Somatotopic semantic priming and prediction in the motor system

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The recognition of action-related sounds and words activates motor regions and reflects the semantic grounding of these symbols in action information (Hauk *et al.,* 2004). Furthermore, modality-preferential motor cortex even exerts a causal influence on sound perception and language comprehension (D'Ausilio *et al.,* 2009; Schomers *et al.*, 2015). However, proponents of classic symbolic theories dispute the motor system's role in the semantic processing of meaningful stimuli, but attribute meaning to an amodal semantic system instead (Caramazza *et al.*, 2014). To clarify whether the motor system carries genuine semantic processes, we used multi-channel, event-related potentials (ERPs), to investigate priming effects between sounds and spoken words semantically related to face or leg actions (Grisoni *et al.,* in press). To direct subjects' attention away from the sounds, a distraction-oddball design was used and the mismatch negativity (MMN; Näätänen *et al.,* 2007) to rare "deviant" mouth- and leg-related action words ("kiss" and "kick") was recorded in the context of frequent "standard" mouth- ("whistle") or leg ("footstep") related-action sounds or non-action ("water drop") meaningful sound. Event-related potentials revealed that action-related stimuli produced significantly larger word-evoked (MMN) and sound-induced predictive brain responses when presented in body-part-incongruent context (i.e., "kiss" in footstep sound context; "kick" in whistle context) than in body-part-congruent context, a pattern consistent with semantic priming. Cortical generators of the semantic relatedness effect were localized in areas traditionally associated with semantic memory, including left inferior frontal cortex and temporal pole, and, crucially, in motor areas, where body-part congruency of action sound–word relationships was indexed by a somatotopic pattern of activation. As our results show neurophysiological manifestations of semantic priming in the motor cortex, they prove genuine semantic processing in the motor system and thus semantic grounding in a modality-preferential system of the human brain.

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