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Do patients from the Democratic Republic of Congo with schizophrenia have facial emotion recognition deficits?

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ABSTRACT

Patients with schizophrenia can have difficulty recognizing emotion, and the impact of this difficulty on social functioning has been widely reported. However, earlier studies did not thoroughly explore how this deficit may vary according to emotion intensity, or how it may differ among individuals and across cultures. In the present study, our aim was to identify possible deficits in facial emotion recognition across a wide range of emotions of different intensities among patients with schizophrenia from the Democratic Republic of Congo (DRC). Thirty stable patients with schizophrenia and 30 healthy controls matched for age and level of education were evaluated using a validated and integrative facial emotion recognition test (TREF). A total recognition score and an intensity threshold were obtained for each emotion. Patients with schizophrenia had emotion recognition deficits, particularly for negative emotions. These deficits were correlated to the severity of negative symptoms. Patients showed no threshold deficit at the group level, but analysis of individual profiles showed marked heterogeneity across patients for the intensity of the emotion decoding deficit. Our study confirms the existence of deficits in emotion recognition for negative emotions in patients with schizophrenia, generalizes it to DRC patients, and underlines considerable heterogeneity among patients.

1. Introduction

The ability to understand another person's affective state (notably through the decoding of emotional signs) constitutes a central aspect of social cognition, which is the set of mental operations underlying social interactions. It is now well established that patients with schizophrenia have a large range of deficits, particularly in terms of interpersonal functioning and social cognition (Turetsky et al., 2007; Kholer et al., 2010; Muller et al., 2014). Part of social cognition is related to the decoding of facial emotions; deficits in this ability play a major role in the impairment of social cognition (Green et al., 2005; Penn et al., 2008), interpersonal misunderstanding and inadequate social behavior (Pinkham and Penn, 2006). Emotion decoding is impaired in schizophrenia and plays a role in the development and maintenance of the disorder, constituting both a vulnerability marker and a trait factor (Edwards et al., 2001; Leppanen et al., 2008; Phillips and Seidman, 2008; Granato et al., 2009). The difficulties encountered concern negative emotions in particular (Schneider et al., 1995; Bryson et al., 1997; Silver et al., 2002; Kholer et al., 2003; Strauss et al., 2010).

However, several questions remain unanswered regarding this deficit. First, most studies have focused on a limited set of emotions presented at high intensity, and the variation in the deficit across emotional states and according to intensity level remains to be clarified. Second, this deficit has predominantly been observed in Western patients, and its cross-cultural generalization has not yet been estimated in depth. Leppanen et al. (2008) conducted two studies among South African patients with schizophrenia, exploring emotional discrimination. However, emotion recognition was explored using tests based on a binary choice between positive/negative or neutral emotions, leading to a very partial view of emotion recognition. Finally, all previous

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studies have exclusively focused on group comparisons and did not determine the heterogeneity of the deficit across patients with schizophrenia. In the present study, we therefore aimed to: (1) evaluate variation in the emotion recognition deficit in schizophrenia across different emotion valences and intensities; (2) investigate the generalizability of emotion recognition deficit to non-Western cultural contexts; and (3) explore the inter-individual heterogeneity of emotion recognition deficit, to determine whether this deficit is a common feature observed in all patients with schizophrenia or is highly variable across patients.

2. Materials and methods

2.1. Participants

Thirty patients (9 women/21 men, 8 hospitalized/22 not hospitalized), diagnosed with schizophrenia according to DSM-5 criteria, were recruited in the Neuro-Psychopathological Center of the University of Kinshasa and in the Mental Health Center Telema in Kinshasa (Democratic Republic of Congo). Data collection was performed between December 1, 2016 and April 28, 2017. All patients were stable on antipsychotic agents (typical and atypical); the mean equivalent chlorpromazine dose was 584.33 mg. The psychopathological state was evaluated using the positive and negative symptoms scale (PANSS, Kay et al., 1987) and negative symptoms scale (SANS, Andreasen, 1989). Patients were individually matched for sex and educational level with 30 healthy controls who were free of any psychiatric disorder or psychoactive substance abuse. Educational level was assessed according to the highest diploma obtained. All participants were of Congolese nationality, holders of at least a State diploma (secondary level) and were fluent in French. Exclusion criteria for both groups were a history of current or previous neurological disease (epilepsy, dementia, cerebrovascular accident), drug addiction, and age more than 60 years. Participants received all the details concerning the study objectives and the procedure to be followed, then gave their written informed consent. The study was approved by the Ethics Committee of the Public Health School of the University of Kinshasa (ESP / CE / 083 / 2016) and conducted according to the Declaration of Helsinki.

2.2. Procedure and measurements

The Facial Emotion Recognition Test (TREF) is a validated emotion decoding task in which participants are asked to recognize six basic emotions expressed on faces: anger, contempt, disgust, fear, happiness, and sadness. Each facial emotion was morphed (from neutral to full-blown emotion) to evaluate 9 different levels of emotional intensity (i.e., from 20% to 100%) and each emotion was expressed by 6 different faces (3 women, 3 men) from people of different cultures, aged between 20 and 60 years old (Gaudelus et al., 2014). Faces were standardized for size (13 × 19 cm format) and presented randomly one at a time with the six possible answers and a corresponding response key for each emotion listed on the right side of the screen. The response keys corresponded to the first letter of the emotion and stickers were used on the keyboard for easy access (i.e., all response keys on the same line). Participants had to indicate which emotion was presented by each face by pressing the corresponding button with their dominant hand. The total task contained 54 trials (6 blocks of 9 trials). Each face was presented for a maximum of 10 s (faces were replaced by the next one as soon as the participant answered). There was no time limit for participants to respond. The dependent variables were the accuracy score (percentage of correct responses) and the detection threshold (intensity at which the emotional content was reliably detected) for each emotion. This threshold was obtained by averaging the intensity of the first correct recognition (i.e. the first correct response for a specific emotion), and the intensity at which the emotion was perfectly recognized (i.e. the intensity above which the emotion was always correctly detected): (first threshold + perfect threshold) / 2. Total accuracy and threshold scores were also computed. This procedure, previously validated (Gaudelus et al., 2014), enables the comprehensive investigation of emotion recognition by considering the ability to perceive low-intensity emotions. The task was presented on a computer screen located at 70 cm viewing distance (images subtended by a visual angle of 10°36′ X 15°27′). Before the test phase, participants completed Beck's questionnaire (Beck and Steer, 1987), to screen for depressive symptoms.

2.3. Statistical analyses

Statistical analyses were performed using IBM SPSS Statistics (Version 25.0; IBM Corp., Armonk, NY), and the following strategy. First, between-group Student *t*-tests were performed on demographic and psychopathological characteristics and a chi-square test was performed for group comparisons on educational level and sex. Second, two repeated measures analyses of variance (ANOVAs) were performed with Group (schizophrenia, healthy controls) as between-subjects factor and Emotion (Anger, Contempt, Disgust, Fear, Happiness, Sadness) as within-subjects factor, separately for accuracy score and detection threshold. Significant main effects and interactions (corrected using a Greenhouse- Geisser procedure when needed) were followed by univariate contrasts (post hoc independent sample *t*-tests). Finally, bivariate Pearson's correlations were performed between task performance and the clinical symptoms defined by the PANSS and SANS scales. The threshold of statistical significance was set at 0.05. A complementary single case analysis, based on Crawford's method (Crawford et al., 2010) was applied to estimate the variability of the emotion recognition deficit across patients (i.e. the percentage of patients with emotion recognition deficit when compared individually with a small group of matched control participants).

3. Results

3.1. Socio-psycho-demographic characteristics of the participants (Table 1)

There was a significant group difference between patients with schizophrenia and healthy controls for age [$t(29) = 3.410$, $p = 0.002$] and depressive symptoms [$t(29) = 2.127$, $p = 0.042$] but no significant difference for gender [$\chi 2(1, 30) = 2.857$, $p = 0.91$] or educational level [$\chi 2(6, 30) = 8.782$, $p = 0.186$] (Table 1).

3.2. Emotion recognition abilities

Mean performances are reported in Fig. 1.

3.2.1. Accuracy score

There was a main effect of Group [$F(1,58) = 9.917$, $p = 0.003$, $\eta 2p = 0.146$], showing that patients had lower accuracy scores than controls. There was also a main effect for Emotion [$F(5290) = 52.306$,

Table 1
Demographic and psychological measures for patients with schizophrenia (SZ) and control participants (CP): mean (*SD*).

Variables	SZ (n = 30)	CP (n = 30)
Demographic measures		
Age* (years)	31.4 (6.19)	26.90 (4.90)
Sex ratio*ns* (female /male)	9/21	10/20
Age of illness onset	20.43 (3.13)	/
Education (high/low)	4/26	12/18
Psychological measures		
Beck depression inventory *ns*	8.33 (7.76)	4.43 (4.75)
PANSS +	11.93 (5.94)	/
PANSS-	12.60 (8.65)	/
PANSSG	11.93 (5.94)	/
PANSSTot	50.13 (22.41)	/
SANS	28.57 (19.99)	/

Note. *ns* = non-significant; *p < 0.05.

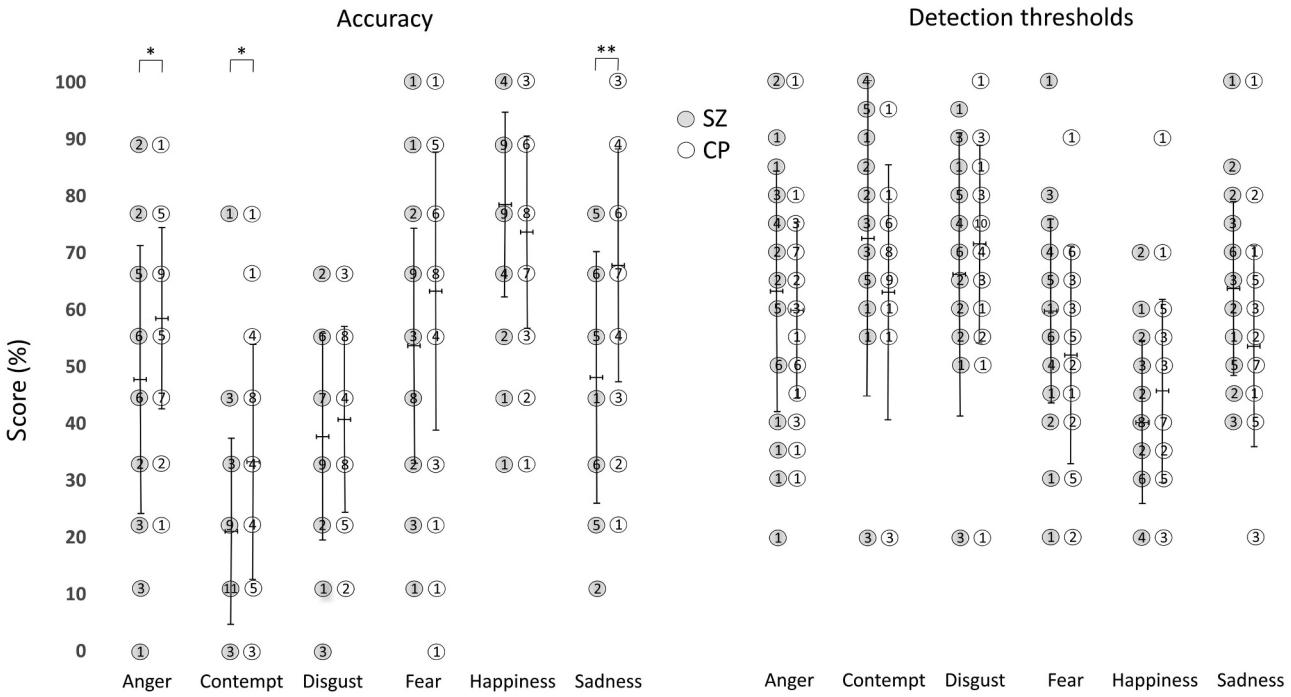

Fig. 1. Individual values for accuracy scores and detection thresholds for patients with schizophrenia (SZ) and control participants (CP) for each emotion in the Facial Emotion Recognition Test (TREF). Group means are represented by horizontal bars, standard errors by vertical bars, the number in each circle corresponds to the number of individuals in the group presenting this score; *$p < 0.05$; **$p < 0.01$.

$p < 0.001$, $\eta 2p = 0.203$): Happiness was associated with higher accuracy scores than Fear [$t(59) = 4.719$, $p < 0.0001$], Sadness [$t(59) = 5.233$, $p < 0.001$], Anger [$t(59) = 7.543$, $p < 0.001$], Disgust [$t(59) = 13.579$, $p < 0.001$] and Contempt [$t(59) = 15.579$, $p < 0.0001$]. Fear was associated with higher accuracy scores than Disgust [$t(59) = 5.748$, $p < 0.001$] and Contempt [$t(59) = 7.945$, $p < 0.001$], but similar scores to Sadness [$t(59) = 0.152$, $p = 0.88$] and Anger [$t(59) = 1.412$, $p = 0.163$]. Sadness was associated with higher accuracy scores than Disgust [$t(59) = 5.526$, $p < 0.001$] and Contempt [$t(59) = 8.873$, $p < 0.001$] but with similar scores to Anger [$t(59) = 1.573$, $p = 0.121$]. Anger was associated with higher scores than Disgust [$t(59) = 4.357$, $p < 0.001$] and Contempt [$t(59) = 8.873$, $p < 0.001$] and Disgust with higher scores than Contempt [$t(59) = 4.599$, $p < 0.001$].

A Group x Emotion interaction was observed [$F(5290) = 3.208$, $p = 0.008$, $\eta 2p = 0.052$), with post-hoc *t*- tests showing that patients with schizophrenia had lower accuracy scores than did control participants for Anger [$t(58) = 2.068$, $p = 0.043$], Contempt [$t(58) = 2.544$, $p = 0.014$] and Sadness [$t(58) = 3.573$, $p = 0.001$]. There were no significant differences between groups for Disgust [$t(58) = 0.666$, $p = 0.508$], Happiness [$t(58) = 1.126$, $p = 0.265$] or Fear [$t(58) = 1.649$, $p = 0.105$].

Crawford single case analysis of emotion recognition accuracy showed that 36.7% (11/30) of the patients had deficits for Fear, 36.7% (11/30) for Anger, 16.77% (5/30) for Disgust, 10.0% (3/30) for Happiness, 10.0% (3/30) for Sadness and 6.7% (2/30) for Contempt. The small proportion of patients with a significant deficit for Contempt may be explained by the low scores obtained for this emotion among control participants.

3.2.2. Detection threshold

There was no main Group effect [$F(1,58) = 2.946$, $p = 0.091$, $\eta 2p = 0{,}048$] or Group x Emotion interaction [$F(5,90) = 1.904$, $p = 0.094$, $\eta 2p = 0.032$] but there was a main effect of Emotion [$F(5290) = 14.754$, $p < 0.001$, $\eta 2p = 0.203$]: Happiness had a lower threshold than Fear [$t(59) = 4.426$, $p < 0.001$], Sadness [$t(59) = 6.396$, $p < 0.001$], Anger [$t(59) = 6.991$, $p < 0.001$], Disgust [$t(59) = 8.255$, $p < 0.001$] and Contempt [$t(59) = 6.649$, $p < 0.001$]. Fear had a lower threshold than Disgust [$t(59) = 3.302$, $p = 0.002$] and Contempt [$t(59) = 2.83$, $p = 0.006$] but a similar threshold to Sadness [$t(59) = 0.968$, $p = 0.337$] and Anger [$t(59) = 1.703$, $p = 0.094$]. Sadness had a lower threshold than Disgust [$t(59) = 2.612$, $p = 0.011$] and Contempt [$t(59) = 2.286$, $p = 0.026$], but a similar threshold to Anger [$t(59) = 0.971$, $p = 0.336$]. There were no differences in detection threshold between Anger and Disgust [$t(59) = 1.973$, $p = 0.053$], Anger and Contempt [$t(59) = 1.552$, $p = 0.126$], or Disgust and Contempt [$t(59) = 0.236$, $p = 0.815$].

Crawford single case analysis of emotion detection threshold showed that 40.0% (12/30) of the patients had deficits for Contempt, 30.0% (9/30) for Anger, 10.0% (3/30) for Sadness, 6.77% (2/30) for Disgust, 10.0% (3/30) for Fear and 3.3% (1/30) for Happiness.

3.2.3. Correlational analyses

There were negative correlations between emotion recognition and negative symptoms among patients; patients with more intense negative symptoms had greater emotion recognition deficits ($r = -0.502$, $p = 0.005$). There were also moderate negative correlations between the Negative PANSS or Total PANSS scores and emotional recognition ($r = -0.362$, $p = 0.049$; $r = -0.367$, $p = 0.046$). There was no significant correlation between detection threshold and psychopathologic scales: PANSS Pos ($r = -0.081$, $p = 0.672$); PANSS Neg ($r = -0.1$, $p = 0.599$); PANSS G ($r = -0.134$, $p = 0.48$); PANSS Tot ($r = -0.122$; $p = 0.52$) and SANS ($r = 0.032$, $p = 0.865$).

4. Discussion

Our study is the first to explore the possible generalization to non-Western patients of facial emotion recognition deficits in schizophrenia. To achieve this, we used a comprehensive test among Congolese patients and explored inter-individual heterogeneity of this deficit.

Our results showed that patients with schizophrenia had reduced scores for emotion recognition compared to healthy control subjects, with no deficit for detection threshold. Post-hoc *t*-tests showed that this impairment was specifically for anger, contempt and sadness, with no

significant differences between groups for other emotions. These findings indicate that our patients, although they did not need more information than controls to recognize the emotions of presented faces, were more likely to make errors and misjudge negative emotions, which is coherent with previous results. Indeed, in South Africa, Leppanen et al. (2006) observed this impaired recognition of negative emotions in patients with schizophrenia using a discrimination test based on positive, negative and neutral valence. The same deficit has been observed in studies of patients with schizophrenia in Western countries (Schneider et al., 1995; Bryson et al., 1997; Silver et al., 2002; Kohler et al., 2003). Despite some variation across studies, the deficit is most often observed for sadness and anger. This deficit for negative emotions is observed in all modalities (visual and auditory), leading to the proposal of a specific dysfunction for negative emotions (Granato et al., 2009). Conversely, patients did not differ from controls concerning threshold intensity, and there was no correlation between this threshold and psychopathologic scales, which also confirms earlier findings (Hargreaves et al., 2016).

We also observed that participants with more negative symptoms had a stronger deficit in emotion recognition, which is also in line with earlier results (Ventura et al., 2013). However, Sachs et al. (2004) and other authors (Wölwer et al., 1996; Addington and Addington 1998; Weiss et al., 2009), reported a positive correlation between these two parameters. To explain these discrepancies and try to understand the factors underlying the links between emotion recognition deficits and negative symptoms, several researchers (Sergi et al., 2007; Penn et al., 2008) have focused their exploration on the negative symptoms of anhedonia and emotional blunting, which may be more associated with impaired emotion recognition than other negative symptoms (Franck, 2014).

Our results, by generalizing the observation of emotion recognition deficits to African patients with schizophrenia, also offer insight regarding the hypothesis of the universality of emotion recognition defended by several studies, and consequently the universality of deficits in facial emotion recognition in schizophrenia. The contributions of cross-cultural studies in this domain are considerable, supporting some universality of emotion recognition but also recognizing specificities in the expression and regulation of emotions across cultures. As one example, Habel et al. (2000) demonstrated the presence of deficits in emotion recognition in three subgroups of patients of different ethnocultural origin (German, Americans and Indians). Brekke et al. (2005) found impairments in Latin American, Afro-American and Euro-American patients with schizophrenia. However, the fact that this study found variable results across the three groups pleads, according to Brekke, for an influence of ethnocultural mechanisms on emotional perception, potentially transcending the common variation between perception mechanisms.

According to certain studies, impaired emotion recognition does not improve by taking antipsychotics or by usual psychotherapy techniques (Harvey et al., 2006; Sergi et al., 2007; Demily and Franck, 2008). However, it is improved by specific cognitive remediation programs. This therapeutic approach has become a major strategy in the management of schizophrenia. Treating impaired emotion recognition can help improve daily functioning, interpersonal relationships and quality of life for patients with schizophrenia (Couture, 2006). However, an important insight of the present study, obtained through single case analysis, is the large degree of heterogeneity observed across patients for emotion recognition deficit. Only a small proportion of patients actually showed a significant deficit for each emotion, highlighting the importance of a patient-tailored approach when proposing cognitive remediation. It should, however, be noted that the scores observed in our study appear low compared with those obtained by Gaudelus during the TREF validation study (Gaudelus et al., 2014). Nevertheless, they respect the standard defined by these authors, according to which subjects who deviate by more than two standard deviations from the control subjects' average are said to have severe impairments in emotion recognition (Gaudelus et al., 2014). We cannot underestimate the possibility that cultural biases could at least partly explain the low mean scores obtained by the participants overall and for certain emotions more specifically (i.e. contempt, disgust). Indeed, according to previous studies, culture influences the style of emotion expression (Elfenbein and Ambady, 2002), and there are societies in which certain emotions are expressed in a specific way (Elfenbein and Ambady, 2002; Matsumoto, 2006). The consequence would be that these emotions may be poorly recognized by the subjects of one ethnic group, especially when they are depicted by people from a different ethnic group (Pinhkam et al., 2008). The poor performance of participants for disgust and contempt (also observed among controls) can be explained by a cultural factor, with low scores given by Africans for negative emotions when the faces are Caucasian. For example, for French participants, Okada et al. (2015) showed a trend towards better recognition of disgust when expressed by Caucasian than by Asian faces. Generally, members of collectivistic cultures (Africans, Asians) demonstrate decreased recognition when judging stimuli from other regions, particularly for negative emotions (Matsumoto, 1992), raising doubts regarding the universality of emotional expression recognition. It should also be noted that our paradigm was based on a forced-choice, which did not allow participants to choose a "no response" or "don't know" option when they did not recognize the emotion. As underlined earlier (Franck and Stennett, 2001; Russel, 1993), this methodological choice, while being in line with most earlier studies in schizophrenia, may have influenced the results observed. Finally, the limited sample size of the present study may have limited the reliability of our findings, which should thus be confirmed in larger groups.

In conclusion, our study showed, using a validated and exhaustive test, a deficit in facial emotion recognition in Congolese patients with schizophrenia, specifically for negative emotions. This deficit was correlated with negative symptoms. These results are coherent with those of the international literature confirming deficits in core emotion recognition in schizophrenia. We also showed, for the first time, that emotion recognition impairment is not homogeneously present in all patients with schizophrenia, but that there is marked inter-individual heterogeneity. Future studies should explore emotion recognition deficits in larger numbers of patients and using tests adapted to the African cultural context in general and to the Congolese context in particular.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2019.03.030.

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