Associative learning in cortical visual area MT of macaque monkeys

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Associative learning is frequently thought of as a high level process. We sought to determine whether associative learning-induced neuronal plasticity is limited to high-level visual processing stages, or whether it is a more general property that could occur also in earlier brain areas.

To achieve this goal, we trained monkeys to behaviorally associate naturally effective stimuli for neurons in area MT (translatory motions) with arbitrary non-effective stimuli (static 2D patterns). We hypothesized that learning of the behavioral association would be paralleled by the emergence of selective neuronal responses to the static stimuli. We recorded from MT neurons before training began and after training was complete to a criterion of 80% correct performance.

Before training, only 4% of the neurons showed selective responsiveness to the static stimuli. After training this percentage increased to 19%. Remarkably, the preferred static stimulus for a given neuron tended to be the one that the monkey had learned to associate with the preferred direction of motion for that neuron. This result was highly significant over the population of neurons recorded ($p<0.001$). We conclude that stimulus selectivities of many neurons in area MT, a relatively early visual processing stage, are plastic and selectively modifiable by associative learning.