

Depression and schizophrenia: an fMRI study of reward prediction errors

V.B. Gradin¹, P. Kumar², G. Waiter^{3,4}, T. Ahearn^{3,4}, I. Reid¹, C. Stickley⁵, M. Milders⁶, J. Hall⁷ and J.D. Steele⁸

¹ Dept. of Mental Health, ² Dept. of Medical Physics, ³ Dept. of Radiology, and ⁴ Dept. Of Psychology, University of Aberdeen
⁵ Dept. of Psychiatry, University of Oxford
⁶ Cornhill Hospital, Aberdeen
⁷ Division of Psychiatry, University of Edinburgh
⁸ Centre for Neuroscience, Division of Medical Sciences, University of Dundee

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UNIVERSITY OF ABERDEEN



BACKGROUND

- Dopamine (DA)** has been linked to **anhedonia** (inability to experience pleasure) in depression and **negative plus psychotic symptoms** in schizophrenia. It remains unclear, how a dysfunction of DA could mechanistically lead to symptoms such as anhedonia or psychosis.
- DA signals code a **reward prediction error**: increased (decreased) firing rate if rewards are better (worse) than expected (Schultz, 1998). Temporal difference (TD) models provide a mathematical description of this signal (Dayan & Abbot, 2001). This signal could mediate **learning** of stimulus-response-outcomes associations and/or the attribution of **"incentive salience"** to reward related stimuli (Berridge, 2007).
- A disturbance in DA signals could be contributing to anhedonia in depression (Kumar et al., 2008) and negative symptoms in schizophrenia (Juckel et al 2006), and also to positive symptoms by attributing an **aberrant salience** to external and internal objects (Kapur, 2003).

STUDY AIM

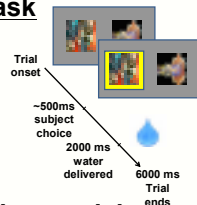
To investigate the encoding of prediction errors in the brain of patients with depression and schizophrenia.

METHODS

A depression (n=15), a schizophrenia (n=14) and a Control (n=17) group were scanned using **fMRI**

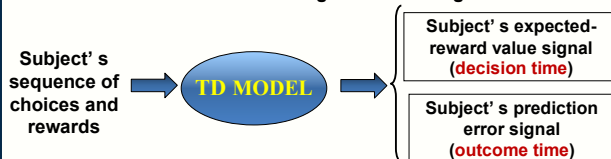
Instrumental reward learning task

- Subjects choose between two pictures. If they choose the "correct" one they get two drops of water ("reward").
- Subjects learn, by **trial and error**, which is the picture more likely to deliver the water.



Temporal Difference (TD) learning model

A **SARSA** TD model was used to generate two signals:



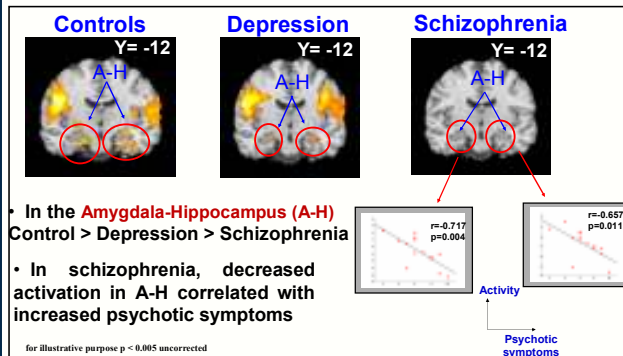
RESULTS

1 - Behavioural results

Schizophrenia scored less than controls.
(No other significant differences)

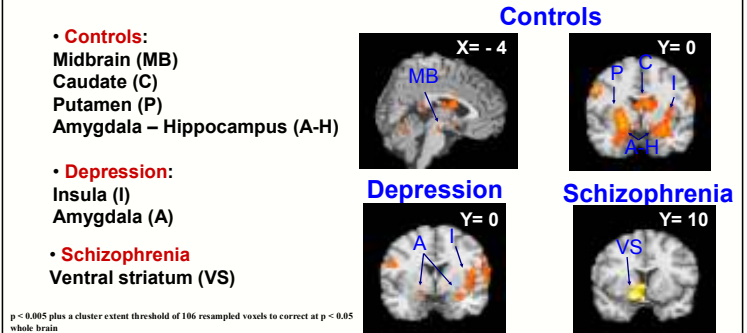


2 - Neural responses to expected-reward value

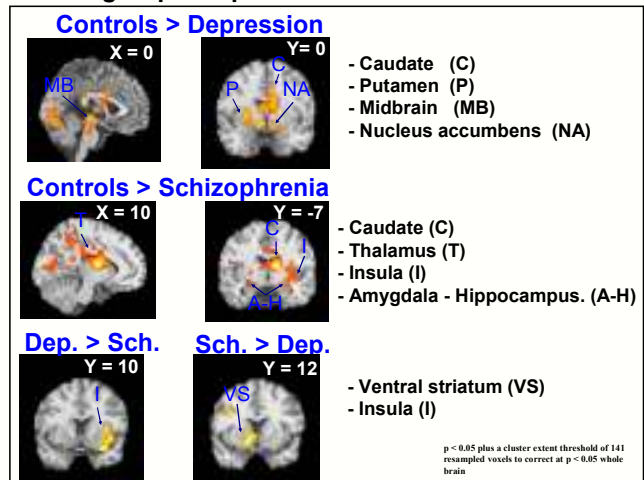


3 - Neural responses to prediction error

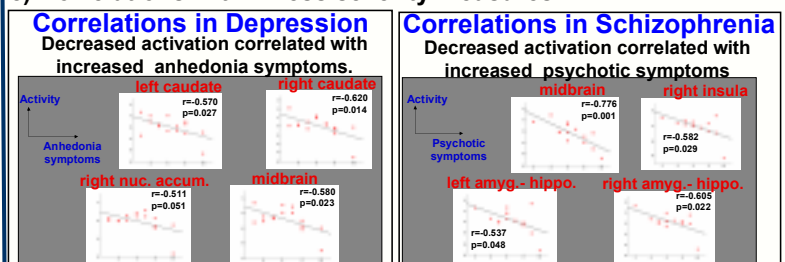
a) Within group analysis



b) Between group comparisons



c) Correlations with illness severity measures



DISCUSSION

- A dysfunction of DA signals could be underlying anhedonia symptoms in depression and also contributing to negative symptoms in schizophrenia. While a truly diminished DA functioning has been associated to depression a "noisy" functioning of DA may be happening in schizophrenia.
- Findings suggest that abnormalities in DA signals are associated to psychotic symptoms in schizophrenia. This result supports the notion that abnormal DA signals could mediate attribution of aberrant salience leading to abnormal associations (Kapur, 2003).
- In the striatum (amygdala-hippocampus and insula) abnormalities in reward prediction error signals seem more marked in depression (schizophrenia).
- Findings may help to bridge the gap between the biology and phenomenology of the illnesses.

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