A COMPUTATIONAL MODEL FOR PREPLAY IN THE HIPPOCAMPUS

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During offline states hippocampal place cells are activated in a sequence that strongly correlates with the sequence of their place fields recorded on a preceding run. Recently, Dragoi and Tonegawa observed that the sequence of offline activity is correlated with the order of place fields in novel environments experienced only later [1]. This preplay phenomenon suggests that the sequential activity is generated intrinsically in the hippocampal network, rather than imprinted in the network by sensory inputs. It was shown previously that continuous attractor networks with asymmetric pattern of connectivity, or with slow, local negative feedback, can generate sequential activity [2,3]. This mechanism could account for preplay if the network only represented a single spatial map. However, the global remapping observed in the hippocampus implies that multiple spatial maps are represented in the hippocampal network and it remains unclear how the intrinsically generated sequences come to be correlated with the order of place fields in a spatial map that emerges only later. We propose that the hippocampus can store only a relatively small number of spatial maps, lest the maps would strongly interfere with each other, and show that a computational model can account for preplay. We combine the model mentioned above with the multiple chart idea of [4]. This combined model generates sequences that are consistent with the order of place fields in one map, but not with any other. Driven with random inputs the model generates sequences in every map. The network simulations show that the number of maps is small, one of which is re-used to represent the novel environment. As a result, we found some of the previously generated sequences to be correlated with the order of place fields in the novel environment.

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