Inter-hemispheric communication is altered during learning of a new bimanual coordination in teenagers with developmental coordination disorder

Mélody Blais, David Amarantini, Jean-Michel Albaret, Yves Chaix & Jessica Tallet

Aim: Several studies reported impairment of motor learning skills in Developmental Coordination Disorder (DCD). Some hypotheses emerged regarding the neural mechanisms of motor learning deficit in DCD but, to date, functional brain imaging studies are scarce. The aim of this study is to assess the possible differences in communication between brain areas during learning of a new bimanual coordination in teenagers with DCD compared to matched control teenagers.
Method: Ten typically developing (TD, 13.49 +/- 1.76 yo) and 10 DCD (13.47 +/- 1.39 yo) teenagers were asked to learn a new bimanual coordination pattern: they had to tap with their thumbs on two required buttons in synchrony with a visual stimuli during a practice session of 5 Blocs × 5 trials of 15 seconds. Before and after practice, three coordination patterns were tested: the new pattern, and two pre-existing inphase and antiphase patterns that are supposed to be accurate and stable without practice. Electroencephalogram (EEG) was recorded during the Pre- and Post-Tests. Three behavioural and two EEG variables were computed: (1) the Absolute Error (AE) of the produced coordination reflecting accuracy and (2) its Standard Deviation (SD) reflecting stability, (3) the number of additional taps of both right and left thumbs (N) reflecting motor overflows and the Task-Related EEG Coherence (TRCoh) in the 13-30 Hz frequency band (4) over left and right hemispheres (FC3-FC4) reflecting inter-hemispheric communication and (5) over left (FC3-C3) and right (FC4-C4) fronto-central regions reflecting intra-hemispheric communication. The values obtained during the practice were analyzed with Group × Test × Patterns ANOVAs on all variables, and Group × Bloc ANOVAs on behavioural variables.
Results: At a behavioural level, AE, SD and N were higher for DCD compared to TD. AE of the new coordination decreased with practice for both groups. SD and N remained higher in the DCD group despite practice. At a neural level, TRCoh over FC3-FC4 regions was lower for DCD compared to TD. The TRCoh over right FC4-C4 regions increased between Pre- and Post-Tests for the new coordination for both groups.
Conclusion: Results reveal that practice a new motor coordination leads to the improvement of accuracy, associated with the increase of intra-hemispheric (right) fronto-central communication in both groups. However, practice did not decrease the persistent lack of behavioural stability and the inability to inhibit manual incorrect responses, associated with a difference in inter-hemispheric communication in DCD teenagers.