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Session 335 - Cortical and Allocortical Mechanisms of Attention

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335.02 / TT27 - Layer dependent attentional modulation of broad and narrow spiking cells in primate V1

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Abstract
Attention is critical to high level cognition and it improves perceptual abilities. Many studies have delineated how attention affects neuronal firing rates, rate variability, and neuronal correlations, but a detailed understanding how this differs between cortical layers and different cell types is only just emerging[1, 2].
We investigated how attention affects neuronal firing rates, rate variability, and neuronal correlations in broad and narrow spiking cells[3] in macaque V1, while animals performed a top down cued spatial attention task. Recordings were performed with 16 contact laminar silicone probes (150 um intercontact distance) inserted normal to the V1 surface. Layer location was assignment based on current source density and latency analysis, with the earliest current sink and visual responses assigned to layer 4cα. Layer assignment of sufficiently active cells (>3Hz) was possible for 325/364 broad spiking cells and 224/262 narrow spiking cells.
Sustained neuronal activity (following the initial transient after stimulus onset) was higher in supra and infragranular than in granular layers in both cell types. Narrow spiking cells showed a trend towards higher firing rates than broad spiking cells. Attention induced firing rate changes were quantified using Area Under the Receiver Operating Characteristics (AUROC). Braod and narrow spiking cell AUROC distributions did not significantly differ ($p=0.72$, rank-sum test). AUROCs were largest ($p<0.05$, rank sum test) in supragranular layers and smallest in granular layers. Rate variability was assessed using spike count based Fano Factors (FF), and gain variance. Both FFs and gain variance were significantly larger in narrow than broad spiking cells ($p=0.004$, rank sum test). Across both cell types, FF and gain variance was largest in supragranular layers, intermediate in granular, and smallest in infragranular layers (all pairwise comparisons $p<0.05$, rank sum test). Attention did not affect FF in either cell type or layer. However, gain variance was reduced by attention in both cell types. The attention induced reduction in gain variance was largest in supragranular layers, and smallest in infragranular layers (latter comparison $p=0.029$, rank sum test).
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