Effect of environmental complexity on the role of medial and lateral entorhinal cortex in spatial and non-spatial information processing in rats

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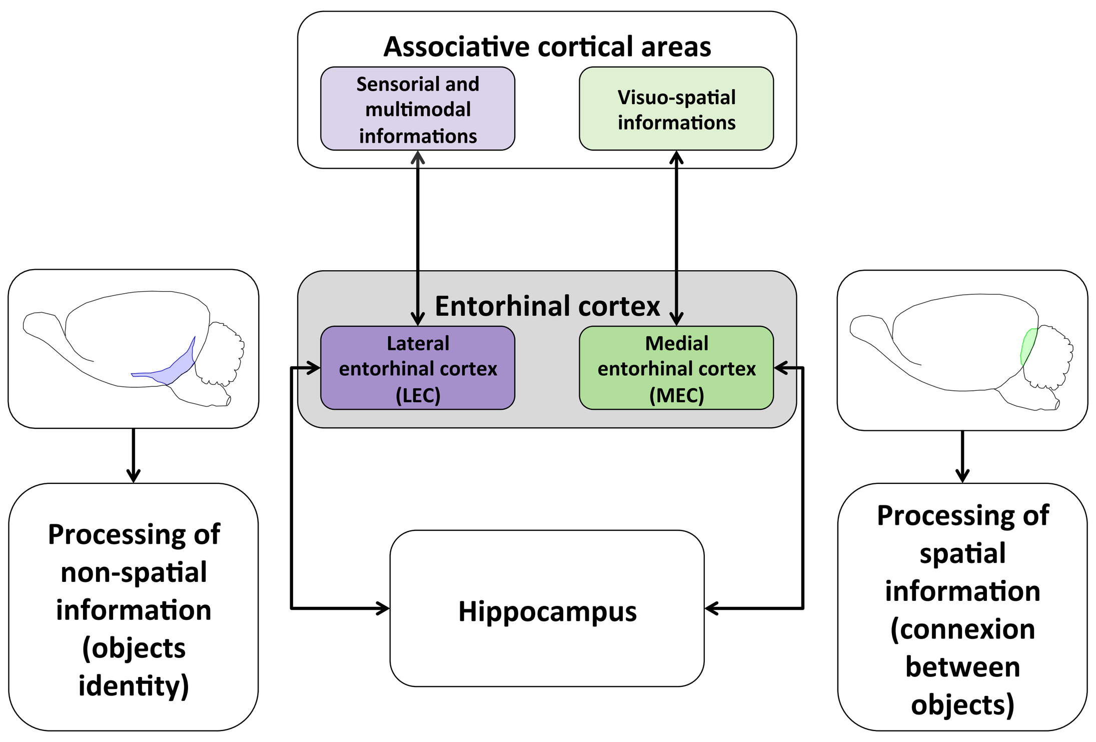
Introduction



Neuroanatomical and electrophysiological data suggest that the medial entorhinal cortex (MEC) is involved in the processing of spatial information, whereas the lateral entorhinal cortex (LEC) is involved in the processing of non-spatial information.

Recent studies have suggested that such functional dissociation is not so well-established. In particular, LEC lesion has been found to impair both spatial and non-spatial information processing.

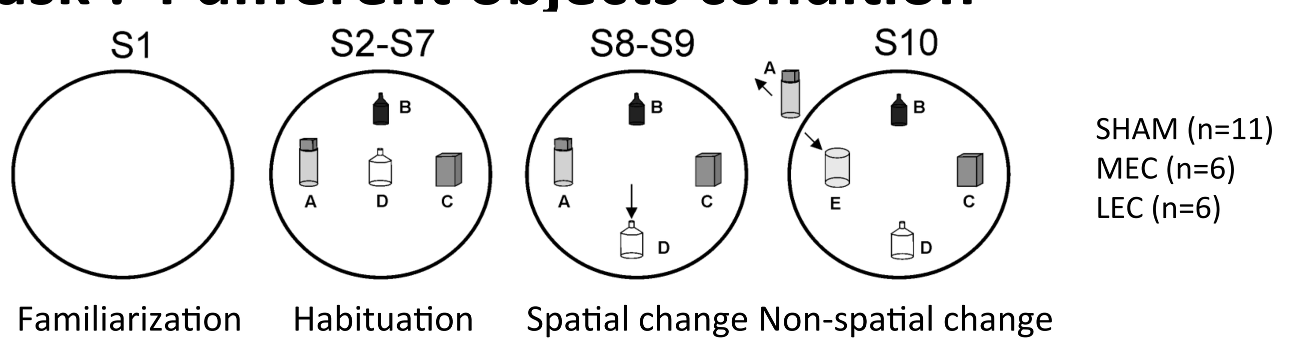
We hypothesized that the function of the MEC and the LEC in the processing of spatial and non-spatial information is dependent on the complexity of the information to be processed.

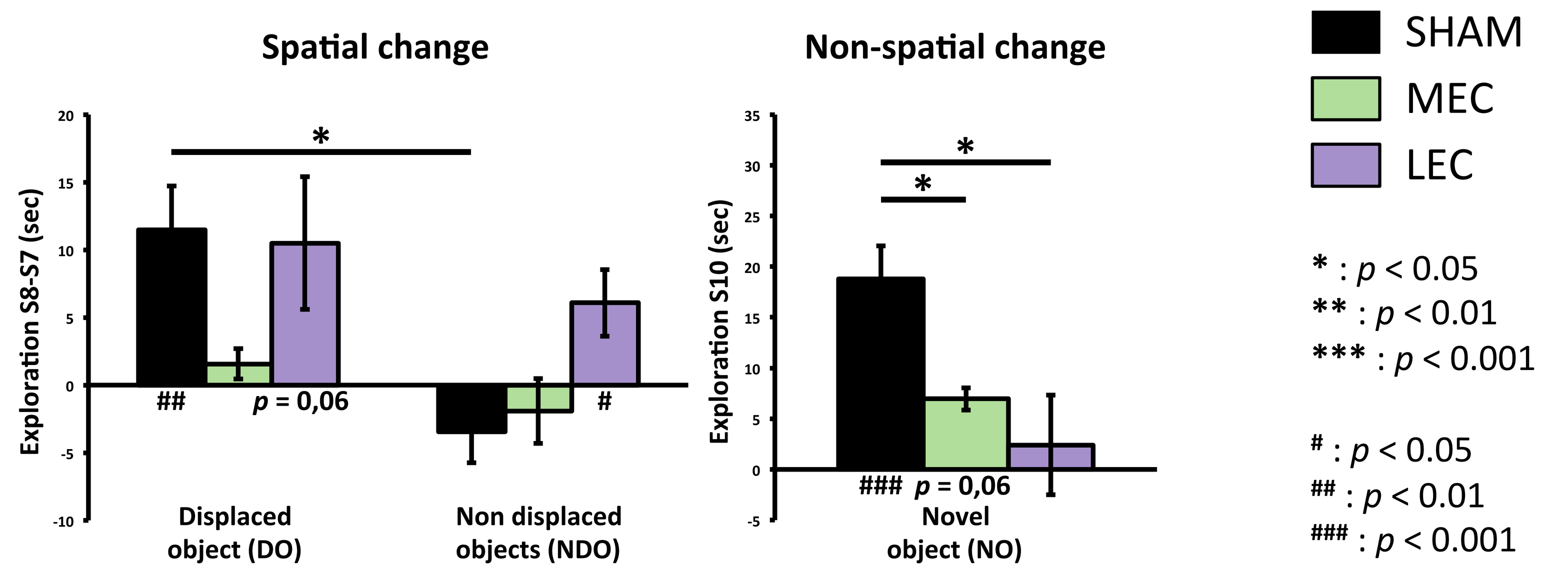
Methods

- Surgery : SHAM animals (n=12) & NMDA lesions of MEC (n = 8) and LEC (n = 8).
- Behavioral paradigm : object exploration task, three conditions (three different objects or four identical objects or four different objects). Rats are submitted to ten (S1-S10) successive 4-min exploration sessions in a circular arena containing objects. Following habituation (S2 to S7) their ability to detect a **spatial change** (S8 : an object is moved to a new location) and **non-spatial change** (S10 : a familiar object is replaced by a novel object) in the configuration of objects is tested. An increase in exploration directed toward the change would indicate that the animal is able to process spatial and non-spatial information. This was measured by calculating exploration indexes : **displaced (and non displaced) objects in S8-S7** and **novel object - familiar objects in S10**.
- Measured variables : exploration duration of each object. All animals are sumitted to the three experimental conditions.
- Statistical analysis : spatial change : two-way ANOVA + Newman Keuls *post hoc* tests (*), non-spatial change : one-way ANOVA + Newman Keuls *post hoc* tests (*) & one sample t-test to compare the means to 0 (no detection of the change) (#).

Results

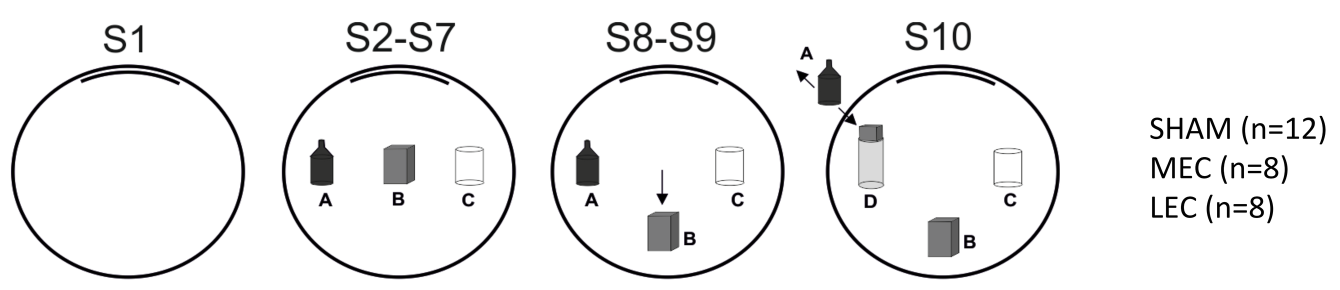
Basic task : 4 different objects condition

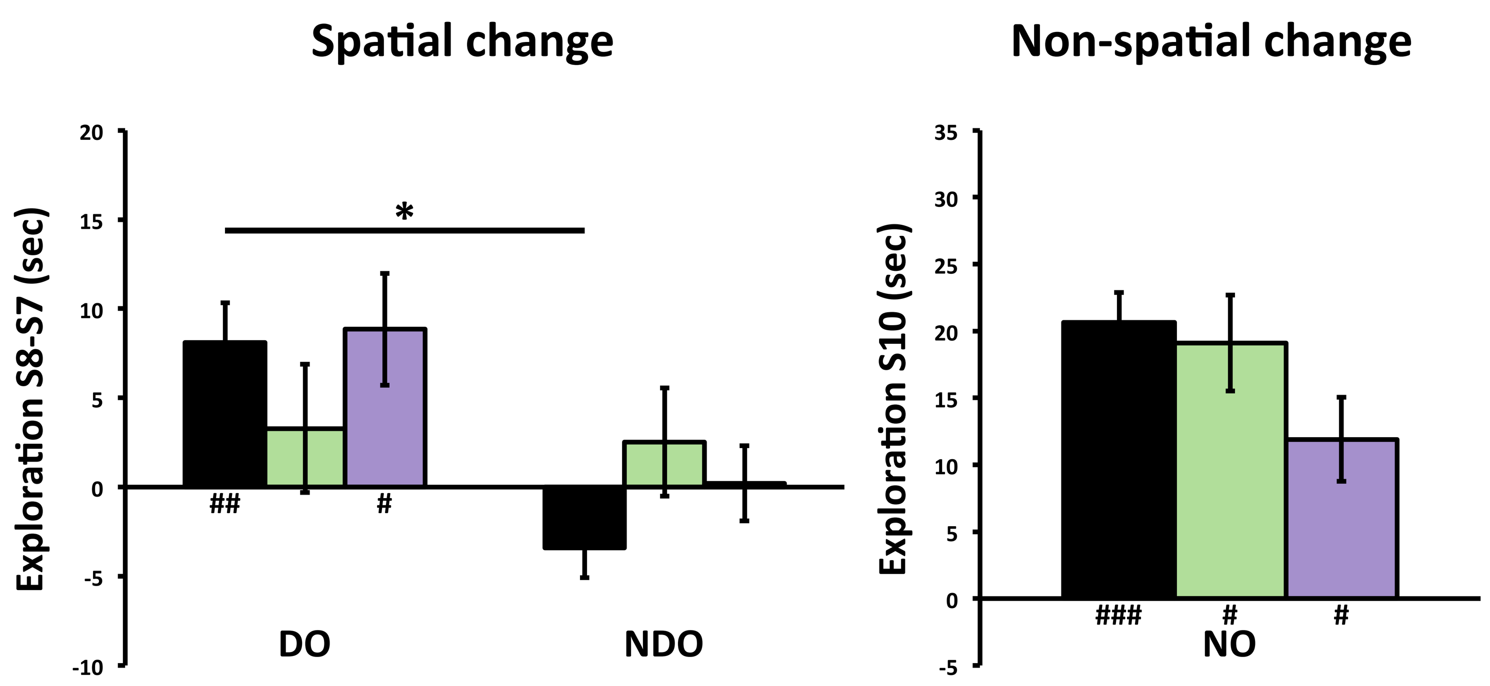




- **Spatial change : MEC rats did not detect the change. LEC rats detected the change but re-explored all the objects.**
- **Non-spatial-change : MEC rats detected the change but to a lesser extent than SHAM rats. LEC rats were impaired.**

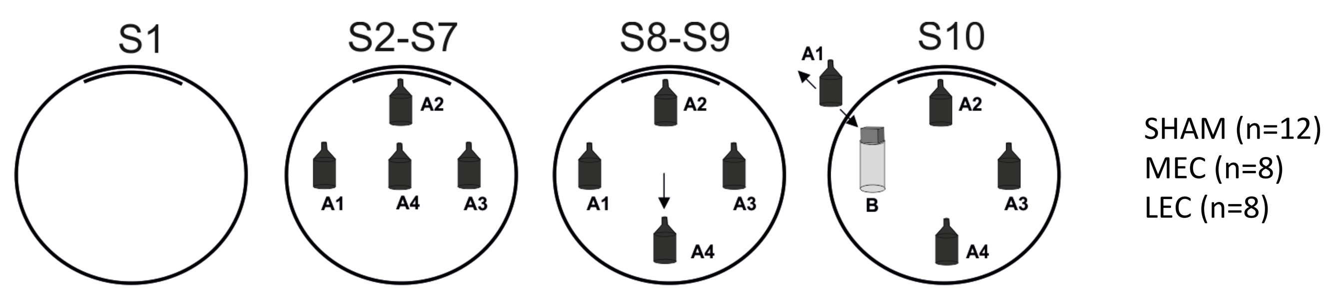
3 different objects condition

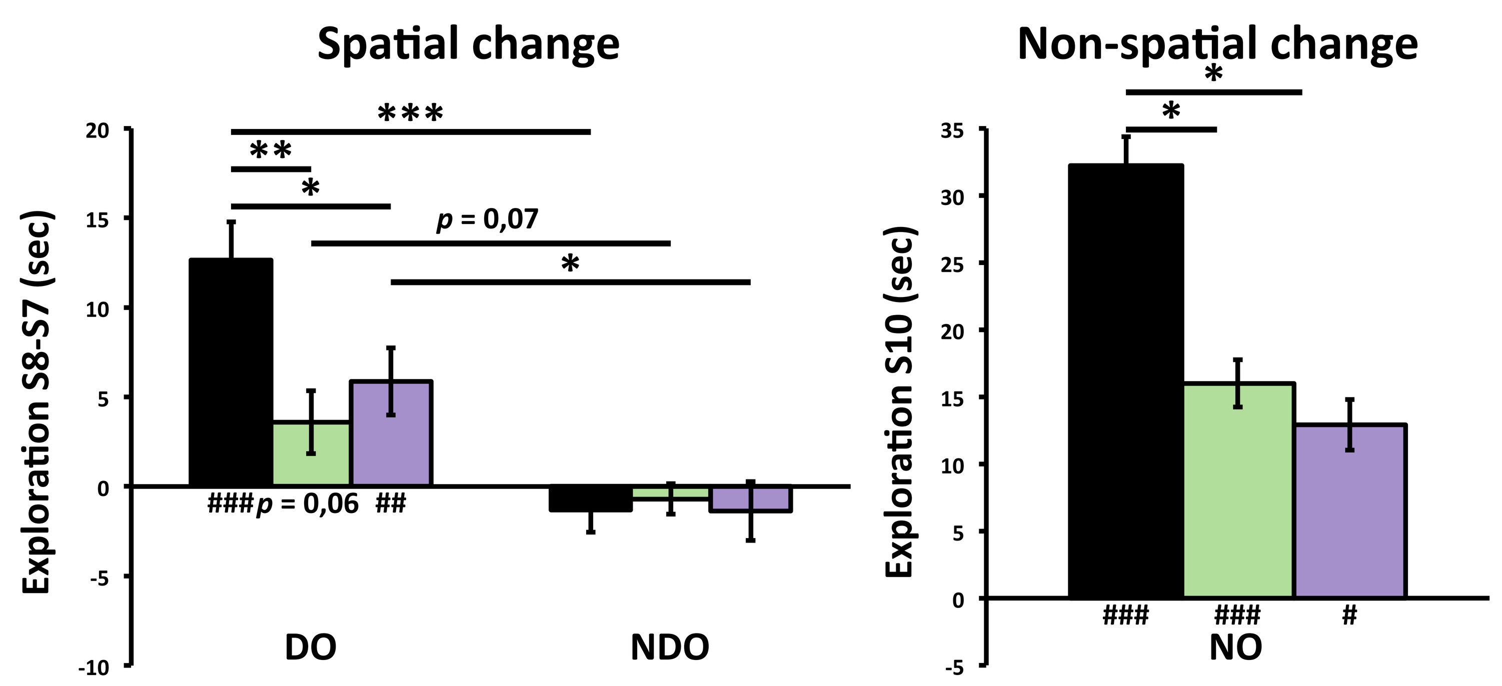




- **Spatial change : MEC rats did not detect the change. LEC rats detected the change but to a lesser extent than SHAM rats.**
- **Non-spatial change : MEC & LEC rats were able to detect the change.**

4 identical objects condition



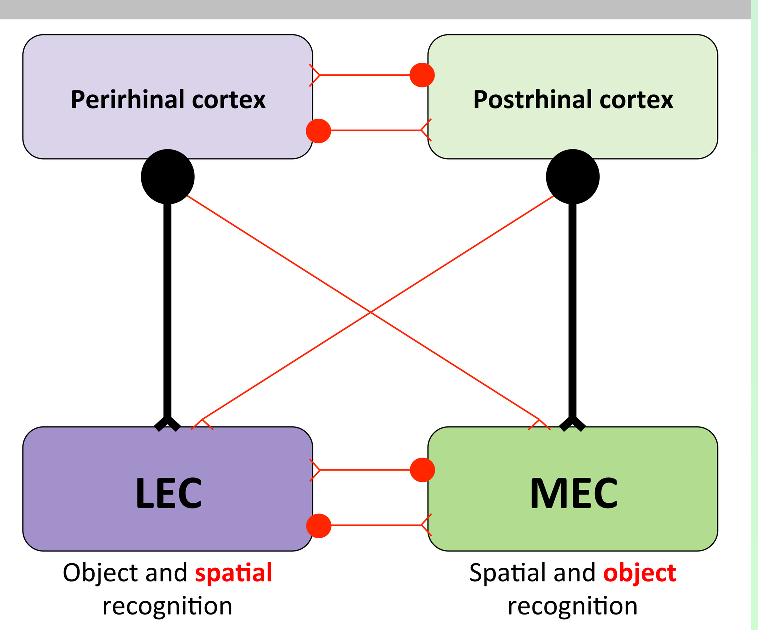


- **Spatial change : MEC & LEC rats detected the change but to a lesser extent than SHAM rats.**
- **Non-spatial change : MEC & LEC rats detected the change but to a lesser extent than SHAM rats.**

Conclusion

The results show that 1) **SHAM rats** were able to process both spatial and non-spatial information in the 3 tasks, 2) **MEC rats** were impaired in spatial processing when objects are distinct (3 or 4 objects) but not when objects are identical. They were able to process non-spatial information in the 3 tasks, and 3) **LEC rats** were impaired to process non-spatial information in the most complex condition (4 distinct objects) but not in simpler ones (3 distinct objects or 4 identical objects). They showed moderate deficit in spatial information processing when the objects were different (3 or 4 objects). Overall the results indicate an interaction between spatial and non-spatial processing in both MEC and LEC.

These results indicate that the **role of the MEC and LEC both depends on the complexity of information** to be processed. They suggest that these **two regions interact for combining spatial and non-spatial information**, a fundamental step for the formation of "episodic-like" memory.



Functionnal interaction