Do neuroplasticity and genetic factors contribute to cognitive training ? An imaging-genetics study in healthy children.

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Introduction

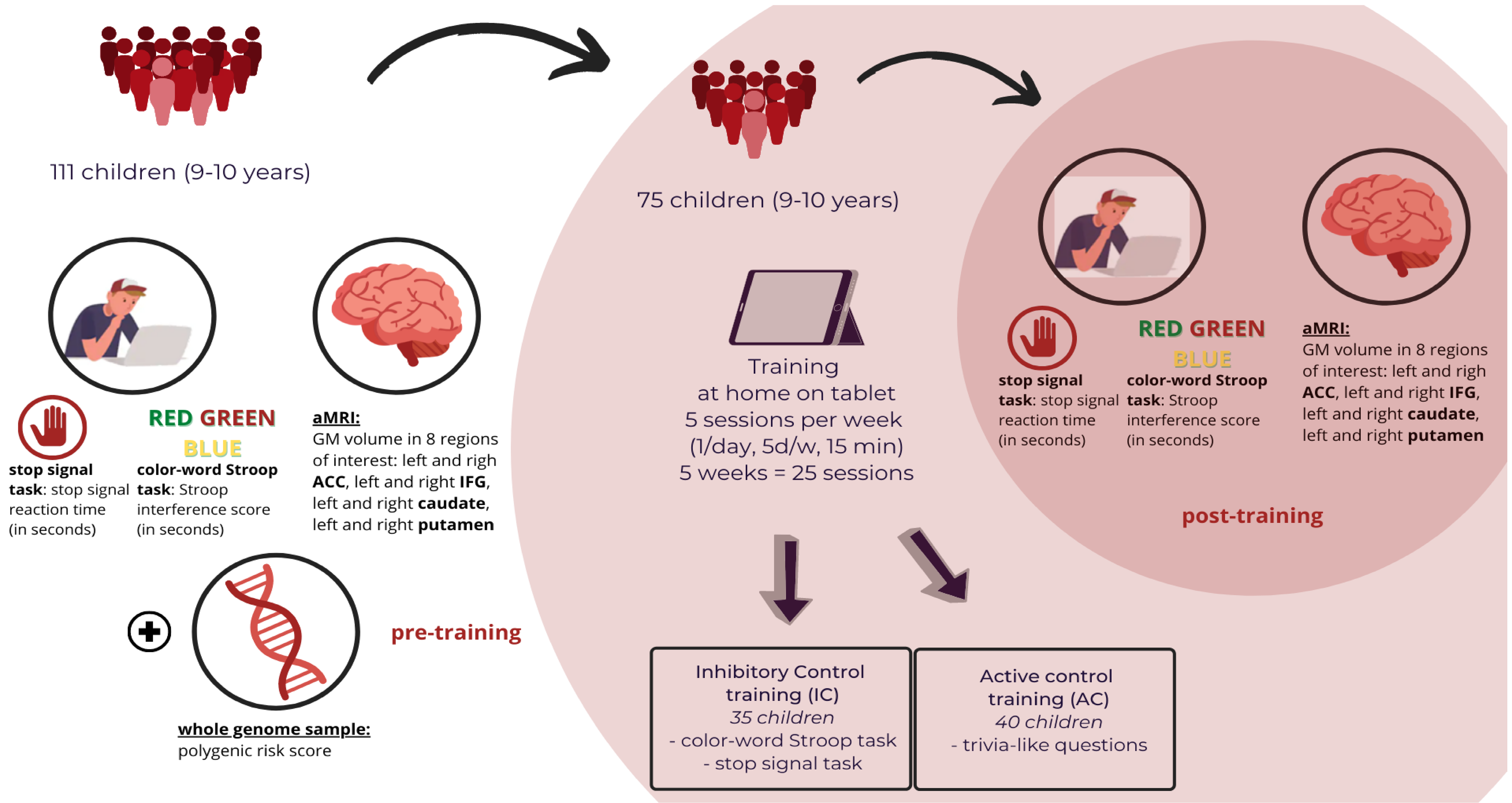
Inhibitory control (IC)

- 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 activity/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; McArdle, 2009) to investigate training-related changes at both cognitive and brain levels (in yellow)
- 2 mediation models to investigate whether the genetic effect on cognition was mediated by the grey matter volumebaseline (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)

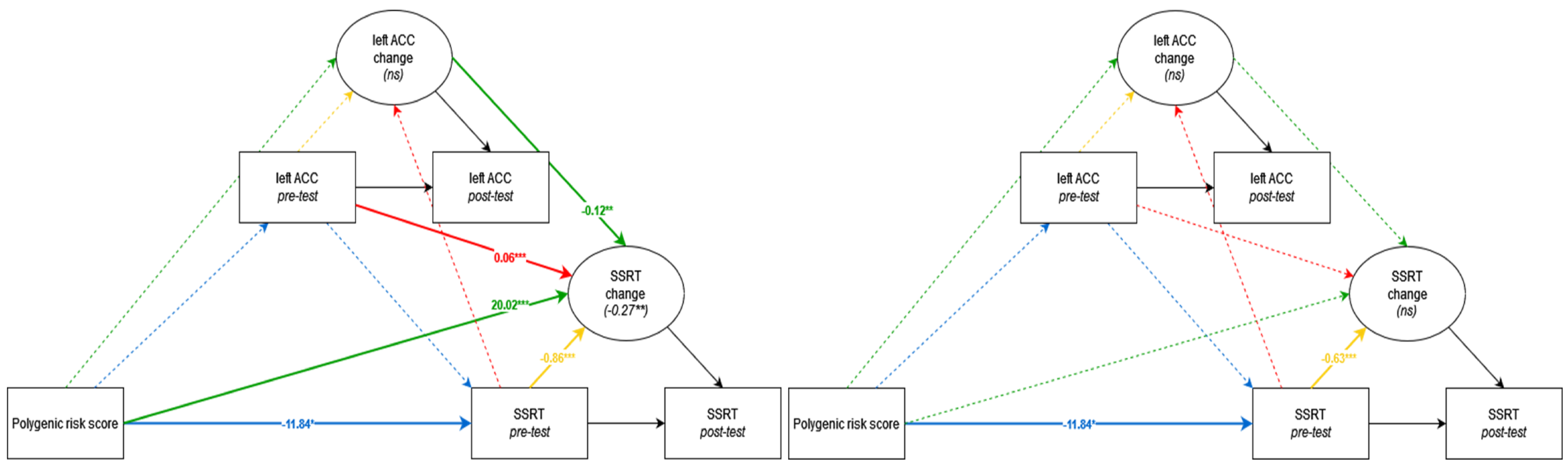
- *IC training*: IC changes depend on **genetic** (PRS), **brain** (basal and changes of left ACC volume) and **cognitive** (baseline SSRT) features
- *Control training*: IC changes only depend on the **cognitive** (baseline SSRT) features

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

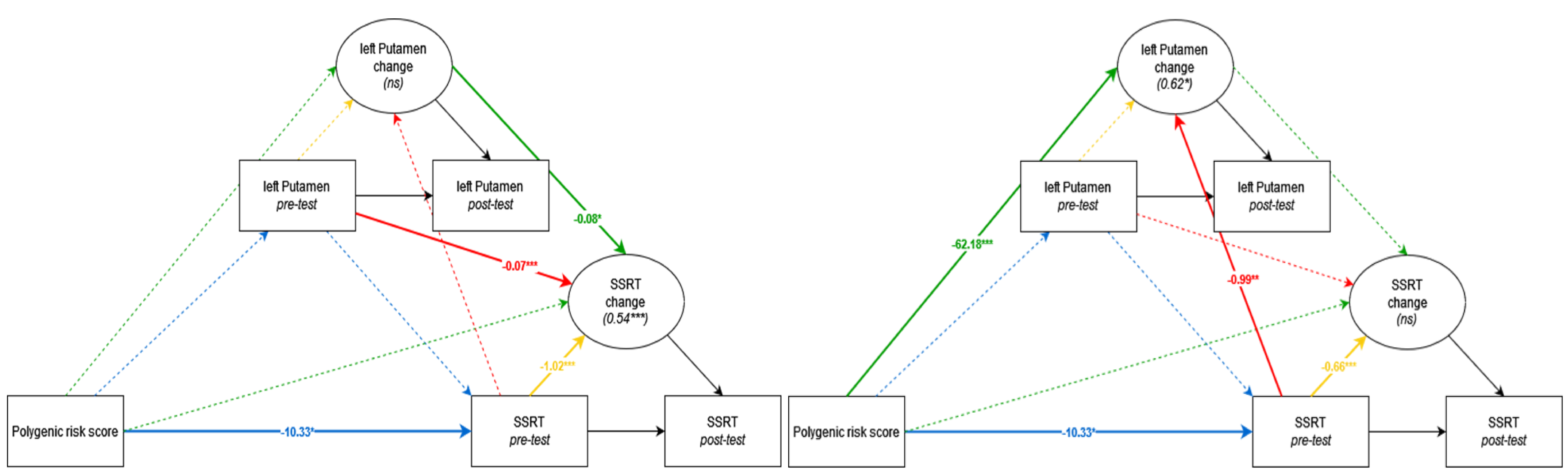
Without spatial normalization (left ACC)

IC training | Control training



With spatial normalization (left Putamen)

IC training | Control training



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➔ **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)