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# 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 (Karchach & 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 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)

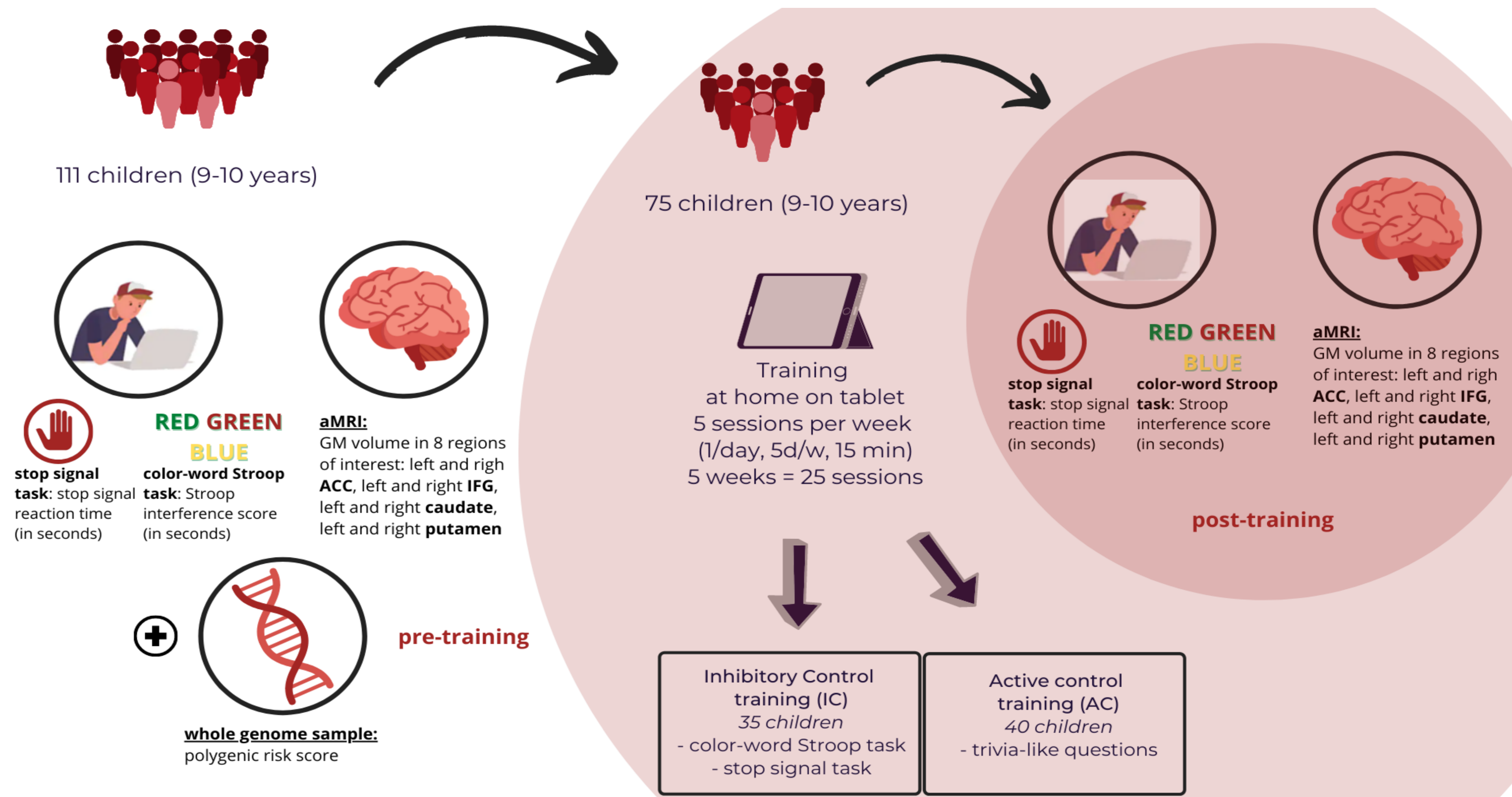
- IC training:** IC changes depend on genetic (PRS), brain (basal and changes of left ACC volume) and cognitive (baseline SSRT) features
- Control training:** IC changes only depend on the cognitive (baseline SSRT) features

### 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

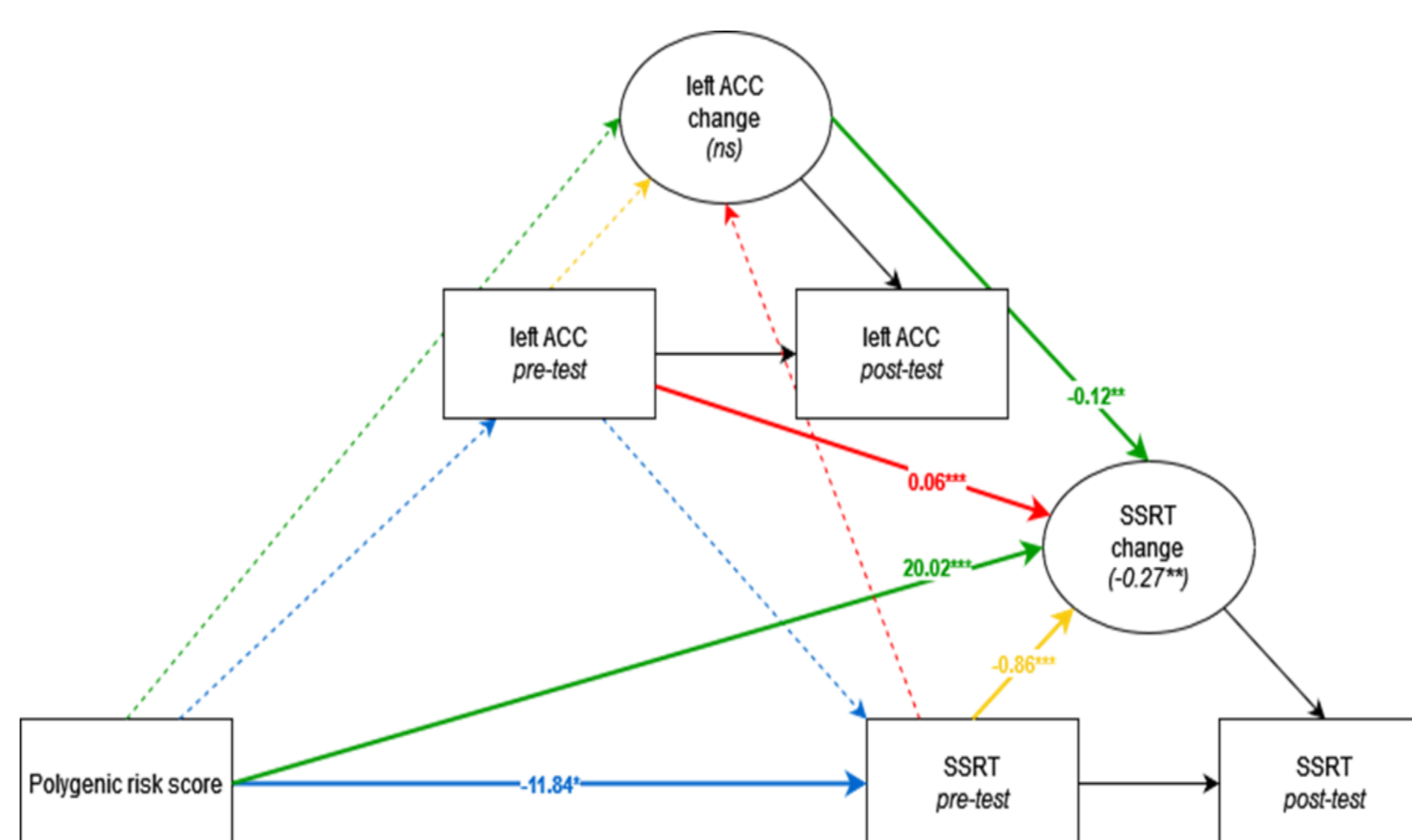
**References:** Baniqued, P. L., et al. (2018). *Frontiers in Aging Neuroscience*. Chaddock-Heyman, L., et al. (2020). *Frontiers in Human Neuroscience*. Diamond, A. (2013). *Annual Review of Psychology*. Diamond, A., et al. (2011). *Science*. Jaeggi, S. M., et al. (2011). *Proceedings of the National Academy of Sciences*. Karchach, J., et al. (2014). *Frontiers in Psychology*. Kievit, R. A., et al. (2018). *Developmental Cognitive Neuroscience*. Leckie, R. L., et al. (2014). *Frontiers in Human Neuroscience*. McArdle, J. J. (2009). *Annual Review of Psychology*.

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

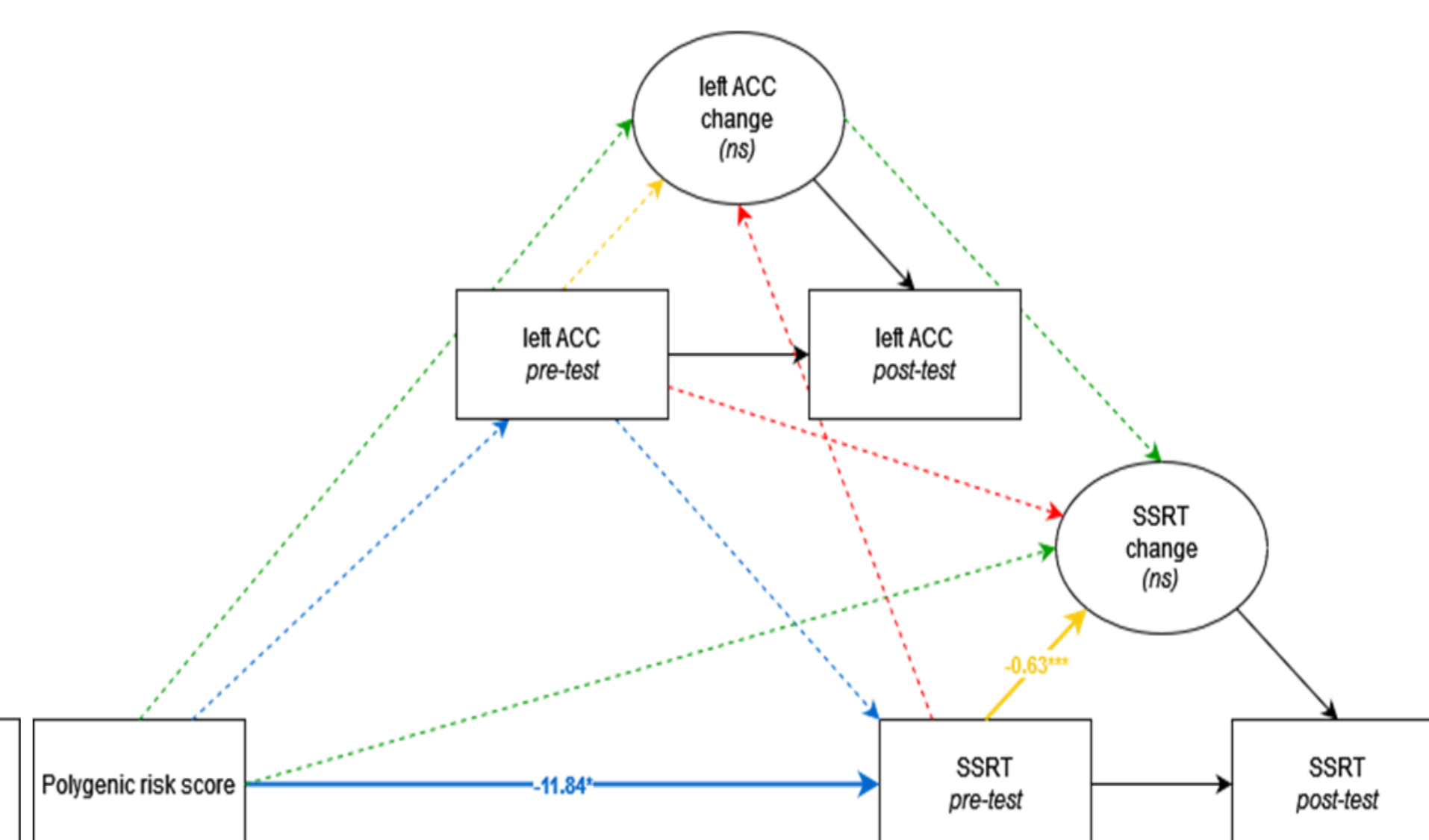


### Without spatial normalization (left ACC)

#### IC training

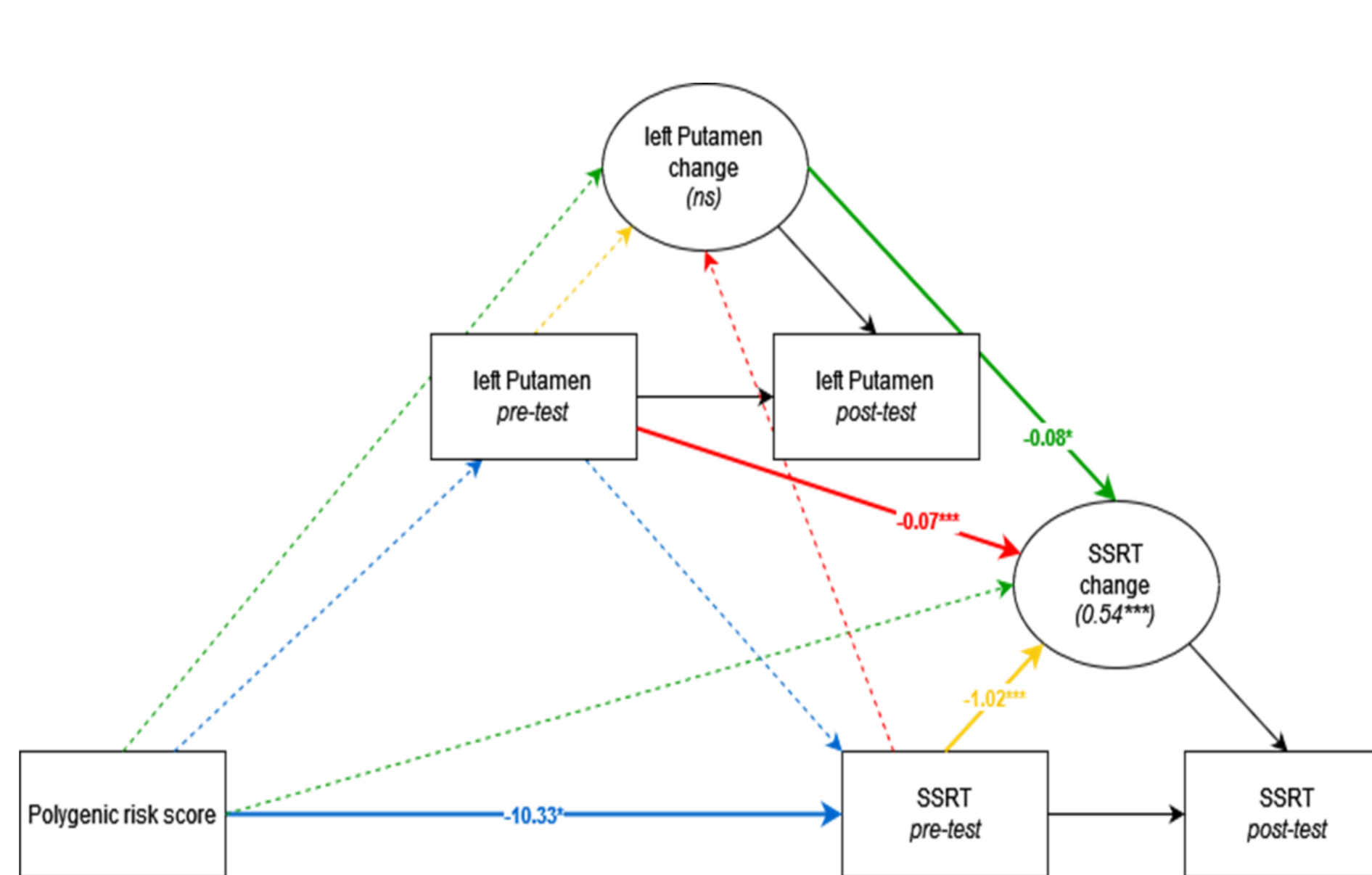


#### Control training



### With spatial normalization (left Putamen)

#### IC training



#### Control training

