Age-related effects on resting state default, executive and salience networks reveal different pruning mechanisms – a resting state fMRI study.

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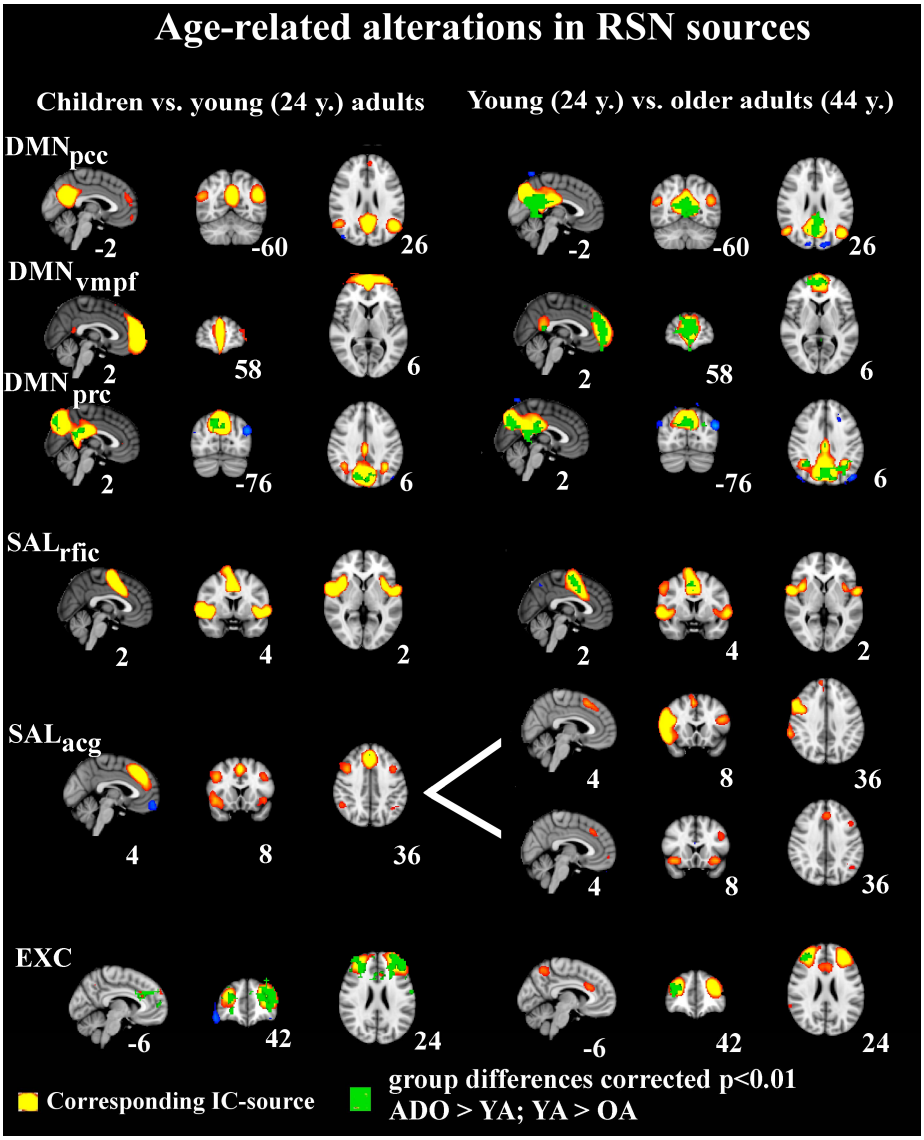
Introduction Background *(i.e. resting state)* activity of the brain cortex can be used in functional segmentation of the cortex into multiple independent signal sources (1,2). In this study we investigated differences in the functional segments between three age groups children, young and older adults. The hypothesis was that the age affects the networks via neuronal pruning. The analysis was focused on default mode (DMN), executive (EXC) and salience (SAL) networks.

Methods In total 55 adolescents (ADO 13.2 ± 2.4 yrs, 20 ♀), 59 young adults (YA 22.2 ± 0.6 yrs 35 ♀), and 54 older adults (42.7 ± 0.5, 25 ♀ OA), all healthy, were included. Subjects were imaged with identical protocols at 1,5 T GE Hdx, GRE EPI, Asset 2x, TR 1800 ms, TE 40 ms, flip angle 90,64x64 matrix, 28 x 4 mm slices, FOV 25.6 cm, 250 volumes. T1-weighted 3d FSPRG scan was used for individual normalization. High model order (70) group PICA was performed in MELODIC after standard FSL pre-processing (2). After ICA, dual regressions were performed between ADO vs. YA and YA vs. OA groups (3). The difference results were TFCE-corrected for multiple comparison p<0.01.



Results. In DMN_{pcc}, DMN_{vmpf} and Sal_{rfic} differences occur in adulthood (YA-OA), whereas the EXC networks alters in younger life. SAL_{acg} splits in adulthood and to left and right dominant sources without strength changes. DMN_{prc} shows alterations from childhood to older adulthood. The detected changes were usually so that younger subjects have more power than their older controls in each comparison.

Discussion. Resting state networks undergo multiple age related changes both in strength and spatial distribution. In some the networks are more changing in adulthood while others alter in younger life. Some seem to alter continuously like the DMN_{prc}. The salience network near anterior cingulate gyrus splits without much strength alterations in either age group. These different mechanisms may reflect different pruning or re-distribution mechanisms of normal ageing of the central nervous system.

References:

1. Smith et al., PNAS 2009 Aug 4;106(31):13040-5
2. Kiviniemi et al., Hum Brain Mapp. 2009
3. Filippini et al., PNAS 2009 106(17):7209-14.