Probing the Neural Representation of Space by Training Recurrent Neural Networks to Perform Spatial Localization

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Presentation Abstract Summary It has been well-established that rodent's Entorhinal Cortex (EC) contains a rich set of spatial correlates which are essential for spatial navigation, including grid cells which encode space using tessellating patterns. Although intensely investigated, the mechanisms and functional significance of these spatial representations remain largely mysterious. As a new way to address these questions, we trained recurrent neural networks (RNN) to perform navigation tasks in 2-d arenas based on velocity inputs. Surprisingly, we find that grid-like spatial response patterns emerge in trained networks, along with units that exhibit other spatial correlates, e.g., border cells and band-like cells. All these different functional types of neurons have been observed experimentally. Our results suggest that grid cells, border cells and others as observed in EC may be a natural solution for representing space efficiently given the predominant recurrent connections in the neural circuits.

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