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Facial Affect Recognition Deficit as a Marker of Genetic Vulnerability to Schizophrenia

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The aim of this study was to investigate the possibility that affect recognition impairments are associated with genetic liability to schizophrenia. In a group of 55 unaffected relatives of schizophrenia patients (parents and siblings) we examined the capacity to detect facially expressed emotions and its relationship to schizotypal personality, neurocognitive functioning, and the subject's actual emotional state. The relatives were compared with 103 schizophrenia patients and 99 healthy subjects without any family history of psychoses. Emotional stimuli were nine black-and-white photos of actors, who portrayed six basic emotions as well as interest, contempt, and shame. The results evidenced the affect recognition deficit in relatives, though milder than that in patients themselves. No correlation between the deficit and schizotypal personality measured with SPQ was detected in the group of relatives. Neither cognitive functioning, including attention, verbal memory and linguistic ability, nor actual emotional states accounted for their affect recognition impairments. The results suggest that the facial affect recognition deficit in schizophrenia may be related to genetic predisposition to the disorder and may serve as an endophenotype in molecular-genetic studies.
Keywords: affect recognition, genetics, cognition, schizophrenia, schizotypal personality

El objetivo de este estudio era investigar la posibilidad de que el déficit para reconocer el afecto se asocie a la vulnerabilidad genética a la esquizofrenia. En un grupo de 55 familiares (padres y hermanos/as) no afectados de pacientes de esquizofrenia examinamos la capacidad para detectar emociones expresadas y su relación con la personalidad esquizotípica, el funcionamiento neurocognitivo y el estado emocional actual del sujeto. Se compararon los familiares con 103 pacientes esquizofrénicos y con 99 sujetos sanos sin ninguna historia familiar de psicosis. Los estímulos emocionales eran 9 fotos en blanco y negro de actores, quienes representaron las 6 emociones básicas, además de interés, desprecio y vergüenza. Los resultados revelaron déficit en reconocimiento afectivo en los familiares, aunque más leve que en los propios pacientes. No se detectó ninguna correlación entre el déficit y la personalidad esquizotípica medida con SPQ en el grupo de familiares. Ni el funcionamiento cognitivo, incluyendo la atención, la memoria verbal y la habilidad lingüística, ni tampoco los estados emocionales actuales explicaron el déficit en el reconocimiento del afecto. Los resultados sugieren que el déficit en reconocimiento de afecto facial en la esquizofrenia puede relacionarse con una predisposición genética al trastorno y puede servir de endofenotipo en los estudios moleculares genéticos.
Palabras clave: reconocimiento de afecto, cognición, esquizofrenia, personalidad esquizotípica

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Social cognition is an aggregate of mental processes associated with the processing of information on socially significant stimuli. The given sphere at the present time is being intensively studied in psychology and the neuro-sciences. The deficits of social cognition are included in the list of main components of cognitive deficit under schizophrenia within the MATRICS programme (Measurement and Treatment Research to Improve Cognition in Schizophrenia, 2002) of the National Institute of Mental Health, USA (Nuechterlein, Robbins, & Einat, 2005). This signifies that they are viewed as an important target for medicinal intervention aimed at improving the prognosis of the illness and the patient's quality of life.

Social cognition is a broad construct which includes affect recognition, social perception, theory of mind, social knowledge, and atributional styles (Couture, Penn, & Roberts, 2006; Green, Olivier, Crawley, Penn, & Silverstein, 2005). The recognition of faces' emotional expressions may be considered the most studied aspect of social cognition in schizophrenia. Numerous studies indicate the reduced capability of schizophrenia patients to identify facial emotions and to assess their intensity. These data are confirmed for patients of different ages, chronic and acute sufferers, and patients with the first episode of the illness, including those not receiving neuroleptics (Mandal, Pandey, & Prasad, 1998; Tremeau, 2006). Although schizophrenia patients process any information on facial patterns more poorly (for example, they more poorly remember faces and more poorly determine age by the face), we do not categorise affect recognition deficit as a generalised facial recognition disorder and, clearly, it has its own additional specific causes and mechanisms (Combs & Qouvier, 2004; Kohler et al., 2003; Kosmidis et al., 2006;Schneider et al., 2006). Many studies have been devoted to their research, but results thus far have been ambiguous. Thus, contradictory data have been obtained on the nature and degree of the influence of clinical and cognitive features of patients for them to recognise facial expressions, and on the specifics of the deficit regarding different emotions (Mandal et al.,1998; Sachs, Steger-Wuchse, Crispin-Exner, Gur, & Katschnig, 2004; Tremeau, 2006). The impact of patients' own emotional status for them to recognise emotional information has been insufficiently studied (Gur et al., 2006; Mandal et al., 1998).

In association with the necessity of medicinal correction for social cognition deficit, the most important issue is of its relationship to the biological bases of the illness, including genetic factors, predisposing to the development of schizophrenia. The link between facial affect recognition deficit and genetic precursors of schizophrenia may be attested to by the presence of similar anomalies in people with a family history of the said illness. At the present time several studies have been conducted into facial affect recognition by relatives of schizophrenia patients. McCown, Johnson, Austin, and Shefsky (1988) found a facial emotion recognition deficit in parents, and Bediou et al. (2007) in patients' siblings. In the work of Kee, Horan, Mintz, and Green (2004), the siblings of patients who are only at the tendency level identified facial and vocal emotions worse than control subjects, and also the emotions of a character from a video clip, differed significantly from the control in the composite index of emotion recognition. In tests for facial recognition and emotional expressions, Loughland, Williams, and Harris (2004) obtained data on relatives having the same pattern of 'limited' facial scanning (avoiding significant facial features – eyes, nose and mouth) as the patients themselves. In two other studies, patients' relatives did not differ from the control group in facial affect recognition (Bolte & Poustka, 2003; Toomey, Sideman, Lyons, Faraone, & Tsuang, 1999). Thus, the results of studies on relatives are ambiguous. Moreover, it should be noted that patients' relatives have a mild cognitive dysfunction (Snitz, Macdonald, & Carter, 2006), the influence of which on facial affect recognition has not been studied. It is also unknown if for the patients' relatives there exists a link between facial affect recognition deficit and schizotypal personality traits which, like the symptoms of the illness or a cognitive deficit, may be the reason for poor emotion recognition. To resolve the issue of the status of facial affect recognition deficit as a marker of genetic vulnerability to schizophrenia, it is necessary not only to confirm a corresponding deficit for relatives, but also to study its link with cognitive and behavioral features.

The task of the given research included the study of facial affect recognition in relatives of schizophrenia patients and the connection of the said process with neurocognitive features and schizotypal symptoms, and also with the identification of their own emotions. Conformities observed in the group of relatives were compared with tendencies typical of schizophrenia patients and healthy subjects without any family history of psychoses.

Method

103 patients with schizophrenia spectrum disorders (from 18 to 56 years old, average age 29 ± 9 years, 61 women and 42 men) took part in the study, as well as 55 of their relatives (from 18 to 66 years old, average age 45 ± 13 years, 27 women and 28 men), and 99 control subjects (from 18 to 60 years old, average age 32 ± 12 years, 66 women and 33 men). Patients at the time of the study were hospitalised. In accordance with ICD-10 (International Classification of Diseases), 90 persons had a diagnosis of schizophrenia (F20), and 13 had an schizo-affective disorder (F25). The average duration of the illness was 7 ± 7 years. The severity of positive symptoms according to the Positive and Negative Syndrome Scale (Russian version of the Positive and Negative Syndrome Scale; Mosolov, 2001) was equal to 21.1 ± 6.2, negative symptoms 22.2 ± 5.5, and

general pathological 40.0 ± 12.8. The group of relatives included parents (n = 43) and adult siblings (n = 12) of patients not suffering from schizophrenic or affective disorders (F2, F31-33). Control subjects were mentally healthy people without mentally ill first-degree relatives. The study was approved by the Ethics Committee of the Mental Health Research Center. Subjects gave informed consent to participation in the study.

All subjects passed experimental and psychological examination which included the task of recognising facial expressions of emotion, and also a study of their own cognitive processes: verbal memory, verbal associations, and attention. Patients were examined after improvement in their condition –before discharge.

Nine black-and-white photographs of actors served as the stimulus material in the task of assessing facial emotional expressions, presented in the Izard monograph (1980). They were depictions of the six basic emotions (*happiness, surprise, sadness, anger, disgust, fear*) and three more complicated social emotions (*interest/excitement*, *contempt*, *shame*). From the set of photographs placed before him, the subject was asked to choose one or two which to the greatest degree corresponded to his state at that moment and to give a name to this emotion. The subject then had to know each emotion depicted by the actor. The time for completing the task was not limited or fixed. The subject was presented with the possibility to examine the photographs in any order and position. For each correctly named emotion a score of one point was added.

To assess short-term verbal memory, a task of immediate recall of 10 words was used, and for long-term associative memory –the pictogram method. It should be noted that the figure for long-term associative memory in the pictogram method to a significant degree reflects the general level of cognitive performance (Alfimova, 2006). Verbal associations were assessed using tests for semantic verbal fluency and the syllabic method. In the latter, the subject had to answer with the first word entering his head which began with the syllable posed by the experimenter. To assess attention and working memory, a count-down series was used from 200 in 2s and 5s, and to assess voluntary and involuntary visual attention and visual perception – a modified Munsterberg test. In the Munsterberg test, the subject had to find and name words looking through a sheet with rows of letters. The number of correctly identified words was recorded, the time for completion of the task, and the time taken on searching for a single word. The latter figure presumably reflects the features of perceptive organisation and visual scanning. To study involuntary attention, the letters ‘o’ and ‘n’ were written in a dark-green colour, whilst the others were in black. Two-three minutes after completion of the task, the subject was asked if he had noticed what colours the letters were. Where there was a correct answer, he was asked to remember which letters exactly were in green. Answers were assessed in points, from 0 (*did not notice the colour)* to 3 (*named the colour and both letters*). A more detailed description of the pictograms, syllable method, and series countdown may be found in Alfimova and Uvarova (2003).

The control group and relatives were asked to complete a Schizotypal Personality Questionnaire (SPQ-74; Raine, 1991). It was designed to assess nine diagnostic indications specific to schizotypal personality disorder, in accordance with DSM-III-R, which were grouped in three factors: Cognitive-perceptual factor (ideas of reference, odd beliefs or magical thinking, unusual perceptual experiences, suspiciousness); Interpersonal factor (excessive social anxiety, no close friends, constricted affect, suspiciousness); and Disorganized factor (odd or eccentric behaviour and odd speech). The factors listed relate to the three main schizophrenia syndromes. The Cognitive-perceptual factor is considered similar to positive symptoms (hallucinations and delusions), the Interpersonal factor similar to negative symptoms, and the Disorganized factor as similar to disorganization of thought and behavior.

For a statistical analysis of the data, the Statistica 6.0 program was used. When processing the data, it was taken into consideration that the distribution of the ‘emotion recognition’ and cognitive-indicators index – with the exception of involuntary attention – did not significantly differ from the normal one, and the distribution of SPQ indices was positively skewed.

Results

Effectiveness of emotion recognition. A statistical analysis was conducted with the General Linear Model method. As predictors of emotion recognition, the sex, age, and education (secondary/higher) of the subjects were input, and their group (patients/relatives/control). The main effects and the interaction effects of the listed factors were assessed. In the main, women demonstrated a higher capability to recognise emotions than men (main effect of sex: $F = 7.26$, $p = .01$), although the differences between the sexes within each of the three groups were not reliable. Age also had a significant effect on completing the task ($F = 11.10$, $p = .01$), and the correlations of age and emotion recognition were reliable in the relatives group (Pearson´s $r = –.33$, $p = .02$), having a higher education only influenced emotion recognition on the tendency level ($F= 2.98$, $p = .09$).

With control of sex, age, and educational level, the differences between the three groups in effectiveness of facial affect recognition were significant ($F= 28.50$, $p < .01$). Further comparison of the groups using a post-hoc Bonferroni test and taking sex into consideration showed that both patients and relatives more poorly assessed facial expressions than control subjects (Table 1). Differences of male and female patients and female relatives from the corresponding sex in the control group were statistically

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Table 1
Means (± standard deviations) of emotion recognition index by group

Group	Men	Women
Patients	4.5±1.5**	4.8±1.5**
Relatives	5.1±1.6	5.4±1.2*
Control Group	5.8±1.2	6.4±1.2

Note. The significance of differences from values in the control group: * – $p < 0.05$, ** – $p < 0.01$.

significant. No reliable effects of interaction of the various factors were detected.

In comparison with the control group, relatives, as also the patients, slightly more poorly recognised each of the emotions, with the exception of happiness (Figure1). At the same time, differences between patients and healthy subjects were significant for contempt and all basic emotions apart from sadness. Relatives demonstrated reliable differences from the control group only in the recognition of sadness. All subjects poorly distinguished interest from surprise. Interest was named surprise by 46% of control subjects, by 24% of relatives, and by 33% of patients. Another common error was incorrect recognition of fear as surprise. This was typical, first and foremost, for patients: 24% of patients gave an incorrect answer. Such an error was also made by 13% of relatives, and by 4% of control subjects.

Effect of cognitive and personal performance on emotion recognition. Of the cognitive indicators, a significant link with emotion recognition in patients was detected for the coefficient of standard responses in the syllabic method (Pearson's $r = .20$, $p = .04$). Of the clinical indicators, which included severity of various symptoms, age of manifestation and duration of illness, only an assessment of negative symptoms on the PANSS correlated significantly with the identification of emotions (Pearson's $r = –.22$, $p = .04$). In the control group there were reliable correlations between recognition of emotions and verbal memory and perceptive organisation. Moreover, in the control group emotion recognition was strongly associated with schizotypal features: the cognitive-perceptual SPQ factor and the 'unusual perceptual experiences' scale of the given factor. At the same time, in the relatives group emotion recognition correlated with a whole series of cognitive indices, including verbal memory and verbal fluency, and also involuntary visual attention and perceptive organisation. Also, it was not associated with evidence of schizotypal features (Table 2).

In order to assess the degree of the independent effect of various cognitive and schizotypal features on emotion

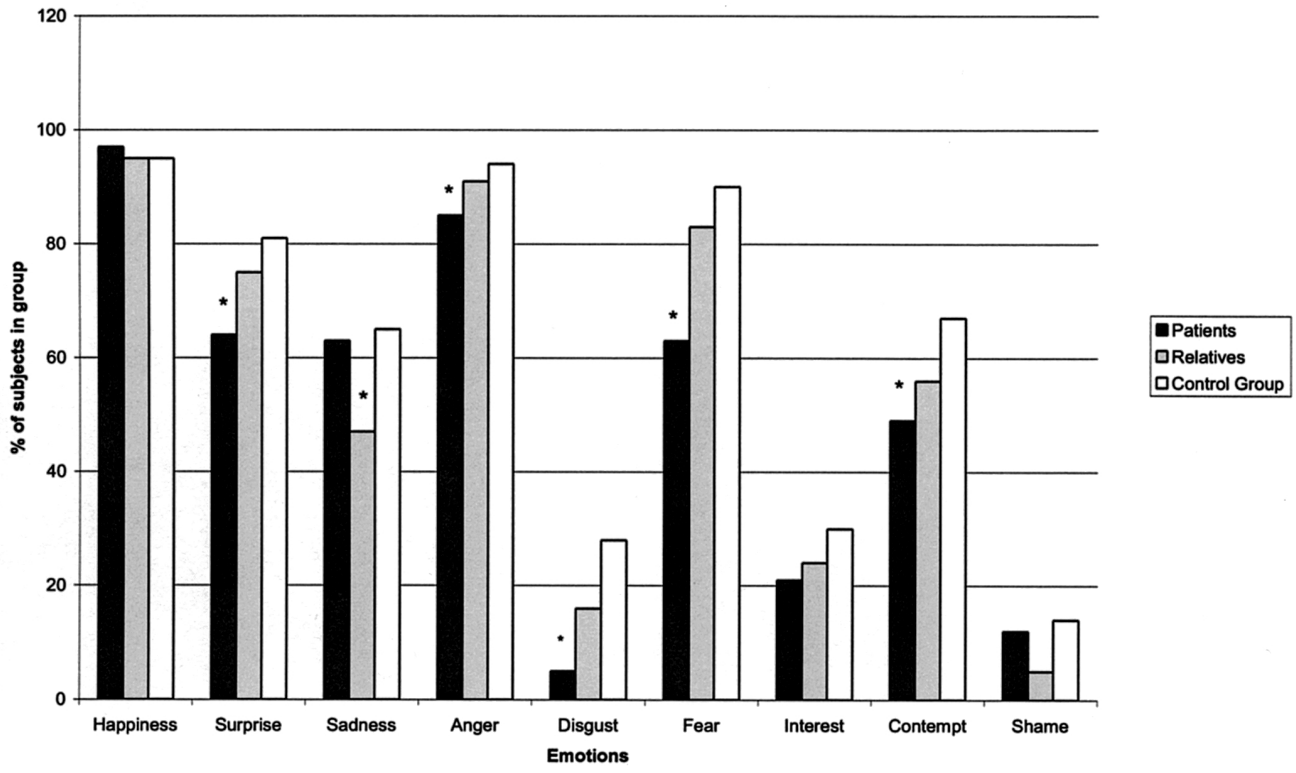

Figure 1. Percentage of subjects in each group correctly recognising an emotion. * - differences from the control group at the level p<0.05 (chi square).

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Table 2
Correlations in emotion recognition and cognitive and schizotypal indicators in relatives and control groups

Indicator	Relatives		Control Group	
	r	p	r	p
Short-term memory	0.29	0.03*	0.20	0.05*
Long-term associative memory	0.41	0.00*	0.30	0.00*
Standard associations in Syllabic Method	–0.00	0.99	0.01	0.90
Verbal fluency	0.38	0.00*	0.02	0.87
Attention/working memory	0.14	0.32	0.15	0.16
Voluntary visual attention	0.23	0.10	–0.02	0.86
Visual attention/perceptive organisation	–0.29	0.04*	–0.22	0.03*
Involuntary visual attention	0.28	0.04*	0.13	0.21
SPQ Ideas of reference	–0.01	0.96	–0.11	0.30
SPQ Excessive social anxiety	–0.04	0.80	–0.09	0.39
SPQ Odd beliefs or magical thinking	0.08	0.55	–0.11	0.29
SPQ Unusual perceptual experiences	0.08	0.57	–0.23	0.02*
SPQ Odd or eccentric behaviour	0.23	0.10	–0.15	0.14
SPQ No close friends	–0.02	0.89	–0.10	0.36
SPQ Odd speech	0.03	0.82	–0.12	0.27
SPQ Constricted affect	–0.03	0.82	–0.08	0.44
SPQ Suspiciousness	–0.15	0.28	–0.13	0.21
SPQ Cognitive-perceptual factor	–0.04	0.79	–0.22	0.03*
SPQ Interpersonal factor	–0.05	0.74	–0.14	0.17
SPQ Disorganized factor	0.07	0.61	–0.18	0.08
SPQ Total score	–0.01	0.94	–0.18	0.08

Note. For cognitive indicators, Pearson correlations were calculated, for involuntary attention and SPQ – Spearman correlations; * - significance of correlation coefficients where $p < 0.05$.

Table 3
Parameters of regression equations for the prognosis of emotion recognition effectiveness

Variables	β	SE	B	SE	t	p	Δr^2
REGRESSION EQUATION FOR PATIENTS GROUP F=4.42, p<0.01; R=0.37, R^2_{adj}=0.11							
Intercept			4.08	1.00	5.00	0.00	
Negative syndrome	–0.32	0.11	–0.09	0.03	–2.85	0.01	0.05
Age	0.28	0.12	0.05	0.02	2.41	0.02	0.05
Syllabic method	0.21	0.10	0.03	0.01	2.00	0.05	0.04
REGRESSION EQUATION FOR RELATIVES GROUP F=5.71, p<0.01; R=0.56, R^2_{adj}=0.26							
Intercept			5.25	1.03	5.09	0.00	
Perceptive organisation	–0.23	0.13	–0.09	0.05	–1.81	0.08	0.04
Involuntary attention	0.25	0.12	0.43	0.21	2.02	0.05	0.06
Age	–0.28	0.12	–0.03	0.01	–2.39	0.02	0.04
Verbal fluency	0.25	0.13	0.04	0.02	1.98	0.05	0.02
REGRESSION EQUATION FOR CONTROL GROUP F=8.71, p<0.01; R=0.48, R^2_{adj}=0.20							
Intercept			8.07	0.41	19.92	0.00	
Age	–0.36	0.10	–0.04	0.01	–3.80	0.00	0.11
Sex	–0.25	0.10	–0.67	0.25	–2.67	0.01	0.06
SPQ Cognitive perceptual factor	–0.24	0.09	–0.06	0.02	–2.59	0.01	0.06

Note. R - multiple correlation coefficient, R^2_{adj} - adjusted coefficient of multiple determination, Δr^2 – change in coefficient of determination when introducing corresponding variable into equation, SE – standard error.

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Table 4
Number of subjects choosing each of the emotions to assess their own actual state

Emotion	Patients	Relatives	Control Group
Happiness**	20 (17.7%)	9 (15.3%)	37 (34.9%)
Surprise	15 (13.3%)	6 (10.2%)	8 (7.6%)
Sadness**	22 (19.5%)	18 (30.5%)	7 (6.6%)
Anger	0 (0%)	0 (0%)	1 (0.9%)
Disgust	5 (4.4%)	1 (1.7%)	0 (0%)
Interest	24 (21.2%)	15 (25.4%)	29 (27.4%)
Contempt	9 (8.0%)	3 (5.1%)	7 (6.6%)
Shame	12 (10.6%)	6 (10.2%)	14 (13.2%)
Nothing[a]	6 (5.3%)	1 (1.7%)	3 (2.8%)

Note. [a] 'nothing' – subjects answered that none of the emotions from the offered selection reflected even remotely their state; 'fear' was not named by a single subject. ** - differences between groups are significant by frequency of selecting happiness (chi square = 11.92, $p < 0.01$) and by frequency of selecting sadness (chi square = 16.31, $p < 0.01$).

recognition in each group, a stepwise multiple regression analysis was performed in which the predictors were indices in the cognitive and personal sphere correlating with emotion recognition (see Table 2). Additional independent variables were the sex and age of the subjects. The obtained results are presented in Table 3. The data testifies that in the patients group, negative symptoms and commonality of word associations were statistically significant independent predictors of emotion recognition accounting for, respectively, 5% and 4% of the variance in the resulting indicator. In the control group, the regression equation included the Cognitive-perceptual SPQ factor which accounted for 6% of the variance. In the relatives group, the regression equation included verbal fluency, involuntary attention, and perceptive organization. They accounted for from 2% to 6% of the variance.

*Effect of emotional state on emotion recognition***.** In no group were any difficulties noted when naming their own emotions. Even those subjects who refused to select an emotion from the proposed set could explain in words what they were feeling at the given time. Most frequently as the actually experienced emotion, control subjects chose *happiness* and *interest* (often naming it *surprise*) (Table 4). Patients most frequently of all chose *interest* –and relatives, *sadness*. There were significant differences between the groups in the frequency of choosing *happiness* and *sadness*. It should also be noted that of the 18 relatives choosing the depiction of sadness as a marker of their own actual state, more than half (10 persons) incorrectly named the said emotion as *concentration/thoughtfulness* or *indifference*. At the same time, patients and relatives on the whole, in comparison with the control group, insignificantly more frequently incorrectly named the emotion chosen in the self-assessment process. Such persons in the patients group were 35%, in the relatives group 41%, and in the control group 31%. As was to be expected, these errors were significantly associated with a general capability to recognise emotions (GLM, $F = 10.66$, $p < .01$).

Comparing the success of emotion recognition in subjects who assessed their state as *interested, happy*, or *sad*, when using ANOVA no significant differences were found in any of the groups.

Discussion

The study showed that in success of emotion recognition, relatives were between the patients and the control group. Moreover, their differences from the control group were substantial and in the women's group reach statistical significance. The given regularity is observed when considering the subjects' age and education. These results are similar to such for evidence of cognitive deficit in patients' relatives (Snitz, Macdonald, & Carter, 2006) and testify in favour of relatives having impaired affect recognition, although less severe than in the patients themselves. In light of the available data on the insignificant role of the shared environment in the formation of psychological indicators, it may be posited that the family nature of emotion recognition disorders with schizophrenia reflects a link between this indicator and a hereditary predisposition to the illness. However, further confirmation is required of the status of emotion recognition disorders as a schizophrenia endophenotype using quantitative genetics methods, which allow assessing genetic and environmental components of the phenotypic variance of the given indicator.

It is important to note that with a general reduction in the capability to identify emotions, the normal regularity of recognising basic emotions in the groups of patients and their relatives are retained. This concerns both demographic differences and also emotion recognition features of different valences. Thus, it is known that women somewhat better cope with the identification of emotional facial expressions than men. This regularity is confirmed for schizophrenia patients in a number of preceding studies (Kucharska-Pietura,

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David, Masiak, & Phillips, 2005; Schneider et al., 2006), and by us also for patients and for their relatives. The resultant data corresponds to the fact that with age the capability to identify emotions, especially negative ones, somewhat deteriorates (Keightley, Chiew, Winocur, & Grady, 2007). In the general population, of the basic emotions, happiness is recognised best of all, followed by surprise, anger, and fear, with sadness and especially disgust being most difficult to identify (Adolphs, 2002). Moreover, in the general population fear is often confused with surprise which, obviously, is explained by the categorisation of both emotions to the more general category of surprise as reactions to an unforeseen circumstance (Adolphs, 2002). The integrity of recognising happiness in comparison with negative emotions under schizophrenia was noted previously in a whole series of studies (Brune, 2005; Kohler, Bilker, Hagendoorn, Gur, & Gur, 2000; Kucharska-Pietura et al., 2005; Schneider et al., 2006). We identified similar regularities both in patients and in their unaffected relatives. The typical errors for subjects in all groups when recognising interest are clearly connected with the fact that a facial expression of interest is not as unambiguous as with other emotions (Izard, 1980). The retention of normal regularities regarding the success of recognising concrete emotions testifies in favour of the hypothesis that patients more poorly recognise certain emotions due to their degree of complexity, but not because of damage to specific neuronal structures involved in identification of concrete emotions (Johnston, Katsikitis, & Carr, 2001).

The study's results indicate a link between emotion identification disorders in patients with negative symptoms. Similar data was obtained in the majority of works, although certain authors found associations with positive symptoms or did not find any at all (for a review, see Tremeau, 2006). Thus, Hall et al. (2004) showed that patients scoring no less than 4 on the PANSS positive symptoms subscale, more poorly recognised facial emotions than patients with minimally expressed positive symptoms. Clearly, the presence of positive symptoms may also have an effect on emotion recognition, but this link is not linear and therefore is not identified in the majority of works.

On the basis of the results we obtained in the patients group, correlation could be expected between the interpersonal SPQ factor (similar to negative symptoms) and the recognition of emotional facial expressions in relatives. However, there were no correlations in them between schizotypal features and emotion recognition. The data may be viewed as favouring the point of view that disorders in emotion identification in persons with a genetic risk of developing schizophrenia have different mechanisms to schizotypal personality traits. At the same time, symptoms which develop in the progression of the illness may have an additional negative effect on emotion recognition. It is interesting to note that in the control group, identification of emotional expressions was linked to the effect of schizotypal features which are considered similar to positive symptoms in patients. In conformity with literature data, for persons in the general population with high scores on scales assessing various schizotypal features, including also SPQ, facial affect recognition deficit, as a rule, is not revealed (Jahshan & Sergi, 2007; Poreh, Whitman, Weber, & Ross, 1994; Toomey & Schuldberg, 1995), as distinct from patients with a schizotypal disorder diagnosis (Waldeck & Miller, 2000). Only in the research of Meyer and Shean (2006), in which the Magical Ideation Scale was used, were individuals with high scores on the said scale found to have a link between emotion recognition and aberrant beliefs –results close to those we obtained.

One further factor which may affect emotion recognition is cognitive performance. Actually, data exists on a link with emotion recognition disorders in patients with cognitive indicators. Most frequently correlations are identified with attention, especially with visual scanning (Addington & Addington, 1998; Combs & Qouvier, 2004; Gur et al., 2006; Kee, Kern, & Green, 1998; Kohler et al., 2000). Correlations have also been found with executive functions, verbal memory, and spatial and linguistic (verbal-semantic) features (Gur et al., 2006; Kohler et al., 2000; Poole, Tobias, & Vinogradov, 2000; Sachs et al., 2004). In our research, emotion recognition in patients correlated with features of verbal associations, i.e., verbal-semantic abilities. In the syllabic method, in schizophrenia patients a reduction was noted in the regularity of associations, which is expressed in the naming of low-frequency nouns, other parts of speech, and word-combinations. The link discovered is probably explained by the fact that in both processes – emotion identification and the naming of a word by its first syllable – mechanisms are involved for retrieval the necessary word from semantic memory. The choice of suitable name, as is known, «crowns» the emotion recognition process (Adolphs, 2002). Previously, Combs and Qouvier (2004), to analyse this link in processing emotional information in patients, used verbal fluency; however, the correlation link detected between verbal fluency and emotion recognition was weak and disappeared when considering other cognitive features. In our study, the lack of correlations with attention and executive functions is, obviously, explained by the methodological differences from the majority of research. As a rule, in such works the subject is presented with dozens of photographs and the exposure time may be limited to a few seconds. Such features of the experiment increase the reliability of measurements, but simultaneously bring it closer to studies of sustained attention and psychomotor speed which necessitates the presence of corresponding correlations. At the same time, the subject is asked to categorise the image against an available bench-mark, rank stimuli by intensity, or choose the name of an emotion from a list. This reduces the load on verbal-semantic features and facilitates identification, as it has been shown that the naming of emotions, which requires associations between emotional

expressions and words, presents more difficulties in comparison with discrimination of emotions or selection by sample (Mandal et al., 1998).

In relatives and in the control group we initially discovered a whole series of correlations with cognitive functions, including verbal memory and visual attention. However, in the control group none of the cognitive indicators when considering demographic features was a significant predictor of emotion recognition, which corresponds to the findings of other authors (Brune, 2005; Kohler et al., 2000). In relatives, verbal fluency and attention measures together described approximately 12% of variance in the emotion recognition results. The detected links indicate possible sources of a reduction in the capability to recognise emotions in patients' relatives. In particular, interesting is the correlation with verbal fluency. It testifies that for relatives, as for patients, one such source is the difficulties in retrieving the necessary word from semantic memory. Another possible mechanism in relatives' reduction in capability to recognise emotions is a lack of attention resources and its organisation on the basis of available knowledge, of which speak the detected correlations with indices for voluntary and involuntary visual attention. Inasmuch as we used a limited battery of cognitive tests, we cannot exclude other cognitive processes also contributing to emotion recognition disorders in persons with a genetic risk of developing schizophrenia. However, it should be emphasised that the detected correlations were statistically weak and the greater proportion of variance in the scores for identifying emotions in relatives was not associated with cognitive performance.

In the majority of studies, when considering effect of patients' emotional status on their recognition of emotional expressions, what is primarily analysed is the effect of flat affect, that is, a definite negative symptom. At the same time, as also for the negative syndrome on the whole, ambiguous results have been obtained (Gur et al., 2006; Sweet, Primeau, Fichtner, & Lutz, 1998). Our aim was to track the effect on the processing of emotional information of a broader spectrum of emotional conditions and the capability to understand and name one's own feelings. For this a method was used for identifying one's actual emotional state with one of those depicted in photographs (Khomskaya and Batova, 1998). In particular, in light of data on facial affect recognition disorders in depression (e.g., Joormann & Gotlib, 2006), we were especially interested in the consequences of depressive mood. We did not find difficulties with patients and their relatives identifying their own emotions. These results diverge from data on the presence of alexithymia symptoms, i.e., inability to understand and name one's emotions, in male schizophrenia patients and their siblings (van't Wout, Aleman, Bermond, & Kahn, 2007). The cause of this divergence may be the lack of emotional strain in our experiment's subjects, a link with which alexithymia was noted (van't Wout et al., 2007). At the same time, patients and relatives as groups showed definite changes in actual emotional state. In the control group, more than half the subjects (64.3%) chose positive emotions of happiness and interest which corresponds with available normative data (Izard, 1980; Khomskaya and Batova, 1998), and sadness almost 10 times less (6.6%). Among patients, and especially their relatives, this gap was significantly less. It shortened primarily due to an increase in the number of people with depressive mood, but the number of interested subjects reduced insignificantly. Such results are not surprising in light of data on the frequency of depressive symptoms in patients and their relatives. Also, for relatives no effect was noted of reduced mood on the success of identifying all emotions, although it is possible to track a definite link between the selection of a depiction of sadness as the marker of their own actual condition and errors in identifying exactly this emotion. Also, in patients and control subjects no effect was found of their own emotional state on identifying emotions.

Conclusion

The results obtained indicate the existence of recognition disorders of the emotional state of another person not only in patients, but also in persons genetically predisposed to schizophrenia. The data testify also that these disorders, clearly, are autonomous in relation to schizotypal personality changes and cannot be fully explained by a reduction in cognitive performance or features of patients' relatives' own emotional state. Thus, the data obtained indicate the advantage of further study into facial affect recognition deficit under schizophrenia as a marker of genetic predisposition to the illness with its subsequent use as an independent schizophrenia endophenotype in molecular-genetic research.

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