Plasticity during Motherhood: Changes in Excitatory and Inhibitory Layer 2/3 Neurons in Auditory Cortex

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Abstract:

Maternal behavior can be triggered by auditory and olfactory cues originating from the newborn. Here we report how the transition to motherhood affects excitatory and inhibitory neurons in layer 2/3 (L2/3) of the mouse primary auditory cortex. We used in vivo two-photon targeted cell-attached recording to compare the response properties of parvalbumin-expressing neurons (PVNs) and pyramidal glutamatergic neurons (PyrNs). The transition to motherhood shifts the average best frequency of PVNs to higher frequency by a full octave, with no significant effect on average best frequency of PyrNs. The presence of pup odors significantly reduced the spontaneous and evoked activity of PVN. This reduction of feedforward inhibition coincides with a complimentary increase in spontaneous and evoked activity of PyrNs. The selective shift of PVN frequency tuning should render pup odor-induced disinhibition more effective for high-frequency stimuli, such as ultrasonic vocalizations. Indeed, pup odors increased neuronal responses of PyrNs to pup ultrasonic vocalizations. We conclude that plasticity in the mothers is mediated, at least in part, via modulation of the feedforward inhibition circuitry in the auditory cortex.

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