

## Visual-motor connectivity relates to autism trait severity

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**Background:** Autism Spectrum Disorder (ASD) affects many areas of skill development, including motor skills. Research suggests that motor, communication, and social skill learning may share a common brain-basis [1]. ASD-associated deficits in imitating others' actions, dependent on visual-motor integration, likely impact both motor and social skill acquisition and many ASD behavioral interventions target imitation. However, it is unclear what brain mechanisms contribute to these deficits. The purpose of this study was to investigate the relationship between visual-motor functional connectivity (FC) and both imitation ability and autistic trait severity in children with ASD.

**Methods:** Resting state (rs) fMRI scans were acquired from 100 children (50 ASD; 50 typically developing [TD]) on a Phillips 3T (Achieva, Philips Healthcare, Best, The Netherlands) using a single-shot, partially parallel (SENSE) gradient-recalled echo planar sequence (TR/TE = 2500/30 ms, FA = 70°, 3-mm axial slices with no slice gap, 128 time points [n = 27] or 156 time points [n = 73]). Data were interpolated to account for slice acquisition order, rigid body realignment parameters were estimated with respect to the first functional volume to adjust for motion, and the images were registered to the MNI template. Linear trends were removed from the rs data and a Gaussian filter (6-mm FWHM kernel) was applied. Voxel timecourses were intensity-normalized to have a mean of 100. All 100 rs scans were combined to estimate visual and motor networks using group independent component analysis [2]. Participant-specific spatial maps and timecourses were back-reconstructed from the group-level components. To estimate visual-motor FC, Pearson correlations between each pair of participant-specific motor and visual network timecourses were computed and

converted to z-scores using Fisher's transform [3,4]. Brain-behavior relationships were assessed by regressing visual-motor FC with imitation and autistic trait severity scores. Imitation ability was assessed using the Florida Apraxia Battery; scores reflected the number of imitative gestures performed correctly. Autistic trait severity was assessed using the Social Responsiveness Scale (SRS); higher scores indicated more severe autistic traits.

**Results:** Two motor networks (dorsal "DM" and ventral "VM") and three visual networks were identified. Two visual networks included early visual processing areas (BA 17 and 18), while the third ("VC3") included higher-order visual areas involved in perspective processing. In children with ASD, VM was more negatively correlated with VC3 (-.12) compared to TDs (.08,  $p < .05$  corrected), and the strength of this coupling was inversely correlated with total SRS score in the ASD group ( $R = -.42$ ,  $p = .004$ ;

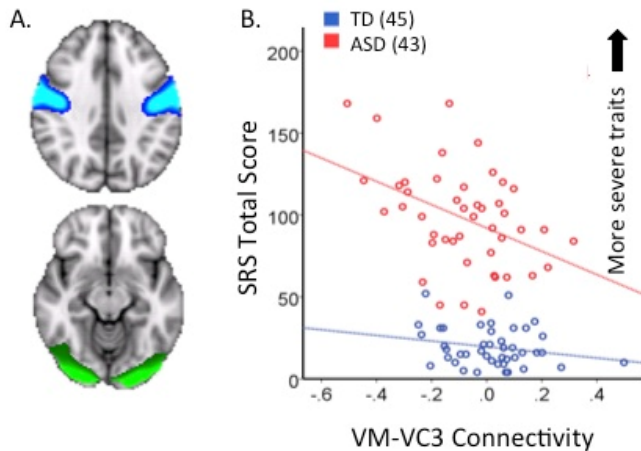


Figure 1). In TDs, stronger VM-VC3 FC was associated with better imitation ( $R = .41$ ,  $p = .01$ ) and better overall performance of gestures on praxis examination ( $R = .61$ ,  $p < .001$ ). No relationship was observed between visual-motor FC and imitation ability in ASDs.

**Figure 1 Relationship between visual-motor connectivity and ASD trait severity.** A. Connectivity between the ventral motor (VM: brain areas in blue) component and the third visual component (VC3: brain areas in green) was negatively correlated with total SRS in the ASD group (red circles). B. Children with stronger negative coupling between VM and VC3 demonstrated more severe ASD traits (higher SRS total score).

**Discussion:** Children with ASD exhibited significantly stronger anticorrelation between motor and higher-order visual areas compared to their TD peers, and the strength of this negative coupling was associated with the severity of autistic traits. Children with stronger negative coupling between VM and VC3 demonstrated more severe autistic traits. In TD children, motor-

visual FC strength was correlated with imitation performance; children with stronger positive VM-VC3 coupling were better imitators.

**Conclusion:** The findings suggest that visual-motor connectivity is associated with the ability to imitate others actions, and that for children with ASD, decreased visual-motor connectivity may contribute to impaired social skill development.

**References:** 1. Dziuk et al. (2007). *Developmental Medicine & Child Neurology*, 49(10), 734-739. 2. Calhoun et al. (2001). *Human Brain Mapping* 14, 140-151. 3. Jafri et al. (2008). *NeuroImage* 39, 1666-1681. 4. Joel et al. (2011). *Magnetic Resonance in Medicine* 66, 644-657.

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