ABSTRACT

Autonomy of the individuals is dependent on their ability to carry out daily-life activities, particularly sequential actions, which are an integral part of our motor skills. They range from finger movements such as tying your shoes to whole-body movements such as dancing. Therefore, developing and maintaining both fine and gross motor skills are necessary to 1) maintain independence and 2) engage in leisure activities, two crucial factors in successful aging. Motor sequence learning (MSL) is a process by which a combination of distinct movements comes to be performed with ease and fluidity after repeated practice. It is primarily investigated through finger tapping tasks, which examine how we acquire, consolidate, and retain new motor skills.

The main aim of this Doctoral dissertation was to study the effects of two methods, motor imagery (MI) and transcranial direct current stimulation (tDCS), on the MSL of fine and gross motor skills, in individuals young and old. MI consists of mental simulation of actions, while tDCS is a non-invasive brain stimulation that can modify cortical excitability. Their association could facilitate motor learning.

First, we applied the classical model of sequential finger movements learning to a whole-body task. This was learned either by physical (PP; *study 1*) or mental practice based on MI (MIP; *study 2*) in young (s*tudies 1 and 2*) and old (*study 5*) individuals. Overall, older participants exhibited lower performance than young people. Their learning, although impaired for fine movements was preserved for global movements, remaining at the level of that of young people. These studies provide fundamental insights into the acquisition and consolidation processes of fine to gross movements during a brief training period.

Second, we assessed the effect of MIP on a single training session (Studies 2, 4, 5) or multiple sessions (s*tudy 3*) with a young (*studies 2, 3, and 4*) and elderly group (*Studies 3 and 5*), in comparison or in combination with PP (s*tudies 4 and 5*). Overall, MIP provided varied benefits. In some cases, it improved performance (*Studies 2 and 3, 5*). In others, the results were less conclusive, sometimes even with no difference from the groups that did not follow training (s*tudies 2 and 5*). The effect of MI varies depending of the individual, task and practice time. MI is not always a beneficial for learning, when used alone and/or for short training whether you are young or old. When MIP is combined with PP in the elderly, it induces the same benefits as physical training alone, and should be favored.

Finally, we tested the application of anodal tDCS over M1 during or after mental or physical training of fine or gross motor tasks in young and older adults. The tDCS did not improve performance, whether stimulation was applied during (*Study 3*) or after (*Study 5*) the learning of these tasks. In this context, with the parameters used and the population samples examined, anodal tDCS over M1 does not appear effective in promoting motor learning.

Keywords: Motor sequence learning, acquisition, consolidation and retention, motor imagery, transcranial direct current stimulation, fine and gross motor skills, aging.