

Sense of ownership and sense of agency during trauma

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Abstract This paper seeks to describe and analyze the traumatic experience through an examination of the sense of agency—the sense of controlling one’s body, and sense of ownership—the sense that it is my body that undergoes experiences. It appears that there exist (at least) two levels of traumatic experience: on the first level one loses the sense of agency but retains the sense of ownership, whilst on the second one loses both of these, with symptoms becoming progressively more severe. A comparison of the traumatic experience with various modulations of the senses of agency and ownership, from cases involving prostheses to tools requiring greater or lesser extents of control, suggests that the harsher the traumatic event, the greater the damage is to the sense of ownership, resulting in the increasing sense of the body as a tool rather than an original organism. Likewise, the long-term ramifications become more severe according to the significance of the damage to the sense of ownership.

Keywords Sense of ownership · Sense of agency · Prostheses · Tools · Trauma · Dissociation

1 Introduction

1.1 Trauma—a short definition

Traumatic events usually involve fundamental threats to life or bodily integrity, for example physical abuse or injury (DSM-IV — Diagnostic and Statistical Manual of Mental Disorders). If the emotional stress caused by extended exposure to horrifying scenes is sufficiently lengthy, the onset of trauma is only a matter of time, as is exemplified in the British War Office’s statement regarding trauma experienced during the First World War: “under conditions such as existed in France it is inevitable for the man to break down at one time or another” (War Office Committee 1922, p. 5).

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Shocking as it may be, about 90 % of us will encounter a serious traumatic event at least once during our lifetimes (Norris and Slone 2007), and yet a much smaller percentage will develop posttraumatic stress disorder (PTSD).¹ Clearly, a fundamental question is why one person develops PTSD after a particular traumatic event, while in a similar case (the same traumatic event in similar conditions) another person will not? A scientific answer to this problem is still lacking (for a brief dissuasion of this issue see Keana and Barlow 2002; Keane et al. 2009).

Thus I believe that by focusing on the bodily level of experience during a traumatic event we may be able to move a step closer to such an answer, precisely because one of the central characteristics of the traumatic experience is that it is stored the bodily (van der Kolk and van der Hart 1991; van der Kolk and Fisler 1995).

1.2 Dissociation from the world

Traumatic events can, and usually do, lead to altered states of consciousness (ASC). In particular, when resistance (fighting or escape) is impossible, survival may necessitate a shift in consciousness (Herman 1992). In addition, during traumatic events perception may become distorted; events may seem unusual and unreal (derealization). Numbing, indifference, emotional detachment, and passivity are also common (Lifton 1967).

Essentially, the above phenomena are considered features of the dissociative experience, which is defined as “a partial or complete loss of the normal integration between memories of the past, awareness of identity and immediate sensations, and control of bodily movements” (World Health Organization 1992, p. 151) and is characterized by detachment from one’s own body and from the world (Spiegel 1996; van der Kolk 1987).

Dissociation during trauma may provide at least a partial answer to the question of why one person develops PTSD while in a similar case another does not, precisely because dissociation during trauma is the strongest predictor for PTSD (Ozer et al. 2008). It appears that detachment from one’s body during the traumatic event plays a significant role in the complex web of symptoms that develop after trauma (compare to the approach found in Candel and Merckelbach 2004; Marshall and Schell 2002).

1.3 Adopting a phenomenological approach

In order to improve our understanding of the traumatic experience we need to adopt a phenomenological approach both as a method and in the practice of analysis, mainly because severe traumatic events are experienced bodily and organized without semantic representations. As a result of this “the memories of trauma may have no verbal (explicit) component at all: the memory may be entirely organized on an implicit or perceptual level, without an accompanying narrative about what

¹ The estimated prevalence of lifetime PTSD was 7.8 % in the general population of America. Among women the rate is estimated at 10.4 %, and among men 5 % (Keane et al. 2009; Yehuda 2002). However, while between 6.6 % and 35 % of subjects exposed to terror attacks will develop PTSD (Bleich et al. 2003; Njenga et al. 2004), about 91 % (!) of survivors of torture will develop the disorder (Wenzel et al. 2000). On the basis of this one example (and there are many more) it is clear that we cannot limit trauma to one kind of experience; rather each traumatic experience has its own unique features and symptoms.

happened” (van der Kolk and Fisler 1995), hence there is a need for a methodological approach that goes beyond words and penetrates into the subjective bodily level of experience. Phenomenology, as a method, demands from the subject to redraw her old beliefs, conceptions, and opinions, thus revealing the bodily level of experience (Depraz et al. 2003). It is hoped that through the application of phenomenological concepts and distinctions — in particular “sense of ownership” and “weak/strong sense of agency” — we will be able to describe (and even explain) the dissociative experience during trauma as a spectrum (continuum) and not as a yes/no mechanism. This spectrum includes paralysis, blindness, deafness, lack of first-personal perspective, out of body experience (OBE), all of which are possible outcomes of severe traumatic events and, in addition, can be defined as dissociative experiences during trauma. Yet it would be wrong to treat these phenomena as a single package and not to distinguish and differentiate between them; in particular, the bodily experience in each of the case is unique and therefore must be explained differently.²

1.4 Aims and goals

The goal of this paper is *not* to re-explain or re-define terms such as sense of ownership or sense of agency, which will be discussed and defined briefly in the next section, but rather to employ these terms in explaining the traumatic experience — mainly the bodily level of experience during trauma.³

This paper argues that as the traumatic experience becomes harsher the sense of ownership decreases: the sense that *this is my body* grows weaker and, as a result, one’s sense of body becomes similar to the way an amputee experiences prosthesis. When the traumatic experience becomes unbearable, one feels the body as a tool, and eventually, in the most radical cases, one’s sense of body ownership disappears entirely, as does the sense of agency.

2 Sense of ownership and sense of agency, tools and prostheses

2.1 (Lack of) sense of ownership

Ownership and sense of ownership are not identical.⁴ Sense of ownership is defined by Gallagher (2000) as “the sense that I am the one who is undergoing an experience” (p. 15). Indeed, while “it may seem as if it was nonsensical to ask whether you are sure that this is your own body” (de Vignemont 2007, p. 427), one can indeed experience a lack of sense of ownership (de Vignemont 2010), and in order for there to be a lack of sense of ownership some identifiable sense of ownership must exist in the first place. This positive phenomenological experience of ownership is described

² For instance, although paralysis and OBE are both defined broadly as dissociative experiences, the bodily experience in each of these cases differs fundamentally.

³ The reverse, namely using the traumatic experience to improve our understanding of the sense of body ownership and sense of agency, is also possible. However, this is not the aim of this paper.

⁴ As de Vignemont (2011) asks: “Am I a body, or do I own this body?” (p. 231). In James’s (1890) words, “And our bodies themselves, are they simply ours, or are they us?” (p. 291)

by de Vignemont (2010) as “a positive phenomenology of ‘myness’” (p. 83) or “something it is like to experience our body as our own” (de Vignemont 2011, p. 232; and compare to Bermúdez 2011).

Interestingly, the Rubber Hand Illusion (RHI) demonstrates how (a weak) sense of ownership can be projected onto a rubber hand (Botvinick and Cohen 1998; Tsakiris 2011; Tsakiris and Haggard 2005). According to de Vignemont (2010) the RHI indicates that:

- (a) Sense of ownership can extend beyond the boundaries of the organism. In other words, the boundary between what one can experience as one’s own and what one cannot experience as one’s own is somewhat ambiguous, and;
- (b) The sense of ownership is not a yes/no mechanism but is flexible; it is “a matter of degree” (de Vignemont 2010, p. 84).

Indeed, de Vignemont (2010) defines four different levels for the lack of sense of ownership:

- i. Unfamiliarity: abnormal bodily feelings.
- ii. Unreality: a limb feels like a dead body part, one feels that the “real” limb is missing.
- iii. Uselessness: the limb feels worthless.
- iv. Disownership: one feels that the body part(s) is alien. However, it is important to note that disownership and lack of sense of ownership are not necessarily the same phenomenon (see de Vignemont 2010, pp. 91–2).

This flexibility of the sense of ownership is central to the paper’s discussion of the weakened sense of ownership during trauma.

2.2 Sense of agency

While the sense of ownership is the sense that I am the one who is undergoing a movement, the sense of agency is the experience that I cause or generate an action (Gallagher 2000). Accordingly, in the case of involuntary movement the sense of agency becomes weakened, but that is not necessarily true of the sense of ownership: “It is possible to say that I am moving, and therefore that it is my movement, and thus have a sense of ownership for it, in cases where there is no sense of agency for the movement” (Gallagher 2007, p. 1).⁵

In addition, we should distinguish between a strong and weak/thin sense of causing an action, “the pre-reflective feeling that a given movement is performed by me” (Hohwy 2007, p. 1). A thin/first-order sense of agency can exist even when one is not fully aware of one’s actions: “I am pre-reflectively aware that I am reaching for the bottle and that this is part of what it means to have a sense of agency for my action” (Gallagher 2011, p. 24). As a matter of fact a weak, pre-reflective, sense of agency without a strong sense of controlling one’s actions is true of most “motor

⁵ It should be noted, however, that “the exact relation between agency and body-ownership remains unknown” (Tsakiris et al. 2010, p. 740). Furthermore, some researchers claim that sense of agency and sense of ownership do not work according to the same mechanisms (Sato and Yasuda 2005). Others even claim that sense of agency and sense of ownership are rooted in different kinds of neural activity (Chaminade and Decety 2002; Farrer et al. 2003; Tsakiris et al. 2010).

control and body schematic processes” which are “non-conscious and automatic” (Gallagher 2007, p. 8; 2011, p. 28).

In this regard, Tsakiris and Haggard (2005) argue that sense of agency is directly connected to motor control and efference signals. In addition, Gallagher (2011; 2007) argues that the pre-reflective sense of agency is generated by motor-control processes and “an integration of efferent, afferent, and intentional feedback” (Gallagher 2007, p. 9). Clearly, at least on some levels, the sense of agency is dependent upon body movement and action.

2.3 Prostheses and tools

Essentially, prosthesis is a kind of tool. Although intended to replace a missing limb, a prosthetic limb is, nevertheless, not objectively part of the body-as-object (Körper). Yet while an appropriate and well-controlled tool “becomes an extension of the hand that wields it” (Maravita et al. 2003, p. 536) and therefore becomes “strongly related to a feeling of nonmediation between the agent and the world” (De Preester and Tsakiris 2009, p. 312), a successful prosthesis should become “non-existent”, experienced as if it were not there. In other words, a successful prosthesis should form an integral part of the body in the same way that the original limb was part of the biological body and as such should be experientially transparent; to this end “the prosthesis becomes a *knowing body-part*, in other words, something that shares in the knowledge of the body” (De Preester and Tsakiris 2009, p. 311).⁶

Prosthesis is not simply another tool, coded within the brain as though it were lengthening the hand. Although we have the ability to control tools, a strong sense of ownership does not extend to them; although tools may become embodied, no sense of ownership is projected onto them (de Vignemont 2010). Conversely, since a prosthetic limb is intended to become an integral part of the *knowing* body, a strong sense of ownership should be projected onto it. In addition, one must feel that one controls the prosthesis (sense of agency). However this sense of agency is not restricted to the body or prosthesis and extends also to tools: one should be able to control a hammer.

2.4 Short versus long term body model

In light of this comparison of tools and prostheses it is clear, and nevertheless surprising, that body ownership is much looser, or less limited to the actual boundaries of the body as pure object, than we perhaps imagine—as is demonstrated also by the RHI (Botvinick and Cohen 1998). This can be explained by the fact that any sense of ownership demands a twofold body model: a *long-term-body-model* and a *short-term-(online)-body-model* (De Preester and Tsakiris 2009). Replacing one’s hand with a rubber hand changes one’s short-term-body-model (STBM), yet this exchange would not be possible unless the long-term-body-model (LTBM) functions as if the

⁶ The use of the term *non-existent* does not suggest that bodily experience does not occur during perception. Rather, while perceiving (X) one experiences direct connection with the object that is being perceived (for more on this issue see Legrand 2007, 2006).

real hand were part of the original/fixed model in the first place. On the basis of the LTBM one knows that a hand should be located in the phenomenal field in a specific way. Therefore, while a tool is not governed by a sense of ownership, the rubber hand gears naturally into the LTBM and hence acquires a sense of ownership. If this is the case, there clearly exists more than one level of body representation (Ramachandran and Blakeslee 1998; Damásio 2003, 1999; Carruthers 2008): (1) long-term-body-representation, stable and constant over time (top-down), and (2) online-representation (bottom-up), anchored in the current moment (synchronized). The latter, online representation, is much more easily manipulated than the former (Tsakiris 2011). This is demonstrated by the fact that during the RHI, subjects do not feel that they have three hands but rather the rubber hand replaces the “real” hand (Moseley et al. 2008) in the *short-term-(online)-body-model*.

Indeed, in order for a real sense of ownership to exist, one’s limb must become experientially transparent, and in order for this to happen it must become fixed within the LTBM, precisely because the sense of transparency is constituted by the LTBM. In other words, unless the prosthesis is geared naturally into the LTBM it will never become transparent and consequently cannot become part of the self. Using Murray’s (2004) terminology, such a prosthetic limb could be experienced as “mine” yet, it would not turn out to be “me”. To achieve the latter, the prosthesis must be geared into the LTBM.

3 The sense of body during trauma

3.1 The sense of body ownership as a mechanism of defense

Merleau-Ponty (2002) famously argues that “a theory of the body is already a theory of perception” (p. 235), that is to say that we perceive the world through our body, a body which is, according to Sartre, “the instrument which I am” (1956, p. 359). Based on this, if one’s sense of body ownership decreases (the body becomes less one’s own), as a result, the world around will become strange to us, unlike the “already familiar world” (Merleau-Ponty 2002, p. 327) in which we usually exist. Thus without a sense of body ownership the world becomes an alien place, resulting in the feeling that the world is unreal. In more radical cases (e.g. total lack of sense of ownership), a subject may feel that the world ceases to exist.

In order to understand this notion one need to see that according to Merleau-Ponty (2002):

“The essence of subjectivity [is] bound up with that of the body and that of the world, this is because my existence as subjectivity is merely one with my existence as a body and with the existence of the world, and because *the subject that I am, when taken concretely, is inseparable from this body and this world*” (p. 475, my emphasis).

The sense of body ownership is at the core of this structure (subjectivity-body-world) and binds the subject to the world or, put differently, grounds the subject in the world. Thus when the sense of body ownership decreases the

subject feels that she is, at least partially,⁷ detached both from her body and from the world.

According to van der Kolk and Saporta (1991) the biological defense mechanism activated during trauma prevents the subject from being aware of what is happening around her. I would like to argue that when this biological defense mechanism is activated the sense of body ownership weakens. As a result, the subject's perception of the world becomes distorted, and if the traumatic event continues the subject becomes dissociated both from her own body and from the world.

This is demonstrated by how I., a former prisoner of war (POW), describes his experience

The world starts to be unreal, distorted, like objects in space that lose their meaning...I become more and more distant from what is happening to me now... it's like the torture starts and as it gets stronger I just get further away from the body, from the world and from life... But I am still there, even understanding part of what is happening around me, I am not totally cut off and not completely there, the body is mine and is not really mine... I understand more or less what is going on but don't really understand that it is happening to me. (Ataria 2010, p. 38)

I.'s body becomes less and less his own (his sense of body ownership decreases), yet he is not totally dissociated. Likewise, I.'s surroundings become distorted, twisted and unreal.

In more radical cases, the sense of ownership becomes even weaker and the subject becomes dissociated from her body as well as from the world. This is true, for example, in the case of Robin, a 32-year-old woman, a survivor of incestual sexual abuse: "what I decided to do was to separate my body and my mind" (Herman 1992, p. 225). Robin's situation is radical and accordingly her reaction is also extreme—total separation from her surroundings. Yet it seems that there even more severe cases than this; indeed, a rape survivor describes an OBE she experienced in the following manner:

"I left my body at that point. I was over next to the bed, watching this happen...I dissociated from the helplessness. I was standing next to me and there was just this shell on the bed...There was just a feeling of flatness. I was just there. When I repicture the room, I don't picture it from the bed. I picture it from the side of the bed. That's where I was watching from" (Herman 1992, p. 43)

Evidence of this need to detach from surroundings during trauma can also be found in the testimonies of former POWS, which suggest that during the traumatic experience of captivity the subject becomes disconnected from his-own body. As one such subject, D., says, "From the moment that I was caught there was no body" (Ataria and Neria 2013, p. 164), or as L. notes, "It is the body which suffers and not the soul" (Ataria and Neria 2013, p. 164). In both these cases, the sense of ownership

⁷ Because the sense of body ownership is a matter of degree (de Vignemont 2010), the experience of being detached from the world is also flexible; there are different levels of derealization and detachment from the world.

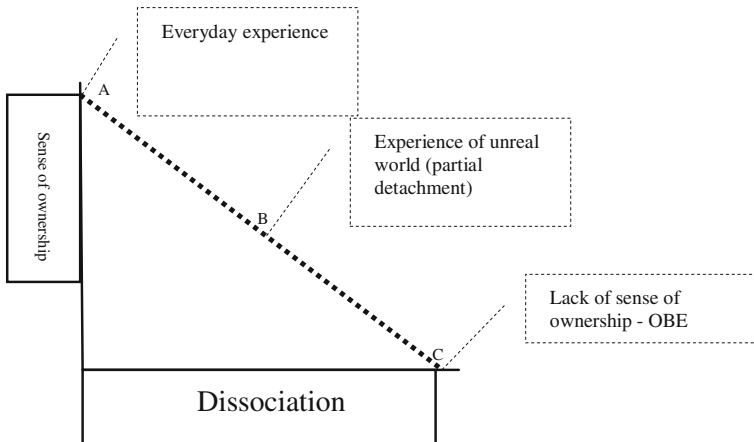


Fig. 1 Schematic and simplified (for example it is not necessarily linear as in this representation) presentation of the relationship between the weakening of the sense of ownership and sense of dissociation from the world. This depiction shows the movement from the everyday experience (A) to the experience of an “unreal” world—as in I’s testimony, for example—and then to (C) a lack of sense of ownership which can lead, in the case of rape, as discussed below, to OBE. Robin’s experience is located on the diagram somewhere between B and C

is weakened, enabling the captive to separate himself from the traumatic event (Fig. 1).

Thus it becomes apparent that, at least in the short term, a weakened sense of body ownership during trauma can operate as a flexible defense mechanism, enabling the subject to separate herself from an unbearable reality.

3.2 The loss of sense of agency

As was discussed above, to have a sense of agency is to feel that one *controls* (at the very least in a weak sense) the body’s movements (Gallagher 2011, 2007). Neither a woman being raped nor a POW being tortured possesses a strong sense of agency, since they are not voluntarily controlling their bodies (Herman 1992); in L.’s words: “You are in zero control” (Ataria and Neria 2013, p. 168).⁸ During such a severe trauma one’s body can be controlled by someone else.

To lose the sense of control is, in many ways, to become helpless. Indeed, the traumatic experience is often characterized by a sense of helplessness: “Traumatic stress is the ultimate experience of helplessness and loss of control over one’s body”

⁸ Indeed, “Political prisoners who are aware of the methods of coercive control devote particular attention to maintaining their sense of autonomy. One form of resistance is refusing to comply with petty demands or to accept rewards. The hunger strike is the ultimate expression of this resistance. Because the prisoner voluntarily subjects himself to greater deprivation than that willed by his captor, he affirms his sense of integrity and self-control. The psychologist Joel Dimsdale describes a woman prisoner in the Nazi concentration camps who fasted on Yom Kippur in order to prove that her captors had not defeated her. Political prisoner Natan Sharansky describes the psychological effect of active resistance: ‘As soon as I announced my hunger strike I got rid of the feeling of despair and helplessness, and the humiliation at being forced to tolerate the KGB’s tyranny...The bitterness and angry determination that had been building up during the past nine months now gave way to a kind of strange relief; at long last I was actively defending myself and my world from them.’” (Herman 1992, p. 79).

(Spiegel 1997, p. 227). I would like to argue that this sense of helplessness is, in fact, a loss of the strong sense of agency.

Furthermore, based on the distinction between a weak sense of agency and a strong sense of agency, I would like to further argue that one may lose the strong sense of agency yet still retain a weak sense of agency. While in the former case one may be able to function, in the latter situation, when the weak sense of agency collapses, one completely loses the ability to move one's body. Hence, the collapse of the weak sense of agency results in phenomena such as paralysis.

Thus similarly to the sense of ownership, the sense of agency is not a yes/no mechanism. Rather it flexible and extremely complex (Gallagher 2011). Yet, while the sense of ownership can work as a defensive mechanism during trauma, this is not true of the sense of agency. Loss of the strong sense of agency results in a feeling of helplessness (which does not necessarily lead to an inability to act); loss of the weak sense of agency during trauma leads to a total inability to function.

3.3 Body as tool versus body as prosthesis: implications

Sense of ownership is not projected onto a tool, yet, as we have seen, it can be projected onto prosthesis. Accordingly, while a tool will never become transparent,⁹ because it will never be part of the LTBM, a prosthesis can (at least in some cases and to some degree) develop into an experientially/known transparent limb.

An examination of various testimonies provided by subjects who have experienced trauma demonstrates that as traumatic situations become more severe (from a subjective point of view), (1) the level of ownership decreases, thus the sense of body becomes closer to the way that the world is perceived through prosthesis: in D.'s words, "In captivity the body was as if it were not completely mine" (Ataria and Neria 2013, p. 164). In more severe cases (2) the body becomes a mediating tool: as D. puts it, "[my body] was a *tool*...[yet]... My head was mine" (ibid), yet this tool is at least weakly controlled (the subject has a weak sense of agency)—this sense of control stems from the fact that the prisoner manages to maintain certain limited realms of control and is not completely dominated by his captors. In yet worse scenarios, (3) one loses control over one's body: in Y.s description, "Nothing was under my control" (ibid, p. 168). It should be noted that in this situation someone else can gain control over the body, and this is exactly what D experienced: "the body 'belonged to captivity'" (ibid, p. 164).

Thus, during traumatic events the sense of body ownership goes through three stages:

- (a) Prosthesis: at least weak sense of body ownership and a sense of agency.

⁹ However it is important to note that, according to Head (1920) and Merleau-Ponty (2002), a blind man's cane functions transparently and yet will never become part of the organism. In the end a blind man perceives the world through his cane and as such experiences the world differently to a person who is not blind; when perceiving through the cane, the fabric of the world, its sense and richness differ. The reason for this is clear: the world is perceived through a (second order) mediator, a tool that is not part of the organism. Hence, even though blind people can feel that the cane is part of their body—the cane "tells" the blind person what is in front of him just as the eyes tell a person who can see what is in front of him—this is in fact an intermediate situation, between tool and prosthesis. A cane is indeed transparent, and it is even part of who I am, but it will never be part of the real body.

- (b) A tool: lack of sense of ownership without a total loss of sense of agency.
- (c) Tool that one cannot control (total dissociation): neither sense of agency nor sense of body ownership.

Returning to the question of why one subject develops PTSD after a particular traumatic event, in a similar case (the same traumatic event in similar conditions) another subject will not, I would like to argue that as the subject moves from A to B to C, so the traumatic experience becomes more severe. As a result the probability of developing PTSD in the long term, and in particular dissociative symptoms, rises. Thus two people may experience the same traumatic event, but if one undergoes a more severe experience of dissociation during the trauma (expressed through a weakened sense of ownership), the likelihood that she will develop post traumatic symptoms increases.

3.4 The “Long-Term-Body-Model” (LTBM) and the “Online Body Model” (“Short-Term-Body-Model”)

In light of the above discussion, it is possible to argue that in extremely radical traumatic situations (such as ongoing torture), a disconnection occurs between “long-term-body-model” (LTBM) and the “online body model” (“short-term-body-model”). Thus, metaphorically and practically, during a traumatic experience the sense of body corresponds to same degree of the sense of ownership as in tool use: the online body model has no connection to the LTBM. Under these conditions one becomes completely disconnected from the body, as if someone else underwent the experience: “It wasn’t like she was hitting me any more — [it was] like she was hitting someone else” (Herman 1992, p. 99). Clearly, in this situation the sense of body ownership decreases and becomes almost non-existent.¹⁰

This disconnection of the online body model from the LTBM can work, at least in the short-term, as a defensive mechanism, since it enables the subject to detach herself from the current moment. However, if the synchronization of the online body model and the LTBM ceases completely, the loss of the sense of ownership becomes fixed and permanent — as is true of depersonalization, the feeling that one is a robot and that the body is no longer one’s own (Simeon and Abugel 2006). Gal’s experience provides an excellent example of this. Gal has permanently lost her sense of ownership and consequently feels like a robot: “I only see what I need to do. I am like a robot... complying without feelings, without crying and without feeling sorry for myself. I simply go and do it” (Ataria and Somer [submitted for review](#)). Clearly Gal does not control her body like one controls a fork while eating; it is as if she lacks a direct-physical connection to her own body. Yet even in this situation one can retain

¹⁰ It may be that in this situation one experiences disownership of the body. Indeed, we saw that sense of ownership is not projected onto a tool (de Vignemont 2010). Furthermore, the above statement is very similar to testimonies of subjects who suffer from the alien hand syndrome (somatoparaphrenia), in which one may experience disownership of one’s hand (Sacks 1985). For instance, AR (Bisiach et al. 1991) responds to the question “whose arm is this?” with the answer: “it’s not mine...I found it in my bed...” (p. 1030). In the future we should focus on different levels of sense of disownership toward one’s body during trauma—see for instance Lucy B’s testimony in “I get terrified, trapped in my own alienlike body” (Luci B 2009). It is possible that a lack of sense of ownership is not similar to the sense of disownership and, in addition, the symptoms may differ.

control over the body. Thus, it should be noted that a person is able to control a robot even though the robot is not simply a tool. As Gallagher and Zahavi (2008) noted, when we link “a human agent to a NASA robot, allowing the agent to steer the robot’s arms by moving his own, and to see the robot’s visual field through cameras mounted in the robot’s head. After a few minutes of practice with this technology, the agent starts to have a strong sense of embodiment with the robot” (p. 139). Indeed, this is the manner in which Gal controls her body, like an astronaut controlling a NASA robot. Interestingly, an anonymous comment posted in a forum for people suffering from dissociation supports this theory: “I feel like I’m not in my body and I’m observing my surroundings. I would compare it to being a character in the Sims video game. I do what I think I should do” (Chrisk89 2012). On this basis, I would like to argue that when the sense of ownership is cut off permanently from sense of agency, one experiences one’s body as a different kind of tool—a tool with which one does not have a direct physical connection, but which nevertheless one has the ability to control.¹¹

To conclude, as long as the online model and the LTBM continue to operate in synchrony, one experiences the body as one’s own. As the level of synchronization between the online model and the LTBM decreases, the sense of body ownership weakens, from prosthesis to tool to total dissociation. At the same time, as the level of dissociation during the traumatic experience rises, the long term symptoms become correspondingly more severe.

4 Concluding remarks

This paper has examined the traumatic experience from the perspective of the sense of agency and sense of body ownership. This analysis has led to the following conclusions:

1. The sense of ownership is flexible and functions as a defense mechanism during trauma.
2. As the sense of ownership becomes weaker (from prosthesis to tool to total dissociation), so the level of dissociation during trauma rises. Correspondingly, the symptoms in the long term become more severe and the probability of developing PTSD increases.
3. The sense of helplessness experienced during trauma can be conceived in terms of a loss of sense of agency. However, while without a strong sense of agency one can nevertheless continue to function, when the weak sense of agency collapses one can no longer function at all.
4. In the case of a traumatic event that leads to a permanent separation between the sense of agency and sense of ownership the subject can, in the long term, begin to

¹¹ The case of IW can illuminate this issue further: IW suffers from differentiation; he has lost the sense of touch and proprioception below the neck (Cole and Paillard 1995; Gallagher and Cole 1995). More specifically, he does not feel his posture, as well as his sense of movements, and the location of his limbs. Nevertheless, by relying exclusively on his visual and cognitive control IW can carry out actions, for instance walking and driving. It seems that IW controls his body like one controls a very good NASA robot.

feel that he is a robot. This can find expression in the subject's sense that he is in control of his body but the body is not his own.

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