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## Sensory Prediction and Repetition Suppression in the tactile modality as early markers of executive attention development at preschool age

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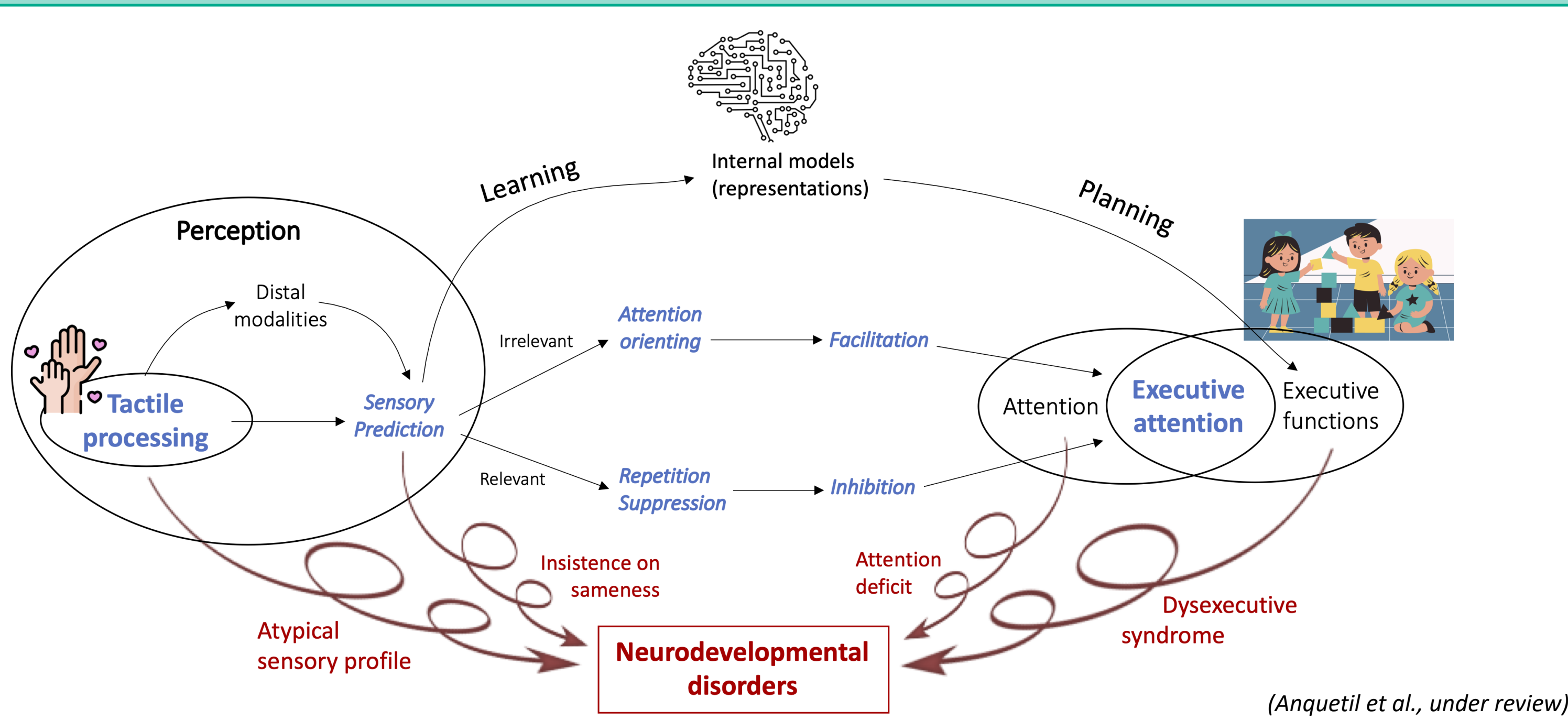


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## INTRODUCTION

- The **tactile modality**, the first to develop, is the foundation of cognitive development.
- **Sensory Prediction (SP)** is a core mechanism sustained by our perceptions and allows the brain to anticipate future stimulations on the basis of previous sensory inputs (Friston, 2005). Repetition Suppression (RS) refers to the reduction of activity in the brain when a predicted stimulus is repeated or becomes irrelevant.
- **Sensory Prediction in the tactile modality** was suggested as an early precursor of cognitive development (Dumont et al., 2022).
- **Predictive mechanisms may form the basis of executive attention** development by sustaining self-regulation processes such as habituation or anticipation (Bubic et al., 2010).

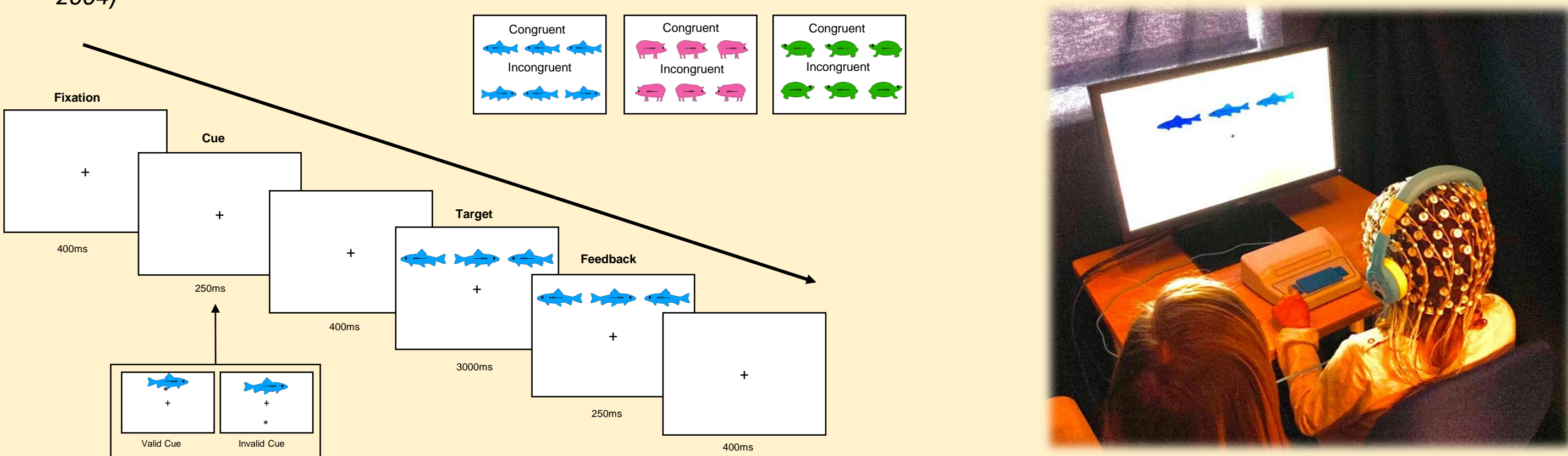
The aim of this study is to investigate how tactile prediction and other tactile processing phenomena are related to executive attention development at preschool age.



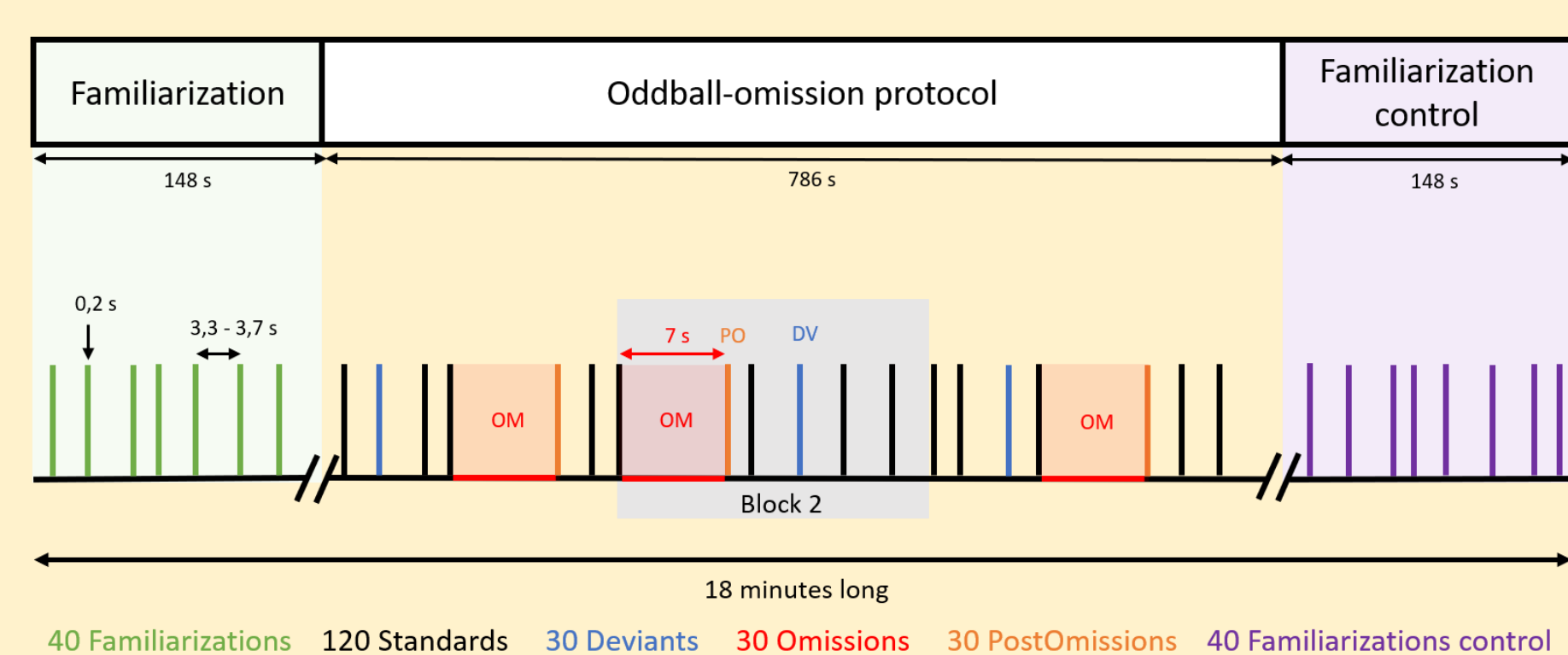
## METHODS

Children between 48 and 60 months perform the following tasks in random order while 128-electrodes electroencephalography (Magstim EGI) is being acquired:

- an adapted version of the **Child-Attention Network Task (ANT)**, a measure of executive attention (Rueda et al., 2004)



- a **tactile oddball-omission paradigm** (vibrotactile stimuli are presented on the forearm randomly interspersed with deviant and omitted stimuli).



- Children also perform the following behavioral tasks in random order :
- **Movement Assessment Battery for Children 2<sup>nd</sup> edition (MABC-2)**
  - **Stroop task** adapted for non-reading children (Wright et al., 2003)
  - **Head-Toes-Knees-Shoulders (HTKS)** task (McClelland et al., 2014)

Parents are also invited to complete 3 questionnaires : **Dunn's Full Sensory Profile**, **BRIEF-P** and **ESSENCE 2-5**.

We investigate the relationship between evoked potentials for executive attention (via the Child-ANT) and tactile sensory processing (via the oddball paradigm).

- For executive attention, we investigate the modulation of the **N2 component**, between **congruent** and **incongruent** conditions.
- For tactile sensory processing, we assess **repetition suppression**, i.e., the decrease in somatosensory evoked potential (SEP) between the **familiarization** and the **control sequence** during the oddball omission-paradigm in the somatosensory cortex. We also assess potentials evoked by **deviant** stimulations.

We also investigate the relationship between brain evoked potentials and behavioral measurements.

## CONCLUSION AND PERSPECTIVES

- During the Child-ANT, we observe **differences of N2 amplitude for atypical profiles of children**, associated with their performance on inhibitory control at the Stroop.
- We also demonstrate **RS and deviance detection in the tactile modality**.
- We find an association between **N140** in the tactile modality and **N2 amplitude**, but also with the executive composite score at the BRIEF-P, suggesting that **sensory regulation mechanisms could be markers of executive attention development**.

Such findings could help to promote new screening and remediation tools for children at-risk of atypical attentional development.

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## PRELIMINARY RESULTS

### AIMED POPULATION

60 children in kindergarten between 48 and 60 months

- 30 born at term with typical development
- 30 born prematurely and/or with atypical development

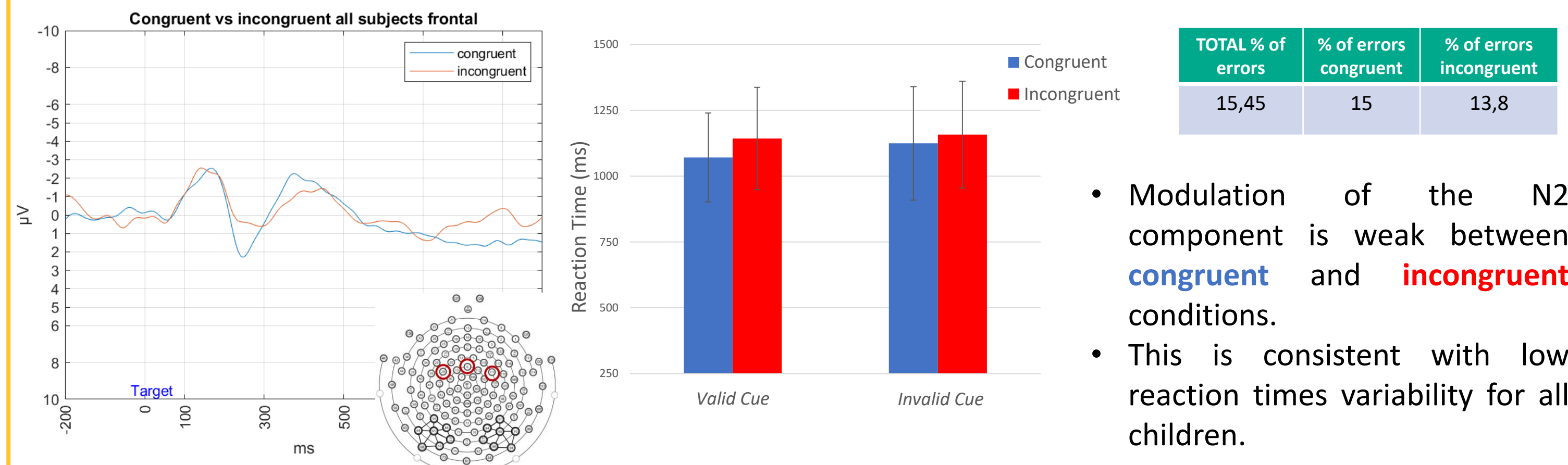
### CURRENT POPULATION

16 children in kindergarten between 48 and 60 months (4 ♀, 12 ♂; m=54 months ± 5 months)

- 10 born at term with typical development
- 6 born prematurely and/or with atypical development

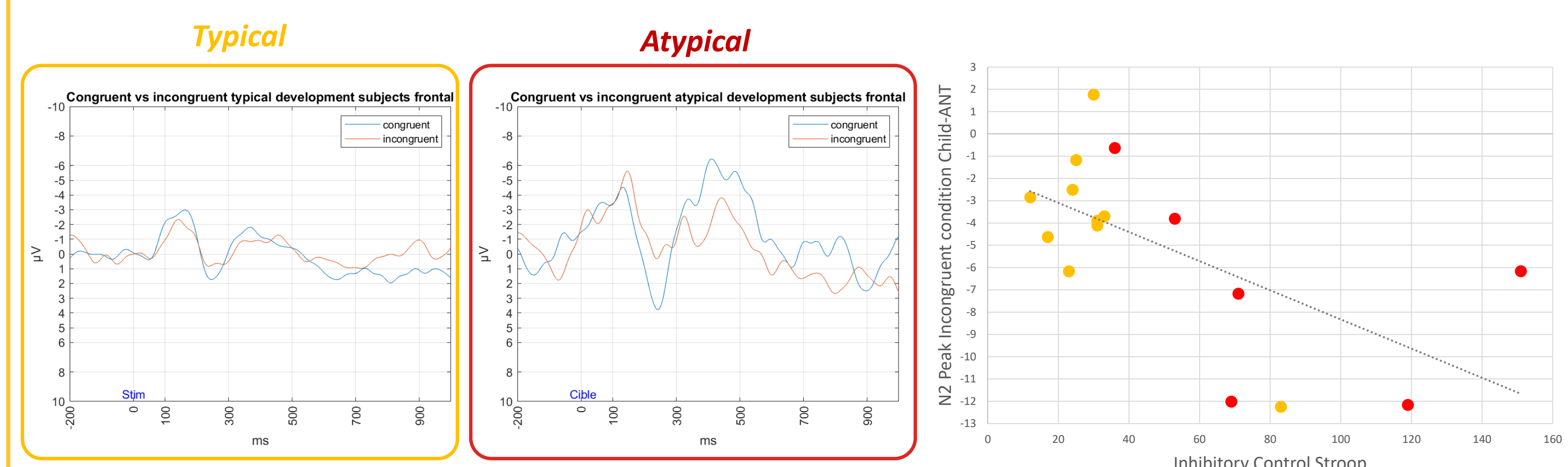


- **Frontal activity and behavioral performance at the executive attention task of the Child-ANT (all participants)**



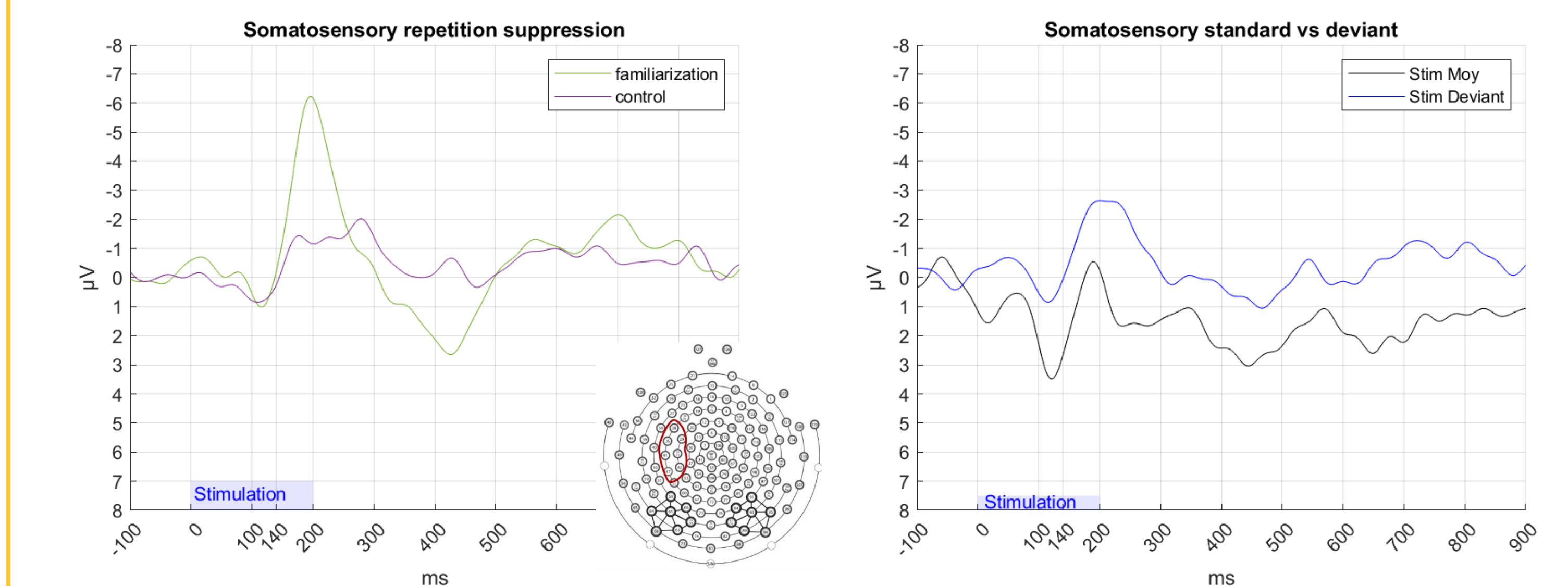
- Modulation of the **N2 component** is weak between **congruent** and **incongruent** conditions.
- This is consistent with low reaction times variability for all children.

- **Executive attention as a function of group, and as a function of inhibition**



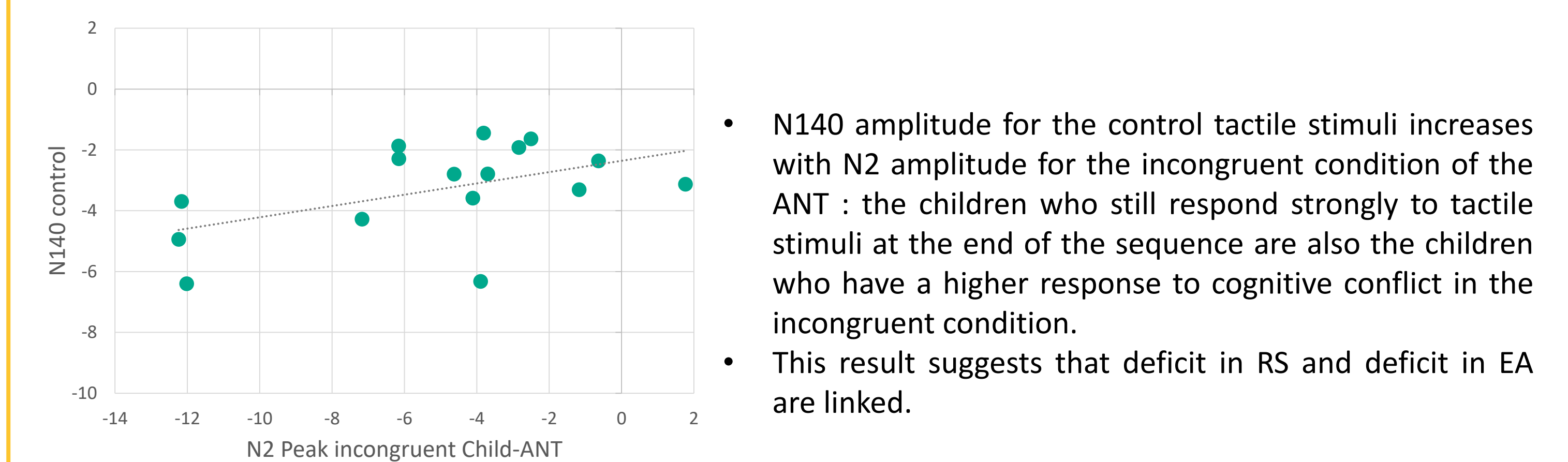
- The **N2 component** is larger for both conditions in children with atypical development or born prematurely.
- The peak amplitude of **N2** in the incongruent condition is positively related with inhibitory control performance at the Stroop task.

- **Tactile sensory processing (all participants)**



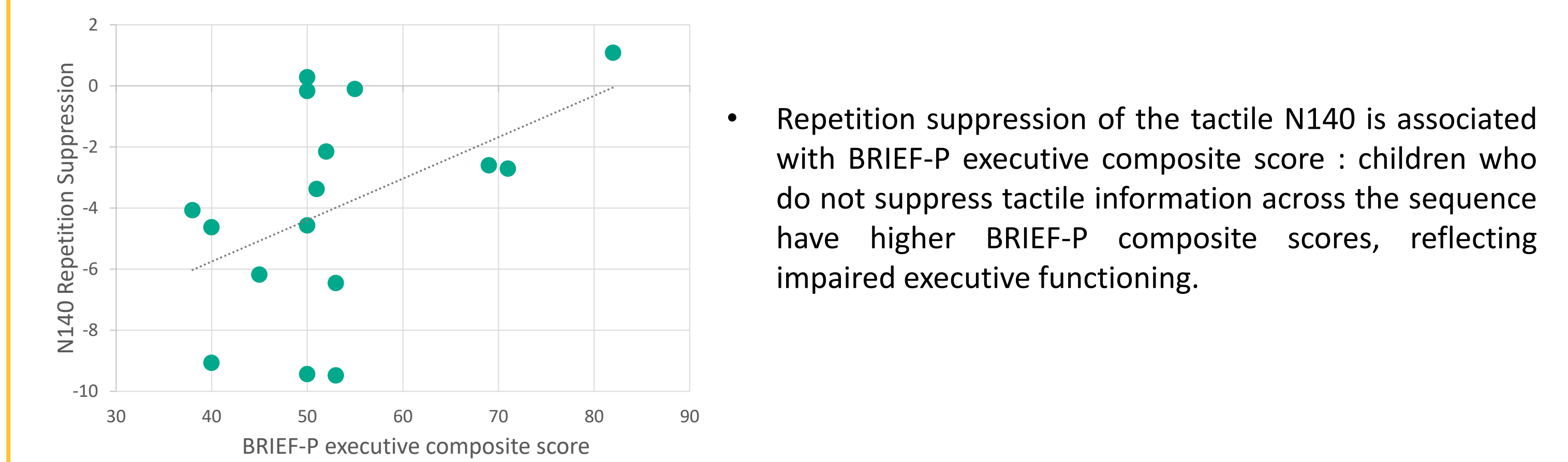
- **Repetition suppression** : the amplitude of SEP at **N140** decreases across the sequence.
- **Deviance detection** : the amplitude of SEP at **N140** during **deviant** stimulations is higher compared to an equal number of standard stimulations.

- **Tactile processing as a function of executive attention**



- **N140 amplitude** for the control tactile stimuli increases with **N2 amplitude** for the incongruent condition of the ANT : the children who still respond strongly to tactile stimuli at the end of the sequence are also the children who have a higher response to cognitive conflict in the incongruent condition.
- This result suggests that deficit in **RS** and deficit in **EA** are linked.

- **Tactile repetition suppression as a function of executive functions**



- **Repetition suppression** of the tactile **N140** is associated with **BRIEF-P executive composite score** : children who do not suppress tactile information across the sequence have higher **BRIEF-P composite scores**, reflecting impaired executive functioning.

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