Sense of direction may be innate

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Courtesy of Norwegian University of Science and Technology
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Are we born with a sense of direction, or is it learned? New research suggests the brain comes hard-wired with working navigational cells, or neurons.

While these neurons – head direction cells, place cells and grid cells – mature over time, they function in rodents as soon as they make their first exploratory steps outside the nest, a study suggests.

New research with baby rats suggests the brain comes hard wired with a sense of direction. (Courtesy Norwegian University of Science and Technology)

Researchers Rosamund Langston of the Norwegian University of Science and Technology and colleagues wanted to know how the brain mapped place and space when an animal navigates for the first time ever.

The group implanted miniature sensors in rat pups before their eyes had opened and before they were mobile. That enabled the researchers to record brain cell activity when the pups left the nest for the first time.

The researchers were not only able to see that the rats had working navigational neurons from the beginning, but they were also able to see the order in which the cells matured.

The first to mature were head direction cells, the group found. These neurons tell the animal which direction it is heading, and are thought to enable an internal inertia-based navigation system, like a compass. "These cells were almost adult-like right from the beginning," Langston said.

Next to mature were place cells, found in a brain structure called the hippocampus. These cells represent a specific place in the environment, and in addition provide contextual information — perhaps even a memory — that might be associated with

the place. Last to mature were grid cells, which provide the brain with a geometric coordinate system that enables the animal to figure out where it is in space and how far it has travelled, said Langston and colleagues. Grid cells essentially anchor the other cell types to the outside world so that the animal can reliably reproduce the mental map that was made last time it was there.

Baby rats open their eyes and begin exploring by about 15 days of age. At this point, researchers found direction cells were fully developed, and the rudiments of the other two cell types in place. By the time they were 30 days old, or on the threshold of rat adolescence, virtually all of the different navigational cell types had matured, according to the scientists.

Langston said the findings are a partial answer to the age-old question of whether or not you are born with the innate ability to find your way around. "It really seems that this is hard-wired," she said, "You do have a basic foundation that is there as soon as you can explore – there are strong building blocks for a system that you can use to navigate." Langston said experience could also play a role, which makes this topic an important theme for further research.

The researchers found no difference in navigational skills between male and female rat pups, suggesting both sexes have the same building blocks with which to construct representations of space. Perhaps the age-old question of whether males or females have a better sense of direction could be a case of how we choose to build our map, rather than the materials we start with, Langston said.