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To cite this version:
Iris Menu, Qin He, Julie Victor, Gabriela Rezende, Lorna Le Stanc, et al.. Do neuroplasticity and genetic factors contribute to cognitive training in children?. OHBM (Organization for Human Brain Mapping) 2022 Annual Meeting, Jun 2022, Glasgow, United Kingdom. hal-04045235

HAL Id: hal-04045235
https://hal.science/hal-04045235
Submitted on 24 Mar 2023

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Do neuroplasticity and genetic factors contribute to cognitive training in children?

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Introduction

Inhibitory control (IC)
• important for academic achievement, physical and mental health (Diamond, 2013)
• can be improved with cognitive training programs (e.g., Diamond & Lee, 2011; Jaeggi et al., 2011)

Factors contribute to cognitive training gains
• basal cognitive level (Karbach & Unger, 2014)
• brain anatomy/anatomy (Baniqued et al., 2019; Chaddock-Heyman et al., 2020)
• genetic factors (Leckie et al., 2014)

Aim of this study: investigate the genetic, cerebral and cognitive factors contributing to the receptivity of IC training

Material & methods

Brain anatomy (pre- and post-training)
• Grey matter volumes in regions of interest (ROI) of the IC network
Cognition (pre- and post-training)
• color-word Stroop task (Stroop interference)
• stop signal task (stop signal reaction time, SSRT)

Genes (saliva sample, pre-training)
• Polygenic risk score (PRS) calculated with the summary statistics of UK Biobank GWAS (N=84,259) related to IC (Trail Making Test, TMT).

Multilevel Structural Equation Model (SEM):
Test simultaneously and globally a set of a priori defined hypothetical relationships, combining:
• 2 latent change score models (LCS; Kievit et al., 2018; McArule, 2009) to investigate training-related changes at both cognitive and brain levels
• 2 mediation models to investigate whether the genetic effect on cognition was mediated by the grey matter volume baseline (in blue) and change (in green)

Model selection for the ROI based on:
• specific IC-training effect
• good SEM fit indices
• significant training-related cognitive changes

Results

Raw grey matter volume (without spatial normalization)
• IC training: IC changes depend on genetic (PRS), brain (basal and changes of left ACC volume) and cognitive (baseline SSRT) features
• Control training: IC changes only depend on the cognitive (baseline SSRT) features

Normalized grey matter volumes (with spatial normalization to MNI)
• IC training: IC changes depend on brain (basal and changes of left Putamen volume) and cognitive (basal SSRT) features
• Control training: IC changes depend only explained on the cognitive (baseline SSRT) feature


→ Training-relative cognitive changes depends on the interrelation of factors at different levels: molecular (genetics), neural (basal and change of reginal grey matter volumes) and cognition (basal level)