Title of the PhD project: Effects of transcranial direct current stimulation on motor learning by physical or mental practice in older adults

Disciplines: Behavioral Neuroscience and motor skills
Laboratory: Laboratoire Inter-universitaire de Biologie de la Motricité – Director: Pr. Christian Collet – Research team name: Mental processes, sensorimotor processes and motor performance
Doctoral school: Interdisciplinary Doctoral program in health-sciences (EDISS) - ED 205

Scientific background and rationale: Promoting healthy aging is one of the main economic and social challenges for the coming years. In normal aging, structural and functional brain changes may result in reduced neuroplasticity (Sawaki et al., 2003), which, in turn, may impair motor functions with deleterious effects on autonomy. Among the cutting edge and cost-effective strategies to optimize motor learning and rehabilitation, motor imagery (MI) training (or mental practice), and transcranial direct current stimulation (tDCS), have gained considerable attention during the last decade. On the one hand, MI training relates to mentally practicing movements without actual execution. This method has been shown to advantageously complement or even replace physical practice (Schuster et al., 2011). On the other hand, tDCS is a safe and noninvasive brain stimulation method used to modulate cortical excitability and enhance neuroplasticity. Associated with physical practice, anodal tDCS targeting the motor cortex can significantly improve motor function/learning (Buch et al., 2017). Until now the effects of MI training and tDCS interventions have been extensively investigated independently, but the beneficial effect of their combination remains to be explored in the elderly.
Aim: The main aim of this project is to investigate the effects of tDCS on motor learning by physical or mental practice in older adults. It will also provide insight into the underlying mechanisms of mental and physical practice, and their interaction with tDCS.
Description of the methodology: A hand version of the sequential finger tapping task (Gudberg et al., 2015), and a sequential whole-body task involving leg movements (currently developed in our lab) will be used. Both tasks involve 8 discrete elements to be connected to complete a motor sequence. One hundred healthy elderly adults will be recruited and attend three sessions of MI training on three consecutive days and one follow up session one week later. They will be allocated to one of the five groups of 20 participants: (1) a control group with no practice while receiving sham tDCS, two groups with mental practice while receiving sham (2) or anodal (3) tDCS and two groups with physical practice while receiving sham (4) or anodal (5) tDCS. At the beginning and the end of each training session as well as during the follow up session, motor performance will be recorded while cortical excitability changes associated with each training method will be explored by EEG.
Expected results: (1) Both mental and physical practice should enhance motor performance as compared to no practice (2) Physical and mental practice combined with anodal tDCS will better enhance performance than with sham tDCS (3) Cortical excitability will be larger after either type of practice to the pre-training condition.
Perspectives: Beyond its impact in the field of aging neuroscience, the results of this project should provide a rationale for tDCS use, in association, or not, with mental practice, in geriatric – and potentially neurological – rehabilitation.
Skills required: Background in behavioral neuroscience and motor skills, Fluent English, Computer programming and data processing. Experience in EEG analysis will be appreciated.
Bibliography: Buch et al. (2017), Clinical Neurophysiology; Gudberg et al. (2015), Neurobiology of Aging; Sawaki et al. (2003), Annals of Neurology; Schuster et al. (2011), BMC Med.
Key-words: motor imagery, motor learning, tDCS, aging.

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Application should include: CV, application letter, Names and addresses of two references.
The application file should be sent before May 31, 2019 to: christian.collet@univ-lyon1.fr
The open competitive recruitment process is in two steps: 1. Internal laboratory procedure. 2. Interdisciplinary jury of EDISS.