**Exploration of source flexibility in schizophrenia: Specificity and relationships with real world functioning and hallucinations**

Julien Laloyaux1 & Frank Larøi1,2

1 University of Liège, Psychology and Neuroscience of Cognition Research Unit, Liège, Belgium
2 University of Bergen, Department of Biological and Medical Psychology, Bergen, Norway

**BACKGROUND**

- Source flexibility in one important aspect of human cognition (Burgess et al., 2007)
- This cognitive mechanism is hypothesized to be implicated in a number of different activities of real world (Burgess et al., 2007)
- It may also play a central role in the apperception and maintenance of specific symptoms such as hallucinations
- Such a hypothesis is congruent with the self-regulatory executive function model (Wells and Matthews, 1994)
- However, it has received very little interest in the literature
- Moreover, this is unclear if such mechanism is independent of cognitive flexibility and processing speed
- The aim of the present study is to explore a potential impairment of source flexibility in a group of persons diagnosed with schizophrenia and to examine whether or not this mechanism is independent from processing speed and cognitive flexibility
- A second aim is to examine the extent to which source flexibility is related to real world functioning and auditory hallucinations

**METHODS**

**Participants**
- 36 patients diagnosed with schizophrenia
- 28 healthy controls

**Materials**
- Computerized tasks
  - Source flexibility – Alphabet task (Gilbert et al., 2005)
  - Cognitive flexibility (Zimmermann and Fimm, 2010)
  - Processing speed (Verhaegen and Poncelet, 2013)

**Clinical measures**
- FROGS
- PSP
- PSYRATS/Hallucination subscale: Emotion, Cognitive interpretation, Disruption, and Physical characteristics

**RESULTS**

1. Performance on the cognitive tests in the two groups

<table>
<thead>
<tr>
<th>Source flexibility</th>
<th>Patients - Mean(SD)</th>
<th>Healthy controls - Mean(SD)</th>
<th>t (62)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RT – SO (ms)</td>
<td>1076.79 (231.94)</td>
<td>882.60 (149.72)</td>
<td>3.97***</td>
</tr>
<tr>
<td>RT – SI (ms)</td>
<td>1348.28 (406.49)</td>
<td>1040.47 (312.71)</td>
<td>3.63***</td>
</tr>
<tr>
<td>RT – SI to SO (ms)</td>
<td>1584.33 (599.00)</td>
<td>1160.58 (338.10)</td>
<td>3.34***</td>
</tr>
<tr>
<td>RT – SO to SI (ms)</td>
<td>1910.05 (780.15)</td>
<td>1329.62 (366.60)</td>
<td>3.67***</td>
</tr>
<tr>
<td>RT – Mean slowing Switch vs Stay (ms)</td>
<td>534.65 (448.04)</td>
<td>283.56 (221.90)</td>
<td>2.71***</td>
</tr>
<tr>
<td>RT – Mean slowing SI vs SO (ms)</td>
<td>298.60 (333.50)</td>
<td>163.45 (176.40)</td>
<td>1.94*</td>
</tr>
<tr>
<td>Error % – SO</td>
<td>8.64 (13.66)</td>
<td>2.28 (13.24)</td>
<td>2.40*</td>
</tr>
<tr>
<td>Error % – SI</td>
<td>14.35 (8.75)</td>
<td>4.26 (6.94)</td>
<td>2.75**</td>
</tr>
<tr>
<td>Error % – SI to SO</td>
<td>5.82 (2.33)</td>
<td>4.46 (6.20)</td>
<td>0.53</td>
</tr>
<tr>
<td>Error % – SO to SI</td>
<td>15.30 (9.79)</td>
<td>2.77 (6.92)</td>
<td>3.19**</td>
</tr>
</tbody>
</table>

**Cognitive flexibility**

| RT (ms)         | 1440.44 (502.23)    | 846.05 (293.54)             | 5.56***|
| Error %         | 15.18 (12.47)       | 5.84 (5.85)                 | 3.67***|
| Processing speed | 777.14 (129.40)     | 645.25 (131.88)             | 4.01***|
| Error %         | 12.00 (10.56)       | 6.11 (10.64)                | 2.20*|

* = p<0.05, ** = p<0.01 (Benjamini-Hochberg-Yekutieli correction), *** = p<0.001

- Controlling for processing speed or cognitive flexibility did not affect the original differences

**DISCUSSION**

- Persons diagnosed with schizophrenia presented a significantly slower RT and a higher percentage of errors for all the cognitive measures
- Controlling for the impact of processing speed or cognitive flexibility on the source flexibility tasks did not affect the original differences
- Such results suggest the specificity of source flexibility abilities
- Patients’ difficulties in maintaining attention to one’s inner thoughts was related to real world impairments
- Moreover, difficulties in maintaining attention to one’s inner thoughts and to the outside world were related to the presence of hallucinations
- The present results have several clinical implications. In particular, Wells (1990, 2006) described an attention training technique designed to reduce the self-focused attention by training the patient to focus on several external sounds introduced in the treatment room. Recently, a case study (Levaux et al., 2011) demonstrated this technique to be effective in reducing positive symptoms in a patient diagnosed with schizophrenia. However, the results of the present study suggest adding a specific training aiming to increase the focus on the internal world would benefit the reduction of hallucinations

**Address for correspondence:** j.laloyaux@ulg.ac.be