Mouse nose nerve cells mature after birth, allowing bonding, recognition with mother

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For rodent pups, bonding with mom isn't hard-wired in the womb. It develops over the first few weeks of life, which is achieved by their maturing sense of smell, possibly allowing these mammals a survival advantage by learning to identify mother, siblings, and home.

Blending electrophysiological, biochemical, and behavioral experiments, Minghong Ma, PhD, an associate Professor of Neuroscience at the University of Pennsylvania School of Medicine, led a study published in a recent issue of the Journal of Neuroscience. With students Anderson Lee and Jiwei He, she demonstrated that neurons in the noses of mice mature after birth.

Using patch-clamping – a technique that measures electrical signals at the cellular level -- Ma's team found that between birth and day 30 of development, normal neurons become six times more sensitive to their sibling's scent, in this case, a fragrance called lyral. In addition, the mice transition from a relative indiscriminate response to different odors to being highly attuned to one specific smell. They also respond to that specific odor with a faster speed over time.

The olfactory marker protein (OMP) likely mediates this developmental maturation. In olfactory sensory neurons lacking OMPs, response fails to speed up over 30 days as compared to normal neurons. The authors suggest this could be due to altered intracellular communication, since loss of the protein is associated with decreased phosphorylation of an associated enzyme called adenylate cyclase, a key player in the chemical

signaling underlying the sense of smell.

The team also used a novel behavioral assay to illustrate one consequence of mistakes in this cellular maturation process. Normal mouse pups, given the choice between their mother and an unrelated, lactating female, will choose to huddle with or suckle their mother 78 percent of the time. But in the absence of OMP, newborn mice fail to make that distinction.

According to Ma, the maturation of olfaction in early development could offer animals that need nursing and care for a long time before maturing (altricial species, including some mammals) a survival advantage. Rather than being hard-wired at birth, Ma says, they learn to identify their surroundings and their family. "They actually learn to find their mother, home, and siblings, and to stay alive," she says. But whether the same is true of human infants, of course, remains an open question.

One key question yet to be addressed, Ma says, is the mechanism underlying this olfactory tuning process. How, for instance, do the cells develop a faster response speed? How do they get so good at focusing on just one odorant to the exclusion of all others? And can this process be modulated by early experience? The answers to those questions, she says, could possibly provide tools to influence the bonding between mother and child in early development, and even promote social interactions in autistic children.

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