# 172 - BODY SCHEME: THEORETICAL CONSIDERATIONS

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## 1.INTRODUCTION

Body Schema (BS) has been the subject of several studies related to human movement and body awareness (HIDER et al, 2002; WETTERHAHN et al, 2002, STEWART et al, 2003; FONSECA, 2008), the diseases that have chronic pain (FLORT et al, 1997; SCHWOEBEL et al, 2001; SCHWOEBEL et al, 2002; PRIDMORE et al, 2003; THURM, 2007), neurological diseases (REED & FARAH, 1995; KANDEL et al, 2003; CHE-SEA, 2000; MEADOR et al, 2000; MACHADO, 2006, BERTI et al, 2007) and psychiatric diseases (FITCHER et al, 1986; MOLINARI, 2002), but many times it is noticed that the term to be used should be body image (BI), leading to a methodological and conceptual misunderstanding.

Both terms are related to the concept of body awareness. Thus it´s possible to percept the body from two perspectives : subjective character, associated with value judgments about psychosocial issues, called BI (THOMPSON, 2004; SCHILDER, 1999), and by kinesthetic mechanisms and proprioceptive recognition of the anatomical body, the relationship it establishes with the environment and the objects around, called BS (LE BOUCH, 1988; HOLMES & SPENCE, 2004; FREITAS, 2004; BARROS, 2005).

Body schema allows to interact with the three functional areas in which space can be divided, personal space, that is, the very contours of the body surface, peripersoal space, that is what hands can reach; and extrapersonal space, in other words , beyond the reach of the upper limbs (BERTI et al, 2007). According to some authors, the BS also allows the individual to recognize parts of own body, thus a perception of body dimension, regardless of satisfaction or not of the body, or issues related to self-esteem (ASKEVOLD,1975; LAUTENBACHER et al, 1993; FREITAS, 2004; STEWART et al, 2003).

According to Freitas (2004) and Barros (2005) BS is a neuromotor structure that presents a plastic character. As the subject is exposed to new situations, he is able to restructure the body schem ir order to develop appropriate responses to a new stimuli. It is built from multimodal sensory stimullus : exteroception, proprioception, somatosensory and visual that interact with the motor system, thus serving as a guide of movement (Schwoebel et al, 2001; MARAVITA, 2004).

The aim of this study is to analyze and discuss some conceptual issues relating specifically to the BS, presenting its features and relationships to the organization of the central nervous system (CNS), and their relationship with the movement.

## 2.METHODOLOGY

We performed a literature review, using studies related to body awareness, BS and its neurophysiological aspects. The keywords used were: body awareness, body scheme and body movement. The texts were found using the Medline database, PubMed, Lilacs, SciELO and Google Scholar. Articles were used only in Portuguese and English, published from 1984-2008, priority was given to the most recent publications. With the exception of a single article of 1975, that was essential to the current discussion. Also, we use classic books for the description of the anatomical areas of the nervous system related to body schema.

## 3. THE BODY SCHEMA IN THE CENTRAL NERVOUS SYSTEM

For a better understanding of the relationship of the Nervous System (NS) with the BS it is necessary to know the functioning and structuring of both.

Organic functions and the integration of people and the environment depends on the NS, in other words, it is responsible for controlling all the functions of internal organs, and also receives external stimuli that are interpreted to trigger appropriate responses (afferent and efferent stimulus, respectively) (DANGELO & Fattini, 2007). NS development was structured in a complex and highly organized organs, so that each of their structures perform specific functions and are connected with each other (Guyton & Hall, 2006).

The cortical projection areas are those that connect the cortex to subcortical organs, and association areas establish the connection between the cortical areas themselves (MACHADO, 2006). These areas may also be termed primary, secondary and tertiary. The primary areas are directly linked to sensory and motor stimulus, a projection area (MACHADO, 2006). The extent of neural representation in the primary cortical areas will be greater when the modalities of sensation or movement of the segment are more complex. Thus, the extent of cortical representation is not proportional to the dimension of the segment or the stimulus intensity, but the complexity of the movements performed by the muscles stimulated. The secondary areas, which also receive signals from the primary areas and pass on to the tertiary areas, may be called unimodal areas, it would establish relationship with a particular sensory modality or motor, and they are responsible for interpreting sensations from comparisons with data stored memory and the planning of motor sequences (MACHADO, 2006). Finally, the tertiary areas are the most complex because they are responsible for behavior strategies, and also called supramodal area. Tertiary areas are associated with activities such as memory and reasoning, for example (MACHADO, 2006). Among these tertiary areas highlight the temporoparietal area, which is close auditory, visual and somesthetic association areas (DANGELO & Fattini, 2007) and integrates information received from these three areas (Machado, 2006). This area is well known as the area of the body schema, that allows the individual to become related to bjects around them and recognize the segments of the body.

The brain mechanisms of perception of objects that are within peripersonal space is more complex, because it involves an interplay of all sensory systems, while those that are located in extrapersonal space may be perceived by a limited number of senses (Holmes & SPENCE, 2004). The BS and the peripersonal space are based in a network of neural mechanisms in the cortical region, and this process of multisensory interaction provides grants, through which the body moves (HOLMES & SPENCER, 2004).

The neural representation of peripersonal space consists of a network of interacting cortical and subcortical areas, and is constructed from several reference points, such as the primary cortex and somatosensory, and other areas like the motor prefrontal cortex and supplementary motor area, secondary somatosensory cortex and putamen. Another point of reference for

perception of objects in peripersonal space, occurs from the visual stimulus (with neural representations in the visual cortex). Thus, according to the reference used the brain encodes information in an appropriate way, involving several brain areas and determining an adaptive response (Holmes & Spence, 2004).

**4.CAUSES AND CONSEQUENCES OF THE BS ALTERATIONS**

The BS is related to specific areas of the cerebral cortex, so if these regions suffer some kind of deficit or change in the information, as a result of neurological damage, it will cause a reorganization and expansion of the affected region in the cortex, thus causing an alteration of BS (BERTI et al, 2007).

We highlight the Neglect Syndrome, in which the individual does not recognize part of your body as your own body (MACHADO, 2006) or Unilateral Spatial Neglect, syndrome which causes an individual's non-response to any stimulus in the hemi -space opposite the side of the injury (BERTI et al, 2007). In such cases, the nervous system play a role in compensation, correcting, complementing and integrating such information (BERTI et al, 2007).

Another example of BS alteration is related to people with chronic pain. This kind of perception is a mechanism of constant sensory feedback. The presence of chronic pain affects the body's own perception (Flor et al, 1997A). This causes a reorganization of the BS. These data taken together show that the BS is plastic, because it changes the face of certain circumstances (Freitas, 2004).

The most of the cases of spatial perception alteration is not limited to visual perception, but a integrated process of proprioceptive and visual informations (BERTI et al, 2007), auditory perception (Holmes et al, 2004) conducted in regions of the cerebral cortex (BERTI et al, 2007).

The literature reports on changes in the BS caused by neurological disorders are extensive and relate to various phenomena, which can be observed in cases where real changes occur in the body (limb amputation), but also occur when brain damage or even due to lesions in the cerebral cortex, specifically in the parietal lobe, a region specifically related to the BS (BERTI et al, 2007).

**5.BODY SCHEME AND MOVEMENT**

It is important to analyze the influence of vestibular inputs that provide information about the position and movement of the head. Cortical association areas and the cerebellum, adjust the posture, assist in maintaining the balance and where necessary correct the motor gesture (HOLMES & SPENCE, 2004).

Another important contribution in guiding the movement, and directly related to the BS, refers to the organization of proprioceptive stimuli to maintain posture and balance, breath control and the laterality ( BARRETO, 1999).

Laterality is defined according to Coste (1992) as the complete awareness and symbolically internalized right and left sides of the body, is directly related to the spatial organization of the body (NEGRIN, 1996). According PACHER (2001) laterality is directly related to a hemispheric organization, that takes place during the entire period of the child's motor development, and is made up of the motor experiences of the child, so she settled permanently after the child had gone through all the processes of maturation, the ocular-motor coordination, concerning the organization of motor and visual perception, the spatial structure, which involves the organization of the size and shape of the body, and finally, the laterality (FARIA, 2001). Thus, laterality is a fundamental aspect of BS, because it is an integral part in the process of spatial structure of the body (Costa, 1992; NEGRIN, 1996, Coslett, 1998; PATCHER, 2008).

The BS, therefore, results from the interaction of somatossenssories, kinesthetic and proprioceptive inputs, and from these interactions develops posture, balance, laterality and motor gesture. There is a close relationship between body schema and movement. The more structured BS the best movement occurs and the relationship with the own body and space (HIDER et al, 2002; WETTERHAHN et al, 2002; STEWART et al, 2003).

**6.CLOSING REMARKS**

Finally, according to Critchley (1979), cited by Berlucchi & Aglioti (1997) it can be said that human beings are born with a mechanism for spatial perception and in the course of development, all these neural mechanisms involved, are gradually being polished, resulting in the perception of the dynamic organization of his own body and its relations with other bodies (BS).

This anatomofunctional constituition, characterized by the systematic integration of neural mechanisms is from genetic origin, but can be influenced, according to Melzack (1992) cited by Berlucchi & Aglioti (1997) by experiential facts and, thus, is a highly dynamic process, such as in cases of individuals who suffer brain injuries that cause significant changes in the way as the body is perceived and represented.

In addition to the conceptual issues discussed we understand the need to elaborate strategies for remodeling, expansion and restructuring of the BS in order to allow individuals who have disorders or changes to this particular form of body awareness, new cortical pathways that allow a good interaction with his own body, with other bodies and objects around.

**7. REFERENCES**

ASKEVOLD, F. Measuring Body Image. **Psychotherapy and Psychosomatics**, v. 26, p. 71-77, 1975

BARRETO, J.F. Sistema Estomatognático Y Esquema Corporal. Colombia Médica, v. 30, n.4, p. 173-180, 1999.

BARROS, D. D. Imagem Corporal: a descoberta de si mesmo. **História, Ciências, Saúde – Manguinhos,** v. 12, n. 2, p. 547-554, mai/ago, 2005.

BERTI, A.; CAPPA, S.T.; FOLEGATTI, A. Spatial representations, distortions and alterations in the graphic and artistic production of brain-damage patients and of famous artistics. **Functional Neurology,** v. 4, n. 22, p. 243-255. Oct/dec, 2007.

BERLUCHI, G.; AGLIOTI, S. The body in the brain: neural bases of corporeal awareness. **Trends in Neurosciences,** v. 20, n. 12, p. 560-564, dec,1997.

CHEN-SEA, M-J. Validating the Draw-A-Man Test as a personal neglect test. American **Journal of Occupational Therapy**, v.54, n. 4, p.391-397, aug, 2000.

COSTE, J.C. **A Psicomotricidade.** 4. ed. Rio de Janeiro: Guanabara Koogan, 1992. 96p.

COSLETT, H.B. Evidence for a Disturbance of Body Schema in Neglect. **Brain and Cognition**, v.37, n. 3, 527-544, aug, 1998.

DANGELO, J.G.; FATTINI, C.A. **Anatomia humana sistêmica e segmentar**. 3. ed. São Paulo: Editora Atheneu, 2007. 763 p.

FARIA, A.M. **Lateralidade: Implicações no Desenvolvimento Infantil.** Rio de Janeiro: Sprint, 2001. 118p.

FICHTER, M.M.; MEISTER, I.; KCOH, H.J. The measurement of body image disturbances in anorexia nervosa: experimental comparison of different methods. **The British Journal of Psychiatry**, v.148, p.453-461, apr, 1986.

FLOR, H. et al. Extensive reorganization of primary somatosensory cortex in chronic back pain patients. **Neuroscience Letters**, v.224, n. 1, p.5-8, mar, 1997.

FONSECA, C.C. **Análise do esquema corporal e imagem corporal na dança de salão e seus aspectos motivacionais.** Dissertação de mestrado. São Paulo: Universidade São Judas Tadeu, Faculdade de Educação Física, 2008.

FREITAS, G.G. **O esquema corporal, a imagem corporal, a consciência corporal e a corporeidade.** 2. ed. Rio Grande do Sul: Unijuí, 2004. 96 p.

GUYTON, A.C.; HALL, J.E. **Tratado de Fisiologia Médica.** 11. ed. Rio de Janeiro: Guanabara Koogan, 2006. 1264p.

HIDER, S. et al. Does a regular exercise program for ankylosing spondylitis influence body image? **Scandinavian Journal of Rheumatology,** v.31, n. 3, p.168-171, may, 2002.

HOLMES, N.; SPENCE, C. The body schema and the multisensory representation of peripersonal space. **Cognitive Process**, v.5, n.2, p.94-105, jun, 2004.

KANDEL, E.; SCHWARTZ, J.; JESSEL, T**. Princípios da Neurociência.** 4.ed. São Paulo: Manole, 2003. 1412p.

LAUTENBACHER, S. et al. Theoretical and empirical considerations on the relation between body image, body schema and somatosensation. **Journal of Psychossomatic Research**, v.37, n.5, p.447-454, jul, 1993.

LE BOULCH, J. **Educação Psicomotora: A psicocinética na idade escolar.** 2. ed. Porto Alegre: Artes Médicas, 1988. 356p.

MACHADO, A.B.M. **Neuroanatomia funcional.** 2. ed. São Paulo: Editora Atheneu, 2006. 363 p.

MARAVITA, A.; IRIKI, A. Tools for the body schema. **Trends in Cognitive Sciences,** v.8, n. 2, p. 79-86, feb, 2004.

MEADOR, K.J. et al. Anosognosia and asomatognosia during intracarotid amobarbital inactivation. **Neurology,** v.55, n. 6, p.816-820, sep, 2000.

MOLINARI, E. Body-size estimation in anorexia nervosa. Percept Motor Skills, v.81, n. 1, p.23-31, aug, 1995.

NEGRINE, A. **Educação Psicomotora: Lateralidade e Orientação Espacial**. Porto Alegre: Palloti, 1986. 156p.

PATCHER, L.A.G.; FISCHER, J. Lateralidade e Educação Física, Instituto Catarinense de Pós-graduação, disponível em < http://www.icpg.com.br>, acesso em: 15 de julho de 2008.

PRIDMORE, S.; SAMILOWITZ, H.; OBEROI, G. The brain and chronic pain. **German Journal of Psychiatry**, v.6, p.8-15, feb, 2003.

REED, C.L.; FARAH, M.J. The psychological reality of the body schema: a test with normal participants. **Journal of Experimental Psychology : Human Perception Performance**, v.21, n.2, p.332-343, apr, 1995.

SCHILDER, P. **A imagem do corpo – As energias construtivas da psique.** 3. ed. São Paulo: Martins Fontes, 1999. 405p.

SCHWOEBEL, J. et al. Pain and the body schema. Evidence for peripheral effects on mental representations of movement**. Brain**, v. 124, n. 10, p. 2098-2104, oct, 2001.

SCHWOEBEL, J. et al. Pain and the body schema: effects of pain severity on mental representations of movement. **Neurology**, v.59, n. 5, p.775-777, sep, 2002.

STEWART, A. et al. Body image perception, satisfaction and somatotype in male and female athletes and non-athletes: results using a novel morphing technique. **Journal of Sports Sciences**, v.21, n. 10, p.815-823, oct, 2003.

THOMPSON, J. K. The (mis)measurement of body image: ten strategies to improve assessment for applied and research purposes**. Body Image,** v. 10, n. 5, 7-14, jan, 2004.

THURM, B.E. **Efeitos da Dor Crônica em Atletas de Alto Rendimento em Relação ao Esquema Corporal, Agilidade Psicomotora e estados de Humor**. São Paulo: Universidade São Judas Tadeu, Dissertação de mestrado apresentada ao Programa de Pós-graduação Strictu Sensu da Faculdade de Educação Física da USJT, São Paulo, 2007.

WETTERHAHN, K.A.; HANSON, C.; LEVY, C. Effect of participation in physical activity on body image of amputees. **American Journal of Physical Medicine & Rehabilitation**, v.81, n.3, p.194-201, mar, 2002.

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**BODY SCHEME: THEORETICAL CONSIDERATIONS**

**ABSTRACT**

The mental construction of the own body from subjective impressions (judgment values) and afferent input of multimodal (sigh, touch, proprioception) is called body awareness. We can identify two different aspects, but complementary in structuring of the body and its relationship with the environment and other bodies, corporal image and body scheme. It can be seen in the literature that studies published in this area refer to these terms as synonyms, but there are considerations consistent distinguishing these two concepts. Thus, the aim of this study is to clarify some conceptual issues relating to the body schema, presenting characteristics and relationships of this aspect of body awareness with the neurological organization of central nervous system.

**KEYWORDS**: Body Image, Body Scheme, Central Nervous System

**SHÉMA CORPOREL ET DE SES RELATIONS AVEC LE SYSTÈME NEURO-MOTEUR**

**SOMMAIRE**

La construction du corps mental des impressions subjectives (tribunal de valeurs) et la contribution de afférente multimodal (vision, toucher, proprioception) est appelée conscience corporelle. Nous pouvons identifier deux distinctes mais complémentaires dans la structuration de l'organisme et sa relation avec l'environnement et d'autres organismes, image du corps et schéma corporel. On peut voir dans la littérature que les études publiées dans ce domaine se référer à ces termes comme synonymes, mais il existe des considérations cohérente en distinguant ces deux concepts. Ainsi, la présente étude, à travers une revue de littérature, de clarifier certaines questions conceptuelles relatives au régime de caporal, présentant des caractéristiques et des relations de cet aspect de la conscience du corps avec l'organisation neurologique du système nerveux central.

**MOTS-CLÉS:** image, schéma corporel, du système nerveux central.

**ESQUEMA CORPORAL Y SU RELACIÓN CON EL SISTEMA NEUROMOTOR**
**RESUMEN**

La construcción mental del propio cuerpo a partir de impresiones subjetivas (juicio de valores) y del subsidio de aferencias multimodales (visión, tacto, propiocepción) se denomina percepción corporal. Se pueden identificar dos aspectos distintos, pero que se complementan, en la estructuración del propio cuerpo y la relación de él con el entorno y con los otros cuerpos: la imagen corporal y el esquema corporal. Hay trabajos en la literatura del área que se les refieren a estos términos como sinónimos, pero existen consideraciones pertinentes que distinguen esos dos conceptos. Así, el presente trabajo, a través de una revisión de la literatura, pretende analizar algunos conceptos que se refieren al Esquema Corporal, presentando características y relaciones de ese aspecto de la percepción corporal con la organización neurológica del sistema nervioso central.

**PALABRAS CLAVE:** Percepción Corporal, Esquema Corporal, Sistema Nervioso Central.

**ESQUEMA CORPORAL E SUA RELÇÃO COM O SISTEMA NEUROMOTOR**
**RESUMO**

A construção mental do próprio corpo a partir de impressões subjetivas (juízo de valores) e do aporte de aferências multimodais (visão, tato, propriocepção) é denominada percepção corporal. Podem-se identificar dois aspectos distintos, mas complementares, na estruturação do próprio corpo e sua relação com o meio e os outros corpos, a imagem corporal e o esquema corporal. Percebe-se na literatura que os trabalhos publicados nesta área referem-se a estes termos como sinônimos, porém existem considerações consistentes distinguindo estes dois conceitos. Desta forma, o presente estudo, através de uma revisão de literatura, pretende esclarecer algumas questões conceituais referentes ao Esquema Corporal apresentando características e relações deste aspecto da percepção corporal com a organização neurológica do sistema nervoso central.

**PALAVRAS CHAVE:** Percepção Corporal, Esquema Corporal, Sistema Nervoso Central.

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