MEG-based BMI controlled the sensorimotor cortical plasticity and phantom limb pain

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Abstract:
Phantom limb pain is neuropathic pain after the amputation of a limb and partial or complete deafferentation. The underlying cause of this pain has been attributed to maladaptive plasticity of the sensorimotor cortex. It has been suggested that experimental induction of further reorganization should affect the pain, especially if it results in functional restoration. Here, we use a brain–machine interface (BMI) based on real-time magnetoencephalography signals to reconstruct affected hand movements with a robotic hand. BMI training induces significant plasticity in the sensorimotor cortex, manifested as improved discriminability of movement information and enhanced prosthetic control. Contrary to our expectation that functional restoration would reduce pain, the BMI training with the phantom hand intensifies the pain. In contrast, BMI training designed to dissociate the prosthetic and phantom hands reduces pain. These results reveal a functional relevance between sensorimotor cortical plasticity and pain, and may provide a novel treatment with BMI neurofeedback.