MedicalXpress

Sensory experience and rest control survival of newborn neurons in adults

September 7 2011

When it comes to the circuits that make up the olfactory system, it seems that less is more. Much like the addition and elimination of extra synapses that helps fine-tune brain circuitry, the olfactory system continues to produce and remove neurons throughout life. Yet it is not entirely clear how and why some newborn neurons are preserved while others are eliminated. Now, new research published by Cell Press in the September 8 issue of the journal *Neuron* reveals that both olfactory experience during feeding and a subsequent period of rest contribute to both the likelihood that a new olfactory neuron will escape elimination and be incorporated into existing circuitry.

In mice, olfactory neurons called "granule cells" are generated and incorporated into the neuronal circuitry from birth through adulthood. About half of these neurons are integrated into existing circuitry, while the other half are eliminated through a process called apoptosis. The mechanisms that underlie the selection process are not well understood, though some clues have come from studies showing that synaptic elimination associated with memory and learning depends on the sleep-wake cycle.

A research group led by senior study author Dr. Masahiro Yamaguchi from the University of Tokyo examined whether distinct behavioral periods might also impact plasticity in the olfactory system. "We were interested in determining whether the selection of adult-born granule cells in the olfactory bulb occurs continuously throughout the day or whether it occurs in association with specific behavioral states," explains

Dr. Yamaguchi.

Using a combination of behavioral analysis and a staining technique that allowed detection of apoptotic cells, Dr. Yamaguchi and colleagues observed that extensive elimination of adult-born granule cells occurred during the period immediately after the mice had eaten, a time during which the mice engaged in typical post-meal behaviors such as rest, extended grooming, and sleep. Interestingly, when these behaviors were disrupted, apoptosis was prevented. The researchers also observed that the extent of apoptosis was regulated by prior olfactory sensory experience. Sensory deprivation (occlusion of one nostril) enhanced granule cell apoptosis specifically during the time period after feeding. The authors suggest that sensory experience thus serves to "tag" key synapses and prevent them from being eliminated during subsequent sleep.

"Our results suggest that extensive structural reorganization of the circuitry in the olfactory bulb occurs during the period after feeding and that this reorganization reflects sensory experience from the preceding waking period," concludes Dr. Yamaguchi. "Complex mechanisms of experience-dependent reorganization in the olfactory bulb will likely be revealed in the framework of two sequential behavioral periods, the waking period with olfactory behavior and the rest/sleep period that follows olfactory behavior."

Provided by Cell Press