INSTITUTE OF NEUROSCIENCE – PARMA HEADQUARTER

Title: NEUROBIOLOGY OF LANGUAGE

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Abstract:
A staple of contemporary neurobiology of language is that the neural processing of human spoken language and its comprehension rely on a distributed network not limited to the Broca’s and the Wernicke’s areas, respectively located in left inferior frontal and posterior temporal lobe. Rather, the different motor, auditory, semantic, syntactic, social and cognitive aspects of language processing depends on multiple anatomical streams of process, encompassing several regions devoted to different motor, sensory and cognitive regions.

A longstanding and yet unsettled issue in the neurobiology of language concerns the relationship between the motor system – and the premotor cortex in particular – and the semantics of action concepts. “Embodied cognition theory” hypothesizes that action concepts and action control share the same motor representations and, more specifically, that action concepts recruits the same premotor fields devoted to the control of the corresponding action. An issue related to this hypothesis concerns the neural encoding of abstract concepts, and their possible independence from perceptual and motor brain systems. An alternative perspective, based on the “motor theory of speech perceptions”, states that the perception of all spoken language, regardless of its semantic content, triggers the same vocal tract gestures recruited during its production to facilitate the identification of the vocal tract gestures pronounced by the speaker. Of note, both hypotheses postulate a possible involvement of the fronto-parietal mirror mechanism, to whom an independent set of studies is devoted (see 5.1). Our aim is to investigate these issues by means of a multi-technique approach, based on high-density scalp EEG, TMS and intracranial sEEG recordings on patients during pre-surgical monitoring.

Another line of research investigates the interaction between motor control of hand gestures and mouth articulation gestures. This set of studies is based on the hypothesis that language evolved from manual gestures, gradually incorporating motor acts with vocal elements – an hypothesis also related to the existence of the fronto-parietal mirror mechanism. This line of research is mainly based on TMS and behavioral studies based on the quantification of kinematics and voicing parameters (vocal spectrum).

Skills/technology: high-density EEG, TMS, intracranial recording, kinematics, vocal spectrum.

Publications


