Converging results from resting state and task response fMRI-studies in ASD

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Introduction. Autism spectrum disorder (ASD) refers to a set of complex, polygenetic neurodevelopmental disorders of unknown etiology and is diagnosed according to three behavioral characteristics: social and communication deficits, repetitive behavior and restricted interests. Our goal was to find out if background brain activity abnormality should also accompany task response activity abnormalities related to ASD. In order to test this we overlapped our results of task activation and spontaneous activity in order to see if the alterations overlap spatially.

Materials and Methods. 30 ASD subjects and age & gender matched typically developing (TD) controls were recruited from over a 5500 child cohort from the registers of Child Psychiatry of Oulu University Hospital. The subjects were screened using ADOS, ADI-R, ASSQ and Kiddies-Sads screens. Resting and activation scans were imaged with GE 1.5 T, ASSET x 2, TR 1800 ms, TE 40 ms, flip angle 90, 64x64 matrix, FOV 25.6 cm, 28 4 mm slices. Dynamic facial expression task (happy & fear) had TR 3200 ms, matrix 128x128, 37 3 mm slices. Resting state data was analysed using ReHo, ICA-dual regression and Fractal dimension (Df) after typical pre-processing described earlier (1-5). GLM analysis with FSL was performed on dynamic facial expression and visuo-spatial n-back tasks (6). The results were all spatially normalized into the same MNI 152-template based on individual T1-weighted 3D FSPGR scans for overlap analysis. Results were corrected for multiple comparisons on a cluster level, p=0.05 threshold.

Results. Right anterior insula was found to have converging differences between controls and ASD-subjects in four separate analyses: ReHo, Df in resting state and , Happy facial expressions n-back in task state, c.f. Fig 1. Right visual cortex was also found to have abnormal resting state Df, ICA signal source as well as abnormal de-activation while viewing Fear expressions. ReHo & Df abnormality accompanied n-back response abnormality in right S1. ReHo and Happy facial expressions altrations were detected in right IFG-frontal pole in ASD. Df detected 4/5, ReHo 3/5 and best task activation 2/5 of the converging areas.

Discussion. Uddin & Menon have postulated that right anterior insula as a central hub in salience network should be a core region for ASD abnormality (7). Our results show strong evidence supporting this idea: we detected spatially overlapping differences in regional BOLD signal homogeneity and fractal dimension under rest and 2 activation tasks in identical areas of right anterior insula in ASD group. Also visual cortex abnormalities during rest accompany non-conscious, background facial expression evaluation that occurs on the right hemisphere (8).

Conclusion. Spontaneous brain activity abnormalities coincide with task activation abnormalities in identical key regions of ASD. Resting state markers are more effective in detecting these converging changes in brain disorders than task activation scans.
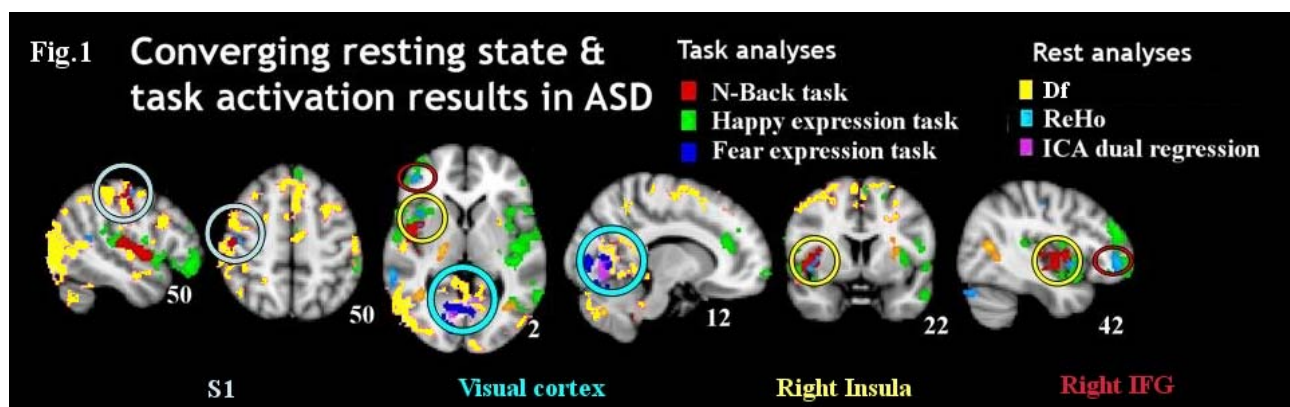

Figure 1. Combined resting state and task activation results (corrected, p 0.05 threshold) overlaid on a MNI-template image with corresponding coordinates. Circles with different colors mark the areas having both activation and resting state significant differences in ASD group compared to matched TD controls.

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