Asymmetrical patterns of corticomuscular coherence during unilateral and bilateral rhythmic wrist movements.

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Background:
During rhythmic unimanual and bimanual movements, the contribution of motor cortices has been extensively emphasized. By contrast, little is known about the motor commands sent to active muscles during such coordinated movements. Corticomuscular coherence (CMC) allows to evaluate the direct implication of the cortical structures in modulating muscle activations. Recent researches reported lower *beta* (15-30 Hz) CMC when two homologous fingers are bilaterally engaged in an isotonic precision grip task as compared to unilateral contractions. Besides, increased *gamma* (31-60 Hz) CMC is observed during dynamic tasks requiring sensorimotor adjustments and/or more attention. This study investigated the modulation of *beta* and *gamma* CMC during bimanual versus unimanual rhythmic wrist movements at different speeds to bring further knowledge on the contribution of cortical activity to the control of active muscles.

Methods:
Eleven right-handed young adults produced self-paced rhythmic wrist(s) extension and flexion in the horizontal plane with the two forearms semiproned. Unimanual (right) and bimanual inphase conditions were proposed at two tempos: 1 and 2 Hz. EEG, EMGs of right and left extensor carpi radialis (ECR) and wrists angles were simultaneously recorded. Inter-tap duration of the right hand was assessed to verify if the participants correctly completed the speed requirements. The mean absolute temporal delay between the two hands and its variability were also computed to measure the performance in the bimanual condition. For each condition and each tempo, CMC magnitude was calculated in both *beta* and *gamma* frequency bands between C3 and C4 EEG signals and unrectified contralateral ECR EMG signals.

Results:
Behavioral results showed that the speed requirements were accurately achieved in both conditions. In the bimanual inphase condition, temporal delay and stability between the two hands were significantly improved at 2 Hz as compared to 1 Hz. During the unimanual condition, CMC in both *beta* and *gamma* bands were significantly higher on the contralateral side as compared to the ipsilateral side at 1 Hz only. In the bimanual condition, the non-dominant side (i.e. right hemisphere-left ECR) showed significant higher *gamma* CMC as compared to the dominant side (left hemisphere-right ECR) at 2 Hz only.

Conclusion:
Unilateral and bilateral rhythmic wrist movements elicited CMC in both *beta* and *gamma* frequency ranges, with specific patterns according to the condition and the movement speed. The observed changes in hemispheric asymmetries support the notion that frequency-related CMC modulations contribute to the control of active muscles according to inter-manual dynamics.