Prediction in vision - elements of predictive coding in awake and anaesthetized primates

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Abstract:

Effects of suppression and expectation are hypothesized to be independent elements of predictive coding with expectation being dependant on long-range cortical connections. We tested this by comparing neuronal activities recorded in awake and anaesthetized monkeys presented with visual stimuli manipulating both elements. Awake monkey was performing a fixation task and was presented with pairs of gratings of either the same (match trials) or orthogonal orientations (non-match), while anaesthetized monkey's gaze was artificially fixated. Expectation was controlled by setting probabilities of match and non-match trials to 80% (expected) or 20% (unexpected). Local field potentials (LFP) and neuronal spikes were recorded from the primary visual cortex (V1) of awake (N sites = 28) and anaesthetized (N sites = 16) monkeys. In awake monkeys we also conducted simultaneous recordings from receptive field matching sites of V1, lateral intraparietal (LIP) and dorsolateral prefrontal (dlPFC) cortices to assess oscillatory activity in the dorsal stream. Expectation changes V1 LFP amplitude only in the awake monkey (24/28 recordings in awake, 0/16 in anesthetised), while repetition effects were present in both. Repetition leads to LFP peak-to-peak amplitude increase (12/28) or decrease (4/28) in V1, but LIP and dlPFC demonstrate only suppression, strongest in LIP, and dlPFC shows amplification of the difference in response to common/novel stimuli. LFP coherence is expectation-sensitive in gamma range for both V1-LIP and V1-dlPFC pairs and in theta-low alpha in LIP-PFC pairs. Thus, V1 is affected by both expectation and repetition, but effects of expectations are eliminated by anaesthesia.

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