Hand coordination in space overrules the optimization of variability and effort during bimanual tracking

James Mathew[1,*], Aymar de Rugy[2,3] and Frederic R. Danion[1]

[1]Institut de Neurosciences de la Timone, Aix Marseille Université, CNRS, UMR 7289, Marseille, France

*Current affiliation : Institute of Neuroscience, Institute of Communication & Information Technologies, Electronics & Applied Mathematics, Université Catholique de Louvain, Belgium

[2]Institut de Neurosciences Cognitives et Intégratives d'Aquitaine, Université de Bordeaux, CNRS, UMR 5287, Bordeaux, France

[3]Centre for Sensorimotor Performance, School of Human Movement and Nutrition Sciences, The University of Queensland, Australia

ABSTRACT

Optimal control theory suggests that minimizing motor costs such as the variability of movement and effort is an objective for every movement. However, it is well established that during bimanual tasks, humans have a natural tendency to generate similar hand movements. Here we examined to which extent this natural tendency influences the minimization of effort and variability. We consider a task in which participants were requested to track a moving target by means of a single cursor controlled simultaneously by the two hands. Two types of hand-cursor mappings were tested: one in which the cursor position resulted from the average location of two hands (MEAN), and one in which horizontal and vertical positions of the cursor were driven separately by each hand (SPLIT). First, we supported previous studies on manual dexterity, with dominant hand being better in unimanual-tracking than the more variable non-dominant hand. More interestingly, instead of exploiting this effect by increasing the use of the dominant hand during bimanual cooperative tasks, the contributions from both hands remained symmetrical. Indeed, for both mappings and even after 6min of practice, right and left hands remained strongly correlated and performed very similar movements in extrinsic space. Persistence of this bimanual coupling demonstrates that participants prefer to maintain similar movements at the expense of unnecessary movements (SPLIT) or increase in noise from the non-dominant hand (MEAN). Altogether, during bimanual tracking, coordination of both hands in extrinsic space is more important than minimizing motor costs associated with variability and effort.