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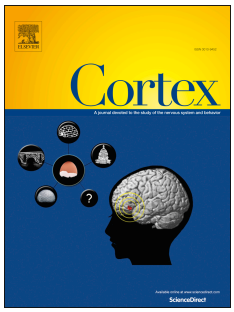

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Vittorio Gallese, Valentina Cuccio

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The neural exploitation hypothesis and its implications for an embodied approach to language and cognition: Insights from the study of action verbs processing and motor disorders in Parkinson's Disease

Vittorio Gallese[1, 2] and Valentina Cuccio[3]

[1] Dept. of Medicine and Surgery, Unit of Neuroscience, University of Parma, Italy.
[2] Institute of Philosophy, School of Advanced Study, University of London, UK.
3 Dept. of Humanities, Social Sciences and Cultural Industries, University of Parma, Italy.

Abstract

As it is widely known, Parkinson's disease is clinically characterized by motor disorders such as the loss of voluntary movement control, including resting tremor, postural instability, and bradykinesia (Bocanegra et al., 2015; Helmich, Hallett, Deuschl, Toni, & Bloem, 2012; Liu et al., 2006; Rosin, Topka, & Dichgans, 1997). In the last years, many empirical studies (e.g. Spadacenta et al. 2012; Bocanegra et al. 2015) have also shown that the processing of action verbs is selectively impaired in patients affected by this neurodegenerative disorder. In the light of these findings, it has been suggested that Parkinson disorder can be interpreted within an embodied cognition framework (e.g., Bocanegra et al. 2015). The central tenet of any embodied approach to language and cognition is that high order cognitive functions are grounded in the sensory-motor system. With regard to this point, Gallese (2008) proposed the neural exploitation hypothesis to account for, at the phylogenetic level, how key aspects of human language are underpinned by brain mechanisms originally evolved for sensory-motor integration. Glenberg and Gallese (2011) also applied the neural exploitation hypothesis to the ontogenetic level. On the basis of these premises, they developed a theory of language acquisition according to which, sensory-motor mechanisms provide a neurofunctional architecture for the acquisition of language, while retaining their original functions as well. The neural exploitation hypothesis is here applied to interpret the profile of patients affected by Parkinson's disease. It is suggested that action semantic impairments directly tap onto motor disorders. Finally, a discussion of what theory of language is needed to account for the interactions between language and movement disorders is presented.

1. Introduction

Embodied Cognition is a promising field of study and currently one of the most debated approach to the study of the human mind, in all its complexity. Embodied Cognition, however, at present, is far from being a unitary paradigm. It is, instead, a research program within which different accounts of the classic mind-body problem have been proposed (see Shapiro, 2011 for a review). These accounts, although differing one from another in many respects, share two aspects: 1) the rejection of the Computational Theory of Mind (henceforth, CTM; Fodor 1983; Phylyshyn, 1984) that proposes that cognitive processes are computations on amodal symbol; 2) the proposal that bodies play a central role in our cognition. According to such proposal, cognitive processes are mainly the expression of the neural systems controlling the body. These two aspects can undoubtedly be considered as the marking features of the Embodied Cognition research program.

The discovery of mirror neurons, premotor neurons that are activated both by the execution of purposeful motor acts and their observation when performed by others (di Pellegrino et al. 1992; Gallese et al. 1996), marked a major turning point in the fields of Embodiment and Embodied Cognition, as it revealed a neurophysiological mechanism, to be later on discovered also in the