Neural Basis for the Production of Facial Expressions

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Both human and non-human primates use facial expressions to communicate their emotions and intentions. The primate amygdala, by virtue of its vast connectivity to sensory association and prefrontal cortices, is involved in the evaluation of facial expressions made by conspecifics. Efferent projections from the amygdala, in turn, may instigate activity in a set of brain structures that culminates in the coordinated engagement of face motor nuclei producing facial expressions. These motor pathways, however, are unknown. In preliminary studies, we have used high density electrodes to record population neural activity simultaneously in the amygdala and lateral primary motor cortex while awake macaques made natural facial expressions in response to emotionally relevant stimuli. We also recorded from these structures while the monkey made voluntary facial actions, such as pursing the lips toward juice tubes or during operantly conditioned mouth opening. Thus far, we have found distinct neural states in the amygdala that precede and are linked to the production of different emotional but not voluntary facial expressions. Conversely, we observed little organized activity in face motor cortex during emotional expressions but clear-cut neural states associated with different voluntary actions. These findings (together with classical clinical observations) imply a non-cortical pathway for the production of facial expressions.