Neural Stimulation to Enhance Motor Plasticity

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Introduction

Preclinical and preliminary clinical investigations have demonstrated the basic efficacy of vagal nerve stimulation (VNS) to increase cortical plasticity, and suggested a role in stroke rehabilitation. To harness the full potential of VNS to drive modification of neural circuits, more needs to be known regarding the mechanisms by which VNS drives neuroplasticity and the conditions by which it can facilitate learning.

Methods

The goal of this work is to understand the influence of temporally-precise VNS on cortical plasticity in the motor system and on the subsequent learning of a skilled motor task in healthy rodents. Mice are trained to perform a dexterous reach through a narrow slit to grab a food pellet. VNS is applied following a reach success. To test if cholinergic neuromodulation from basal forebrain (BF) afferent projection neurons may mediate this effect, we applied optogenetic stimulation to cholinergic BF neurons.

Results

Temporally-paired stimulation of the vagus nerve doubled the reach success rate on training days 2 and 3, as compared to unimplanted

Conclusions

We find that VNS stimulation and optogenetic modulation of cholinergic afferents enhance motor learning and behavior. Future work will explore circuit mechanisms for this effect, and the way in which neuromodulation shapes the plasticity of neural ensembles in motor cortex.

Learning Objectives

To explore the influence of peripheral neuromodulation on motor behavior

References