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Recognition of facial expressions of emotions in schizophrenia

Abstract Deficits in recognition of facial expressions of emotions are considered to be an important factor explaining impairments in social functioning and affective reactions of schizophrenic patients. Many studies confirmed such deficits while controversies remained concerning the emotion valence and modality. The aim of the study was to explore the process of recognizing facial expressions of emotion in the group of schizophrenic patients by analyzing the role of emotion valence, modality and gender of the model. Results of the group of 35 patients and 35 matched controls indicate that while schizophrenic patients show general impairment in recognizing facial expressions of both positive and the majority of negative emotions, there are differences in deficits for particular emotions. Expressions also appeared to be more ambiguous for the patients while variables connected with gender were found less significant.

Keywords:

Impairments in social functioning observed in schizophrenic patients can in part be attributed to general cognitive deficits. Many studies showed that patients perform worse in abstract thinking and have problems in understanding social situations (Addington, McCleary & Munroe-Blum, 1998; Mitrushima, Abara & Blumenfeld, 1996). It was also observed that schizophrenic patients encounter difficulties in attributing feelings and intentions of participants in such situations correctly. One of the possible explanations of such deficits is that schizophrenia is associated with less accurate recognition of facial expression of emotions what was demonstrated in many studies (see Edwards, Jackson & Pattison, 2002 or Mandal, Pandey & Prasad 1998 for a review). Affective impairment has been considered to be one of the most characteristic negative symptom in schizophrenia since the beginning of scientific studies of that disease but after some time the interests of researchers shifted into the perception of emotion since it could explain more directly problems in social functioning encountered by schizophrenic patients (Walker, Marwit & Emory, 1980). Recent studies indicated that deficits in facial expression recognition could be attributed to structural abnormalities of the amygdala (Namiki, Hirao, Yamada,

Hanakawa, Hayashi & Murai, 2007) or hyperactivation of that structure (Mier et al., 2010).

There were other studies indicating that schizophrenia patients exhibit more general impairment in social cognition and executive functioning. Brune (2005) found that compared to healthy controls patients performed worse on Wisconsin Card Sorting Task and in understanding social situations such as the ability to perceive cooperation, cheating and recognizing true and false beliefs of the characters in presented picture stories.

Recent studies showed clearly that schizophrenia is associated with general impairment in recognizing facial expressions of emotions (Green, Waldron & Coltheart, 2007; Mendoza et al., 2011; Silver, Bilker & Goodman, 2009; Vernet, Baudouin & Franck, 2008). Moreover it seems that the deficit mentioned above is universal from the culture point of view since it manifests in people with schizophrenia coming from different cultures. It was found in patients from China (Chan, Wong, Wang, & Lee, 2008; Leung, Lee & Lee, 2011), Japan (Okada, Murai, Kubota, & Sato, 2003), Pakistan (Malik, Khawar, Chaudhry, & Humphreys, 2010), Cuba (Mendoza et al., 2011) and a South African Xhosa population (Leppanen, Niehaus, Koen, Du-

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Toit, Schoeman, & Emsley, 2006). Those results appeared when patients were compared with healthy controls, but the study of Americans of different ethnic groups showed that Latinos and African Americans scored lower on emotion recognition task than Caucasians (Brekke, Nakagami, Kee, & Green, 2005).

While the general effect of lower recognition accuracy in schizophrenia can be considered as well documented in earlier studies (Archer, Hey, & Young, 1992; Davis & Gibson, 2000; Mandal, Pandey, & Prasad, 1998; Salem, Kring & Kerr, 1996), there are still some controversies concerning a few particular aspects of that impairment. The first is associated with the valence of expressed emotions. Some studies indicated that only negative emotional states are recognized less accurately. Vernet, Baudouin, and Franck (2008) showed that recognition of happiness was significantly more accurate than of other emotions in schizophrenia patients. A study based on signal detection analysis (Tsoi et al., 2008) indicated that happy faces were more easily recognized than other facial emotions. Other studies (Dougherty, Barlet & Izard, 1974; Muzeraki & Bates, 1977; Weiss et al., 2007; Weiss et al., 2006). Brune (2005) found that there were no significant differences in the recognition of happiness between schizophrenic patients and healthy controls. However, according to some earlier studies the effect concerns both positive and negative affective states (Walker, Marwit & Emory, 1980; Zuroff & Colussy, 1986).

Modality of the expressed emotion appeared to be the second source of controversy. Some researchers concluded that impairment is associated with particular negative emotions but pointed at different emotional states. Poorer recognition of anger was showed by Green, Waldron and Coltheart (2007) as well as Muzeraki and Bates, (1977). Other studies indicated impairment in cases of sadness (Muzeraki & Bates, 1977; Silver, Bilker, & Goodman, 2009; Walker, Marwit & Emory, 1980), disgust (Dougherty, Barlet, & Izard, 1974; Vernet, Baudouin & Franck, 2008), fear (Green, Waldron, & Coltheart, 2007; Muzeraki & Bates, 1977; Walker, Marwit & Emory, 1980) or surprise (Walker, Marwit, & Emory, 1980).

Each of the controversies should be seen in the context of differences in emotional expression recognition in the general population. There is some empirical evidence that contempt appeared to be the worst recognizable emotional state while happiness the best (Matsumoto & Ekman, 1994). However results concerning other emotions were less conclusive. There were also some gender differences found in normal population with women showing generally better recognition of expressions than men (Brody & Hall, 2005). The question of whether that is also true for schizophrenic patients remains unanswered, however a study by Weiss et al. (2007) indicated that there were differences between male and female schizophrenic patients in recognition of neutral faces. They also found that female faces were generally better recognized.

There were also other important factors studied. Davis and Gibson (2000) found that deficits in expression recognition in schizophrenia appeared only when posed expressions were used and were absent for genuine expression. However according to Dyck, Winbeck, Leiberg, Chen, and Mathiak (2010) the effect indicating poorer recognition was true when patients rated virtual faces as well as natural photographs.

It would be difficult to identify the sources of discrepancies in results of the studies mentioned above since they were undertaken in an empirical manner and focused on the description and specificity of schizophrenic patients' cognitive functioning. We can only expect that continuing the studies of that sort would eventually lead to more conclusive results.

Aim of the study

The purpose of the present study was to explore the process of recognizing facial expressions of emotion in schizophrenia by analyzing the role of emotion valence, modality and gender of the model. The patient's gender and duration of the disease were also taken into consideration. More specifically the study was to answer whether there were differences in recognition of particular emotions, like fear, anger or happiness, as well as between positive and negative emotions and feelings posed by male and female models. Differences in recognition between male and female patients were also tested. Finally recognitions of patients differing in the duration of the disease, indicated by the number of hospitalizations, were also analyzed. The latter factor can be treated as a provisory indicator of the severity of disease. It can also be assumed that greater number of hospitalizations caused more severe impairment in patients' cognitive functioning so it seemed necessary to control that variable.

The general hypothesis was formulated that schizophrenic patients will show impairment of social perception exhibited in the recognition of emotions in others. Four hypotheses were put forward respectively. According to the first one it was expected, in congruence with many previous studies, schizophrenic patients would exhibit less accuracy than healthy controls in recognizing facial expressions of emotion. According to hypothesis two it was expected that patients would show better accuracy in recognition of positive emotion than of negative emotions. Hypothesis three stated that patients would recognize facial expression of female models more accurately than male models. According to the fourth hypothesis, women from both groups would exhibit greater accuracy in recognition of emotions than men. Inconclusive previous empirical results did not allow formulating a hypothesis concerning emotion modality, so only a question could be formulated whether there were any differences in recognition of individual emotions.

Method

Participants

The sample consisted of two groups, 35 patients with diagnosed paranoid schizophrenia and 35 individuals with no history of mental disorders selected to match the group of patients according to gender, age and education. There were 19 women and 16 men in the patient group aged between 20 and 64. Detailed characteristics of both groups of participants are given in Table 1. Patients had the diagnosis of paranoid schizophrenia according to ICD -10 and were recruited after completing the hospital treatment. At the time of the study they were having pharmacological intervention and rehabilitation focused on social functioning. They were in good reality contact and did not manifest any current psychotic symptoms. Patients differed in the number of hospitalizations ranging from 1 to 14 (mean 4.69, SD 2.85).

Table 1. *Demographical characteristics of participants*

Group	Schizophrenic patients	Healthy controls
Gender		
men	19	19
women	16	16
Education		
elementary	3	1
secondary	26	25
higher	6	9
Age		
Mean	37.4	37.2
SD	11.3	11.8
19-30	8	8
31-50	22	21
51-65	5	6

Method

Materials

Color slides of Caucasian male and female faces expressing emotions selected from the JACFEE set (Matsumoto, Ekman, 1989) were used. There were four slides of each of the seven basic emotions: anger, contempt, disgust, happiness, fear, sadness and surprise, two showing faces of men and two of women for 28 slides altogether. Each emotion expression corresponded to the prototypic universal expressions described by Ekman and Friesen (1975) and was posed by a different individual. As indicated by Biehl et al.(1997) that set of expressions produced good cross cultural agreement in categorical emotion judgment.

The method is one of the most commonly used in studies of emotion expression recognition. There is however some discrepancy between the number of positive and negative emotional expressions but it cannot be avoided due the widely accepted list of basic emotions. Still the comparisons focused on emotion valence should be treated with some cautiousness.

Procedure

Patients were recruited in the center for rehabilitation of schizophrenia outpatients. Participants were informed about the confidentiality of participation and provided with the information about the general aim and procedure of the study and then gave informed consent. In the patient group as well as in the control group nobody asked to participate refused. Subjects were tested individually in a room where only the experimenter was present. They were instructed that their task was to identify the emotional state in each of the faces they were going to see. They were further informed that the faces would be exposed for a short time and then they would have time to give the answer. The slides were exposed on the 15 inch monitor of the laptop computer – each for 10 seconds with a 10 second break showing a blank screen. During the 10 second break the participants indicated with a check which of the seven emotions they had just identified on an answer form which had the number of each slide with the list of seven emotions. The set of 28 slides showing emotions was exposed to participants in a random order prepared individually for each person.

Results

Recognition accuracy

Number of correct recognitions of emotions was calculated for each participant, including total score for all expressions, summed score for negative emotions (anger, contempt, disgust, fear, sadness) and for each emotion separately. Results for schizophrenic patients and the healthy control group are given in Table 2. Since the distributions of all analyzed variables were negatively skewed (Kolmogorov – Smirnov test, p ranging from $< .05$ to $< .01$) nonparametric tests of group differences were applied.

Significant differences between schizophrenic patients and healthy controls were observed for the total number of correct recognitions showing a clearly reduced ability to recognize facial expressions of emotion in schizophrenia. When particular emotions were taken into consideration the same tendency appeared for happiness, anger, surprise and contempt. Patients' deficits were less prominent in case of fear with differences not significant but showing a strong trend ($p < .06$). Compared to healthy controls schizophrenic patients did not show significantly lower accuracy in cases of sadness or disgust. However when the number of correct recognitions summed for all negative emotions (anger, fear, sadness, disgust, contempt) was analyzed, schizophrenia

Table 2. Recognition accuracy in the group of schizophrenic patients and healthy controls. Mean number of correct recognitions (sum of 4 expositions of each emotion) and percent of correct recognitions (mean for 4 expositions of each emotion). Scores for individual emotions, general score for all emotions, negative emotions and expressions in male and female faces. Percent scores only for individual emotions.

	Schizophrenia patients			Healthy controls			Mann Whitney U
	Mean	SD	%	Mean	SD	%	
Anger	2.22	1.51	55.7	3.17	.85	79.27	2.539 $p < .01$
Contempt	1.31	1.38	33.55	2.25	1.06	56.42	3.119 $p < .002$
Disgust	2.22	1.33	55.72	2.65	1.13	66.42	1.208 $p < .22$
Fear	1.71	1.38	42.85	2.28	1.1	57.15	1.896 $p < .058$
Happiness	3.77	.49	93.57	3.97	.16	99.77	2.247 $p < .025$
Sadness	2.71	1.34	67.82	3.25	.98	81.4	1.706 $p < .088$
Surprise	3.02	1.04	76.42	3.54	.74	88.57	2.329 $p < .02$
Negative emotions	2.2	.74		2.86	.48		3.777 $p < .0001$
Male faces	8.4	2.2		10.71	1.79		4.116 $p < .0001$
Female faces	8.6	2.65		10.4	1.78		3.012 $p < .003$
All 7 emotions	17.0	4.43		21.14	2.88		4.084 $p < .0001$

Table 3. Emotion expression ambiguity in the group of schizophrenic patients and healthy controls. Number of other emotional states recognized incorrectly in expressions (mean for 4 expositions of each emotion)

	Schizophrenic patients	Healthy controls	Mann Whitney U
Anger	4.75	2.5	-2.397 $p < .029$
Contempt	5.5	4.25	-1.858 $p < .11$
Disgust	4.25	2.75	-2.381 $p < .029$
Fear	5.0	3.25	-2.000 $p < .11$
Happiness	1.75	0.25	-1.548 $p < .2$
Sadness	4.25	2.5	-2.097 $p < .057$
Surprise	2.5	1.5	-1.214 $p < .34$

patients showed significantly lower accuracy than healthy controls. The tendency was the same as for the positive emotion of happiness with lower accuracy of perception obtained in the schizophrenic group.

Recognition and gender

Differences between schizophrenia patients and healthy controls in recognition of female and male expressions of emotion (total scores for all seven emotions) are also showed in Table 2 indicating the same tendency as for general recognition scores with patients showing lower accuracy for both female and male faces.

Recognition accuracy was also analyzed with participant's gender taken into consideration. There were no differences between men and women either in total score or in the recognition of particular emotions with only the exception of surprise where men showed significantly

greater accuracy (Mann Whitney U 3.373, $p < .001$). When gender differences were tested separately in the group of patients and healthy controls only one significant emotion difference was found in patients – men were more accurate than women in the recognition of surprise (Mann Whitney U 2.953, $p < .015$). Due to the abnormal distribution of variables it was not possible to test the gender x group interaction since the analyses were limited to nonparametric tests. However when recognitions of male and female expressions were compared in men and women participants no significant differences were found between the groups.

Recognition of particular emotion expression

Two other aspects of emotion expression recognition were also analyzed. The average percent of correct recognitions for each emotion is given in Table 2 and the average

number of other emotional states attributed incorrectly to expressions are presented in Table 3. Since there were 4 slides for each emotion, the mean of four values was calculated in case of both parameters.

While the schizophrenic patients showed generally a lower percentage of correct recognitions there were also reasonable differences between emotions within the group. Comparison of accuracy scores between particular emotion expressions analyzed separately in the group of patients and healthy controls revealed significant differences. Both patients and healthy controls recognized some expressions better than other (Friedman ANOVA – patients 69.285, *df* 6, $p < .0001$, controls 82.447, *df* 6, $p < .0001$). In schizophrenic patients post hoc tests revealed significant differences between happiness and expressions of other five emotions: anger (4.011, $p < .001$), contempt (6.473, $p < .0001$), disgust (4.565, $p < .0001$), fear (5.809, $p < .0001$) and sadness (3.126, $p < .037$). Moreover there were differences between contempt and both sadness (3.347, $p < .017$) and surprise (-4.316, $p < .0001$) as well as between fear and surprise (-3.652, $p < .005$). Similar differences were found in healthy controls between happiness and expressions of: anger (3.071, $p < .045$), contempt (6.390, $p < .0001$), disgust (5.007, $p < .0001$) and fear (6.280, $p < .0001$). There were also differences between contempt and three other states: anger (-3.320, $p < .019$), sadness (3.486, $p < .01$) and surprise (-4.675, $p < .0001$) as well as between fear and expressions of anger (-3.209, $p < .028$), sadness (3.375, $p < .015$) and surprise (-4.565, $p < .0001$). Finally differences between disgust and surprise were found in the control group (-3.292, $p < .021$). Generally we may conclude that happiness was the most recognizable expression in both groups. There was the smaller number of significant differences between other emotions in schizophrenia patients while contempt appeared to be the least recognizable expression in both groups.

In order to verify hypothesis two, a comparison within the group of patients was performed between recognitions of positive and negative emotion expressions (accuracy score for happiness and sum of scores for five negative emotions divided by 5). It indicates that patients recognized positive emotional states significantly better than negative (Wilcoxon test for dependent samples -5.066, $p < .0001$).

When comparing facial expressions of each emotion it seemed also reasonable to estimate how ambiguous they were for participants. One can expect that when only one other emotion was incorrectly attributed to expression it appeared as less ambiguous to respondents than when there were more erroneous emotions attributed. Table 3 shows comparison of the number of other emotional states attributed incorrectly to each emotion expression in both groups (average for four expositions of each emotion). In order to test group differences a new variable was created – number of other emotional states attributed to each emotion in four trials. Mann Whitney U test comparing distributions

of those variables in two groups was applied. It shows that compared to healthy controls patients attributed incorrectly significantly more other emotional states when anger and disgust were exposed. The strong trend appeared also for sadness ($p < .057$). Those three emotion expressions appeared to be more ambiguous for patients.

It should be pointed out clearly that the two aspects of emotion recognition are not the same – it is possible that the number of correct recognitions is low while the number of other emotions attributed to it can be different ranging from one to six. Expression of disgust can serve as a good example – it was recognized correctly at the level of about 50 percent in both groups while there were differences in the ambiguity index – for schizophrenia patients it appeared to be much more ambiguous (average number of other emotional states attributed incorrectly 4.25) than for healthy controls (average 2.75).

Analysis of responses showed that in some cases patients recognized sadness, disgust, anger, contempt or surprise in the expression of fear while the healthy participants only surprise, anger and in very few cases disgust. When expression of anger was exposed all other emotions appeared in patients' incorrect recognitions even the positive emotion of happiness in two cases while in healthy controls only contempt and disgust. Even in case of the least ambiguous expression of happiness there were 3 recognitions of surprise, 2 of anger as well as singular responses indicating disgust, contempt, sadness and fear in the patients group while in the control group there was only one incorrect recognition of contempt.

Finally the significance of the number of hospitalizations was tested as an indicator of the disease duration and severity. Patients group was divided into two (number of hospitalizations below and above the mean) and no significant differences were found for any variable used in analysis. Two subgroups of patients had similar demographic characteristics namely gender (6 women and 9 men in the more hospitalized group and 10 women and 10 men in the other), age (means 35.7 and 40.87 respectively) as well as level of education.

Discussion

When compared with healthy controls schizophrenia patients revealed lower accuracy in recognition of facial expressions of emotions which is consistent with many earlier studies (Edwards, Jackson & Pattison, 2002; Green, Waldron & Coltheart, 2007; Mandal, Pandey & Prasad, 1998; Mendoza et al., 2011; Silver, Bilker & Goodman, 2009; Vernet, Baudouin & Franck, 2008). While it is still not decided whether that impairment is secondary to general cognitive deficits in schizophrenia or not, one may say that the occurrence of patients' difficulties in recognition of emotions in the faces of other people is based on strong empirical support. It is reasonable to expect that those defi-

cits contribute significantly to impairment of general social functioning observed in schizophrenia.

Results of a present study also indicate that while schizophrenia patients show general impairment in the recognition of facial expressions of both positive and majority of negative emotions there are within group differences concerning positive and negative emotions. Patients recognized positive emotional states much more correctly than negative. When emotion modality was taken into consideration the results showed the same tendency in the patients and healthy controls indicating significant differences in accuracy between particular emotional expressions. Happiness appears to be the best recognized emotion and contempt the worst. Thus results obtained in some earlier studies (Vernet, Baudouin and Franck, 2008, Tsoi et al., 2008) were supported. Schizophrenia patients, however, showed generally lower recognition scores for all emotion expressions while in the case of happiness, anger, surprise and contempt, the differences were significant. Thus hypotheses 1 and 2 were confirmed. It seems that when emotion modality is taken into consideration the tendency in recognition remains the same in schizophrenia patients and healthy persons while patients showing generally lower accuracy. That conclusion does not confirm the results of Brune (2005) indicating no differences between schizophrenia patients and healthy controls in the recognition of happiness. Observed differences in the recognition of anger, contempt and surprise confirm the results obtained in studies of Green, Waldron, and Coltheart (2007), Muzeraki and Bates (1977), Vernet, Baudouin, and Franck (2008), Walker, Marwit, and Emory, (1980).

Considering some studies suggest a more general impairment as responsible for poorer emotion expression recognition in schizophrenia (Johnston, Katsikitis, & Carr, 2001; Vernet, Baudouin, & Franck, 2008), results of the present study as well as earlier, previously mentioned studies, allow the conclusion that while happiness is generally better recognized, patients still perform worse.

Results revealed also another difference between the two groups. In case of incorrect recognitions schizophrenia patients attributed greater number of different emotions to the presented expressions than healthy controls which suggests that for the patients facial expressions were more ambiguous. While healthy participants recognized erroneously generally one or two other emotions the patients four or five and in few cases even negative states were attributed to expressions of positive emotions. In particular expressions of anger, disgust and sadness appeared to be significantly more ambiguous for patients.

Hypotheses 3 and 4 concerning the aspect of gender were not confirmed in the results of the present study. The patients' tendency to recognize emotions less accurately than healthy controls appeared to be true for both male and female faces. Moreover differences in emotion recognition between male and female participants were found only

in the case of surprise with men showing better accuracy. No significant differences were found for other emotional states or in total correctness score for all emotions. Results were the same when recognitions of male and female participants were compared in two groups together or separately. Generally the results of the presented study suggest that gender variables appear to be less important than other studies would indicate (see Weiss et al., 2007). It allows for a tentative conclusion that the impairment of social cognition is a more general characteristic of schizophrenia.

In view of the above results, the general hypothesis was confirmed. Schizophrenia patients show general impairment in the processes of social perception and one may expect that it will be related to poorer social cognition and functioning. Moreover it seems reasonable to expect that deficits in social perception can be seen as primary to patient's poorer social functioning. Results obtained in a study by Brune (2005) indicate that three important processes involved in social functioning are interrelated and impaired in schizophrenia namely social perception, social cognition and executive functioning. The question concerning the mechanism of such deficits in social perception remains unanswered however the results obtained from the neural network model analysis by Johnston, Katsikitis, and Carr (2001) suggest that impairment in emotion expression recognition processes can be rather attributed to more generalized deficit in the brain information processing than to specific processing modules of emotion recognition.

While the fact that obtained results are congruent with many other studies speaks in favor of the present study there are obviously some limitations as well. First is connected with the relatively small group of participants. While the clinical samples in some other studies mentioned earlier were similar in number it should be pointed out clearly that further studies require larger groups that would also allow some more sophisticated, multivariable analyses. It should also be pointed out that it was not possible in the study to separate the effects of pharmacological treatment from the effect of the disease itself. Thus while it seems less likely still we cannot rule out the possibility that observed impairment in emotion recognition should be attributed to medical treatment as one of its side effects. In order to control the influence of that factor it would be necessary to include the additional group of patients that do not have pharmacological treatment or differ in diagnosis but take the same substances.

Another factor than needs more thorough examination is the variability in the group of schizophrenia patients. There are different types of schizophrenia and patients differ in their psychopathological state and duration of the disease. Results of the present study concerned only paranoid schizophrenia and while they indicate no differences connected with the number of hospitalizations it requires confirmation in further studies.

The study has also some practical implications. It seems that cognitive rehabilitation of schizophrenia outpatients should also concentrate on practicing emotion expression recognition as an important aspect of social cognition. Moreover the procedure of such training is neither complicated nor expensive. It can also be suggested that testing recognition of facial expressions of emotions should be used in the diagnosis of schizophrenia patients' cognitive deficits since it is an important indicator of social cognition efficacy.

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