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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** *(Cascio, 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.

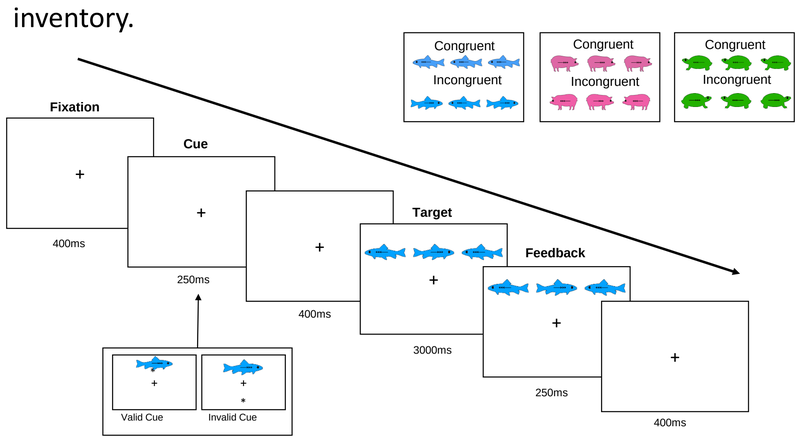


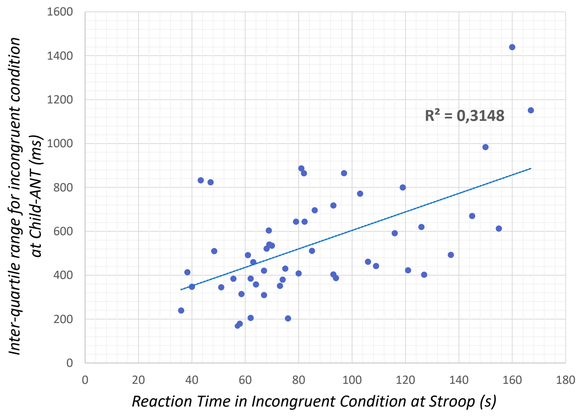
Figure 1 : Experimental design of the Child-ANT

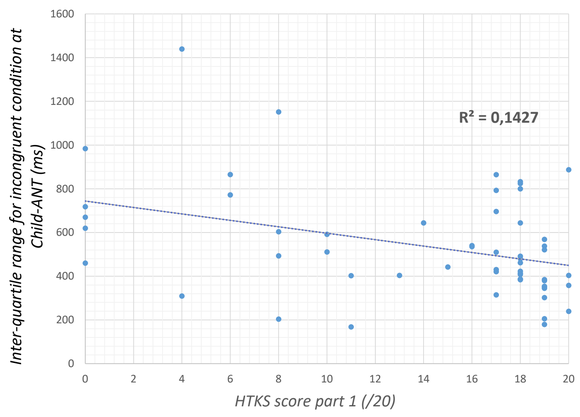
Figure 2 : A participant during the Stroop (at the top) and HTKS (at the bottom)

RESULTS

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

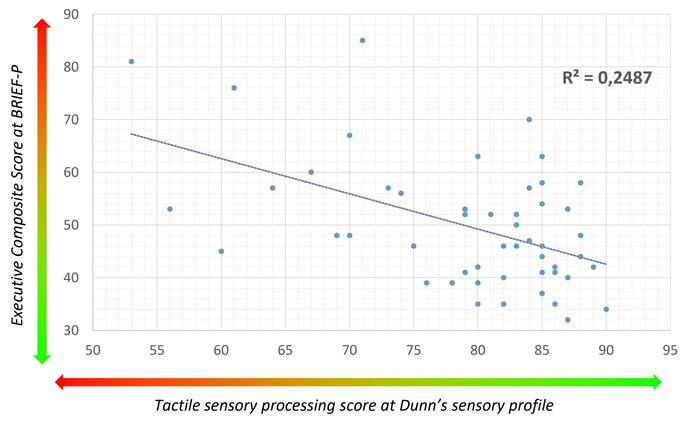
The data were analyzed in regression using the generalized linear model.





- 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

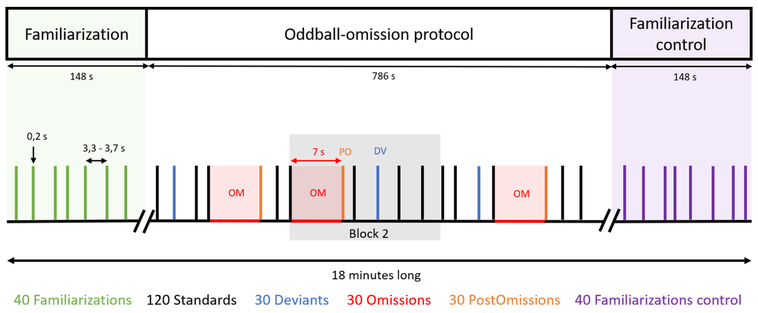


Figure 3: Tactile oddball-omission paradigm

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.

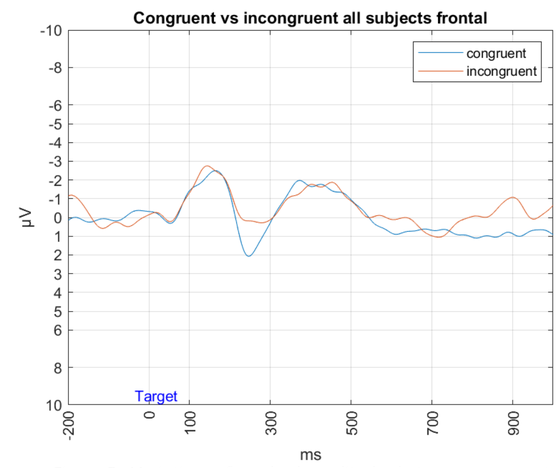


Figure 5 : Variations of cerebral amplitudes between congruent and incongruent condition during the Child-ANT

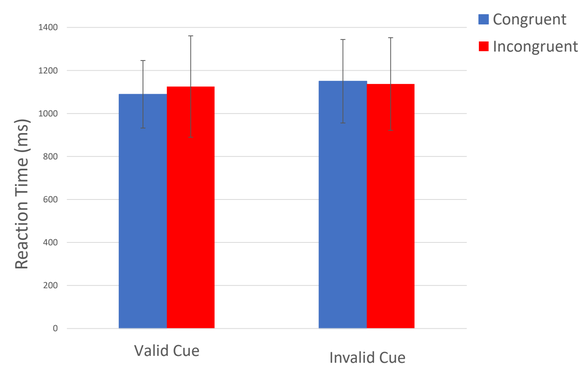


Figure 6 : Variations of reaction time between congruent and incongruent condition during the Child-ANT according to cue validity

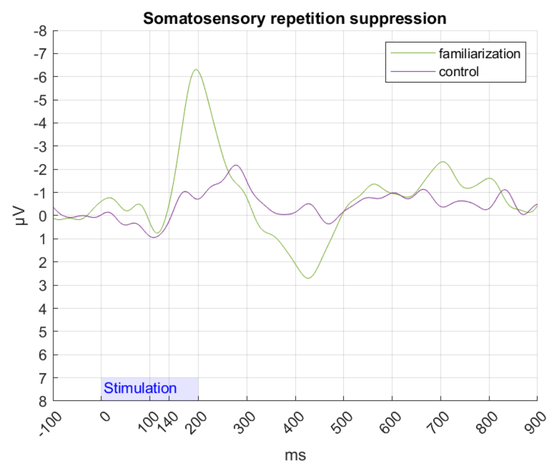


Figure 7: Repetition suppression during the oddball-omission paradigm

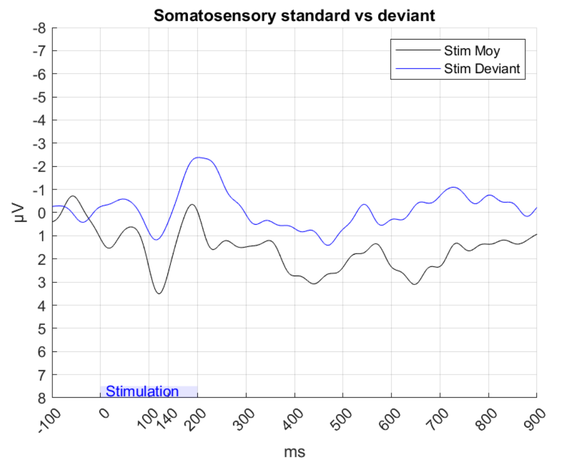


Figure 8: Mean amplitudes between standard and deviant stimulations

- 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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