Bimanual motor transitions : A paradigm to investigate electrocortical correlates of various types of behavioral inhibition

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INTRODUCTION

Motor transitions in bimanual coordination require selective - or non-selective - inhibition mechanisms. Two experiments were conducted to investigate those mechanisms in which adults switched from bimanual in-phase tapping to different patterns of movement.

GENERAL METHOD

- **Bimanual in-phase tapping / switching to another condition**
- Tempo of the auditory metronome = 700 ms (~1.4 Hz)
- **Each conditions of switching** : 2 x 24 trials
- **Rest condition** 2 x 24 trials
- EEG from 64 surface electrodes (NeuroScan Inc.)

- **VD** = Task-Related Power (**TRPow**) and Task-Related Coherence (**TRCoh**)
- Two epochs of the EEG signal were compared (Pre-transition vs. Transition)
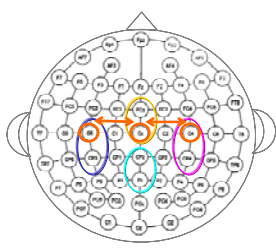
4 regions of interest (ROI):
- left central (C3 + CP3) : **ROI 1**
- right central (C4 + CP4) : **ROI 2**
- anterior midline (Cz + FCz) : **ROI 3**
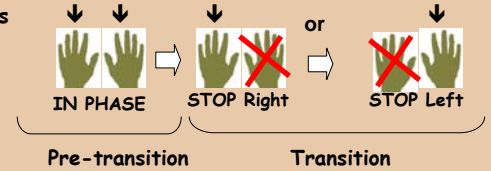- posterior midline (Pz + CPz) : **ROI 4**

3 pairs of interest (POI):
- left central to anterior mid (**C3-Cz**)
- right central to anterior mid (**C4-Cz**)

EXPERIMENT 1

PARTICIPANTS

9 right-handed adults (4 women) aged from 24 to 38 years.
Experimental conditions

IN PHASE   STOP Right   or   STOP Left
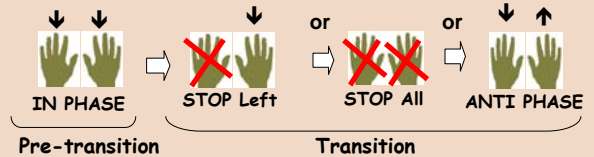Pre-transition   Transition

STATISTICS

Five specific contrasts were performed on EEG data, with a corrected significant threshold p = .01

EXPERIMENT 2

PARTICIPANTS

11 right-handed adults (6 women), mean age: 29 years (SD = 7,8)
Experimental conditions

IN PHASE   STOP Left   or   STOP All   or   ANTI PHASE
Pre-transition   Transition

STATISTICS

Repeated measures ANOVAs were performed on EEG data, with significant threshold p = .05

RESULTS

1 / Behavioral performance

Whatever the condition of switching, the stability of the first unimanual tapping after the transition was significantly perturbed (**EXP 1** & **EXP 2**)

2 / TRPow

In the **alpha band** (8 – 12 Hz), the transition from the in-phase condition to all the conditions (except Stop Right in **EXP 1**) induced a significant decrease of TRPow (in blue, Fig. 1) in **ROI 1** and **ROI 4** (**EXP 1** & **EXP 2**).
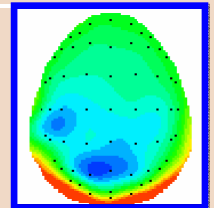
3 / TRCoh

In the **beta band** (13–30 Hz), when switching from in-phase to **unimanual right** hand movements, **TRCoh** decreased for **C4-Cz** but not for **C3-Cz** (**EXP 1** & **EXP 2**, Fig. 2 & 3). In **EXP 1**, the pattern of results was reversed when switching to the left hand, although this effect was not significant.
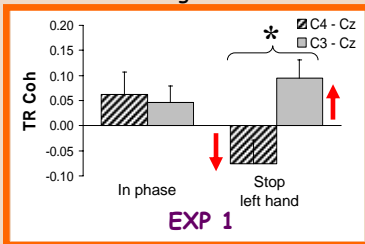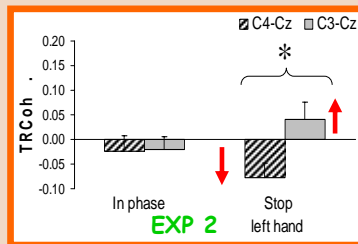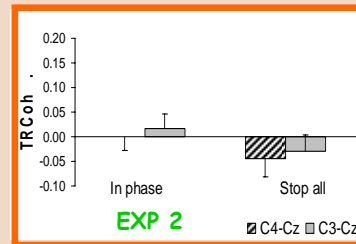
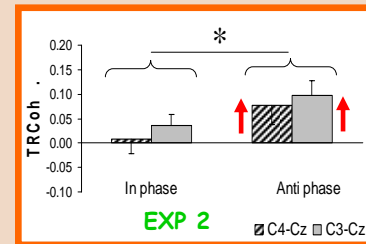In **EXP 2**,
- **Stop All condition** : no effect (Fig. 4)
- **Anti phase condition** : both TRCoh of **C3-Cz** and **C4-Cz** links increased (Fig. 5)

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

DISCUSSION

I. The general cerebral activity increase in the alpha band (TRPow) was not specific to the type of transition, suggesting an overall « *effort of transition* ». In the beta band, the changes in the functional coupling (TRCoh) was specific to the type of transition : **Selective inhibition** mechanisms were characterized by an **asymmetrical pattern** of the **functional coupling** ; this was not the case for non-selective inhibition.

II. The transition **from In-phase to Anti-phase** showed specific changes : there was an **increase in both** couplings.
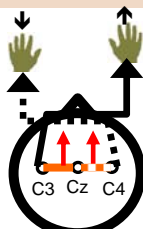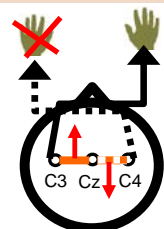
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DeJong, R., Coles, M. G. H. & Logan, G. D. (1995). Strategies and mechanisms in non selective and selective inhibitory motor control. *J. Exp. Psychol. Hum. Percept. Perform., 21*(3),498-511
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