Encoding of the kinematics of observed actions in the responses of mirror neurons

ABSTRACT:

Background
Despite more than 20 years of research we are still missing a precise characterization of the stimulus-response characteristics of the activation of motor areas during action observation.

Aims
The goal of this project is to tackle this question in humans by means of cutting-edge stimulus presentation techniques and EEG recordings.

Method
We first developed an innovative immersive virtual reality (VR) experimental setup in which subjects can act in real time or observe actions executed by humans or avatars. We then recorded the EEG responses of 24 subjects while they executed and observed goal-directed (grasping an object) and non-goal-directed (placing the hand on an object) actions presented in three different modalities: executed live in front of them ("live" condition) or displayed by means of movies showing either a person ("movie person" condition) or a photorealistic avatar ("movie avatar" condition).

Results
We first used the action execution capabilities of our setup to show that embodiment in VR can be effectively used to promote motor rehabilitation in stroke patients and modulate racial bias. In an EEG study, we then showed that observation of live goal-directed actions, compared to the same actions displayed in movies or by means of an avatar, produced patterns of stronger mu suppression across a spatially distributed set of electrodes. Observation of non-manipulative actions produced instead patterns of mu suppression that were similar across all three observation modalities.

Conclusions
Our results suggest dissociations in the neuronal processes activated by the observation of goal-directed and non-manipulative actions respectively when observed in different stimulus presentation modalities.

Keywords

Action observation, Action execution, Mirror neurons, Immersive virtual reality, EEG, Movement kinematics, Photorealistic animation

Published Work:

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Researcher's Contacts:

Antonino Casile
Fondazione Istituto Italiano di Tecnologia,
Center for Translational Neurophysiology
Ferrara, Italy

Phone: +39 375 560 1333
Email: toninocasile@gmail.com