# Egocentric coding unveiled: Researchers unlock the brain's spatial perception mechanisms

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Credit: Human Brain Project

Researchers from the Shenzhen Institute of Advanced Technology and their collaborators have uncovered the coding principle underlying self-centered (egocentric) representation in spatial perception.

Our understanding of the intricate spatial perception mechanisms in the human brain has recently advanced with the discovery that self-centered perception of external items is closely integrated with our world-centered understanding of the world, which is the brain's internal "GPS" system. Given the vast number of items surrounding us, how the brain codes these diverse items has been a mystery.

The encoding of external objects based on an egocentric (subjective perspective) frame of reference is crucial for navigation. Well-known place cells, grid cells, and head direction cells encode from a world-centered (allocentric) perspective, defining location and direction based on a behavioral arena-defined frame of reference.

But allocentric coding is built upon the computation and transformation of egocentric representation. Studies have been done on egocentric representation in brain regions, such as the retrosplenial cortex—a brain area central to navigation and memory. However, scientists have not clearly understood how egocentric encoding processes different objects in the same or different scenes.

The researchers employed in vivo two-photon microscopy during an open-field navigation task to investigate the egocentric representation of environmental boundaries in spines and dendrites whose activity patterns reflect the functional properties of presynaptic and postsynaptic sides, respectively. They published their findings in *Neuron*.

The results revealed functional clustering in dendrites with significant egocentric tuning, suggesting the existence of specialized channels for processing egocentric information about boundaries, likely through egocentric boundary cells.

To examine if these cells also represent other items in different contexts, the researchers compared the egocentric representation of multiple items

during two pairs of tasks: an open-field task paired with a virtual reality task. They found that the boundary-representing cells are largely independent of the visual landmark-representing cells.

This study also contributes to the understanding of Alzheimer's disease, a neurodegenerative disease. The retrosplenial cortex, a key area in this study, is known to be affected in Alzheimer's disease, impairing patients' navigation abilities.

The findings of this study not only enhance our knowledge of spatial perception but also offer insights into the potential neural mechanisms underlying the deterioration of spatial perception in pathological conditions.

**More information:** Egocentric processing of items in spines, dendrites, and somas in the retrosplenial cortex, *Neuron* (2023). DOI: 10.1016/j.neuron.2023.11.018.
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