# Distance coding in entorhinal grid cells

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**Résumé**

Entorhinal grid cells are spatially selective neurons whose firing fields form a regular triangular pattern across an environment. This activity has been suggested to form a euclidian map-like representation of the rat's location and orientation based on movement-related information. To examine whether changes in the exploratory pattern would affect grid cell firing properties, we recorded grid cell activity while the animals explored different environments: an open arena (150 cm in diameter) and a circular track (CT, same diameter), both in light and in darkness. We then compared the firing properties (interfield distance and field stability) of the same grid cells recorded in the two environments. The results show that the firing spots of grid cells adapt to CT geometry where they tend to be organized in a linear way. This novel regular pattern is stable in both light and dark conditions. The interfield distance in the CT tends to increase by a factor that reflects the expansion of the distance between places in the CT compared to the arena. Taken together, the results suggest a potential role of grid cells in estimating the distance travelled by the animals rather than the absolute distance between places.
To confirm this hypothesis, we design a behavioral protocol to test capacities of rats to travel three precise distances on a linear track (30 centimeters, 60 cm and 90 cm). Each session, rats need to cross and turn back on one of the three distances for a reward. We analyze performance of three groups of rats: a sham group, a medial entorhinal cortex (MEC) lesions group and a hippocampus lesions group. First we observe that rats were more difficult to estimate the large distance (90 cm) than small distance (30 cm). This is consistent with the idea that estimating a path longer and longer is subject to error accumulation.

Finally, data show that sham and hippocampus groups have the same performance for estimating distance, while MEC group presents a significant impairment for estimating 60 cm and 90 cm distances.
We confirmed, by this behavioral experiment, that the medial entorhinal cortex is crucial for rats to estimate distance.

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