THE HIPPOCAMPAL PLACE CELL RATE CODE SIGNALS "HERE" BUT NOT "THERE"

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Navigation is a process by which a subject plans an efficient way from the current position ("Here") to an unmarked place ("There") and the hippocampus is a necessary part of the neural system that allows rodents to navigate to unmarked goals in open spaces. A strong indication of the hippocampal participation in navigation is that it has place cells. These are hippocampal principal neurons that discharge in "firing-fields", cell-specific regions of the space in which the animal is located. It has been repeatedly demonstrated that an across-cell pattern of place cell firing rates is capable of encoding the rat's current position and that changes in place cell firing correlate with changes in the environment's spatial information and the rat's associated spatial behavior. This report describes some of the effort to better specify the role of place cells in navigation.

If the place cell representation of space is used to navigate then there should be a place cell firing correlate of navigation, and specifically, one might expect to see discharge that is associated with both the current position ("Here") and where the rat is going, the navigation goal ("There"). This study was designed to determine whether, in addition to signaling "Here", the discharge of place cells also encoded "There". CA1 place cells were recorded while rats performed a task in which searching for randomly scattered food alternated with navigation to an unmarked goal in the same environment. It was found that place cell discharge was unchanged when the navigation goal was changed. Discharge during goal-directed navigation signaled the rat's current position but not the goal or where the animal was going. Discharge was also compared during the episodes of undirected searching that alternated with goal-directed navigation. Although there was no change in where the cells fired, the location-specific firing was faster and more reliable while the rat was going to the goal compared to during undirected searching. The data indicate that during navigation, the CA1 place cell representation signals "Here" but not "There". One may conclude first, that the output of the hippocampus generates a stronger and more reliable rate-encoded signal of current position during target-directed navigation. Second, that to navigate, i.e. to calculate paths between "Here" and "There", the hippocampal firing rate code for place must be used along with a different spatial representation of "There".

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