Brain Networks Underlying Hallucinations in Schizophrenia: A Multisite Hallucinations Experience Study

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INTRODUCTION

• Auditory verbal hallucinations (AVHs) are typically speech perceptions that occur in the absence of an external stimulus, and are a primary symptom of schizophrenia.1
• It has been thought for some time that imagery activates the same brain areas as perception.2 Although there have been a number of reviews and meta-analyses carried out, it has not been demonstrated that the network of activations attributed to the hallucinating brain were not those involved in responding to indicate the start/end of the hallucination.
• In the current study, we analyzed data from two sites (Melbourne and Groningen) that had collected data as patients were hallucinating in the fMRI scanner, using constrained principal component analysis for fMRI (fMRI-CPCA).

METHOD — Data Details

<table>
<thead>
<tr>
<th>Site</th>
<th>Number of subjects analyzed</th>
<th>Tasks</th>
<th>Design</th>
<th>Mean frequency of hallucations (Hz) in subjects with schizophrenia per run</th>
<th>Mean duration of hallucations (s) in subjects with schizophrenia</th>
<th>Start/Medium/Long (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne</td>
<td>17</td>
<td>External (radio)</td>
<td>Hallucinations on/off for External (radio) speech</td>
<td>33.0 (29.4)</td>
<td>6.38 (5.62)</td>
<td>External (S/M/L): Short (1.02 - &lt;3.98), Medium (3.98 - &lt;8.32), Long (8.32 - 20.50)</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>External (S/M/L)</td>
<td>Hallucinations on/off for External (S/M/L) speech</td>
<td>2 minutes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groningen</td>
<td>12</td>
<td>External (radio)</td>
<td>Hallucinations on/off for External (radio) speech</td>
<td>12.5 (12.44)</td>
<td>8.20 (12.44)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>External (S/M/L)</td>
<td>Hallucinations on/off for External (S/M/L) speech</td>
<td>5 minutes</td>
<td></td>
<td></td>
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</tbody>
</table>

RESULTS

Melbourne Patient and Control External (radio) Speech Analysis — Component 2

• Activity in the superior temporal gyrus, inferior frontal gyrus, precentral gyrus, planum temporale, thalamus
• The separation between the peaks for short/medium/long in the HDR plot suggests this network is involved in responding to auditory stimuli.
• A significant effect of duration (F (1,622, 74.623) = 12.445, p = 0.000), time (F (3,269, 150.359) = 84.309, p = 0.000), and significant interaction effect of duration x time (F (12,859, 591.509) = 13.024, p = 0.000).

Melbourne Patient and Control External (radio) Speech Analysis — Component 3

• Positive loadings in bilateral superior temporal gyrus
• Negative loadings in occipital pole, lateral occipital cortex, precuneous cortex
• Negative loadings are a weak match for DMN
• A significant effect of time (F (3,234, 45.275) = 8.414, p = 0.000).

Groningen Patient Hallucination Analysis — Component 1 — Response Network

• Activity in precentral gyrus, juxtapostional lobule cortex, central opercular cortex, superior frontal gyrus, planum temporale, occipital fusiform gyrus, thalamus
• The rise to peak from baseline for short/medium/long and then return from peak to baseline combined with anatomical activation suggests this network is involved in responding.

REFERENCE