

Evolution of functional connectivity following cognitive and behavioural interventions in children with Autism spectrum Disorders

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INTRODUCTION

Autism spectrum disorder (ASD) is characterised by deficits in social and language domains with behavioural abnormalities and fixated interests. Functional magnetic resonance imaging (fMRI) studies have consistently demonstrated abnormalities in the default mode networks, and salience networks in ASD¹. Global hypoconnectivity with increased local hyperconnectivity and reduced inter-hemispheric connectivity is the hall mark finding in ASD². However, literature on dynamics of brain connectivity following various cognitive and behavioural interventions is scarce.

OBJECTIVES

This study was conducted to understand the changes observed in functional connectivity (FC) by resting state fMRI (rs-fMRI) focusing on default mode network (DMN) and various sub-networks after structured intervention in children with ASD.

MATERIALS & METHODS

10 ASD children underwent rs-fMRI at baseline (FCB) and six months after cognitive and behavioural interventions (FCI).

Inclusion criteria: (i) ASD diagnosed as per DSM 5 criteria and childhood autism rating scale; (ii) age between 6 and 12 years

Exclusion criteria: (i) Structural abnormality secondary to hypoxia, hypoglycemia, intrauterine infections, brain malformation etc; (ii) hyperactive and non co-operative children and (iii) contraindications for MRI

The MRI was acquired in 3T MRI (GE Discovery MR750w) machine with standard 24 channel head array coils. The protocol parameters were, TR = 2500 ms, TE = 30 ms, flip angle = 80, slice thickness = 3.2, volumes =300, imaging matrix = 64 × 64, and voxel size = 3.31 × 3.31.

The image processing and data analysis was done using CONN functional connectivity toolbox within the MATLAB software. A group specific template was created using Diffeomorphic Anatomical Registration Through Exponentiated Lie Algebra (DARTEL).

The whole-brain FC differences in networks spanning 32 regions of interest (ROIs) were compared between FCB and FCI. A spatial-to-temporal template correlation was administered and group differences were determined with the contrasts FCI>FCB [1, -1].

RESULTS

- 15 ASD children were enrolled, but 4 were excluded due to motion artifacts and for one, follow up MRI was not available
- The mean age was 9.03 ±1.87 years; all males.
- Improvement was noted in clinical scores pre (T1) and post intervention (T2) using Vineland adaptive behavioural scale and Autism diagnosis observation schedule (ADOS)

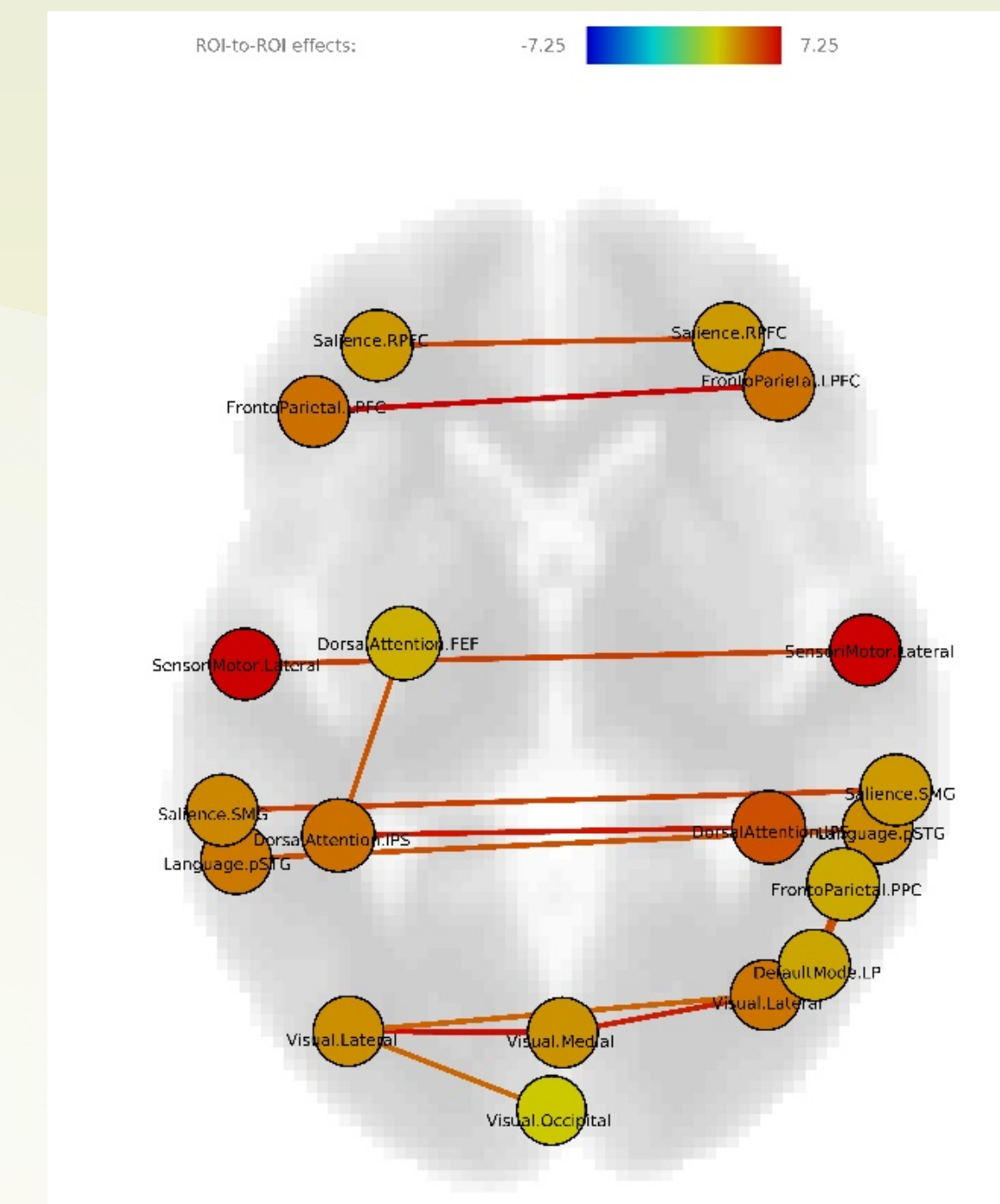
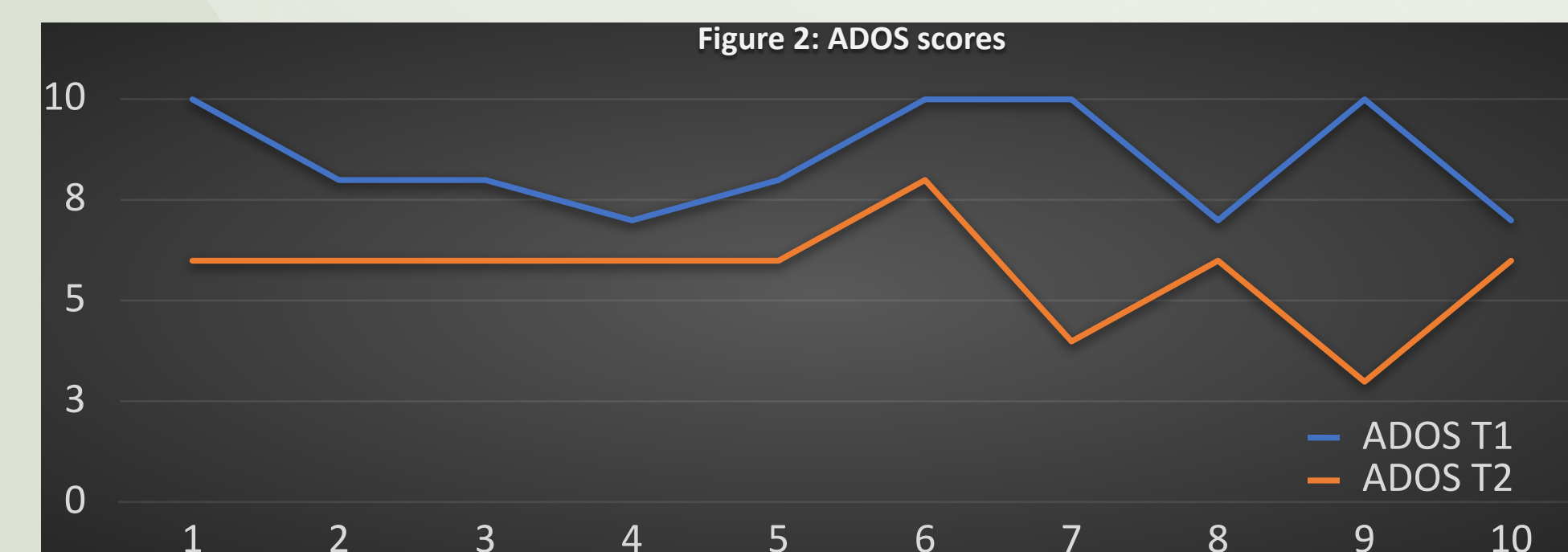
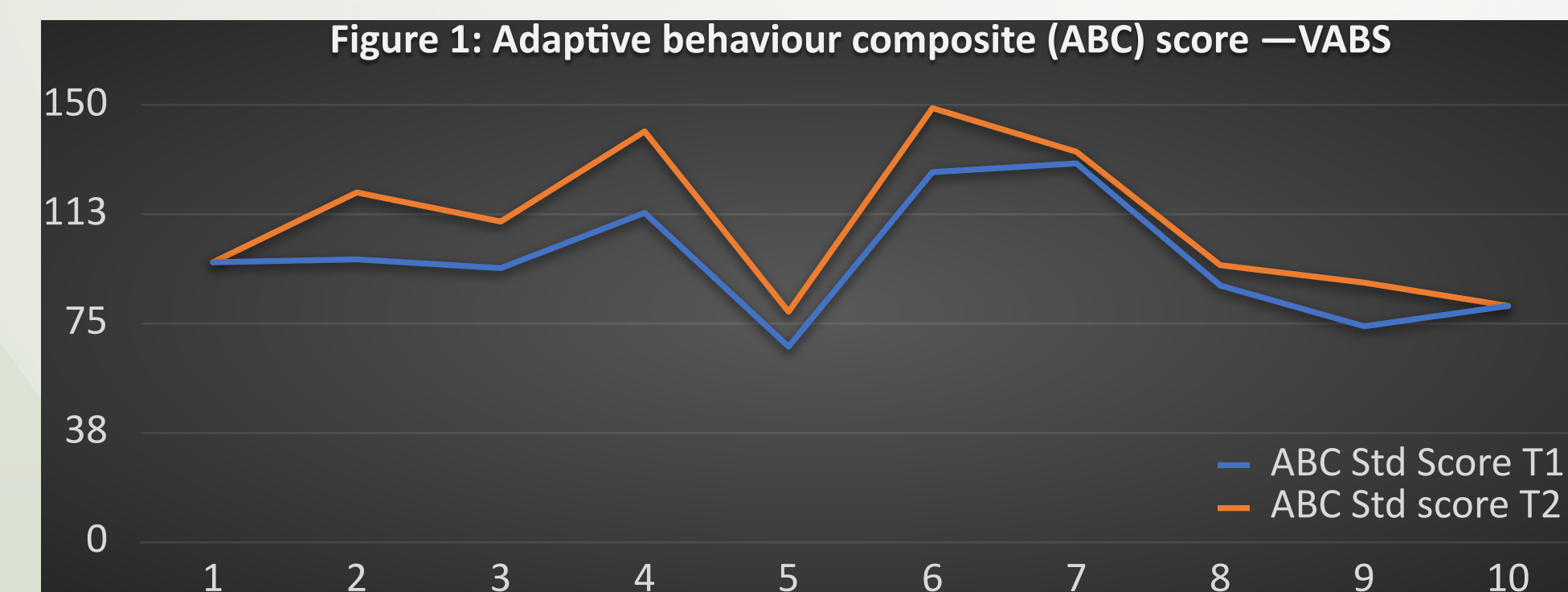


Figure 3: A baseline resting-state fMRI

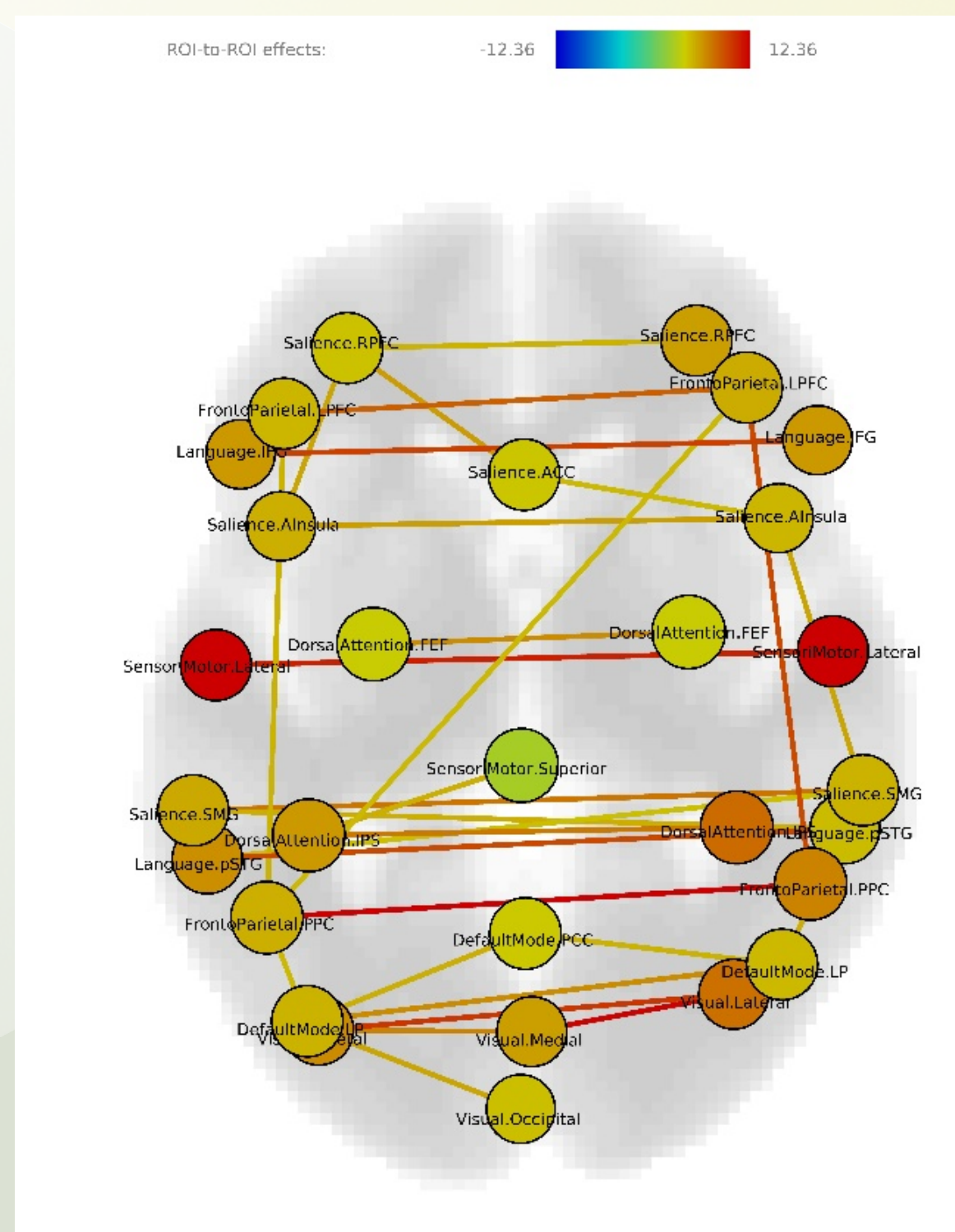


Figure 4: rs-fMRI scan after 6 months interventions. Significant increase in connections within networks is observed in comparison to baseline

- A significant increase in inter-hemispheric connectivity and within networks was observed in FCI as compared to FCB
- Hyper-connectivity between anterior cingulate cortex (ACC) and right anterior insula (AI) (p 0.0083), posterior cingulate cortex (PCC) to the left (p 0.0095) and right (0.0095) lateral parietal regions and sensorimotor region to the intraparietal sulcus (p 0.0075) was observed in FCI
- Increased inter-hemispheric connectivity between bilateral AI (p 0.0045), bilateral frontal eye field (FEF) (p 0.0028), bilateral inferior frontal gyrus (IFG) (p 0.0001) and lateral sensorimotor (p<0.0001) regions were found in FCI

LIMITATIONS

- Small sample size may limit the generalisability of the study results
- Correlation of fMRI with clinical parameters could not be performed due to the small sample size.

CONCLUSIONS

- This study highlights the significant changes in FC in ASD children following structured cognitive and behavioural interventions.
- Rs-fMRI might be an useful investigative modality for monitoring these children in addition to the clinical evaluation.

REFERENCES

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