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Impairment of social cognition in comparative studies of patients with schizophrenia and their healthy siblings

Rafał Łoś, Aleksandra Gajowiec-Chmielewska

Jan Kochanowski University of Kielce Collegium Medicum

Summary

Social cognition impairment is a kind of neurocognitive disturbance observed during clinical course of schizophrenia. Deficits in this field observed in first – degree unaffected relatives have been suggested as a potential endophenotype. The main purpose of this study was to review the range of published articles, mainly from the last decade, regarding social cognition impairment in patients with schizophrenia and their healthy siblings.

The analysis used articles from the PubMed, Medline and Polish Medical Bibliography databases, searched using the following keywords: schizophrenia, healthy siblings, social cognition, theory of mind, facial emotion recognition. Works published in the time frame from 2010 to 2021 were included; in justified cases, earlier works were also used.

Results of the review indicate a substantial agreement on how to classify relatives' deficits in social cognition. Most analyzed studies indicate their level of neurocognitive disturbance in between schizophrenic siblings and controls. Schizophrenic patients present impairment of social cognition, comparable deficits have been observed to a lesser degree in their healthy siblings. Moreover, results of majority of studies reveal correlations of social cognition disturbances with cognitive dysfunctions and subclinical psychopathology in healthy siblings. However, further research on more numerous groups is needed to draw reliable conclusions on this topic.

Key words: schizophrenia, healthy siblings, social cognition

Introduction

Social cognition is defined as individual capacity to understand, interpreted and respond to other people's intentions [1]. The term refers to both the way of thinking about oneself and others, as well as social interactions, often being their key element [2]. Social cognition in patients with schizophrenia constitute a new area of research, in contrast to antisocial cognition, which has already been extensively described. Research review shows that social cognition is an independent process,

not influenced by other forms of cognition. Confirming this thesis in relation to research, damage to the frontal and prefrontal cortex caused impairment of social cognition and behavior, despite not impaired cognitive abilities [3]. The main areas of social cognition in schizophrenia include theory of mind (ToM) and facial emotion recognition (FER).

Theory of mind is defined as the ability to attribute other person's mental state to oneself and/or interpret other person's behavior and intentions. Theory of mind abilities involve understanding of false believes, allusions, intentions, lies, metaphors, irony, and misbehavior. Hierarchical relationship between these elements brings them together into the theory of mind. First-order ToM components are based on the ability to understand that one's own beliefs about the environment may be false, whereas second-order ToM components are based on the more complex ability to understand the false beliefs of others [4].

Recognizing facial emotions is a key factor in interpersonal relationships and communication. It enables a more complete understanding of other people's intentions and allows us to determine their current emotional states such as joy, sadness and anger, disgust, fear, happiness, surprise, contempt [5]. It has already been proven that patients diagnosed with paranoid schizophrenia tend to misinterpret emotions, intentions and reactions of other people [6]. The question therefore arises whether the deficits in this area observed in schizophrenics are similar to those observed in their healthy first-degree relatives.

Theory of mind

Social cognition impairment in schizophrenia is mainly associated with Theory of Mind (ToM) deficits. The question, however, is whether these dysfunctions are an indicator of susceptibility to the illness, and whether they are independent of other cognitive difficulties.

A study by Cella et al. [7] from 2015 is an attempt to find an answer to this question. Two groups of 21 people took part in the study: healthy siblings of people suffering from schizophrenia and people whose relatives were not affected by the illness. Their results on cognitive and social cognitive functions were measured. Siblings of people with schizophrenia performed significantly worse on theory of mind and social perception tests, but no such difference was found on tests of affect recognition. Moreover, relatives' scores on IQ, executive function and processing speed measures were also lower compared to healthy subjects. Executive functions had a significant impact on the theory of mind, processing speed and social perception test scores. The authors concluded that some social cognition deficits may be considered a genetic vulnerability for schizophrenia. This relationship, however, remains unclear as the cognitive deficits

did not fully contribute to the impairment of social cognition, suggesting that these factors are relatively independent [7].

There have been multiple attempts to investigate whether deficits in theory of mind can be viewed as an endophenotype of schizophrenia. A study by Ho et al. [8] involved 41 patients with first-episode schizophrenia and their 43 first-degree relatives. Social cognition deficits were assessed based on the faux pas test and the Chinese version of the Yoni test results. The Yoni test is used to define patients' ability to interpret mental state of other people [8]. The faux pas test was also included in a Spanish study from 2010 [9] conducted on a group of 20 patients diagnosed with schizophrenia and their 20 first-degree relatives (the control group consisted of 40 people). Participants were matched by age and sex to minimize impact of these factors on the outcomes. Psychotic patients and their relatives showed impaired theory of mind skills in both cited papers. Deficits were observed especially in the second-order ToM components. Patients' relatives showed cognitive deficits also in the faux pas test. Their results were between patients with schizophrenia and the control group [8, 9].

Could abnormalities in theory of mind help distinguish those with a risk of schizophrenia from control group? Such a hypothesis was made by Tikka et al. [13] in their study from 2019. The study group was divided into two subgroups. One group included 50 people with first-degree relatives suffering from schizophrenia, the other group included people meeting the criteria of high clinical risk. In order to assess ToM deficits, the SOCRATIS (Social Cognition Rating Tool in Indian Setting) tool recommended for the Indian population was used. Trial results confirmed above-mentioned hypothesis and revealed statistically relevant differences between the study group and controls. The authors did not find any factors that could differ two groups of individuals at different risk [10–13].

Different results were obtained in a study from 2012 conducted on Greek population [14], which included six equal ($n = 21$) groups: young men suffering from schizophrenia, fathers and mothers with schizophrenia, and three control groups consisting of healthy young men and fathers and mothers who had no children with schizophrenia. First – and second-order theory of mind tests were conducted, intellectual ability was assessed as well. Unaffected parents of schizophrenic patients showed deficits in the second-order theory of mind tests. Based on these results, the authors rejected the hypothesis that theory of mind is an endophenotype of schizophrenia, suggesting the lack of a suitable test for detecting cognitive deficits. The study of the primary ToM representations seems to be insufficiently sensitive, and the result of testing the secondary representations depends to a large extent on the cognitive functions (mainly working memory) of the subjects, especially the parents of the patients [14].

Attachment style

Attachment style plays a significant role in theory of mind, and insecure attachment is likely the basis of ToM disorders. Insecure attachment includes avoidant attachment (discomfort caused by having close relationships, high autonomy value) and anxious attachment (separation anxiety, dependence on others). It is clinically important to assess the relationship between attachment style and ToM as it allows to understand social dysfunctions in schizophrenia.

A study of Dutch authors from 2015 [15] included 111 patients diagnosed with schizophrenia, 106 healthy relatives unaffected by the illness and 63 controls. In the study following tests were used: *Psychosis Attachment Measure*, *Conflicting Beliefs and Emotions Test*, a subsection of the *Wechsler Adult Intelligence Scale*, and *Childhood Trauma Questionnaire-Short Form*. Research has proven that avoidant attachment style is related to cognitive and affective theory of mind impairment. Results showed a U-shaped association indicating better performance in Theory of Mind tasks of patients with extreme (lower and higher) levels of avoidant attachment compared to those with average level. Elevated levels of anxiety in attachment style were associated with greater cognitive problems in ToM. The results of this study support the view that anxious attachment style correlates with poorer ToM performance in patients. The results also suggest that a higher avoidant attachment score may have potential protective role. No significant differences were noted when examining the correlation between attachment style and cognitive functioning in the sibling group and the control group. These findings are clinically relevant, because attachment mechanisms can influence interpersonal relationships, also during therapy [15].

While the association between social deficits and psychosis is well-known, its origin remains unclear. This issue was one of the topics covered in a Dutch study under the acronym GROUP (Genetic Risk and Outcome in Psychosis) [16]. The Dutch and Belgians participated in the study. The study involved a large sample of 1,032 patients suffering from schizophrenia, 1,017 of healthy siblings and 579 controls group. Research was based on tasks taken by participants to evaluate their cognitive skills, including two tests on ToM and emotion recognition. To assess the Theory of mind abilities, participants performed the *Hinting Task* (HT) that is designed to examine the ability to infer the true intentions behind indirect statements. The test consists of 10 stories about interactions between two persons. One of the speakers ends the conversation with an indirect statement, a hint. The provided comments are treated as a hint. If the participant fails to take the hint, another, more obvious one is given. The study also used other research tools: *Degraded Facial Affect Recognition Task* (DFAR), *Benton Facial Recognition Test*, *Wechsler Adult Intelligence Scale*, *Positive and Negative Syndrome Scale* (PANSS), and *Structured Interview for Schizotypy – Revised*. Psychotic patients

have performed significantly worse than healthy relatives and controls in the *Hinting Task*. The difference between unaffected relatives and controls was not statistically significant. Patients also performed poorer on the DFAR compared to the other two groups. Again, the difference between the control group and healthy siblings was not significant. All participants, when asked to recognize facial affect, identified positive and neutral emotions best compared to negative emotions. There were no significant differences between unaffected relatives and control group in any of four categories of emotions. There were no significant differences between the patients, relatives and the control group in recognizing positive and neutral emotions, however, they had worse results in identifying negative emotions. Based on these study, it can be concluded that ToM deficits, including difficulties in recognizing facial affect, are associated with a family risk of psychosis, and could become an endophenotype useful in assessing the risk of illness in patients. However, the results obtained by unaffected siblings are not sufficient evidence to conclude that there is a continuity between ToM deficits and subclinical illness symptoms. A common etiology may underlie the coexistence of psychotic symptoms and cognitive impairment [16].

The study of cognitive functions related to ToM with the use of neuroimaging methods can be considered particularly interesting. The aim of a study from 2014 [17] was to test whether social deficits in schizophrenia can be at least partially explained by abnormal lateralization of the brain. The authors checked brain activity using MRI while performing Theory of Mind tasks and two tests of social competences. The *Test of Adaptive Behavior in Schizophrenia* (TABS) and *Social Skills Performance Assessment* (SSPA) were used. Three 14-person groups typical for this type of research participated in the study. Healthy participants had the strongest correlation between tests results and right hemisphere activity, while patients diagnosed with schizophrenia showed a correlation with left hemisphere activity. Results obtained by healthy siblings of psychotic patients were in the middle. These results support the hypothesis that schizophrenia is associated with impaired activity of the non-dominant hemisphere of the brain, responsible for the processing of socially relevant information, also related to ToM [17].

The research on the relationship between smoking marijuana as an epigenetic factor and the efficiency of social cognition processes was also conducted. Several previous studies have shown an improvement in the cognitive function of patients diagnosed with schizophrenia spectrum disorder using cannabis preparations. The aim of the study by Sánchez-Torres et al. [18] was to evaluate the cognitive processes in a group of patients suffering from schizophrenia and their healthy siblings during a 10-year follow-up. In the group of siblings, as in the group of ill people, cannabis use had a negative impact on the efficiency of cognitive processes – the speed of information processing and the efficiency of declarative memory. However, such a relationship was

not found in the control group. The diverse pattern of relationships between cannabis use and cognitive performance in the group of ill people, healthy siblings and the control group suggests a negative impact of the underlying illness on cognitive processes [18].

Facial emotion recognition

The ability to recognize emotions from facial expressions is an important part of social cognition. It is also being studied in patients with schizophrenia. Although there is ample evidence that such impairments are present in schizophrenia, the significance, nature and persistence of these deficits are still unclear. It is also unknown whether facial emotion recognition (FER) present in healthy siblings of people with schizophrenia may be a potential endophenotype of the illness [19].

One of the studies on this problem is a paper by Erol et al. [20] from 2010. The included 57 patients diagnosed with schizophrenia, 58 unaffected siblings and 58 controls. The three study groups did not differ significantly in terms of gender, age and education level. Groups were examined with the *Facial Emotion Identification Test* (FEIT), consisting of 19 black and white photographs of faces showing one of six emotions: happiness, sadness, anger, surprise, fear, shame (each of them is displayed for 15 seconds, with 10 seconds of blank screen in between), and *Facial Emotion Discrimination Test* (FEDT), consisting of 30 pairs of monochrome photos, each with two different people showing one/two of the six emotions depicted in the FEIT (the pairs are displayed for 15 seconds with 10 seconds of blank screen in between). The results obtained by patients in both the FEIT and FEDT tests were significantly worse than in the other two groups. Healthy siblings did better than the patients, however, significantly worse than the control group. The authors say this supports the thesis that FER is an endophenotype of schizophrenia [20].

The aim of another study [21] was to assess the relationship between the ability to recognize facial emotions and IQ in three studied groups: 52 schizophrenia patients, 55 unaffected siblings and fifty-one healthy controls. *Benton Facial Recognition Test* (BFRT), in which subjects are presented with a face and then they indicate which of the six test faces matches it, was used in the study. Another tool was the *Degraded Facial Affect Recognition Task* (DFAR), in which the subjects are presented with photos of 4 actors (2 men and 2 women) expressing specific emotions through facial expressions. *Wechsler Adult Intelligence Scale-III* (WAIS-R) and the *Global Assessment of Functioning Scale* (GAF) were also used. There were no significant differences between siblings and other participants in recognizing anger, but there was a trend towards an intermediate result between the other two groups. There were no significant differences between groups in recognizing happy facial expressions. The best recognizable emotions by all participants were happiness followed by neutral facial expression. Anger

and fear had the lowest percentage of correct answers. Analysis did not show any significant differences between siblings and controls in IQ and effectiveness of facial emotion recognition, but all the 3 groups revealed a dependency between the DFAR test results and intelligence quotient. The strongest correlation occurred in patients' siblings, then controls and patients diagnosed with schizophrenia. After adjusting for overall facial recognition (BFRT), the correlation between general IQ and overall DFAR performance remained significant in the sibling group. Such a revelation implies that there is a significant connection between FER abilities and overall IQ in unaffected relatives. In conclusion both these traits may appear to be potential early markers of schizophrenia spectrum disorders [21].

Facial emotion recognition impairment in psychotic patients and their healthy family have been discussed many times before. The authors agree that above-mentioned groups present significant deficits in this field [9, 22–24]. In a study from 2015 [22], both healthy relatives and patients with the first episode of schizophrenia showed significantly impaired ability to recognize facial emotions. The deficits mainly concerned fear recognition. A 2010 study [23] revealed significant differences between participants at family risk of psychosis and healthy people, showing that at risk people were more likely to recognize neutral facial expressions as negative. In an article from 2020, San et al. [24] tried to explain inability to recognize neutral facial expressions using neuroimaging. The authors observed brain functioning while performing *Social-Cognitive fMRI Task*. Study included patients with schizotypy and people with single-nucleotide polymorphism rs1344706 in ZNF804A, i.e., with recognized increased risk factors for schizophrenia. Hyperfunctioning of the right posterior superior temporal sulcus is an indicator of susceptibility to misinterpretation of neutral facial expressions and may turn out to be an endophenotype of schizophrenia [23, 26–28].

Irani et al. [25] observed the impairment of distinguishing facial emotions by the expression of the eyes. The study involved 10-person groups of patients with psychosis, healthy relatives and a similarly large control group. Patients needed more time and were less accurate in the *Mind in the Eyes Test* (MET) than their relatives, who performed worse than healthy controls. Moreover, people from risk groups had a much longer reaction time when performing tasks, regardless of the type of recognized emotion [25].

However, it is difficult to formulate a thesis regarding FER disorders in relatives of patients with schizophrenia, which is also indicated by the discrepancy in the results of various scientific studies on this subject. The aim of a study by Kelemen et al. [29] from 2004 was to demonstrate the social cognition deficits contained in the Theory of Mind in people with a family risk of schizophrenia. However, the emotion recognition test based on eye photographs showed no statistically significant differences between patients with schizophrenia, their close relatives and the control group. In a study from 2013 [31], researchers investigated disturbances in three domains included in

the *Social Cognition Scale* (SCS): recognition of emotions, style of attribution and social perception. The scale was previously described as a useful tool to assess social cognition deficits [30]. Patients' results were significantly worse compared to their relatives and the control group. However, results obtained by relatives and healthy controls did not differ [31].

The latest research on the above issues is a work from 2022 [32]. The study included 2,039 people suffering from schizophrenia, 2,141 healthy siblings and 2,049 controls. Facial emotion recognition (FER) was considered an intermediate phenotype, using two possible approaches that are indicators of the genetic background of schizophrenia: substitute genetic risk (family project) and polygenic risk score for schizophrenia (PRS-SCZ). The DFAR test (*Degraded Facial Affect Recognition Task*) and *Structured Interview for Schizotypy-Revised* (SIS-R) were used. Different association patterns were observed for individual emotions. DFAR scores were negatively associated with total SIS-R scores in the sibling group. However, no significant relationship was found between the DFAR and PRS-SCZ results. The conclusions drawn by the authors suggest that FER deficits may constitute an intermediate phenotype in terms of the substitute genetic risk [32].

Table 1. **Psychological assessment of the efficiency of social cognition in siblings of patients diagnosed with schizophrenia**

	Author, year of publication	Sibling group size	Methods of assessment of the efficiency of social cognition	Results
1	Cella et al. 2015 [7]	21	Social Scene Perception Test, Projective Imagination Test, Theory of Mind Vignettes, Facial Affect Identification Assessment.	Relatives have impaired Theory of Mind and social perception abilities, but not affect recognition
2	Ho et al. 2015 [8]	43	Faux Pas Test, Yoni test (Chinese version)	The relatives presented deficits in the second-order representation of Theory of Mind. In the Faux Pas Test – obtained results were intermediate between patients with schizophrenia and the control group
3	de Achával et al. 2010 [9]	20	Faces Test, Reading the Mind in the Eyes Test, Theory of Mind Stories Test, Faux Pas Test	The results revealed deficits in the second-order representation of Theory of Mind. In the Faux Pas Test – obtained results were intermediate between patients with schizophrenia and the control group

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4	Tikka et al. 2020 [13]	50	SOCRATIS (Social Cognition Rating Tool in Indian Setting)	There were no significant differences between relatives and the group at clinical risk of psychosis
5	Pentaraki et al. 2012 [14]	42	The False Belief Stories, The Revised Eyes Test	Relatives presented second-order Theory of Mind deficits
6	Pos et al. 2015 [15]	106	Psychosis Attachment Measure, The Conflicting Beliefs and Emotions	There were no significant differences between relatives and patients. The siblings presented less severe impairment of Theory of Mind stories understanding than the patients
7	Fett et al. 2013 [16]	1,017	Hinting Task, Degraded Facial Affect Recognition Task, Benton Facial Recognition Test	There were no significant differences between relatives and the control group in recognizing positive and neutral emotions
8	Erol et al. 2010 [20]	58	Facial Emotion Identification Test, Facial Emotion Discrimination Test	The results obtained by healthy siblings were intermediate between patients with schizophrenia and the control group
9	Andric et al. 2016 [21]	55	Benton Facial Recognition Test, Degraded Facial Affect Recognition Task	The relatives result of recognizing anger were intermediate between patients with schizophrenia and the control group. There were no significant differences between relatives and the control group in recognizing happiness
10	Allott et al. 2015 [22]	27	Facial Affect Recognition Task, The Prosody Emotion Recognition Task	Healthy relatives showed a significantly impaired ability to recognize facial emotions, mainly fear
11	Eack et al. 2010 [23]	70	Penn Emotion Recognition Test	Relatives more often incorrectly assigned negative emotions to neutral faces
12	Irani et al. 2006 [25]	10	Revised Mind in the Eyes Test (MET)	It was much more difficult for relatives than for controls to recognize emotions. They also needed more time to complete the task

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13	Kelemen et al. 2004 [29]	79	The Eyes Test	There were no significant differences between relatives and the control group
14	Rodríguez Sosa et al. 2013 [31]	21	Social Cognition Scale	There were no significant differences between relatives and the control group

Table 2. **The relationship between cognitive functions, clinical symptoms and social cognition in siblings of patients diagnosed with schizophrenia**

	Author, year of publication	Sibling group size	Methods of cognitive functions and clinical symptoms assessment	Results
1	Cella et al. 2015 [7]	21	Wechsler Adult Intelligence Scal, Letter Number Sequencing, Rey Auditory Verbal Learning Test, Visual Reproduction Test, Hayling Sentence Completion Task, Six Simplified Elements Test, Trail-making Test	Tests of executive functions, information processing speed and overall IQ results were lower in the sibling group
2	Ho et al. 2015 [8]	43	Letter-Number Span Test, Wechsler Memory Scale – Revised – Logical Memory and Visual Reproduction subtests, Sustained Attention to Response Task, Wisconsin Card Sorting Test	Relatives demonstrated cognitive deficits and their results were intermediate between the patients and the control group. Faux Pas recognition results were significantly correlated with impaired logical memory
3	de Achával et al. 2010 [9]	20	Positive And Negative Syndrome Scale, MMSE, Addenbrooke's Cognitive Examination, Frontal Assessment Battery, Facial Recognition Test	Cognitive performance assessed by the Addenbrooke's Cognitive Examination correlated with all measures of social cognition in healthy relatives, while those assessed by the Frontal Assessment Battery and Facial Recognition Test were associated with the Reading the Mind in the Eyes Test and the FauxPas Test.
4	Tikka et al. 2020 [13]	50	Positive and Negative Syndrome Scale, Trail-making test, Auditory verbal learning test, Letter number sequencing, visuospatial memory test, Wisconsin card sorting test, Tower of London Test	Relatives obtained significantly lower social perception results than the control group, even after adjustment with the results of neurocognitive tests

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5	Pentaraki et al. 2012 [14]	42	Stroop Task, Standard Progressive Matrices Test Plus	The presence of positive symptoms and intellectual efficiency have a significant influence on the secondary representations of the Theory of Mind in the sibling group
6	Pos et al. 2015 [15]	106	Wechsler Adult Intelligence Scale, Positive and Negative Syndrome Scale, Community Assessment of Psychic Experiences	Increased level of anxious attachment style was associated with greater cognitive deficits in Theory of Mind
7	Fett et al. 2013 [16]	1017	Wechsler Adult Intelligence Scale, Positive and Negative Syndrome Scale, Structured Interview for Schizotypy—Revised	The performance in the Hinting Task was significantly associated with subclinical signs of disorganization. The performance in the Degraded Facial Affect Recognition Task was significantly correlated with subclinical negative symptoms
8	Erol et al. 2010 [20]	58	Brief Psychiatric Rating Scale	In the sibling group, education was a significant predictor of the Facial Emotion Identification Test and Facial Emotion Discrimination Test results
9	Andric et al. 2016 [21]	55	Wechsler Adult Intelligence Scale, Global Assessment of Functioning	There are significant dependencies between the facial recognition ability and IQ in the sibling group
10	Allott et al. 2015 [22]	27	Positive and Negative Syndrome Scale, Structured Clinical Interview for DSM-IV, Number-Combination Test	There is no significant relationship between the fear recognition deficit and psychopathological symptoms
11	Eack et al. 2010 [23]	70	Wechsler Adult Intelligence Scale, Wisconsin Card Sorting Test, Continuous Performance Test – Identical Pairs version, Spatial Working Memory Test	Recognition of a neutral facial expression is significantly associated with less severe positive symptoms
12	Irani et al. 2006 [25]	10	Schizotypal Personality Questionnaire	Relatives with low level of social anxiety, limited affect and no close friends obtained the highest rates of schizotypy

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13	Kelemen et al. 2004 [29]	79	Mini – International Neuropsychiatric Interview Plus, Wechsler Adult Intelligence Scale	There were no significant differences between relatives and the control group
14	Rodríguez Sosa et al. 2013 [31]	21	Mini-Cog Test (MMSE Variant), The Positive and Negative Syndrome Scale (PANSS)	There were no significant differences between relatives and the control group

Discussion

Healthy, unaffected relatives of psychotic patients are in at-risk group, but the correlation has not yet been adequately studied. It is also still unknown how siblings of patients diagnosed with schizophrenia never develop mental illnesses in many cases. This knowledge could be very useful in creating a more complete theory of mental disorders. Identifying the deficits in people with a family risk of psychosis is a way to understand the mechanism of the illness. Research on this matter is usually based on comparing results obtained by 3 groups: (1) patients with schizophrenia, (2) their healthy sibling or relatives and (3) control group – healthy people with no family history of psychosis. Common limitation of the studies is a small size of the sample that does not allow to make relevant conclusions.

An important limitation is also the fact that almost all studies on social cognition in the group of healthy siblings of people suffering from schizophrenia are cross-sectional, which certainly makes it difficult to conclude about their relationship with the predisposition to the illlness and the presence of potential endophenotypic markers. One of the exceptions is the 2013 study [18] examining the effects of marijuana use on cognitive performance over a 10-year follow-up period.

Our review discusses two points of view of social cognition: theory of mind and facial emotion recognition. Presence of the theory of mind impairment may prove the genetic basis of psychosis burden. However, social cognition deficits cannot be linked with other symptoms of schizophrenia. It can also be assumed that they are only partially related to problems related to social cognition and psychotic symptoms. More research is needed to prove the relationship between ToM disorders, attachment style and lateral brain activity. It is necessary to focus on the functioning of the non-dominant hemisphere, which also affects the efficiency of the ToM functions. There seems to be no detailed and clear description of the deficits linking schizophrenia to ToM impairment, it may appear that these mechanisms are independent of cognitive abilities. These deficits seem to confirm the well-known and accepted thesis that schizophrenia is not an illness associated with the disability of

specific brain structures, but rather with disturbed coordination of various parts of the central nervous system.

Facial emotion recognition is associated with neurocognitive and social functioning. The results obtained by healthy siblings of people suffering from schizophrenia indicate the validity of the thesis about the endophenotypic importance of facial recognition disorders in schizophrenia. In conclusion, both ToM and FER deficits are important phenotypes in genetic research and potential clinical markers of schizophrenia spectrum disorders. However, it remains unclear whether the described deficit is associated with specific psychopathological symptoms and whether it is caused by improper coordination of the functions of various brain centers.

Patients with schizophrenia present the most severe impairment of above-mentioned functions, which is an undeniable fact. Results obtained by the unaffected relatives are usually in the middle between psychotic patients and healthy controls. This also applies to the relationship between the effectiveness of social cognition and the cognitive dysfunctions found in numerous studies and subclinical psychopathology of schizophrenia or schizotypy.

Conclusions

Schizophrenic patients present impairments in both areas of social cognition, theory of mind and facial emotion recognition. Healthy siblings of these patients also show some social cognition deficits, but less serious, usually in the middle between psychotic patients and healthy controls. This also applies to the efficiency of cognitive processes related to the effectiveness of social cognition. Researchers reveal some permanent, pathognomonic changes. Therefore, the assessment of which deficits are significant should be proceed with caution. Especially taking into account the prognosis of the functioning of healthy relatives or the assessment of their risk of developing the illness.

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Address: Rafał Łoś
Jan Kochanowski University of Kielce Collegium Medicum
e-mail: rafal.los@ujk.edu.pl