Neural network oscillations: a bridge between nerve cells and cognition?

Brains oscillate. Rhythmic neuronal activity can be easily recorded from the human scalp and the waveform of such EEG (electroencephalogram) signals varies with different cognitive states. Many brain areas in different species show similar oscillations which cover a wide range of frequencies and spatial extensions. At the cellular level, the activity is based on synchronized oscillations of the electrical membrane potential of neurons which are functionally coupled by chemical or electrical synapses. The state-dependence of neuronal network oscillations has given rise to the hypothesis that these co-ordinated patterns of activity are involved in information processing in the nervous system.

One example of neuronal network oscillations are "ripples", i.e. short bursts of activity at ~200 Hz which occur in the temporal lobe of humans and rodents during rest or sleep. It has been proposed that ripples are involved in the transition of memories from short-term storage to permanent engrams. The oscillation represents a general "clock" which allows encoding information in the timing of individual neuron’s activity relative to this clock. At present, neuroscientists begin to understand how such highly precise oscillations can arise in neuronal assemblies and how they might contribute to the representation and storage of information. Therefore, neuronal network oscillations may be one of the understandable links between cognitive functions (memory formation) and neuronal activity (ripple oscillations).

Further reading:


Wilson MA, McNaughton BL (1994) Reactivation of hippocampal ensemble memories during sleep. Science 265, 676-679. First evidence that neuronal activity patterns are aquired during exploration of a new environment and are re-played during sleep (for memory consolidation?).
