

## 1. Introduction: What is Philosophy of Neuroscience?

The term *neuroscience* designates an interdisciplinary scientific inquiry directed at neural processes. We commonly identify these processes with the brain, but in fact neurons are distributed throughout animal bodies (we have over 500 million neurons in our guts, constituting what is referred to as the *enteric nervous system*). The reason neuroscience is interdisciplinary is that the research techniques of multiple different disciplines are required to understand neural processes. Most obvious are anatomy and physiology, which address the structure and operation of neurons and the larger structures built out of them. Genetics has proven extremely important both for characterizing neural processes but also for intervening on them, as is required in any experimental study. Often, given the complexity of neural processes, it is helpful to model them computationally, making computer science an important contributor. One of the reasons neural processes have drawn so much interest is their role in behavior and cognitive function; accordingly, psychology and cognitive science are important contributors to neuroscience.

What motivates philosophers to examine neuroscience? There are a variety of motives. One is the thought that knowing about the brain tells us important things about ourselves that are relevant to other philosophical inquiries about topics such as whether human action is free, whether we can know our world, and what is it to be conscious. This pursuit often goes by the name *neurophilosophy*, a term introduced by P. S. Churchland (1986). We will take up some questions of neurophilosophy, especially the last section. A second motive is to apply philosophical methods to problems in neuroscience. Philosophers often have skills that enable them to generate hypotheses, integrate different findings, clarify concepts in ways useful to neuroscience. This pursuit might best be termed *philosophy in neuroscience* (the distinction between philosophy of and philosophy in was developed by Brook in the context of cognitive science; see Brook, 2009). In sections 9 and 10 we engage in philosophy in neuroscience. Our primary focus will be on a third approach that investigates how neuroscience functions as a science: what methods are employed? what organisms are studied? what does a neuroscientific explanation look like? Since these are philosophy of science questions about neuroscience, this approach is best labeled *philosophy of neuroscience*.

Since neuroscience constitutes the subject matter of our inquiry, we will at various points present some of the knowledge developed in neuroscience. Thus, in section 2 we introduce neurons and neural processes and in section 5 we offer four vignettes of what neuroscience has learned about basic mental processes: situating ourselves in time and space, seeing the world, and making decisions. We will appeal back to the content of these sections as examples in later sections. In sections 3 and 4 we address fundamental issues about how neuroscientists gain knowledge: how they study neural processes and whose neural processes they study. A major aim of the neuroscientists is to offer explanations for behavior and cognition, and section 6 will offer accounts of what explanation entails. Sections 7 and 8 focus on more specialized issues about neuroscience explanations: the levels at which explanations are offered and whether explanations should attribute representations to neural processes.

Both in neuroscience and in philosophy it has been common to adopt a cortico-centric view of the brain, but in fact there is extensive research in neuroscience on subcortical areas. Subcortical processing is extremely important in determining how we behave. This is significant since cortical areas constitute a different type of neural processing system than subcortical areas and, in section 9, we focus on what is distinctive about the neocortex in particular. We then turn to the question of how the whole brain is organized. It is often viewed as organized as a hierarchy with the neocortex at the top, and indeed one part of the neocortex, the prefrontal region, at the very top, operating as a central executive. In section 10 we contrast this with a heterarchical perspective that views neural processes as organized in an interactive network, with different regions exercising control over different aspects of behavior and cognition. Finally, in section 11 we pull from various topics addressed in earlier sections to address the neurophilosophical question of what neuroscience has to teach us about ourselves as agents in the world.