

tACS- What goes on inside?

The neural consequences of transcranial alternating current stimulation

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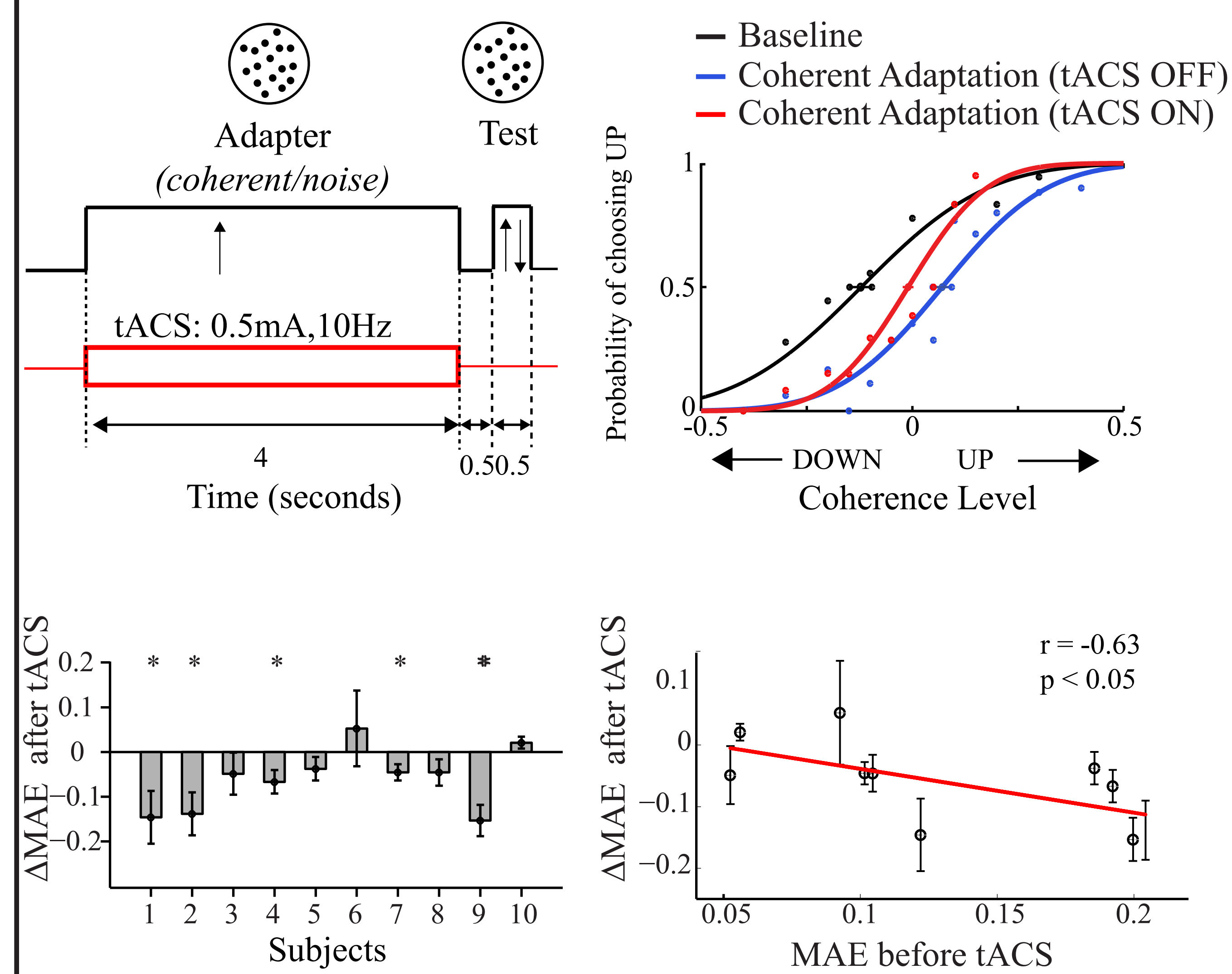
Introduction

Primary Objective

To understand the neural mechanisms of tACS.

Previous Observation:

tACS reduces motion aftereffect (MAE) in human subjects.



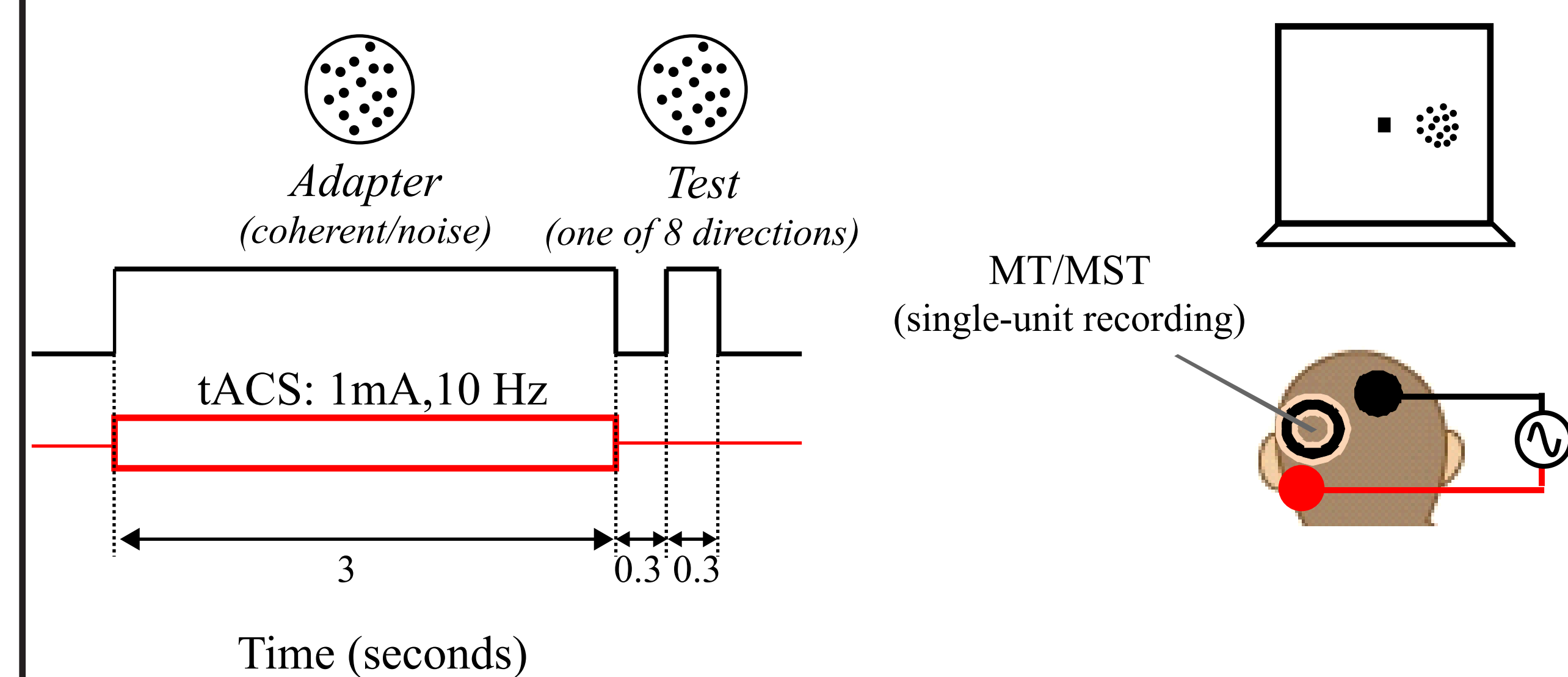
Current Hypothesis:

Rhythmic membrane voltage modulations produce by tACS reduce adaptation in motion selective neurons.

Current Approach:

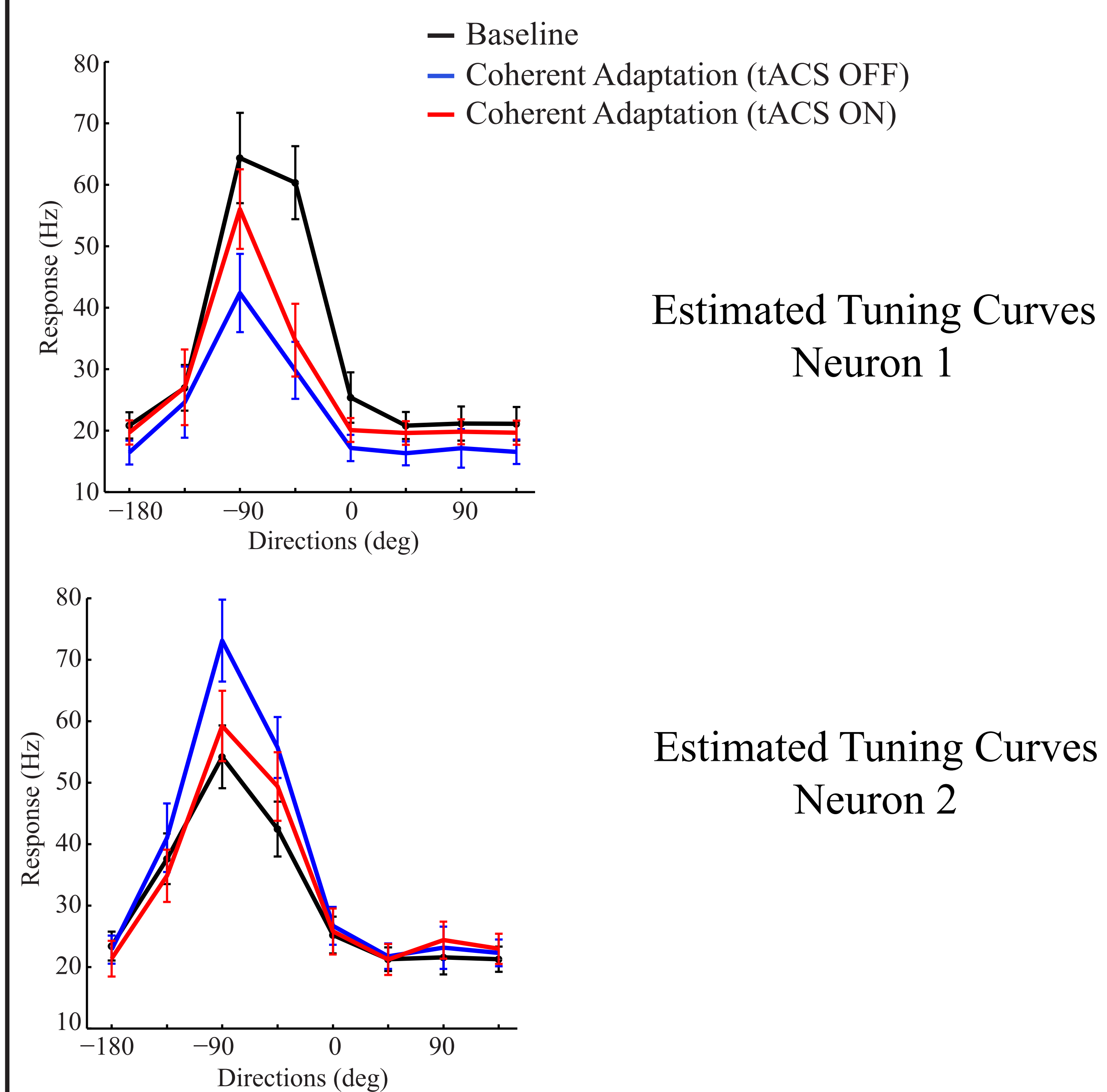
To explicitly test this hypothesis, we recorded from neurons in area MT ($n=82$; 59+23) in awake, behaving macaques while applying tACS.

Electrophysiology Design



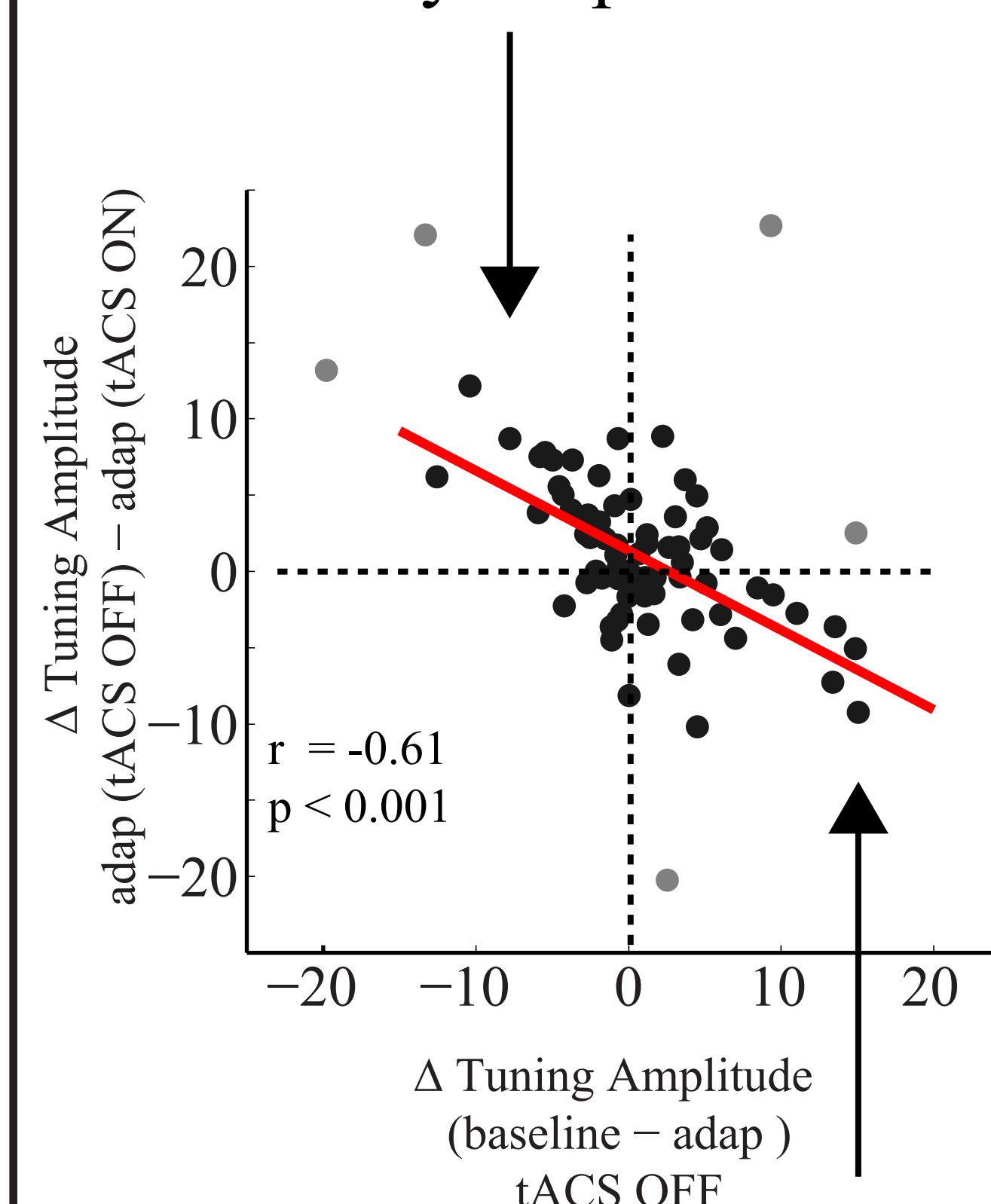
Effect of tACS on adapted MT cells

Representative Neuronal Data



Tuning Amplitude

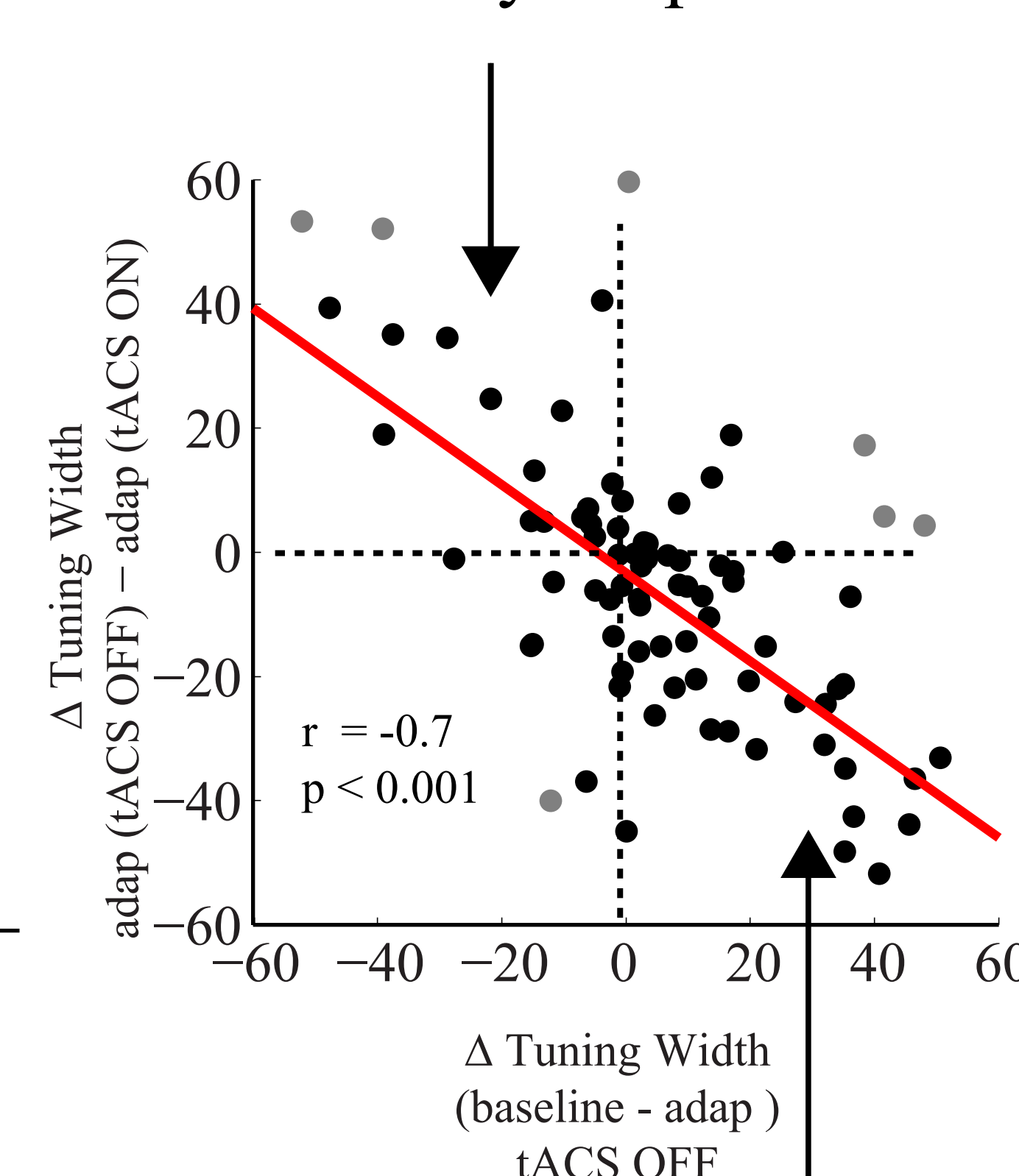
tACS reduces facilitation induced by adaptation



tACS reduces suppression induced by adaptation

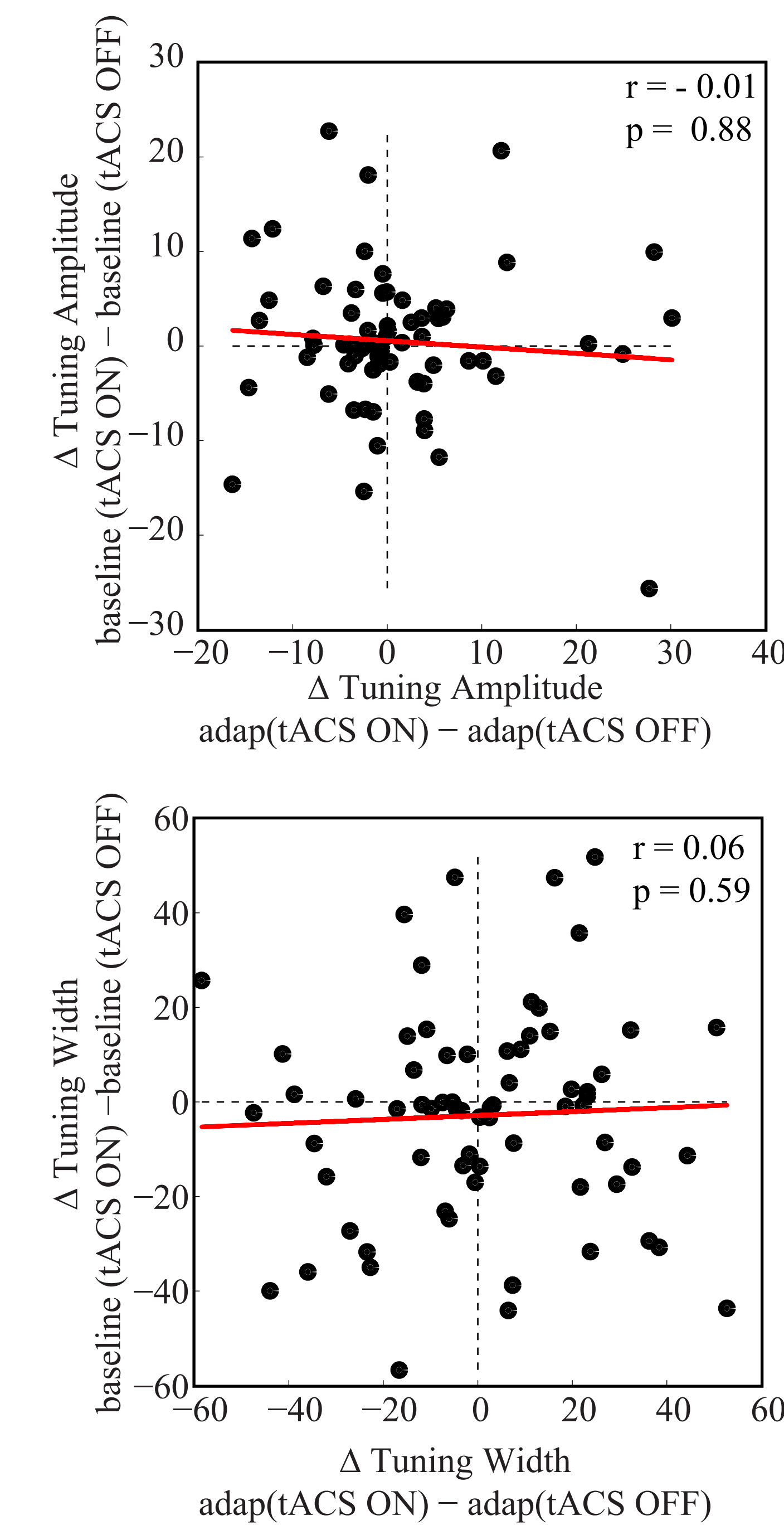
Tuning Width

tACS reduces broadening induced by adaptation



tACS reduces sharpening induced by adaptation

Effect of tACS on unadapted MT Cells

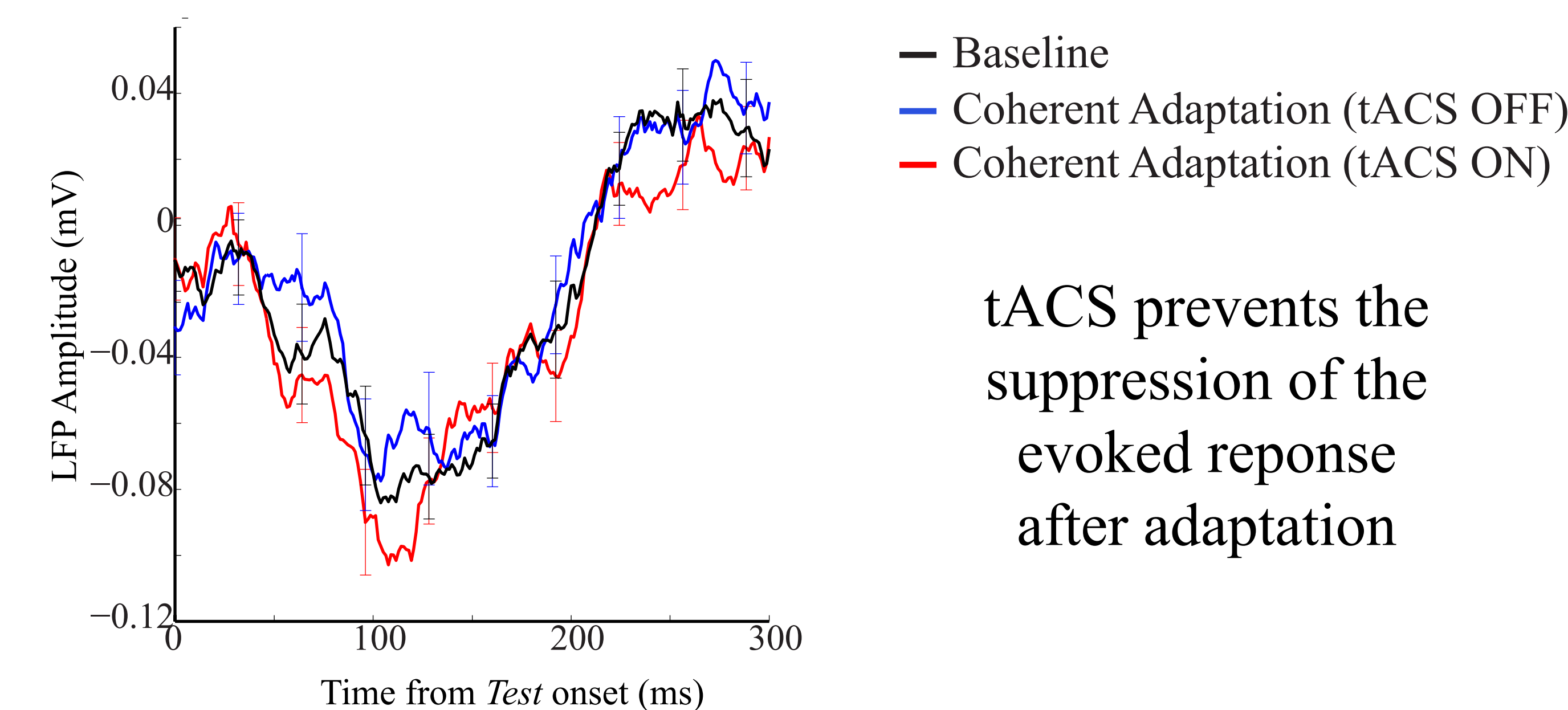


In the absence of (coherent motion) adaptation, tACS has no consistent effect on **Tuning Amplitude**.

In the absence of (coherent motion) adaptation, tACS has no consistent effect on **Tuning Width**.

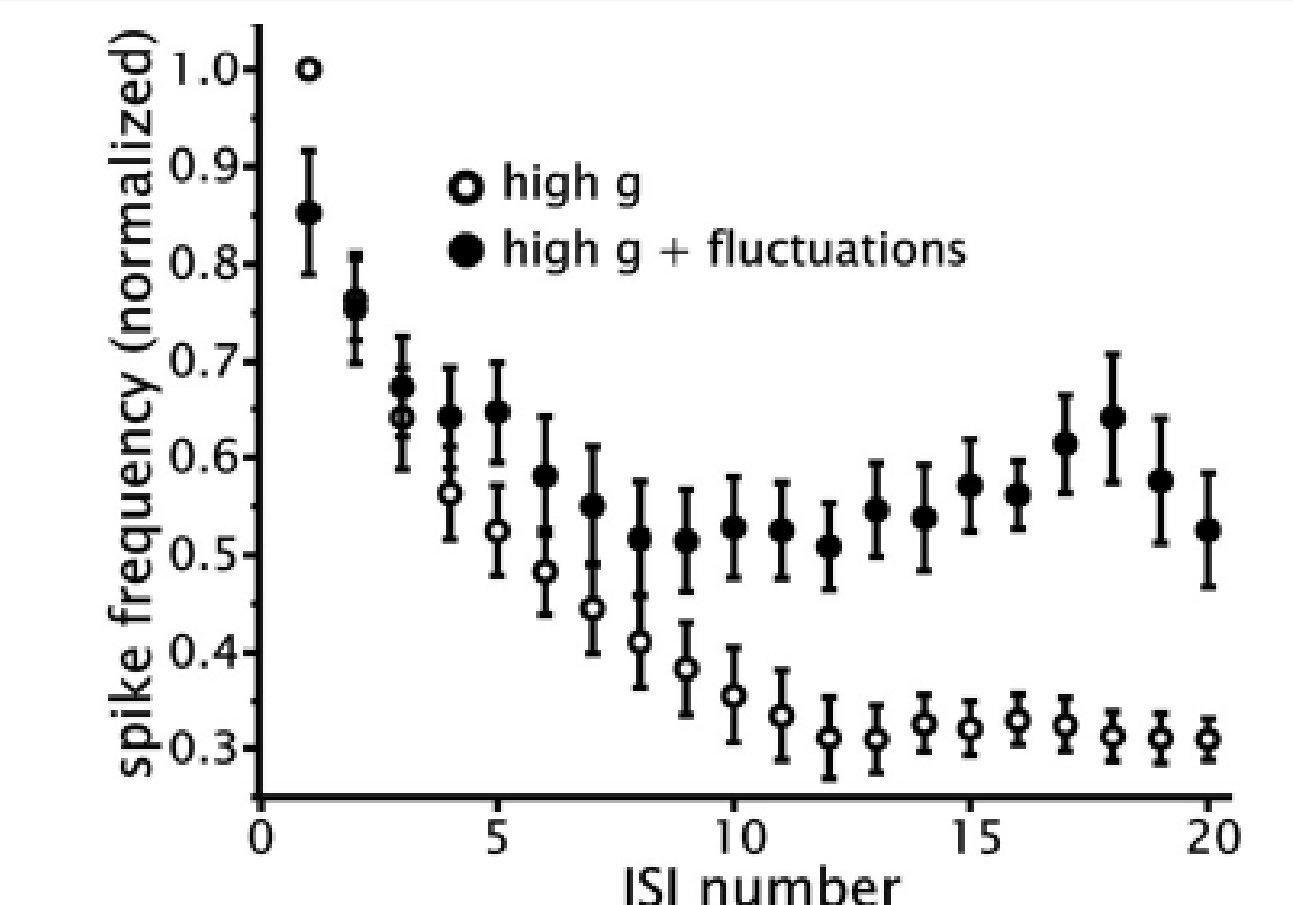
Evoked LFPs in MT

Mean evoked LFP response in the adapted direction



tACS prevents the suppression of the evoked response after adaptation

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
tACS mitigates the effects of motion adaptation measured behaviorally.

Macaque Electrophysiology
tACS 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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