

Sleep states can be divided into rapid-eye-movement (REM) sleep, characterized by awake-like high frequency desynchronized activity, and non-REM (NREM) sleep, characterized by slow wave activity. How these diverse types of activity are produced and structured are disputed, with both bottom-up¹ and top-down² hypotheses being proposed.

In the primary visual cortex (V1), layer 2/3 pyramidal (PYR) neurons possess anatomically segregated dendritic compartments with distinct sources of input: basal dendrites, that primarily receive feedforward and local inputs; and apical dendrites, that receive inputs from higher cortical areas and higher thalamic nuclei. Previous studies have suggested that during REM, V1 activity, when compared to NREM and quiet awake, is increased³, with tuft dendritic activity also being higher^{4,5}. This suggests that, during REM, pyramidal neurons' activity in sensory cortex may be driven by top-down input from higher cortical regions.

To determine whether apical/basal dendrites balance shifts during sleep in favor of greater top-down activation, we measured apical and basal dendritic calcium activity in sparsely labelled L2/3 V1 PYR neurons using 2-photon calcium imaging during visual stimulation, and subsequent sleep states. We then compared their activity across brain states and between layers (apical vs basal).

To assess whether apical and basal inputs structure during REM is similar or not to when visual stimulation occurs, we also measured the dendritic spines' calcium activity. We then compared, for each dendrite, the spine-spine correlational structure across states.

Together, these experiments test whether V1 activity during different sleep states is predominantly driven by top-down or by bottom-up inputs and if these inputs are structured similarly to during awake sensory processing or not.

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