ACQUIRING OF NEW WORD MEANING BY AUDITORY-MOTOR ASSOCIATIONS IN TRIAL-AND-ERROR LEARNING PARADIGM

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According to the embodied cognition theory, speech is largely based on the body motor and sensory experience. The question, which is crucial for our understanding of the origin of language, is how our brain transforms sensory-motor experience into word meaning. We have developed an auditory-motor experimental procedure that allowed investigating neural underpinning of word meaning acquisition by way of associative "trial-and-error" learning that mimics important aspects of natural word learning. Participants were presented with eight pseudowords; four of them were assigned to specific body part movements during the course of learning – through commencing actions by one of participant's left or right extremities and receiving a feedback. The other pseudowords did not require actions, and were used as controls. Magnetoencephalogram was recorded during passive listening of the pseudowords before and after learning. The cortical sources of the magnetic evoked responses were reconstructed using distributed source modeling (MNE software). Neural responses to newly learnt words were significantly enhanced as compared to control pseudowords in a number of temporal and frontal cortical regions surrounding the Sylvan fissure of the left hemisphere. Learning-related cortical activation was inversely related to the number of trials needed to acquire the word meaning (this value varied between participants from 74 to 480 trials to the learning criterion). Our findings revealed a neural signature of associative learning of meaning of nonsense words and highlighted the role of sensory-motor transformation for association-grounded word semantics. Supported by RFBR grant 17-29-02168.

Keywords: embodied cognition, action words learning, cortical plasticity, MEG, speech learning.

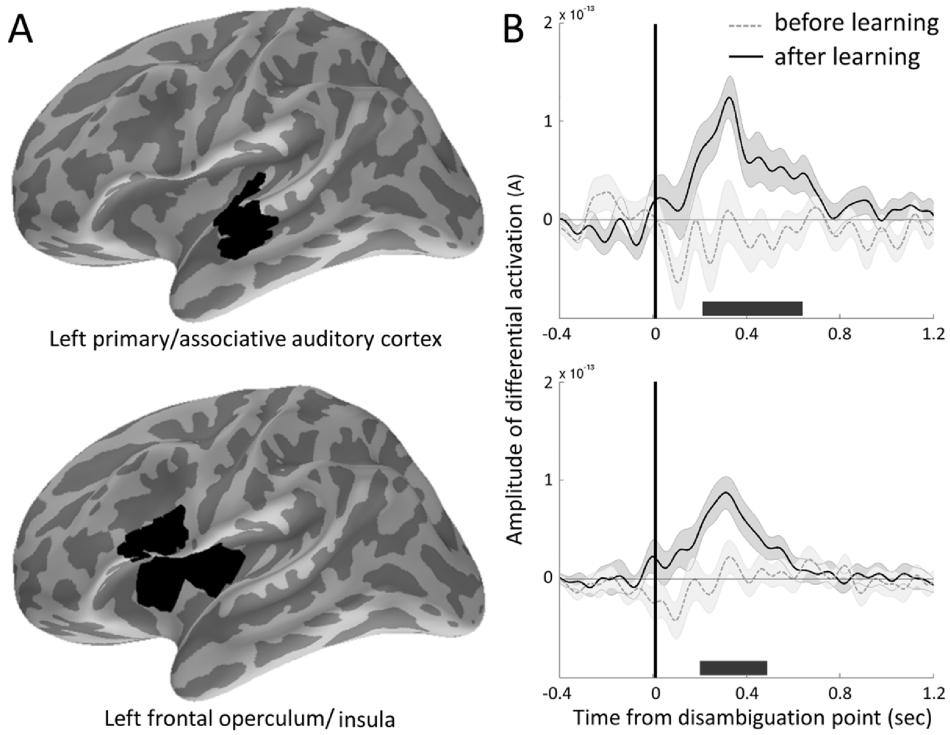

Figure. Spatial clusters (A) and timecourses (B) of learning-related activation. Activation sources are shown for significant difference in activation between meaningful and meaningless pseudowords before and after learning. Bars beneath each timecourse indicate the time windows for which differential activation in the respective cluster was significant. Vertical lines denote the word disambiguation point ("0"), after which meaningful pseudowords started to differ from controls. Shaded areas represent the standard error of the mean.