


 SPATIAL AWARENESS

## In space and time



PHOTODISC

Place cells in the hippocampus and directional and grid cells in the entorhinal cortex contribute to the cognitive representation of space in adult rats. Two independent

studies have now shown that the basic characteristics of these three cell types are present when rat pups first start to navigate outside their nests, and that each cell type has a different rate of maturation.

Using head-mounted microdrives, the authors of both studies investigated cells in hippocampal area CA1 and in the entorhinal cortex in freely behaving young rats. Cells were categorized according to their specific spatial firing characteristics, allowing the authors to monitor the proportion of different cell types as well as their state of maturation.

In both studies, the authors found that directional cells at postnatal days 15 or 16 (P15/P16) were comparable to those in adult rats in terms of the number of cells and their firing characteristics. At P15/P16 there was also a substantial number of place cells with adult-like firing stability, and this number increased over the subsequent 10 days as their firing characteristics became more adult-like. Grid cells showed only immature firing patterns at P15/P16, and both papers report the first occurrence of more-refined, adult-like firing patterns at P19/P20. Grid cell numbers reached adult levels

during the next few days and the cells exhibited adult-like quality of spatial encoding shortly afterwards. These results show that the maturation of the three cell types occurs at different rates during development.

These studies indicate that the development of place and directional systems relies on the interaction of innate and experimentally acquired knowledge, as the cells themselves and some of their mature characteristics are present even before the young rats start to explore their environment. Age is thought to be the main factor that further contributes to the development and maturation of these cells. The presence of mature directional cells at the onset of behavioural exploration raises the possibility that such directional signals might be important for the generation of networks for place and grid representation.

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**ORIGINAL RESEARCH PAPERS** Wills, T. J., Cacucci, F., Burgess, N. & O'Keefe, J. Development of the hippocampal cognitive map in preweanling rats. *Science* **328**, 1573–1576 (2010) | Langston, R. F. et al. Development of the spatial representation system in the rat. *Science* **328**, 1576–1580 (2010)