INTRODUCTION

The formation of an attentional “hotspot,” wherein sustained populations in the frontal cortex and striatum play an important role in the control of arousal, holding attentional tasks, and the execution of behavior. Stills between dominant frequencies in these rhythms may be a signature of transitions between fundamental brain states, and understanding how this activity is modulated in the anterior forebrain has implications for the treatment of brain disorders.

To investigate the role of vigilance and rhythmic activity in striatum and cortex we perturbed the anterior forebrain network by delivering high-frequency (150 and 250 Hz) electrical stimulation to the central thalamus in a masked manner timed to perform a sustained attention task. The central thalamus provides robust afferent drive to the striatum and the anterior forebrain network. The anterior forebrain network, a distributed network above the thalamus, includes the dorsolateral prefrontal cortex (DLPFC), the anterior striatum, the basal ganglia, the globus pallidus, and the cerebral cortex.

METHOD FOR EXTRACTING SAMPLE EFFECTS ON SPECTRA. To compare LFP power spectra recorded under different experimental conditions, we employed the two-sample spectral test (Bokil et al., 2007, available in the CHRONUX software toolbox). The two-sample test calculates a sample size-bias corrected F statistic that compares two groups of trials (here, DBS OFF vs. D&D OFF) and calculates the distribution of a statistic that is sensitive to changes in the power spectrum from lower (delta-alpha) to higher frequencies (beta-low gamma) for both correct and incorrect trials. CTDBS adds a small but significant contribution to the modulation of power produced during correct trials and gamma activity appears during the incorrect trials. The presence or absence of DBS has a significant effect on the activity produced during incorrect trials. The impact of DBS on the cortical rhythms is a time-dependent phenomenon that can be expressed as a decrease in the power of lower frequencies (delta-alpha) whereas correct trial performance is associated with greater power in the beta and gamma range. With OFF-OFF trials the range of frequencies from 100-250 Hz is significant. The inclusion of significant betagamma activity is associated with correct trial performance.

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SUMMARY AND CONCLUSIONS

- Task performance, trial epoch and CTDBS all influence LFP rhythms in the anterior forebrain (FEF, PFC and striatum).
- For correct trials, power displays a transient peak in the cue period while beta power drops during the same epoch before ramping up as the trials decay. For incorrect trials, CTDBS shifts power in the LFP power spectrum from lower (delta-alpha) to higher frequencies (beta-low gamma) for both correct and incorrect trials. CTDBS adds a small but significant contribution to the modulation of power produced by changes in task performance alone in the absence of CTDBS.
- Recordings within the cortex and striatum demonstrate similar changes in LFP spectral power in response to CTDBS supporting the view of the anterior forebrain as a cluster of anatomically distinct but functionally integrated units that together generate stable patterns of rhythmic activity that can be modulated by CTDBS.

REFERENCES:

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