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Task engagement and visuomotor feedback facilitate stimulus encoding in visual cortex

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The adaptation of sensory encoding is critical for efficient information processing and improved behavioral outcomes. To investigate mechanisms of experience-dependent plasticity in primary visual cortex (V1), we assessed neuronal responses before, during, and after presenting a repetitive stimulus under passive or active-learning conditions and when visuomotor feedback was congruent (in a virtual environment) or mismatched. Active engagement and congruent visuomotor feedback increased the representation of the repetitive stimulus in V1, enhanced stimulus encoding, and increased stimulus discriminability. Conversely, mismatched passive viewing led to a decrease in the proportion of responsive neurons and stimulus habituation. Additionally, different subnetworks of neurons were stimulus-selective during congruent and mismatched visuomotor feedback and visuomotor coupling led to a more decorrelated V1 network. We propose that this dynamic regulation of visual processing based on the behavioral relevance of the sensory input ultimately enhances and stabilises the representation of task-relevant features while suppressing responses to non-relevant stimuli.