Representation of movement direction in the human entorhinal cortex

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Our work examines the neuronal correlates of human route navigation. We recorded single-neuron activity from epilepsy patients while they played Yellow Cab, a spatial-navigation video game [1]. In this variant of Yellow Cab, subjects used a joystick to drive between randomly selected stores arranged on the outside of a square track (Figure 1A). The center of this track was closed, limiting movement to either clockwise or counterclockwise directions. We compared the activity of each neuron with the subject’s spatial location and direction of movement in the virtual environment. This analysis identified a set of neurons in the entorhinal cortex (EC) that were preferentially active during either clockwise or counterclockwise movement. For example, Figure 1B shows the activity of a “counterclockwise cell” that had a greater firing rate when the subject was driving in a counterclockwise direction than when they were driving in a clockwise direction. This direction-dependence was present during both turning and straight movement. These findings indicate that the EC is part of the neural representation of movement direction, and support the idea that the EC plays a general role in cognition by representing contextual feature information [2].

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References


Figure 1: A. Overhead view of the virtual square-track environment that the subject navigates in Yellow Cab. B. The activity of a neuron from entorhinal cortex that was preferentially active during counterclockwise (CCW) movement compared with clockwise (CW) movement.