

A user-friendly home-based VEP task, with self-administered dry wireless EEG, is a feasible real-world surrogate marker of LTP



Background & Aims

Neuroplasticity is often altered in neurodegenerative and psychiatric disorders. The visual evoked potential (VEP) modulation task for administration to humans (e.g. Valstad et al., 2020) is based on a paradigm that induces LTP-like change in mouse visual cortex (e.g. Cooke & Bear, 2010; Frenkel et al., 2006; see Clapp et al., 2012). We developed a short task to elicit VEP modulation, delivering stimulation via an electronic tablet-based app and collecting EEG using a dry EEG headset designed for home-based self-administration.



Fig 1. Illustration of set-up using Cumulus 16-channel dry EEG headset, tablet and tablet stand.

Methods

- Twelve adults aged 22-48 (7 male; mean age 35.8 [SD 8.8]) received a tablet, stand and headset to home (see Fig 1.).
- Instructions were given by email and video-call (~5 min).
- Participants viewed full field checkerboard reversals while counting the number of times an always-present central circle changed colour from red to green.
- Potentiation phase delivered 2Hz checkerboard reversal for 5 mins.
- The rate of baseline and post-intervention checkerboard reversals was randomised to give mean 1Hz.
- Participants completed one session each lasting ~11 minutes.
- VEP component peaks were extracted at sites O1, O2 and Pz from robust-averaged single sessions (see Smith & Kutas, 2015).

Results

Fig 2. shows moderate potentiation of peak amplitudes at C1 (Pz), P1 (O1) and P1-N1 difference (O1 & O2), with strongest evidence of an increase in P1 at Pz (all p values uncorrected).

Fig 3. illustrates the robust-averaged group mean VEP modulation effect.

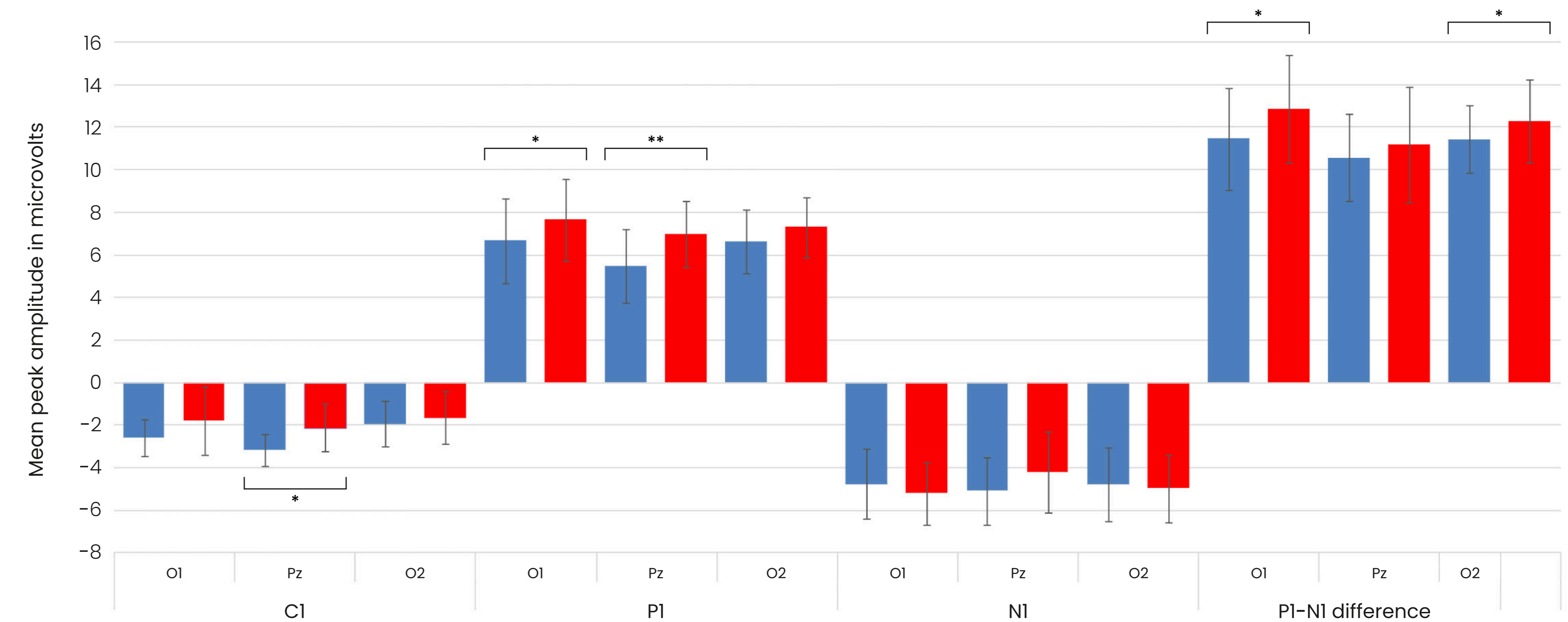


Fig 2. Modulation of C1, P1 and N1 peak amplitudes and P1-N1 difference of the VEP following 5 minutes checkerboard reversal stimulation.

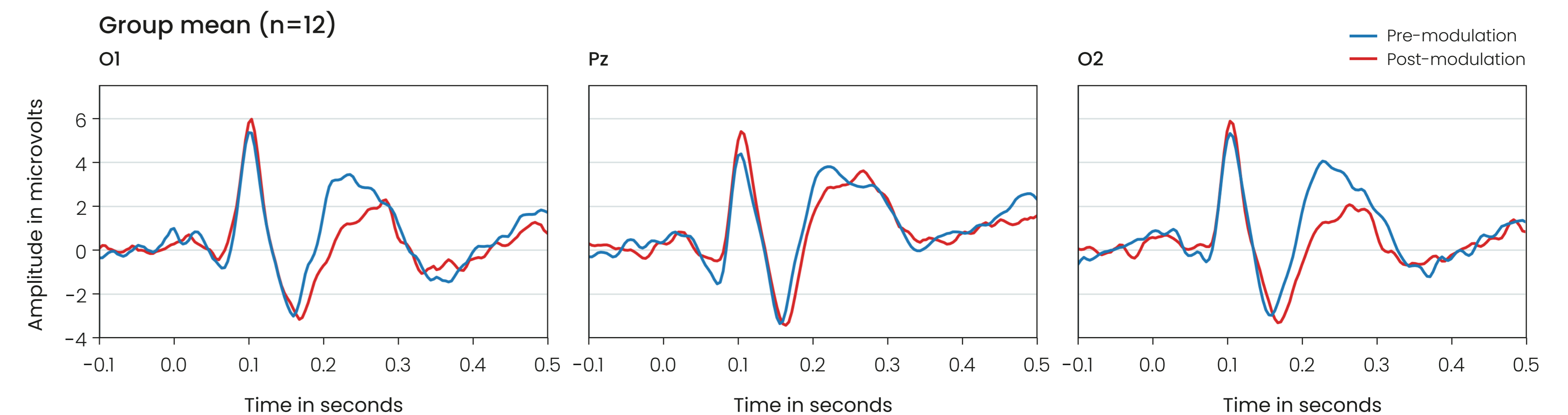


Fig 3. Robust-averaged group mean (n = 12) visual evoked potentials before and after 5 mins 2Hz full-field checkerboard reversal stimulation.

Conclusions

Replication of a lab-based task eliciting a surrogate of LTP plasticity can be achieved in a brief, low-burden session at home using dry-sensor EEG headset and tablet-based stimulation.

Clapp, Hamm, Kirk & Teyler (2012). Translating Long-Term Potentiation from Animals to Humans: A Novel Method for Noninvasive Assessment of Cortical Plasticity. *Biol. Psychiatry*, 71, 496-502.
 Cooke & Bear (2012). Stimulus-selective response plasticity in the visual cortex: an assay for the assessment of pathophysiology and treatment of cognitive impairment associated with psychiatric disorders. *Biol. Psychiatry*, 71, 487-495.
 Frenkel, Sawtell, Diogo, Yoon, Neve & Bear (2006). Instructive effect of visual experience in mouse visual cortex. *Neuron*, 51, 339-349. Smith & Kutas (2015). Regression-based estimation of ERP waveforms: I. The rERP framework. *Psychophysiology*, 52, 157-168. Valstad, Moberget, Roelfs, Slapø, Timpe, Beck et al. (2020). Experience-dependent modulation of the visual evoked potential: Testing effect size, retention over time, and associations with age in 415 healthy individuals. *NeuroImage* 223, 117302.