Source Memory is not Properly Differentiated from Object Memory in Early Schizophrenia
An fMRI study using virtual reality

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Source Memory:
- Identifying the context in which a stimulus was encountered
- Requires binding together elements of an event into a memory trace
  - Temporal context
  - Spatial context
- Typically evaluated at retrieval
- Often tested with relatively simple, artificial tasks
  - E.g., Identifying the encoding question
Source Memory Deficits in Schizophrenia

Altered patterns of neural activity during retrieval of self vs. externally generated stimuli

Vinogradov et al., Cerebral Cortex November 2008;18:2532--2539

Altered functional connectivity when evaluating self vs. other generated words

Wang et al. Schizophrenia Research 125 (2011) 136–142
fMRI of Source Memory in Schizophrenia

- Encoding session with two tasks
- Source memory: identifying the task associated with a word
- 13 Patients and 13 controls

- Patients did not activate the same regions as controls
- ‘Extra’ Patient activity not associated with performance
  • Inefficient rather than compensatory activity
- No significant group differences
## Demographic Info

### 24 patients with schizophrenia spectrum

### 23 controls

<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>Schizophrenia</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24.4 (3.9)</td>
<td>24.4 (4.1)</td>
<td>0.99</td>
</tr>
<tr>
<td>Gender (M:F)</td>
<td>19:5</td>
<td>22:4</td>
<td>0.95</td>
</tr>
<tr>
<td>Education</td>
<td>13.5 (2.0)</td>
<td>11.4 (1.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Parental SES</td>
<td>47.3 (17.1)</td>
<td>38.7 (14.0)</td>
<td>0.078</td>
</tr>
<tr>
<td>Handedness (L/Amb/R)</td>
<td>18/2/2</td>
<td>23/2/1</td>
<td></td>
</tr>
<tr>
<td>Time in Treatment (years)</td>
<td></td>
<td>1.4 ± 1.4 (0.12 to 4.5)</td>
<td></td>
</tr>
<tr>
<td>Total SAPS</td>
<td></td>
<td>10.6 ± 12.1 (0 to 44)</td>
<td></td>
</tr>
<tr>
<td>Total SANS</td>
<td></td>
<td>19.4 ± 18.5 (0 to 66)</td>
<td></td>
</tr>
<tr>
<td>Calgary Depression Scale</td>
<td></td>
<td>1.1 ± 1.99 (0 to 7)</td>
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<tr>
<td>Hamilton Anxiety Rating Scale</td>
<td></td>
<td>3.1 ± 4.4 (0 to 21)</td>
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L= left. R= right. Amb = ambidextrous  
SAPS = Scale for Assessment of Positive Symptoms  
SANS = Scale for Assessment of Negative Symptoms  
Total SANS excludes attention (items 23-25)  
Clinical scores from assessment closest to scanning date
Virtual Reality Encoding Task

Performed outside the MRI prior to scanning

20 Encounters (a person in a place with an object)
fMRI recognition Task

Recognition:
• Person
• Place
• Object
• Bright

20 trials per condition
Image presented for 8000 ms, with 1000 to 5000ms ISI
Data Recording and Analysis

- 3T Siemens Tim Trio MRI
  - TR=2000 ms, TE=30 ms, flip angle=90, 36 slices, 4x4x4mm voxels, 64 x 64 voxel plane, 517 volumes

- Data analyzed using SPM8
- Motion corrected, normalized to MNI space and resampled (2x2x2mm) and smoothed 8 mm
- Contrasts: Person vs. Object and Place vs. Object (source memory)
- Second level analysis separately for each group (1 sample t-test) and comparing groups (two-samples t-test)

- Multiple corrections performed using cluster extent defined by monte-carlo simulation
Schizophrenia vs. Controls

Object > place
A closer look …
Relationship between source memory and hallucinations

SAPS total hallucinations at baseline assessment regressed against source memory contrasts

Regions associated with hallucinations
<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>Schizophrenia</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person</td>
<td>79 (14)</td>
<td>70 (14)</td>
<td>p = 0.03</td>
</tr>
<tr>
<td>Place</td>
<td>75 (17)</td>
<td>78 (14)</td>
<td>p = 0.66</td>
</tr>
<tr>
<td>Object</td>
<td>92 (13)</td>
<td>91 (13)</td>
<td>p = 0.95</td>
</tr>
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