INTRODUCTION
The involvement of the frontal cortex (FC) and central thalamus (CT) in executive functions is suggested by anatomical connectivity, clinical studies and physiological evidence. Although certain components of executive function have been studied in both areas independently, there is a dearth of evidence comparing their independent and joint engagement during tasks that require the temporal organization of goal-directed behavior. In this study, we investigated two processes central to most executive functions - sustained attention and working memory, while conducting simultaneous microelectrode recordings within the frontal cortex and central thalamus of an awake behaving non-human primate. In a second animal, we included a grid of EEG electrodes to investigate brain-wide interactions during the tasks.

MOTIVATION
Central thalamic deep brain stimulation (CT/DBS) has been proposed as a strategy to remediate impaired consciousness resulting from severe brain injuries (Schiff and Purpura, 2002) and is the subject of ongoing human clinical trials. A recently published single-subject human study has demonstrated that CT/DBS facilitated behavioral recovery after longstanding severe traumatic brain injury (Schiff et al., 2007). However, the precise physiological mechanisms underlying this promising intervention are not well understood and have only recently been investigated. Understanding the neurophysiological basis of measured behavioral effects, from both human and non-human primates, and how to optimize the efficacy of CT/DBS motivate current studies within our group.

CURRENT APPROACH: LARGE-SCALE CORTICAL AND CENTRAL THALAMIC RECORDINGS

RESULTS: SINGLE UNIT AND LFP ACTIVITY

SUMMARY & CONCLUSIONS

> Neurons recorded within the frontal cortex and central thalamus exhibit a variety of response profiles during both tasks, see poster 201.12.
> Significant coherence in the upper gamma (60-100Hz) and beta (15-30Hz) bands were observed between single units and local field potentials recorded within multiple frontal and central thalamic locations. Significant fronto-LFP and central thalamic LFP coherence from DC-25Hz was observed for a large percentage of recordings and exhibited task dependence.
> We observed consistent and significant thalamocortical interactions, based on LFP/EEG coherence, most prominently within the beta band (20-30Hz), but not exclusively, as other frequency bands, including alpha and gamma, also exhibited significant coherence associated with the behavioral task.
> Thalamocortical coherence was most pronounced within the frontal cortex, consistent with the known anatomy and physiological role of the central thalamus, as a rostral extension of the midbrain reticular formation and in the modulation of global forebrain arousal and facilitation of executive function.

References:
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