Cortico-cortical connectivity reorganizations during intentional switching tasks depend on the stability of the required bimanual patterns.

Jérôme Barral[1], Jessica Tallet[2] & Claude-Alain Hauert[3,4]

[1] Institut des Sciences du Sport de l'Université de Lausanne, Suisse

[2] Laboratoire Adaptation Perceptivo-Motrice et Apprentissage (EA3691) - UFR STAPS - Université Paul Sabatier Toulouse III, France

[3] Laboratoire du Développement et des Apprentissages Moteurs, Faculté de Psychologie et des Sciences de l'Éducation, Université de Genève, Suisse

[4] Centre Inter-Facultaire de Neurosciences, Université de Genève, Suisse

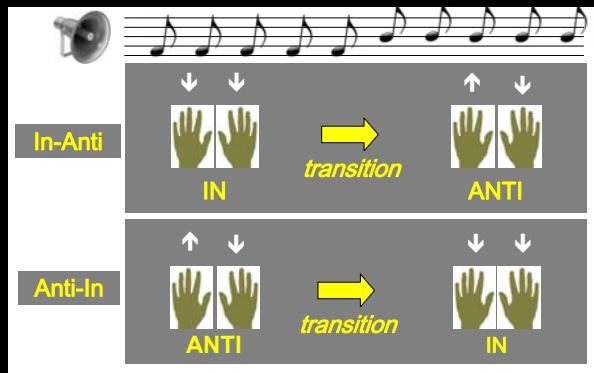
jerome.barral@unil.ch

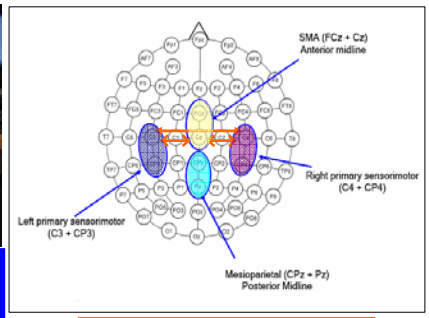
INTRODUCTION

Daily motor tasks require switching between coordinated movements of the upper limbs, i.e. reorganizing the ongoing behaviour in order to engage in a more or less complex one. Bimanual coordination paradigm revealed that 1) the switching time depends on the stability of the tapping modes [1] and 2) alternate or anti-phase tapping (Anti) is less stable than synchronous or in-phase tapping (In) [2]. Anti requires also greater inter-regional coupling than In, as measured by ElectroEncephaloGraphy (EEG) [3]. The goal of the present study is to examine whether the behavioural and electro-cortical reorganizations induced by bimanual switching tasks are stability-dependent. As In-Anti switching requires engaging in a less stable mode, we expect an increase of behavioural perturbations and additional neural resources than the inverse Anti-In switching. As the functional connectivity seems to depend on the stability of the tapping mode, the In-Anti switching may induce an increase in inter-regional coupling over sensori-motor regions while the Anti-In switching may lead to a decrease in inter-regional coupling.

METHODS

- **Participants**: 7 right-handed adults (2 women); mean age: 26 years (+/- 4 years)
- **Tasks**: Bimanual In-phase or Anti-phase fingers' tapping / auditory metronome (tempo = 700 ms)
- **Experimental conditions:** when the metronome changes from low-pitched to high-pitched tones:
  - 2 experimental conditions: In-Anti *vs.* Anti-In switching (each : 2 x 24 trials)
  - 1 rest condition (2 x 24 trials)
- EEG from 64 surface electrodes (BioSemi)
- **Data analyses**:
  - Behavioural data: tempo of the tapping and its variability
  - EEG data:
    - Task-Related Power : $TRPow = \log(Pow_{act}) - \log(Pow_{rest})$
    - Task-Related Coherence : $TRCoh_{xy} = \tanh(Coh_{xy_{act}}) - \tanh(Coh_{xy_{rest}})$
    - 2 epochs: the pre-switching tapping (P1) and the very moment of the switching (P2)
    - 4 regions of interest (ROI) and 3 pairs of interest (POI) over the sensori-motor regions
    - 2 ranges of frequencies: alpha (8-12 Hz) and beta (13-30 Hz)



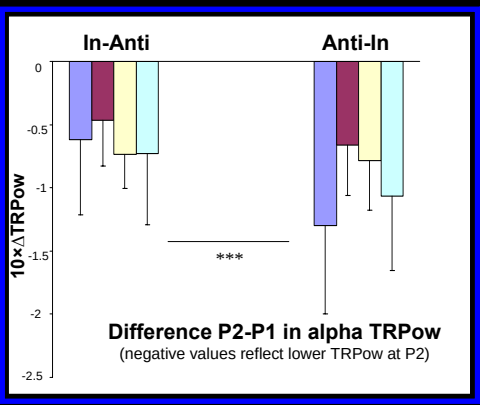


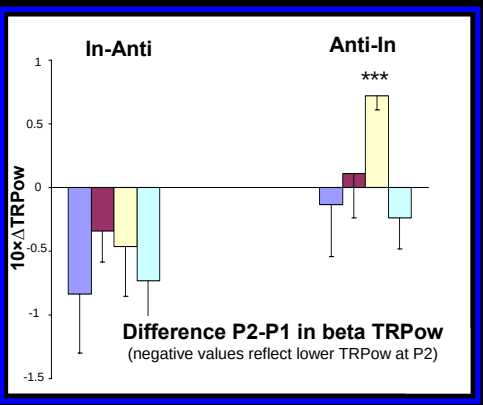
TRPow = 4 ROI :
-C3 + CP3
-C4 + CP4
-Cz + FCz
-Pz + CPz

TRCoh : 3 POI :
C3 - C4 / C3 – Cz / C4 - Cz

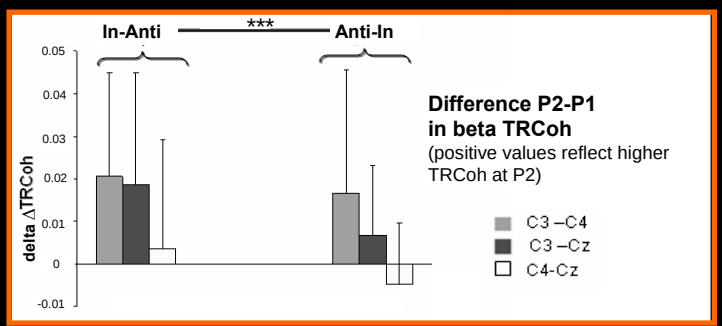
RESULTS

→**Behaviour** : Overall increase of variability at P2 in both conditions / deceleration of tempo at P2 in the In-Anti condition only (*** p<.05).





→ **alpha TRPow (left panel)** : decrease for all the ROI whatever the condition (*** p<.05)
→ **beta TRPow (right panel)** : increase for FCz-Cz only in the Anti-In condition (*** p<.05)



→ **beta TRCoh** : greater increase for the In-Anti switching (*** p<.05)

DISCUSSION

Our results revealed that the intentional In-Anti switching is associated to :

- ➢ greater behavioural perturbations
- ➢ supplementary neural activation over the frontal region that reflects an increase of the sensorimotor resources required to switch to the less stable and more attention-demanding anti-phase tapping mode.
- ➢ enhanced inter-regional coupling as compared to the Anti-In switching suggesting that the cortico-cortical connectivity increase is stability-dependent.

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