



**HAL**  
open science

## **Inhibitory control training induces cortical thickness changes linked to global/local visual abilities in children**

Nicolas Poirel, Arnaud Cachia, Marine Moyon, Lisa Delalande, Valérie Datin-Dorrière, Katell Mevel, Grégory Simon, François Orliac, Bernard Guillois, Olivier Houdé, et al.

### ► To cite this version:

Nicolas Poirel, Arnaud Cachia, Marine Moyon, Lisa Delalande, Valérie Datin-Dorrière, et al.. Inhibitory control training induces cortical thickness changes linked to global/local visual abilities in children. 26th Cognitive Neuroscience Society meeting, Mar 2019, San Francisco, United States. . hal-04043192

**HAL Id: hal-04043192**

**<https://cnrs.hal.science/hal-04043192v1>**

Submitted on 23 Mar 2023

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# Inhibitory control training induces cortical thickness changes linked to global/local visual abilities in children

N. Poirel<sup>1,2</sup>, A. Cachia<sup>1,2</sup>, M. Moyon<sup>1</sup>, L. Delalande<sup>1</sup>, V. Datin Dorrière<sup>1</sup>, K. Mevel<sup>3</sup>, G. Simon<sup>3</sup>, F. Orliac<sup>1</sup>, B. Guillois<sup>4</sup>, O. Houdé<sup>1,2</sup>, & G. Borst<sup>1,2</sup>



LaPsyDÉ



<sup>1</sup>LaPsyDÉ, UMR 8240, CNRS, Université Paris Descartes, <sup>2</sup>Institut Universitaire de France (IUF), <sup>3</sup>ISTS, UMR 6301, CNRS, CEA, Caen, <sup>4</sup>LPCN, Université de Caen Normandie



UNIVERSITÉ  
PARIS  
DESCARTES



UNIVERSITÉ DE CAEN  
BASSE-NORMANDIE



institut  
universitaire  
de France

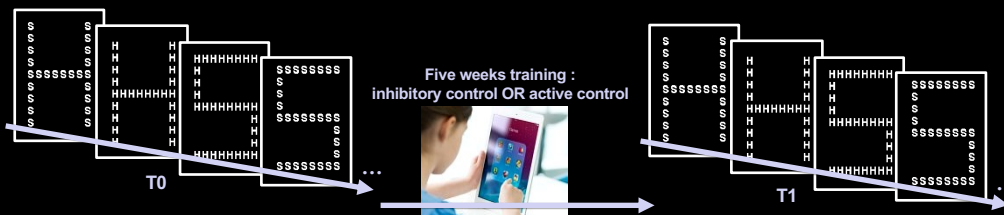


## Introduction

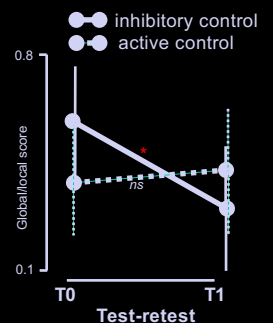
Visual environments are composed of global shapes (e.g. the forest) and local details (e.g., the trees) that compete for attentional resources (Navon, 1977; Krakowski et al., 2015). In adults, when local and global information are in conflict, global information must be inhibited to process the local ones (Poirel et al., 2014). Children, who present a weaker bias toward global visual information, have also to inhibit the local information during global processing (Krakowski et al., 2018). The present work used for the first time a longitudinal design to test the effect of an individualized inhibitory control computerized tactile device adaptive training (five weeks) on cortical thickness changes linked to global/local visual abilities in children.

## Method & Results

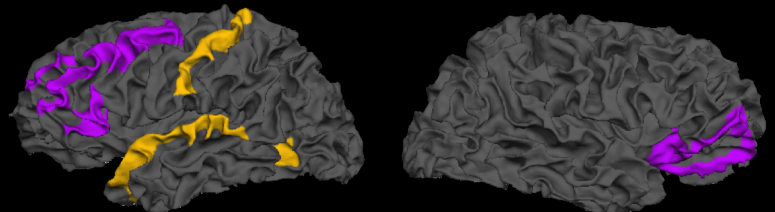
Ten years-old children (N=36) were randomly assigned to an inhibitory control (N=17, color word stroop and stop signal tasks) or an active control (N=19, knowledge and vocabulary based tasks) training group. In the pre- and post-training sessions, children performed a classic global/local selective visual attention task. During two blocs of 24 trials, participants had to focus their attention to one level (global or local) while ignoring the other, and they had to discriminate between two types of targets (H or S). Trials were either consistent (same target at both levels) or inconsistent (the different targets appeared at the two levels). Children also participated to a MRI session in a 3-Tesla MRI scanner. Mean cortical thickness values were extracted with Freesurfer software using the Destrieux Atlas (2010) for 30 of children who participated in this study (N=14 for inhibitory group and N= 16 for active control group) .



Standardized mean difference indexes were computed from global/local task RTs to obtain a global advantage score and a global interference score (Cohen's *d*, see Gerlach & Poirel, 2018) . The 2 (group : inhibitory control ; active control) x 2 (scores: global interference ; global advantage) x 2 (test-retest : T0 ; T1) repeated-measures ANOVA revealed a test-retest X group interaction ( $p=.028$ ), characterized by a better general gain of visuo-spatial abilities between T0 and T1 for the inhibitory control group ( $p=.004$ ) than for the active control group ( $p=.69$ ).



We observed that in comparison to the control group, the better abilities to deal with interference from local information after inhibitory control training was associated with changes in cortical thickness in several prefrontal regions (insula, inferior, middle and orbital, all results reported are statistically significant at 0.05). On the other hand, the better abilities to deal with interference from global information after inhibitory control training was associated with changes in cortical thickness in postcentral, superior temporal and occipital regions.



Significant variation between T0 & T1 associated with :  
Global interference dealing efficiency  
Local interferences dealing efficiency

## Discussion

Behavioral results revealed that children's performances during global/local visual attentional task improved from the pre- to the post-training more in the inhibitory control group than in the active control group. The present study is the first to evidenced the beneficial impact of inhibitory control training on neural levels for visuo-spatial abilities in children. In particular, inhibitory control training allow (1) a posterior neural plasticity linked to the ability to deal with conflicting global visual information, and (2) an anterior neural plasticity linked to the ability to deal with conflicting local visual information. In agreement with the ontogenetic view regarding global/local processes (i.e., local precedence effect that evolve with age to a global precedence effect, see Poirel et al., 2008), these results suggests an involvement regarding global interference dealing efficiency that appeared first in posterior brain regions, and an involvement regarding local interference dealing efficiency that is present in anterior brain regions, in line with the view of a postero-anterior gradient in brain plasticity (Sowell, 2004) after inhibitory control training.



Destrieux (2010) *NeuroImage*;  
Gerlach & Poirel (2018) *Scientific Reports*;  
Krakowski et al. (2015) *Acta Psychologica*;  
Krakowski et al. (2018) *Journal of Experimental Child Psychology*;  
Navon (1977) *Cognitive Psychology*;  
Poirel et al. (2008) *Developmental Psychology*  
Poirel et al. (2014) *Exp. Psychology*.  
Sowell et al. (2004) *The Journal of neuroscience*

## Contact

Prof. Nicolas Poirel  
GIP CYCERON, Bd Henri Becquerel  
14074 CAEN Cedex, France  
[nicolas.poirel@parisdescartes.fr](mailto:nicolas.poirel@parisdescartes.fr)

Reprographie de l'Université Paris Descartes