Influencing coherent motion perception through rTMS

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Background
- Pre-stimulus activity in right hMT/V5 as measured by functional magnetic resonance imaging (fMRI) predicts perception in a random dot kinetogram (Hesselmann et al. 2008).
- Pre-stimulus repetitive TMS (rTMS) entrains local frequencies and thereby enhances cognitive performance (Klimesch et al. 2003, Thut et al. 2011, Romei et al. 2012).

Perceptual threshold
- We will measure individual motion coherence thresholds in a moving dot detection task.
- Stimulus: random dot kinetogram with varying coherence levels.
- Task: detect coherent versus random motion.
- Two training sessions of 100 trials each with feedback, then thresholding.
- Method of constant stimuli: 30 trials each of seven different coherence levels (range 2-25%), order randomised.
- The threshold is the 50% detection level of a cumulative normal distribution fit.

Stimulation frequency
- We want to determine the frequency at which rTMS stimulation could influence coherent motion perception.
- We will use EEG to record the event-related frequency spectrum when subjects perceive coherent versus random motion at periliminal trials (i.e. at their individual motion coherence threshold).
- Three blocks of 100 trials each (20 catch trials 0% coherence, 60 periliminal trials at individual motion coherence threshold and 20 trials with 30% coherence).
- This will allow us to find the frequency that shows greater power at coherent versus random percepts as measured over right occipital electrodes.

Figure 2. Coherent motion detection task in a random dot kinetogram measures the individual motion coherence threshold. Plot shows the fitted curve for one participant, threshold of 15.5% coherence given by the 50% detection level.

Figure 3. EEG recordings during the presentation of catch trials, periliminal and supraliminal trials will allow us to find the frequency that differs mostly in power when subjects view coherent versus random motion.

rTMS
We will then deliver prestimulus rTMS at right hMT and vertex to look at its effect on motion perception for periliminal stimuli.
- Three conditions; motion coherence frequency, control frequency and sham stimulation.
- Two stimulation sites: right hMT and vertex (localised for each subject in previous fMRI study).
- Five blocks of 100 trials each (20 catch trials 0% coherence, 60 periliminal trials at individual motion coherence threshold and 20 trials with 30% coherence), ISI 5-7s.
- We will use signal detection theory to calculate behavioural measures, both the sensitivity index and the response bias, for the different conditions and coherence levels.

Analysis
- A two-way repeated-measures ANOVA (location x frequency) on the behavioural measures will investigate the effect of rTMS on coherent motion perception and response.
- If rTMS over right hMT at the motion coherence frequency enhances coherent motion perception, we expect an interactive effect of location and frequency on the sensitivity index.

Discussion
- Hypothesis: rTMS at the motion coherence frequency over right hMT will increase participants’ perception of coherent motion.
- This would indicate that the prestimulus entrainment of hMT can be used to enhance coherent motion perception.

Figure 4. Prestimulus rTMS is used in three experimental conditions: the motion coherence frequency (as indicated by EEG), a control frequency and sham. From the behavioural responses we can calculate the effect of rTMS on perception.

Figure 1. Left: areas that localise perception of moving versus stationary dots (1 left hMT, 2 right hMT). Right: fMRI signal time course over right hMT, significantly different for coherent versus random percepts. From Hesselmann et al. (2008).

Research question:
Can we influence the perception of coherent motion through prestimulus rTMS of right hMT?

References