LEFT LATERALIZATION OF MOTOR CIRCUIT CONNECTIVITY IS ASSOCIATED WITH BETTER MOTOR PERFORMANCE IN CHILDREN

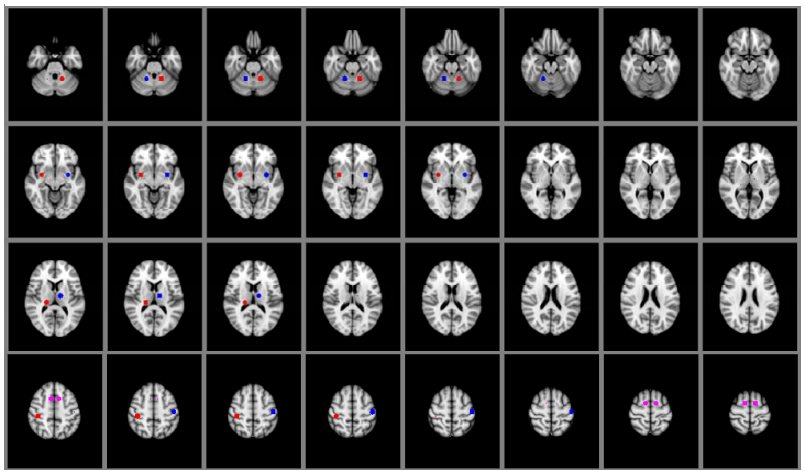
A. D. Barber[1,2], S. E. Joel[1], P. Srinivasan[2], S. Spinelli[2], J. J. Pekar[1,2], and S. H. Mostofsky[1,2]
[1]Johns Hopkins School of Medicine, Baltimore, MD, United States, [2]Kennedy Krieger Institute, Baltimore, MD, United States

Introduction: Imaging studies have examined the functional roles of individual regions for motor control [1,2], however there has been limited examination of the importance of network connectivity to motor performance. In this study, resting state differences in functional connectivity within left and right motor circuits are associated with motor performance in right-handed typically developing (TD) children.

Methods: 40 healthy, TD children ages 8-12 years were assessed for motor performance outside of the scanner using the Physiological and Neurological Examination for Subtle Signs (PANESS). The PANESS is a standardized battery of axial and appendicular motor control that is sensitive to developmental changes in children's motor abilities [3]. Total PANESS score is made up of several subscores including overflow and timed scores. Overflow measures inadvertent movements other than the intended movement. Fewer overflow movements, lower total timed scores, and lower total PANESS scores are indicative of better motor performance.

Gender M F	Age Mean (SD)	FSIQ Mean (SD)	Handedness
19 21	10.20 (1.06)	112.07 (10.45)	All **Right** Handed

Figure 1. Motor Circuit Seed Regions. (LH Circuit in Red, RH Circuit in Blue, Bilateral rostral and dorsal SMC, involved in both circuits, in Pink)



Resting state scans were acquired for 5 minutes 20 seconds using a 3T Philips scanner (2D-SENSE EPI, 8-channel head coil, TR = 2500ms, TE = 30 ms, Flip angle = 70°). Participants were instructed to relax and fixate on a center cross. Preprocessing of functional images included slice time correction, motion correction, normalization, removal of nuisance variables (6 motion parameters, CSF signal, white matter signal, and global mean signal, using CompCor [4]), 6mm FWHM spatial smoothing and temporal filtering.

Motor circuit connectivity was examined across each participant's resting state run. 6mm-radius 3D seeds were placed at coordinates for the left and right motor circuits shown in Figure 1 [1]. The **Left Hemisphere (LH) motor circuit (right side movements)** included left M1, left thalamus, left putamen, bilateral rostral-SMC, bilateral dorsal-SMC, and right anterior cerebellum seeds. The **Right Hemisphere (RH) motor circuit (left side movements)** included right M1, right thalamus, right putamen, bilateral rostral-SMC, bilateral dorsal-SMC, and left anterior cerebellum seeds. Time-series from seed regions were extracted, and correlation coefficients were computed for each pair, which were then converted to z-scores. Mean connectivity was determined by averaging all pairwise z-scores within a hemisphere. Simple regression was used to determine inter-individual brain-behavior relationships between hemispheric circuit connectivity and PANESS scores.

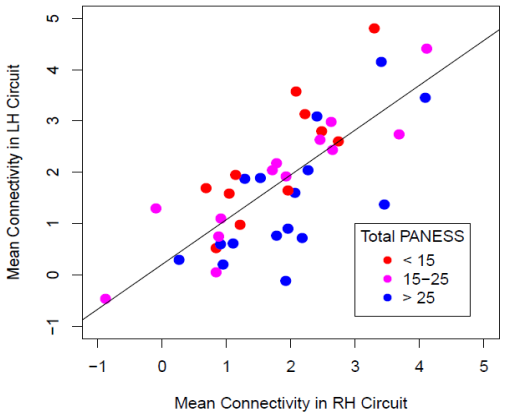


Figure 2. Mean connectivity is significantly correlated across both hemispheres. Lower Total PANESS is associated with stronger LH than RH connectivity.

Results and Discussion: There was a significant relationship between mean connectivity within the LH and RH motor circuits (R=0.573, p=0.0001: Figure 2). Neither mean connectivity within the LH nor the RH motor circuits was significantly associated with motor performance as measured by either Overflow scores (LH: R=-0.26, p=0.100; RH: R=0.09, p=0.570), Timed scores (LH: R=-0.24, p=0.133; RH: R=0.17, p=0.302), or Total PANESS scores (LH: R=-0.18, p=0.259; RH: R=0.21, p=0.18). In contrast, highly robust correlations were seen with differences between mean connectivity within the LH and RH motor circuits, with the LH-RH difference predicting better motor performance (Overflow: R = 0.519, p = 0.0006; Timed: R = 0.583, p = 0.0001; Total PANESS (Figure 3): R = 0.555, p = 0.0002).

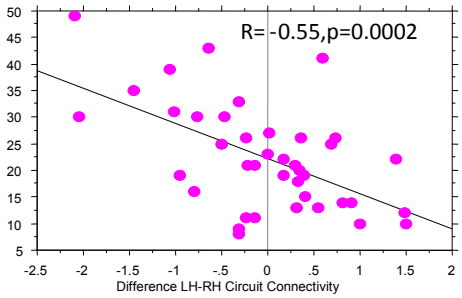


Figure 3. Total PANESS scores are significantly associated with the difference between hemispheres in mean connectivity (LH-RH).

Conclusion: Motor performance in children is associated with LH dominance in motor connectivity.

References:

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