Transcranial electrical stimulation affects adaptation of MT/V5 neurons in awake, behaving macaques

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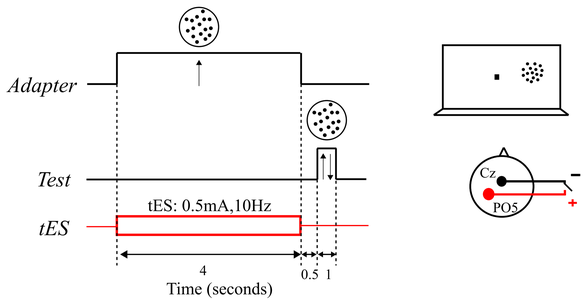
Introduction

Previous Observation:
tES reduces motion aftereffect in human subjects.

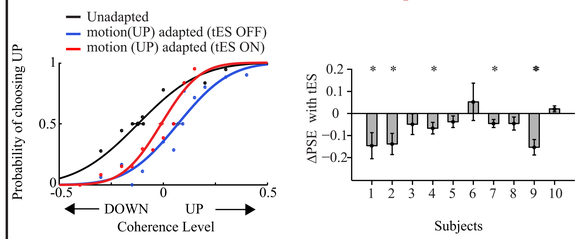
Current Hypothesis:
Subthreshold rhythmic membrane voltage modulations produced by tES reduce adaptation in motion selective neurons.

Current Approach:
To explicitly test this hypothesis, we recorded from neurons (n=69; 55+14) in area MT in awake, behaving macaques while applying tES.

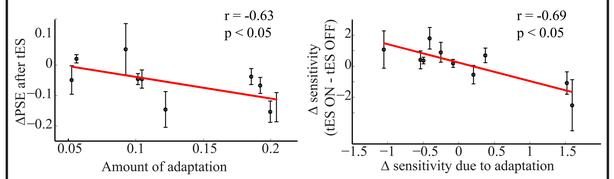
Human Psychophysics



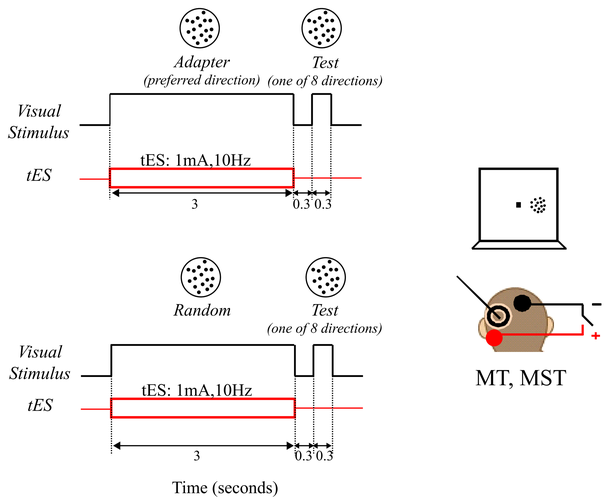
tES reduces motion adaptation



tES reverses the effect of adaptation on PSE & sensitivity of subjects

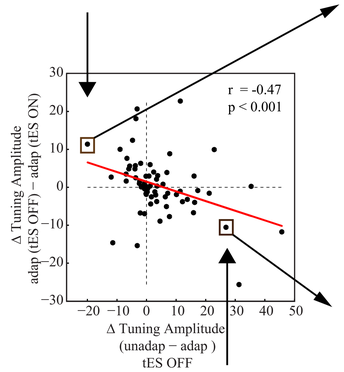


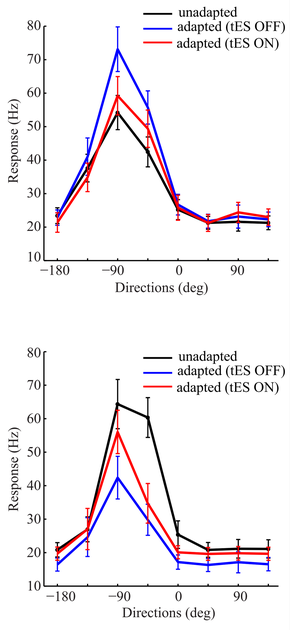
Electrophysiology Design



Changes in Tuning Amplitude (TA)

If adaptation increases TA (facilitation), then tES concurrent with adaptation decreases the facilitation.

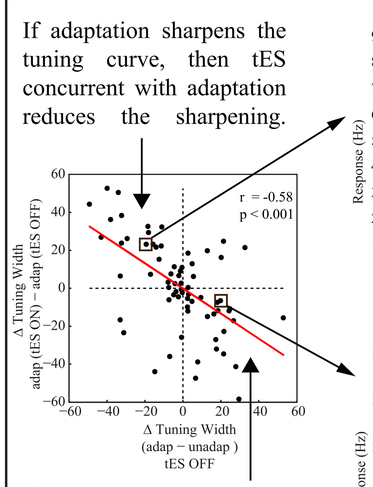


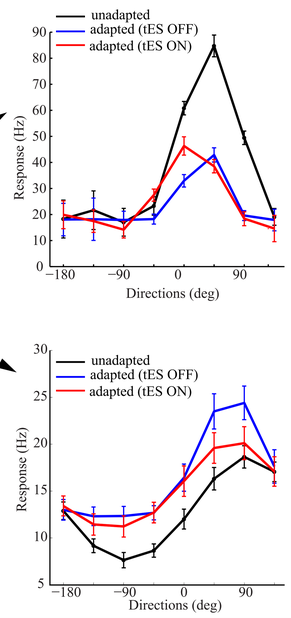


If adaptation decreases TA (suppression), then tES concurrent with adaptation decreases the suppression.

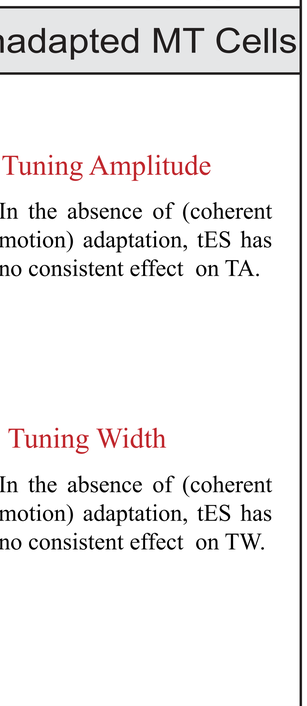
Changes in Tuning Width (TW)

If adaptation sharpens the tuning curve, then tES concurrent with adaptation reduces the sharpening.

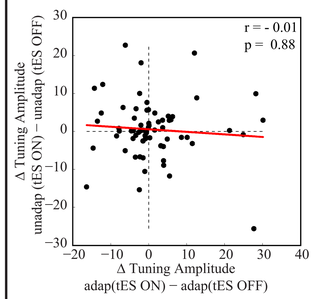




If adaptation broadens the tuning curve, then tES concurrent with adaptation reduces the broadening.

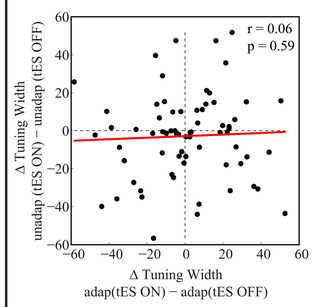


Effects of tES on unadapted MT Cells



Tuning Amplitude

In the absence of (coherent motion) adaptation, tES has no consistent effect on TA.



Tuning Width

In the absence of (coherent motion) adaptation, tES has no consistent effect on TW.

Conclusions

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 neurons.

References

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3. Fernandez, F.R., Broicher,T., Truong,A., White,J.A: Membrane voltage fluctuations reduce spike frequency adaptation and preserve output gain in CA1 pyramidal neurons in a high-conductance state. J Neuroscience, 31, 3880-3893 (2011).

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