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Body Image and the Parietal Lobes

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Focus Points

- The concept of the body image has been central to neuropsychiatry for over a century.
- here are associations between the parietal cortex and consciousness.
- The parietal cortex is anatomically linked widely to many other areas of the brain.

Abstract

In this review, the history of the concept of the body image in neuropsychiatry is presented. Links between the parietal cortex and the body image are discussed and the possible role of the parietal lobe in psychiatric disorders noted. The link between parietal lobe function and some neurophilosophical concepts are introduced.

Introduction

The concept of the body image has been central to neuropsychiatry for over a century, and some anatomical link to the parietal lobes has dominated thinking. However, first of all, some terminology needs to be explored. The neurophilosopher John Smythies¹ pointed out the semantic and philosophical confusions surrounding the term "body image" by drawing distinctions between the actual physical body, the body image, the body concept, the body scheme and the perceived body. The latter represents the collection of somatic sensations present at any one instant in consciousness (the somatic sensory field), while the body concept refers to a collection of beliefs and knowledge that we have about our bodies. The perceived body is regarded as being co-incident with the neurophysiological events that make up the

body image in the brain. For Smythies, "the perceived body should be regarded as being coincidental in space with the neuronal activity in the brain that makes up the body image in the brain".¹ It is the latter that has attracted the most interest among neurologists, while the body concept has more relevance for psychiatry. The body image is that visual (or mental) image we have of our bodies, as, for example, we may see when we view ourselves in a mirror.

The perceived body is often confused with the physical body, since both appear to be physically extended, yet even a brief excursion away from naïve folk psychology and into neurology reveals the stark dissociation. The perceived body is but a part of the totality of sensory experiences we have, as visual, auditory, and other sensory stimuli impinge upon us refracted through the fine filigree of our brains. Thus, in the same sense that only those ignorant of basic neurological principles consider that the objects we experience in our vision are the outside world (a view referred to as naïve realism), they will also consider that the perceived body is identical with the actual physical body. But the perceived body reflects on brain states, and as a consequence, as the neuropsychiatrist Paul Schilder² pointed out "even our own body is beyond our immediate reach."

The discrepancy between the perceived body and the actual body is startlingly revealed by the well-known homunculus (a visual image of the size and sequence of brain anatomical areas related to movements and sensation) (Figure 1), and by descriptions of the body image given to us with patients with neuropsychiatric conditions. Classical disorders, such as the presentation of a phantom limb in an amputee (where the perceived body remains somehow intact in the presence of the absence of a body part) or a somatic anosognosias (in which the presence of a body part is denied), are the Achilles heel of naïve realists.

FIGURE 1.

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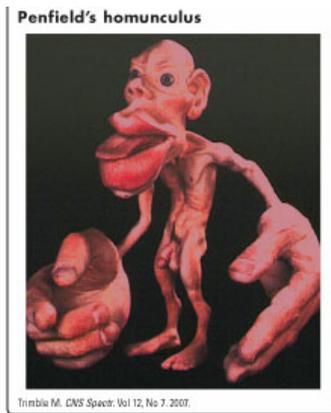
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The Body Schema

One more term needs to be introduced, in part because of its historical importance, which is "the body schema." Head and Holmes³ published their classic paper on the subject entitled "Sensory disturbances from cerebral lesions" in 1911. They noted that certain cortical lesions affected postural recognition and appreciation of passive movements, but did not affect the visual image of any body part. In other words, a patient could lose the ability to recognize the posture of a limb in spite of normal vision, and with the eyes closed could correctly visualize the position of the limb. Since recognizable change of posture enters into consciousness "already charged with its relation to something that has gone before", they referred to the background standard of the body posture as a scheme and "every new posture of movement is recorded on this plastic scheme". It is with this paper that the parietal lobes moved to attract central attention. Head and Holmes³ supported the involvement of the parietal cortex in the body scheme by noting cases of marked alteration of the body scheme following parietal lesions and of phantom limbs having been resolved by a stroke to the parietal cortex or even with surgical corticectomies.

Body Image Disturbances

Unilateral asomatognosia is mainly seen following a non-dominant parietal lobe lesion, the signs and symptoms affecting the left side of the body. This and variants of the clinical picture are discussed in detail the article by Vallar⁴ in this issue. However, disturbances of the perceived body also occur following left (dominant) parietal lesions (such as the in the Gerstmann's syndrome). This has led to speculation about a laterality of functions regarding the parietal lobes, especially with regards to attentional mechanisms, and the suggestion that left parietal lobe is specialized more for motor attention, while the right is linked to spatial attention.⁵

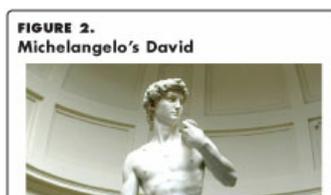
Several disorders of the body scheme have been described, but they are rarely seen in isolation, one presentation merging with another, or changing over time will the underlying pathology. Type of parietal lesion, rate of progression, age and intelligence of the patient, and associated neurological abnormalities (such as the presence or absence of paralysis) all influence the clinical picture.

It was the pioneering investigations of Penfield and Rasmussen⁶ that exposed further the chasm between the physical body and the perceived body, with experimental stimulation of the exposed cerebral cortex in patients undergoing neurosurgery. The image in Figure 1 is a characterization of the homunculus derived from their data. They revealed motor and sensory sequences, beginning in the longitudinal fissure with the toes, genitalia, and rectum, which extends down the surface of the Rolandic strip, representing, in turn, the leg, trunk, arm, head, neck, face, mouth, and throat, which physical representation does not reflect the geometry of the physical body at all, with gross distortions, for example of the lips and mouth.

Although this is the most popular image of the homunculus, in reality other "homunculi" can be revealed, Penfield⁷ himself denoting one in the supplementary motor area and yet another in the thalamus.

For Head and Holmes,³ the body schema was not static but plastic, "charged with its relation to something which has gone before," implying dispositions to action and an active not a passive role in commanding movement. It is a recollective image,⁸ not bound to anatomical boundaries, and under normal circumstances, one which we are unaware of, our perceived body it is at the fringes of consciousness.⁹ With selected attention, honing of motor skills, with pain, and with neurological disease this corporeal awareness can be brought to light and refracted.

Schilder's² contributions are pertinent to the links between the perceived body and our body image. Schilder was one of the 20th century neuropsychiatrists who tried to unite neurological knowledge of the time with Freudian psychodynamics. He used somewhat different terminology to that used in this article, since he considered the body scheme to be more than the totality of sensory images, and while stressing visual, tactile, vestibular, and psychological factors, he also incorporated the self appearance of the body, imbricating therefore the concepts of the body scheme (body image in the brain) with the body concept. These differences between the body concept and the body image in the brain are those between Michelangelo's David (Figure 2) and Penfield's homunculus (Figure 1). As Shakespeare put it "We are such stuff as dreams are made of..."





The anatomical link between the body image and the parietal lobes emerged at a time when the parietal lobe was considered a homogeneous structure, an integrative sensory cortex, which provided some kind of representation of the external world and the position of the body within that. However, such a view of the parietal cortex has now been abandoned. It is now appreciated that within the anatomical boundaries of the parietal lobe there are several subregions, with different afferents and efferents, integrating not only visual and somatic input, but with varying functions with respect to sensation and behavior. While sensory motor integration still remains central, their role in prediction and higher cognitive functions are now being emphasized. Further, alterations of the perceived body are known to be related to posterior parietal lobe in particular and not, for example, the primary somatosensory cortex.

The parietal cortex has widely distributed functional neuronal networks, and the prospect that the body image in the brain could be localized to some specific cerebral location has not stood the test of time, with our changing views of neural activity and integration. From the neuroanatomical point of view, there can be no strict localization of the perceived body. In fact, such was denied by several authors on this subject, even having drawn attention to the overwhelming evidence of the involvement of the parietal lobes.¹⁰ The author of this article has elsewhere pointed out that marked disturbances of the body image can occur in patients with epilepsy, such as macro- and microsomatognosia (body parts becoming large or small) and other elaborate experiences disturbing the relationship between the subject to his body or the surrounding world. While such phenomena are described in seizures from the parietal lobe,¹¹ the epilepsy most linked to these phenomena is localization-related temporal lobe epilepsy. Other studies highlight the temporal-parietal junction as a kernel for bodily integration. For example, experiments using transcranial magnetic stimulation and evoked potential mapping have implicated this area in out-of-body experiences, and the angular gyrus has been implicated as the key anatomical area associated with neglect.¹² Others have drawn attention to the importance of the insula as an area of importance, perhaps integrating the emotional (limbic) potency to the equation.¹³

Body Image and Psychiatric Disorders

In keeping with the work of authors such as Schilder,² who broaden the concept of the body image beyond strict neurological interpretations, alterations of the body concept occur in a diffuse range of psychopathologies, including schizophrenia (with coenaesthetic hallucinations), anorexia nervosa (with dissociation between physically measured body size and weight and imagined body weight), gender dysphoria (where the body concept is at disjunction from the body image), monosymptomatic somatic delusional states (in which various body parts are felt to be too big, small or otherwise distorted), autoscopy (when the person seems to leave their body), depersonalization (in which the self seems to be distanced, unreal, sometimes even dead), drug-induced states (such as the conceptual distortions induced with lysergic acid diethylamide), and such rare states as apotemnophilia (with the desire to have healthy limbs removed). Hysteria is an old-fashioned but useful term for what is now subsumed under the category somatoform disorder, and in its more severe form somatization disorder. Such patients, and those with hypochondriasis, have altered sensations or movements of one or more body parts, in the absence of neurological lesions that could explain these symptoms, and attention to the body concept in such patients, especially with regards to ideas about illness, reveal substantial aberrations.

There are few neurological explorations of these disorders, but they hardly suggest primary involvement of the parietal cortices. In fact, while not undermining the importance of the body image in the brain for understanding human behavior, they reveal the necessity to concern theory with the broadened body concept and seek beyond the parietal lobes.

The clinical-anatomical findings briefly discussed have profound neuropsychiatric and philosophical relevance. The parietal cortex has spatial and non-spatial functions and disorders such as hemispatial neglect lead not only to alteration of the appreciation of the self, but also to misinterpretation of social interactions. Alteration of one's own body concept alters one's relationship to the outside world, for example, in states of depersonalization, but also patients with apraxias and agnosias have difficulties conceptualizing the body parts of others, and depleted social interactions.² It is not possible to localize the body concept although it is possible to distort and disorganize it by various means (neurological or psychological), and this will be associated with alterations of the social being.

Conclusion

Traditional neurology seems to have things back to front, which explorations of the concepts discussed

here reveals. Schilder² pointed out that perceptions were tied to actions in an intimate way, noting that "impression and expression form a definite unit which we can separate in its parts only by artificial analysis." Perception implies a mode of perceiving, a tendency to interact and act, an intention to move. He drew attention to the links between the emotions and what he called the body image (here the body concept): Actions are based on anticipations, tendencies and what Schilder² called a psychic direction. By referring to the libidinous structure of the body concept, he was emphasizing the ontological and emotional aspects of its development. Quite when the parietal-dependent body image in the brain is formed and how plastic it is quite unclear. However, patients with congenitally absent limbs have vivid phantoms¹⁴ and in primates¹⁵ it has been shown that the use of tools alters the activity of subregions of the parietal lobe, in addition to a number of other motor related structures. These data suggest an early embodiment of the cognitive basis of the body image and have an implication of the body image in the brain not only in perception but also for the structure of knowledge.

In humans, the left hemisphere of the brain is considered dominant for language, and language provides

in humans, the left hemisphere of the brain is considered dominant for language, and language provides the basis for our communication about the world and our logical constructions. Yet, left parietal lesions alter praxis and lead to finger agnosia acalculia and agraphia; no more counting to 10, and loss of logical construction. Alongside the alterations of our perceived body, with added left-right confusion, it seems that the a priori data of experience are obliterated.

Kant asked what mental operations must occur to produce universal objective judgements about experience. Mental structures are needed to make sense of our perceptions and give our experience of physical objects—without such organizing principles, how else is it possible to share a common world with others? For Kant, there had to be an objective structure to our consciousness, which is transcendental—in other words, given by the structure of consciousness and not only derived from empirical experience. The question for neuroscience, largely ignored up to the present, is to ask how knowledge is embodied and pace Descartes to consider what is the role of the body in such embodiment? To what extent is the structure and extent of our understanding related to the perceived body in the brain: What has the act of grasping to do with the act of grasping? The motor precedes; ask any mother, all actions are indeed “charged with its relation to something which has gone before”. In the beginning was not the word but the deed.

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