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Plasticity and metaplasticity of the rat primary visual cortex

It is well established that most sensory cortices retain a significant potential for plastic reorganization. In contrast, there continues to be a controversial discussion with regard to the levels of plasticity present and expressed in the primary visual cortex (V1) of adult animals, including humans. To address this issue, we examine long-term potentiation (LTP), a classic form of activity-dependent synaptic plasticity thought to underlie receptive field plasticity and perceptual learning in cortical networks. Our experiments show that LTP can readily be induced in the fully matured V1 of rodents. However, the ability to induce LTP is dependent on local levels of neuromodulators (acetylcholine, histamine), suggesting that this form of plasticity is tightly regulated by "arousal"-related factors. More surprisingly, previous visual experience (light vs. dark exposure, visual discrimination training) exerts a profound influence on levels of LTP in V1. We argue that the mature V1 retains a significant plasticity potential, which can be expressed under the appropriate neurochemical and experiential (metaplastic) conditions. (Work supported by the Natural Sciences and Engineering Research Council of Canada.)

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