Available online at www.sciencedirect.com
ScienceDirect
Schizophrenia Research 95 (2007) 186–196
SCHIZOPHRENIA RESEARCH
www.elsevier.com/locate/schres

The effects of familiarity and emotional expression on face processing examined by ERPs in patients with schizophrenia

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Received 13 April 2006; received in revised form 13 June 2007; accepted 15 June 2007
Available online 17 July 2007

Abstract

Background: The main objective of the study was to determine whether patients with schizophrenia are deficient relative to controls in the processing of faces at different levels of familiarity and types of emotion and the stage where such differences may occur.
Methods: ERPs based on 18 patients with schizophrenia and 18 controls were compared in a face identification task at three levels of familiarity (unknown, familiar, subject's own) and for three types of emotion (disgust, smiling, neutral).
Results: The schizophrenic group was less accurate than controls in the face processing, especially for unknown faces and those expressing negative emotions such as disgust. P1 and N170 amplitudes were lower and P1, N170, P250 amplitudes were of slower onset in patients with schizophrenia. N170 and P250 amplitudes were modulated by familiarity and face expression in a different manner in patients than controls.
Conclusions: Schizophrenia is associated with a genelarized defect of face processing, both in terms of familiarity and emotional expression, attributable to deficient processing at sensory (P1) and perceptual (N170) stages. These patients appear to have difficulty in encoding the structure of a face and thereby do not evaluate correctly familiarity and emotion.

Keywords: Schizophrenia; ERP; Face recognition; Face processing; Emotion

1. Introduction

It has been demonstrated that subjects with schizophrenia are deficient in the recognition of the emotion underlying facial expressions, in particular fear and disgust (Edwards et al., 2002; Mandal et al., 1998). This deficit is stable throughout different clinical stages during the course of the disease (Addington and Addington, 1998; Borod et al., 1993; Salem et al., 1996) and shows a certain degree of specificity relative to other neuropsychiatric diseases (Addington and Addington, 1998; Loughland et al., 2002; Mueser

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doi:10.1016/j.schres.2007.06.015

et al., 1996). It has been hypothesized that a difficulty in interpreting other people's intentions, affects, and desires are at the root of their psychosocial disorders (Addington and Addington, 1998; Hooker and Park, 2002; Mueser et al., 1996).

The question as to whether the processing of emotion is selectively affected in this disease (Borod et al., 1993; Walker et al., 1984), or whether the deficit is the consequence of a more generalized face recognition problem (Kerr and Neale, 1993; Salem et al., 1996) has often been debated. The latter hypothesis is supported by findings that subjects with schizophrenia are deficient in the discriminating the age of faces (Baudouin et al., 2002; Kolher et al., 2000; Schneider et al., 1995) and recognizing the familiarity of faces, as well as their ability to identify them (Archer et al., 1994; Baudouin et al., 2002; Hooker and Park, 2002; Salem et al., 1996). Moreover, schizophrenia is associated with deficiencies in the arrangement of internal facial traits (Archer et al., 1994), as patients show poor exploration of such features measured by eye movements for neutral faces (Phillips and David, 1995; Williams et al., 1999) and for faces expressing various emotions (Loughland et al., 2002; Streit et al., 1997). These authors speculate that initial perceptual stages are affected, for example at the level of strategies necessary for handling the visuo-spatial aspect of faces. In another but related line of inquiry, Grusser et al. (1990) postulated that configural processing is affected in this disease, in particular the analysis of spatial relations existing between facial features, essential for face recognition.

Other authors indicate that schizophrenia is associated with deficits in earlier sensory stages of processing (Butler et al., 2001; Foxe et al., 2001; Leitman et al., 2005; Louchart-de la Chapelle et al., 2005). There is evidence that abnormal processing at the sensory level contributes to higher-level cognitive defects, including processing the emotional attributes of faces (Edwards et al., 2002; Kim et al., 2005; Leitman et al., 2005; Mandal et al., 1998). A third hypothesis is that problems in face recognition are secondary to deficits in selective attention (Addington and Addington, 1998; Baudouin et al., 2002; Kolher et al., 2000).

There is therefore an ongoing interest in delineating more precisely the origin and the underlying reason for deficits in face processing in schizophrenia. The primary objective of the present study was to explore different stages of processing of familiarity and emotional expression in schizophrenic patients by means of event-related potentials (ERPs), which may help to determine at what level pathologic functions are differentiated from normal ones. The P1 component reflects the earliest sensory processing stage (Pfütze et al., 2002; Rebaï et al., 1998), whose characteristics are modifiable by selective attention (Hillyard et al., 1998; Pourtois et al., 2005). If schizophrenic patients differ from controls at this stage, this would be concordant with the hypothesis that deficits in face recognition are attributable to anomalies in selective attention.

The N170 component, maximal in occipito-temporal regions, reflects the structural encoding stage (Bentin and Deouell, 2000; Eimer, 2000). This component is sensitive to the processing of the emotional aspect of faces (Caharel et al., 2005; Campanella et al., 2002; Pizzagali et al., 2000), as well as their level of familiarity (Caharel et al., 2005, 2006; Jemel et al., 2003). The N170 can be used as a tool to determine perceptual processing in patients with schizophrenia. If this component is selectively affected in these patients, such a finding would bolster the hypothesis that the disease is associated with deficits in the perceptual processing stage. To complement our analyses, we also recorded the P250 component associated with retrieval and access to the structural representation of faces in memory (Caharel et al., 2002).

Few studies have examined mechanisms of face processing in schizophrenia. Streit et al. (2001) observed reduced ERP amplitudes between 180 and 250 ms in patients with schizophrenia relative to controls in affect recognition, concordant with the hypothesis that a deficit occurs at the level where perception meets initial stages of cognition. An et al. (2003) reported a reduced P3 component in patients with schizophrenia only for faces with negative emotions. Moreover, Herrmann et al. (2004) found a diminished N170 component for faces but not for objects. This finding suggested a dysfunction of early-stage visual processing of faces in patients with schizophrenia.

In the present study, participants were asked to recognize their own faces as well as those of others (familiar or unknown) in a simple familiarity identification task. It has previously been found that schizophrenic patients have a particular difficulty in recognizing their own faces (Platek and Gallup, 2002). The stimulus faces expressed a neutral expression, a smile, or else bore a look of disgust.

By a combination of behavioral and electrophysiologic approaches, we evaluate two main hypotheses, namely that schizophrenia patients should perform less well than controls on face recognition with respect to emotion and familiarity and that ERPs should differentiate between the groups depending on familiarity and expression of faces.