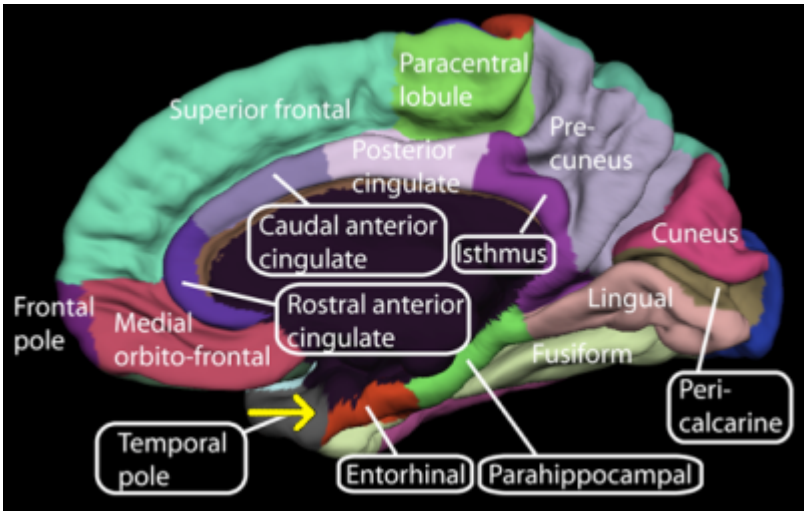
Entorhinal cortex



The entorhinal cortex (EC) (ento = interior, rhino = nose, entorhinal = interior to the rhinal sulcus) is an area located in the medial temporal lobe and functioning as a hub in a widespread network for memory and navigation. The EC is the main interface between the hippocampus and neocortex. The EC-hippocampus system plays an important role in declarative (autobiographical/episodic/semantic) memories and in particular spatial memories including memory formation, memory consolidation, and memory optimization in sleep. The EC is also responsible for the pre-processing (familiarity) of the input signals in the reflex nictitating membrane response of classical trace conditioning, the association of impulses from the eye and the ear occurs in the entorhinal cortex.

The perforant pathway projection from layer II of the entorhinal cortex to the hippocampal dentate gyrus is especially important for long term memory formation, and is preferentially vulnerable to developing a degenerative tauopathy early in Alzheimer disease (AD) that may spread over time trans-synaptically.

The hippocampus and entorhinal cortex (EC), the earliest affected areas, are considered relative to early memory loss in Alzheimer's disease (AD). The hippocampus is composed of heterogeneous subfields that are affected in a different order and varying degrees during Alzheimer's disease pathogenesis. Gao et al. conducted a comprehensive proteomics analysis of the hippocampal subfields and EC region in human postmortem specimens obtained from the Chinese human brain bank. Bioinformatics analysis identified region-consistent differentially expressed proteins (DEPs) which associated with astrocytes, and region-specific DEPs which associated with oligodendrocytes and the myelin sheath. Further analysis illuminated that the region-consistent DEPs functioned as connection of region-specific DEPs. Moreover, in region-consistent DEPs, the expression level of S100A10, a marker of protective astrocytes, was increased in both aging and AD patients. Immunohistochemical analysis confirmed an increase in the number of S100A10-positive astrocytes in all hippocampal subfields and the EC region of AD patients. Dual immunofluorescence results further showed that S100A10-positive astrocytes contained apoptotic neuron debris in AD patients, suggesting that S100A10-positive astrocytes may protect brain through phagocytosis of neuronal apoptosis. In region-specific DEPs, the proteome showed a specific reduction of oligodendrocytes and myelin markers in CA1, CA3, and EC regions of AD patients. Immunohistochemical analysis confirmed the loss of myelin in EC region. Above all, these results highlight the role of the glial cells in AD and provide new insights into the pathogenesis of AD and potential therapeutic strategies [1].

A study showed that DBS in the entorhinal region improved the accuracy of human spatial memory.

Based on this line of work, Jacobs et al performed a series of experiments to more fully characterize the effects of DBS in the medial temporal lobe on human memory. Neurosurgical patients with implanted electrodes performed spatial and verbal-episodic memory tasks. During the encoding periods of both tasks, subjects received Electrostimulation at 50 Hz. In contrast to earlier work, Electrostimulation impaired memory performance significantly in both spatial and verbal tasks. Stimulation in both the entorhinal region and hippocampus caused decreased memory performance. These findings indicate that the entorhinal region and hippocampus are causally involved in human memory and suggest that refined methods are needed to use DBS in these regions to improve memory [2].

1)
Gao Y, Liu J, Wang J, Liu Y, Zeng LH, Ge W, Ma C. Proteomic analysis of human hippocampal subfields provides new insights into the pathogenesis of Alzheimer's disease and the role of glial cells. Brain Pathol. 2022 Jan 11:e13047. doi: 10.1111/bpa.13047. Epub ahead of print. PMID: 35016256.
2)
Jacobs J, Miller J, Lee SA, Coffey T, Watrous AJ, Sperling MR, Sharan A, Worrell G, Berry B, Lega B, Jobst BC, Davis K, Gross RE, Sheth SA, Ezzyat Y, Das SR, Stein J, Gorniak R, Kahana MJ, Rizzuto DS. Direct Electrostimulation of the Human Entorhinal Region and Hippocampus Impairs Memory. Neuron. 2016 Dec 7;92(5):983-990. doi: 10.1016/j.neuron.2016.10.062. PubMed PMID: 27930911.