PART FOUR

DYNAMICS OF COGNITION

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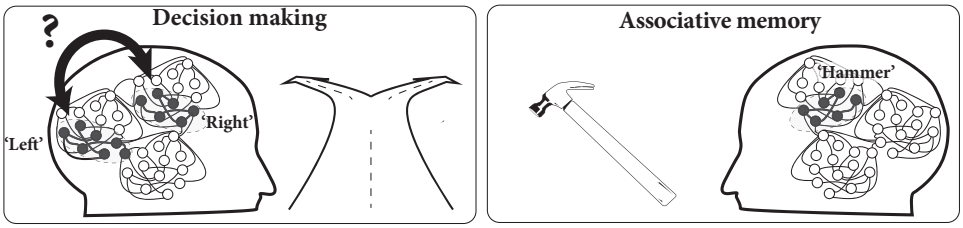

Cognitive science is an academic field of research with its own questions, paradigms, and models. The aim of Part IV is not to review the field of cognitive science, but rather to show by way of four examples how models of neuronal activity can be linked to fundamental questions of cognition. To do so, we use the population rate equations resulting from the mathematical developments of Part III and apply them to questions of cognition.

In Chapter 16 we describe the process of decision making using a network of interacting neurons. Different neuronal populations, each one representing a different option, compete with each other. The population with the highest activity eventually wins the competition, suppresses the others, and determines the choice. The dynamics of decision making can be visualized as a ball rolling down on one side rather than the other side of a hill.

Humans keep memories of important events of their life and can recall these events if they receive appropriate cues or questions. Similarly, humans remember objects and tools, such as a hammer, and can recognize these from noisy images. In Chapter 17, we describe the recall of previously stored items using a model of associative memory. In this model, neuronal assemblies of strongly connected neurons play an important role.

Human visual perception does not give rise to a precise photographic image of the environment, but interprets and reconstructs the outside world based on the raw retinal image. Many models of the visual cortex are formulated as field models, which are reviewed in Chapter 18 and discussed in relation to common visual illusions.

Finally, strong brain oscillations are related to many severe brain diseases. Understanding the mechanisms that would allow suppression of brain oscillations could eventually help patients, as discussed in Chapter 20.

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