Making sense of the senseless: Abnormal brain connectivity in patients with schizophrenia during sentence processing

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Introduction

The language network
- The inferior frontal and temporal lobes of the brain are crucially involved in processing language in context and have been shown to be connected during language unification [1].

The language network in patients with schizophrenia
- A 'loosening of association' is a core feature of schizophrenia that can manifest clinically as incoherent and disorganized language output [2].
- These abnormalities may be driven by an impairment in the use of context to predict and facilitate the processing of words that are semantically congruous with this context [3].
- Patients with schizophrenia can show abnormal increases in neural activity to words that are semantically unrelated to their preceding context [4].
- Language and semantic abnormalities in schizophrenia have been linked to abnormal activity within the left inferior frontal cortex and to abnormal connectivity between frontal and temporal cortices [5].

Present study:
- In the present study we looked at activation and connectivity patterns to sentences versus wordlists in patients with schizophrenia and age and education matched control participants.
- We hypothesize that we will find abnormal fronto-temporal connectivity patterns to sentences in the patient group.

Design

Sentences: “The gray mouse quickly scurried underneath the dusty rug”
Wordlists: “the flour and the painting fireworks were sea”

Methods

Demographic and Clinical Information

<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>19/16</td>
<td>17/12</td>
</tr>
<tr>
<td>Male/Female</td>
<td>16/3</td>
<td>15/2</td>
</tr>
<tr>
<td>Age, y</td>
<td>45.4±6.8</td>
<td>44.8±9.0</td>
</tr>
<tr>
<td>Hollingshead Index</td>
<td>2.9±0.9</td>
<td>2.6±0.9</td>
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<tr>
<td>Education, y</td>
<td>12±1.2</td>
<td>13.1±2.2</td>
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<tr>
<td>Premotor Verbal IQ</td>
<td>13±9.86</td>
<td>12±9.87</td>
</tr>
<tr>
<td>CPZ Equivalent</td>
<td>N/A</td>
<td>499.9±307.4</td>
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<tr>
<td>Duration of Illness, y</td>
<td>N/A</td>
<td>17.9±5.4</td>
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Analysis:
- Preprocessing and analyses of functional activations were run using SPM8.
- Motion was corrected using the ART toolbox [6].
- Connectivity analyses were run using generalised psycho-physiological interactions (gPPI) [7].
- Statistical analyses were conducted using two-sample, between-subjects, t-tests.
- Activations and connectivity patterns are shown at a voxel-level threshold of p<0.005, cluster-level threshold, Pcorr>0.05.

Results

The temporal lobe shows opposite connectivity patterns in patients & controls

Conclusions

Patients with schizophrenia show abnormal activation and connectivity patterns within the language network.

- The patient group shows increased connectivity within the temporal lobe to wordlists (versus sentences).
- Moreover, they show abnormally reduced fronto-temporally connectivity to both sentences as well as wordlists.
- Patients may inappropriately engage the temporal lobes more when trying to make sense of the wordlists.
- In patients the left IFG, which is key to semantic unification, to combine the words into a coherent whole, shows abnormal patterns of activation as well as connectivity.
- These abnormal patterns of activation and connectivity may contribute to the disorganization of thought and language that characterizes schizophrenia.

References

7. Li, Branch, Nierenberg & DeLisi, 2010, Brain Imaging and Behavior.

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