# Altered tract integrity of the social communication network and its functional correlations in high-functioning autism: a diffusion spectrum imaging (DSI) study

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***Objective*** Autism spectrum disorders (ASD) are a group of neurodevelopment disorders with social communication deficits as one of the core symptoms. Patients with high function autism or Asperger's syndrome showed worse performance than typically developing (TD) people in complex language tasks such as pragmatics. In 2014, Catani and Bambini proposed a five-level anatomical model of the language network for social communication [1] including the representation of informative actions, communicative intentions, lexical / semantic processing, syntactic analysis, and pragmatic integration. Among the five-level model, lexical / semantic processing and pragmatic integration may correspond to the symptoms of social communication deficits in high-functioning ASD [2, 3]. The anterior temporal network for lexical and semantic processing was partially composed of the inferior longitudinal fasciculus (ILF) and the uncinate fasciculus (UF), and that the posterior segment of the arcuate fasciculus that linked Wernicke's area to the angular gyrus formed a temporo-parietal network (TPN) for pragmatic integration at the highest level of communication (see Figure 1). Given that the social communication network involved in social language functions, we hypothesized the alterations of the anterior temporal networks and the TPN may be related to the social communication deficits in high-functioning ASD.

***Methods*** Fifty-six right-handed male youths with ASD and 44 matched neurotypical participants (aged 11 to 18) were recruited in this study. All participants were assessed with clinical evaluations, the intelligence test, the Chinese version of the Social Responsiveness Scale (SRS), the Chinese version of the Social Communication Questionnaire (SCQ), and MRI scans. All DSI data were acquired using a twice-refocused balanced echo diffusion echo planar imaging sequence. 102 diffusion encoding gradients with the maximum diffusion sensitivity bmax = 4000 s/mm$^2$ were sampled on the grid points in a half sphere of the 3D q-space. To obtain the transformation between individual's DSI and the DSI template, we employed a registration method under the framework of Large Deformation Diffeomorphic Metric Mapping (LDDMM) fitted to 6D features of DSI datasets, 3D in the image space and 3D in the diffusion-encoding (q) space [4]. The construction strategy incorporated both the gray matter anatomy provided by T1-weighted images and the white matter fiber structures provided by DSI images. Automated Anatomical Labeling (AAL) atlas was invoked to define cortical and subcortical regions as ROIs for each of the targeted tract bundles. A streamline-based fiber tracking algorithm was performed based on the resolved fiber vector fields provided by the DSI template. Targeted tracts were reconstructed on the DSI template using DSI studio (http://dsi-studio.labsolver.org). A template-based approach was employed to sample generalized fractional anisotropy (GFA) of each targeted tract. Three pairs of tracts, namely the UF, ILF, TPN, were identified as the cores of the social communication network.

***Results*** We found that youths with ASD showed reduced GFA of the right ILF (ASD: 0.230±0.022, neurotypicals: 0.239±0.018; p = 0.033) and left UF (ASD: 0.233±0.022, neurotypicals: 0.243±0.018; p = 0.033) as compared to TD youths. In ASD, the GFA of bilateral UF were correlated with social awareness, and the GFA of the right UF was correlated with the social communication. In TD, the GFA of the right TPN was correlated with the social communication (see Table 1).

***Discussion*** The present study is the first attempt to combine DSI analysis and neuropsychological tests to investigate the associations the social communication network integrity with social communication and social awareness in youths with ASD. White matter integrity was partially reduced in the social communication network of ASD. The correlations among SRS, SCQ and white matter integrity reveal a unique pattern in ASD as compared to TD. Our results suggest that functional and structural roles of the social communication network are altered in ASD.

***Reference***

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3.Simmons ES, Paul R, Volkmar F. Assessing Pramatic Language in Autism Spectrum Disorder: The Yale in vivo Pragmatic Protocol. Journal of speech, language, and hearing research : JSLHR. 2014.

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| TD / autism | Social Responsiveness Scale (SRS) — Children report themselves | | Social Communication Questionnaires (SCQ) |
|---|---|---|---|
| | Social communication | Social awareness | Social communication |
| Left UF | | r = -0.385*+ | |
| Right UF | | r = -0.411*+ | r = -0.276* |
| Left ILF | | | |
| Right ILF | | | |
| Left TPJ | | | |
| Right TPJ | r = -0.397* | | r = -0.398* |

Table 1 SRS and SCQ measures were partial correlated with GFA of social communication network in ASD and neurotypicals.

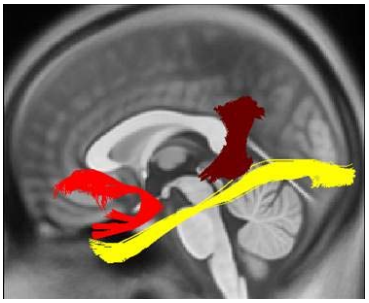

Figure 1 The uncinate fasciculus (red), the inferior longitudinal fasciculus (yellow), tracts in the temporal parietal network (brown) were identified as the social communication network.