# Detecting Functional Connectivity in Adolescent with Disruptive Behavior Disorder using fcMRI

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Purpose:

Aggressive Disruptive Behavior Disorders (DBD) patients were studied using functional connectivity MRI (fcMRI) to evaluate functional connectivity in the steady state.

Methods:

Eleven adolescents (aged 13-17 years) diagnosed with DBD along with 11 age, gender and IQ matched control subjects were scanned on a 1.5T GE Signa MRI scanner. Following high resolution anatomical scans, eight axial slices (7.2-mm thick, 2.8-mm skip) parallel to the AC-PC line were acquired using a spiral sequence with TR/TE=600/50ms, the bottom slice of which was 2 cm below AP-PC line. Two scans with 512 time frames each were acquired. In the first scan (resting state, RS), subjects were instructed to stay awake with eyes closed without thinking of anything in particular. In the second scan (CP), they continuously performed a single Go-NoGo task (event-related designed). After motion correction, spatial normalization, deconvolution (implemented in AFNI[1]) were performed on single subject's EPI data from CP scan on a voxel-by-voxel basis to estimate the hemodynamic response related with four different behavior performance (two for NoGo stimili: Correct Rejected, CR; Error of commission, EC; and two for Go stimuli: Correct Go, CG; Error of Omission, EO) [2]. The correct response to the Go events (CG) was treated as a baseline. Two contrast maps (CR vs. CG and EC vs. CG) were generated for each subject, and then entered into a mixed-effect model ANOVA to create group maps, respectively. All group maps were thresholded using voxelwise $p < 0.001$ and cluster-size of 405*ul* of contiguous significant voxels, as estimated using Monte Carlo simulations. DBD and control group maps were combined so that ROIs were defined by the region of suprathreshold activated clusters common to both DBD and control subjects. For RS scan data, after low-pass filtering with a cutoff frequency of 0.08 Hz and removing the effect of global time course, the average time course of ROIs collected in CP scans was used as reference function. The cross correlation for each pixel was calculated and a correction to a normalized Student's t distribution was performed [3]. The resulting individual Z-maps were entered into a second-level random effects analysis to determine the brain areas that showed significant functional connectivity across subjects.

Results:

Behavioral data did not show significant between group differences in performance of Go-NoGo task. Consistent with our previous report[4, 5], CR vs. CG revealed significant more frontal lobe activation (ACC and right DLPFC) in control subjects compared with DBD. EC vs. CG also demonstrated more rostal ACC/medial frontal activation in controls. Functionally common activated ROIs ($p<0.001$, corrected) were found in Insula and basal ganglia area. Compared to the normal controls, DBD patients had different connectivity maps showing regions that were significantly correlated with the reference time courses of ROIs (Fig.1).

Conclusions:

Low frequency BOLD fluctuations during the resting state identified brain regions showing task-independent functional connectivity[3]. Our results illustrated that spatial extent and strength of the correlation coherence in the steady state was found different in DBD patients than normal control group. The results suggested that fcMRI might be useful to examine abnormal brain circuitry by DBD.

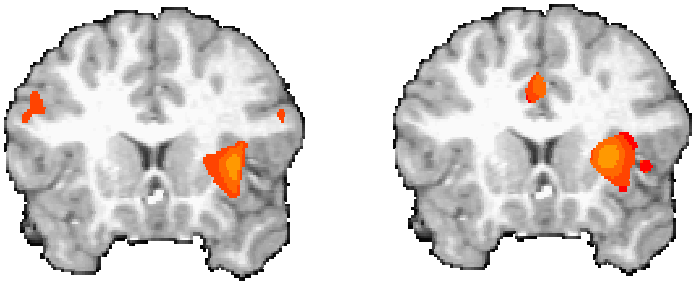

**Fig. 1.** Using average time series of ROI in left Insula as reference, significant connectivity was found on right prefrontal lobe in DBD group (left image), whereas ACC showed greater connectivity in control group (right image).

Reference:

1. Cox, RW. et al.; NMR in Biomedicine 1997.
2. Glover, GH. NeuroImage 1999.
3. Lowe, MJ. et al.; NeuroImage 1998 .
4. Kronenberger, WG. et al.; JCP 2004.
5. Wang, Y. et al.; ISMRM 2002 .