

Facial emotion recognition deficits in schizophrenia – a review of research and a model of pathogenesis

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Abstract

Objective: The aim of the paper is to describe in detail the problems in the field of recognizing emotional facial expressions in patients with schizophrenia. This paper also analyses studies and theoretical literature on the potential connections between deficits in recognition of emotional facial expressions and neuronal dysfunctions and attachment styles.

Materials and method: The literature review was performed using the following databases: EBSCO, PsycINFO, PubMed, and Google Scholar. The databases were searched using the following keywords: 'emotion', 'facial emotion', 'facial expression'. Those terms were combined with the words 'recognition', 'perception', 'genetic', 'attachment style' and each time with the term 'schizophrenia'.

Results: The literature review clearly confirms that among people suffering from schizophrenia there are problems with recognizing emotional facial expressions. Studies suggest that the visual perception of patients is related to the recognition of facial expressions. Studies also confirm the relationship of neuronal dysfunctions and genetic factors with the recognition of emotional facial expressions.

Discussion and conclusions: The genesis of problems in recognizing emotional facial expressions in patients with schizophrenia is multifactorial in nature. The influence of attachment styles on epigenetic mechanisms and the development of neural structures related to emotion recognition remains unverified. In the future, this study will allow for the creation of more accurate models of the pathogenesis of these deficits.

facial emotion; facial expression; emotion recognition; schizophrenia

INTRODUCTION

Almost all studies have shown that among people suffering from schizophrenia there are problems with recognizing emotional facial expressions [1]. The main conclusion from the meta-analysis of studies [1, 2] conducted with schizophrenia patients was the statement that these people are characterized by a weaker ability to recognize the emotional expression presented on the face than

healthy people. To this day, however, the nature of these problems remains unclear. The aim of this paper is to present the current state of knowledge regarding the ability to recognize the facial expression of emotions by patients with schizophrenia and to analyze the factors that may be associated with the pathogenesis of problems in this area.

Material and methods

A systematic review of the literature was made using the following databases: EBSCO, PsycINFO, PubMed, and Google Scholar. Each database

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was searched using the following keywords: „emotion”, „facial emotion”, „facial expression”. These words were combined with the term „recognition”, „perception”, „genetic”, „attachment style” and each time with the term „schizophrenia”. 524 publications were identified during the database search. Duplicates and articles unrelated to the purpose of this thematic review were excluded. On the basis of such selection, 67 publications were included in the qualitative analysis. The process of searching and selecting research papers is presented in the PRISMA scheme (Figure 1) [3].

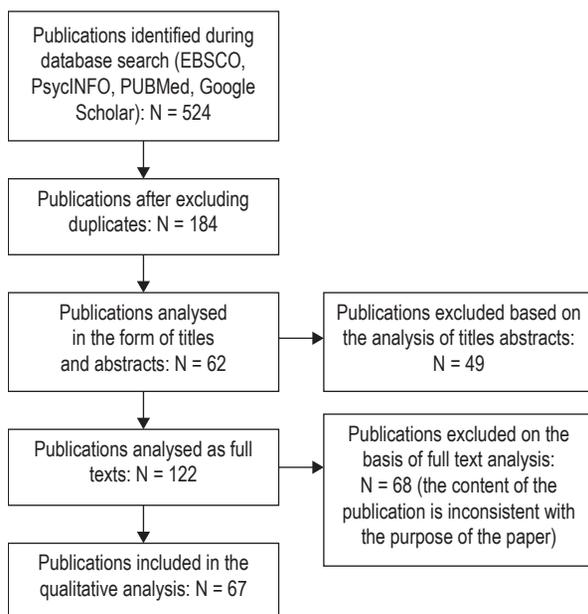


Figure 1. Recognition and visual perception of emotional facial expressions in people suffering from schizophrenia

Recognition and visual perception of emotional facial expressions in people suffering from schizophrenia

The meta-analysis of 86 publications published in 1970-2007 [2] indicates deficits in recognizing emotions in patients with schizophrenia. Among the demographic factors, a relationship between age and sex with the obtained results was demonstrated. The sick men and the elderly gave less correct answers in the facial expression recognition tests. Mandal and Rai [4] showed that patients suffering from schizophrenia have problems especially with recognizing the emotions

of fear and disgust on faces. The results of the study by Lee, Lee, Kweon, Lee and Lee [5] conducted on Korean patients suffering from schizophrenia showed that patients recognized facial expressions of sadness, fear and anger worse than healthy people. As in the study by Burch [6], it did not however show differences between the groups in recognizing the emotions of joy on faces. Different results were however obtained in a study by Tang, Yu, Duan, and Zhang [7] conducted on Chinese patients suffering from schizophrenia, who recognized both joy and negative emotions, such as sadness, fear, disgust and anger, worse than healthy people. However, these were patients with a deficit type of schizophrenia characterized by persistent primary negative symptoms [8]. Limitations in recognizing emotions on faces were greater in the group of people suffering from schizophrenia, the group after the first psychotic episode, the mixed group of psychiatric patients and people at high risk of psychosis than among healthy people [9, 10]. Patients suffering from paranoid schizophrenia recognize facial expressions more precisely than patients with non-paranoid schizophrenia [11, 12]. It has also been shown [13] that mistakes in recognizing emotional facial expressions correlate with symptoms of alogia and hallucinations, but not with depressive symptoms.

One study [14] also indicated that the ability to recognize facial expressions is influenced by the intensity of expressions exposed to patients. In this study, patients diagnosed with schizophrenia recognized facial expressions of joy, sadness, anger, fear, disgust and neutral facial expressions. For all emotions, except for disgust, the recognition of strong emotions was more often correct than the recognition of emotions of mild intensity. In their mistakes, patients were characterized by too frequent noticing the expression of disgust and not noticing the expression of joy compared to healthy people.

The ability to recognize emotional facial expressions may also be influenced by the time during which the subjects identify the emotions exposed to them. In the study by Jaracz, Grzechowiak, Raczowski, and Rybakowski [15] conducted on a group of patients meeting the criteria for paranoid schizophrenia, the mean time of recognizing emotional facial expressions was significantly extended compared

to the control group. The exposure time of faces displaying emotional expressions may be related to visual perception. Some researchers [16] have shown that both schizophrenic patients and healthy people look longer at faces displaying emotional expressions than at neutral faces. The visual perception of sick and healthy subjects was compared in three time intervals (0-500 ms; 500-1000 ms; 1000-1500 ms). Compared to healthy people, patients with schizophrenia focused their attention on faces to a lesser extent in the third time interval (1000-1500 ms), when one of the emotions in the exposed pair was a negative one. Phillips [17] compared the perceptual strategies of patients with paranoid ($n = 7$) and non-paranoid ($n = 7$) schizophrenia with a group of healthy people. The results of patients with paranoid symptoms showed statistically significant differences compared to the other groups. Both in the facial scanning and facial recognition tasks, they displayed different perceptual strategies, as they showed significantly less fixation and focused them rather beyond the functional affective parts of the face.

The process of reading emotional information from the face was also studied by Loughland, Williams and Gordon [18]. They compared people suffering from schizophrenia with a group of healthy people, presenting stimuli in the form of happy, sad and neutral faces. Compared to healthy people, the patients showed strongly narrowed scan paths, which was manifested by a smaller number and limited length of saccades, and much less attention to emotionally significant key elements of the face, such as the eyes, nose or mouth.

Williams et al. [19] also showed that visual perception when recognising facial expressions is related to the administered antipsychotics. Both patients with schizophrenia treated with haloperidol and risperidone showed a lower total number of fixations and a shorter total eye scanning length (sum of saccades) than healthy people. However, those treated with haloperidol showed a smaller number of fixations on the areas of the face important for the recognition of joy and neutral features than those treated with risperidone. Taking risperidone (as compared to haloperidol) is therefore associated with more frequent shifting of visual attention to emotionally significant areas of the face, which may be im-

portant in recognizing emotions. However, Kerr and Neale [20] postulate that deficits in recognizing emotions are not caused by antipsychotics, as they are also observed in people before the first episode of the disease and in patients not previously treated with neuroleptics [9, 21].

Summing up, the literature review suggests that the visual perception of patients, the exposure time of emotions and their intensity are related to the deficits in recognising emotional facial expressions. Some studies suggest differences in the recognition of certain types of emotions and the impact that the symptoms of the disease, patient age, gender and medications have on their recognition. The effects that medications taken may have on the recognition of emotions should be taken into account by the physician when determining pharmacotherapy. This has an impact on the quality of patients' social functioning.

Neural dysfunctions and recognition of emotional facial expressions among people suffering from schizophrenia

So far, deficits in recognizing emotional facial expressions have been explained by the neuronal dysfunctions of patients with schizophrenia. Two concepts dominate the research on the organization of the emotional functions of the brain [22]. In the first one, it is assumed that the activity of the right hemisphere is dominant in the perception of negative emotions, while the left hemisphere is associated with positive emotions. According to the second concept, the right hemisphere plays a major role in the perception of all types of emotions (both positive and negative).

The experiments – based on tachistoscopic exposure of photographs of faces with different emotional expressions – indicate slower and less correct identification of stimuli directed to the left visual field of people suffering from schizophrenia. This could suggest a right-hemispheric dysfunction in the process of facial recognition in this clinical group [22]. In other studies [23, 24], people with schizophrenia showed a weakened tendency to perceive the left halves of chimeric faces. These may be other arguments suggesting the dysfunction of the right

hemisphere among patients with schizophrenia. Studies show that people with schizophrenia have problems especially with recognizing negative emotions [25], especially fear [26, 27]. This would be in line with the concept that the right hemisphere, which is deficient among people suffering from schizophrenia, dominates the perception of negative emotions [22].

Another study indicating the dysfunction of the right hemispheric structures among people suffering from schizophrenia was carried out with the use of magnetic resonance imaging. Researchers [28] showed a correlation between the size of the grey matter and increased perception of threatening emotions. "Harmless" emotions that were wrongly classified by the subjects as "threatening" were interpreted as "exaggerated identification". Analysis by voxel-based morphometry showed a significant correlation between results characterized as "exaggerated identifications" and decreased grey matter volume in the right prefrontal cortex. According to the authors of this study, the right hemisphere is mainly involved in the emotional processing of emotions associated with threats. Studies also indicate that the key to facial recognition is the fusiform gyrus, which is smaller among people suffering from schizophrenia compared to healthy people [29]. During the facial recognition task, activation of the fusiform gyrus was lower in schizophrenic patients than in healthy subjects [30].

Goghari et al. [31] conducted a study involving 27 patients with schizophrenia, 23 biological family members and 36 volunteers from the control group. The results showed that the volume of grey matter in the left fusiform gyrus was reduced by 11% in schizophrenic patients compared to the control group. Among their relatives, it was reduced by 7% compared to the control group. Patients with schizophrenia were also characterized by reduced medial temporal areas and hippocampal atrophy. Patients were not able to correctly recognize facial expressions in the conditions of no time constraints, but they were able to adequately recognize the age of people in the photographs exposed to them. The study also showed a relationship between the reduction in grey matter volume in the temporal lobe and greater deficits in the recognition of facial expressions. For the middle temporal

regions, the relationship between their size and the level of task performance was found only in the case of tasks related to recognizing emotional facial expressions. This relationship did not occur in the case of tasks related to recognizing the age of the people on the photos exposed to them.

Summing up, the research results seem to clearly indicate deficits in recognizing emotional expressions among people suffering from schizophrenia [2]. So far, deficits in recognizing emotional facial expressions have been explained by the neuronal dysfunctions in patients with schizophrenia. Studies show that the key to facial recognition is the fusiform gyrus, which is smaller among people with schizophrenia than among healthy people [29]. Moreover, a relationship has been demonstrated between the reduction in grey matter volume in the temporal lobe and greater deficits in the recognition of facial expressions by people with schizophrenia [31]. The frontal lobes may also be responsible for deficits in the perception of facial expressions. A significant correlation was shown [28] between the increased perception of negative emotions and the decreased grey matter volume in the right prefrontal cortex of people suffering from schizophrenia. Changes in these neuronal structures of patients [32-34] may also influence deficits in the area of executive functions [35] and deficits in the cognitive sphere, including: attention processes [36], categorization of stimuli and working memory [37]. This may have to do with the mistakes patients make in recognizing emotional facial expressions.

Emotion recognition deficits in patients with schizophrenia – a model of pathogenesis

The causes of the neuronal dysfunctions in patients discussed above are probably related to the etiology of schizophrenia. Future research should address the role of genetic and epigenetic factors – related to the etiology of the disease – in the pathomechanism of problems in emotion recognition [38-43]. A meta-analysis [44] confirmed that problems with recognizing emotional expressions are greater among first-degree relatives of people with schizophrenia than in the control group. Problems with recognizing

emotions are therefore probably related to the genetic susceptibility to schizophrenia [45, 46]. However, research still has not clarified exactly what genes are associated with the recognition of emotions by patients.

There is an interesting study suggesting the influence that early experiences in the attachment relationship may have on the development of emotional recognition problems [47]. The Schore's concept [48] emphasizes that the lack of trusting attachment in childhood has a direct impact on the maturing right hemisphere during its critical growth period, causing it to become immature. Some studies [28] suggest that it is the dysfunctions of the right hemisphere – especially in the right prefrontal cortex – that are associated with deficits in the recognition of negative emotions on the face. Connections in the limbic system in a child, which is not supported by the caregiver in the process of emotional regulation, are exposed to the effects of toxic neurotransmitters, such as glutamate and cortisol, with longer exposure time [49]. The influence of the environment inhibits thus the development of the structures of the right hemisphere, generating at the same time an immature and defective orbital-frontal system. The Schore's concept [48] is also supported by scientific research [50]. Researchers [51] showed that children with secure attachment styles had a greater gray matter volume in the temporal sulcus, superior temporal gyrus, and the temporoparietal junction compared to those with insecure attachment styles. Reduction of the grey matter volume in the temporal lobe is also associated with greater deficits in the recognition of emotional facial expressions by patients with schizophrenia [31]. Children in a secure attachment relationship observe the facial expressions of the caregiver and thereby learn to identify their own and others' emotional states [52]. The exact opposite is true for an insecure attachment relationship. Children in such relationships do not learn to recognize affective states from the parent's face, which may result in problems with recognizing facial expressions in the future and inhibit the development of neural structures that play a role in recognizing emotions on the face.

Among people suffering from psychosis, including schizophrenia, the prevalence of avoidant attachment style (high level of avoidance

and low level of anxiety in the attachment relationship) is assessed at the level between 48% and 71%, while in healthy people it is 27% [53, 54]. An anxious attachment style (low level of avoidance and high level of anxiety) affects 12-20% of psychotic patients compared to 19% of healthy people. A secure attachment style (low level of avoidance and anxiety) is manifested by about 27-32% of psychotic patients and about 58% of healthy people [53, 55]. These data indicate that insecure attachment styles affect people suffering from schizophrenia to a greater extent than healthy people. Some studies [56, 57] and theoretical concepts [58, 59] also suggest an association of insecure attachment styles with the development of symptoms of schizophrenia and with the interpersonal functioning of patients. It is likely that neural dysfunctions – arising from experiences in an insecure attachment relationship – contribute to the development of psychotic symptoms [60]. For example, a negative correlation was found between the avoidant attachment style in adults and the volume of the left middle temporal gyrus and the right parahippocampal gyrus [61]. The loss of volume in the temporal regions is associated with symptoms of schizophrenia such as auditory hallucinations [62], negative symptoms [63] and with cognitive deficits widespread in this disease [64]. Future research should evaluate the effect of attachment styles on structures related to emotion recognition in patients with schizophrenia.

Steele, Steele, and Croft [47] showed that children with a secure attachment style most accurately recognized the expression of happiness (86%) and the expression of mischievousness (47%). The expression of surprise was best recognized by children with an avoidant attachment style. No child with an anxious-ambivalent attachment style recognized this emotion correctly. Children with insecure attachment styles (anxious-ambivalent and avoidant) also had much greater problems than children with a secure attachment style (47%) in recognizing the expression of mischievousness. Only 25% of children with an anxious-ambivalent attachment style and 11% of children with an avoidant attachment style correctly recognized it [47].

Research by Meyer [65] indicates that attachment styles in adults – classified according to Fraley and Shaver [66] by the dimensional mod-

el of adult attachment – like attachment styles in children [47], are related to the recognition of emotional facial expression. Adults with an anxious attachment style (low level of avoidance and high level of anxiety) are characterized by greater accuracy in recognizing emotions, while people with an avoidant attachment style (high level of avoidance and low level of anxiety in the attachment relationship) – less accurate recognition of emotions. The intensification of anxiety according to the dimensional model [66] improved the recognition of negative emotions. On the other hand, the intensification of avoidance in the attachment relationship was negatively related to the ability to recognise negative emotions. The avoidance of close relationships with the attachment figure does not favor the perception of its emotional expressions, which is why the child does not learn to recognize them. In the study by Meyer [65], the attachment style was not related to the ability to recognize positive and neutral emotions.

There are still no studies that would verify the relationship between attachment styles and the recognition of emotional facial expressions among people suffering from schizophrenia. A hypothetical explanation of such a relationship is the influence of experiences in the attachment relationship on changes in the expression of genes predisposing to deficits in emotion recognition. The next stage in the pathogenesis of problems with recognizing emotional facial expressions would be neural dysfunctions which, according to the Schore's [48] concept, concern especially the right hemisphere and develop within the insecure attachment relationship. The interaction of genetic factors with environmental factors early in life is reflected in epigenetic modifications that program gene expression patterns during brain development [67]. Due to the fact that epigenetic processes are potentially reversible, training in recognizing emotional facial expressions and psycho-education in this field may probably affect changes in the expression of genes predisposing to deficits in emotion recognition. The development of such trainings may improve the quality of life and social functioning of patients in the future. With the current state of knowledge, however, there are no data on specific genes and epigenetic mechanisms that may mediate the relationship

between the attachment styles and the deficits in recognizing emotional facial expressions in this clinical group.

Therapeutic interactions

The reduction of deficits in recognizing emotions is motivated by problems in the field of social cognition of patients. Social cognition can be defined as the ability to construct mental representations about others, oneself, and one's relationships with others. The scope of social cognition includes cognitive processes involved in understanding, perceiving and interpreting the social world. The ability to recognize emotions is a key problem in the field of social cognition in people with schizophrenia [68]. Despite the fact that the causes of the deficits in recognizing emotions have not been sufficiently explained, trainings to reduce them are already being developed.

Studies suggest that interactions aimed at recognizing the expression of emotions bring positive results. An example is the GAIA program based on recognizing emotional expressions displayed in photos and videos. The therapy consists of 30 sessions over 10 weeks. Studies suggest that participation in therapy results in a 16.21% increase, on average, in the ability to recognize emotions compared to the result obtained by patients with schizophrenia before starting therapy [68]. Other researchers [69] suggest that the training of facial expression recognition conducted among patients with schizophrenia shows better results in case of recognizing the expression of fear than other emotions. A meta-analysis [70], which included 8 studies with a total of 300 participants, showed a significant impact of the training of facial affect recognition on improving the ability to recognize emotions in patients with schizophrenia. However, there has been relatively little research on the effectiveness of these programs and it is necessary to continue them. This is of practical importance because researchers [70] confirm the impact of emotional recognition training on improving the social functioning of patients.

Virtual reality may turn out to be the future direction of the development of programs aimed at training the recognition of the expression of

facial emotions. The results confirm that deficits in recognizing emotions also occur when reading them from the dynamic faces of avatars [71]. Virtual reality allows you to create situations in which the subject will have to recognize emotions in everyday life. In addition to the correct reading of emotions, the ability to adjust one's behavior to social expectations is also important. The trainings should therefore also concern the adequacy of patients' reactions to the emotional reactions of avatars. An alternative form of assistance may also be neuropsychological rehabilitation aimed at improving the cognitive functions that mediate the recognition of emotional expressions [68]. In this case, the ability to focus attention on the areas of the face important from the point of view of emotional information and the processes of processing this information are particularly important. An interesting therapeutic direction may also be interventions aimed at mentalizing and working through attachment traumas. However, further research is required to assess their effectiveness in recognizing emotional expressions.

CONCLUSIONS

The genesis of problems in recognizing emotional facial expressions by people suffering from schizophrenia is multifactorial in nature. It is associated with dysfunctions within the neural structures that may be influenced by genetic and environmental factors. Neural dysfunctions, in turn, may be associated with the cognitive deficits in patients and with the visual perception of emotional facial expressions. The concepts that suggest the relationship between the ability to recognise emotions and the attachment styles are very interesting. Future research should carefully evaluate the impact of experiences in attachment relationship on epigenetic mechanisms and the development of neural structures responsible for emotional recognition in people with schizophrenia. This will allow the development of more accurate models of the pathogenesis of emotion recognition deficits. Undertaking this effort is necessary to develop more effective forms of therapy for patients. Increased competence in recognizing the emotions of others increases the ability of patients to understand, per-

ceive and interpret the social world. It allows them to communicate better and create more satisfying interpersonal relationships. This, in turn, translates into the quality of their professional and private life.

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