Cognitive flexibility in Pathological Gambling and Alcohol Dependence: An fMRI study

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Introduction

A lack of cognitive flexibility is evident in alcohol dependence (AD):
- Perseveration and stereotypical behaviour emerge as compulsive drinking behaviour.
- Neurocognitive studies indicate cognitive inflexibility in AD, which is sometimes attributed to the neurotoxic effects of ethanol.
- Cognitive inflexibility has also been found in pathological gambling (PG), an addictive behaviour without toxic effects of drugs on the brain with broad neurobiological resemblance to substance use disorders (van Holst et al., 2010).
- Yet, brain functioning underlying diminished cognitive flexibility in pathological gambling and alcohol dependence has not been studied as of yet.

Aims:
- Compare the neural correlates of cognitive flexibility in pathological gambling and alcohol dependence to healthy controls
- To better understand perseverative behaviour in addictions
- Compare substance dependence to addictive behaviour without neurotoxic effects of substances

Methods

Cognitive flexibility paradigm: Switch-task (Sohn et al., 2000)
- Presentation of two stimuli: a letter and a digit.
- If color of letter is red: press left for vowel, press right for consonant.
- If color is blue: press left for even, press right for odd

Trial types:
- Same as previous trial (repetition trials: 4-6 trials)
- Switch from color previous trial (switch trials)

Event related paradigm. Task duration: 15 minutes.

The task was explained and practiced outside the scanner.

Participants:
20 pathological gamblers (PG), 21 alcohol dependent (AD) persons, 19 healthy controls.
PG and AD groups recruited from a local outpatient treatment clinic.
Exclusion: severe psychopathology, psychoactive drugs, TBI.

<table>
<thead>
<tr>
<th></th>
<th>Problem gamblers (n=20)</th>
<th>Alcohol dependents (n=21)</th>
<th>Healthy controls (n=19)</th>
<th>ANOVA (two-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>38.15 (12.11)</td>
<td>42.90 (8.67)</td>
<td>37.47 (11.33)</td>
<td>p=0.125</td>
</tr>
<tr>
<td>Age of onset, mean (SD)</td>
<td>27.25 (11.43)</td>
<td>30.38 (8.13)</td>
<td></td>
<td>χ²(1)=1.90, p=0.16</td>
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<td>South Oaks</td>
<td>11.16 (3.16)</td>
<td>0.14 (0.39)</td>
<td>0.05 (0.22)</td>
<td>χ²(1)=49.36, p&lt;0.001</td>
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<tr>
<td>Gambling Screen</td>
<td>5.15 (2.94)</td>
<td>28.75 (6.55)</td>
<td>4.89 (4.50)</td>
<td>χ²(1)=38.89, p&lt;0.001</td>
</tr>
<tr>
<td>Number of trials during training</td>
<td>139.4 (68.1)</td>
<td>167.0 (61.4)</td>
<td>134.4 (68.1)</td>
<td>F(2,50)=1.46, p=0.24</td>
</tr>
<tr>
<td>RT during fMRI trials</td>
<td>1142.9 (200.1)</td>
<td>1167 (298.9)</td>
<td>1040 (213.0)</td>
<td>p=0.15</td>
</tr>
</tbody>
</table>

Analysis

ANOVA (two-tailed) followed by group comparisons for behavioral data

fMRI data:
- Contrast images for switch versus repetition trials were entered into a second-level (random effects) analysis.
- Main effects across groups for each contrast were analyzed with one-way ANOVA implemented in SPM5 corrected for multiple comparisons according to the Family Wise Error (FWE) method.
- Group interactions are reported at p<0.001, masked with the appropriate main effect at p<0.05.

Results

Behavioral:
- The Alcohol Dependent group tended to have slower reaction times than the healthy controls (HC), p<0.07

fMRI:
- Main effects of switching behavior (switch vs. stay) in all three groups:
  - Bilateral: putamen, medial, middle, and superior frontal gyrus, parahippocampal gyrus
  - Right: anterior cingulate cortex (ACC) (see figure below left).
- Group interaction alcohol dependents vs healthy controls and pathological gamblers vs healthy controls (switch vs. stay):
  - AD < HC: right anterior cingulate
  - Bilateral parahippocampal gyrus
  - Right middle frontal gyrus

Conclusions

First study to investigate cognitive flexibility and its neuronal substrates in pathological gambling and alcohol dependence.

Less activation during switching may result in more difficulty exerting flexibility over addiction related behavior: e.g. disengaging from addictive behavior.

References


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