ERP Measures Of Human Cortical Long-Term Depression

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Introduction

Long-term potentiation (LTP) is a synaptic mechanism underlying learning and memory. LTP is thought to reflect the storage of new information in the brain (Baudrey, 2009). Previous studies provided evidence that high-frequency, repetitive visual stimulation can induce long-lasting plastic changes within the human visual system (Clapp et al., 2012). These studies showed that ERP responses were significantly larger after repetitive high frequency stimuli compared to before.

Long-term depression (LTD) occurs after repetitive low frequency stimulation. It is usually activity dependent and occurs in response to the strengthening of synapses from LTP. Previous studies show that in order for LTD to take place LTP must also occur (Pegado et al., 2016). LTD weakens certain synapses so information being collected during LTP can be encoded efficiently and without error.

There were two main goals for the current study. First was to see if LTP could be induced using similar methods from previous tasks. Second was to see if participants experiencing depression or anxiety had an effect on LTP and LTD.

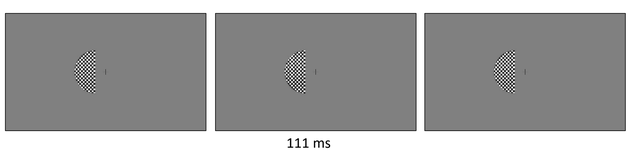
Methods

- There are 27 participants (M=22, SD=6.27, 23 Females)
- **Task Design**
- Semi-circular checkerboard stimuli were presented to the left (LVF) and right (RVF) visual fields.
  - Stimuli were 8° (vertical) x 4° (horizontal) and presented 4° deg from fixation
  - Each check in the semi-circle was 0.33° x 0.33°
- The task had 3 phases
  - The **Baseline** block was 7 minutes long and stimuli were presented at random to either LVF or RVF at 1 Hz
  - The **9Hz Stimulation** block was 2 minutes long and occurred directly after baseline. Stimuli were presented to a single visual field with the colors reversing (White to Black to White) at 9 Hz
  - The three **Post Test** blocks identical to the Pre-LTP block and occurred 2, 15, and 30 minutes after the LTP Induction
- Mean amplitude for N1, P2 and P3 were compared across baseline and post 9Hz stimulation blocks.

Task

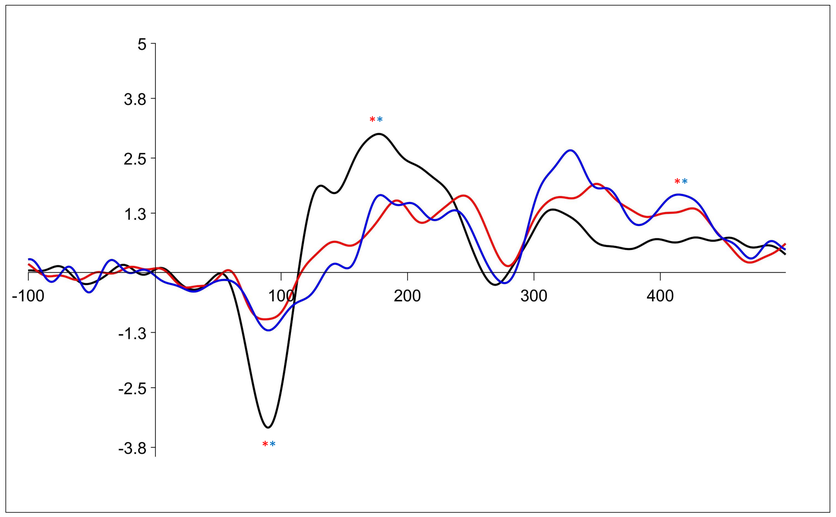
Baseline and Post Tests

9Hz Stimulation

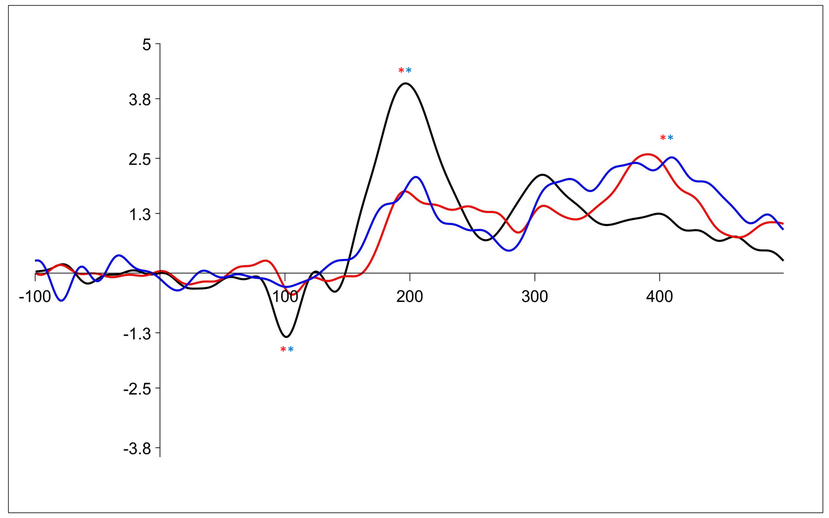


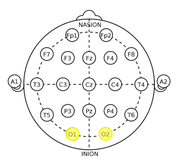
Results

Ipsilateral to 9Hz Stimulation



Contralateral to 9Hz Stimulation



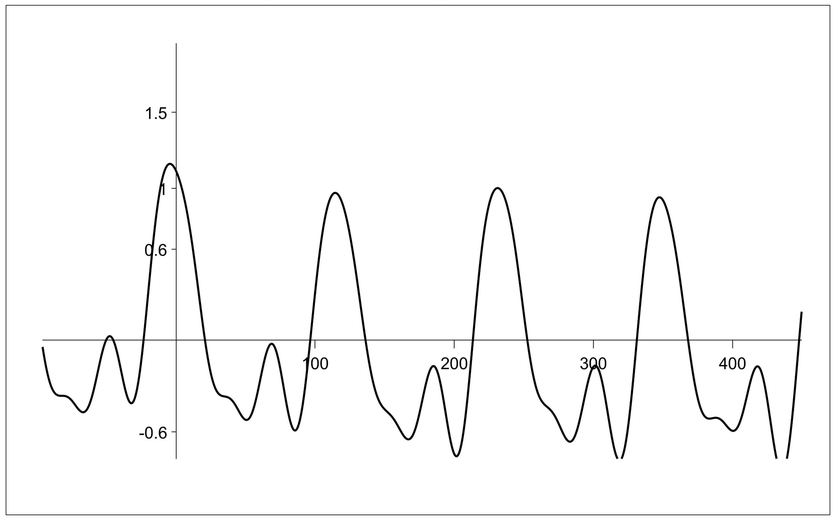


* = Post Test 2min < Baseline, p<.05

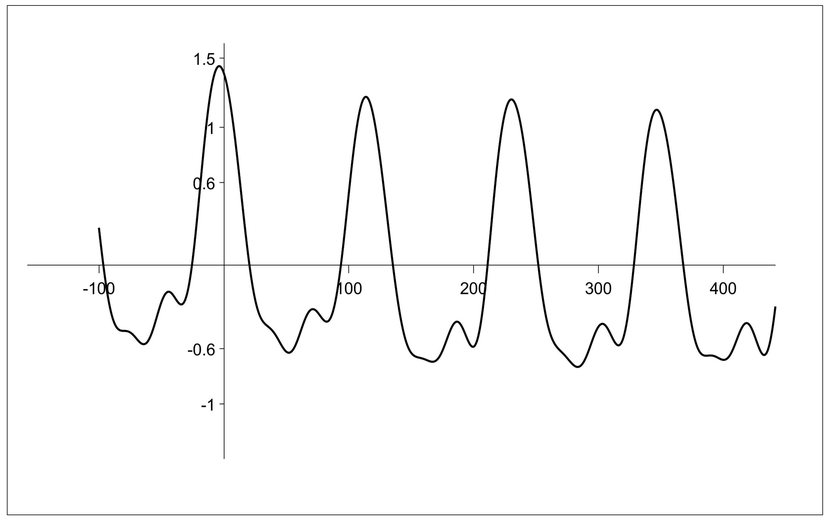
* = Post Test 30min < Baseline, p<.05

Baseline
Post Test 2min
Post Test 30min

Ipsilateral During 9Hz Stimulation



Contralateral During 9Hz Stimulation



Discussion

Results show that contrary to previous studies, (e.g. Clapp et al., 2012) following 9Hz stimulation the current study shows evidence of long-term depression. Consistent with these previous studies, the learning seen here is long lasting. There is a significant decrease in N1 and P2 amplitudes during blocks 2-9 minutes and 30-37 minutes following the 9Hz stimulation.

There are two goals for our future work (1) assess the impact of higher and lower frequency stimulation on LTP and LTD induction and (2) assess whether medications such as SSRIs which have been shown to impact neuroplasticity will alter the learning demonstrated in this type or paradigm.

References

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