RIVISTA INTERNAZIONALE DI FILOSOFIA E PSICOLOGIA
DOI: 10.4453/rifp.2012.0002
ISSN 2039-4667, E-ISSN 2239-2629
Vol. 3 (2012), n. 1, pp. 12-19

Studi

I Move, Therefore I Am. A Comment on "The Importance of Sensing One's Movements in the World for the Sense of Personal Identity" by Haselager, Broens, & Quilici Gonzalez

Sandro Nannini

Articolo pubblicato su invito, ricevuto il 31 marzo 2012, accettato il 22 maggio 2012

Riassunto *Mi muovo dunque sono. Alcune osservazioni su "L'importanza della percezione dei propri movimenti nel mondo per il senso di identità personale" di Haselager, Broens e Quilici Gonzalez* - L'argomento proposto da Haselager, Broens e Quilici Gonzalez in *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity* consta di tre tesi fondamentali, che possono essere così riassunte: (1) al cuore dell'autocoscienza umana sta il linguaggio o il pensiero, ma il senso del corpo; (2) la dicotomia tradizionale tra sensi esterni e sensi interni è falsa; (3) non c'è un primato del cervello sul resto del corpo in rapporto al senso di identità che ogni essere umano possiede. Il presente studio si propone di mostrare che, mentre la tesi (1) è perfettamente convincente, le tesi (2) e (3) devono essere parzialmente rivisitate, poiché troppo compromesse con un tipo di anti-rappresentazionalismo *à la* Brook. Difatti, molti risultati sperimentali (si pensi soprattutto al riflesso vestibulo-oculare) mostrano, diversamente da quanto sostenuto in (2), che anche a livello puramente percettivo il cervello distingue tra sé e mondo esterno. Esistono inoltre esperimenti che confermano l'"importanza"del corpo per la cognizione e l'interazione costante tra corpo e cervello anche per quel che concerne l'esecuzione di compiti cognitivi, questi stessi esperimenti mostrano al contempo, diversamente da quanto sostenuto in (3), che l'influenza del movimento corporeo sulle aree associative della corteccia non è direttamente dovuta agli schemi motori che dirigono il movimento corporeo ma a rappresentazioni cerebrali di "alto livello" delle azioni, ognuna delle quali può essere eseguita da schemi motori differenti.
PAROLE CHIAVE: Movimento; Anti-rappresentazionalismo; Identità; Senso corporeo; Schema motorio.

Abstract The position taken by Haselager, Broens, and Quilici Gonzalez in *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity* consists in three fundamental theses which can be summarized as follows: (1) The fundamental core of human self-consciousness is not language or thought but the body sense; (2) The traditional dichotomy between external and internal senses is false; (3) There is no prominence of the brain over the rest of the body with regard to the sense of identity that every human being has. This paper aims at showing that – while thesis (1) is perfectly convincing – theses (2) and (3) must be revisited in part since they are too committed to the kind of anti-representationalism proposed by Brooks. In fact, several experimental findings (see above all the vestibulo-ocular reflex) show – in contrast to (2) – that the brain distinguishes even at a purely perceptual level between self and external world. Moreover, while other experiments do confirm the "importance" of the body for cognition and the steady interac-

S. Nannini - Dipartimento di Filosofia e Scienze Sociali - Università degli Studi di Siena (✉)
E-mail: sandro.nannini@unisi.it

tion between the brain and the body including for the execution of cognitive tasks, they also show – in contrast to (3) – that the influence of bodily movement on the associative areas of the cortex is not directly due to the motor schemata that direct bodily movements but to "higher" brain representations of actions each of which can be executed by different motor schemata.
KEYWORDS: Movement; Anti-representationalism; Identity; Bodily Sense; Motor Scheme.

HASELAGER, BROENS, AND QUILICI GONZALEZ aim to show «the importance of sensing one's own movements for the development of a "basic, non-conceptual sense of self" and at the same time they want to argue against "the traditional dichotomy between so-called external and internal senses", agreeing with Gibson that perception of the self and of the environment invariably go together. By referring to J.J. Gibson and to M. Sheets-Johnstone's book *The Primacy of Movement* the Authors make clear that their conception of the self is a further development of a very general theoretical framework to which philosophers such as J. Bermùdez and S. Gallagher, neuroscientists like A. Damasio and experts of robotics like R.A. Brooks have been strongly contributing for twenty years. Their work changed the image that we human beings have of ourselves.

From this earlier research it is easy to arrive at the claim that I am not a mind which controls the movements of my body as a helmsman drives his ship (according to the famous image by which Aristotle criticized Plato's conception of the soul). Moreover we must not confuse – the Authors emphasize – the "body image" that we adult human beings have of our own bodies (especially if the bodily movements we are referring to are consciously controlled and our attention is focused on what we are doing) with the basic "body sense" that automatically accompanies all of our motor responses and is possessed by very small children as well.[1]

If you do not confuse the body image with the body sense you can clearly understand that you must reject the primacy given by cognitivists to the brain over the rest of the body. According to Haselager, Broens, and Quilici Gonzalez,

> the body is doing more than just translating brain output into movements as if it is executing commands. The body does more than merely selecting sensory information and channeling it back into the brain. Chiel and Beer provide many examples indicating the importance of the body for cognition.[2]

In other words, the Authors implicitly criticize the image of the mind that D.C. Dennett has called *Cartesian Theater*:[3] an image that according to the anti-cognitivist stream of thought Haselager, Broens, and Quilici Gonzalez belong to remains wrong even if, unlike Descartes, the mind is no longer considered an immaterial substance separable from the brain and it is on the contrary identified with the activity of the brain itself.

Even if my mind is identical to the activity of my brain I am not in any case a mind/brain that in rapid succession (a) receives information from the periphery of the body to which it is connected, (b) works with this information in the associative areas of the cortex in order to obtain an internal objective representation of the external world and combines this representation of the world with the subjective goals suggested by the cortical areas that implement memory, emotions, innate needs and any other drive to act and (c) finally, gives the motor-neurons the command to execute bodily movements oriented to realize the goals previously selected.

According to the Authors this image of the mind is deeply wrong in the light of empirical data offered by neuroscience, cognitive psychology and robotic simulation of human behavior since it represents human beings as

similar to robots internally controlled by computers that previously calculate the movements to be executed and only afterwards provide the command to the muscles and skeleton to passively execute the motor schemata prepared by the brain.

If human beings were indeed robots endowed with a mind/brain program able to construct an *objective* representation of the external world (and possibly of their own body but only insofar as it is considered a body like any other external body) but devoid of any proprioceptive feedback from their own movements, their behavior could not be so effective, stable and at the same time flexible as it really is. As the Authors write: «it is because of proprioception and the body sense that we are able to move as fluently as we do».[4]

The brain can drive the body only insofar as the body drives the brain through proprioceptive feedback. This is the first step of Haselager, Broens, and Quilici Gonzalez' thesis. The second one is that the existence of this kind of interaction between the brain and the rest of the body shows that Cognitivists propose a false conception of the relationship that human beings have with the world and are induced by this first mistake to inevitably commit a second mistake in maintaining a false conception of the image that we have of ourselves, that is, a false conception of the self.

According to the Authors on the one hand it is false that sensorimotor coordination presupposes that the brain is able to construct an *objective* representation of the external world before acting, that is, a representation independent of any possible action that one can execute. As a matter of fact when one acts on external objects in many cases one simply reacts to the "affordances" given by sensory inputs.

For example[5] a goal keeper who saves a shot must react so quickly to the visual stimulus of the oncoming ball that he does not have the time to construct a complete objective image of the ball that he is trying to catch with its spherical form, white color etc. He reacts only to "something to be caught". In the phenomenal world of an agent, a material object is primarily only the affordance to execute some movements.

On the other hand if the external world in which we move and on which we act is primarily for us only a certain amount of affordances for possible movements we too are for us (that is, according to the basic sense that we have of ourselves) first of all the authors of such movements. Therefore, it is not the ability to speak or to think which is the primary source of self-consciousness but the ability to move. Whereas Descartes said "I think, therefore I am" the Authors implicitly suggest to correct him by saying "I move, therefore I am":

> having an identity is having the capacity to have "I"-experiences, these "I"-experiences need not require linguistic or conceptual capacities. Indeed, we follow Gallagher in suggesting that the moving body provides for a minimal self (at times also called a non-conceptual or "ecological" self) that is more basic than the reflexive, conceptualized, consciously experienced self that is the primary focus of philosophy and most cognitive science.[6]

Moreover, according to Haselager, Broens, and Quilici Gonzalez (who follow Sheets-Johnston) such a non-conceptual ecological self is a product of proprioception, not its presupposition. For example,[7] let us assume that I want to open a window that is in front of me and I *feel* that I am able to do it.

Such a feeling can obtain only because firstly I perceive myself as the author of similar actions in similar situations in the past and secondly, the sense of agency, qua first core of my self-consciousness, is based on the proprioception of my movements. I become conscious of myself (that is, self-conscious) by feeling that my body is moving.

Therefore I do not perceive by proprioception that I am moving my body (or better, a body that I would perceive as *my* body only because I would be previously and directly sure that *I* am moving it). On the contrary I become conscious of myself as the author of my sponta-

neous movements only after I have discovered through proprioception that they have been executed. And only thanks to this 'body sense' a first image of myself as the author of such movements could be formed in my experience:

> the starting point of our investigation is formed by the idea of Sheets-Johnstone that "move" precedes the "I move" just as this precedes the "I can move". As she says: 'Movement forms the I that moves before the I that moves forms movement'. It is important to note that the transition from "move" to "I move" is a process of *discovering our bodies* through movement. The basis of our identity arises out of these spontaneous movements that *happen to us before we make them happen*. It is only at a later stage that attention can be focused at controlling the movements.[8]

Haselager, Broens and Quilici Gonzalez' conclusion is that «the proprioceptive sensing of our movements in the world constitutes the origin of our non-conceptual self. It is the body sense, not the body image that forms the foundation of our identity».[9] However, according to the Authors it would be a mistake to think that our non-conceptual self, since it is based on the proprioceptive sensing of our own body, is unrelated to the information that we receive from other senses: sight, hearing and so on. The opposite is true. As for the relationship between consciousness of the world and consciousness of the self (that is, self-consciousness) in the primary form of non-conceptual body sense, the Authors quote Gibson and endorse his point of view: «perception and proprioception are not alternatives or opposing tendencies of experience but complementary experiences».[10]

The Authors argue indeed «against a dichotomy between perception of self-movement and of the environment».[11] Human beings with an impaired body sense – for example a patient known in literature as Ian Waterman (IW) – can only partially compensate for the lack of proprioception from their muscles by using visual feedback from their own movements perceived as if they were the movements of another person.[12] Moreover the lack of movement fluidity found in patients such as IW obtains also in robots. The reason is just the same: robots usually have no proprioception.

> The situation robots without proprioception find "themselves" in can be compared to the situation of IW. That is, they may be equipped with an explicit representation of their physical selves, a body image, but they lack a body sense, allowing them to direct their bodies gracefully and without explicit and detailed attention.[13]

To sum up, Haselager, Broens, and Quilici Gonzalez criticize many aspects of the too "intellectual" image that Cognitivists have given of the self. I think his thesis can be so summarized:

► The fundamental core of human self-consciousness is not language or thought but the body sense, that is, the proprioception of the movements of one's own body: «the origin of the sense of self stems from the sensitivity to spontaneous movements»;[14]

► The traditional dichotomy between internal and external senses is false: «perception of the self and of the environment invariably go together [...] perception and proprioception continuously, simultaneously and interrelatedly circle around the two poles of self and environment, they are reciprocal processes»;[15]

► There is no prominence of the brain over the rest of the body with regard to the sense of identity that every human being has of himself. Unlike what is suggested by many authors (for example D. Parfit) with reference to thought experiments involving brain transplantation it is not true that I am identical to the mere psychological continuity of my memory and that my personal identity resides in causally connected brain states. If I woke up in another body I would be another person even if my brain was transplanted into that new body:

> this approach [that is, Parfit's approach]

> neglects profoundly the importance of the sense of one's bodily movements in an environment for the experience of one's self and identity.[16]

Moreover, according to Haselager, Broens, and Quilici Gonzalez authors who recognize the role of the body in relation to personal identity and the self (such as A. Damasio) also put too much emphasis on the role of the brain and think that the body contributes to the construction of the self only insofar as the whole organism and its bodily movements are represented inside the brain:

> Although we agree with Damasio that the living body is an essential "deep root" for the self, we think that he too puts too much emphasis on the role of the brain. Indeed, we think that the body is of *primary*, not of secondary importance to the self.[17]

I think that the point (1) of Authors' thesis is on the whole empirically well founded and acceptable. Haselager, Broens, and Quilici Gonzalez show how traditional philosophical questions can be enlightened by cognitive neuroscience and robotics. However, I find it difficult to entirely accept points (2) and (3). As for point (2) it is indubitable that the images we have of ourselves and of the world are intertwined and that they are both based not in a contemplative perception of internal and external objective events or states but in a practical interaction between us and our environment.

More generally, it is plausible to maintain that every form of cognition stems from sensorimotor coordination. However, this does not imply that we and our environment are present to us only as the terms of a relation (that is, as the two extremes of an interaction *process*) and that sensorimotor coordination processes do not need any *distinct representations* of the world and of the self. Haselager, Broens, and Quilici Gonzalez' anticognitivism seems to be similar to R. Brooks' anti-representationalism or to D. Chalmers and A. Clark's theory about the so-called "*Extended Mind*".[18]

Although the Authors reproach R. Brooks for not being interested in endowing his robots with proprioception mechanisms,[19] in fact they seem to be very near to Brooks' maxim: «the best model of the world is the world itself».[20]

Brooks' robots directly react to the features of their environment without having at their disposal any internal "map" of the environment itself. In fact a Brook's robot is a set of perceptrons, that is, a set of two layer neural networks: every perceptron directly reacts to inputs of a certain kind without working out any intermediate step between input and output. Analogously, according to Haselager, Broens and Quilici Gonzalez it is not the case that I need a certain image of myself to drive the movements of my body. On the contrary, I have a sense of myself after (and through) perceiving movements of my body which are almost automatically executed in the course of a primitive direct interaction with the environment.

Moreover Haselager, Broens and Quilici Gonzalez' conception of the brain-body relationship is close to the absence of borders that Chalmers and Clark see between the mind and its environment. According to Chalmers and Clark part of me is in the world I live in and I interact with. For example a big part of my knowledge is in the books I can consult on my bookshelf or in the files saved on my computer. If I am driving a car I can often find my way only thanks to road signs or a navigator without having in my mind any map of the roads I am crossing. Similarly Haselager, Broens and Quilici Gonzalez maintain that I do not need any previous *representation* of myself to control the movements of my body. It is true instead that those movements are directly "me".

In my opinion this all is partly true and partly wrong. It is true that we need not have any objective representation of the world and of ourselves before we interact with it. Our representation of the world and of ourselves is not a *presupposition* of our ability to act on it. It is instead the *result* of our interaction with

the world. However, this does not prevent the results of previous interactions with the environment from forming two *distinct representations* of the two poles of the sensorimotor coordination process – the external world and the self – which can then play a central role not only in the execution of more complex successive acts as well as other types of basic sensorimotor coordination.

The latter is evident in the vestibulo-ocular reflex (VOR).[21] If you look at a video taken by a camera installed in a car during a rally you see that the image strongly oscillates. If you had been in the same car during the camera take you would have experiences this scene differently. You would have seen the street in front of you as rather stable while you were sensing that your body oscillated together with the car. During an actual rally, thanks to VOR, the movement of your eyes compensates for the movements of your head so that your eyes are always focused at the same point of the scene in front of you.

This automatic adaptation of the position of your eyes is obtained because your brain applies information coming from the proprioceptive feedback of your head movements to the retinal image of the street in the fovea of your eyes.

It is noteworthy that the movement of retinal images in the fovea of your eyes is just the same independently of whether it is brought about by a movement of the external object represented in the retinal image while your head is moving quickly or whether it is brought about, the other way round, by a movement of your head while the object is moving quickly.

Therefore during a rally the oscillation of the retinal image of the road in the fovea is not passively received by your brain but actively interpreted – first of all in the light of further information coming from proprioception – as a consequence of the movement of your head, movement which must be compensated for by the movement of your eyes.

Therefore VOR shows that already at the low level of an automatic reflex the information coming from the eyes is actively analyzed by the brain in two components (the seen object and the seeing eye) which are the first step in the construction of two distinct conscious representations: a representation of the external world (e.g. G. Edelman's "complex scene")[22] and a representation of the self.[23]

To sum up, the example of the VOR emphasizes the importance of proprioception for the construction of the self. The VOR distinguishes a seen object from a seeing subject already at the low level of an automatic reflex. This is still compatible with Haselager, Broens and Quilici Gonzalez' thesis. However, the VOR also shows that basic bodily movements such as reflexes need (and contribute to create) two distinct *internal* representations of the world and the self. Brook's robot movements are so simple that they can work by means of a direct reaction to a certain amount of affordances offered by their environment and need no stable objective internal representation of their environment and of themselves.

However, this is not the case for human beings whose flexible and multifunctional behavior not only requires continuous proprioceptive feedback but also a stable multipurpose representation of the world and of themselves. In order to coordinate your actions you must sometimes know that two distinct affordances to which you react in two different ways are offered by the *same* object.

For example a soccer player "knows" (or better sees) that the ball he is stopping with his left foot is the same object he wants to kick with the right foot a second later. Analogously, you could not coordinate your actions if you did not have a sense of personal identity, that is, if you did not feel that you are the author of all these actions. Maybe D.C. Dennett is right and this feeling refers to a self that is only "fictive".[24] Nevertheless you need such a feeling in order to be a normal person.

A similar criticism can also be made in relation to point (3) of Haselager, Broens, and Quilici Gonzalez' thesis. According to them there is no prominence of the brain over the rest of the body with regard to the sense of

identity that every human being has of himself. In this case too it is indubitable that our brain could not work without proprioception from the periphery of the body and that such feedback is fundamental for our "I-perceptions".

Haselager, Broens, and Quilici Gonzalez are right about this. However, many experiments show that what I perceive as an action of mine (and therefore what contributes to the construction of the self by sending my brain a feedback signal of itself) is not directly a bodily movement but its internal representation in my brain.

Therefore, while it is true that bodily movements make an essential contribution to the construction of the self, they do this not directly but (at least in a large measure) through their "image" in the brain.

For example, two experiments show that bodily movements certainly influence the activity of associative areas of the cortex through feedback and therefore confirm "the importance of the body for cognition". However, these experiments also tell us that such an influence is not directly due to the motor schemata that direct bodily movements but to "higher" brain representations of these actions each of which can be executed by different motor schemata. I mean higher representations that are located not at the periphery of the body but in the cortex or in the spinal inter-neurons.

The first experiment I am speaking of is the so-called "escargot-experiment".[25] It is one of the experiments which suggests the existence of the famous Mirror Neurons. The name of the experiment comes from the fact that reverse clamp tweezers are used in France to extract snails ("escargots" in French) from their shells.

A macaque was trained to catch peanuts by two instruments: usual tweezers and reverse clamp tweezers. In the former case the macaque had to close its hand to catch a peanut, in the latter case it had to open it. The action was the same in both cases: catch a peanut. But the motor schemata that directed the movements were opposite in the two cases. Independently of which movement the macaque was executing EEG recording from of a determined point of its cortex proved that in both cases the same mirror neurons fired!

That is, the activity of these neurons proved on the one hand that pre-motor areas of the cortex have an important cognitive role in sensorimotor coordination (and this is on the whole in agreement with Haselager, Broens, and Quilici Gonzalez' thesis). However, the experiment also proved on the other hand that even at a relatively low level of the sensorimotor coordination process (in premotor areas) there are neurons that do not directly implement motor-schemata but represent *abstract* actions (e.g. catching a peanut) whose execution can be realized by distinct (or even opposite) motor-schemata.

Something similar was proved by an experiment performed by E. Bizzi and colleagues.[26] In this experiment Bizzi proved that stimulation of certain spinal inter-neurons of a decerebrated frog did not always produce the same movement of one of its legs. On the contrary, by touching a point along the frog's spinal cord a force field was generated. This field produced different movements of the leg in such a way that the leg always reached the same final point independently of its starting point.

This experiment clearly shows that the inter-neurons of a decerebrated frog are also not a simple switch able to spark off only a single automatic movement. They implement instead the abstract representation of an action described in functional terms: that is, they spark off such a movement that, given any starting point whatsoever in a certain space, a determined final point is reached.

Bodily movements play an important cognitive role. But they do so only because in the central nervous system there are abstract representations of these very peripheral movements. In other words, the peripheral body does play an important cognitive role in directing the interaction between an organism and its environment but it does so in a large measure only through a neural model of itself internal to the brain.

Notes

[1] See W.F.G. HASELAGER, M. BROENS, M.E. QUILICI GONZALEZ, *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity*, in: «Rivista Internazionale di Filosofia e Psicologia», vol. III, n. 1, 2012, pp. 1-11, here p. 2.
[2] *Ivi*, p. 3.
[3] See D. DENNETT, *Consciousness Explained*, Little, Brown & Co., Boston-Toronto-London 1991, p. 107.
[4] W.F.G. HASELAGER, M. BROENS, M.E. QUILICI GONZALEZ, *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity*, cit., p. 10.
[5] The example is mine. I do not know whether the Authors would accept it.
[6] W.F.G. HASELAGER, M. BROENS, M.E. QUILICI GONZALEZ, *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity*, cit., p. 4.
[7] This example is mine, too.
[8] W.F.G. HASELAGER, M. BROENS, M.E. QUILICI GONZALEZ, *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity*, cit., p. 4.
[9] See *ivi*, p. 8.
[10] J.J. GIBSON, *The Ecological Approach to Visual Perception* (1979), as quoted in W.F.G. HASELAGER, M. BROENS, M.E. QUILICI GONZALEZ, *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity*, cit., p. 6.
[11] W.F.G. HASELAGER, M. BROENS, M.E. QUILICI GONZALEZ, *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity*, cit., p. 5.
[12] See *ivi*, p. 7.
[13] *Ibidem*.
[14] *Ivi*, p. 2.
[15] *Ivi*, p. 6.
[16] *Ivi*, p. 3.
[17] *Ibidem*.
[18] See A. CLARK, D.J. CHALMERS, *The Extended Mind*, in: «Analysis», vol. LVIII, n. 1, 1998, pp. 7-19.
[19] W.F.G. HASELAGER, M. BROENS, M.E. QUILICI GONZALEZ, *The Importance of Sensing One's Movements in the World for the Sense of Personal Identity*, cit., p. 1.
[20] R. BROOKS, *Intelligence Without Representation*, in: J. HAUGELAND (ed.), *Mind Design,* vol. II, MIT Press, Cambridge (MA) 1988, pp. 395-420, here p. 416.
[21] A useful definition of VOR (vestibulo-ocular reflex) can be found in Wikipedia: «The vestibulo-ocular reflex (VOR) is a reflex eye movement that stabilizes images on the retina during head movement by producing an eye movement in the direction opposite to head movement, thus preserving the image in the center of the visual field. For example, when the head moves to the right, the eyes move to the left, and vice versa». See URL: http://en.wikipedia.org/wiki/Vestibulo_ocular_reflex
[22] See G. EDELMAN, *Wider Than the Sky. The Phenomenal Gift of Consciousness*, Yale University Press, New Haven (CT) 2004, pp. 56-58.
[23] On "constructivism" in cognitive neuroscience see G. ROTH, *Das Gehirn und seine Wirklichkeit. Kognitive Neurobiologie und ihre philosophischen Konsequenzen*, Suhrkamp, Frankfurt a.M. 1994; G. ROTH, *Fühlen, Denken, Handeln. Wie das Gehirn unser Verhalten steuert*, Suhrkamp, Frankfurt a.M. 2001.
[24] See D.C. DENNETT, *Brain Children. Essays on Designing Mind*, MIT Press, Cambridge (MA) 1998, p. 39.
[25] See V. GALLESE, L. FADIGA, L. FOGASSI, G. RIZZOLATTI, *Action Recognition in the Premotor Cortex*, in: «Brain», vol. CXIX, n. 2, 1996, pp. 593-609.
[26] Cfr. E. BIZZI, S.F. GISZTER, E. LOEB, F.A. MUSSA-IVALDI, P. SALTIEL, *Modular Organization of Motor Behavior in the Frog's Spinal Cord*, in: «Trends in Neurosciences», vol. XVIII, n. 10, 1995, pp. 442-445.