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# IS TACTILE PERCEPTION RELATED WITH ATTENTION DEVELOPMENT?

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## BACKGROUND

- **Touch**, the first sense to develop, is the **foundation of cognitive development** (Rigato et al., 2017).
- **Prediction in the tactile modality** was suggested as an early precursor of cognitive development (Dumont et al., 2022).
- Predictive mechanisms, such as sensory prediction or repetition suppression (RS), allows exogenous forms of attention.
- Attention sustains the development of executive functions, which develops rapidly during the preschool period.
- **Deficits of attention** are frequently reported in **neurodevelopmental disorders (NDD)** in conjunction with an **atypical sensory profile**, which particularly affects the **somesthetic senses** (Casco, 2010).

## AIM OF THE PROJECT

**IDENTIFY BEHAVIORAL AND CEREBRAL MARKERS OF ATTENTION DEVELOPMENT AT PRESCHOOL AGE THROUGH TACTILE SENSORY PROCESSING**

## BEHAVIORAL STUDY

51 children in kindergarten between 48 and 71 months (25 ♀, 26 ♂; m = 59 months ± 6 months)

### METHODS

- Adapted version of the Child Attention Network Task (ANT), a computerized task assessing different forms of attention, including executive attention (Rueda et al., 2004).
- Stroop adapted for non-reading children and the HTKS, two inhibitory control tasks (Wright et al., 2003; McClelland et al., 2014).
- Parental questionnaires: Dunn Sensory Profile and BRIEF-P, an executive functions inventory.

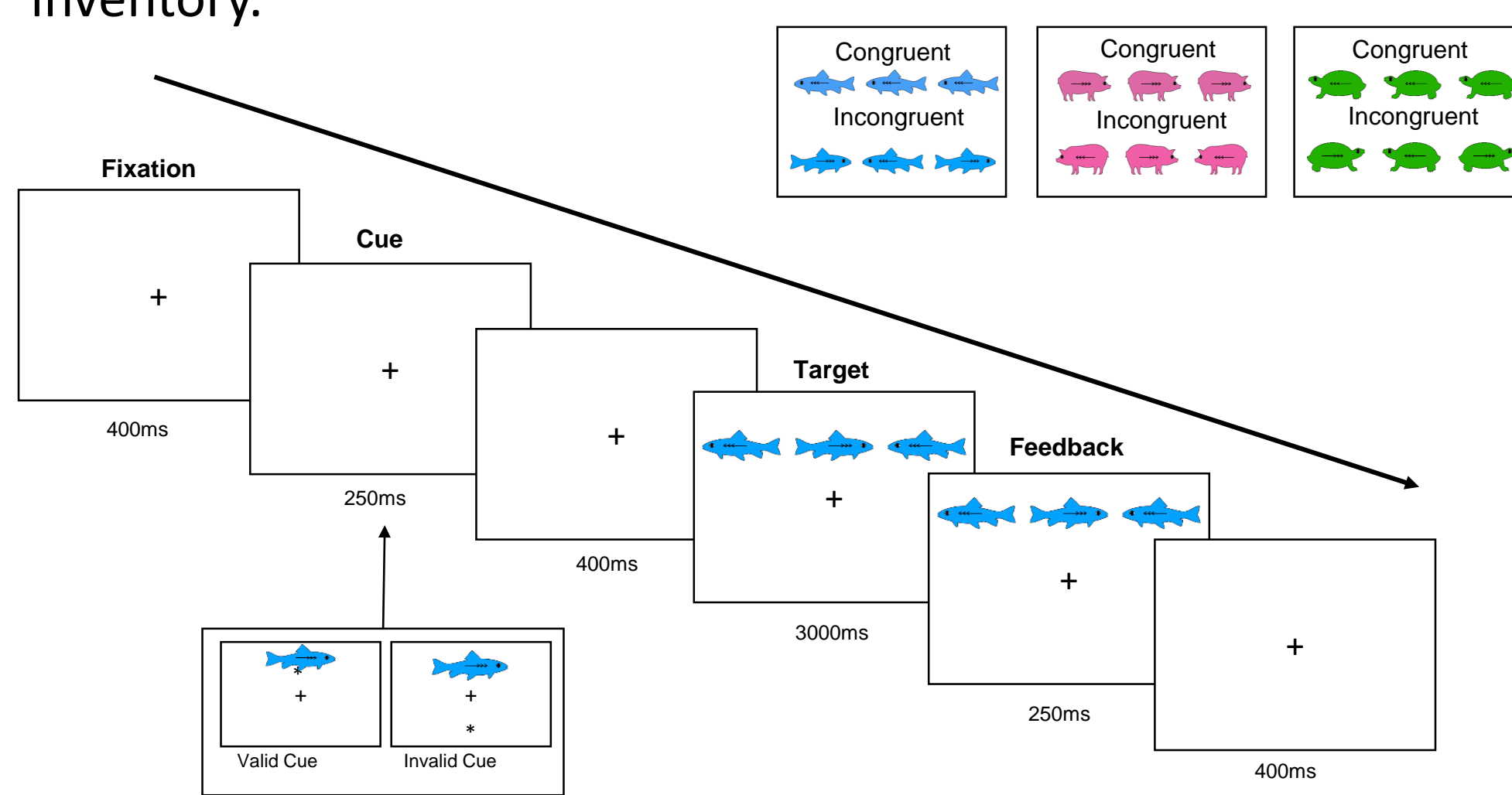


Figure 1 : Experimental design of the Child-ANT

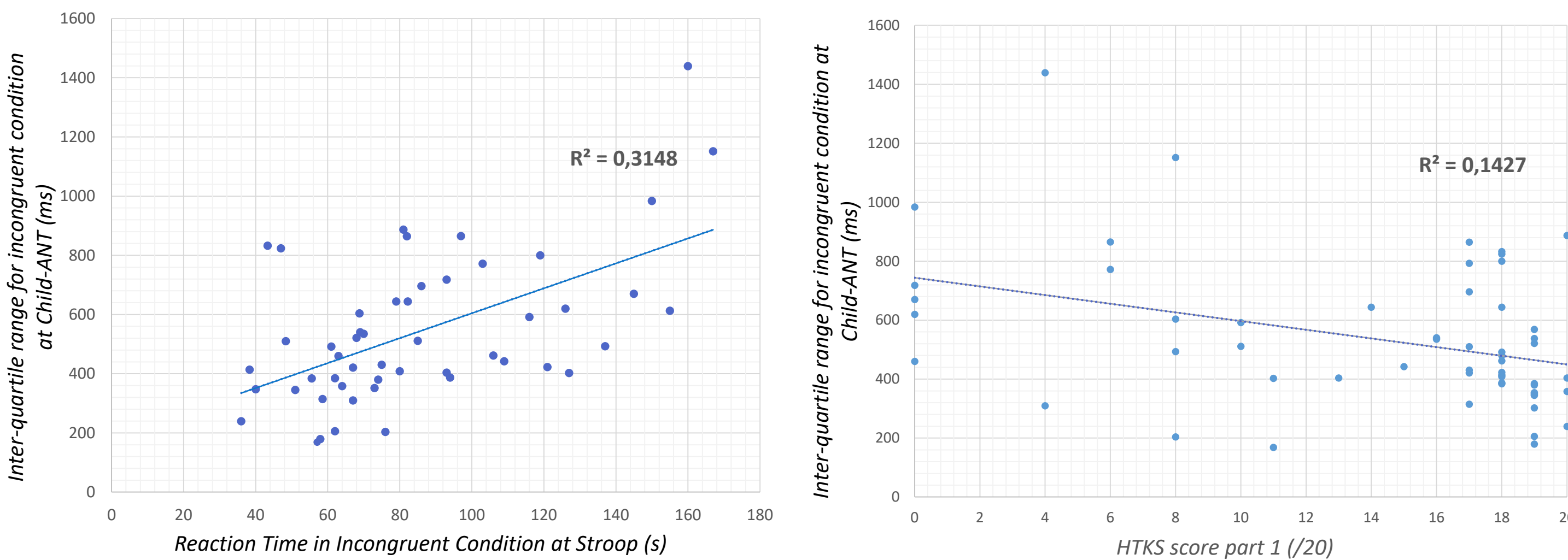


Figure 2 : A participant during the Stroop (at the top) and HTKS (at the bottom)

## RESULTS

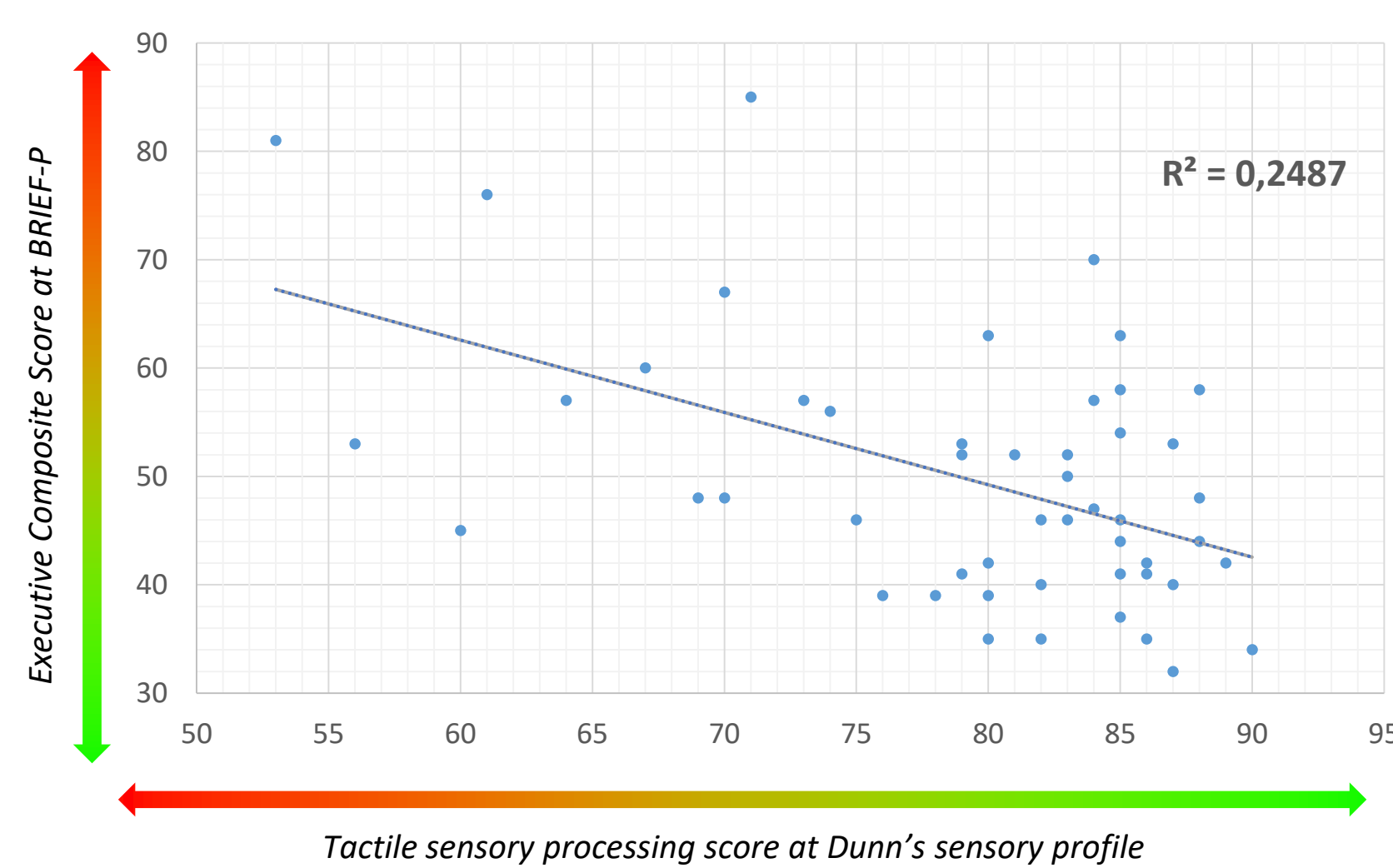
### 1 - Validation of the Child-ANT designed for preschool children

The data were analyzed in regression using the generalized linear model.



- Children with the most variable reaction times to the Child-ANT have longer reaction times in the incongruent condition of the Stroop ( $t(49) = 4,74$ ;  $p < .001$ ;  $b = 0,56$ ) and are in greater failure on the HTKS ( $t(49) = -2,91$ ;  $p = .005$ ;  $b = -0,38$ ).
- Children performance at Child-ANT, measuring executive attention, is associated with performance on inhibitory control tasks.

### 2 – Relation between Dunn's Sensory Profile and BRIEF-P



- Children with the most atypical scores on the BRIEF-P executive composite score also have lower tactile sensory processing scores on the Sensory Profile questionnaire ( $t(45) = -4,34$ ;  $p < .001$ ;  $b = -0,54$ ).
- Tactile sensory processing is related with executive functions in everyday situations but not in performance tasks.

## EEG STUDY

15 children in kindergarten between 48 and 60 months (4 ♀, 11 ♂; m = 54 months ± 5 months)

### METHODS

- Electroencephalography (EEG) recording during the Child-ANT and a tactile perception task (an oddball omission paradigm)
- Behavioral measurements : Stroop, HTKS and M-ABC 2 ( a battery for movement assessment)
- Parental questionnaires: ESSENCE 2-5, Dunn Sensory Profile and BRIEF-P

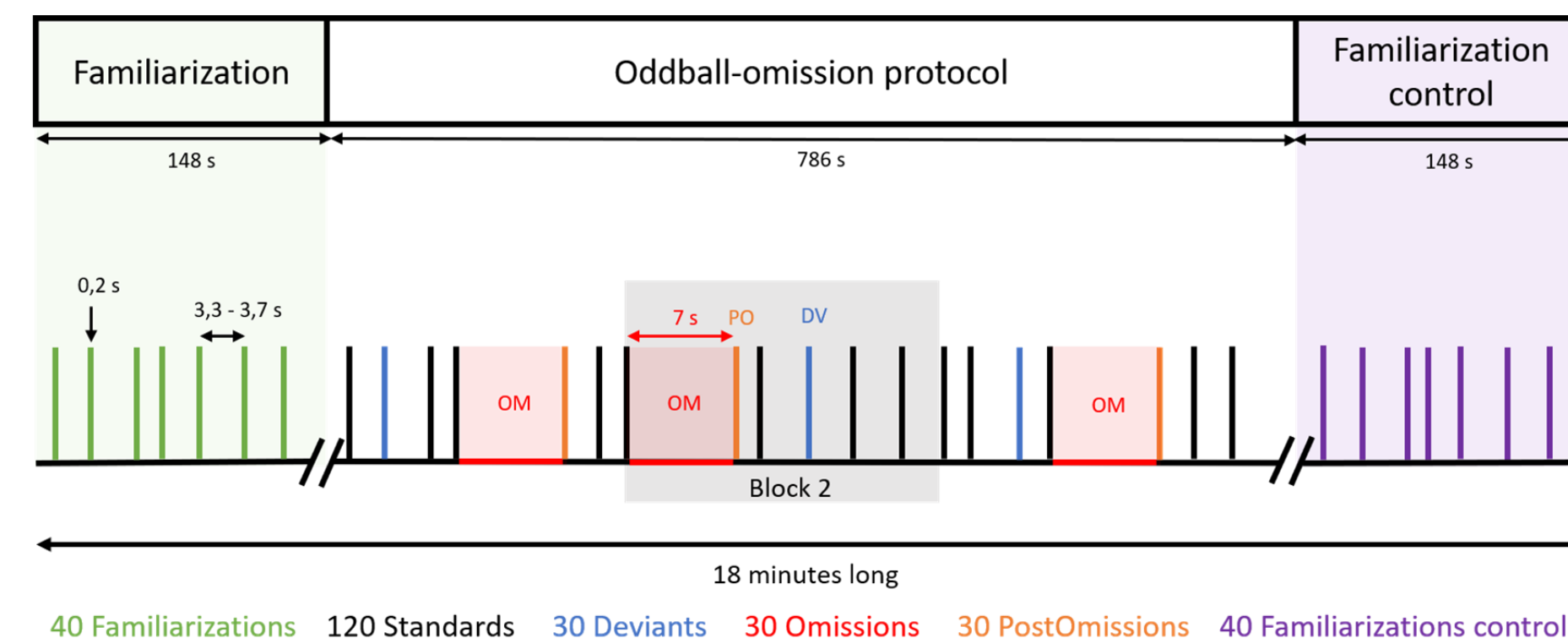


Figure 3: Tactile oddball-omission paradigm



Figure 4 : A participant with EEG and vibratory matrix (left) and the vibratory matrix designed by Caylar (right)

## DESCRIPTIVE RESULTS

- For executive attention, we investigate modulation of the N2 component, between **congruent** and **incongruent** conditions at the Child-ANT in the frontal cortex.
- For tactile sensory processing, we investigate RS, i.e, if there is a decrease in neural response between the **familiarization** and the **control sequence** during the oddball omission-paradigm in the somatosensory cortex. We also investigate electrical activity during **deviant** stimulations.

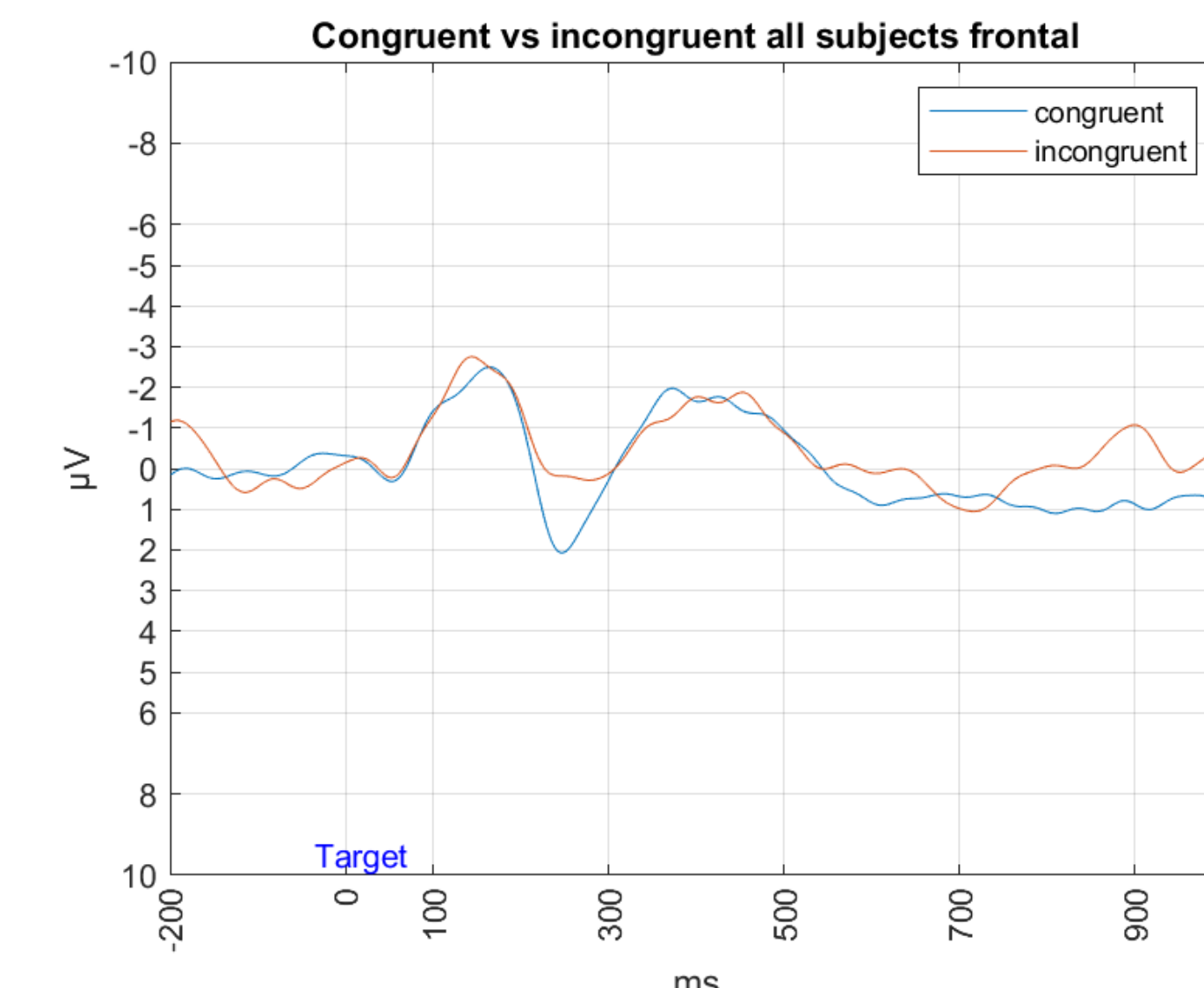


Figure 5 : Variations of cerebral amplitudes between congruent and incongruent condition during the Child-ANT

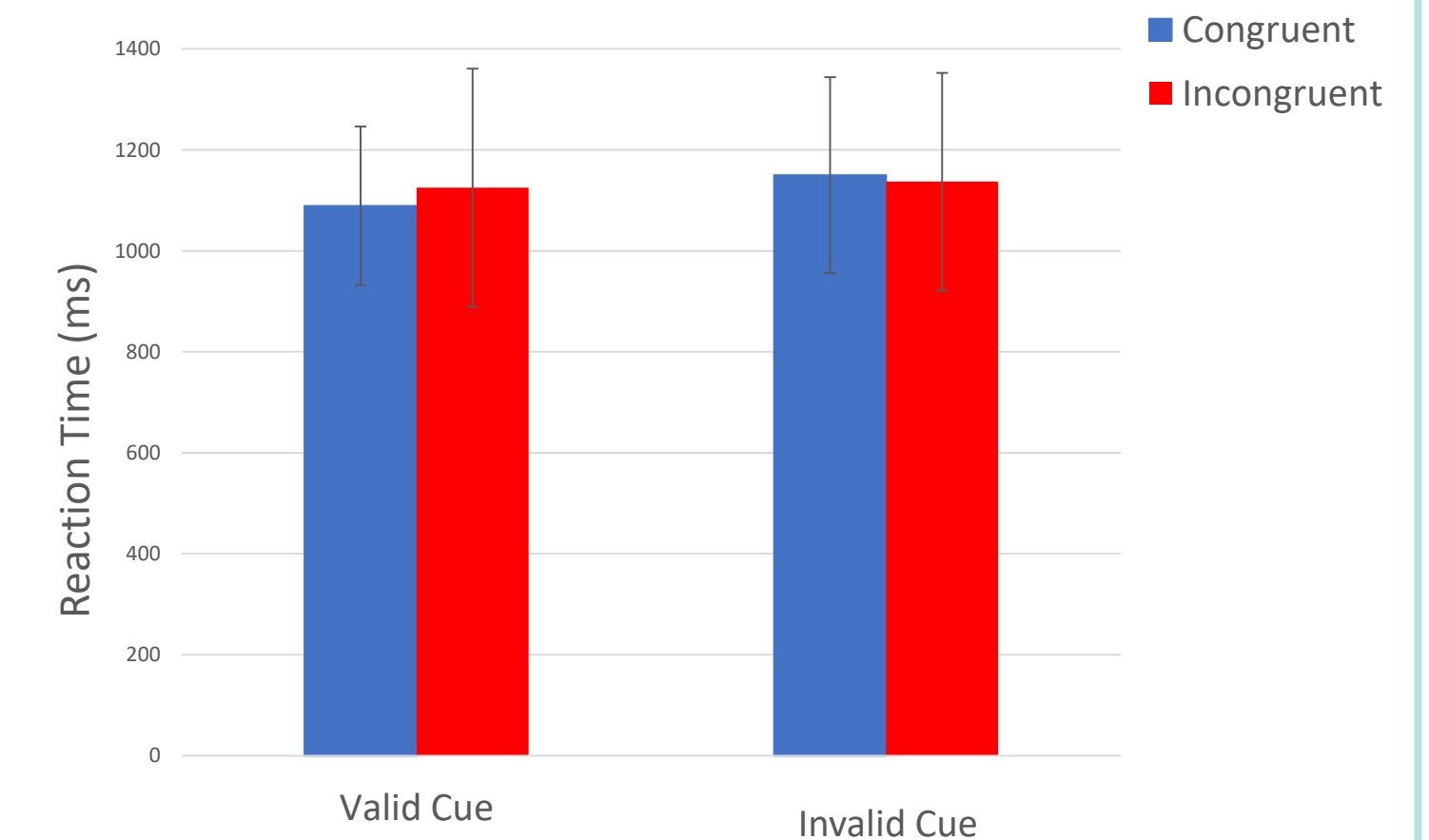


Figure 6 : Variations of reaction time between congruent and incongruent condition during the Child-ANT according to cue validity

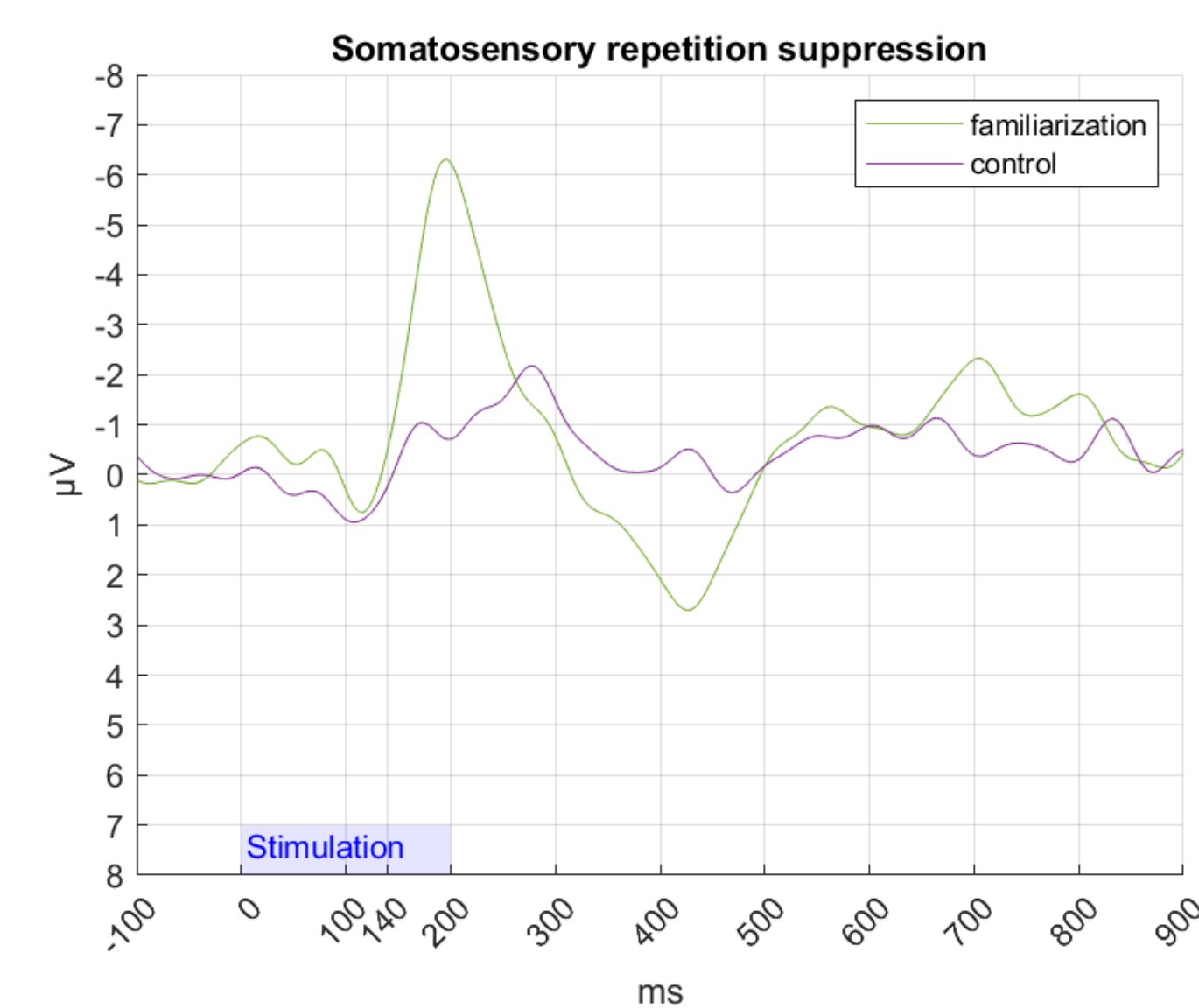


Figure 7: Repetition suppression during the oddball-omission paradigm

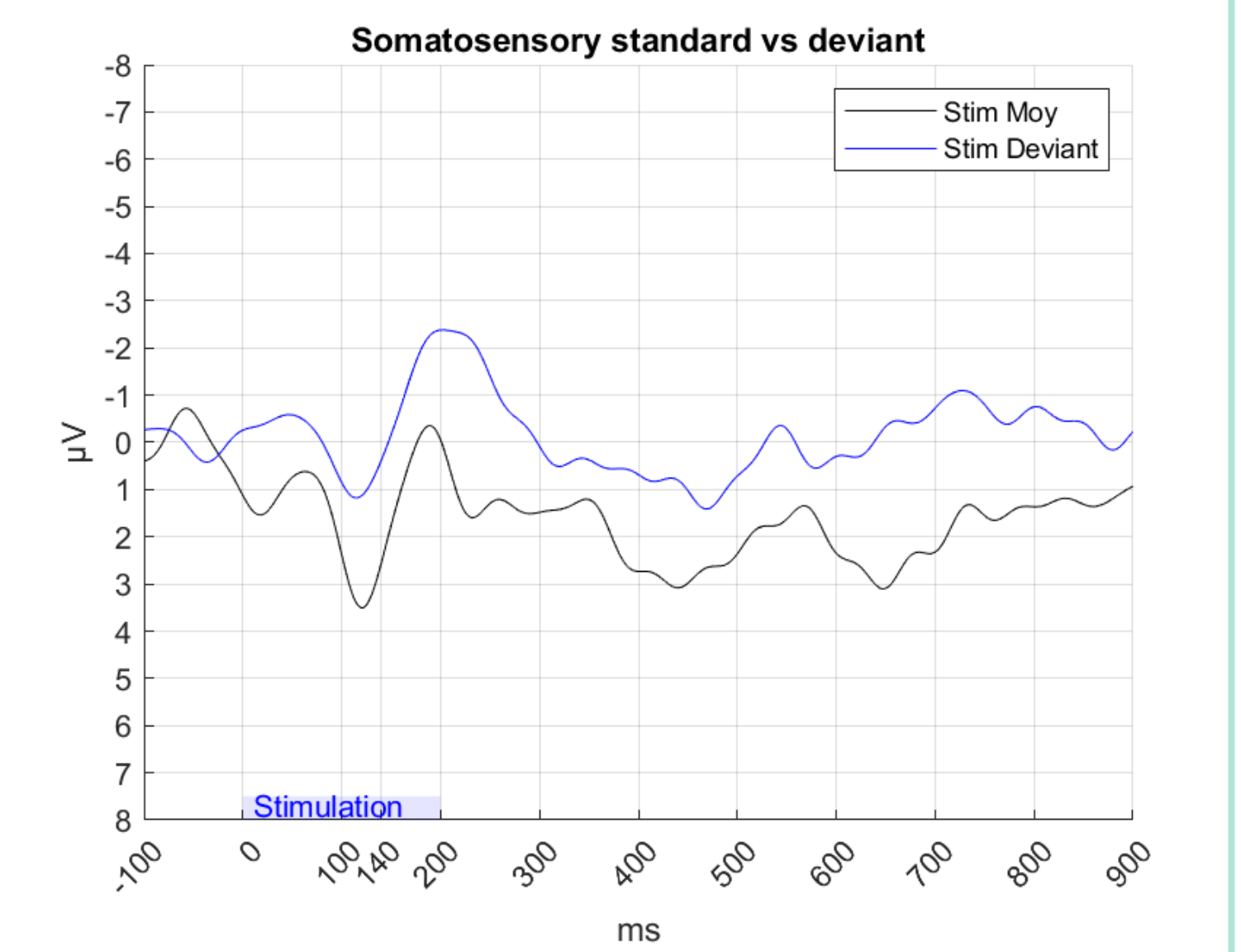


Figure 8: Mean amplitudes between standard and deviant stimulations

- Modulation of N2 component at the Child-ANT is weak between **congruent** and **incongruent** condition (Figure 5), consistent with low reaction times variability (Figure 6).
- The amplitude of the electrical activity decreases at N140 for the last 40 stimulations (**Control**) compared to the first 40 stimulations (**Familiarization**) in the somatosensory cortex (Figure 7). The amplitude of the electrical activity increases at N140 during **deviant** stimulations compared to the standard stimulations (Figure 8). RS is present in the tactile modality and children's brain detect deviant stimulations.

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## CONCLUSION AND PERSPECTIVES

- **Tactile sensory processing is related with executive functions in everyday situations.**
- EEG measurements show **RS and deviance detection in the tactile modality in 4 years old children**. During the Child-ANT, we do not observe a strong difference between congruent and incongruent conditions, suggesting that our sample of children perform well on this task.
- To further investigate the relationship between brain evoked potentials for tactile sensory processing and attention, we need a larger sample of children, including younger children and children with high developmental risk or NDD, who may show larger differences between the congruent and incongruent conditions.
- Such findings could help to **promote new screening and remediation tools for attention deficits**, based on the quality of tactile sensory processing.



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