# Building of anticipatory control in a posture-movement coordination task : MEG approach in children.

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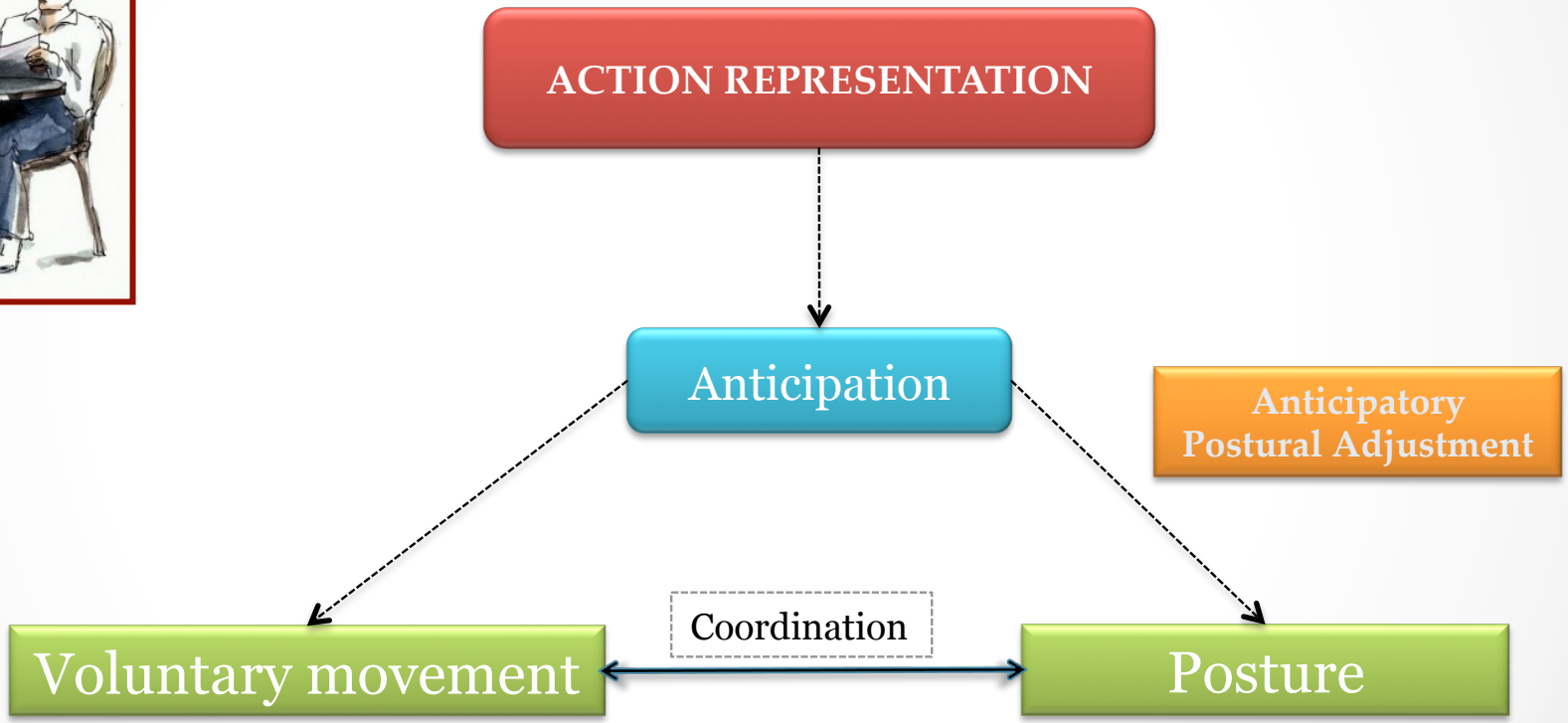
# Posture, Action and Anticipation

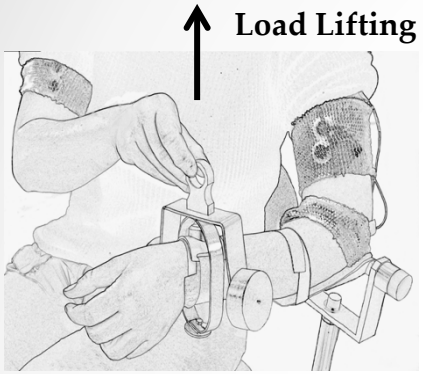
*Hugon et al., 1982; Massion et al., 1999*

# Posture, Action and Anticipation

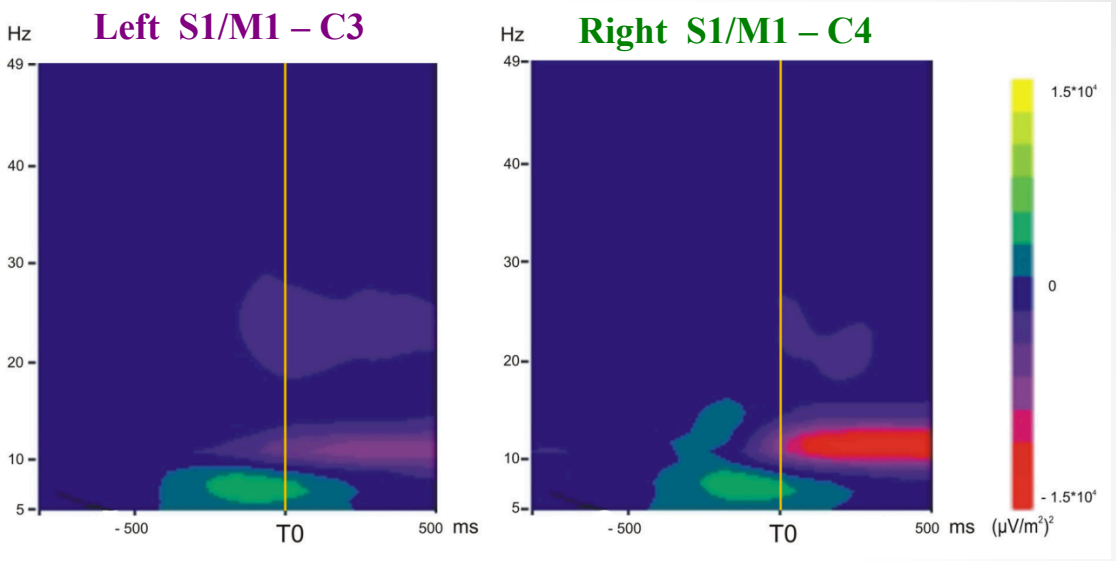


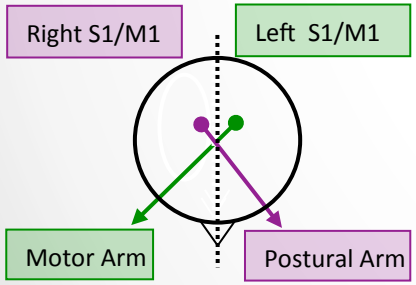

*Hugon et al., 1982; Massion et al., 1999*

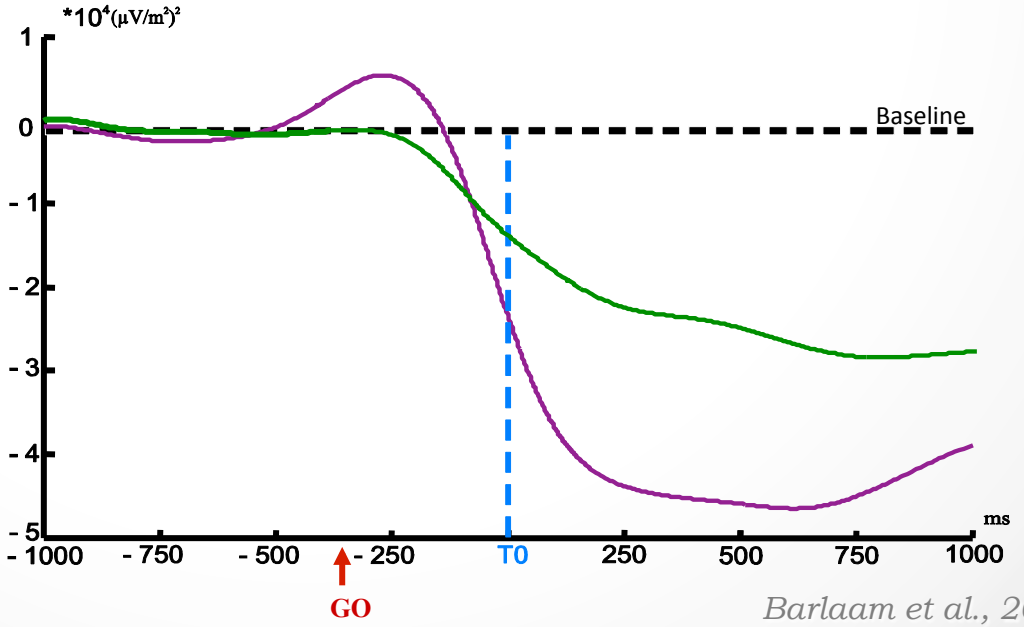
# Central organization of APAs




EEG

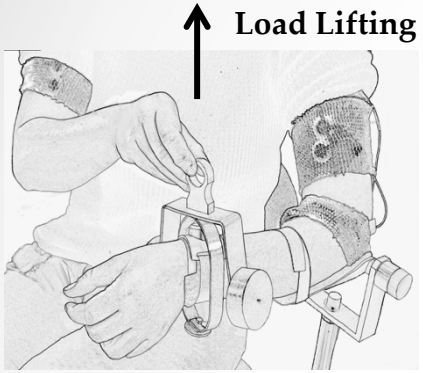


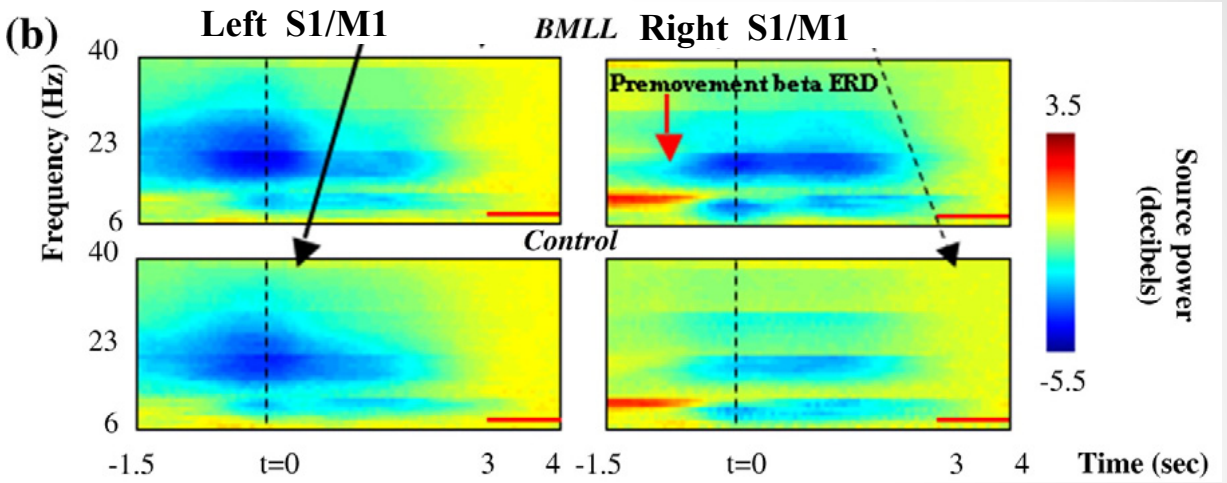




*Barlaam et al., 2011*

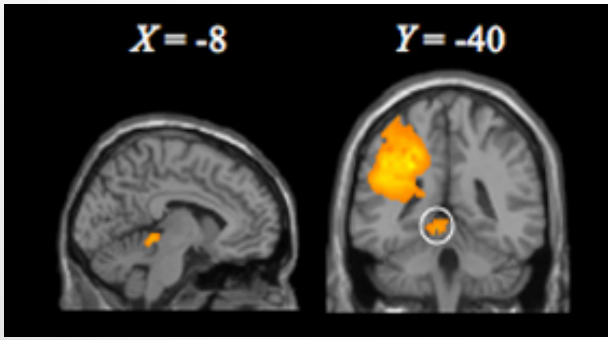
# Central organization of APAs




MEG

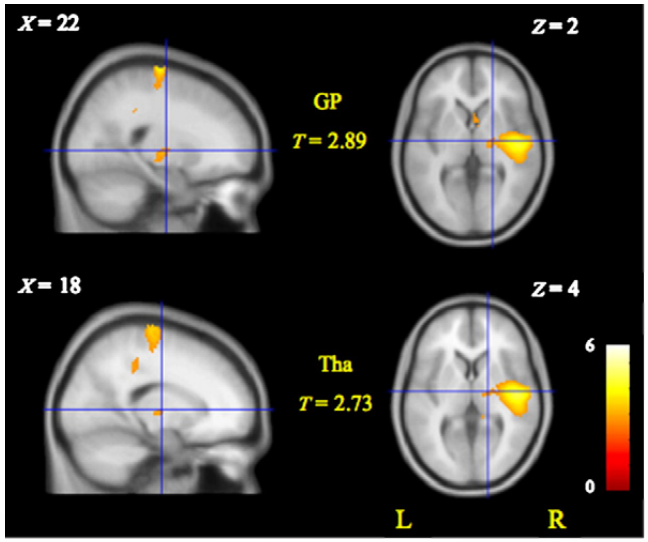


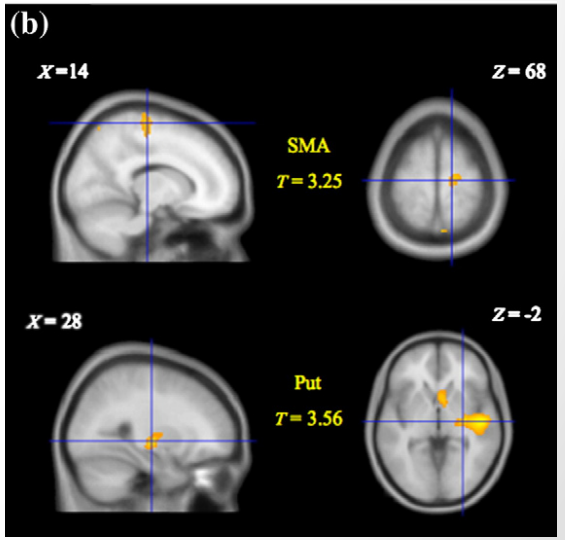

Left hemisphere




**SMA and medial cerebellum**

Right hemisphere



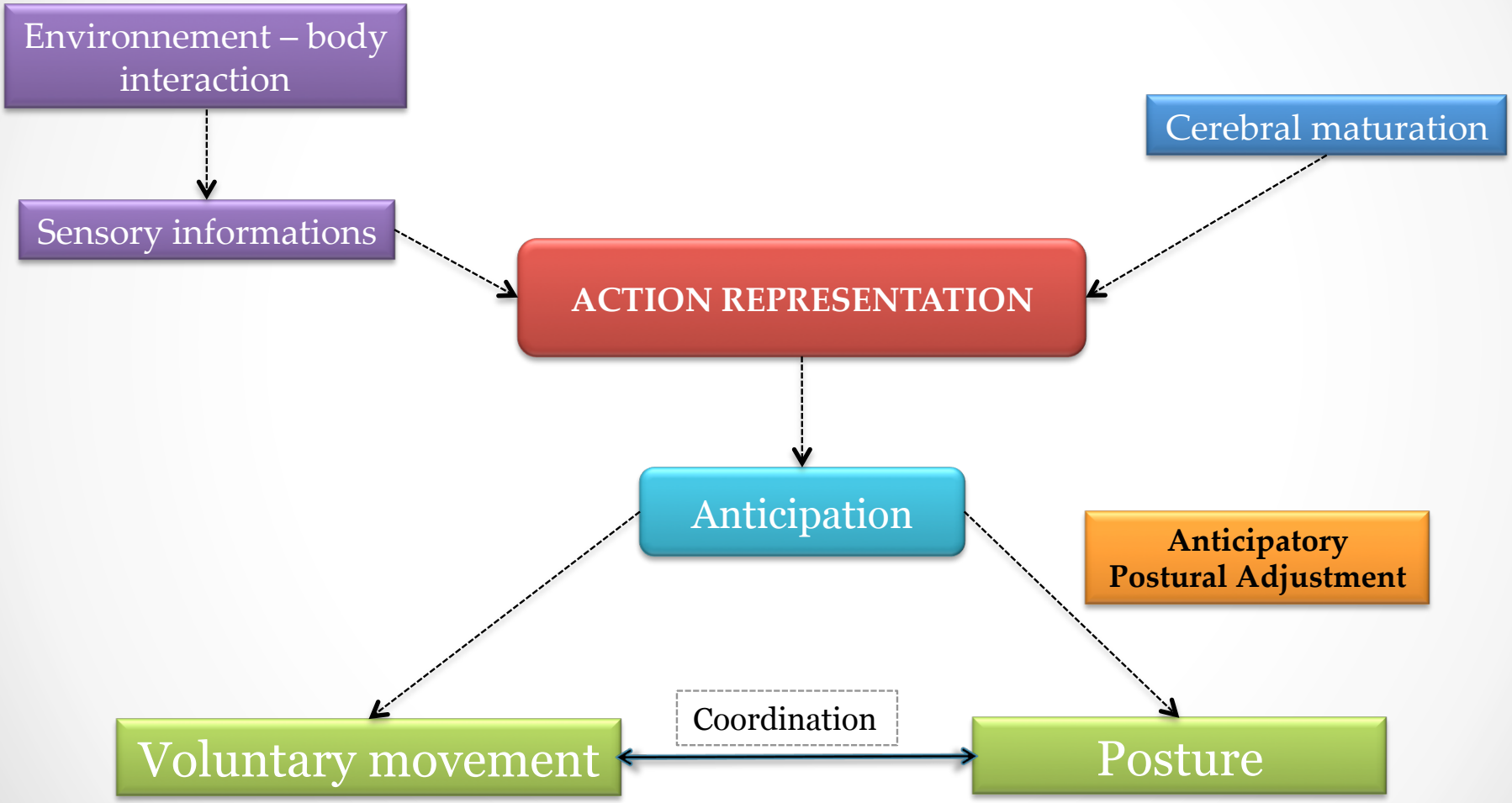




**SMA, basal ganglia and S1/M1**

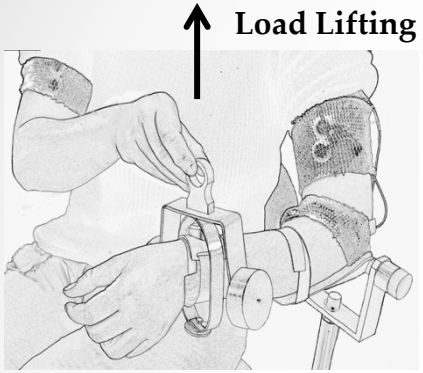


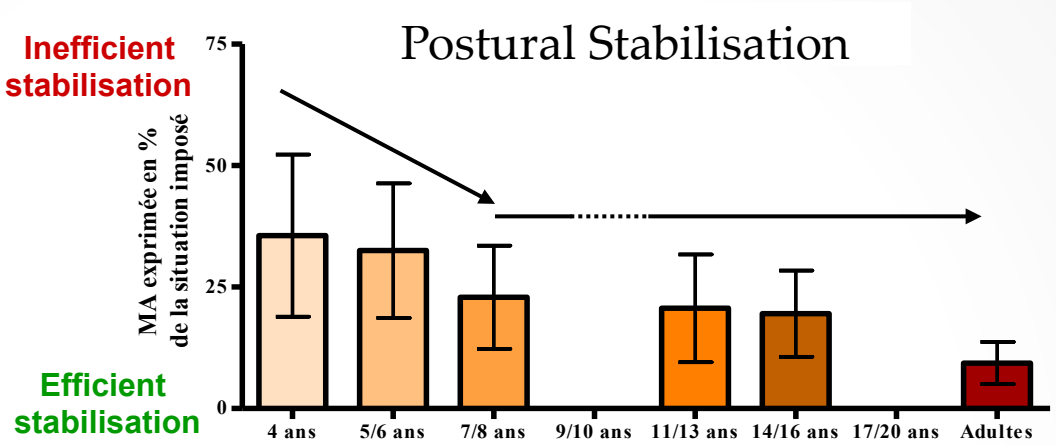
*Ng et al., 2012, 2013*

# Action representation during childhood and adolescence



# APAs during childhood and adolescence

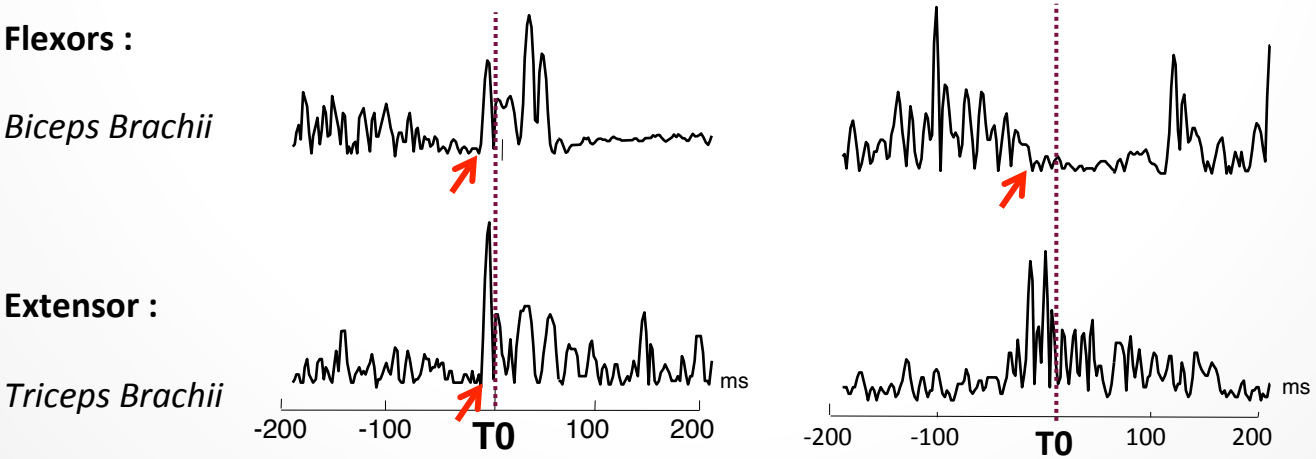



## Electromyographic strategy

**Immature Pattern :**
Flexors / Extensors
Co-contraction

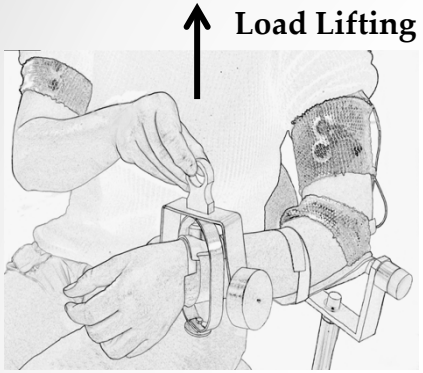
**Mature pattern**
Flexors Inhibition

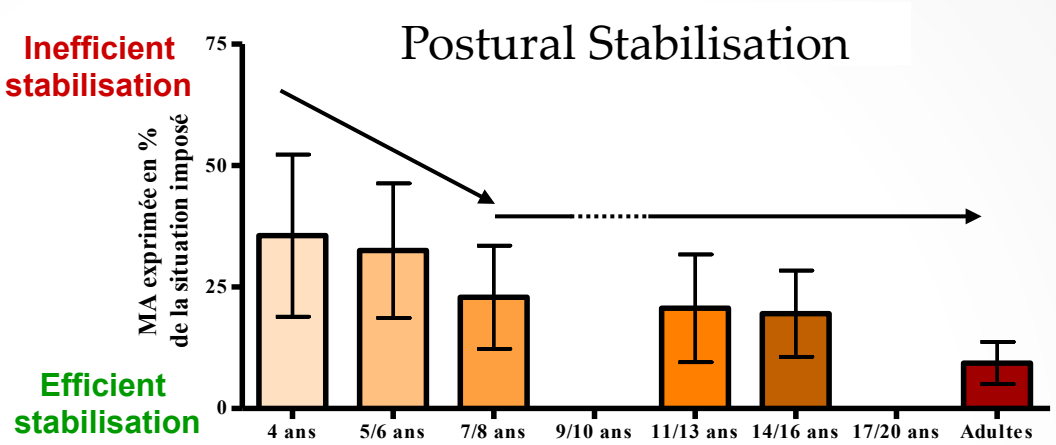





*Schmitz et al., 1999, 2002; Barlaam et al., 2012*

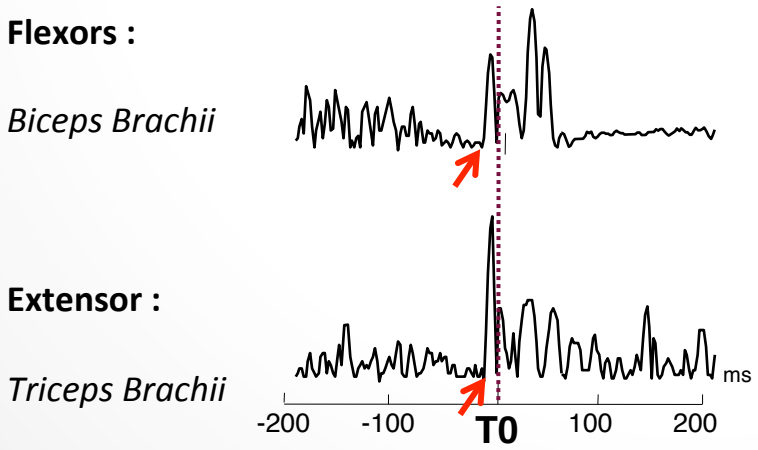
# APAs during childhood and adolescence



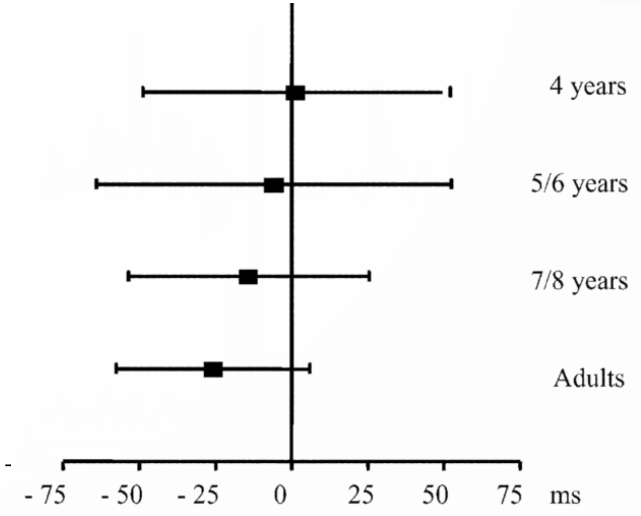




## Electromyographic strategy

**Immature Pattern :**
Flexors / Extensors
Co-contraction




**Mature pattern**
Flexors Inhibition




*Schmitz et al., 1999, 2002; Barlaam et al., 2012*

# AIM

Neurophysiological signature of the maturation of Anticipatory Postural Adjustements across childhood

# Protocols

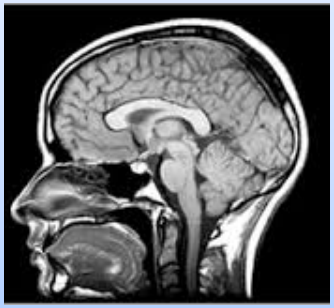
**Session N° 1**

**Session N° 2**

**Session N° 3**

**Bimanual Load-Lifting Task**

**MRI Scan**
**(T1, DTI, Resting State)**



**Neuropsychological Evaluation**

- **Cognitive Test : WISC**
- **Motor Test : m-ABC**

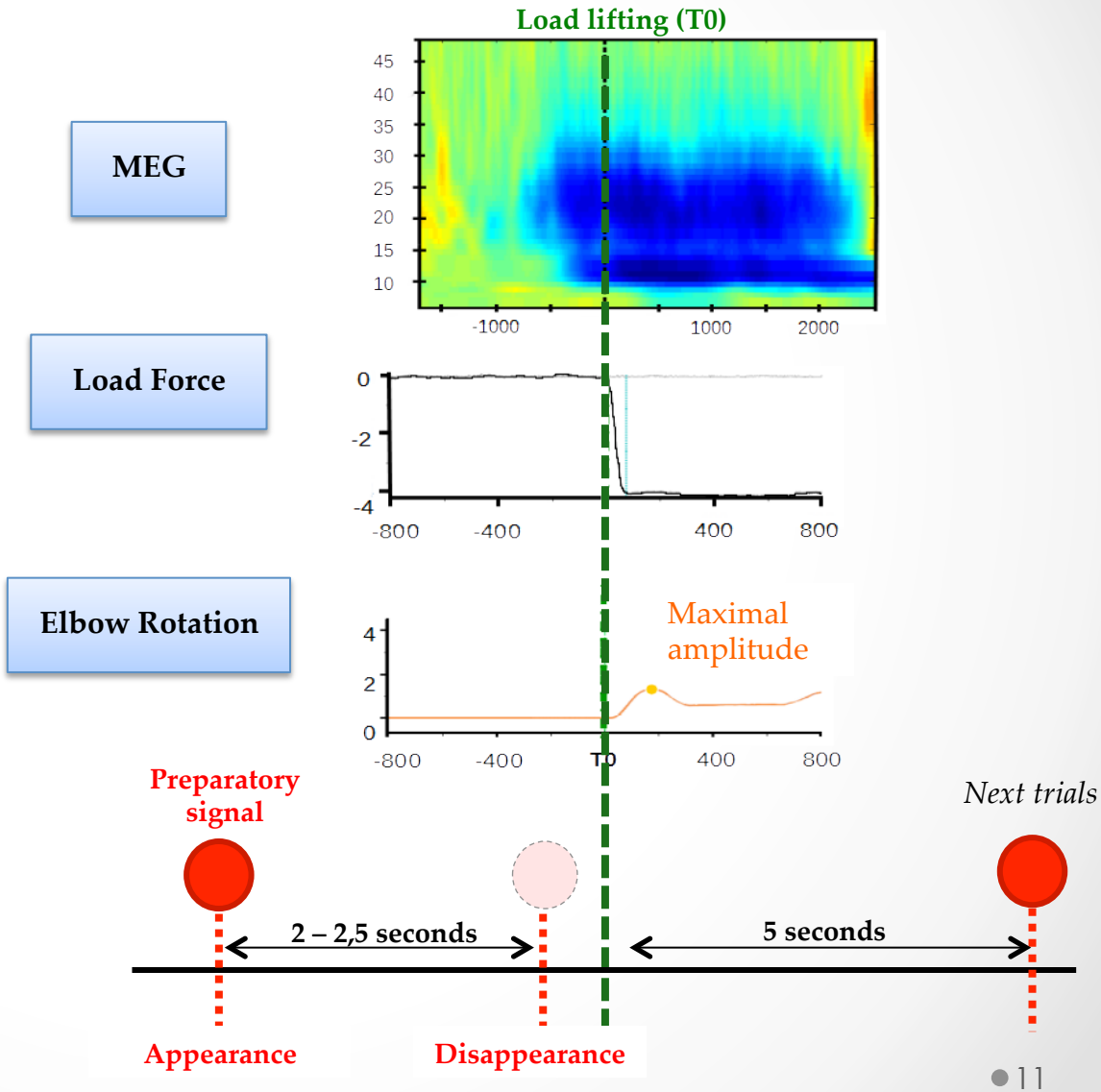
# Protocols

## Participants

16 adults: 27,9 years ± 3,9
18 children : 10,2 years ± 1,09

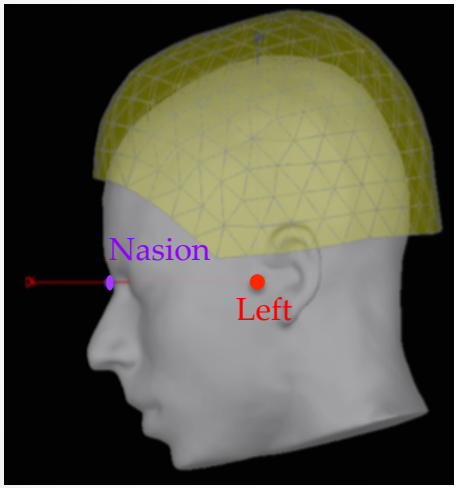
**Bimanual Load-Lifting Task**

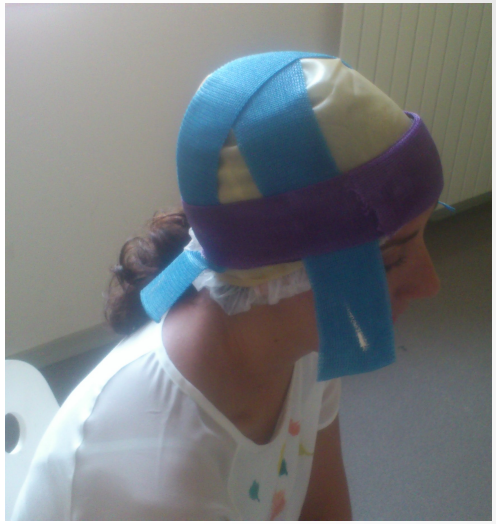
Adults : 9 blocs x 10 trials (40min)
Child : 7 blocs x 8 trials (25min)



# MEG analysis

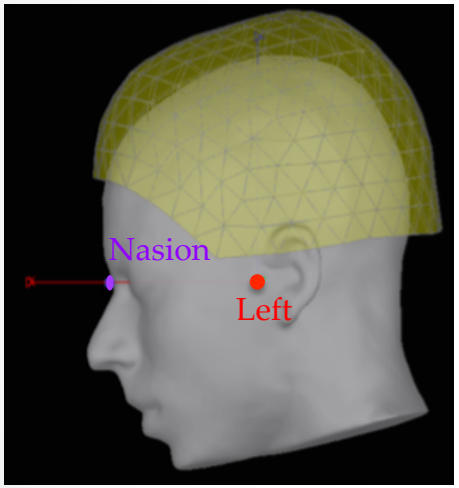
Head motion :

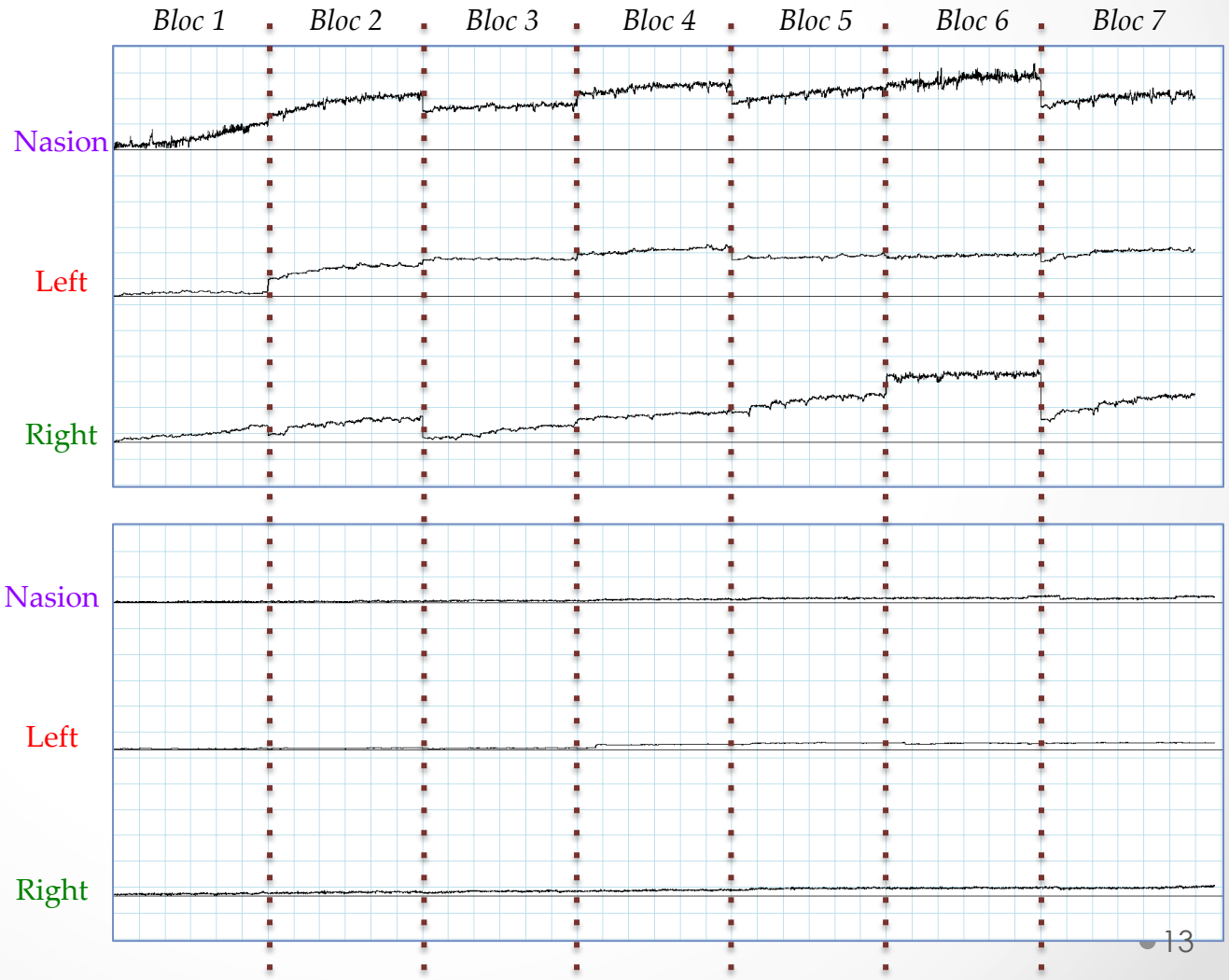


# MEG analysis

Head motion : Threshold > 0.8 cm



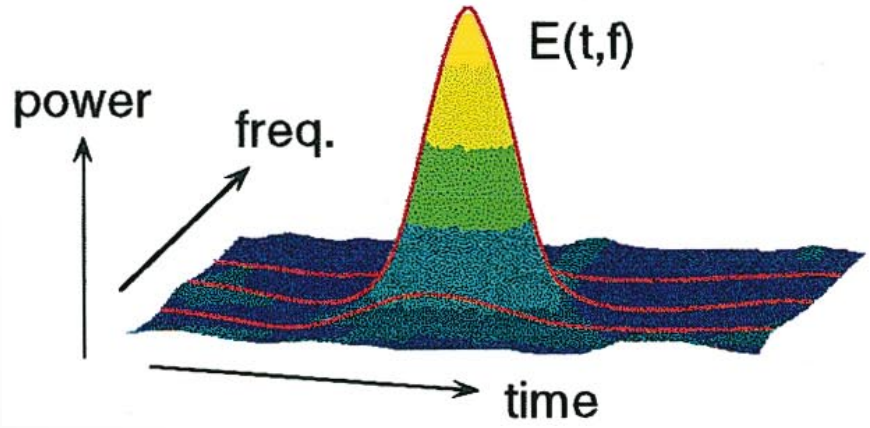



# MEG analysis

**1. Head motion :** Threshold > 0.8 mm

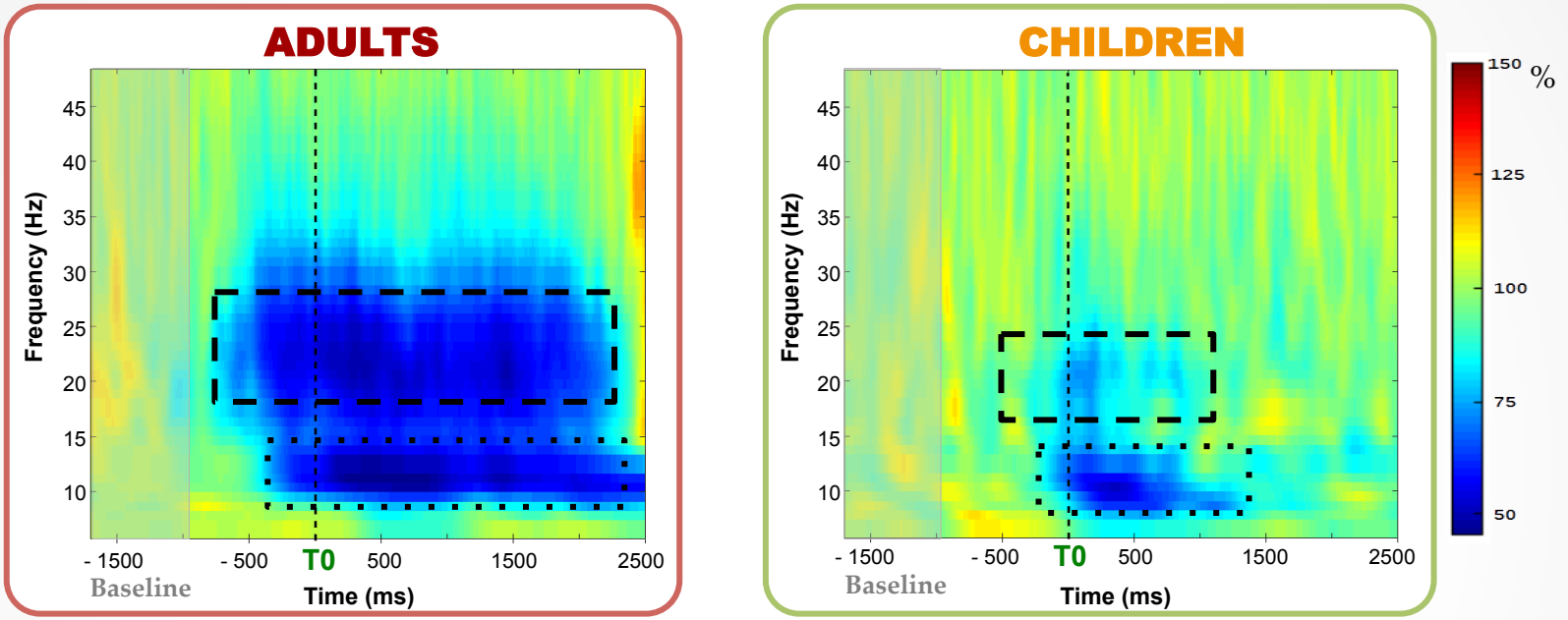
**2. Time-frequency analysis over the sensors :** Morlet's Ondelette

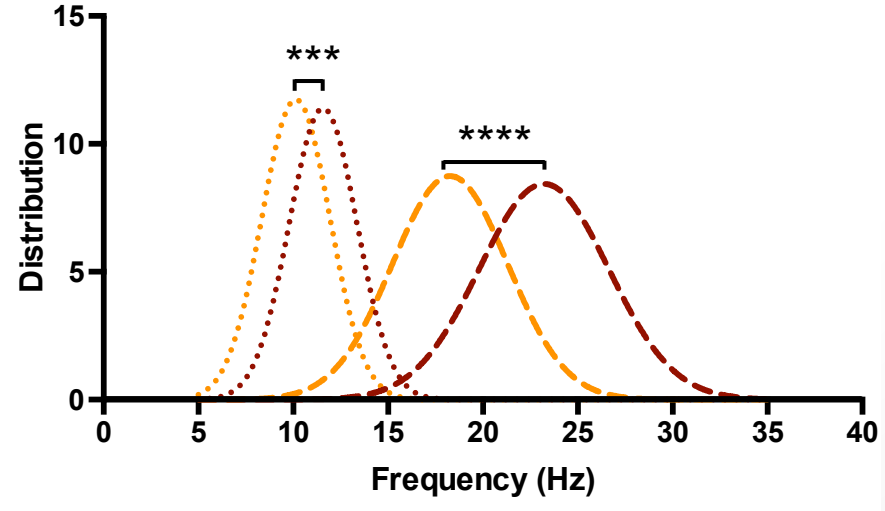
Artefacts rejection : Independant Composante Analysis



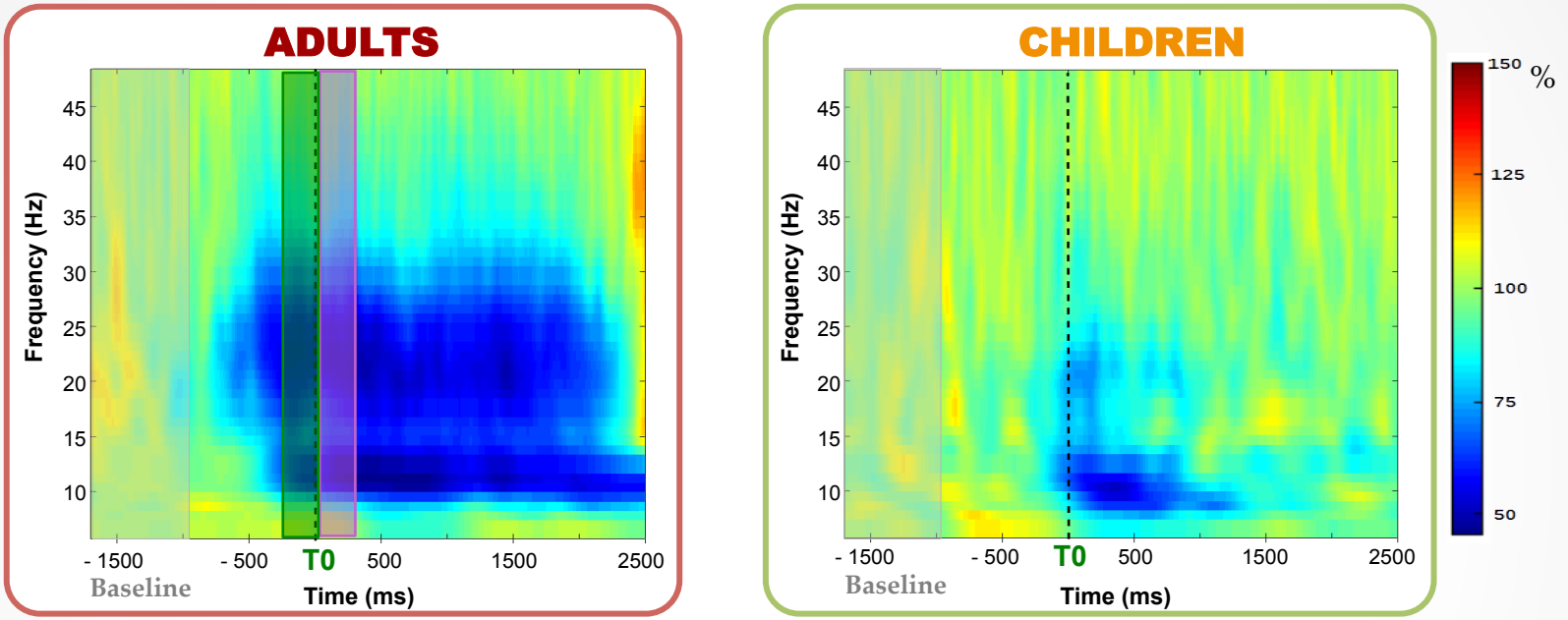

*Tallon-Baudry & Bertrand, 1999*

# Time-frequency maps on sensors



# Time-frequency maps on sensors




**Anticipation**

[-350 ; -50 ms]

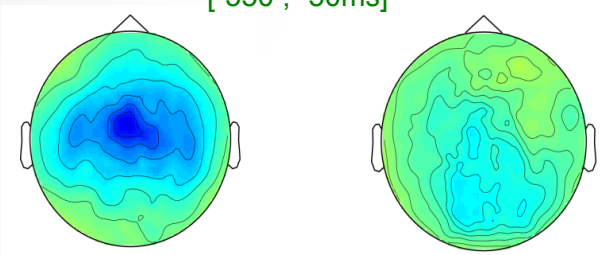
**Movement**

[0 ; 300 ms]

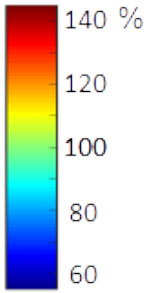
# Beta Rhythm

**Anticipation**

[-350 ; -50ms]

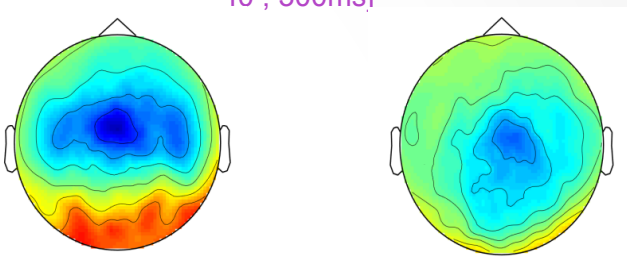


**Adults** **Children**

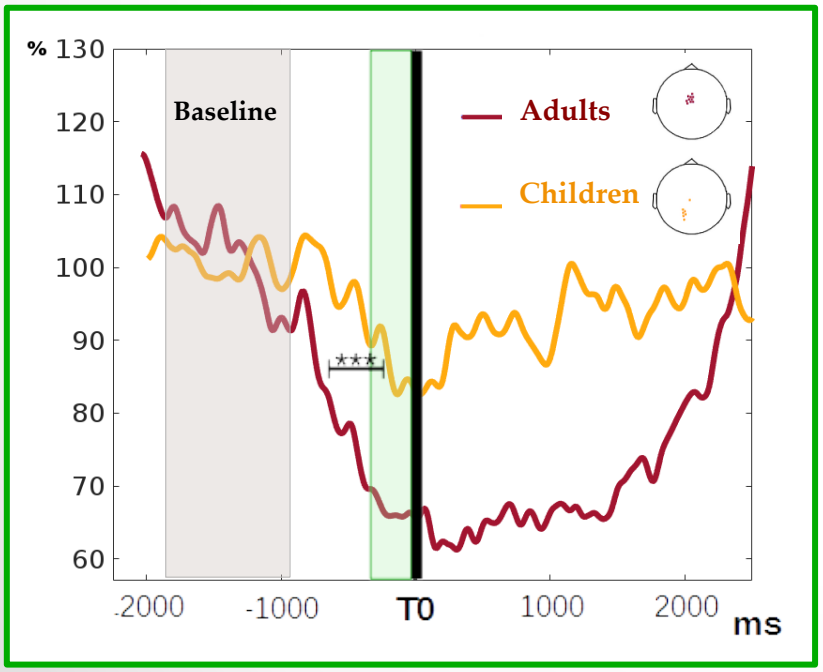


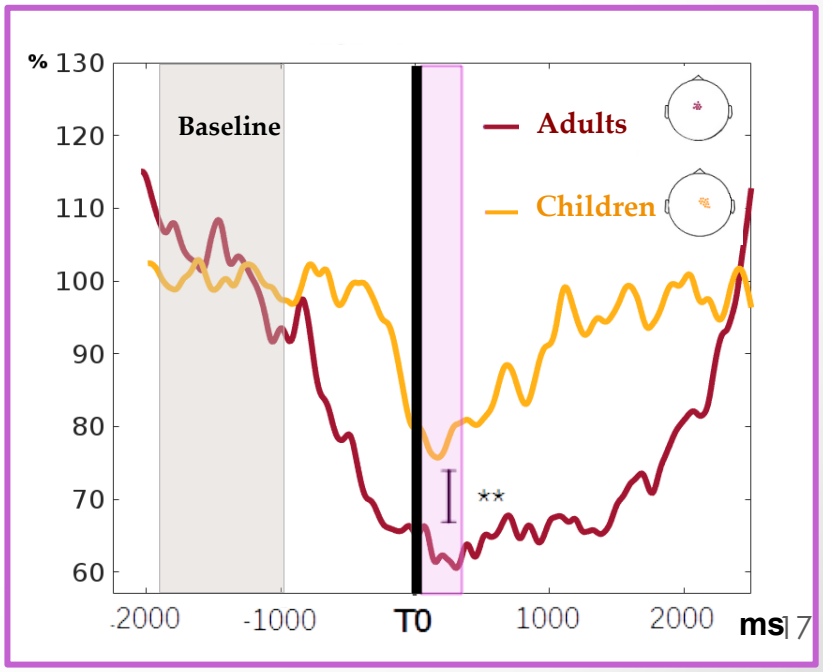

**Movement**

[0 ; 300ms]



**Adults** **Children**

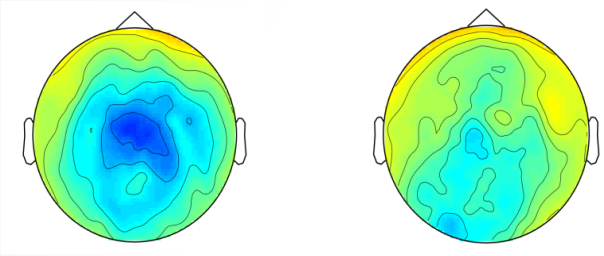


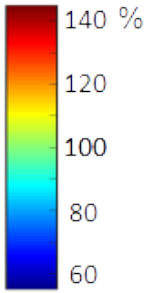
# Mu Rhythm

**Anticipation**

[-350 ; -50ms]

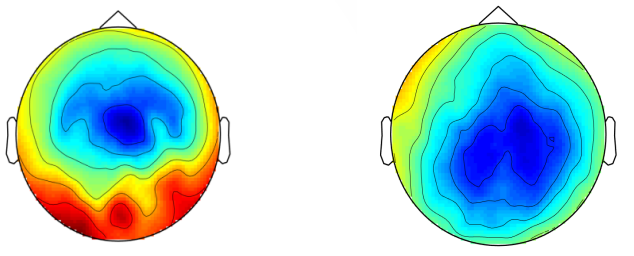


Adults Children

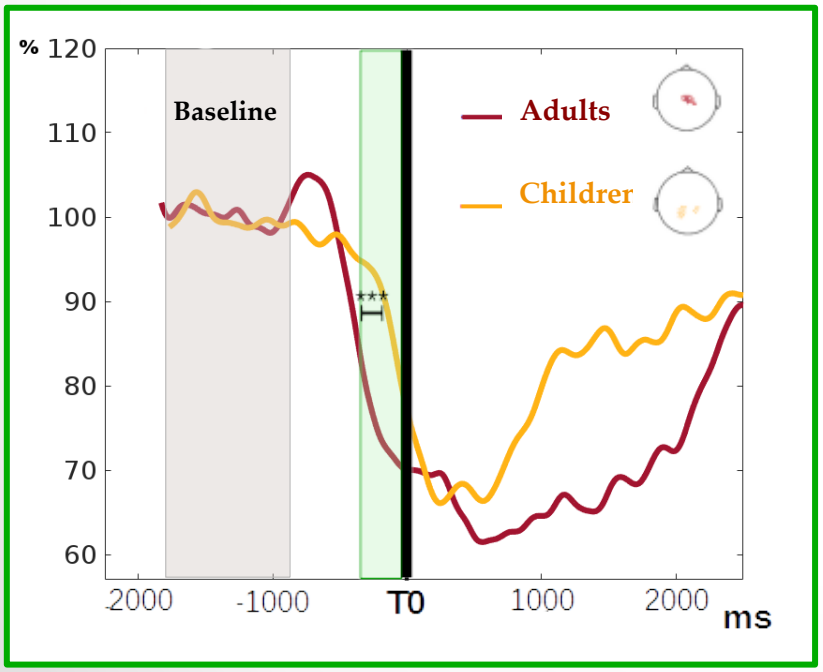


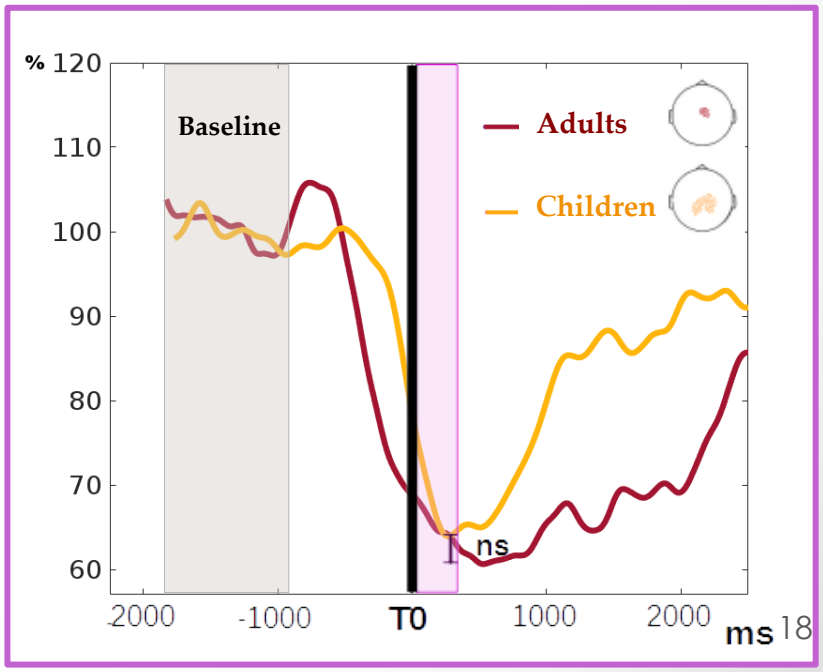

**Movement**

[0 ; 300ms]



Adults Children



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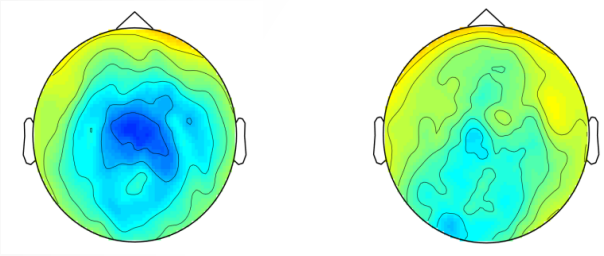
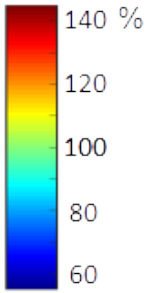
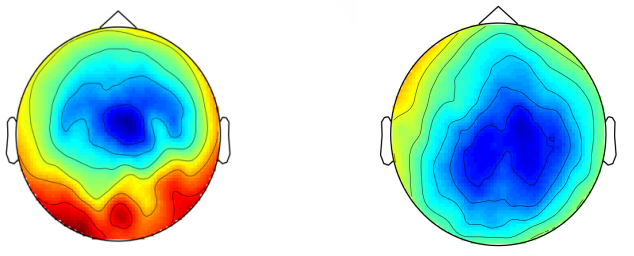


Adults Children

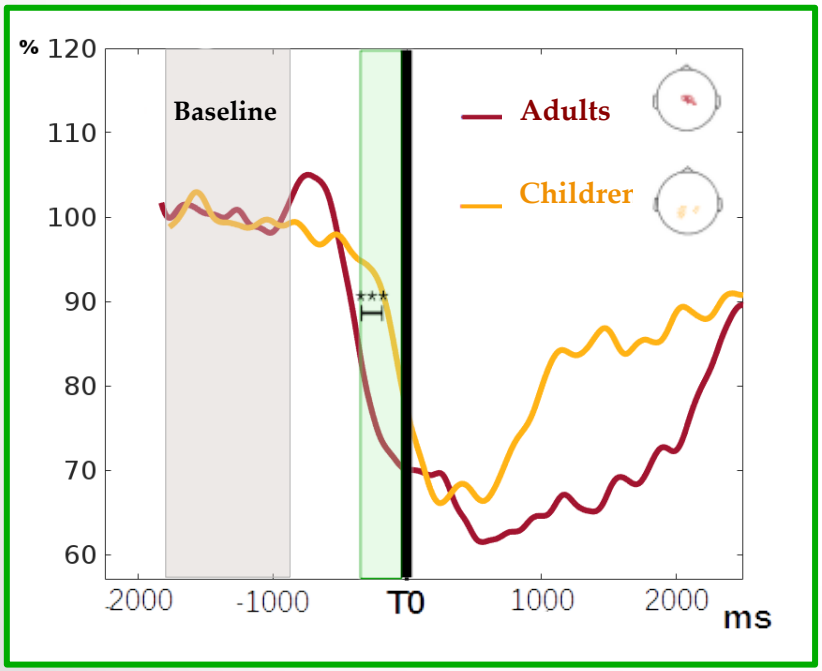


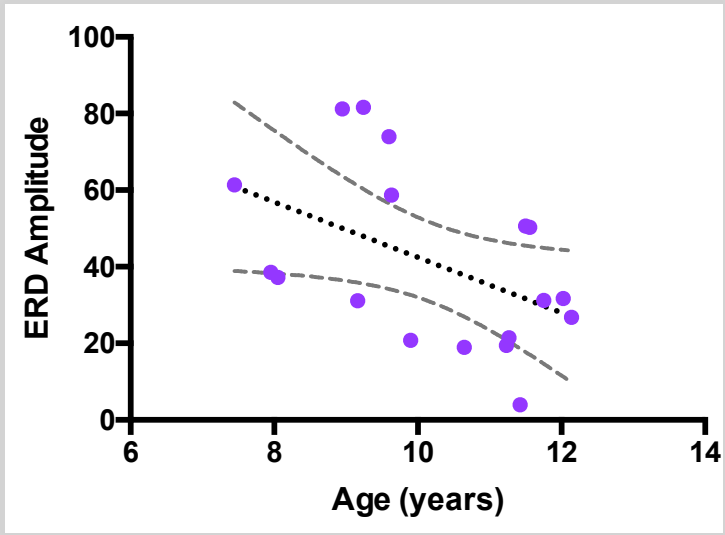

**Movement**

[0 ; 300ms]



Adults Children



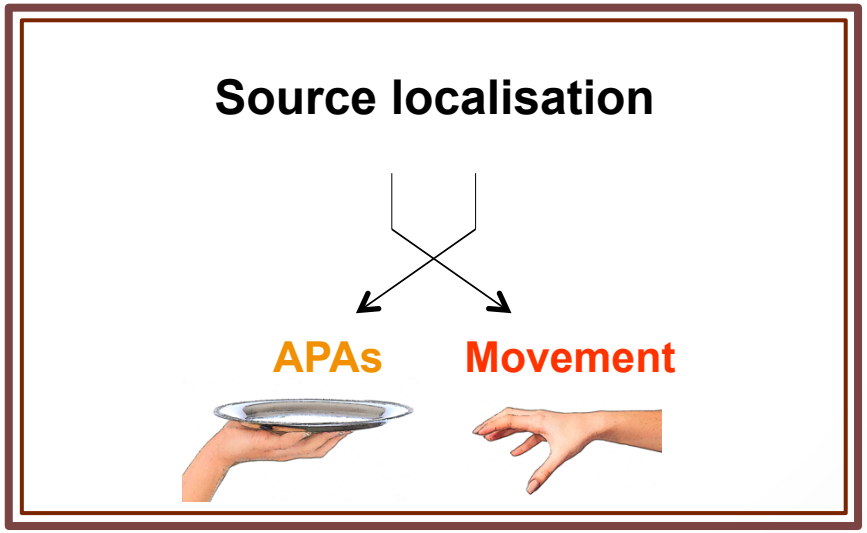



# Neurophysiological signature of the maturation of Anticipatory Postural Adjustements across childhood

★ **Sensors analysis in mu and beta rhythms:**

1. Lower Frequency spectrum in Children
2. Timing and Amplitude differences

*Immature anticipatory processes in children*



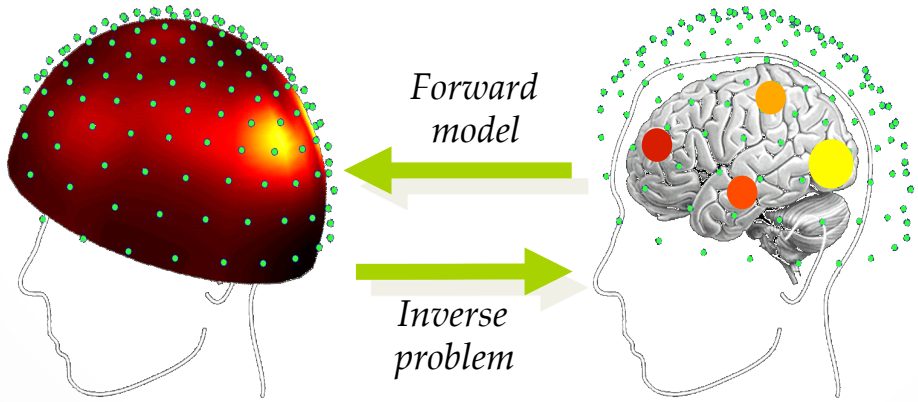
# MEG analysis

**1. Head motion :** Threshold > 0.8 mm

**2. Time-frequency analysis over the sensors**

Artefacts rejection : Independant Composante Analysis

**3. Source localisation**



# MEG analysis

**1. Head motion :** Threshold > 0.8 mm

**2. Time-frequency analysis over the sensors**

Artefacts rejection : Independant Composante Analysis

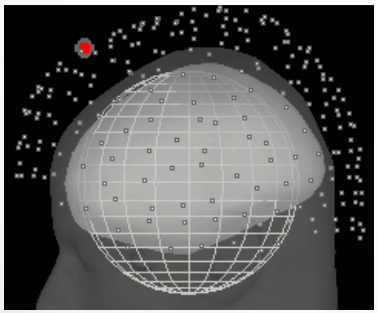
**3. Source localisation**

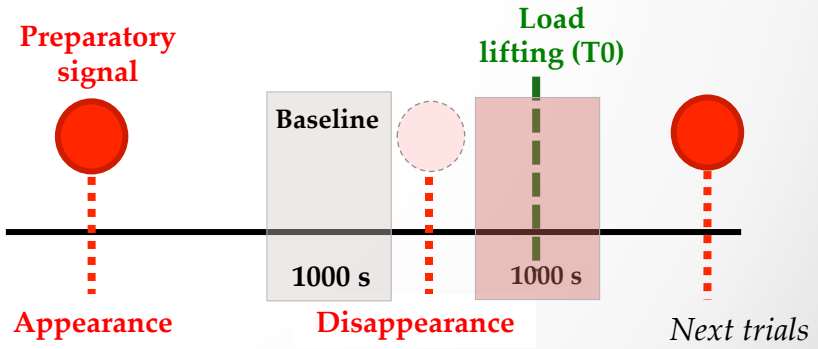
- Inverse Model : Beamformer approach (SAM)
- Forward Model

✦ Co-registration IRM & MEG

✦ Head Model

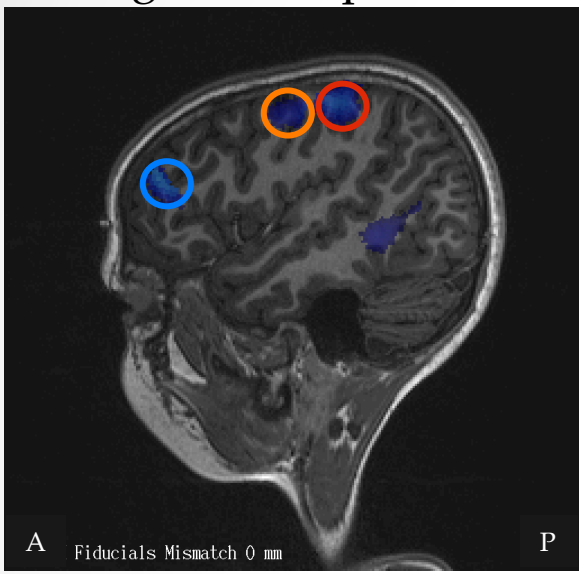
**Multiple Spherical Model**

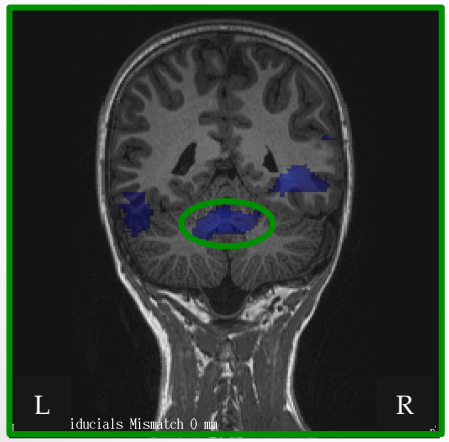


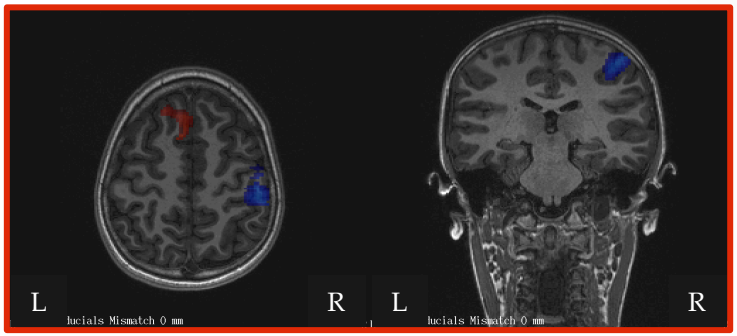


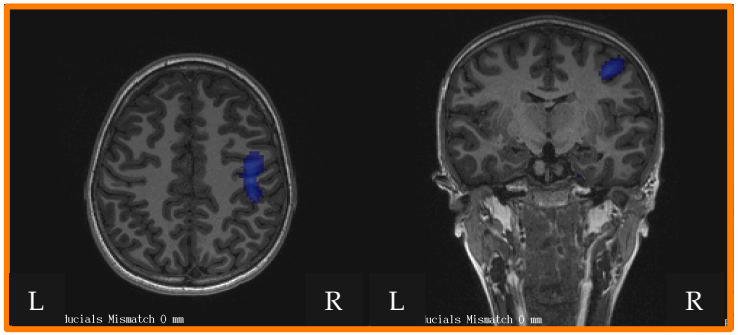
# Source localisation : Mu Rhythm

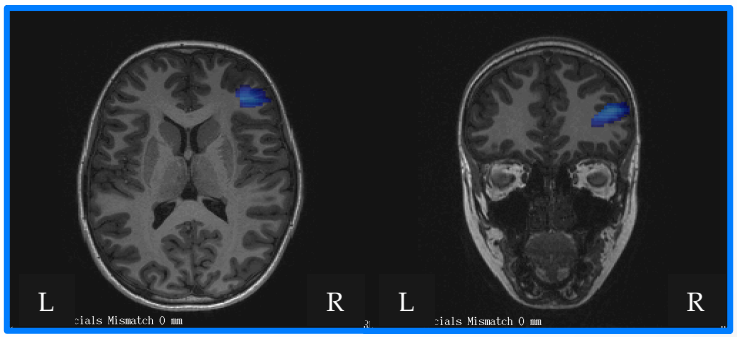
Rigth hemisphere



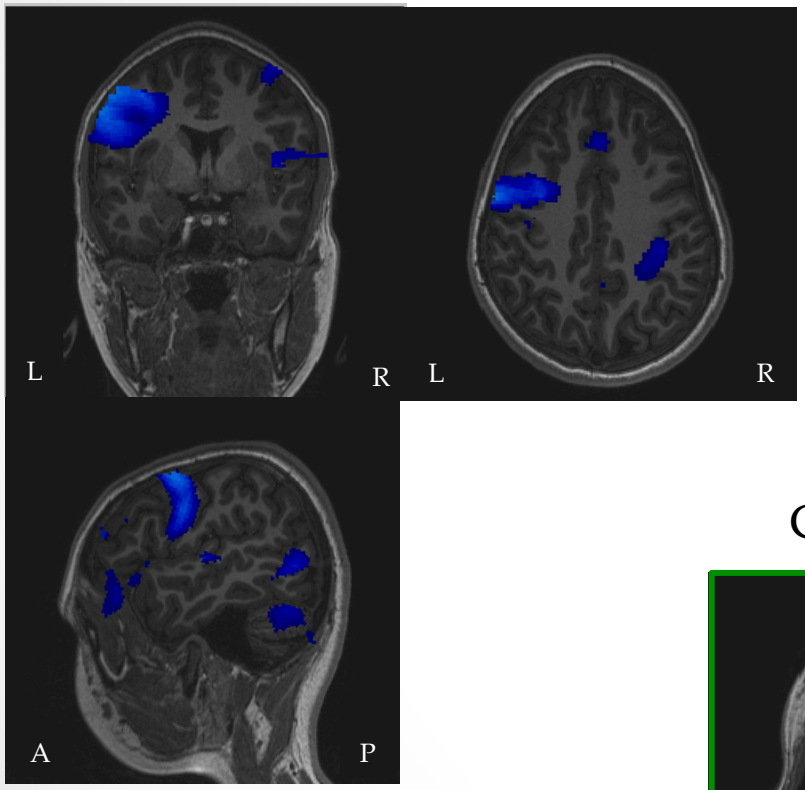



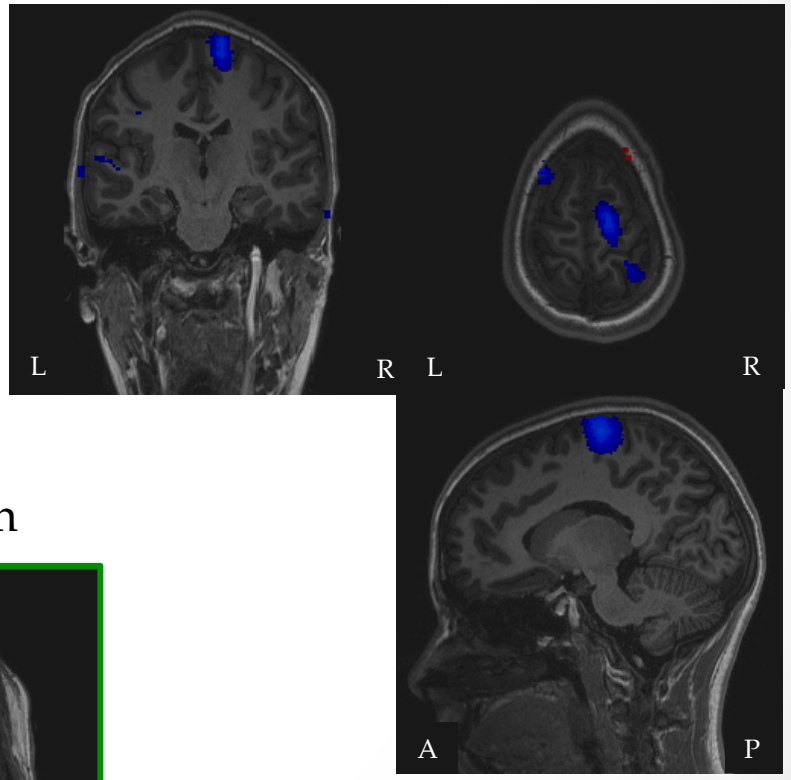



# Source localisation : Beta Rhythm

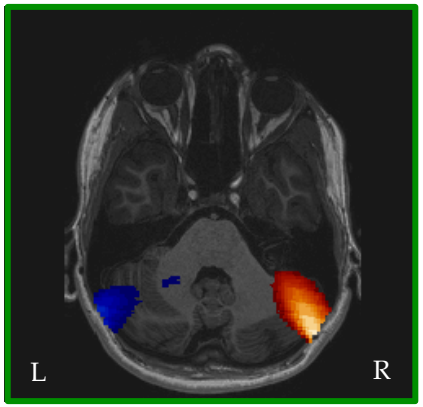
Left hemisphere




Right hemisphere




Cerebellum



# Neurophysiological signature of the maturation of Anticipatory Postural Adjustements across childhood

★ **Sensors analysis in mu and beta rhythms:**

1. Lower Frequency spectrum in Children
2. Timing and Amplitude differences

*Immature anticipatory processes in children*

★ **Cortical activations:** Preliminary results

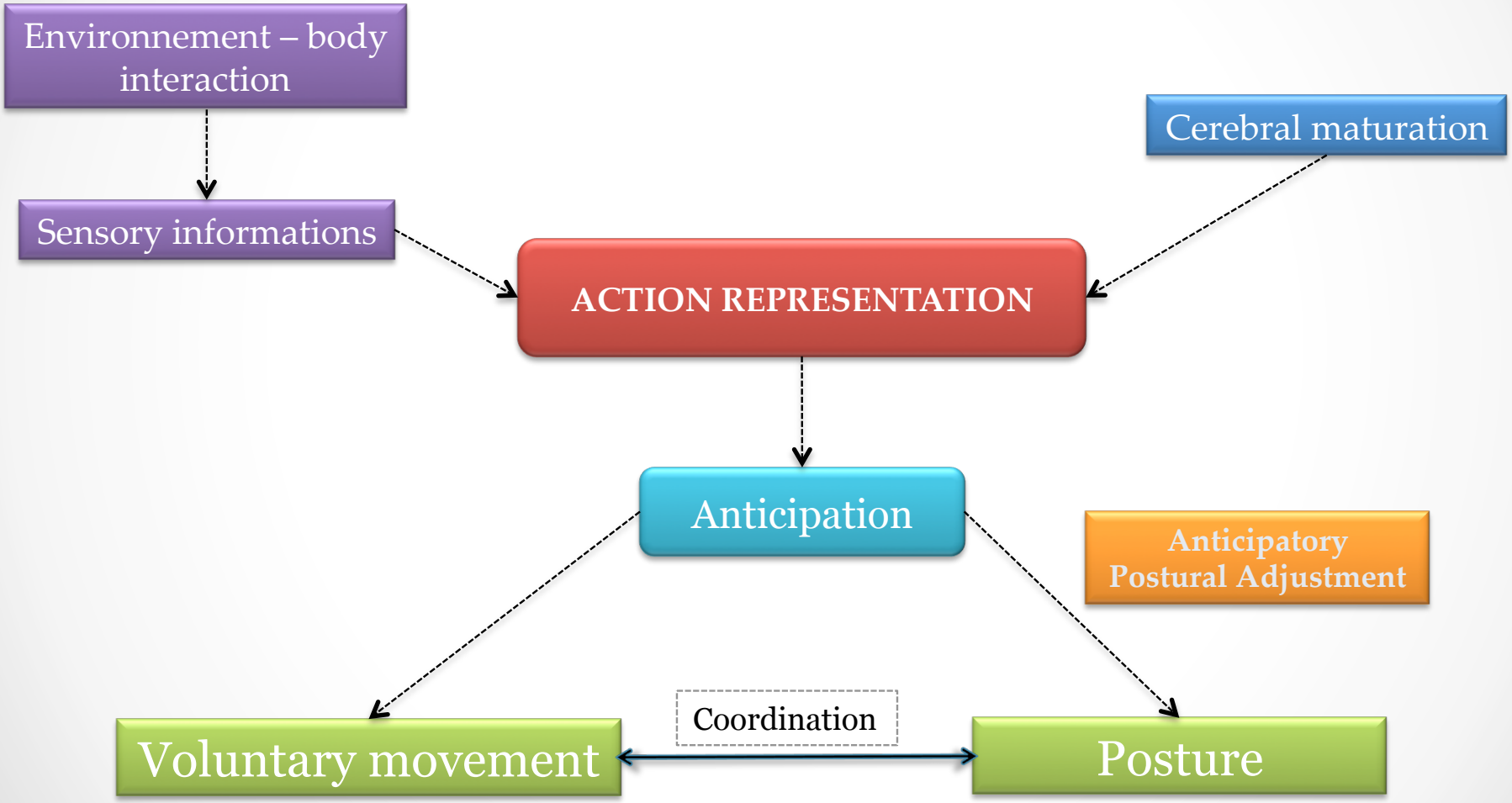
1. Mu rhythm : **ERD** in Right motor & somatosensory cortices, Right Premotor Cortex, Bilateral Anterior part of the cerebellum

*Networks involved in the APAs*

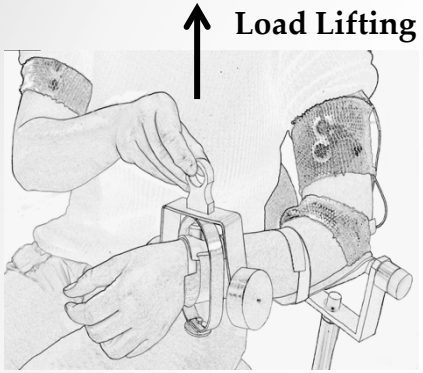
2. Beta rhythm :

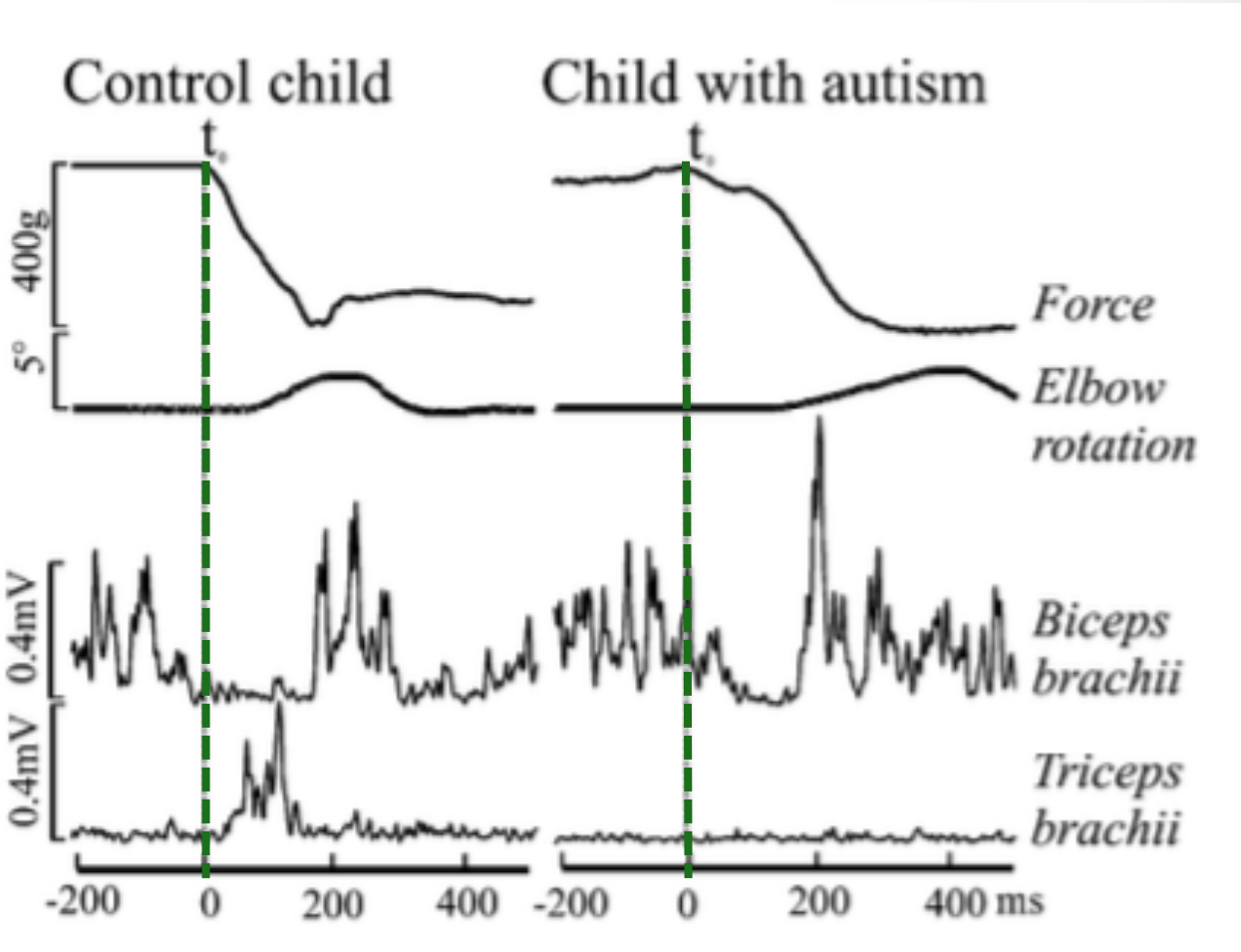
- **ERD** in Left motor cortex *Load lifting*
- **ERD** in Right SMA *APAs*
- Basal ganglia ? *Timing between APAs and movement ?*

# Action representation in Autism Children



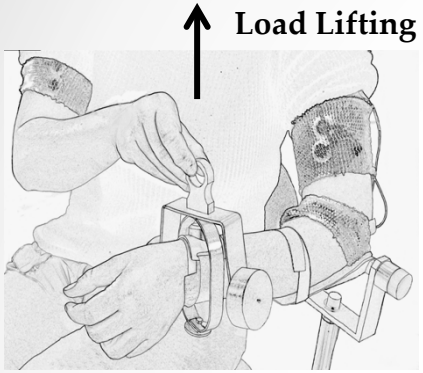
# Action representation in Autism Children



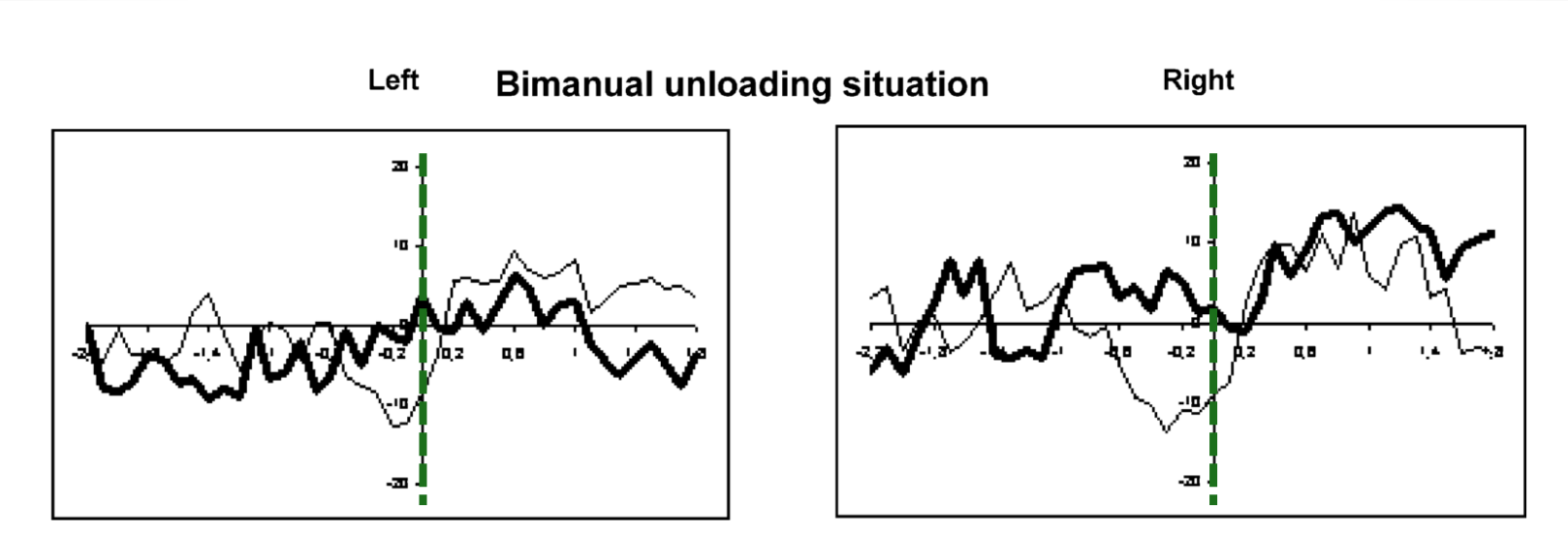




*Schmitz et al., 2003*

# Action representation in Autism Children




EEG




*Martineau et al., 2004*

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# Thanks for you attention !