Comparing Resting-state Functional Connectivity of Reading between Children and Adult

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INTRODUCTION

- **Reading Development**: Reading development involves changes in functional brain networks. Children show widespread activation, while adults have more specialized connectivity.[1]
- **Resting-State Functional Connectivity (RSFC)**: RSFC measures spontaneous brain activity and reveals stable functional connections that contribute to reading proficiency. It provides insights that task-based fMRI cannot capture.[2]
- **Key Research Gap**: Prior studies have reported mixed findings on the role of different brain regions in reading development.[3]
- **Current Study**: Our study examined age-related differences in RSFC among key reading regions. The goal is to clarify how their connectivity patterns change from childhood to adulthood.

MATERIALS & METHODS

• **Participants**: 29 children (mean age = 7.02, SD = 1.19) and 53 adults (age 31.1–74.3), all native English speakers with normal or corrected vision and hearing. Children completed IQ, cognitive, and reading assessments. Adults completed IQ tests and MRI scanning.
• **Procedures**: The first visit included IQ and reading tests. Parents provided developmental and literacy background. In the second visit, participants underwent a 10-minute resting-state fMRI scan after a 30-minute mock training. During scanning, they fixated on a cross.
• **FMRI Acquisition**: Data were collected on a 3T Siemens Skyra scanner. Structural images used MPRAGE; functional images used EPI (TR = 1000 ms, voxel = 2.5 mm^3).
• **Preprocessing & Denoising**: Data were realigned, normalized to MNI space, smoothed (6 mm), and denoised using CompCor, motion regressors, and bandpass filtering (0.008–0.09 Hz).
• **Connectivity Analysis**: ROI-to-ROI and seed-based correlations were computed using Fisher-transformed bivariate correlations. Group-level analyses were conducted using a General Linear Model with FDR correction ($p < 0.05$).

RESULTS

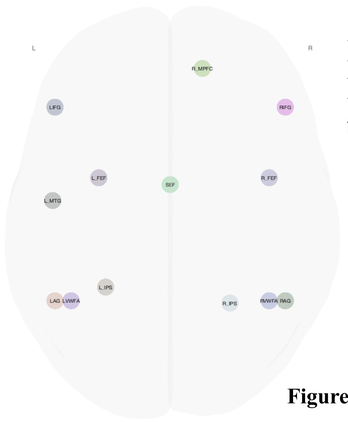

Figure [1]

Figure [1]
Displays all ROIs included in the analysis

Figure [2]
Highlights ROIs with significant functional connectivity differences

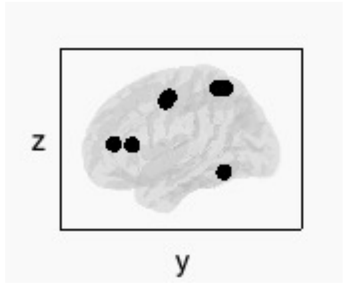

Figure [2]

Adults > Children (Red in Figure [3])

- Right Visual Word Form Area (RVWFA) and Left Intraparietal Sulcus (LIPS), Right Frontal Eye Field (RFEF) and LIPS → Cross-hemispheric connection in adults

- Supplementary Eye Field (SEF) and RFEF/bilateral IPS → Adults presented increased functional integration between SEF and FEF/IPS as cognitive control mechanisms became more refined in adulthood.

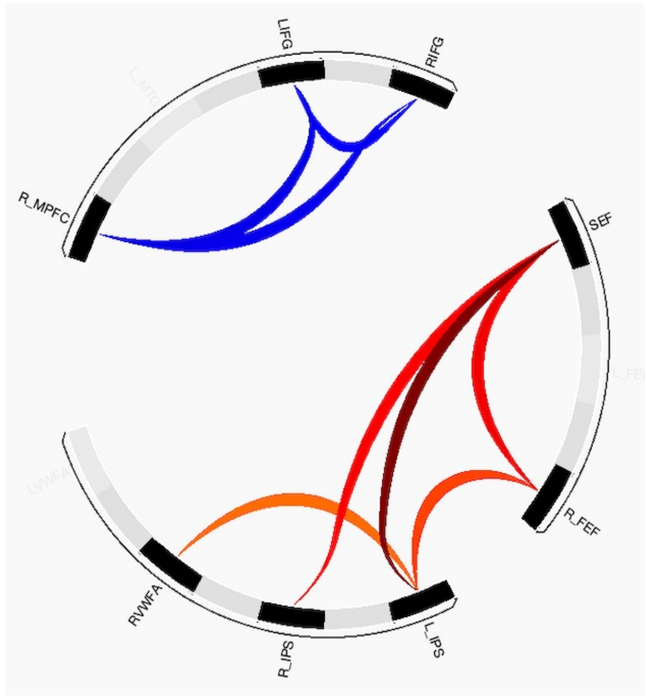

Figure [3]

Adults < Children (Blue in Figure [3])

- Left Inferior Frontal Gyrus (LIFG) and Right Inferior Frontal Gyrus (RIFG) → Interhemispheric connection in children since adults use a more left-lateralized reading network.

- Right Medial Prefrontal Cortex (RMPFC) to bilateral IFG → Children need more attention modulation while adults relay less since they have a more automatic decoding process during reading.

CONCLUSION

Developmental Shift in Reading Networks

- Reading development shifts from a broad dorsal-attention network in children to a specialized ventral-lateralized system in adults.[4]

- Children rely more on visuospatial attention and eye movement control, while adults develop efficient phonological and lexical processing.

- This transition reflects increasing automation, reduced executive control involvement, and stronger left-lateralization in skilled reading.[5]

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