



Altered medial prefrontal activity during dynamic face processing in schizophrenia spectrum patients



Omar Mothersill^{a,b}, Derek W. Morris^{a,b,d}, Sinead Kelly^{a,b}, Emma Jane Rose^{a,b,c}, Arun Bokde^b, Richard Reilly^b, Michael Gill^{a,b}, Aiden P. Corvin^{a,b}, Gary Donohoe^{a,b,d,*}

^a Neuropsychiatric Genetics Group, Department of Psychiatry, Trinity College Dublin, College Green, Dublin 2, Ireland

^b Trinity College Institute for Neuroscience, Trinity College Dublin, College Green, Dublin 2, Ireland

^c Transdisciplinary Science and Translational Prevention Program (TSTPP), Research Triangle Institute International, Baltimore, MD, United States

^d School of Psychology, National University of Ireland Galway, University Road, Galway, Ireland

ARTICLE INFO

Article history:

Received 14 February 2014

Received in revised form 30 April 2014

Accepted 18 May 2014

Available online 2 June 2014

Keywords:

schizophrenia
face processing
emotion
medial prefrontal

ABSTRACT

Background: Processing the emotional content of faces is recognised as a key deficit of schizophrenia, associated with poorer functional outcomes and possibly contributing to the severity of clinical symptoms such as paranoia. At the neural level, fMRI studies have reported altered limbic activity in response to facial stimuli. However, previous studies may be limited by the use of cognitively demanding tasks and static facial stimuli. To address these issues, the current study used a face processing task involving both passive face viewing and dynamic social stimuli. Such a task may (1) lack the potentially confounding effects of high cognitive demands and (2) show higher ecological validity.

Methods: Functional MRI was used to examine neural activity in 25 patients with a DSM-IV diagnosis of schizophrenia/schizoaffective disorder and 21 age- and gender-matched healthy controls while they participated in a face processing task, which involved viewing videos of angry and neutral facial expressions, and a non-biological baseline condition.

Results: While viewing faces, patients showed significantly weaker deactivation of the medial prefrontal cortex, including the anterior cingulate, and decreased activation in the left cerebellum, compared to controls. Patients also showed weaker medial prefrontal deactivation while viewing the angry faces relative to baseline.

Discussion: Given that the anterior cingulate plays a role in processing negative emotion, weaker deactivation of this region in patients while viewing faces may contribute to an increased perception of social threat. Future studies examining the neurobiology of social cognition in schizophrenia using fMRI may help establish targets for treatment interventions.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Social cognition is a broad construct consisting of cognitive processes that allow people to perceive, interpret and store information about themselves and others (Penn et al., 2008; Van Overwalle, 2009). Examples include recognising emotions from facial expressions or tone of voice, or thinking about the thoughts and goals of others. Deficits in social cognition have been identified in several neurodevelopmental disorders including autism (Frith, 2001), attention deficit hyperactivity disorder (ADHD) (Uekermann et al., 2010), and schizophrenia (Couture et al., 2006). In schizophrenia, social cognitive deficits are a defining feature, affecting quality of life and functional outcomes in work,

relationships and independent living (Brekke et al., 2005; McGlade et al., 2008). For example, a recent meta-analysis by Fett et al. (2011) suggests that social cognition predicts more variation in social and occupational functioning than cognitive performance alone.

One aspect of social cognition that is significantly impaired in schizophrenia is processing the emotional content of faces (Li et al., 2010). For example, patients have been reported to have difficulties recognising emotions from faces (Aleman and Kahn, 2005), but are also more sensitive to negative facial expressions such as anger and fear compared to healthy controls (Mandal et al., 1998; Evans et al., 2011). Excessive threat detection from facial expressions has also been hypothesised to contribute to the development of persecutory delusions (Green and Phillips, 2004), which are associated with patient distress (Freeman et al., 2002) and predict admission to hospital (Castle et al., 1994).

At the neural level, emotional face processing activates limbic regions including the amygdala, which is important for detecting the emotional salience of a stimulus and generating an affective response,

* Corresponding author at: School of Psychology, National University of Ireland Galway, University Road, Galway, Ireland. Tel.: +353 91 495122.

E-mail address: gary.donohoe@nuigalway.ie (G. Donohoe).

and the medial prefrontal cortex (mPFC) and anterior cingulate (ACC), which are important in expressing negative emotion and regulating other limbic regions (Etkin et al., 2011). Meta-analysis of fMRI studies by Li et al. (2010) indicates that schizophrenia patients generally show reduced activation of the bilateral amygdala in response to emotional faces compared to healthy controls, which may contribute to difficulties understanding the emotions of other people. Similarly, Hempel et al. (2003) and Habel et al. (2010) report decreased activation of the ACC in patients viewing emotional faces. However, increased activation of the amygdala and ACC have been reported in response to neutral faces in patients versus controls, which may result in patients mistakenly attaching emotional salience to non-emotional expressions (Hall et al., 2008; Habel et al., 2010).

There are two limitations, however, with many previous studies of face processing in schizophrenia. One limitation is that many studies have used explicit face processing tasks, where participants must judge the emotional content of the faces presented and select an emotion from a list of two or more. Taylor et al. (2003) have previously shown that explicit emotional face processing during a task can reduce neural activity in limbic regions. Some studies have tried to overcome this limitation, for example, by instructing participants to determine the gender of faces to ensure attention to the task but also to make sure that the emotion recognition component of the task was implicit (e.g. Phillips et al., 1999). However, this type of task may also modulate limbic activity, given the widespread dysconnectivity and cognitive deficits observed in schizophrenia (Meyer-Lindenberg et al., 2005; Stephan et al., 2009); e.g. these tasks may influence limbic responses in ways that vary with connectivity, cognitive ability and/or task difficulty (Holt et al., 2006). Therefore, implicit face processing tasks with minimal additional demands may provide a more accurate measure of neural activity during face processing.

A second limitation is that many of the previous studies of face processing in schizophrenia have used static stimuli, such as Ekman's Pictures of Facial Affect (Ekman et al., 1975) (e.g. Holt et al., 2006). However, human faces and facial expressions are dynamic in nature, and temporal cues contribute to the recognition of facial expressions (e.g. Sato et al., 2004). Therefore, tasks that include dynamic facial expressions may more accurately reflect real world social interactions. fMRI has revealed that several brain regions, including the amygdala, are more active while viewing dynamic facial expressions compared to static images (Sato et al., 2004), and task-induced functional connectivity between the amygdala and cingulate is also increased in response to dynamic facial expressions compared to static stimuli (Foley et al., 2012). Similar to studies using static images, schizophrenia patients show poorer ability to recognise dynamic facial expressions compared to healthy controls during neuropsychological examination (Johnston et al., 2010). Also, patients have been reported to show increased limbic activation while watching dynamic fearful faces compared to controls under fMRI (Russell et al., 2007).

The purpose of the present study was to further explore and characterise activation differences between schizophrenia/schizoaffective disorder patients and healthy controls during face processing. We used a dynamic face processing task designed by Grosbras and Paus (2006), which is also being used to examine the effects of cognitive remediation therapy for psychosis (Cognitive Genetics and Therapy Research Group, Ireland), and in the IMAGEN project, a longitudinal neuroimaging project examining risk factors for mental illness in adolescents (Schumann et al., 2010). We examined neural activation in patients with schizophrenia/schizoaffective disorder and age- and gender-matched healthy controls during passive viewing of dynamic angry and neutral faces. Specifically, we tested the hypothesis that patients with schizophrenia or schizoaffective disorder would show altered limbic activity while passively viewing dynamic angry and neutral facial expressions, compared to healthy controls.

Identifying differences in these regions in patients during a task that involves both (1) implicit face processing, and (2) dynamic face stimuli

is important for better understanding the neurobiological correlates of social cognitive deficits in schizophrenia spectrum patients.

2. Methods

2.1. Sample characteristics

39 patients with a DSM-IV diagnosis of schizophrenia or schizoaffective disorder were recruited for the present study. All subjects were right-handed, aged between 18 and 65, had no history of substance misuse in the preceding six months, no prior injury to the head associated with a loss of consciousness of more than a few minutes and provided consent in compliance with the local ethics committee. Five patients were excluded due to excessive movement during functional imaging (>3 mm translation and/or 3° rotation), seven patients were excluded due to bad quality MRI data and/or significant artefacts and two patients were excluded due to missing data for the faces follow-up task (see Section 2.2), yielding a total of 25 patients.

These patients were then compared to 21 healthy controls matched for age and gender from our on-going imaging genetics study on psychosis (Rose et al., 2012a,b; Mothersill et al., 2013; Rose et al., 2013).

2.2. Face processing task

Participants performed a face processing task designed by Grosbras and Paus (2006), which has previously been shown to robustly activate several brain regions involved in face and emotion processing, such as the amygdala and medial prefrontal cortex (Grosbras and Paus, 2006; Schneider et al., 2011; Tahmasebi et al., 2012; Mothersill et al., 2013). During the task, participants watched a series of 2-5 second black-and-white video clips of faces starting from a neutral expression, and then turning into an angry expression or displaying a neutral/ambiguous expression (e.g. licking of lips). A non-biological control condition consisted of videos of black and white concentric circles expanding and contracting. Videos were divided into 18-second blocks consisting of four to seven video clips. Overall five angry, five neutral and nine baseline blocks were presented (19 blocks in total). The total number of exposures to each condition was the same between participants. To ensure that participants had paid attention to the face videos, participants completed a face recognition task following their time in the scanner based on a still shot of faces presented in the scanner and a series of foils. Patients were excluded if they scored < three/five correct answers for this follow-up task. Healthy controls were excluded if they scored < four/five correct answers for this follow-up task.

2.3. MRI acquisition parameters

All participants were imaged using a Philips Intera Achieva 3 T MRI scanner (Philips Medical Systems, Best, The Netherlands) with a SENSE 8-channel head coil, in the Trinity College Institute of Neuroscience. Whole-brain BOLD EPI was acquired with 40, 2.4 mm slices, 1 mm slice gap, TR = 2 200 ms, TE = 30 ms, field of view = 220 × 220 mm, flip angle = 75° and spatial resolution = 3.4 × 3.4 × 2.4 mm³. Functional scanning lasted 160 TRs or ~5.87 minutes.

In addition, a T1-weighted image (180 slices, ~6 minutes) was acquired using a TFE gradient echo pulse sequence, with slice thickness of 0.9 mm, a 230 × 230 field of view, and a spatial resolution of 0.9 × 0.9 × 0.9 mm³.

2.4. MRI data pre-processing and analysis

Spatial pre-processing and statistical analysis of MRI data was performed using Statistical Parametric Mapping (SPM8, revision 4290, <http://www.fil.ion.ucl.ac.uk/spm/software/spm8/>) and MATLAB R2011b (v7.13; <http://www.mathworks.co.uk/>).

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات