



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

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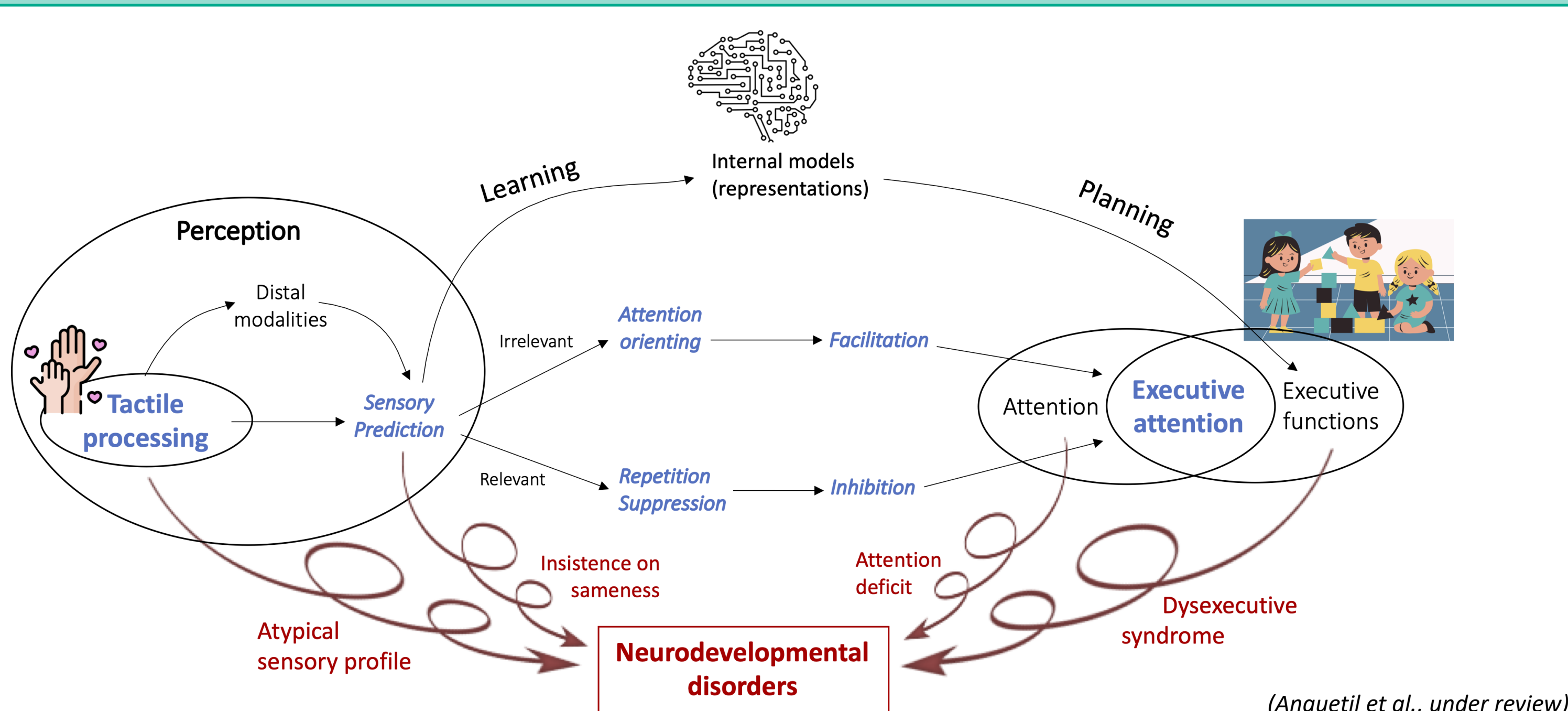


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INTRODUCTION

- 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.

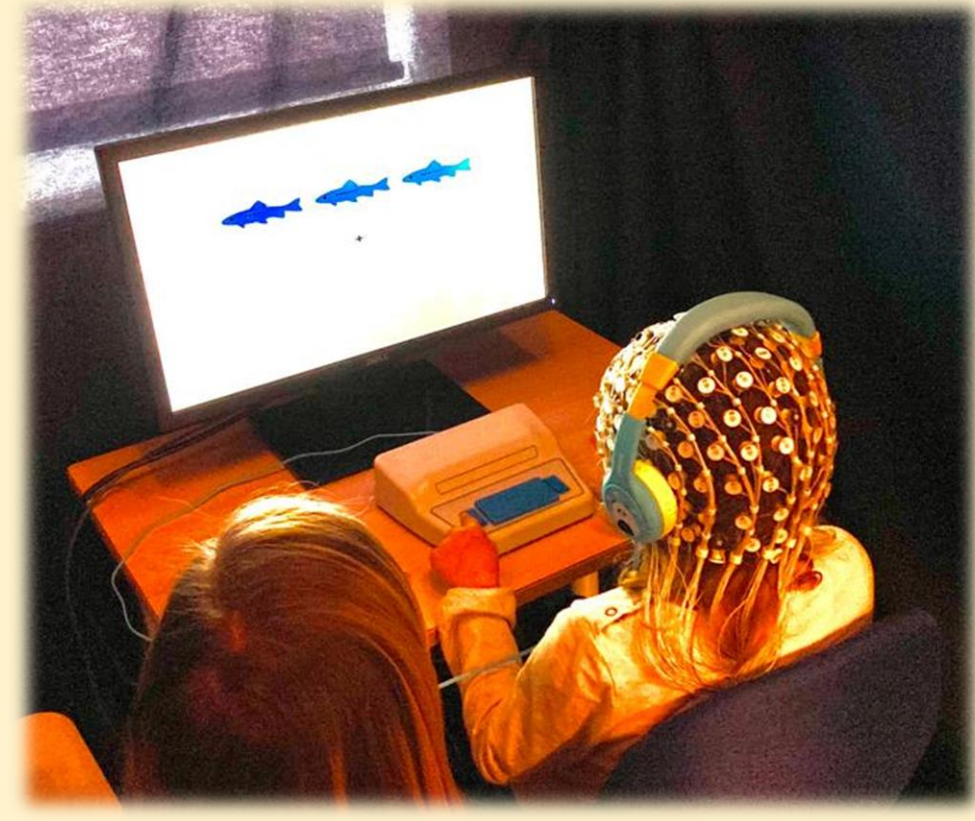
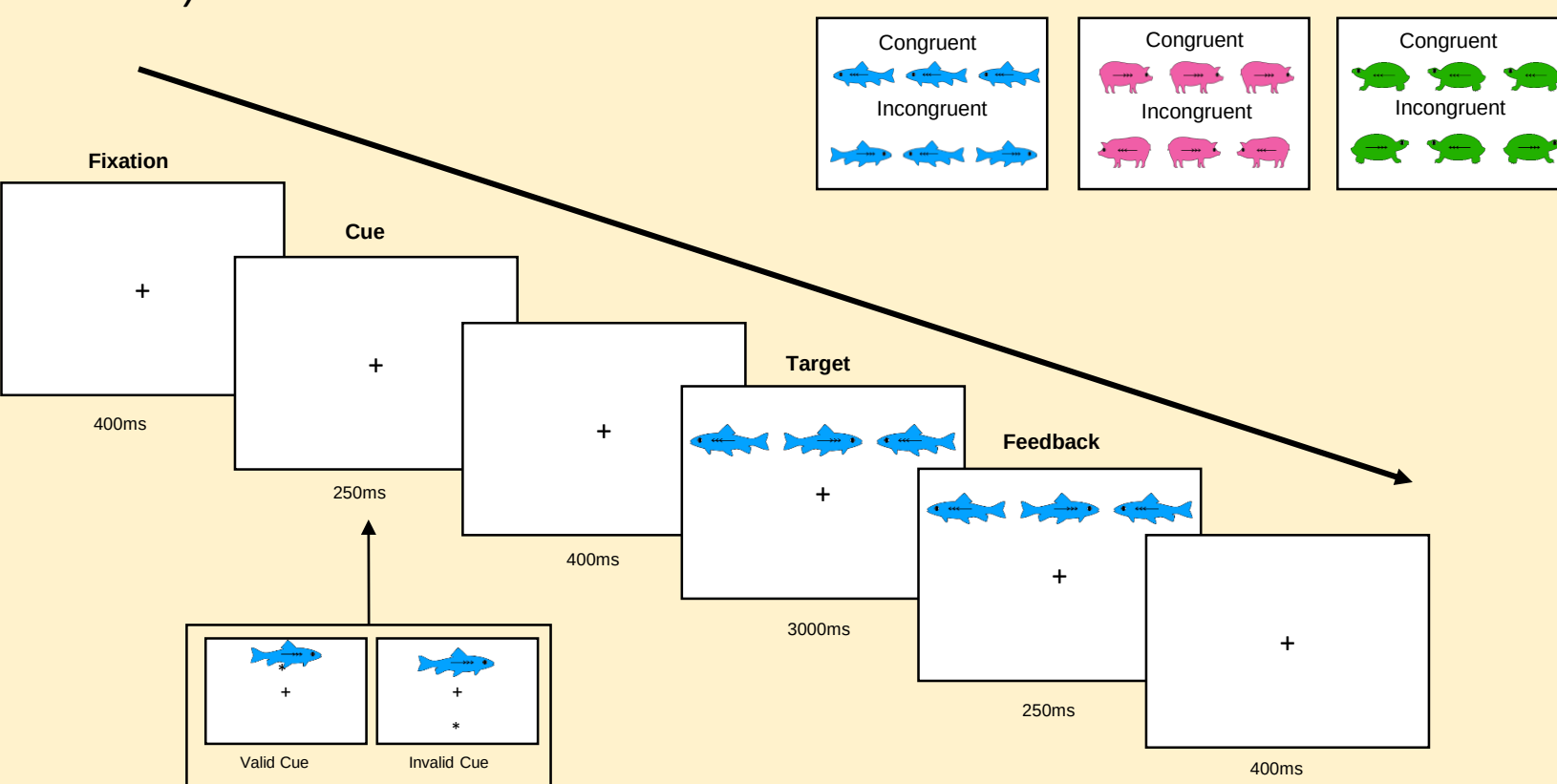


(Anquetil et al., under review)

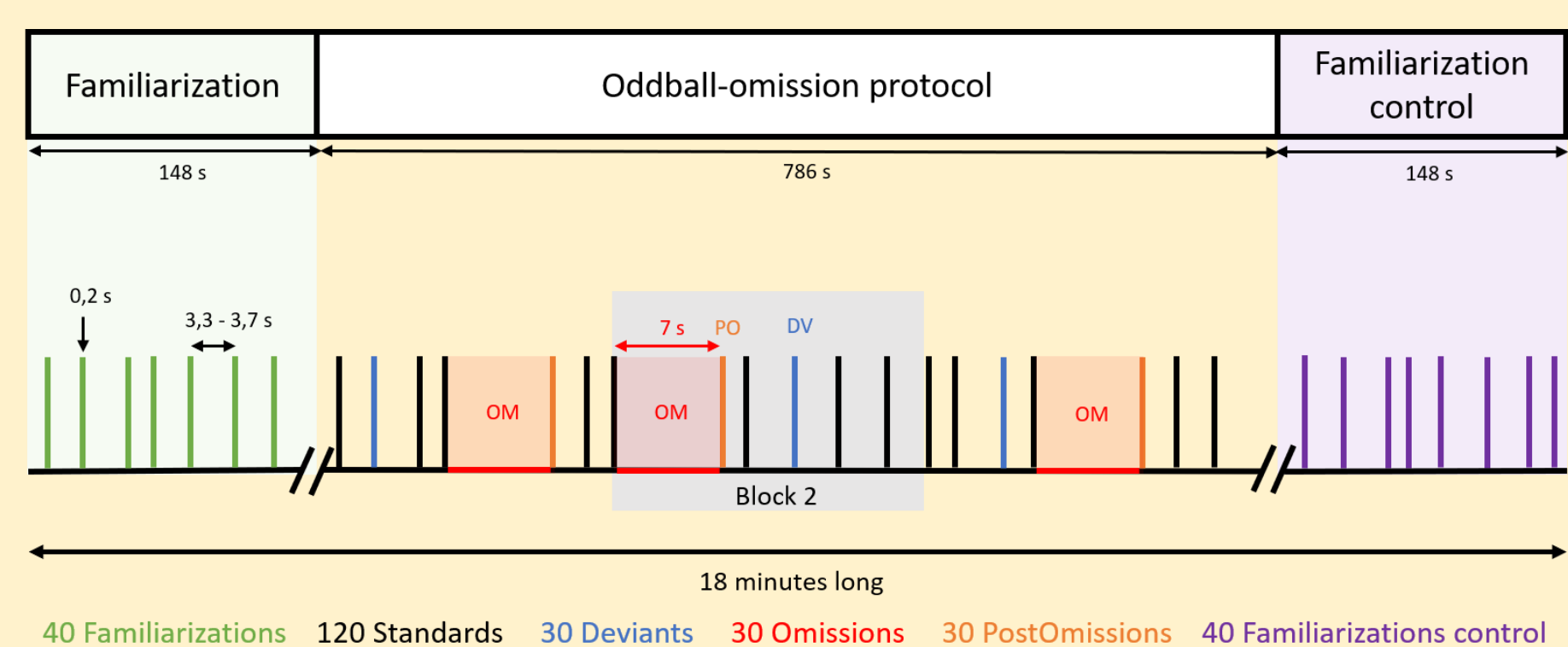
METHODS

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 2nd 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.

REFERENCES

- Anquetil, M., Roche-Labarbe, N. & Rossi, S. (under review). Tactile sensory processing as a precursor of executive attention : towards early detection of attention impairments and neurodevelopmental disorders. *Wires Cognitive Science*.
- Bubic, A., Von Cramon, D. Y., & Schubotz, R. I. (2010). Prediction, cognition and the brain. *Frontiers in Human Neuroscience*, 4.
- Dumont V., Giovannella M., Zuba D., Clouard R., Durduran T., Guillois B. and Roche-Labarbe N. (2022). Somatosensory prediction in the premature neonate brain. *Developmental Cognitive Neuroscience* (accepted article).
- Friston, K. (2005). A theory of cortical responses. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360(1456), 815-836.
- McClelland, M. M., Cameron, C. E., Duncan, R., Bowles, R. P., Acoc, A. C., Miao, A., & Pratt, M. E. (2014). Predictors of early growth in academic achievement : The head-toes-knees-shoulders task. *Frontiers in Psychology*, 5.
- Rueda, M. R., Fan, J., McCandless, B. D., Halparin, J. D., Gruber, D. B., Lercari, L. P., & Posner, M. I. (2004). Development of attentional networks in childhood. *Neuropsychologia*, 42(8), 1029-1040.
- Wright, I., Waterman, M., Prescott, H., & Murdoch-Eaton, D. (2003). A new Stroop-like measure of inhibitory function development: Typical developmental trends. *Journal of Child Psychology and Psychiatry*, 44(4), 561-575.

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

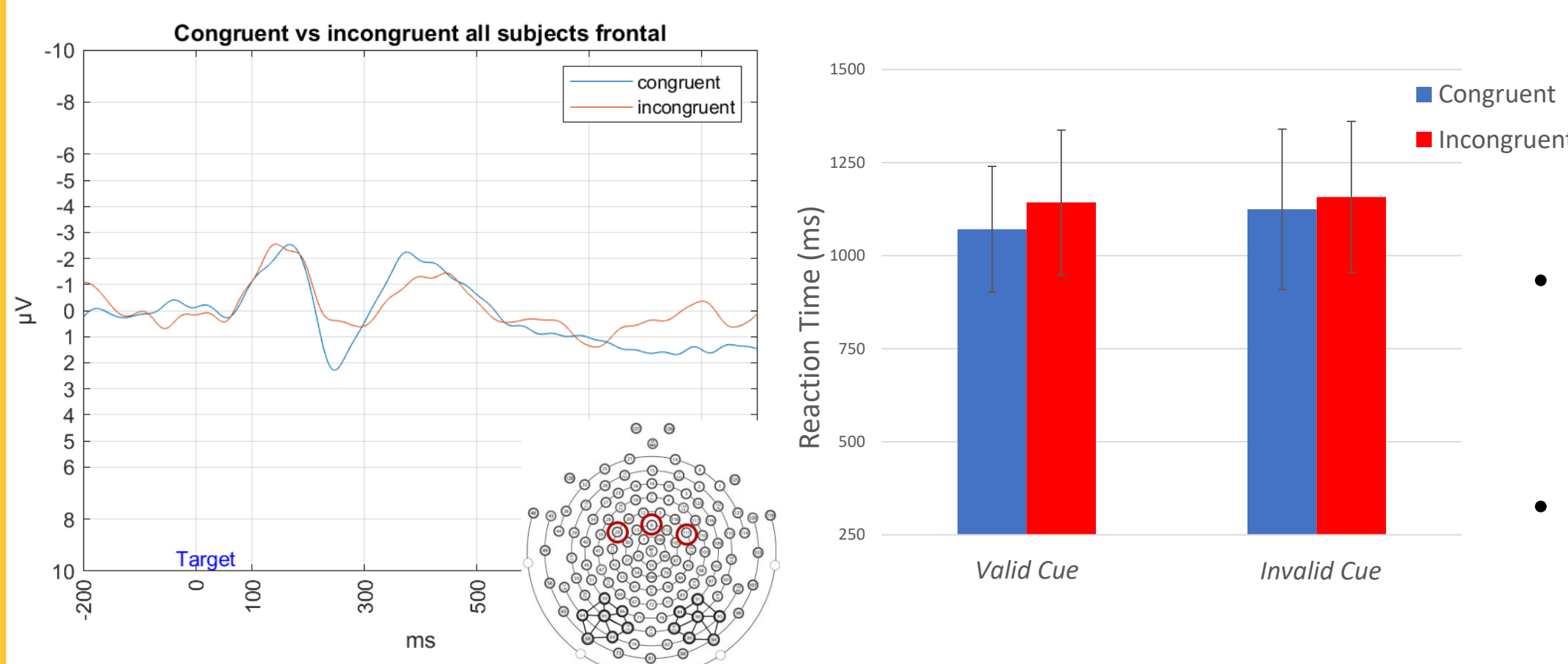
16 children in kindergarten between 48 and 60 months (4 ♀, 12 ♂ ; m= 54 months ± 5 months)

10 born at term with typical development



6 born prematurely and/or with atypical development

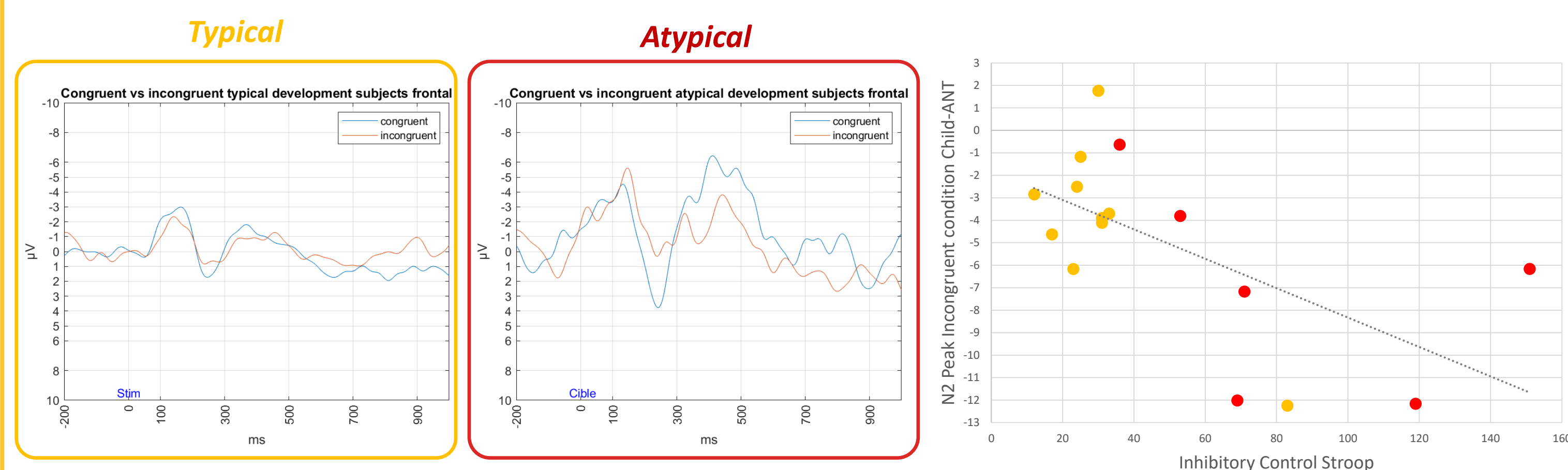
- **Frontal activity and behavioral performance at the executive attention task of the Child-ANT (all participants)**



TOTAL % of errors	% of errors congruent	% of errors incongruent
15,45	15	13,8

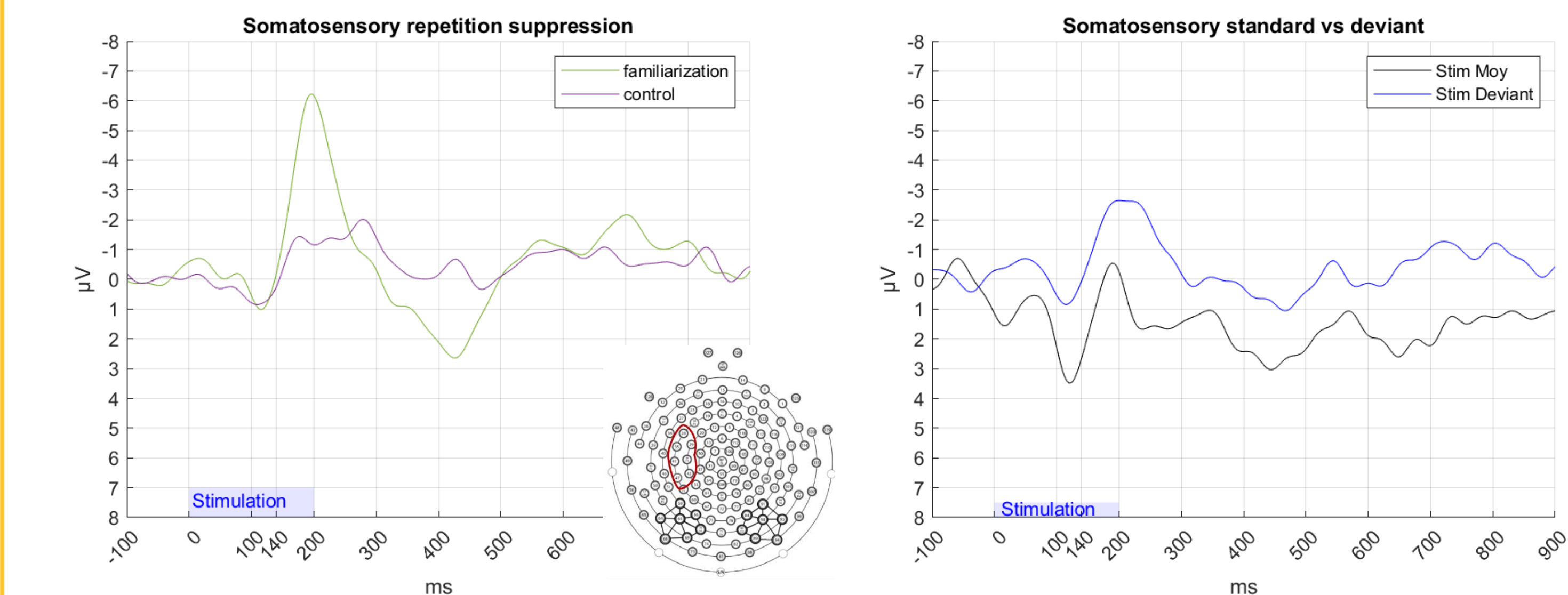
- Modulation of the N2 component is weak between **congruent** and **incongruent** conditions.
- This is consistent with low reaction times variability for all children.

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



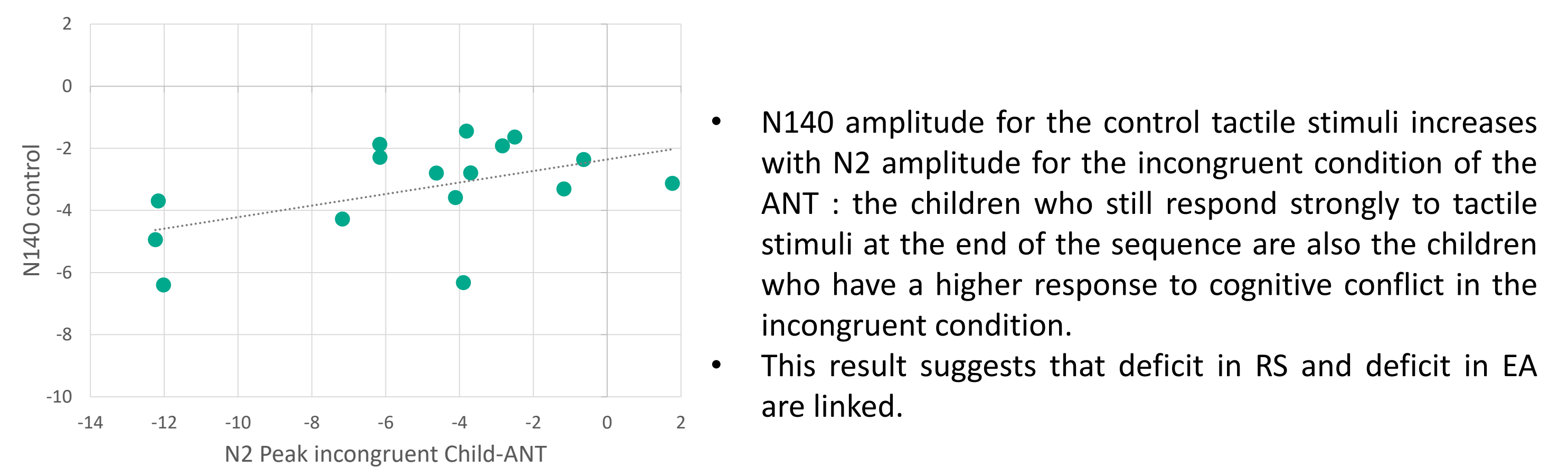
- The N2 component is larger for both conditions in children with atypical development or born prematurely.
- The peak amplitude of N2 in the incongruent condition is positively related with inhibitory control performance at the Stroop task.

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



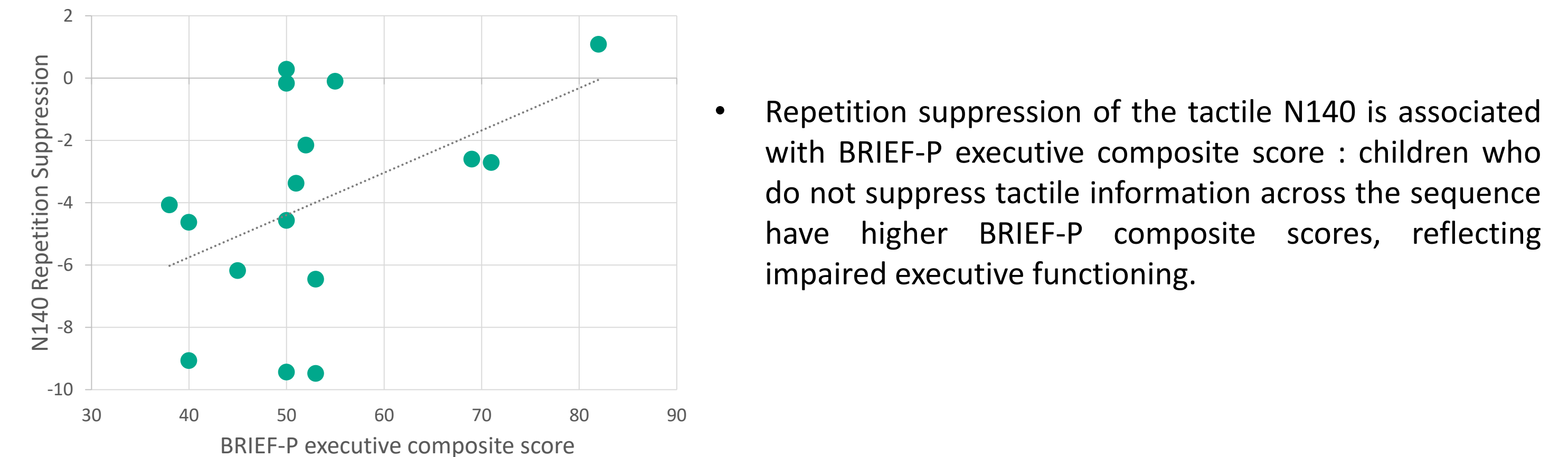
- **Repetition suppression** : the amplitude of SEP at N140 decreases across the sequence.
- **Deviance detection** : the amplitude of SEP at N140 during **deviant** stimulations is higher compared to an equal number of standard stimulations.

- **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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