



---

## Hollow mask illusion fails to fool schizophrenia patients

6 April 2009

Patients with schizophrenia are able to correctly see through an illusion known as the ‘hollow mask’ illusion, probably because their brain disconnects ‘what the eyes see’ from what ‘the brain thinks it is seeing’, according to a joint UK and German study published in the journal *NeuroImage*. The findings shed light on why cannabis users may also be less deceived by the illusion whilst on the drug.

People with schizophrenia, a mental illness affecting about one per cent of the population, are known to be immune to certain vision illusions. The latest study confirms that patients with schizophrenia are not fooled by the ‘hollow mask’ illusion, and that this may relate to a difference in the way two parts of their brains communicate with each other – the ‘bottom-up’ process of collecting incoming visual information from the eyes, and the ‘top-down’ process of interpreting this information.

Illusions occur when the brain interprets incoming sensory information on the basis of its context and a person’s previous experience, so called top-down processing. Sometimes this process can mean that people’s perception of an object is quite different to reality – a phenomenon often exploited by magicians. The new study, by scientists at the Hannover Medical School in Germany and UCL Institute of Cognitive Neuroscience in the UK, suggests that patients with schizophrenia rely considerably less on top-down processing during perception.

The study used a variation on the three-dimensional ‘hollow mask’ illusion. In this illusion, a hollow mask of a face (pointing inwards, or concave) appears as a normal face (pointing outwards, or convex). During the experiment, 3D normal faces and hollow faces were shown to patients with schizophrenia and control volunteers while they lay inside an fMRI brain scanner, which monitored their brain responses.

As expected, all 16 control volunteers perceived the hollow mask as a normal face – mis-categorising the illusion faces 99 percent of the time. By contrast, all 13 patients with schizophrenia could routinely distinguish between hollow and normal faces, with an average of only six percent mis-categorisation errors for illusion faces.

The results of the brain imaging analysis suggested that in the healthy volunteers, connectivity between two parts of the brain, the parietal cortex involved in top-down control, particularly spatial attention, and the lateral occipital cortex involved in bottom-up processing of visual information, increased when the hollow faces were presented. In the patients with schizophrenia, this connectivity change did not occur. These results suggest that patients with schizophrenia have difficulty coordinating responses between different brain areas, also known as ‘dysconnectivity’, and that this may contribute to their immunity to visual illusions. The research group is now investigating dysconnectivity in schizophrenia further, which will hopefully advance our understanding of this disorder.

Danai Dima, Hannover Medical School, says: “The term ‘schizophrenia’ was coined almost a century ago to mean the splitting of different mental domains, but the idea has now shifted more towards connectivity between brain areas. The prevailing theory is that perception principally comprises three components: firstly, sensory input (bottom-up); secondly, the internal production of concepts (top-down); and thirdly, a control (a ‘censor’ component), which covers interaction between the two first components. Our study provides further evidence of ‘dysconnectivity’ between these components in the brains of people with schizophrenia.”

Dr Jonathan Roiser, UCL Institute of Cognitive Neuroscience, says: “Our findings also shed light on studies of visual illusions which have used psychomimetics – drugs that mimic the symptoms of psychosis. Studies using natural or synthetic tetrahydrocannabinol (THC), the ingredient of cannabis resin responsible for its psychotic-like effects, have found that people under the influence of cannabis are also less deceived by the hollow mask illusion. It may be that THC causes a temporary “disconnection” between brain areas, similar to that seen in patients with schizophrenia, though this hypothesis needs to be tested in further research.”

### **Notes for Editors**

1. For more information or to set up an interview, please contact Dr Jonathan Roiser, UCL Institute of Cognitive Neuroscience, on tel: +44 (0)20 7679 1170, email: [j.roiser@ucl.ac.uk](mailto:j.roiser@ucl.ac.uk), or Danai Dima, Hannover Medical School, on tel: +49 (0)511 532 6765, email: [Dima.Danai@MH-Hannover.DE](mailto:Dima.Danai@MH-Hannover.DE).
2. Alternatively, please contact Jenny Gimpel in the UCL Media Relations Office on tel: +44 (0)20 7679 9726, mobile: +44 (0)7747 565 056, out of hours +44 (0)7917 271 364, e-mail: [j.gimpel@ucl.ac.uk](mailto:j.gimpel@ucl.ac.uk).
3. An illusory image used in the study is available from the UCL Media Relations Office. A video of the hollow mask illusion can be obtained from UCL Media Relations Office, along with a copy of the paper.
4. ‘Understanding why patients with schizophrenia do not perceive the hollow mask illusion using dynamic causal modelling’ by D Dima, JP Roiser, DE Dietrich, C Bonnemann, H Lanfermann, HM Emrich and W Dillo, is published online in the journal *NeuroImage*.
5. The project was funded by a Marie Curie Early Stage Training Fellowship from the European Community.