Transcranial stimulation, exercise and motor cortex plasticity

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The acquisition of motor skills following training occurs through the modification and organisation of muscle synergies into effective sequences of movement. This 'learning' process is reflected neurophysiologically as a change in the synaptic efficacy of the intrinsic neuronal circuitry of the primary motor cortex (leading to mechanism, of neuroplasticity), which can be quantified by transcranial magnetic stimulation (TMS). In a similar context, training for increased muscle strength not only affects muscle tissue, but it also results in adaptive modifications within the primary motor cortex and more precisely the corticospinal tract. There are several published reports that have used complex electrophysiological techniques, including non-invasive transcranial stimulation of the human brain to determine the neural adaptations to strength training. Despite a considerable body of work, uncertainty remains regarding the type of neural adaptation that mediates the rapid gain in strength. To determine the adaptations that occur within the central nervous system following short-term strength training, a series of studies collected in our laboratory, using sophisticated electrophysiological recordings such as single motor unit analysis, transcranial direct current stimulation, and single and paired-pulse transcranial magnetic stimulation demonstrates that the neural adaptations to strength training are complex and involve many levels of neural plasticity (*i.e.* cortical, spinal and at a motor unit level). The general conclusion is that the current evidence regarding neuroplasticity following strength training, appear to be influenced by the type of strength training performed and muscles trained.