The neurophysiological markers of dyadic motor interactions

Betti Sonia[1], Zani Giovanni[1,2], Guerra Silvia[1], Castiello Umberto[1] and Sartori Luisa[1,3]

[1]Dipartimento di Psicologia Generale, Università degli Studi di Padova, Padova, Italy
[2] School of Psychology, Victoria University of Wellington, Wellington, New Zealand
[3] Padova Neuroscience Center, Università degli Studi di Padova, Padova, Italy

Abstract

Many daily activities involve responding to other people's actions. Despite the ever-growing interest in motor preparation and execution of social interactions, the functional connection between these two processes still needs to be clarified. The aim of the present study was to investigate this aspect from both a behavioral and a neurophysiological point of view. To this end, motor-evoked potentials (MEP) induced by single-pulse transcranial magnetic stimulation (spTMS), reaction times (RTs), electromyography (EMG) and 3-D motion capture data were simultaneously recorded. Participants were requested to observe a co-experimenter taking some sugar with a teaspoon, then stretching out the arm toward a mug full of coffee placed in front of the participant, as if to pour some sugar in it. Participants were then requested to either perform a precision grip (PG) on a sugar spoon inserted in the mug to stir the coffee or to grasp the mug and lift it with a whole-hand grasp (WHG). A non-interactive condition was also included, simply showing the co-experimenter taking some sugar and then coming back to the starting position. Participants thus performed identical actions in terms of motor goals, but driven by different (social) intentions.
Observing the interactive gesture speeded motor preparation (RTs) and execution (wrist velocity, grasping time, time to maximum grip aperture) of the participants' actions. Critically, this effect was preceded by a greater reduction of MEP amplitudes in the interactive condition compared to the non-interactive one. Our results suggest that observing an interactive gesture while aiming to socially interact leads to a substantial preparatory inhibition during action planning. Given that participants were waiting for a go signal ("on hold" status) throughout the experiment, a preparatory inhibition was always necessary to avoid untimely overt reactions. However, this corticospinal inhibition was greater when planning an interactive gesture, which was then associated with a more efficient action execution. Notably, tightly timed suppression of muscle activity is essential for skilled movement. The increasing possibilities for simultaneous recordings of a large number of signals hold particular promise for exploring the neuro-behavioral bases of dyadic motor interaction.