

The organization of the motor system: a modern perspective.

Giovanni Buccino

Department of Neuroscience, University of Parma

e-mail: giovanni.buccino@unipr.it

Up to two decades ago the view on the organization of the motor cortex in primates was rather simple. It was thought that in the posterior part of the frontal lobe there are two complete representations of body movements: the first one, located on the lateral convexity of the cortex, included Brodmann's area 4 and lateral area 6; the second one, located on the mesial surface of the cortex, was known as the supplementary motor area (SMA). A number of anatomical and functional studies have challenged this view. Nowadays it is known that the motor cortex is formed by numerous functionally and anatomically distinct areas. Each of these areas is specifically connected with a sector of the posterior parietal lobe, which also consists of a mosaic of areas. These fronto-parietal connections form a series of specialized circuits working in parallel. Each circuit is involved in a specific sensory-motor transformation for action, thus representing a functional unit of the motor system. Some of these circuits are well known: the rostralmost sector of the ventral premotor cortex (area F5 according to the nomenclature proposed by Matelli et al. in 1985) is strictly connected with area AIP, which occupies the rostral part of the lateral bank of the intraparietal sulcus. The AIP-F5 circuit plays a fundamental role in transforming the pragmatic features of an object into the appropriate hand action to act upon it. Similarly, the dorsal sector of the ventral premotor cortex (area F4) is strictly connected with area VIP, which lies in the fundus of the intraparietal sulcus. This VIP-F4 circuit plays a crucial role in coding the peripersonal space and in transforming information about the spatial location of an object into the appropriate arm/hand action to move toward it. Although the organization of the motor system and the existence of fronto-parietal circuits described above is based on studies carried out in the monkey, there is increasing evidence especially coming from brain imaging studies, that the organization of the human motor system follows the same pattern.