

## The Body of Language

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Embodied and grounded cognition theories have assumed that the sensorimotor system is causally involved in processing motor-related language content [1]. Canonical neurons, which likely code object-related affordances, and mirror neurons, which are activated when observing an action and executing the same or similar action, are thought to build the neural basis for these processes of embodiment. Though many studies using transcranial magnetic stimulation (TMS), electroencephalography (EEG) or reaction times (RT) could show an interaction of sensorimotor systems and language processing [2], the level of integration was not clear until now. The present study provides formal confirmation of this longstanding speculation.

Twenty-four healthy, right-handed participants volunteered in the fMRI study. They were presented written verbs and nouns and corresponding 3-dimensional static pictures of implied actions and objects in a randomized fashion, only reacting by button-press to odd-ball events (red stimuli), to make sure they pay attention. Using multivariate pattern analysis (MVPA), a linear classifier successfully generalized from trained to unseen experimental scenarios with different stimuli (54% out-of-sample performance,  $p < 0.01$ ). More precisely, a support vector machine (SVM) trained only on distinguishing verbs from nouns could be applied to pictorial stimuli and successfully differentiated between the corresponding pictures. Embodied language theory is thus merged with actual neurobiological implementation.

The resulting action-related pattern responses were detailed by recently introduced predictive pattern decomposition into the constituent activity atoms and their relative contributions [3], which give us further information on the common contribution of different brain regions in the processing of language.

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