Title: Brain and Cervical Spinal Cord Contributions to Motor Learning Examined Using Functional magnetic resonance imaging.

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Summary: For more than 30 years, my laboratory has used psychophysical, electrophysiological and multimodal neuroimaging techniques in healthy individuals and clinical populations to investigate the behavioural determinants, neural substrates and neurophysiological mechanisms mediating the different learning phases (fast, slow, consolidation, automatization and retention) of motor skills. During this presentation, I will first review some of our work focusing on motor sequence learning (MSL) and will discuss our studies showing that the consolidation of this form of memory trace depends upon greater functional integration of the cortico-striatal system and non-rapid eye movement (N-REM) sleep spindle activity measured during the night following the initial training session. Yet despite such advances, models of motor skill learning have up until recently been incomplete because they do not account for the contribution of another important part of the central nervous system (CNS) : i.e., the cervical spinal cord (CSC). To address this knowledge gap, my group has pioneered a methodological technique that employs simultaneous brain/CSC functional magnetic resonance imaging (fMRI) during MSL in healthy individuals. In 2015 we used this new imaging method to provide the first ever evidence for local, intrinsic plasticity within the CSC, as well as connectivity changes with the sensorimotor cortex and cerebellum over the course of MSL using neuroimaging. Later, we then reported that further local functional plasticity within the CSC can be observed at different phases (fast vs. slow) of MSL using both univariate and data-driven multivariate approaches, depending on the group of muscles involved in the motor task. Finally, I will then discuss these results and highlight a few possible applications of this brain/CSC imaging technique.