

The theory of mind in patients with psychotic disorder and its relation to executive function

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Grant: FPPV-35-2020

Název grantu: Detekcia teórie mysle - Metóda na hodnotenie sociálneho poznania (MASC)

Oborové zaměření: AN - Psychologie

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Abstract In the study, we focused on the theory of mind in patients with psychotic disorder and its relation to executive functions. The first part of the thesis consists of theoretical elaboration of key concepts, their definitions and their implementation to research. The research sample consisted of 30 patients diagnosed with schizophrenia or schizoaffective disorder. In the empirical part, we focused to description the theory of mind and executive functions in psychotic patients, as schizophrenia can be perceived as a disorder of mental states. Data are obtained via questionnaire method and evaluated quantitatively. For research, we have used standardized questionnaires - Clinical Global Impression Scale (CGI), the Stroop Test, and non-standardized mind-based verbal tasks. The results of the research have shown significant results.

Key words theory of mind, schizophrenia, schizoaffective disorder, executive functions

1. INTRODUCTION

To understand and explain a complex construct such as Theory of Mind, we need several scientific disciplines (Koukolík, 2006). During of life, the individual creates ideas about how the human psyche works. Based on his ideas, he is able to understand what is happening in the minds of others. This ability is used to estimate hidden intentions that are not directly expressed in speech. It is also used in assessing false beliefs and predicting the consequences of behavior. Delusion, imagining or sharing humor and using non-verbal gestures can only be achieved if the Theory of Mind (abbreviated ToM) is present as part of our social instinct (Corrigan et al., 2001, Frith et al., 2012, Doherty, 2009, Leslie, 2004). From the perspective of evolutionary psychology, we had to develop a mechanism that helped adaptation to the environment in which we live, at least as important as beliefs (Dunbar, 2009). Impaired ability to apply ToM is mainly associated with autism spectrum disorders - one who has a damaged module ToM is blind to the existence of other minds (School et al., 1999, Baron-Cohen, 2009). This deficit is not necessarily specific to autism (Frith et al., 1996, Pickup et al., 2001). New approaches to brain research in particular, they allow neuroimaging techniques (Kováč, 2008). Clinical processes are complex from a neuropsychological point of view and cannot be

attributed to certain structures and centers (Štulrajter, 2011). Clinical experience speaks of linking the activity of some areas to the right hemisphere (Koukolík, 2005). Its focal damage can lead to blunting of empathy, limiting the understanding of metaphors, irony or sarcasm. The activity of the frontal lobes contributes to the functions of the theory of mental states. Affecting the lower and inner surfaces of the frontal lobes is detrimental to social behavior and essentially changes personality. Injury of the right frontal lobe can damage the sense of humor, self-awareness, face recognition in the mirror, and episodic memory (Baron-Cohen, 2009, Štulrajter, 2011, Koukolík, 2005).

1.1 Mental representations

The concept of mental representation can be considered a synonym for psychic content. These are internal representations of the outside world or mental states and their modeling is based on semantic representation. Palmer (1978) developed a basic analysis of the concept of representation with application to cognitive psychology. The individual has the ability to create representations of external as well as his own internal events, the mental life of other people and interpersonal relationships.

Palmer (1978) pointed out the distinction between what is represented, who represents it, and what is contained in the representation. Based on this statement, we distinguish between representations of the first order, second, third to nth order. The basic attribute of the division of the mentioned representations, or also of the psychic contents, is the final form of the processed information. Sedláková (2002, in Plháková, 2004) divides mental representations as follows:

- A. First-order mental representations: they are the result of the processing of information coming from the outside world, they are often referred to as perceptions.
- B. Second-order mental representations: they are the result of a subjective reflection of psychic events (verbs as I think, I doubt, I believe).
- C. Third-order mental representations: they are the result of an effort to understand the mental life of other people (subjective opinions on what the other person thinks, feels, or experiences).

1.2 Schizophrenia and schizoaffective disorder

Schizophrenia is one of the most fascinating mental disorder and at the same time one of the most serious psychotic disorders. It is an endogenous psychosis with serious disturbances, particularly in the areas of emotion, thinking, action and personality (Kolibáš, 1996). Schizophrenia is a serious psychotic disorder affecting the ability to act and behave in accordance with the environment; changing external relations and relationships with people (Libiger et al., 2002). It is a disorder that affects human thinking, feeling and acting and decreases the quality of human life by causing an inability to satisfy the requirements of life roles (Libiger et al., 2002.). Among the basic features are ambivalence, unimportant emotions and thoughts, the release of thought flow. Symptoms of individual clinical forms of the disease are gradually present. Schizophrenia is the most devastating disease that is treated in psychiatry (Black et al., 2010). The symptoms of schizophrenia are so diverse that we look at its types rather than syndromes - a group of symptoms (Motlová et al., 2017). The disease is of a chronic nature and permanently damages the individual's personality as well as disqualifies the possibility of work and social employment. Mortality in schizophrenia is exceptional - 0.4 - 0.6%. Even in the first half of the 20th century, the prevailing opinion was that cognitive deficit in schizophrenia is not a primary symptom, but is related to the reduced motivation of patients in test examinations and positive symptoms. Later, it was believed to be an adverse side effect of typical antipsychotics (Tuma et al., 1999). With the development of new research methods, the occurrence of specific structural and functional changes in the brain of patients with schizophrenia has been confirmed and refined. The findings of damage to certain parts of the brain have made cognitive deficits to be seen as the primary symptom of schizophrenia (Gold et al., 1999, Green et al., 2000). In patients with schizophrenia, it is disrupted in the dorsolateral prefrontal cortex (Minzenberg, 2009). The presence of negative symptoms such as emotional dullness is associated with dorsolateral prefrontal cortex involvement. Impairment of cognitive functions also affects the social area of patients. Patients' social capacities are significantly lower than in healthy subjects and correlate with the severity of negative symptoms and cognitive deficit (Patterson et al., 2001).

The term schizoaffective psychosis refers mainly to a psychotic disorder with a mixture of schizophrenic affective symptoms. It is defined by both episodic disorders in which both affective and schizophrenic symptoms are at the forefront, so that the episode cannot be diagnosed as either schizophrenia, depressive episode or manic episode (Smolík, 1996).

1.3 Executive functions

The main deficit in schizophrenia in several patients is impairment of functions that control behavior through the use of will processes, attention regulation, the ability to plan and act purposefully and achieve a goal (Kučerová, in Preiss, 2006). Sharma and Harvey (2000) talk about the difficulties of patients with schizophrenia in tasks such as making plans or solving complex tasks. Tuma and Lender (1999) also justify the failure of management functions in planning, cognitive reconstruction, flexibility and abstraction skills. Dysexecutive syndrome is repeatedly diagnosed in patients with schizophrenia and is currently considered one of the major cognitive impairments. Goldman et al. (1992) report a reduced level of conceptualization and cognitive flexibility. Due to the complexity of the construction of executive functions, there is a relatively large inconsistency in the interpretation of the results of individual studies. The cause is a reduced level of analytical and anticipatory thinking (Morice and Delahunty, 1996), a deficit in the inhibition of

adverse reactions (Müller et al., 2004;) or an inability to remember the context (Stratta et al., 1998). In a meta-analysis of 40 fMRI studies, Minzenberg (2009) points to impaired activity in patients with schizophrenia in the dorsolateral prefrontal cortex, anterior cingulate cortex, and mediodorsal thalamic nucleus. Increased activity was found in other areas of the prefrontal lobe, which may have been compensatory in source.

1.4 Research problem

The individual is able to understand what is likely to happen in the minds of others based on their ideas. He uses his ability of understanding to estimate hidden intentions, to judge false beliefs, or to predict the consequences of behavior. This can only be achieved if ToM is present - one of the most important tools of social cognition (Corrigan et al., 2001). Schizophrenia is considered to be one of the most fascinating mental disorder and at the same time the most serious psychotic disorders. Schizophrenia can be perceived as a disorder of mental state representations and impaired mental ability is considered to be its central feature (Kolibáš, 1996). The main aim of the research is to determine the relation between the theory of mind and executive functions in psychotic patients and also to determine whether there is a relation between the severity of the illness and the state of executive functions.

1.5 Research questions

RQ1: Is there a statistically significant relation between the total score in the tasks of the theory of mind and the state of the executive function in patients with psychotic disorder?

RQ2: In which tasks of the theory of the mind do patients with psychotic disorder fail the most?

RQ3: Is there a statistically significant relation between first-order mind theory and the state of executive functions in patients with psychotic disorder?

RQ4: Is there a statistically significant relationship between second-order mind theory and the state of executive functions in patients with psychotic disorder?

RQ5: Is there a statistically significant relationship between severity of illness and state of executive function?

2. METHOD

2.1 Research Sample

The research sample consisted of 30 patients diagnosed with schizophrenia or schizoaffective disorder. The sample was obtained by deliberate selection. The condition in research sample was a diagnosis of F.20 schizophrenia or F.25 schizoaffective disorder according to diagnostic criteria MKCH-10. The diagnosis in both cases was made by the attending physician and psychologist. The second condition was that the respondent should be at least 18 years of age, the upper age limit was not set. 11 women and 19 men participated in the research. The data were collected between December 2018 and March 2019 in agreement with the local psychologists and the attending physician. Remission and chronicity of the disease were determined based on the judgment of the attending physician and psychologist according to research criteria routinely used in clinical practice.

2.2 Materials and apparatus

2.2.1 Word problems focused on the Theory of Mind

Word problems focused on the ToM are not a standardized method. Different types of tasks are used in the research. From a psychometric point of view, the diversity of tasks is often criticized because it is impossible to assess whether the same concept is measured by verbal tasks. For our research, we have selected stories from foreign research based on their availability. We have chosen 11 short stories to create a comprehensive set of tasks focusing on the theory of mind 1st and 2nd order, mental states and intentions of the actors and last but not least on metaphors. We adapted the names of the story's actors to the current situation. The translation of verbal tasks from English and their validity was determined by means of bilingual verification and Cronbach's alpha. The scoring was done according to the story authors. In tasks 1 - 4 the respondent got 1 point for the correct answer, the point for the wrong answer was not scored. The correct answer pointed to the presence of the 1st or 2nd order mind theory. In the 5th - 9th tasks, the respondent obtained 2 points for the correct answer if he referred directly to the mental state of the characters in the story - they think, believe, desire, or refer to their intention. Recognition of the correctness of the response proceeded directly according to the instructions of the authors. In tasks 10-11, the respondent earned 1 point for the correct answer if he pointed out that it was a metaphor, comparison, or game, and he did not get a point for the wrong answer.

2.2.2 CGI – The Clinical Global Impressions

Among the most used scales in psychiatry, we rank the Clinical Global Impressions (CGI). The standardized assessment scale contains three subscales - severity of illness, global improvement and efficacy index. On the first two subscales, the patient's condition is rated on a seven-point scale. The efficacy index contains a contention table with values from 1-16 (Guy, 1976). The result is the score obtained by the sum of points obtained in individual subscales. In our research, we used only the first subscale, severity of the illness, which we describe below. The patient's condition was assessed by the attending physician or clinical psychologist. 1. Severity of the illness - *Considering your total clinical experience with this particular population, how mentally ill is the patient at this time?* 0 = Not assessed 1 = Normal, not at all ill 2 = Borderline mentally ill 3 = Mildly ill 4 = Moderately ill 5 = Markedly ill 6 = severely ill 7 = Among the most extremely ill patients

2.2.3 Stroop test

The stroop test is a standardized method. It is a diagnostic method of executive functions. In addition to executive functions, it is able to detect cognitive conflict processing (Raz, Buhle, 2006), attention concentration effectiveness (Lezak et al., 2004), selective attention function (Strauss, Sherman, Spreen, 2006), cognitive control and speed of information processing (Boone et al., 1998). It is suitable for individuals from 15 to 90 years. The total length of administration is estimated at 5 minutes. The test is presented in paper form.

2.3 Procedure

Data are obtained via questionnaire method and evaluated quantitatively. Questionnaires were submitted to the respondents in printed form and were without time limit. Respondents were assured that the completion of the questionnaire was anonymous.

We used the statistical program SPSS 22 to process and analyze the obtained group data. To determine the relationships between the variables, we used non-parametric tests depending on the normality tests (Spearman's correlation coefficient).

3. RESULTS

Results of univariate descriptive analysis shows values deviates from -1 to 1, indicating that our data is not normally distributed population.

RQ1: Is there a statistically significant relation between the total score in the tasks of the theory of mind and the state of the executive functions in patients with psychotic disorder?

Table 1 : Spearman's correlation coefficient - total score of Tom, executive functions

Spearman's correlation coefficient		Executive functions
Total score ToM	r	0,60
	P	<0,001
	N	30

In the first research question, we determine whether there is a statistically significant correlation between the overall score of the theory of mind and the state of executive functions. For this purpose, we decided to use Spearman's correlation coefficient. As Table 1 shows, a statistically very significant ($p < 0.001$), strong, positive correlation ($r = 0.60$) between the overall score of the theory of mind and the state of executive functions has been demonstrated, which means as the value of the total score of the theory of mind increases, the level of executive functions increases too.

RQ2: In which tasks of the theory of the mind do patients with psychotic illness fail the most?

Table 2: Frequency table

Frequency table expressed in %			
	Failed	Neither failed nor failed	Did not fail
ToM 1	30%	13,3%	56,7%
ToM 2	26,7%	33,3%	40%
ToM ES	16,7%	53,3%	30%
ToM phys	23,3%	30%	46,7%
ToM meta	60%	26,7%	13,3%

Table 3: Frequency table

Frequency table expressed in %					
	Completely failed	Failed	Neither failed nor failed	Did not fail	Completely did not failed
ToM MS	50%	6,7%	13,3%	13,3%	16,7%

The next step in our statistical processing is to examine the level of failure in the individual dimensions of the theory of mind. As we can see, based on frequency tables 2 and 3 psychiatric patients failed the most in the dimensions of the theory of mind - metaphors (60%) and mental states (50%). In other variables they scored better, with 30% of probands failing in the theory of the first-order mind, 26.7% of probands in the theory of the 2nd-order mind, and only 16.7% in emotional states and 23.3% in all physical characteristics of all psychiatric patients. .

RQ3: Is there a statistically significant relation between first-order mind theory and the state of executive functions in patients with psychotic disorder?

Table 4: Spearman's correlation coefficient - score of Tom 1, executive functions

Spearman's correlation coefficient		Executive functions
Score ToM 1	r	0,82
	p	<0,001
	N	30

In research question 3, we decided to investigate a statistically significant relation between the theory of the 1st order mind and the state of executive functions, and this time Spearman's correlation coefficient was used. Based on Table 4, we claim that a statistically very significant ($p < 0.001$), strong, positive correlation ($r = 0.82$) between the theory of the 1st order mind and the state of executive functions was demonstrated. Which means that with the rising value of first-order mind theory, the level of executive functions also rises.

RQ4: Is there a statistically significant relation between second-order mind theory and the state of executive functions in patients with psychotic disorder?

Table 5: Spearman's correlation coefficient - score of Tom 2, executive functions

Spearman's correlation coefficient		Executive functions
Score ToM 2	r	0,72
	p	<0,001
	N	30

In the research question 4, we test a statistically significant correlation between the theory of the 2nd order mind and the state of executive functions. The value of the Spearman correlation coefficient indicates a strong, positive correlation ($r = 0.72$), which again proved to be statistically very significant ($p < 0.001$). Which means that with the increasing value of 2nd order mind theory, the level of executive functions also rises.

RQ5: Is there a statistically significant relation between severity of illness and state of executive function?

Table 6: Spearman's correlation coefficient - CGI severity of illness, executive functions

Spearman's correlation coefficient		Executive functions
CGI severity of illness	r	-0,75
	p	<0,001
	N	30

Research question 5 tests the relation between the severity of the illness and the state of executive functions. In this case, we can demonstrate a statistically very significant ($p < 0.001$), strong, negative ($r = -0.75$) correlation between illness severity and the state of executive functions. Thus, with the increasing severity of illness, the state of executive functions decreases.

4. DISCUSSION

4.1 Interpretation of results

In the study, we focused on the theory of mind in patients with psychotic disorder and its relation to executive functions. Firth (1996) attributes the disorders of formal thinking that are characteristic of schizophrenia to the inability to acknowledge the state of knowledge of other individuals. The presence of delusions, in turn, is associated with a dysfunction that makes it impossible to represent the thoughts, beliefs, and intentions of other individuals. Our results mostly support the literary and starting points of the studies. The main goal of the research was to determine the relationship between the theory of mind and executive functions in psychotic patients and also to determine whether there is a relationship between the severity of the disease and the state of executive functions.

One of the questions in our research was to verify the relation between executive functions and the theory of mind. In schizophrenia, there is a general impairment of cognitive functions and it was appropriate to examine their possible relation to the results in the tasks of theories of the mind. Because people with schizophrenia have general neurocognitive impairment, which causes lower scores in the theory of mind in psychotic patients compared to healthy populations.

We used the Stroop test to measure executive functions. The stroop test is a diagnostic method of executive functions. It is an explicitly statistical method that is easy to operate in data processing. In addition to executive functions, the Stroop test is able to detect cognitive conflict processing (Raz, Buhle, 2006), attention concentration efficiency (Lezak et al., 2004), selective attention function (Strauss, Sherman, Spreen, 1974), cognitive control and speed of information processing. (Boone et al., 1999). We were able to find a positive relation between executive functions and the theory of mind and also a very positive relation between the severity of the disease and the state of executive functions. We also noticed statistically significant differences between the theory of the 1st and 2nd order minds and the state of executive functions. functions and performance in the theory of mind. Impaired executive functions negatively affected patient performance. Executive functions are very necessary when using the theory of mind (Doherty, 2009). There are two syndromes of schizophrenia, a patient with positive symptoms and no cognitive deficits and a patient with predominant negative symptoms and cognitive deficits (Crow, 2006). Frith (1996), on the other hand, argues that impaired performance is also present in patients who have positive symptoms such as delusions and hallucinations, as they are overly attributed to incorrect

intentions. However, our results contradict those reported by Bozikas et al. (2011). In interpreting their results, they suggest the independence of the theory of mind from cognitive functions. They state that cognitive deficit in the case of schizophrenia is nuclear and is not a consequence of impaired cognitive functions. With similar results, Mazza et al (2011) support these claims. On the other hand, the emphasis on the relation between executive functions and the theory of mind has already been given by Ozonoff et al. (1991). Brune (2005) agrees with these claims, who does not think that schizophrenia has real mental impairment than autism. Brune (2005) and Harrington et al. (2005) state that the theory of mind is probably a deficit independent of cognitive functions, but that tasks on the theory of mind identify several components at once. In essence, we can find the relationship between the results in the tasks of the theory of mind and the executive functions as well as the result of the tasks of the theory of mind as such, ie the testing process. The individual tasks focused on the theory of the mind consist of stories that the patient must be able to read carefully, memorize and operate with information. Although the stories contained control questions focused on the factual data related to the story and thus checked whether the respondent was careful and remembered specific data from the story, the way the test is constructed is certainly not negligible. This, too, is a reflection of the psychometric problems involved in mind theory test.

These are also pointed out, for example, by e.g. Bora et al. (2009b). The dorsolateral prefrontal cortex is closely connected to the prefrontal cortex, which is in charge of analytical-synthetic thinking. Stories require analysis and subsequent synthesis to answer questions correctly. Possible causes are the fact that a patient with a psychotic illness has a reduced level of analytical and anticipatory thinking (Morice and Delahunty, 1996), a deficiency in the inhibition of adverse reactions (Müller et al., 2004;) or an inability to remember the context (Stratta and et al., 1998). In the tasks of the theory of mind, as mentioned above, the patient with a psychotic illness must understand the abstraction by his own abstraction, and the executive serves this purpose. That is why it is appropriate to choose a method that directly measures the level of executive functions, as we have done in our research.

4.2 Limits

Our work has several limits. Working with psychiatric patients is extremely difficult to work on. Not every person with mental illness is willing to participate in research of this type. In some questionnaires there were answers that were only marked with a cross. The fact is that psychotic patients have weakened will properties. Reduced effort could translate into the actual test results. We cannot generalize the results of our research to the entire population as our sample of psychotic patients consisted of only 30 patients diagnosed with schizophrenia or schizoaffective disorder. We cannot judge the ability to measure stories by themselves, even if the stories contained control questions focused on factual data, the way the test is designed is certainly not negligible. The heterogeneity of tasks can also indicate a psychometric problem. The reflection of psychometric problems related to mind-testing tests would be advisable to consult with a specialist, as we do not yet have many years of experience.

4.3 Future intentions and practical application

An interesting question for future research is whether patients with psychotic illness fail only to solve the research tasks themselves, or if the deficit in the theory of the mind manifests itself in everyday life. If, in the future, we continue to focus on the study of mind

theory in patients with psychiatric diagnosis, it would be interesting to compare the presence of diagnosis. Research (Fiszdon, 2012, Mazza et al., 2001) points to impaired ability to apply mind theory to patients with bipolar disorder, and the findings illustrate the assumption of some common mechanism between bipolar disorder and schizophrenia. Another interesting area would be to find out what differences exist in executive functions in a healthy and psychotic population.

We are currently working on research with psychotic patients and patients with bipolar disorder. We focused on the theory of the mind and its relation to emotions, and we also examine the cognitive style of patients. We believe that this will bring us interesting results, which we will be able to present in further studies.

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