. The question then is how I am aware that this is my own body rather than someone else's. A good starting point for analysing the sense of bodily ownership is to compare the awareness of my own body with the awareness of other bodies. Through vision, audition, touch, smell and taste, I have access to bodily properties, whether they are instantiated by my body or by other bodies (e.g. skin colour, bodily posture). Clearly, the awareness of those bodily properties from the outside, so to speak, does not suffice for the sense of bodily ownership. For example, one can relatively easily fail to recognize that the body that one sees is one's own, like in a photograph or in a mirror. As Brewer says, the visual body does not bear the "stamp of ownership" (1995, p. 305). But the classic five senses do not exhaust the list of ways of gaining information about my own body. Let us imagine that I wake up in the middle of the night. I feel my heart beating too fast. My

left arm feels in an awkward posture, which is painful. It feels nice to stretch on the bed and to feel the contact of the cold sheet on my skin. I feel too warm. I am thirsty. I get up but I lose my balance. These various types of information about my body are not directly available about other people's bodies.² Unlike other bodies, not only do I perceive my body through external senses, but I also receive information through what I call body senses (including touch, proprioception, interoception, nociception and the vestibular system), which give rise to bodily experiences. One may then suggest that there is no need to go further in the analysis of the sense of bodily ownership. Indeed one never has bodily experiences for any body other than one's own, whereas we have visual experiences for many bodies. Thanks to their privileged relation to one's body, bodily experiences may thus be all it takes to be aware of one's body as one's own (Brewer 1995; Cassam 1997; Dokic 2003; Martin 1995; Bermúdez, 2011). On this view, it is one and the same thing to be aware of one's body through pain (or through any other bodily experience) and to be aware of one's body as one's own. Feeling pain in a part of the body suffices for experiencing the body part as one's own. Bermúdez (2011) calls this view the 'deflationary conception of ownership'.

One can then note that the deflationary conception assumes no difference between pain and other types of bodily experiences like proprioceptive, thermal and tactile experiences. Actually, according to Martin (1995, p. 277), the sense of ownership is "possessed by all located sensations". There is nothing special about pain. However, when we look more closely at pain itself, it may seem to have an even more intimate link to the sense of ownership than other types of bodily experiences.

1.2 The special status of pain

² I may be able to feel *indirectly* the location of your hand if I am holding it while keeping my eyes closed. But then my experience of your hand results from the combination of proprioception and the exteroceptive content of touch.

Pain also reminds us of our ‘real’ body and thus seems to have a special status in body ownership. (Kammers et al., 2011, p. 1320)

What “special status” does pain have? One of the main features of pain is that it can grab our attention far more than any other bodily experiences. Most of the time, we are indeed only marginally aware of our body. Likewise, the phenomenology of ownership is recessive and elusive. One may then say that by attracting attention to the body, pain enhances our sense of bodily ownership, which becomes more vivid. The difference with the other types of bodily experiences is then quantitative, a matter of mere intensity. The question is whether there are also qualitative differences. I will now consider two hypotheses. The first will focus on spatial peculiarities of pain. The second will focus on its motivational role.

There has been extensive discussion about the spatial ascription of pain in the literature. Typically, it has been asked how we should interpret the term “in” when one reports feeling pain in one’s hand since such ascriptions do not seem to follow the rule of spatial transitivity (e.g. Noordhof, 2001; Tye, 2002).³ But there is another interesting feature of the spatiality of pain, which has been neglected. Pain seems indeed more attached to the body than tactile sensations. In the case of touch, it is commonly accepted that tactile sensations can be felt beyond the biological boundaries of one’s body, at the tip of a tool for instance (Katz, 1925; Lotze, 1888; Gibson, 1979; Martin, 1993; O’Shaughnessy, 2003; Vesey, 1961). One might say, for instance, that the blind man is aware of the obstacles on the floor *at the end* of his white cane rather than on his palm.⁴ However, there is no comparable sense in which the blind

³ I feel pain in my thumb and my thumb is in my mouth. Yet I do not feel pain in my mouth (Block, 1983).

⁴ One may reply that the blind man experiences pressure first in his hand and then only does he project the sensation on the tip of his cane when touching the floor. However, some empirical findings indicate that there is a sense in which he does feel sensation as being located at the tip of the cane. A well known effect in psychology is that one has difficulty judging which hand is touched first when the two hands are crossed and they are touched one after the other (Yamamoto and Kitazawa, 2001a). What is interesting is that participants experience the same difficulty if they cross their hands and if they cross two sticks with their hands uncrossed and the two sticks are vibrated one after the other (Yamamoto and Kitazawa, 2001b). This indicates that the vibration is experienced as being located at the tip of the sticks (which were crossed) rather than on the hands that hold them (which were uncrossed).

man could be said to feel pain at the tip of his cane. Of course he can wince when the cane falls on the floor. But he does not feel pain as being localized in the cane. The fact is that one uses tools in harmful situations in which one would not use one's limbs. This is so because if a tool is damaged, one does not feel hurt. To recap, although there is a sense in which one can be said to feel resistance or vibration in a tool, the same cannot be said of pain.

This is not to say that one can feel pain only within the limits of the biological body. Unfortunately, pain in phantom limbs does exist and is extremely unpleasant. But the difference between tools and phantom limbs is that the amputee feels the phantom limb as part of her own body whereas the blind man does not feel the cane as part of his body.⁵ Pain thus seems more robustly attached to the body that one experiences as one's own than other types of bodily experiences.⁶ One way to interpret this relation is to claim that one can localize pain only within the spatial frame of reference given by the representation of the body that one experiences as one's own (Pia et al., 2013). On this view, where there is pain, there is the sense of bodily ownership.

I want now to consider another difference between pain and other types of bodily experiences. Let us focus on tactile experiences for the moment. Most of the time they are devoid of affective valence. I feel the pressure of the table on my arm but unless it feels uncomfortable, my tactile sensation is affectively neutral and has no immediate implication for action. By contrast, along with itches and tickles, pain has affective and motivational dimensions that are lacking in most other bodily experiences. Pain feels unpleasant and motivates us to act accordingly. It has then been recently argued that pain plays such a role because we care about our body (Bain, 2014; Klein, forthcoming): "a pain will represent

⁵ This is actually problematic for the deflationary conception. Contrary to what Martin claims, the sense of ownership is not possessed by all located sensations, at least if we agree that one does feel tactile sensations as being located in tools. See de Vignemont (2013) for further discussion of the deflationary conception.

⁶ Pain is not the only sensation that one cannot feel in tools. Most of the discussion in this section actually also applies to other intransitive sensations in Armstrong (1962)'s terms, including tickles and itches. But this is not so for bodily feelings like hunger and thirst. In this latter case, it is indeed controversial whether one feels them as being localized in specific parts of the body.

damaged states as bad [which is what its unpleasantness and motivational force consists in] only to a subject who cares about her own body” (Bain, 2014, p. 315). When one cares about one’s body, one protects it from injury. On this view, bodily care is a necessary condition for the motivational role of pain.

What is interesting is that a notion that seems quite closely related to bodily care is taken for the best proxy of the sense of bodily ownership in experimental designs in which the sense of bodily ownership is manipulated, like in the Rubber Hand Illusion (RHI). In the classic set-up, participants look at a left rubber hand presented in front of them, while their own left hand is hidden behind a screen. The experimenter then simultaneously strokes with two paintbrushes both the participant’s hand and the rubber hand. After stroking synchronously the two left hands for a couple of minutes, the experimenter asks participants where they feel the touch and whether it seems as if the rubber hand were part of their body. Participants then reply positively (Botvinick and Cohen, 1998). The experimenter also uses an implicit measure. The illusion of ownership is measured by investigating participants’ physiological response to threat, which correlates with their introspective reports (Ehrsson et al., 2007). Seeing a threat approaching the body normally induces an increase of skin conductance response. Results show that participants react in the same way when the rubber hand that they experience as their own is threatened. Another way to put it is to say that they care about it. Another interesting result is that when the experimenter synchronously strokes the participant’s hand and a piece of wood (instead of the rubber hand), there is no illusion. Participants do not report feeling the piece of wood as their own and do not react when it is threatened (Petkova and Ehrsson, 2008). One way to interpret these findings is that one cares only about what one experiences as one’s own. Hence, if bodily care is a necessary condition for pain and if one cares only about the body that one experiences as one’s own, then it follows that the sense of bodily ownership is a necessary condition of the unpleasantness of

pain. Without the sense of ownership, one does not care about the body in pain, and thus pain cannot have its motivational force.

On the basis of these theoretical approaches to the sense of ownership and to pain, we can now formulate the following two hypotheses:

- *Sufficiency claim: If one can feel pain and if one feels x as part of one's body, then one can feel pain in x.*
- *Necessity claim: If one does not feel x as part of one's body, then one cannot feel pain in x.*

Here, it should be made clear that the sufficiency claim states the conditions for the *localization* of pain in a specific body part, and not for the ability to feel pain. From now on, I will assume that the normal conditions for pain are fulfilled.⁷ Given that one can feel pain anywhere, the question is *where* one can feel it. I will now test these two hypotheses with the help of three borderline cases of the sense of ownership: the Rubber Hand Illusion, patients with ownership delusion and patients with disownership syndromes.

2. Borderline cases of ownership

Several borderline cases of ownership are of special interest for us here. In particular, it will be useful to consider the Rubber Hand Illusion (RHI) in more detail, since it makes it possible to experimentally manipulate the sense of bodily ownership, and thus possibly pain. According to the sufficiency claim, if one can feel pain anywhere and if one feels the rubber hand as part of one's body, then it may be possible to localize pain in the rubber hand. The RHI can also shed light on whether the sense of ownership is a necessary condition or not. It has indeed been argued that when one feels the rubber hand as one's own, one no longer feels

⁷ I am excluding patients with pain asymbolia or with congenital pain insensitivity, for instance.

the biological hand (which is stroked in synchrony with the rubber hand) as one's own. Roughly speaking, one can have only one left hand and the rubber hand replaces the biological hand (Moseley et al., 2008; Tsakiris, 2010). If the sense of ownership were a necessary condition for pain and if the biological hand were disowned because of the rubber hand, then one should no longer be able to feel pain in the biological hand. Hence, the RHI seems to be a useful tool to test both claims.

We shall also consider pathological syndromes of ownership. In particular, we will consider patients with a lesion in the right hemisphere who report that another person's left hand is their own (Pia et al., 2013). For instance, when they see in front of them both their own left arm and the experimenter's left arm, they claim that the latter belongs to them. When the other left arm moves, they report feeling their arm moving. Furthermore, they treat the other person's left arm as if it were they own. For instance, they reach for the other's left hand when asked to reach for their own left hand. When asked to name the colour of the object in front of their own hand, they name the colour of the object in front of the other left hand. Finally, they vividly react when the other left hand is threatened (Garbarini et al., 2014). Their delusion of ownership, however, requires the other person's hand to be next to their own hand. When only their own hand is on the table, their performance is normal. If the sufficiency claim is true, then it may be possible for those patients should — under certain circumstances — to localize pain in the other person's hand.

We will finally consider a series of neurological and psychiatric conditions in which patients deny ownership of their own limbs. This is well illustrated by the following quotation from the famous neurologist Oliver Sacks, who was victim of such an experience of *disownership* after he broke his leg:

The more I gazed at that cylinder of chalk, the more alien and incomprehensible it appeared to me. I could no longer feel it as mine, as part of me. It seemed to bear

no relation whatever to me. It was absolutely not-me – and yet, impossibly, it was attached to me – and even more impossibly, continuous with me. (Sacks, 1984, pp. 47-8)

If the sense of ownership is a necessary condition for pain, then one should not be able to feel pain in the hand that feels as alien. With the help of these various borderline cases of ownership and disownership, we should be able to test the validity of the sufficiency claim and the necessity claim.

2.1 Pain in alien body

Let us first consider the sufficiency claim. Can one localize pain in a hand that one feels that one owns, although the hand does not actually belong to one's body? Unfortunately, the results with the RHI are not conclusive. The few studies on pain in the RHI argued that participants could feel pain in the rubber hand but these studies suffered from various methodological issues. Either pain was not directly measured (Mohan et al., 2012) or it was badly measured (Capelari et al., 2009). Let us just note a study by Valenzuela-Moguillansky and her colleagues (2011). Both the rubber hand and the subject's hand were synchronously stroked. Immediately after that they both received a painful stimulation. Subjects were then asked whether they felt pain *in the rubber hand*. They only mildly agreed (rating at 4 on a scale from 0 to 10). Still they agreed more than when they did not feel the rubber hand as their own.

More convincing may be the case of the patients with ownership delusion. As noted earlier, these patients can claim that another person's left hand belongs to them. What happens when this other left hand is injured? Pia and his coll. (2013) compared pain intensity judgments after noxious stimulation either on the patient's hand or on the co-experimenter's

hand. They did the study with the left hand (the affected side) and the right hand (the non-affected side). They found that the patients reported feeling pain with the same intensity when their own left hand was hurt and when the co-experimenter left hand (which they experienced as their own) was hurt. It seems unlikely that these results merely reveal a kind of empathy because when the experiment was done with the co-experimenter's right hand, the patients rated the pain significantly lower than when it was their own right hand that was hurt. Moreover, this pattern of performance was specific to patients with ownership delusion and could not be found in other patients with right hemisphere lesions who did not have ownership delusion. Hence, it was only when patients felt that they owned the other person's body part that they reported feeling pain there.⁸

To conclude, one can feel pain beyond one's biological boundaries. This was already known for phantom limbs. We now know that this can be true also for limbs that are physically real, including limbs that belong to someone else. However, this is so only if one experiences these extraneous limbs as parts of one's body, that is, if they are included in the representation of one's body. There are then two compatible ways to interpret the fact that one can feel pain in extraneous objects. First, the representation of the body in which they are incorporated delimits the boundaries of the territory in which one can localize pain. Secondly, the representation of the body in which they are incorporated delimits the boundaries of the territory that one cares about. In both cases, this is consistent with the sufficiency claim: where there is the sense of ownership, one can localize pain. What is less certain is whether the necessity claim is also confirmed: where there is no the sense of ownership, there cannot be pain.

⁸ This result is especially puzzling because it was the *visual* experience of noxious stimuli applied to the co-experimenter's hand that induced pain sensations, whereas the visual experience of noxious stimuli applied on one's hand normally does not induce pain sensations. But the role of vision for pain is another issue, which I will not address here.

2.3 Pain in the body that feels as alien

In the first section, I highlighted various explanations of the hypothesis that one can feel pain in a body part if and only if one feels the body part as one's own. This may be because one localizes pain only in the body that one experiences as one's own. This may also be because pain requires caring about the body that one experiences as one's own. However, in order to determine whether the sense of bodily ownership is a necessary condition for pain, one should not look at cases of bodily ownership. Rather, one should analyse what happens in the *absence* of the sense of bodily ownership, namely, in disownership cases. The prediction made by the necessity claim then is the following: if one does not feel the body part as one's own, then one cannot localize pain in the body part. However, as we shall now see, this prediction is not empirically confirmed.

As said earlier, it has been argued that the illusion of ownership of the rubber hand is associated with an illusion of dis-ownership of the biological hand (Moseley et al., 2008; Tsakiris, 2010). On this view, the rubber hand replaces the biological hand, so to speak. In favour of this view, it was found that the temperature of the biological hand decreased and that participants were slower in making judgments about tactile stimuli presented on the biological hand. If the biological hand were no longer represented as part of one's body due to the illusion, then one should no longer be able to localize pain in the biological hand. One should then expect pain processing to be disrupted. At least, one should expect a modulation of pain by the RHI, that is, a relief from pain. The RHI, however, is not a way to cure pain. Several studies found no decrease of pain intensity when noxious stimuli were applied to the biological hand (Kammers et al., 2011; Mohan et al., 2012; Valenzuela-Moguillansky et al., 2011).

But do these results challenge the necessity claim? There is an alternative interpretation, according to which there is simply no sense of disownership of the biological hand in the

RHI. The fact is that the evidence in favour of disownership is relatively weak. In particular, the slowing down of tactile processing found by Moseley and coll. (2008) can be explained by other factors than disownership. Similar tactile performance has indeed been found following prismatic displacement independently of any feeling of disownership (Folegatti et al., 2009). What the RHI study and the prism study have in common is the fact that participants see their hand at a location different from where they feel it. This visuo-proprioceptive conflict is most probably responsible for the disruption of tactile perception in the RHI, rather than putative disownership of the biological hand. In addition, several studies have now shown that one can simultaneously embody two rubber hands (Ehrsson, 2009; Newport et al., 2010). Hence, the rubber hand could be perceived merely as a supernumerary limb added to the two biological hands. We thus need to look at clearer cases of disownership to assess the validity of the necessity claim. I shall now focus on patients who do not feel their hand as their own. Unlike the RHI, there is little doubt this time that they experience disownership.

Let us for instance consider the neurological condition of somatoparaphrenia, which often follows a lesion of the right parietal lobe. Not only do somatoparaphrenic patients feel their hand as alien, but they are absolutely convinced that it is not their own hand and that it belongs to another individual (Vallar and Ronchi, 2009). Another disorder of disownership is known as xenomelia (also called Body Identity Integrity disorder). Patients with xenomelia have apparently normal sensory and motor functions. Yet they have an overwhelming desire to be amputated of one of their perfectly healthy limbs, and when surgeons agree to cut their undesired limb off, they feel relieved. The undesired limb is not perceived differently from the other limbs: it neither looks ugly or deformed nor does it feel impaired, but it does not feel to be part of their body (First, 2004; Braam et al., 2006, Hilti et al., 2013).

If the sense of bodily ownership were necessary for pain, then patients suffering from syndromes of disownership should not be able to feel pain in the 'alien' body part. And it is

true that sometimes patients with somatoparaphrenia also suffer from anaesthesia and their ‘alien’ body part is numb. But this is not always true. In particular, some patients with somatoparaphrenia can report feeling painful sensations in the hand that they disowned. For example, it has been reported that a patient cried out of pain when the examiner pinched his ‘alien’ hand (Melzack, 1990). Another patient asked his doctor:

Patient: I still have the acute pain where the prosthesis is. Examiner: Which prosthesis? P: Don’t you see? This thing here (indicating his left arm). The doctors have attached this tool to my body in order to help me to move. But it’s completely useless and very painful (...) Once home could I ask my wife, from time to time, to remove this left arm and put it in the cupboard for a few hours in order to have some relief from pain?” (Maravita, 2008, p. 102).

The patient’s pain behaviour thus appears as normal. If the ‘alien’ hand is hurt, he winces and spontaneously verbally complains, and more generally shows aversive reaction to the pain felt in the ‘alien’ hand. The situation is even clearer in patients with xenomelia. As said earlier, the limb they want to cut off displays no sensory and motor abnormalities. They can feel pain normally and they can normally react to it.

Not only can patients feel pain in their ‘alien’ limbs, but it can also happen that pain itself induces a syndrome of disownership (Moseley et al., 2012). This is the case in complex regional pain syndrome. It is a chronic pain condition, which often happens after an injury like a broken arm, and which causes intense burning pain, associated with a decreased ability to move the affected body part with swelling and stiffness in affected joints. Interestingly, patients report a sense of disconnection from the affected limb: ‘It was just like this foreign body you were carrying around with you cause it didn’t feel like it was part of you’ (Lewis et al., 2007, p. 114). In one study on 114 patients, more than half of them reported finding their

hand ‘foreign’ or ‘strange’ (Förderreuther et al., 2004). The average pain at rest was rated higher in patients with this feeling.

To conclude, some evidence points in favour of the sufficiency claim. If one is able to feel pain, then it suffices that one feels an extraneous object as one’s own to feel pain as being located there. But we have just seen that the sense of ownership is not a necessary condition for pain. Pain can occur in the absence of the sense of bodily ownership without losing its intensity or its motivational force. In other words, when one loses the sense of ownership, one neither feels relief nor displays pain asymbolia. Contrary to what Dokic (2003) and Martin (1995) claim, the idea of feeling a pain in a limb that does not seem to be ours is not only intelligible but also actually realized.

The possibility of pain in ‘alien’ hand then shows against the deflationary conception that the sense of bodily ownership cannot be reduced to bodily experiences, and more specifically to pain.⁹ The fact that one can feel pain in a part of the body does not suffice for experiencing this body part as one’s own. Nor does pain require feeling the body part in pain as one’s own. This can be interpreted in two ways, depending on what aspect of pain one puts emphasis on. If one focuses on the localization of pain, then it shows that one does not need to localize pain relative to the frame of reference of the body that one experiences as one’s own. If one focuses on the motivational dimension of pain, then it shows that one does not need to care about the body that one experiences as one’s own. One may then conclude that bodily care does not require the sense of bodily ownership. Alternatively, one may conclude against Bain and Klein that pain simply does not require bodily care.¹⁰

⁹ See Vignemont (2013) for further discussion of the deflationary conception.

¹⁰ It actually seems most doubtful that patients with xenomelia who can feel pain in their ‘alien’ limb care about the limb they want to be amputated of. At least, they do not display the type of behaviour one might expect from people who care about one’s body. Patients with somatoparaphrenia also seem to feel little concern for their ‘alien’ limb, often trying to pull their leg out of their bed, to give it to the doctor, or to put it in the garbage. See Vignemont (in press) for further discussion of the care theory of pain.

3. Who cares whose body is in pain?

We have just seen dissociations between pain and the sense of bodily ownership. I now want to focus on a different dissociation, which may appear even more surprising: one can react to pain felt in a body part that one does not protect from threat. We shall see that whereas reacting to pain does not involve feeling one's body as one's own, reacting to threats does. Unfortunately, the notion of threat has been less extensively discussed in the philosophical literature than the notion of pain. Here I will argue that unlike pain, being able to detect and react to threats requires being aware of the bodily boundaries, of what is beyond it, and of their spatial relation. I will further suggest that this is an essential feature of the sense of bodily ownership.

3.1 Pain and threat

I claimed earlier that the somatoparaphrenic patients' aversive behaviour was normal. But by that I mean only that they normally reacted to noxious stimulation. It was indeed found that their aversive behaviour was *abnormal* when their 'alien' hand was threatened, rather than injured. A series of recent studies measured the skin conductance response (SCR) while participants saw a needle approaching their hands (Romano et al., 2014; Romano, 2014). The control group displayed an increase in SCR. Likewise, patients with somatoparaphrenia and with xenomelia showed an increase in SCR when the needle was approaching their non-affected limb (which they experienced as their own). However, when the needle was approaching the limb that they felt as alien, they showed no increase. In other words, they displayed no physiological sign of aversive behaviour when their 'alien' limb was threatened.

The disownership patients' attitude reveals what may appear as a counterintuitive dissociation. One can react to pain but not to threat. This dissociation seems puzzling if one

assumes that we react to pain and we react to threat for the same reason, namely to avoid (further) injury or (further) pain. One can also analyse our response to threat as being guided by the anticipation of forthcoming pain (Haggard et al., 2013; Romano et al., 2014). It is actually not always easy to take apart our reaction to threat and our reaction to pain. For instance, when I retrieve my hand from the fire, do I act because of the actual pain or because of the threat of burning myself even more? Recent results in neuroimaging even show that the same areas are partly activated when one is in pain and when one perceives a threat approaching one's body through vision or audition (Legrain et al., 2011). Yet patients with somatoparaphrenia and xenomelia do not show protective reaction when they perceived a threat approaching their 'alien' limb while they react normally to pain.

Hence, we face two dissociations: dissociation between pain and the sense of bodily ownership and dissociation between reaction to pain and reaction to threat (see Table). It may then seem that the sense of bodily ownership is more tightly linked to threat reaction than to pain. In a nutshell, (i) in the RHI subjects react when they see a threat approaching the rubber hand that they experience as their own (Ehrsson et al., 2007); (ii) patients with ownership delusion react when they see a threat approaching the other person's hand that they experience as of their own (Garbarini et al., 2014); (iii) patients with disownership syndromes do not react when they see a threat approaching the hand that they experience as alien.¹¹

Table -

	Pain	Sense of bodily ownership	Reaction to threat
RHI	Possibly	YES	YES

¹¹ There is no evidence for chronic regional pain syndrome on that question so far but I predict that they react to a lesser extent when their painful limb is threatened rather than their non-painful limb.

Ownership delusion	YES	YES	YES
Disownership syndrome	YES	NO	NO
Chronic regional pain syndrome	YES	NO	?

It thus seems that threat reaction is not separable from the sense of bodily ownership. By contrast, we have seen that pain is separable from the sense of bodily ownership. The question then is why there is such a difference. In order to answer this question, we need to track the other aspects on which pain and threat reaction differ. Here I will argue that the ability that allows us to react when a threat approaches our body is characterized by two main features that are involved in the sense of bodily ownership. I will further argue that one of those two features is absent in the case of pain.

3.2 A narcissistic conception of bodily boundaries

Let us go back to the deflationary conception. Martin (1993, p. 212, my emphasis) claims that the sense of bodily ownership consists in the fact that “we have a sense of ourselves as being bounded and limited objects within *a larger space* which can contain other objects”. Martin defends the position that the sense of ownership requires a sense of spatial boundary, which can be given by the awareness of objects. On his view, the experience of other objects in contact with one’s body given by tactile experiences suffices to delineate the boundaries of the bodily space. The content of tactile sensations is indeed dual. It is both exteroceptive, about the object in contact with the skin (a pen, for example), and interoceptive, about the body part that is contact with the object (my fingers, for example). Thanks to this duality, one can contrast what is inside from what is outside and become aware of the boundaries of the body.

One may wonder, however, whether the awareness of bodily boundaries suffices for the sense of ownership, or more precisely for the first-personal content of the sense of ownership. The awareness of the boundaries of the body is not self-referential. How can one then inject some first-personal character into the spatial awareness of the body? How can bodily awareness become bodily self-awareness?

The beginning of an answer may be found in Kathleen Akins (1996)'s notion of a *narcissistic* sensory system: "What the organism is worried about, in the best of narcissistic traditions, is its own comfort" (Akins, 1996, p. 349). The notion of narcissistic sensory system may be able to answer our problem here, that is, how to make the awareness of spatial boundaries of one's body first-personal. What better than the notion of a narcissistic person to eke out the notion of self-awareness? By being narcissistic, bodily awareness is not simply about one's body. It is about one's body *for the self*. The body matters for the self, for its needs, its comfort, and its preservation. This, on Akins's terms, can give "a self-centered glow" (Akins, 1996, p. 345) to bodily awareness. Hence, it is not simply in virtue of the awareness of the boundaries of one's body that one is aware of one's body as one's own. It is in virtue of the awareness of the boundaries as having *a major import for the self* that one is aware of one's body as of one's own.

This account of the sense of bodily ownership is still relatively sketchy but it points to two main characteristics of what it takes to be aware of one's body as one's own. Firstly, as Martin claims, the sense of ownership involves not only being aware of one's body but also of being aware that there is something beyond the boundaries of the body. Secondly, it involves being aware of the body that matters for the self. We can now shed new light on the relationship between pain and threat reaction. Both can be characterized in narcissistic terms. In other words, both aim at securing what is best for the organism. Hence, the difference

between them cannot be there. Rather, I will argue that the difference follows from their respective spatial organization.

We suggest that the spatial organisation of pain expectation [reaction to threat] may differ sharply from that for pain perception, because of the different roles that these processes play in responding to pain. (Haggard et al., 2013, R170)

3.3 Beyond the boundaries of one's body

Threats can be conceived as a specific type of relational property between the environment and the agent.¹² Threats are both subject-dependent (what is threatening for me may not be threatening for another individual) and space-dependent (an event is more or less threatening depending on its location). For instance, I hear the bee close to my face as threatening, while I do not hear the bee on the other corner of the room next to you as threatening for me. Something is an external threat only if it stands in an appropriate spatial relation to one's body. Hence, representing things as external threats requires representing their spatial relation to a body, and to the 'right' body, that is, the body that presents as one's own. The representation of threats then describes how the environment is arranged while informing how one should move within this environment (to avoid the bee for example). Threat reaction thus requires being aware of the space beyond the boundaries of the body. More precisely, it requires perceiving what is known as peripersonal space, that is, the space immediately surrounding the body. As Graziano and Gross (1993, p. 107) described it, peripersonal space is like "a gelatinous medium surrounding the body that deforms whenever the head rotates or the limbs move". One of the functions of the representation of peripersonal space is to

¹² In many respects, threats are similar to affordances (Gibson, 1979). One can conceive them as negative affordances.

allocate attentional and motor resources to the area immediately surrounding the body for its protection (for review, see Vignemont and Iannetti, forthcoming).

By contrast, pains do not depend on their spatial relation to the body: a pain cannot be more or less close to the body. Representing things as pain does not require representing their spatial relation to a body, let alone to the ‘right’ body. Pain is not even like touch. Like pain, a touch cannot be more or less close to the body. The difference, however, is that touch has both an interoceptive and an exteroceptive component, whereas pain has only an interoceptive component, which is about the body. Pain thus involves a spatial frame of reference that is exclusively filled in by the body, which Haggard and his colleagues (2013) call a “somatotopic code”, by opposition to the “spatiotopic code” of threat reaction. Many findings actually show that the representation of the body influences pain (for review, see Haggard et al., 2013). For instance, merely seeing the body part that is hurt (without seeing what is hurting the body part) reduces the reported intensity and the unpleasantness of pain (Longo et al., 2009). Furthermore, this effect can be modulated by the perceived size of the body part: if one sees a magnified version of one’s hand, the relief is stronger; if one sees a reduced version of one’s hand, the relief is weaker (Mancini et al., 2011).

What are the implications of those fundamental differences in spatial organization for the relationship between threat reaction, pain and the sense of bodily ownership? As argued, pain requires encoding the body represented as an inner space. Hence, there is no contrast between an inside and an outside. Reacting to pain does *not* require representing the spatial relation between pain and the body that presents as one’s own. One can then conclude that it does not require the ability to distinguish between one’s body and other bodies. Nor can it ground this distinction. On the contrary, threat reaction requires encoding objects and events in peripersonal space in their spatial relation to the body that presents as one’s own. The perception of threats to the body thus requires going beyond the inner space of the body and

drawing the line between the inside and the outside. One may then conclude that it requires a sense of bodily ownership. One may even go a step further and follow Martin's overall conception of ownership. In Martin's view, what it means to be aware of one's body as one's own is to be aware of one's body *within a larger space*. Perceiving peripersonal space precisely involves this kind of awareness of one's body within a larger space. One may then suggest that what it means to be aware of one's body as one's own is that one is aware of the boundaries of the body and of the spatial relationship between the threat and those boundaries.

To conclude, we started with the common sense intuition that pain is tightly linked to the sense of bodily ownership. We then explored different reasons that could ground this intuition, reasons about the nature of bodily ownership and reasons about the spatial and motivational nature of pain. Some reasons are common to all bodily experiences. For instance, according to the deflationary conception of ownership, bodily experiences, including pain, may be the be-all and end-all of the sense of bodily ownership. Other reasons are specific to pain. Firstly, unlike some other bodily experiences, pain may be a peculiar type of sensation that is never felt outside the confines of what one experiences as one's body. Secondly, pain has a motivational component that may require caring about the body that one experiences as one's own. However, we have seen a series of counterexamples that hardly seem compatible with the necessity claim (i.e. that one can feel aversive pain only in a body part that one feels to be one's own). In particular, if the sense of bodily ownership were a necessary condition for pain, then it should be impossible to localize pain in a body part that is not experienced as one's own. Yet this is possible. We then revealed a puzzling dissociation between reactions to pain and to threat. Threat is the enemy from the outside whereas pain is already the enemy from the inside and we are aware of the boundaries of one's body only in

the former. In pain, one is too fixated on the body in pain with no awareness of the larger space to which the body belongs among other objects. Hence, feeling pain does not involve being aware of one's body as one's own. But I am not claiming that pain is completely independent of the first-person. In the introduction, I distinguished between two occurrences of the first-person in pain statements: the subjectivity of pain (*I feel pain*) and the sense of bodily ownership (in *my hand*). I would like to suggest that provided a pain is felt as one's own, one will react to it normally, even if the body part in which it is felt is not itself felt as one's own. Feeling pain is always of great concern to me, no matter where I feel it. In this sense, I agree with Dokic (2003): pain is primitively compelling so that when one experiences it one cannot but feel *oneself* in pain. But I disagree with him when he claims that this compellingness is such that one cannot help but feel pain in *one's own body*.

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