

# Connecting motor control and language

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Singapore 2010 Youth Olympic Games

Is it true, as some scientists believe, that to understand words like "spike" (in the volleyball sense) the brain has to "mentally" retrace the sequence of motor commands that accomplish the action? According to a study just published as a cover story in the December issue of *Brain Research* and conducted with the participation of scientists from SISSA, the International School for Advanced Studies of Trieste, the high-level motor expertise of subjects (in the case at hand of the volleyball players who responded to instructions to perform volleyball-specific actions)

modulates the involvement of the brain motor areas in understanding the actions. The effect of experience is a novelty that challenges some recent hypotheses, making the theoretical picture more complex.

According to theories of embodied cognition, conceptual representations are construed based on the brain's sensory and motor experience and, when we need to understand or recognise a concept, apparently our brain will subconsciously mime that experience. In practice, to understand the word "drink" our brain implicitly activates the motor processes involved in drinking. But is that really how it works? "According to our studies, the involvement of the [motor system](#) is not so direct or obvious but depends on several variables: the context, the experience and the feasibility/unfeasibility of the actions", explains Barbara Tomasino.

Tomasino, a former SISSA student now at the IRCSS "E. Medea-La Nostra Famiglia" in San Vito al Tagliamento, is the first author of this study which was conducted together with, amongst others, Raffaella Rumiati, the coordinator of the PhD course in Neuroscience at SISSA.

Tomasino, Rumiati and colleagues used "expert" subjects from the motor point of view, namely professional [volleyball players](#). "The idea of using expert subjects is interesting because it allows us to see if the degree of mastery of the act has an effect on performance in understanding. In fact, supporters of embodied theories state that motor activation is always present and there should be no difference", explains Rumiati, differences which were nonetheless identified.

The subjects (two groups: one of volleyball players and one of non-experts) had to read silently sentences describing acts in the form of commands. The cue could be an action that was either possible - "go block" – or impossible – "do a forearm dig during a leap" in volleyball. The sentences could also be positive – "do..." – or negative – "don't do..."-. Even on the basis of a previous behavioural study the research

team supposed that the motor system is activated by positive but not by negative orders.

"In the present study we used functional magnetic resonance imaging to observe the activity of the brain during performance of the task. In particular, we monitored the activity of the motor areas and the changes in the way these "speak", or rather connect functionally, to the cognitive areas", explains Rumiati. "One of the interesting things we found is an inhibition of motor activity in expert subjects in response to a positive but impossible command".

By contrast, in non-expert subjects the motor activity had a non-specific character, without the differences observed in experts. "Overall this indicates that there is a modulating effect of the interaction between the possible/impossible cue and the positive or negative command", comments Tomasino. "It's as if the volleyball players' experience gave rise to a sort of motor alphabet that affects they way they perform the task", says Rumiati, "an alphabet that is instead absent in non-experts. This suggests that the assumption of embodied theories, that is, the constant intervention of the motor system, is not always true but is modulated by contextual factors, such as the subject's experience".

**More information:** Barbara Tomasino, Marta Maieron, Elisa Guatto, Franco Fabbro, Raffaella Ida Rumiati "How are the motor system activity and functional connectivity between the cognitive and sensorimotor systems modulated by athletic expertise?" *Brain Research* Volume 1540, 2 December 2013, Pages 21–41  
[dx.doi.org/10.1016/j.brainres.2013.09.048](http://dx.doi.org/10.1016/j.brainres.2013.09.048)

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