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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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. However 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. Here we hypothesized that the function of the MEC and the LEC in the processing of spatial and non-spatial information is dependent of the complexity of the information to be processed. Rats with MEC or LEC NMDA lesions were submitted to 3 object exploration tasks in which they were allowed to freely explore a configuration of objects. Their ability to detect a spatial (displacement of an object) and a non-spatial (replacement of an object) change was measured. What differed across tasks was the complexity of the object configuration in terms of number (4 vs.3) and identity (identical vs. distinct) of objects. Thus, rats were exposed to a complex configuration, 4 distinct objects, and two simpler configurations, 4 identical objects, and 3 distinct objects.
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.