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Are there differential deficits in facial emotion recognition between paranoid and non-paranoid schizophrenia? A signal detection analysis

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ABSTRACT

This study assessed facial emotion recognition abilities in subjects with paranoid and non-paranoid schizophrenia (NPS) using signal detection theory. We explore the differential deficits in facial emotion recognition in 44 paranoid patients with schizophrenia (PS) and 30 non-paranoid patients with schizophrenia (NPS), compared to 80 healthy controls. We used morphed faces with different intensities of emotion and computed the sensitivity index (d') of each emotion. The results showed that performance differed between the schizophrenia and healthy controls groups in the recognition of both negative and positive affects. The PS group performed worse than the healthy controls group but better than the NPS group in overall performance. Performance differed between the NPS and healthy controls groups in the recognition of all basic emotions and neutral faces; between the PS and healthy controls groups in the recognition of angry faces; and between the PS and NPS groups in the recognition of happiness, anger, sadness, disgust, and neutral affects. The facial emotion recognition impairment in schizophrenia may reflect a generalized deficit rather than a negative-emotion specific deficit. The PS group performed worse than the control group, but better than the NPS group in facial expression recognition, with differential deficits between PS and NPS patients.

1. Introduction

The recognition of emotions from others' faces is a universal and fundamental skill for social interaction (Ekman, 1992). Impairment of facial emotion recognition has been evidenced in patients with schizophrenia (Edwards et al., 2002; Chan et al., 2010; Kohler et al., 2010). This deficit impairs interpersonal and social functioning and has been shown to be a crucial predictor of clinical outcome (Kee et al., 2003; Addington et al., 2006; Couture et al., 2006; Pinkham et al., 2007; Pan et al., 2009).

The emotion recognition impairment in schizophrenia has been found to be moderated by certain clinical and demographic factors (Chan et al., 2010; Kohler et al., 2010), such as age, gender, inpatient/outpatient status, age of onset, clinical symptoms (e.g., negative symptoms), antipsychotics, and duration of illness. Furthermore, the recognition of negative facial emotions, particularly fear, seems more impaired than the recognition of positive ones (Bell et al., 1997; Silver et al., 2002; Kohler et al., 2003). However, the precise characteristics of such deficits in schizophrenia are still being debated; for example, whether the deficit is dependent upon subtypes of schizophrenia. It has been reported that schizophrenia with negative symptoms (Mandal et al., 1999) or disorganized schizophrenia (Weniger et al., 2004) show generalized impairments for both positive and negative emotions, whereas paranoid schizophrenia (PS) with positive symptoms shows specific deficits for negative emotions (Mandal et al., 1999; Mandal and Ambady, 2004; Weniger et al., 2004), and a positive bias for neutral faces (Mandal et al., 1999; Constant et al., 2011). Nevertheless, the relationships between schizophrenia subtypes and facial emotion recognition remain inconclusive. Only a few attempts have been made to investigate this clinically relevant topic. Some studies support an advantage for paranoid over non-paranoid patients (Kline et al., 1992; Lewis and Garver, 1995; Phillips et al., 1999; Davis and Gibson, 2000; Van't Wout et al., 2007; Chan et al., 2008), while others show a contrary pattern (Mandal and Rai, 1987; An et al., 2006; Russell et al., 2007; Williams et al., 2007). A recent study showed no difference in

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overall task accuracy between patients who were actively paranoid and those not actively paranoid (Pinkham et al., 2011). Some authors argued that this different pattern may be related to emotion type (Kline et al., 1992), as they found that paranoid patients were more accurate in identifying negative emotions, but did not differ from other patients in correctly identifying positive emotions.

Social threat perception and the evolution of paranoia have been an interesting and important topic of research (Green and Phillips, 2004; Huang et al., 2011). Rapid and efficient judgments about the significance of social threat are important for species survival and may recruit specialized neurocognitive systems. For example, faces depicting anger are detected quickly when presented amongst other facial expressions, on the basis of distinguishing facial features. Research using visual scanpath techniques provide evidence for increased foveal attention to facial features of threat-related expressions (anger, fear) (Green et al., 2003), which may facilitate rapid detection and subsequent appraisal of the significance of threat. The potential role of paranoia in emotion recognition was raised by several neuroimaging studies showing differences in amygdala functioning between individuals with paranoid schizophrenia (PS) and non-paranoid schizophrenia (NPS). fMRI studies indicated that paranoid patients generally show reduced amygdala activation compared to non-paranoid patients (Phillips et al., 1999; Williams et al., 2004; Russell et al., 2007).

Nevertheless, studies on paranoia and facial affect recognition in schizophrenia have come out with conflicting results. These discrepancies may be partially explained by the relatively small samples and some methodological differences between studies. For example, previous studies have used stimuli of varying quality obtained under differing conditions, including emotions with black and white posed faces for some and colored faces for some others (Edwards et al., 2002; Huang et al., 2011). The study paradigms required participants to identify or recognize the categories of emotions illustrated in photographs, with either dichotomous-choice tasks (discrimination) or multiple-choice tasks (identification). These a priori differences in task difficulty may have influenced the results (Edwards et al., 2002; Huang et al., 2011). Most of the study paradigms used a single intensity level to rate the subjects' accuracy of perception of emotional expressions. Whether emotion recognition deficits simply reveal task difficulties, and whether so-called "negative-emotion specific deficits" exist (Johnston et al., 2006), is debatable. The use of an instrument with stimuli of various emotional intensities may help clarify the potential confounding factors of task difficulty, because emotion recognition accuracy is correlated positively with intensity level (Kohler et al., 2003). In addition, almost all the studies calculated the percentage of correct responses as the dependent measure for performance in the recognition of each emotional expression, except for the recent work by Tsoi et al. (2008), which employed signal detection theory to investigate facial emotion recognition in patients with schizophrenia, however, only three emotions (happiness, sadness, fear) were measured in their study. Compared to measure of the correct response rate (i.e. true positives only) in most of the previous studies, the measures from signal detection theory consider both true positives and false positives and are more powerful to detect the ability to differentiate the target emotion from other emotions (more details in the method section).

Our hypothesis was that facial expression recognition performance would differ between the schizophrenia and control groups in the recognition of both negative and positive affects. Furthermore, the paranoid schizophrenia (PS) group would perform worse than the control group, but better than the non-paranoid schizophrenia (NPS) group, with differential deficits between PS and NPS patients. In the present study, we applied signal detection theory to explore the differential deficits of facial emotion recognition in PS and NPS patients, compared to healthy nonclinical controls. We adopted a measure of facial emotion recognition with morphed faces to manipulate the intensities of various emotion that has been used in the Chinese Facial Emotion Recognition Database (CFERD) (Huang et al., 2012). The aims of the current study were (1) to clarify whether schizophrenia patients would show specific emotion recognition impairments using signal detection theory, (2) to examine if these impairments would differ between PS and NPS patients in different categories of emotions and emotional intensities; and (3) to investigate the association of emotion recognition with demographic characteristics and clinical aspects of schizophrenia.

2. Materials and methods

2.1. Subjects and design

One hundred fifty-four subjects participated in the current study; including 74 with schizophrenia and 80 healthy nonclinical controls, with ages ranging from 18 to 50 years. Schizophrenia patients were recruited from the outpatient clinic and inpatient ward of a general hospital in central Taiwan, and they met the DSM-IV-TR (American Psychiatric Association, 2000) criteria for schizophrenia based on the diagnosis made by psychiatrists using the Structured Clinical Interview for DSM-IV (SCID-P) (First et al., 2001). All of the patients were medicated and clinically stable without prominent positive symptoms at the time of testing. These patients were placed in the paranoid group ($n=44$) or the non-paranoid ($n=30$, including 18 disorganized patients with schizophrenia) group, based on the information obtained in the clinical interview. Nonclinical controls were recruited from hospital staff and the community. They had no past or current psychiatric disorders according to SCID-P criteria and could not have a familial history of an Axis I DSM-IV disorder. All participants were excluded from the study if they met DSM-IV criteria for substance dependence, or had a documented neurological or ophthalmic condition. The study protocol was approved by the ethical review committee of the local hospital, and all subjects participated after giving written informed consent.

2.2. Measures

2.2.1. Clinical assessment

The Positive and Negative Syndrome Scale (PANSS) was used to assess the psychopathology and severity of symptoms (Kay et al., 1987). The PANSS is a 30-item semi-structured interview that generates three subscales, rating positive symptoms, negative symptoms, and general psychopathology, as well as a total score. All items are scored between 1 (not present) and 7 (severe); a higher score indicates more severe symptoms.

Since depression may affect emotion recognition performance (Weniger et al., 2004; Bediou et al., 2005), depressive symptoms among the subjects were also controlled for using the Calgary Depression Scale for Schizophrenia (CDSS) (Addington et al., 1990), and in the control group using the Beck Depression Inventory (BDI) (Beck et al., 1961).

2.2.2. Facial emotion recognition task

We used a measure of facial emotion recognition derived from morphed faces from the Chinese Facial Emotion Recognition Database (CFERD) (Huang et al., 2012). A detailed description of its development and validation can be found in our previous work (Huang et al., 2012).

The measures use static color photographic images of six basic facial emotional expressions (happiness, sadness, disgust, fear, anger, and surprise), which were morphed with neutral faces to create an intensity of expression continuum. A total of 130 faces from five male and five female faces were morphed between the neutral and an extreme emotional expression in each of the six emotional categories in 10% steps. Each stimulus was presented in random order on a computer screen for 3000 ms, preceded by a fixation cross for 1000 ms, and followed by a choice list which remained on the screen until the participants responded. The subjects were asked to match each face with the emotion label (happiness, disgust, fear, anger, sadness, surprise, or neutral) by pressing the corresponding key on the key board.

2.3. Data analyses

Patients with schizophrenia were compared with healthy controls. Then the PS patients (PS group) were compared with the NPS patients (NPS group) and the