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Social and nonsocial affective processing in schizophrenia — An ERP study

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ABSTRACT

Background: Despite social cognitive dysfunction that may be observed in patients with schizophrenia, the knowledge about social and nonsocial affective processing in schizophrenia is scant. The aim of this study was to examine neurophysiological and behavioural responses to neutral and negative stimuli with (faces, people) and without (animals, objects) social content in schizophrenia.
Methods: Twenty-six patients with schizophrenia (SCZ) and 21 healthy controls (HC) completed a visual oddball paradigm with either negative or neutral pictures from the Nencki Affective Picture System (NAPS) as targets while EEG was recorded. Half of the stimuli within each category presented social content (faces, people).
Results: Negative stimuli with social content produced lower N2 amplitude and higher mean LPP than any other type of stimuli in both groups. Despite differences in behavioural ratings and alterations in ERP processing of affective stimuli (lack of EPN differentiation, decreased P3 to neutral stimuli) SCZ were still able to respond to specific categories of stimuli similarly to HC.
Conclusions: The pattern of results suggests that with no additional emotion-related task demands patients with schizophrenia may present similar attentional engagement with negative social stimuli as healthy controls.

1. Introduction

Although it is classically defined as a disorder of cognition, schizophrenia is a complex neuropsychiatric disorder, in which both cognitive and emotional deficits may be observed. Since the earliest descriptions of schizophrenia, blunted affect and lack of appropriate emotional reactivity have been included among its most prominent features (Tandon et al., 2009). Nowadays, emotion processing is studied within the framework of social cognition, which is an umbrella term covering a number of abilities which allow one to interact with other people (Billeke and Aboitiz, 2013). Patients with schizophrenia show substantial impairment when it comes to emotion expression and emotion recognition which are two out of the three dimensions in which emotion processing is usually partialised (Kohler et al., 2013).

In the last decade, the third domain of emotion processing, emotional experience, has been examined in multiple studies in patients with schizophrenia. These investigations have shown contradicting results, deemed as a "paradox of emotional functioning in schizophrenia" (Strauss, 2013). Patients tend to recall less positive experiences (Myin-Germeys et al., 2000) and show substantial traits of anhedonia in questionnaire assessment (Kirkpatrick et al., 2011). At the same time, patients are generally able to respond to emotional stimuli in a similar manner as healthy people (Kring and Moran, 2008). Although a vast amount of research demonstrated in most of the studies shows intact "in-the-moment" emotion processing in patients with schizophrenia, several studies questioned this effect. Diminished (Mathews and Barch, 2004) and heightened responses to emotional stimuli (Herbener et al., 2007) were reported in patients with schizophrenia. Alterations in response to unique valence categories have been also observed in that population (Burbridge and Barch, 2007). Moreover, differences in the neurophysiological patterns of reaction to affective stimuli were found even if both patients and controls provided identical behavioural self-assessment ratings of visual affective stimuli (Horan et al., 2010; Pinheiro et al., 2013).

Multiple theories, tapping into various mental processes, have been proposed to explain the above mentioned discrepancies. One of the

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possible explanations accentuates the role of the cognitive impairment observed in patients, e.g. semantic and episodic memory deficits (Cohen et al., 2011). Patients with schizophrenia may be able to respond adequately to affective stimuli. However, due to the dysfunction of memory encoding or recall they are unable to recall these experiences when faced with measures of emotional experience (Cohen and Minor, 2010).

An additional factor, rarely taken into consideration while discussing the nature of emotional experiences in patients with schizophrenia, is the content of the stimuli. Studies on emotional experiences generally use affective stimuli which are selected on the basis of arousal and valence ratings, typically collected in the normative sample (Lang et al., 2008; Marchewka et al., 2014). At the same time, a number of other factors was found to impact the emotional experience in healthy people, e.g. experience of different basic emotions may be linked to different patterns of brain activation (van Hooff et al., 2013; Stark et al., 2003), despite emotion-evoking stimuli being similarly rated in terms of arousal and valence. Sociality has been proposed as an alternative important factor that might have an impact on the reaction to the emotional stimuli. Disparities in neurophysiological activity have been found even for the same basic emotions presented with or without social context (Luo et al., 2013; Zhang et al., 2015). The rationale for differences between social and nonsocial affective processing may be associated with the different roles of these two types of emotions. Nonsocial emotions are usually driven by the direct biological imperatives (e.g. reaction to natural predators or contaminated food) while the social emotions are rarely associated with consequences for survival and serve more for the purpose of navigating through a complex reality of social relations and intentions (e.g. empathetic reaction towards crying person) (Britton et al., 2006). Nonsocial emotions may also be detected automatically, while socio-emotional stimuli may require more elaborate processing to be interpreted correctly (Sakaki et al., 2012). A number of operations, engaging both basic social perception (facial emotion recognition, gestures interpretation) and high-order Theory of Mind processes, have to be carried out to attribute the emotional meaning to ambiguous social stimuli (Billeke and Aboitiz, 2013). Accordingly, a widespread network of brain structures, including medial and lateral prefrontal cortices, superior temporal sulcus, temporo-parietal junction, cingulate cortex, fusiform gyrus, amygdala and insula has been linked to social emotions processing (Jimenez et al., 2013).

Up to date, a substantial body of research on social cognitive deficits in patients with schizophrenia has been accumulated (Green et al., 2015). The results from a meta-analytic study have confirmed significant impairment in facial emotion recognition in schizophrenia (Kohler et al., 2010) that may be directly linked to worse social functioning and poorer functional outcome in those patients (Irani et al., 2012) and is correlated with both positive and negative symptoms of schizophrenia (Ventura et al., 2013). Abnormalities on a behavioural level are accompanied by alterations of neural activity – "social brain" and specifically amygdala under-recruitment were found in meta-analytic reviews of neuroimaging studies of facial emotion recognition in schizophrenia (Anticevic et al., 2012; Li et al., 2010). Alterations in face-processing event-related potentials (ERP) (e.g. N170) were also observed in patients (McCleery et al., 2015; Turetsky et al., 2007). Deficient emotion identification observed in patients may substantially affect their ability to comprehend the emotional meaning of affective stimuli containing human agents. Moreover, problems with Theory of Mind application, which are well documented in patients, may hinder their capacity to infer other peoples' intentions and mental states (Sprong et al., 2007). Hence, aberrant attribution of mental states and reduced ability to empathise with other people are additional factors, which may impact social emotion processing in patients with schizophrenia (Abu-Akel and Shamay-Tsoory, 2013).

Even though the disturbances of social cognition are now regarded as one of the prominent features of schizophrenia (Green et al., 2015), studies examining the impact of sociality on emotional experience in patients are virtually non-existent. Both behavioural (Aminoff et al., 2011; Bodapati and Herbener, 2014) and physiological (Peterman et al., 2015) studies documented differences between patients' and controls' responses to social and nonsocial affective stimuli, thus there is a strong rationale to hypothesise discrepant neural patterns in both groups in reaction to the two types of the stimuli.

Due to its excellent temporal resolution, electroencephalography is often a method of choice for studying sub-second processes associated with emotional experience (Olofsson et al., 2008). Altered neurophysiological patterns have been found in patients in regard to various stages of affective processing. Between-group differences in event-related potentials (ERP) associated with early visual processing (Pinheiro et al., 2013), selective attention (Champagne et al., 2014) and sustained attention to affective stimuli (Horan et al., 2010) were reported. At the same time, none of these studies controlled the emotional stimuli for content, with often various ratios of social and nonsocial stimuli across different valence categories.

Given the evidence of differences between social and nonsocial emotional experience in healthy controls and substantial social cognitive impairment observed in patients with schizophrenia, we propose that the lack of control for the type of content constitutes a significant methodological shortcoming in the research on affective processing in schizophrenia. The aim of this study is to examine neurophysiological and behavioural responses to social and nonsocial affective stimuli by administrating them to patients with schizophrenia and healthy controls during a visual oddball task. A number of studies have successfully used a visual oddball task and its modifications to observe neural patterns associated with emotional experience both in patients (Dichter et al., 2010; Horan et al., 2012) and their relatives (Hart et al., 2015). The oddball paradigm allows for analysis of a number of ERPs associated with subsequent stages of emotional processing, starting with early perceptual process (visual potentials P1 and N1), through selective attention allocation (Early Posterior Negativity, N2, P3) to attentional engagement with the affective stimuli (Late Positive Potential) (Hajcak et al., 2012). A main advantage of the visual oddball task is the fact that the emotional content of the presented stimuli is task-irrelevant thus reaction to it is not confounded by additional task demands. Moreover, construction of the oddball paradigm allows monitoring if participants attended presented affective material, by requiring the behavioural response to target stimuli, which is an extra advantage over passive viewing paradigms (i.e. Magnuski and Gola, 2013).

This study aims to test the hypothesis that different patterns of behavioural and neurophysiological responses to social compared to nonsocial affective stimuli may be found in patients with schizophrenia and in healthy controls. However, due to the exploratory nature of this study and the fact that contradicting results are available regarding which ERPs are altered during affective processing in patients with schizophrenia (Champagne et al., 2014; Horan et al., 2010; Pinheiro et al., 2013), we eschew formulating hypotheses about which event-related potentials associated with affective processing will be differentially affected by the content of the stimuli in both groups.

2. Materials and methods

2.1. Participants

Twenty-six patients with schizophrenia (SCZ) and twenty-one matched controls (HC) were recruited to participate in the current study (see Table 1 for demographic and clinical characteristics of the sample). Patients were diagnosed with schizophrenia according to the International Classification of Diseases Tenth Revision (ICD-10) criteria and were recruited from inpatients of the Institute of Psychiatry and Neurology in Warsaw. Only clinically stable patients (lack of treatment change of any medication/clinically significant symptom change during last two weeks preceding the procedure) were recruited for the study.