Transcranial electrical stimulation mitigates motion adaptation in V1, MT, and MST neurons of awake, behaving macaques

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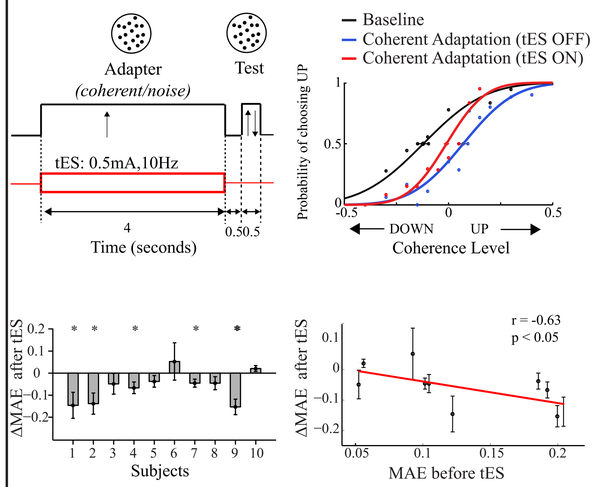
Introduction

Primary Objective

To understand the neural mechanisms of tES.

Previous Observation:

tES reduces motion aftereffect (MAE) in human subjects.



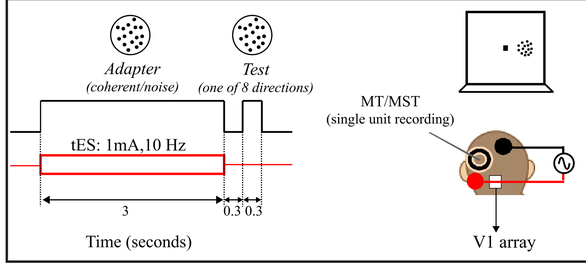
Current Hypothesis:

Rhythmic membrane voltage modulations produced by tES reduce adaptation in motion selective neurons.

Current Approach:

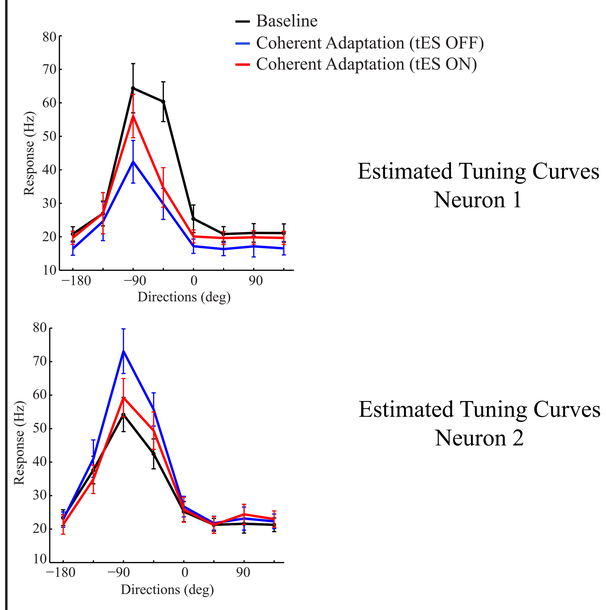
To explicitly test this hypothesis, we recorded from neurons in area MT (n=82; 59+23) and V1 (n = 66; 35+31) in awake, behaving macaques while applying tES.

Electrophysiology Design



Effect of tES on adapted MT neurons

Representative Neuronal Data

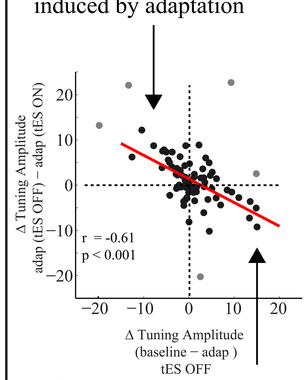


Estimated Tuning Curves
Neuron 1

Estimated Tuning Curves
Neuron 2

Tuning Amplitude

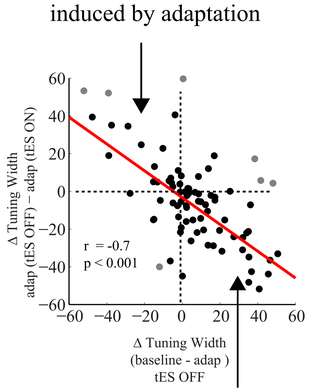
tES reduces facilitation induced by adaptation



tES reduces suppression induced by adaptation

Tuning Width

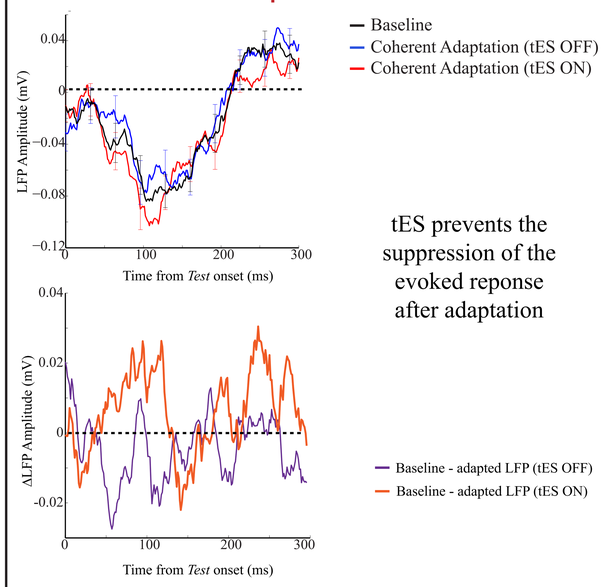
tES reduces broadening induced by adaptation



tES reduces sharpening induced by adaptation

Evoked LFPs in MT

Mean evoked LFP response in the adapted direction

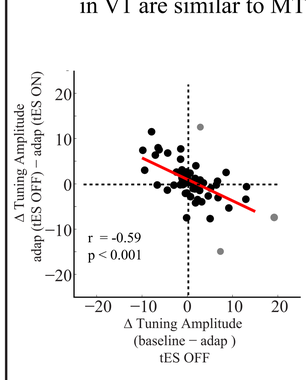


tES prevents the suppression of the evoked reponse after adaptation

Effect of tES on adapted V1 cells

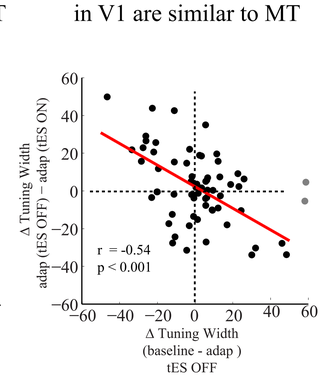
Tuning Amplitude

Tuning Amplitude changes in V1 are similar to MT

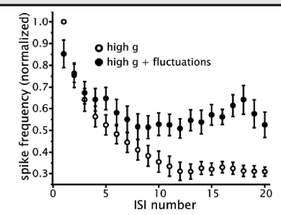


Tuning Width

Tuning Width changes in V1 are similar to MT



Mechanism



Fernandez et al. [3] showed that sub threshold membrane voltage oscillations significantly reduce the hyperpolarizing effect of prolonged stimulation, and thereby attenuate spike frequency adaptation

Take-Home Messages

Human Psychophysics

tES mitigates the effects of motion adaptation measured behaviorally.

Macaque Electrophysiology

tES mitigates changes in tuning amplitude and width in motion adapted MT and V1 neurons.

References

1. Kar et al., Journal of Vision (2012). VSS Abstracts

2. Van Wezel et al., J Neurophysiology (2002).

3. Fernandez et al., J Neuroscience (2011).

Acknowledgements

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