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Acquiring an image of the brain is difficult, particularly in a living subject, since the brain itself is made up of soft tissues but is surrounded by a hard casing—the skull. Magnetic resonance imaging (MRI) is a very powerful and versatile method, with the ability to safely and noninvasively measure a wide range of properties within the living brain. MRI is able to capture images that provide information about gross anatomy, neuronal activity, connectivity, pathologies, and more. As a single imaging device, it is far more flexible than any of the alternatives—such as positron emission tomography (PET), computed tomography (X-ray/CT), ultrasound, electroencephalography (EEG), and magnetoencephalography (MEG)—although each method still has its own specific strengths and weaknesses. In fact, combining methods can be even better (see section 2.7).

The great flexibility of MRI is due to the fact that there are many ways in which it can be used to manipulate and measure signals from the tissues of the brain (or of other body parts or objects placed in the scanner). As a consequence, there are many choices to be made in the setup of the MRI scanner—and also many different types of image that can be acquired. This means that a large number of different methods are available to analyze MRI data and, as a researcher in neuroimaging, you will need to know how to make the appropriate choices. When acquiring data, there are often other experts on hand (radiographers, physicists, etc.) to help you with acquisition decisions; however, it is less common to have experts on hand to help specifically with your analysis, and so you need to be more self-sufficient. The aim of this primer series is to explain how you can make the right choices when analyzing MRI data.

In this primer we will mainly describe human *in vivo* neuroimaging using MRI, although a lot of the material also applies to postmortem imaging or to the imaging of other species. In addition, we will discuss clinical research methods along with basic neuroscience, but will only occasionally touch on things related to clinical practice. Diagnostic radiology, which largely involves structural MRI, is beyond the scope of these primers and we refer the interested reader to the many excellent textbooks on diagnostic radiology and clinical brain imaging.

To begin with, the rest of this chapter will provide a very broad introduction to MRI-based neuroimaging research. This starts with a general overview of some common types of images