How a baby's nose knows Mom's scent

July 6 2005

For newborn mammals, including humans, identifying Mom by her odor can be critical to maternal bonding and survival. However, researchers have not understood how this odor identification develops. Now, Kevin Franks and Jeffry Isaacson of the University of California, San Diego School of Medicine report in the July 7, 2005, issue of Neuron that this process develops in basically the same way that newborns' developing visual systems learn to recognize the world. That is, during a critical early period, the infant's olfactory circuitry wires itself as a result of experiencing Mom's odor.

In their initial experiments with rat brains, the researchers identified two receptors, called AMPA receptors and NMDA receptors, as the key components of the olfactory circuitry that undergoes such early olfactory adaptation.

Such receptors are proteins embedded in the "receiving stations" of neurons and are activated by chemical signals called neurotransmitters--in this case, the neurotransmitter glutamate. Alterations in the relative numbers of such receptors "tune" neurons to be more or less likely to be triggered by neurotransmitters. Thus, such changes in networks of neurons can lay down the preferred neural pathways that constitute learning.

The researchers found in studies of rat brain tissue that as newborn rats aged, the fraction of NMDA receptors tended to go down in a brain olfactory processing region called the lateral olfactory tract. This reduction tended to activate connections among neurons in the region.

To explore whether sensory experience affected this process, the researchers plugged one nostril of newborn rats--thus depriving one side of the rat brain of olfactory input. This technique enabled them to compare, in the same animal's brain, changes in olfactory development with and without odor input.

The researchers found that during a critical period of a few weeks after birth, the olfactory-deprived side of the animals' brains showed a decrease in NMDA receptor activity compared to the spared side. This relative reduction of NMDA receptor activity caused the neurons to become more active, since AMPA receptors convert neurons to those that are more functional and less "silent."

The researchers also found evidence that the changes in the olfactory neurons during this critical period tended to render the animals' early olfactory experience more salient, reducing the significance of odors experienced later in development.

Source: Cell Press