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Do you see what I feel? – Electrophysiological correlates of emotional face and body perception in schizophrenia

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HIGHLIGHTS

- Patients with schizophrenia show overall impaired recognition of emotional faces and bodies.
- In contrast to healthy controls, the P100 and N170 components are not modulated by the emotional and personal identity of faces and bodies in the patient group.
- The absence of a modulation of the electrophysiological correlates of emotional face and body processing in schizophrenia might relate to deficient context processing.

ABSTRACT

Objective: We aimed to elucidate whether impaired affective face processing – behaviourally and with regard to P100 and N170 components – is paralleled by similar deficits in body processing in schizophrenia. Furthermore, we aimed to assess modulations by the processing of emotional or personal identity of the stimuli.
Methods: Fourteen patients with schizophrenia and 15 healthy controls were assessed with a Delayed Matching-to-Sample Task involving variations of the emotional (same vs. different valence) and personal identity (same vs. different person) of bodies and faces.
Results: Patients showed overall poorer behavioural performance. In controls, P100 amplitudes were enhanced in the "same identity/different emotions" vs. "same identity/same emotion" condition and N170 amplitudes were larger for different vs. same emotions. In the patients, P100 amplitudes were enhanced in the right relative to the left hemisphere for faces, but not for bodies.
Conclusions: Patients with schizophrenia show deficient modulation of the P100 and N170 components by emotional and personal identity of faces and bodies, which may relate to deficient context processing.
Significance: Our findings suggest for the first time alterations of the electrophysiological correlates of body processing in schizophrenia.

1. Introduction

Schizophrenia has been associated with impaired social behaviour (Brüne et al., 2009), which may be related to an inability to infer information about the interaction partner's emotional state based on his or her facial and body expressions. There is a certain degree of overlap regarding the cognitive mechanisms and underlying neuronal networks mediating face and body perception (see Minnebusch and Daum, 2009). While objects are processed in a feature-based manner, additional configural processing mechanisms are activated by faces and bodies (Tanaka and Farah, 1991; Leder and Bruce, 2000; Collishaw and Hole, 2000; Maurer et al., 2002). Configural processing is based on the spatial relations amongst the features constituting a stimulus: first-order relational information refers to the position of the face-defining features in space (eyes above nose above mouth); holistic processing denotes the perception of a face in terms of an integrated representation, and second-order relational information refers to the spatial distance amongst internal features (Maurer et al., 2002). The idea that configural mechanisms are involved in the processing of faces and bodies is supported by several lines of evidence. For instance, the inversion effect (Yin, 1969, 1970; Reed et al., 2003, 2006) describes the fact that faces or bodies which are presented upside down are disproportionally more difficult to process (reflected in delayed response times and higher error rates) than other inverted objects.

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Also, in prosopagnosia patients, deficient face perception goes in concert with impaired body processing (Righart and de Gelder, 2007).

In comparison with other stimulus categories, neutral faces and bodies elicit enhanced event-related potentials (ERPs) peaking about 100 and 170 ms after stimulus onset (termed P100 and N170) above occipito-temporal areas (see Minnebusch and Daum, 2009 for a review). While the P100 has been associated with the processing of low-level stimulus features and the classification of a stimulus as a face/body (Herrmann et al., 2005), the N170 has been linked to the structural encoding of a stimulus and to the generation of a global stimulus configuration (Rossion et al., 2000; Eimer, 2000a,b). The P100 appears to be affected by the emotional expression of faces/bodies (Eimer, 2000a,b; Meeren et al., 2005; Righart and de Gelder, 2007; van Heijnsbergen et al., 2007), while it is not clear as yet whether emotional valence affects the N170 or not (see Batty and Taylor, 2003; Vuilleumier and Pourtois, 2007).

Patients with schizophrenia show disrupted discrimination (Archer et al., 1992), encoding and recognition of neutral faces (Walther et al., 2009) as well as deficient facial emotion processing, which seems to be affected by various illness-related and demographic factors such as age at illness onset, inpatient treatment, antipsychotic medication, age (see Köhler et al., 2010) and the severity of positive and negative symptoms (Chambon et al., 2006; Köhler et al., 2010). In part, maladaptive visual face scanning patterns, involving reduced scanpaths and fewer fixations on salient facial features (eyes, nose, etc.), explain the face processing impairments in these patients (Williams et al., 1999), although this might primarily apply to passive viewing conditions (Delerue et al., 2010). Disrupted configural processing and an overreliance on the feature-based processing of faces have also been discussed (Fakra et al., 2008; Joshua and Rossell, 2009), but altered configural processing, as reflected by a reduced face inversion effect, seems to be partly eliminated by increasing stimulus presentation times (Butler et al., 2008). There is an ongoing debate about whether the facial (affect) processing deficits might stand in the broader context of a more generalised impairment of visuoperceptual processing (Norton et al., 2009; Strauss et al., 2010). In any case, it seems that greater signal strength is necessary for reliable discrimination of facial information in schizophrenia (Chen et al., 2009). Bediou et al. (2005) reported that patients with schizophrenia are particularly impaired in matching facial affect in different faces in comparison with the same face. The authors discussed this pattern of impairments in terms of a context processing deficit, a global–local processing deficit or a selective attention deficit.

In electrophysiological studies, compared to healthy controls, patients with schizophrenia show attenuated N170 amplitudes, and partly increased N170 latencies, in response to both neutral and emotional faces (Herrmann et al., 2004; Caharel et al., 2005; Bediou et al., 2007; Lee et al., 2010; Kirihara et al., 2012; Wynn et al., 2013) and no or attenuated modulation of N170 amplitudes by face inversion (Tsunoda et al., 2012) or emotional valence (Campanella et al., 2006; Lynn and Salisbury, 2008; Kirihara et al., 2012; Ibanez et al., 2012). Interestingly, impaired social functioning has been related to reduced N170 amplitudes for upright faces (Tsunoda et al., 2012). P100 amplitudes appear to be attenuated in some studies involving patients with schizophrenia (Caharel et al., 2005; Campanella et al., 2006), although this has not been observed as consistently as for the N170 (Johnston et al., 2005; Wynn et al., 2008).

While impaired (emotional) face processing has been extensively studied in different clinical groups (e.g. schizophrenia: Morris et al., 2009; autism spectrum disorders: Harms et al., 2010; depression: Bourke et al., 2010; social anxiety: Machado-de-Sousa et al., 2010), it is currently unknown whether face perception problems go hand in hand with impaired body processing, e.g. in schizophrenia. Thus, studying patients with schizophrenia could help to elucidate further whether face and body perception rely on similar mechanisms and whether impaired body processing might also contribute to the clinical symptoms and social problems these patients face. As milder degrees of face processing impairments have also been observed in individuals with an increased risk to develop schizophrenia, e.g. in non-affected first-degree relatives of patients with schizophrenia and in participants with an "at-risk" mental state (Li et al., 2010; Kim et al., 2010; Amminger et al., 2011; van Rijn et al., 2011; Wolwer et al., 2012), face processing deficits have been discussed as an endophenotypic marker of the disease, while it is unknown whether disrupted body processing could serve a similar function.

Current literature shows a dearth of studies on body perception in patients with schizophrenia. There is preliminary behavioural evidence of disrupted configural processing of both faces and bodies (but also of cars) (Soria Bauser et al., 2012) and of poorer recognition of emotional body expressions, which is exacerbated further by conflicting emotional vocalizations (Takahashi et al., 2010; Van den Stock et al., 2011) in patients with schizophrenia relative to healthy controls. One functional magnetic resonance imaging study focused on the perception of sports-related, but not necessarily emotional, body movements, yielding evidence of diminished activation of the extrastriate body area in schizophrenia patients relative to healthy controls (Takahashi et al., 2010). To our knowledge, no ERP studies dealing with the processing of emotional body forms have been published. The aim of the current study was thus to elucidate whether patients with schizophrenia show impaired processing of emotions expressed by the body comparable to those for faces. Furthermore, we wanted to investigate whether the identification of emotions across bodies is particularly disrupted in schizophrenia patients by different identities of these bodies, as has been described for faces (Bediou et al., 2005). Also, we aimed to elucidate whether these potential body processing impairments on the behavioural level are mirrored by altered P100 and N170 amplitudes and latencies.

2. Methods

2.1. Participants

Fourteen patients with schizophrenia (SZ; age range: 21–59 years), treated in the LWL University Hospital (Department of Psychiatry, Ruhr University, Bochum) (two as outpatients), and 15 healthy controls (age range: 20–53 years) were recruited as participants for the current study. Patients were diagnosed according to the current version of the International Classification of Disease (Dilling et al., 2000) by senior psychiatrists who were blind to the cognitive data and were well trained in the application of diagnostic criteria in a research context. This was meant to ensure good diagnostic reliability in spite of the fact that a standard clinical interview could not be carried out on top of the already quite comprehensive assessment. Twelve patients were diagnosed with paranoid (ICD10, F20.0) and two with undifferentiated (ICD10, F20.3) schizophrenia. An estimated IQ below 80 represented an exclusion criterion for all participants, and patients were also excluded if they presented with a past or present comorbid psychiatric or neurological diagnosis, with the exception of mild to moderate depression (three patients) due to the high rates of comorbidity. Any current or past psychiatric or neurological disorder and/or a positive family history for schizophrenia represented additional exclusion criteria for healthy controls.

Inclusion and exclusion criteria were screened on the basis of a semi-structured interview which assessed the participants' demographic data (age, sex, handedness, family status, years and degree