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Kathryn R. Hedrick* (khedrick@jhu.edu) and **Kechen Zhang**. *Megamap: Continuous Attractor in a Network of Place Cells Representing a Large Region*.

The brain stores a cognitive map of a spatial region through the activity of specialized cells called place cells. According to the traditional theory, each place cell fires within a single subregion, known as the cell's place field, and the network of place cells forms a continuous attractor by modifying the strength of connections among cells. We extend this theory by proposing that the hippocampus stores a megamap, or a continuous attractor representing a large region, in which each cell may have multiple, irregularly spaced place fields. We first show that the system can stably represent a large region by setting the connections optimally such that the expected attractor states are fixed points of the dynamical system governing cellular activity. Through numerical simulations and perturbation analysis, we then examine the computational properties that emerge as the represented region becomes sufficiently large. We demonstrate that the system transitions to a combinatorial mode in which spurious attractor states reflect environmental changes by combining previously stored memories. Consequently, the megamap extends the size of the region a place cell network can represent while uniting stability and flexibility as two fundamental properties of hippocampal networks. (Received January 25, 2014)