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METAPHOR PROCESSING IN SCHIZOPHRENIA PATIENTS: A STUDY OF COMPREHENSION AND EXPLANATION OF METAPHORS

The study assessed the quantity and quality of errors made by schizophrenia patients in understanding and interpretation of the same metaphors, to evaluate metaphor understanding and explanation depending on the type of presentation material, and to analyze the correlation of illness symptoms with metaphor comprehension and explanation. Two groups of participants were examined: a schizophrenia sample (40 participants) and a control group (39 participants). Metaphor processing was assessed by the subtests of the Polish version of the Right Hemisphere Language Battery (RHLB-PL). The patients were also evaluated with the Positive and Negative Syndrome Scale (PANSS). Schizophrenia patients scored significantly lower in explanation of metaphors, making more incorrect literal and abstract mistakes or providing no answer more frequently. No differences were observed in understanding metaphors; no correlation between symptoms and metaphor processing was obtained. In both groups, picture metaphors were easier to comprehend and written metaphors were easier to comprehend than to explain.

*Key words:*schizophrenia, metaphor explanation, pragmatics, metaphor comprehension

Introduction

Schizophrenia (SZ) is a major psychotic disorder that may result in some combination of hallucinations, delusions, and extremely disordered thinking and behaviour that impairs daily functioning, and can be seriously disabling (Owen, Sawa, & Mortensen, 2016; Parnas, 2011; van Os & Kapur, 2009). Impaired cognition (Kurtz & Marcopulos, 2012) as well as language deficits are also

the main features of this disease (Andreasen, 1979c; Andreasen, Arndt, Alliger, Miller, & Flaum, 1995; Kuperberg, 2010a, 2010b; Pawełczyk, Kotlicka-Antczak, Łojek, Ruszpel, & Pawełczyk, 2017). The most obvious clinical manifestation of language impairments are: disorganized and unintelligible speech, with tangentiality, derailment, incoherent speech, perseveration, and echolalia or “poverty of speech” being frequently observed (Andreasen, 1979). Some of these dysfunctions are seen in the early stages of SZ and their recognitions have been very important in SZ research since many symptoms of the illness are expressed in terms of language (Kuperberg, Kreher, Goff, McGuire, & David, 2006) or are direct language dysfunctions themselves (Andreasen, 1979a, 1979b, 1979c).

As far as language disturbances in SZ are concerned, it is known that patients with this disease generally have difficulty processing semantic aspects of language (Anand, Wales, Jackson, & Copolov, 1994; Blaney, 1974; Nestor et al., 2001; Paulsen et al., 1996), combining semantic and syntactic information (Condray, Steinhauer, Cohen, van Kammen, & Kasperek, 1999; Condray, Steinhauer, van Kammen, & Kasperek, 2002; Sitnikova, Salisbury, Kuperberg, & Holcomb, 2002; Thomas, King, Fraser, & Kendell, 1990), creating lexico-semantic associations (Salisbury, O'Donnell, McCarley, Nestor, & Shenton, 2000; Salisbury, Shenton, Nestor, & McCarley, 2002; Sitnikova et al., 2002; Titone, Levy, & Holzman, 2000), and accessing and using lexical knowledge (McKenna & Oh, 2005). They also exhibit deficits in verbal fluency, especially in category fluency (Bokat & Goldberg, 2003; Kremen, Seidman, Faraone, & Tsuang, 2003). Higher order language functions, such as humor and irony, understanding discourse and metaphor processing, and prosody are believed to be disturbed in SZ patients as well (Kuperberg, 2010a, 2010b; Pawełczyk, Kotlicka-Antczak, Łojek, Ruszpel & Pawełczyk, 2017). Also, impairments of pragmatic language are observed in very early stages of the disease: in people in an at-risk mental state and in first episode of the illness (Pawełczyk, Kotlicka-Antczak, Łojek, & Pawełczyk, 2017). Despite language problems described above, patients retain the ability to read and spell single words, and master vocabulary skills, such as naming (Elvevag et al., 2002; McKenna, Mortimer, & Hodges, 1994; Townsend, Malla, & Norman, 2001).

One of the aspects of higher order language/pragmatic skills is the ability to process metaphors. They are a form of figurative language and refer to words or expressions that mean something different from their literal definition. In its basic form a metaphor consists of two concepts, the tenor and the vehicle, and follows the pattern “A is B,” as in the most frequently used example - the Shakespeare quote “Juliet is the sun” (Gibbs, 2006, 46). Adequate understanding of metaphors requires cognitive operations enabling a shift from direct to the indirect level of encoding and decoding (Sperber, 2002). During communication process, when using a metaphor, the speaker is conveying only the metaphorical meaning. The hearer's task is to figure out what the speaker meant from what he said, given that the context makes it clear that the two are different, and that in that

context the sentence meaning is faulty. This decoding process entails the hearer processing the literal meaning of the utterance to a sufficient extent first, so as to determine whether or not it is compatible with the context. If it is not, the hearer has to engage in further processing to determine the utterance meaning (Searle, 1993).

There is evidence implying that these processes of encoding and decoding metaphor meaning are disturbed in SZ patients (Bryan, 2014; Kuperberg, 2010a, 2010b; Mitchell & Crow, 2005). It was observed that patients with SZ make rather literal than figurative interpretations (Brune & Bodenstein, 2005; Chapman, 1960; Elveg, Helsen, De Hert, Sweers, & Storms, 2011; Kiang et al., 2007). Although this was not so in a study by Iakimova, Passerieux, Laurent, and Hardy-Bayle (2005), in which the authors showed that SZ patients were rather impaired in interpreting the semantic context of sentences, both figurative and literal, rather than showing a specific deficit in metaphor processing. In some other studies, patients with SZ were found to have difficulty in judging if a sentence represented a plausible or implausible metaphor (Corcoran, 1999), in choosing the metaphor that matches the meaning of a proverb (de Bonis, Epelbaum, Deffez, & Feline, 1997) or in assessing whether a metaphor is appropriate to a given situation (Langdon, Davies, & Coltheart, 2002). What is more, when choosing a picture that represented the meaning of a metaphor, the patients preferred the literal meaning (Anand et al., 1994). They also had difficulty creating a metaphor by selecting a word from a selection of alternatives (Drury, Robinson, & Birchwood, 1998). Mossaheb et al. (2014) showed that patients with SZ-spectrum disorders exhibit impairments in the recognition and paraphrasing of conventional metaphors and in the generation of novel metaphors, however, cognitive functions as well as negative symptoms might have influenced the results of this study. Patients with SZ also showed reduced comprehension of both novel and conventional metaphors in a study by Mashal, Vishne, Laor, and Titone (2013).

In recent studies with SZ subjects, it has also been shown that the interpretation of metaphors also requires not only semantic and syntactic information, but also nonlinguistic abilities such as the appreciation of other mental states (a theory of mind, Mo, Su, Chan, & Liu, 2008). What is more, comprehension of metaphors may as well be influenced by the salience of idiomatic meaning (familiarity, conventionality, and frequency of use), verbal intelligence quotient (IQ), and thought disorder (Iakimova et al., 2010) in that group of subjects. Interestingly, however, IQ and verbal IQ did not explain the deficit of metaphor comprehension in remitted SZ patients (Mo et al., 2008). Although other aspects apart from the linguistic one may influence the comprehension of metaphors, there is evidence that impaired access to semantic knowledge plays an important role in SZ (McKenna et al., 1994; Paulsen et al., 1996). Some studies provide evidence of impaired proverb comprehension in SZ (Brune & Bodenstein, 2005; Rapp, Langohr, Mutschler, & Wild, 2014).

Many studies have shown that metaphor comprehension is disturbed in SZ patients in various stages of the illness (Bryan, 2014; Mashal et al., 2013; Mossaheb et al., 2014; Pawełczyk, Kotlicka-Antczak, Łojek, Ruszpel, et al., 2017; Pawełczyk, Kotlicka-Antczak, Łojek, & Pawełczyk, 2017). It was also suggested that comprehension of metaphors may not differentiate patients from controls, however, the ability to explain these metaphors may (Pawełczyk, Kotlicka-Antczak, Łojek, Ruszpel, et al., 2017). There are few studies which also indicated an influence of negative symptoms on metaphor comprehension (Mossaheb et al., 2014) and an influence of thought disorder on metaphor understanding (Iakimova, Passerieux, & Hardy-Bayle, 2006). However, to the best of the authors' knowledge, there is a dearth of research analyzing mistakes made by schizophrenia subjects when explaining metaphors, most of papers describe only literal interpretations. Furthermore, studies on metaphor processing rarely take into account the presentation material and analyzed content of utterances. Hence, the aim of the present study was twofold. First, to compare quantity and quality of errors made by SZ subjects in understanding and interpretation of metaphors with healthy control participants, and to evaluate metaphor understanding and explanation depending on the type of presentation: picture versus written in both assessed groups. Second, to analyze correlation of SZ symptoms with metaphor comprehension and explanation.

Material and methods

Participants

Seventy-nine participants were enrolled: a SZ sample consisting of 40 subjects and a control group of 39 subjects. The members of the SZ group met the ICD-10 criteria for SZ and were considered clinically stable by their physicians, that is, they had been on the same oral antipsychotic therapy for the treatment of SZ with a change in the Clinical Global Impression-Severity (CGI-S, Guy, 1976) score of ≤ 1 for six or more weeks prior to enrolment. The mean duration of illness was 3.89 years (range of minimum one year and three months, maximum seven years). The severity of illness was evaluated with the PANSS (Positive and Negative Syndrome Scale, Kay, Fiszbein, & Opler, 1987; Rzewuska, 2002), which was administered by a specialist psychiatrist. The background antipsychotic therapy and concomitant medications were chosen and titrated according to the Polish standards of pharmacotherapy of mental disorders (Jarema, 2015). Daily doses of antipsychotics used were converted into chlorpromazine equivalents using an equivalency table provided by Gardner, Murphy, O'Donnell, Centorrino, and Baldessarini, 2010.

The inclusion criteria for healthy controls were no psychiatric history and no family history of psychiatric illness. They were confirmed mentally healthy after an evaluation using a Polish version of the Mini International Neuropsychiatric Interview (M.IN.I., Sheehan et al., 1998). The exclusion criteria

for all participants were as follows: a history of neurological or chronic somatic disorder, head injury, or alcohol or substance abuse or dependence. The groups were matched according to age, sex, and education. All participants were native speakers of Polish, Caucasian, and of Polish ethnicity. Demographic information for all participants and clinical information for patients can be found in Table 1 and more detailed data can be found elsewhere (Pawełczyk, Kotlicka-Antczak, Łojek, Ruzpel, et al., 2017).

Procedure

All of the participants were tested during one session with a clinical neuropsychologist. Processing of metaphors was assessed by four subtests of the Polish Version of the Right Hemisphere Language Battery (RHLB-PL, Łojek, 2007): Written Metaphor (WM), Picture-Metaphor (PM), Written Metaphor Explanation (WME), and Picture Metaphor Explanation (PME). In the WM test, the examinee listens to a metaphorical sentence and is asked to choose the correct explanation from three sentences representing possible meanings: the correct metaphorical, a literal, and an inappropriate meaning. The subject is then asked to give his or her own interpretation of the metaphor and the answers are classified as correct, abstract incorrect, or concrete incorrect (the WME test). In the PM test, a participant is asked to point to the picture that matches the meaning of the metaphor read by the examiner. Each set comprises four pictures representing the correct metaphorical meaning, the literal meaning, and two controls, each depicting one aspect of the sentence. This test also measures the accuracy of the examinee matching the metaphor to its correct meaning. The subject is then asked to give his or her own interpretation of the metaphor and the answers are classified as correct, abstract incorrect, or concrete incorrect (the PME test).

In addition, SZ patients were assessed with the PANSS (Kay et al., 1987; Rzewuska, 2002), which evaluates positive and negative symptoms, measures their relationship to one another, and to global psychopathology. It constitutes four scales measuring positive and negative symptoms, their differential, and the general severity of illness.

All participants gave their informed consent prior to their inclusion in this study. The study received approval from the Ethical Committee of the Medical University of Lodz and was performed in accordance with ethical standards laid down in the Declaration of Helsinki.

Statistical Analysis

Descriptive statistics were used to characterize the demographic and clinical data of the study sample. Statistical analyses included descriptive and inference methods. Since distributions assessed with the Shapiro–Wilk test revealed significant discrepancies from the normal range, nonparametric techniques were used. Both between-groups and within-group differences were assessed.

The Wilcoxon signed-rank test was used to compare within-group differences in metaphor processing while the Mann–Whitney test was used to assess differences in between-groups processing of metaphors. To assess the relationships between severity of illness and metaphor processing, the tau b correlation coefficient was calculated. Relationships between qualitative variables were assessed using the Chi-squared test. A significance level of .05 was used for all statistical tests, and two-tailed tests were applied.

Results

Demographic and Clinical Characteristics

Demographic and clinical characteristics are summarized in Table 1.

Table 1. Clinical and Demographic Characteristics of the Study Population

	Healthy controls (<i>n</i> = 39)	Schizophrenia patients (<i>n</i> = 40)	<i>p</i>
Age (years), <i>Mean (SD)</i>	26.25 (10)	26.30 (9.3)	.910 ^a
Sex (male), <i>n (%)</i>	23 (58.9%)	23 (57.5%)	1.0 ^b
Right – Handedness, <i>n (%)</i>	38 (97.4%)	38 (95%)	1.0 ^b
Education (years), <i>Mean (SD)</i>	12.3 (2.2)	12.02 (2.6)	.751 ^a
Illness duration (years), <i>Mean (SD)</i>	N/A	3.89 (4.7)	-
PANSS – Positive, <i>Mean (SD)</i>	N/A	13.9 (3.23)	-
PANSS – Negative, <i>Mean (SD)</i>	N/A	19.4 (3.8)	-
PANSS – General, <i>Mean (SD)</i>	N/A	35.1 (5.6)	-
PANSS – Total, <i>Mean (SD)</i>	N/A	68.4 (9.9)	-
CPZ equivalent dose, <i>Mean, (SD)</i>	N/A	343.16 (143.26)	-

Note: PANSS = Positive and Negative Syndrome Scale; *p* = two-tailed asymptotic probability value (*p*-value); *n* = number of participants; *SD* = standard deviation; N/A = not applicable or not assessed; CPZ = chlorpromazine; a = *p*-value for Student's-t test; b = *p*-value for Chi2 test.

No significant differences were observed in age, education, sex, and handedness between the groups, although there was a significant difference in employment.

People with SZ were more likely to be “people receiving disability benefits” than the healthy controls ($\chi^2 = 8.72$; $p = .013$).

Correlation Between PANSS and Metaphors’ Tests

Correlations are presented in Table 2.

Table 2. Strength of Relationships Between PANSS Scores and Metaphor Processing Tests in Schizophrenia Participants $n=40$; Table contains tau-b Correlation Coefficients and p -values

Test	PANSS			
	Positive	Negative	General	Total
Picture Metaphor Test	0.02 ($p = .875$)	0.046 ($p = .714$)	-0.002 ($p = .990$)	0.024 ($p = .845$)
Written Metaphor Test	-0.213 ($p = .111$)	-0.076 ($p = .571$)	-0.246 ($p = .064$)	-0.257 ($p = .051$)
Picture Metaphor Explanation Test	0.070 ($p = .559$)	0.211 ($p = .078$)	0.026 ($p = .830$)	0.081 ($p = .490$)
Written Metaphor Explanation Test	0.032 ($p = .792$)	0.016 ($p = .895$)	-0.162 ($p = .176$)	-0.064 ($p = .591$)

Note: PANSS = Positive and Negative Syndrome Scale, p = two-tailed asymptotic probability value (p -value) for tau-b correlation coefficients.

No significant correlations were obtained between metaphor comprehension and explanation tests. There was a tendency towards a correlation between WM test and Total PANSS ($p = .051$).

Group Differences in the Metaphors Processing, Comparison of Mistakes Made by SZ and HC Groups

The results showed that the SZ patients scored significantly lower than the healthy controls in WME and PME tests, and no differences were found between the groups regarding WM and PM tests (Pawełczyk, Kotlicka-Antczak, Łojek, Ruszpel, et al., 2017). Statistical analysis of correct and incorrect answers revealed significant differences in explanation of both picture (PM) and written (WM) metaphors. The SZ group obtained significantly lower scores in correct metaphorical answers, higher number of both literal and abstract incorrect answers, and number of unexplained metaphors. Results are presented in Table 3.

Intragroup Comparisons of Metaphor Processing

Significant differences were obtained between WM versus PM and WM versus WME in both evaluated groups, with higher scores in PM and WM, respectively. In the SZ group, differences between PM versus PME, with higher scores in PM, were also observed. There were no differences in comparison of WME versus PME. The results are presented in Table 4.

Table 3. Differences in Metaphor Processing Between Study Groups

Test, Subscale	Group	Descriptive statistic Mean (SD)	<i>U</i>	<i>Z</i>	<i>p</i>
Written Metaphor Test	SZ	8.950 (1.708)	677.5	-1.152	.248
	HC	9.512 (0.790)			
Correct metaphorical answers	SZ	8.950 (1.708)	677.5	-1.152	.248
	HC	9.512 (0.790)			
Literal answers	SZ	0.900 (1.645)	722.0	0.664	.506
	HC	0.461 (0.755)			
Inappropriate meaning	SZ	0.150 (0.483)	721.0	1.359	.174
	HC	0.025 (0.160)			
Picture Metaphor Test	SZ	9.825 (0.712)	740.5	-1.006	.314
	HC	9.974 (0.160)			
Correct metaphorical answers	SZ	9.825 (0.712)	740.5	-1.006	.314
	HC	9.974 (0.160)			
Literal answers	SZ	0.075 (0.349)	760.5	0.562	.573
	HC	0.026 (0.160)			
Inappropriate meaning	SZ	0.100 (0.441)	741.0	1.387	.165
	HC	0.000 (0.000)			
Written Metaphor Explanation	SZ	7.425 (1.824)	336.0	-4.468	<.001
	HC	9.102 (1.071)			
Correct metaphorical answers	SZ	7.425 (1.824)	336.0	-4.468	<.001
	HC	9.102 (1.071)			
Literal incorrect	SZ	0.400 (0.744)	583.5	3.082	.002
	HC	0.026 (0.160)			
Abstract incorrect	SZ	1.900 (1.565)	461.5	2.437	.015
	HC	0.846 (1.065)			
Lack of the answer	SZ	0.275 (0.598)	642.5	-4.050	<.001
	HC	0.026 (0.160)			
Picture-Metaphor Explanation	SZ	7.525 (1.825)	378.0	-4.191	<.001
	HC	9.128 (1.005)			
Correct metaphorical answers	SZ	7.525 (1.825)	364.0	2.251	.024
	HC	9.128 (1.005)			
Literal incorrect	SZ	0.350 (0.802)	641.5	3.065	.002
	HC	0.051 (0.223)			
Abstract incorrect	SZ	1.900 (1.661)	478.5	3.065	.002
	HC	0.821 (0.223)			

Table 3. Differences in Metaphor Processing Between Study Groups

Test, Subscale	Group	Descriptive statistic Mean (SD)	<i>U</i>	<i>Z</i>	<i>p</i>
Lack of the answer	SZ	0.225 (0.479)	624.0	2.916	.004
	HC	0.0 (0.0)			

Note: SZ = schizophrenia; HC = healthy controls; *M* = Mean; *SD* = standard deviation; *U* = Mann-Whitney *t* test statistics; *Z* = standardized value for the Mann-Whitney test statistics; *p* = two-sided asymptotic probability value; significant differences between groups are underlined.

Table 4. Intragroup Comparisons of Metaphors Comprehension and Explanation Tests

Compared tests	Group	<i>Z</i>	<i>p</i>
WM vs PM	SZ	3.179	.001
	HC	3.179	.002
PM vs PME	SZ	4.041	.000
	HC	1.932	.054
WM vs WME	SZ	4.859	.000
	HC	3.919	.000
WME vs PME	SZ	0.444	.657
	HC	0.168	.867

Note: WM = Written Metaphor Test; PM = Picture Metaphor Test; WME = Written Metaphor Explanation Tests Test; PME = Picture Metaphor Explanation Test; *Z* = standardized value for Wilcoxon signed-rank test; *p* = two-sided asymptotic probability value; significant differences are underlined.

Discussion

The study examines the differences in metaphor processing between SZ patients and a control group, and the influence of SZ symptoms on this ability. The SZ group had worse outcomes than the controls in interpretation of picture and written metaphors. They showed impaired ability to produce abstract explanations of metaphors, making significantly more inadequate (literal or abstract incorrect) explanations, or did not provide an explanation for both written and picture metaphors, though patients and controls performed equally in understanding written and picture metaphors. Both groups were less able to understand written than picture metaphors and explain written metaphors than understand them. Additionally, the patients showed impaired capacity to produce explanation of picture metaphors compared to picture metaphor understanding.

There was no difference in picture and written metaphor interpretations between the groups. No association between SZ symptoms and metaphors processing was found.

However, some limitations of the study should be noted. The sample size was small and the study group was not homogeneous with regard to the onset of psychosis, the duration of the illness, or the identification and dosage of medication. As no recordings of premorbid IQ or other cognitive functions, especially semantic memory and executive functions which might influence the processing of metaphors results, were made (Kuperberg, 2010b), it is not clear whether the differences between the two groups are only due to processing of metaphors dysfunctions rather than global cognitive deficits or decreases in executive and cognitive function.

Our general hypothesis, that SZ patients differed from normal controls regarding processing of metaphors, is partly consistent with previous findings which show disturbances both in metaphor comprehension and explanation (Bryan, 2014; Elvegag et al., 2011; Mashal et al., 2013; Mitchell & Crow, 2005; Mossaheb et al., 2014). In our study, the SZ patients matched a metaphor correctly with a sentence explaining it or a picture presenting the meaning, however, they were unable to explain these metaphors. The preserved ability to understand metaphors, both picture or written, was inconsistent with previous research (Anand et al., 1994; Corcoran, 1999; de Bonis et al., 1997; Langdnon et al., 2002; Mossaheb et al., 2014), however, as the authors discussed elsewhere (Pawełczyk, Kotlicka-Antczak, Łojek, Ruszpel, et al., 2017; Pawełczyk, Kotlicka-Antczak, Łojek, & Pawełczyk, 2017), it is possible that the matching test was too easy or that patients show impairments in the access and use of lexical knowledge (McKenna et al., 1994) and disorganization in semantic information retrieval (Paulsen et al., 1996) which might have influenced the process of metaphor interpretations. It could also be hypothesized that disturbances of executive functions, attention, processing speed, or working memory (Bang et al., 2015; Kurtz & Marcopulos, 2012), which were not measured in the study, might have a greater influence on expressive language than comprehension. In addition, patients' speech could have been dominated by associations between words or by difficulty in building up sentence context, leading to incoherence within and across sentences, and unintelligible and unpredictable speech (Kuperberg, Ditman, Kreher, & Goldberg, 2009), which disturbed the process of metaphor explanation. Additionally, expressive language might have also been impaired by the side-effects of medication, or comprehension may have been improved by influence of medication (Kramer, Rauber-Luthy, Kupferschmidt, Krahenbuhl, & Ceschi, 2010; Sestito & Goldberg, 2012). However, these hypotheses require verification in future studies.

Furthermore, the SZ group fell behind the controls in interpretation of picture and written metaphors and they showed impaired ability to produce abstract explanation of metaphors, making significantly more inadequate (literal

or abstract incorrect) explanations or providing no explanation. Our results are coherent with those obtained by Chapman (1960), Brune and Bodenstein (2005), Kiang et al. (2007) and Elvevag et al. (2011) which indicate that SZ patients make rather literal than figurative interpretations. Additionally, our research showed that SZ participants also produced more abstract incorrect explanations or more frequently gave no explanation than controls. These types of mistakes might be due to disturbances in: executive functions, processing speed, working memory, or theory of mind (Kurtz & Marcopulos, 2012; Mo et al., 2008; Scherzer, Leveille, Achim, Boisseau, & Stip, 2012) as well as a result of language production impairments (see above, Kuperberg et al., 2009; Kuperberg, 2010a).

The meaning of incorrect explanations provided by the patients after they chose a correct answer in WM or PM tests have also been analyzed. In some cases, SZ patients did not provide any interpretation of metaphor, instead they said, for example:

“I don’t know”, “Hard for me to get my thoughts together” (in Polish: “*nie wiem, trudno zebrać myśli*”)

which might have been a result of cognitive, executive, or language limitations enabling to describe the meaning of metaphor.

In addition, as described in other studies (see above), SZ subjects gave literal interpretations like:

“To have a face like a raspberry” (in Polish: “*Mieć buzię jak malina*”) “To have colorful mouth, head, face, mouth red” (in Polish: “*mieć kolorowe usta, głowa, usta, twarz czerwone*”)

We also noted explanations, which suggested difficulties with emotion descriptions, for example, a lowered ability to refer to sadness or regret:

“To receive the news with a heavy heart”(in Polish: “*Przyjąć coś z ciężkim sercem*”) – “it is not quite accepted, such situation is demanding, one is adjusting”(in Polish: “*nie do końca się akceptuje, ale taka sytuacja wymaga, się to przystosowuje*”)

In addition, the studied patients could reveal their own associations, individual understanding of situation linked with the metaphor, as well as refer to the information hidden in the context of the particular metaphor:

“Do not let his eyes be lathered”(English metaphor: Do not let pull the wool over one’s eyes) – “do not let yourself be annoyed, walk over some one, talk nonsense” (in Polish: “*Nie pozwolić sobie mydlić oczu*” - “*nie pozwolić sobie dokuczać, wejść na głowę, gadać bzdury*”)

Additionally, both evaluated groups, SZ and controls, were less able to understand written than picture metaphors and explain written metaphors that understand them. The results suggest that visual metaphors were easier to process than verbal ones, which might be a result of picture-superiority effect (Defeyter, Russo, & Partlin, 2009) indicating better recalling of visual information. This, according to Paivio (1991), appears due to visual information processing via two separate pathways, image and verbal, which strengthens the process of encoding.

Another explanation of the advantage of visual material over verbal might be that pictures have more attention-inducing qualities than words (Mashal & Kasirer, 2012). In addition, perceptual metaphor comprehension is supposed to develop earlier in life than verbal (Gentner, 1988; Mashal & Kasirer, 2012; Winner, Rosenstiel, & Gardner, 1976) and as such may be mastered earlier and for longer time. Additionally, our study shows that comprehension of written metaphors is easier than their explanation for both groups of participants, which might be hypothesized as a consequence of generally easier language comprehension than production. In most domains of language development, the comprehension of spoken language is established much earlier than the active production (Benedict, 1979) so it may suggest that these processes, although they interweave (Pickering & Garrod, 2013), are not of same difficulty. Furthermore, producing a metaphor explanation might engage more cognitive and executive functions than comprehension and application of meanings, semantics might be more demanding than just comprehending them. A recent fMRI study of language comprehension and production (Lidzba, Schwilling, Grodd, Krageloh-Mann, & Wilke, 2011) showed that language comprehension is represented more bilaterally than language production, and, most frequently, there is a hemispheric dissociation with left-hemispheric language production. Hence, it could be hypothesized that to explain metaphors, one has to comprehend and then interpret them, so one has to engage more brain regions. However, to the best of the authors' knowledge, there is no research evaluating metaphors understanding and explanation depending on the type of presentation, picture versus written, in both healthy populations and SZ groups, so there are no studies to compare our results with.

We also obtained results showing no correlation between SZ symptoms, measured with PANSS, and metaphor comprehension and explanation. There was only a tendency towards a correlation between WM and Total PANSS which might suggest that more SZ symptoms correlate with worse written metaphor understanding. These results are inconsistent with previous findings, which, although very limited, showed association of negative symptoms with metaphor comprehension (Mossaheb et al., 2014) and severity of the formal thought disorders with interpretation of metaphors (Iakimova et al., 2006). These differences might have appeared due to different methods of metaphor processing evaluation or socio-demographic differences between assessed participants. Nevertheless, association between SZ symptoms and metaphor processing requires more research.

It would be beneficial to accurately evaluate dysfunctions of metaphorical thinking in SZ patients as clinical disturbances of metaphor processing can influence their everyday life, they may impact social and school/vocational functioning especially negatively by disturbing communication, reasoning, and understanding of the world (Lakoff & Johnson, 2003). While the metaphor subtests of the RHLP-PL could be a standardized tool adequate for that purpose,

further validation of the battery in SZ subjects is necessary. What is more, a thorough study of metaphor processing in SZ could help better understand their experiences, and find and develop new strategies for psychotherapy and neuropsychological remediation. Furthermore, further research on metaphor processing comparing comprehension with explanation and considering confounding factors like cognitive and executive functions, symptoms of the illness, duration of the illness, or medication may give a better understanding of the processes. In addition, a systematic study on the variety of mistakes made by SZ subjects in metaphor explanation may facilitate understanding of verbal and abstract thinking. A better understanding of metaphor processing abnormalities in SZ, together with the results gleaned from neurochemical and neuroanatomical studies, may provide new insights into brain dysfunctions in neuropsychiatric disorders as a whole.

In summary, the current study is one of the few to assess metaphor comprehension and explanation with evaluation of mistakes in SZ subjects, and one of the few to be carried out on a homogenous group of SZ subjects. Our results, although somewhat limited in their potential generalization, suggest that metaphor processing is disturbed, implying that metaphor explanation is particularly dysfunctional and that different mistakes appear in the process of metaphor interpretation. Further studies on metaphor processing on different stages of SZ could give a better understanding of metaphorical thinking in the course of disease development and the illness. As the disturbances of metaphor processing may cause serious impairments in the social communication of patients, it is worth evaluating them during clinical examination.

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Conflict of Interest

All the authors declare no conflicts of interest.

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