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Poster title: Task Switching Differentially Perturbs Neural Geometry in the Human Frontal and Temporal Lobes

Abstract: The process of switching between tasks is cognitively taxing, and has long been known to give rise to a "switching cost", leading to a degradation in RT and accuracy after the task switch. The neurophysiological basis of this cost is the subject of significant controversy, with multiple factors thought to play a role including interference of the previous task set and reconfiguration of frontal networks to encode the current task set, known as task set inertia (TSI) and task set reconfiguration (TSR) respectively. Significant research efforts have been dedicated to conducting behavioral and non-invasive neurophysiological studies of the effects of task switching to provide evidence for adjudication between these competing theories, and to generally shed light on the generative mechanisms for switching costs. However, to this day, almost no studies have been conducted at the single-neuron level in humans studying the neural correlates of task switching and switching costs. we conducted single-unit recordings in human patients implanted for clinical purposes who were instructed to alternate many times between two tasks, one involving a sensory-perceptual decision (Category Task) and the other involving a memory-dependent decision (Memory Task). We recorded 975 neurons in 13 patients from frontal and prefrontal cortical structures including the dorsal Anterior Cingulate Cortex (dACC), pre-Supplementary Motor Area (preSMA), and ventromedial prefrontal cortex (vmPFC), and from medial temporal lobe structures, namely the hippocampus (HPC) and the amygdala (AMY). During the task, we find that task variable representations that are un-cued and internally maintained by the individual completing the task are particularly sensitive to task-switching, being perturbed during the immediate post-switch period, unlike representations depending on sensory stimuli or motor decisions and active engagement during the task. We also find neurons that are associated with prolonged reaction time and task errors immediately following a task switch. In summary, neurons in both frontal and temporal lobes are significantly perturbed by switching tasks, and exhibit various dynamics both during baseline and stimulus processing associated with the behavioral cost of switching tasks.