4 Combining MRI & TMS

MRI and TMS have both immense potential in the field of neuroscience. While structural and functional MRI allow for mapping cognitive functions to spatial and temporal features of brain activation, TMS holds the potential to infer on causal relationships between brain areas and cognitive functions (see section 2.7.2). In this chapter, we will examine the combination of both techniques and show how they can support each other based on their respective advantages in order to advance the field of cognitive and clinical neuroscience.

4.1 MRI before, after and during TMS

Magnetic resonance imaging complements TMS in different ways (Figure 15).

(1) Anatomical images acquired *before TMS* can be fed into the neuronavigation software to define the actual stimulation site.

(2) fMRI acquired *before TMS* allows for functional definition of a stimulation target.

(3) Offline imaging (e.g. fMRI during task or in resting-state) allows for evaluating long-term effects *after TMS*.

(4) Finally, fMRI *during TMS*, i.e. concurrent TMS/fMRI, allows for the direct observation of TMS-induced effects.

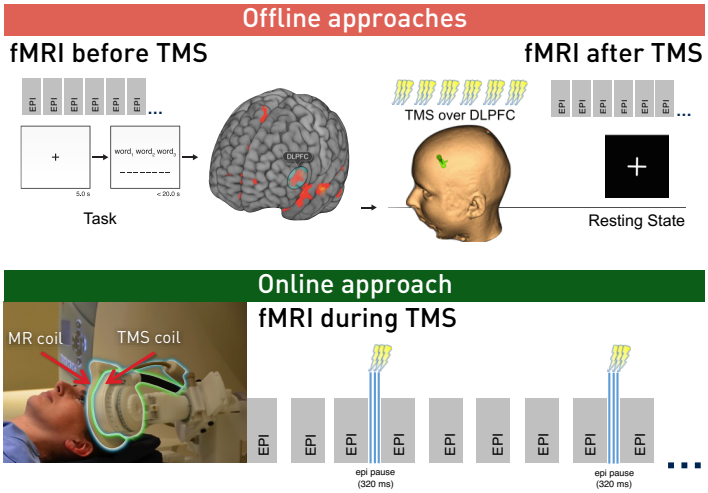


Figure 15. Combining TMS with fMRI. Offline approaches utilise fMRI before TMS to determine stimulation targets and after TMS to investigate lasting changes after rTMS. Finally, in online TMS/fMRI, TMS is applied during fMRI allowing for the investigation of immediate neural effects due to stimulation.