THE MORE EXCITED THE BETTER? OCCIPITAL CORTEX cTBS AND VISUAL PERCEPTION

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Background

Our research questions were based on the assumption that phosphene threshold (PT) informs about occipital cortex excitability and that occipital cortex excitability determines the quality of visual perception. However, there is a lack of evidence on the relationship between PT and visibility measures. Moreover, the results concerning the influence of occipital continuous Theta Burst Stimulation (cTBS) on visual perception are inconclusive [1, 2]. Furthermore, the results concerning the influence of cTBS on PT also are not consistent [3-6].

The study aims were:

- (1) investigating the relationship between occipital cortex excitability and visual identification task accuracy,
- (2) verifying how cTBS affects participants' visual perception,
- (3) determining how cTBS-visual task interaction influences PTs.

Our approach

Assess the influence of cTBS protocol on:

- identification task performence
- awareness ratings
- phosphene threshold

Research question

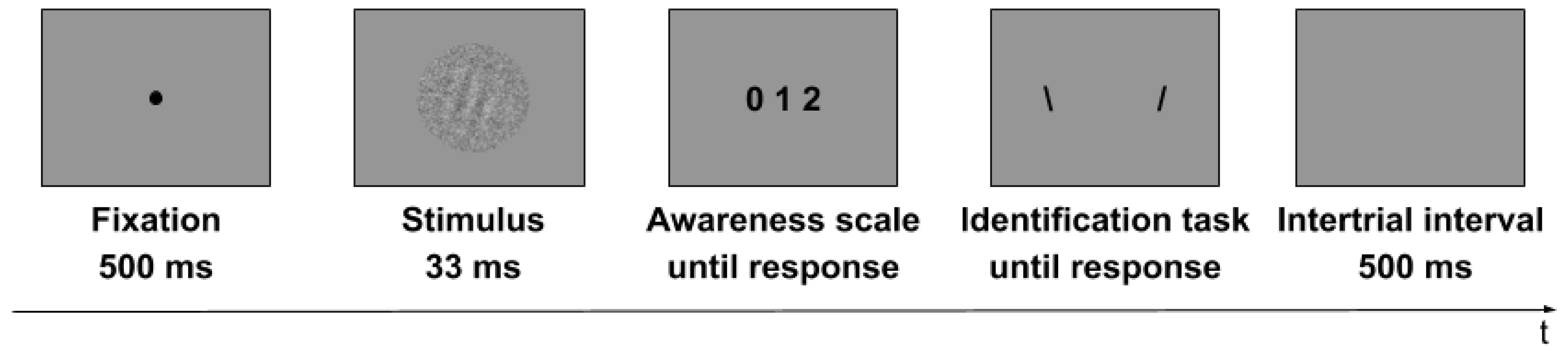
Can we use cTBS to temporarily influence occipital cortex excitability and visual perception?

Methods

Materials and participants

- Identification task stimuli: -45° & 45° Gabor patches; 3° visual angle
- PT estimation: method of constant stimuli (MOCS) [7]
- TMS equipment: Magstim Super Rapid2 Plus1; D702 coil held upwards; Brainsight
- 40 healthy volunteers

Behavioral task



Day 1: performance kept using 1 up 3 down staircase on stimulus contrast (79% accuracy)

Day 2-3: constant stimulus contrast based on day 1 performance

Awareness scale:
0 - nothing: 'No experience'
1 - stimulus detection: 'A glimpse/sth more than the noise appeared'
2 - stimulus recognition: 'An experience of stimulus tilt'

Experimental design

Day 1:

Documents	Behavioral task training session	Head registration	Visual cortex localization	Phosphene learning	Training MOCS
10 min	10 min	10 min	15 min	20 min	10 min

Break	PT estimation with MOCS	Break	Behavioral task testing session
5 min	20 min	5 min	30 min

135 min

Days 2-3 (counterbalanced cTBS sessions):

Head registration & visual cortex localization	pre-cTBS PT estimation with MOCS	Behavioral task training	cTBS 80% or 15%	Behavioral task testing session	post-cTBS PT estimation with MOCS
15 min	10 min	4 min	1 min	40 min	10 min

80 min

Preliminary Results

Aim (1)

Individual PTs were calculated using Palamedes toolbox [7]. No correlation (R = 0.1, p = .520) between individual PT and identification task performance measured by the mean stimulus contrast established with use of the staircase for every participant on day 1 was found.

Aim (2)

The data were analysed using logistic regression and linear regression models with cTBS condition as a fixed effect, participant-specific cTBS condition effect and intercept as random effects.

Outcome

- Behavioral accuracy: a difference was observed for cTBS80% vs cTBS15% (z = -2.06, p = .039), indicating that cTBS impaired visual perception (Fig. 1),
- Identification task reaction times: no difference was observed for cTBS80% vs cTBS15% (t(39) = 1.60, p = .116),
- Awareness scale rating: no difference was observed for cTBS80% vs cTBS15% (t(39) = 0.26, p = .795).

Aim (3)

To investigate PTs we fitted a linear mixed-effects regression model with interaction between pre/post-cTBS condition and cTBS condition as fixed effects, participant-specific cTBS condition effect and intercept as random effects. PTs significantly increased following cTBS15% (t(78) = 2.90, p = .004) but not cTBS80% (t(78) = 1.95, p = .054; Fig 2). However, no difference between cTBS80% and cTBS15% was observed, neither within pre-cTBS condition (t(67) = 1.90, p = .062) nor post-cTBS condition (t(67) = 1.21, p = .229).

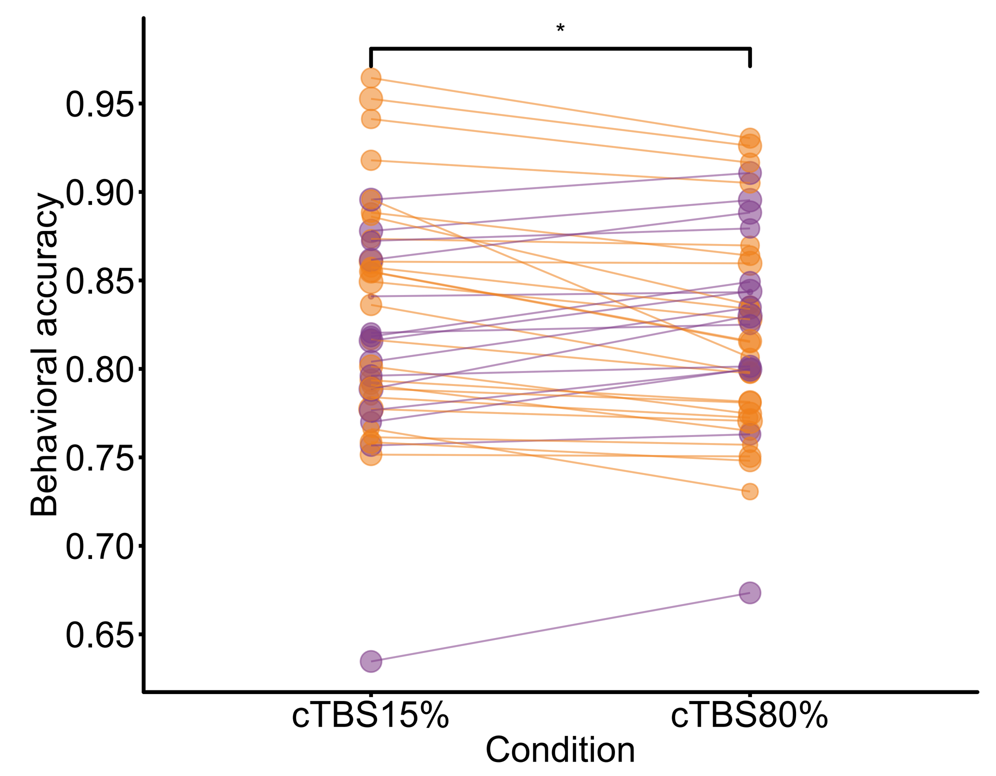


Fig. 1 Mean behavioral (identification task) accuracy dependence on cTBS condition. The dot size represents the value of individual PT.

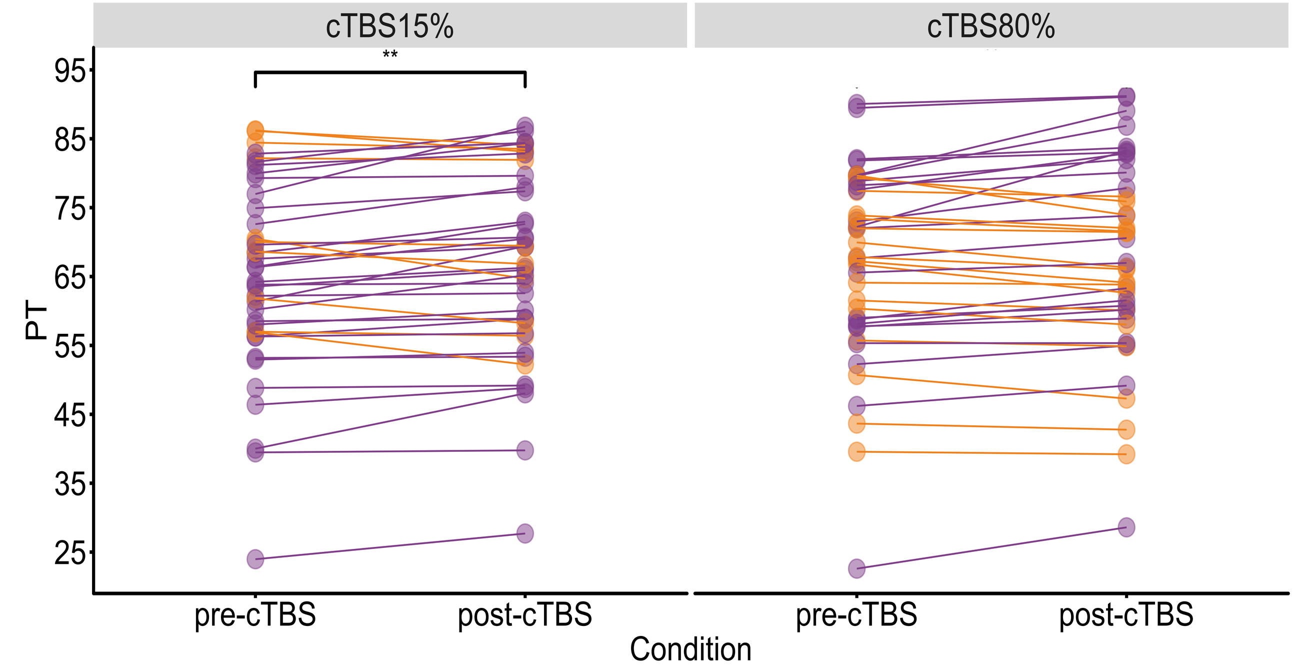


Fig. 2 Individual PT dependence on pre- vs post-cTBS condition.

Discussion

No correlation between PT and the identification task accuracy was found. cTBS resulted in the decrease in identification task accuracy but did not influence awareness ratings. PTs increased following 15% cTBS but not 80% cTBS.

The study challenges the common assumption about the relationship between occipital cortex excitability and visual perception. It may suggest no direct relationship between visual perception and occipital cortex excitability or that PT is not an adequate measure of it – the relationship between PTs and occipital cortex excitability might be non-linear but establishment of its pattern requires collection of a bigger sample of participants. Our study also provides new evidence regarding occipital cTBS influence on visual perception, supporting its inhibitory influence on task performance [2]. Moreover, the previous studies provided inconsistent evidence regarding cTBS influence on PT. Our data suggest that cTBS might inhibit the increase of PT after completion of a visually demanding task.

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