Relationship Between Disorganized Speech, Cognition and White Matter Microstructural Characteristics in the Schizo-bipolar Spectrum

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Background and Aim

- Individuals with schizophrenia-spectrum disorders and bipolar disorder exhibit disturbances in language, impairment in cognition, and alterations in brain white matter microstructure.
- However, how disorganized speech relates to cognition and white matter microstructural alterations in the schizo-bipolar spectrum is still unknown.

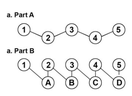
Methods

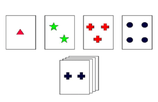
1. Participants

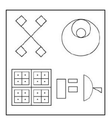
This study included 31 patients with global cognitive impairment (GCI), 28 patients with near-normal cognition (NN), and 29 healthy controls (HC).

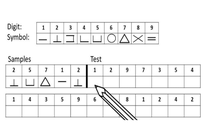
2. Clinical Interviews

- The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I)
- the Clinician-Rated Dimensions of Psychosis Symptom Severity (CRDPSS)









3. Neurocognitive and Social-Cognitive Assessment

- Verbal memory: RAVLT Learning, RAVLT Delayed Recall, RAVLT Recognition
- Processing speed: TMT A, Digit Symbol
- Executive Function: TMT B, Stroop Interference, WCST Category, WCST Per
- Working Memory: Digit Span Forwards, Digit Span Backwards, ACT Total
- Verbal Fluency: Letter Fluency, Semantic Fluency
- Social Cognition: RMET, Hinting Test

4. Neuroimaging

- T1-weighted and diffusion-weighted MRI scans were acquired using a 3T MR scanner.
- T1 images were analyzed using FreeSurfer software.
- Cortical thickness differences between groups were determined using the General Linear Model (GLM).
- Group differences were examined using GLM with Monte Carlo z-field simulation, correcting for multiple comparisons at a threshold of $p < 0.05$.
- Comparisons of the FA values between cognitive subgroups and HCs were analyzed using 'randomize' tool in FSL.
- The threshold-free cluster enhancement method was used to define the clusters and they were corrected for multiple comparisons (5,000 iterations).
- The 'fslmeants' tool of FSL was used to extract mean FA values of each significant cluster for each participant.
- The most probable anatomical location of each significant cluster was defined using JHU DTI-based white matter atlases.
- Pearson correlation analyses were performed for (I) GI, (II) NN, (III) All patients, and (IV) HC groups, separately between disorganized speech scores and FA values of significant clusters.

Results

Table 1 Demographic and clinical characteristics of groups

	Globally Impaired (N = 31)	Near-Normal (N = 28)	Healthy Controls (N= 29)	F /t/ χ2	p	Post-hoc
Age	42.29 (11.39)	36.25 (8.57)	34.86 ± 10.4	4.496	0.014	GI > HC
Sex (female %)	48.4 %	39.3 %	54.2 %	1.188	0.552	
Diagnosis (SCH/SA/BD)	12/5/14 [a]	6/4/18		2.465	0.292	
Age of onset	25 ± 8.67	23.79 ± 7.97		0.524	0.603	
Illness duration	16.71 ± 9.34	13.07 ± 5.23		1.753	0.085	
CRDPSS - Disorganized speech	0.67 ± 0.97	0.14 ± 0.44		2.647	**0.010**	
YMRS	0.74 ± 1.43	0.65 ± 1.44		0.230	0.819	
HAM-D	0.93 ± 2.01	1.57 ± 2.38		-1.10	0.276	

- Globally Impaired subgroup was significantly older than HCs.
- There was no significant difference between the subgroups in terms of traditional diagnostic categories.
- The severity of disorganized speech findings was more evident in the GCI compared to the NN.
- The NN exhibited decreased cortical thickness in three clusters and GCI exhibited decreased cortical thickness in five clusters compared to HCs.
- There was no significant relationship between cortical thickness and disorganized speech measures.
- The NN exhibited increased FA values in four clusters compared to the GCI.

Results (cont.)

Figure 1: Clusters showing significantly decreased cortical thickness in the NN compared to HCs. Left: Inferior temporal and precentral gyri. Right: Precentral gyrus.

Figure 2: Clusters showing significantly decreased cortical thickness in the GI compared to HCs. Left: Pars orbitalis. Right: Superior temporal gyrus, temporal pole, fusiform gyrus and pars opercularis.

Results (cont.)

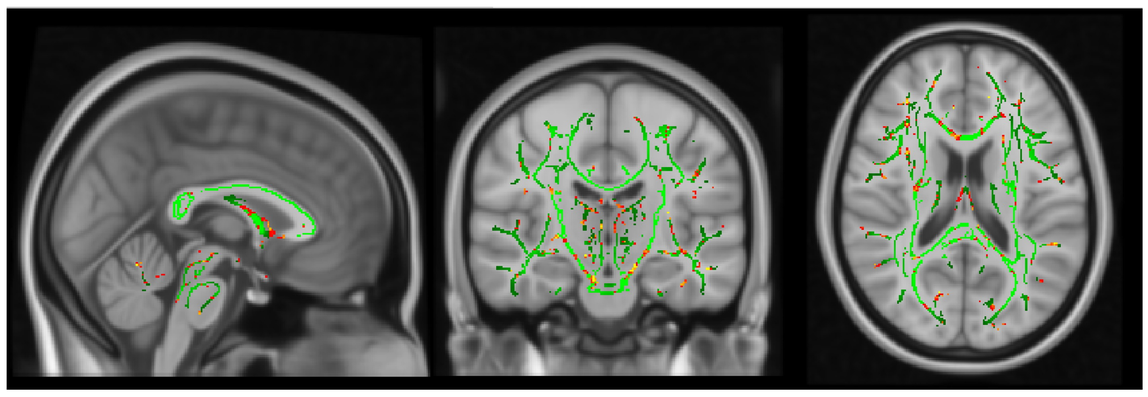


Figure 2: Clusters showing significantly decreased FA in the Globally Impaired subgroup compared to the Near-Normal subgroup.

- In the entire patient group, there was a significant inverse relationship between the severity of disorganized speech and the FA values in one of the significant clusters, which included the **bilateral anterior thalamic radiation**, **cingulum**, **inferior fronto-occipital fasciculus,** and **inferior longitudinal fasciculus (r=-0.31, p=0.01)**.

Table 2 Characteristics of the significant cluster which showed a significant correlation with disorganized speech

Groups	Size (Voxel)	MNI X	MNI Y	MNI Z	P (corr)	Direction
NN vs. GI	747	-13	-23	-18	< 0.05	NN > GI

Discussion

- Findings indicate a significant relation between disturbances in speech, cognitive impairment and structural brain abnormalities in the schizo-bipolar spectrum.
- Future studies including patients in the early phases and employing a multimodal design may provide a better understanding of these complex relationships.

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