

Research Paper

On the specificity of figurative language comprehension impairment in schizophrenia and its relation to cognitive skills but not psychopathological symptoms - Study on metaphor, humor and irony

Przemysław Adamczyk^{a,*}, Joanna Biczak^b, Katarzyna Kotlarska^c, Artur Daren^d,
Łukasz Cichocki^{b,e}

^a Institute of Psychology, Jagiellonian University, Krakow, Poland

^b Babinski Clinical Hospital, Krakow, Poland

^c Institute of Psychology, Pedagogical University, Krakow, Poland

^d Faculty of Psychology, Pedagogy, and Humanities, Andrzej Frycz Modrzewski Krakow University, Krakow, Poland

^e Clinic of Psychiatry, Andrzej Frycz Modrzewski Krakow University, Krakow, Poland

ARTICLE INFO

Keywords:

Schizophrenia
Figurative language
Metaphor
Humor
Irony
Sarcasm
Cognition

ABSTRACT

People with schizophrenia have difficulty understanding figurative expressions, such as metaphors, humor or irony. The present study investigated the specificity of figurative language impairment in schizophrenia and its relation with cognitive and psychotic symptoms. It included 54 schizophrenia and 54 age and sex-matched healthy subjects who performed a cognitive screening (ACE-III) and figurative language comprehension task consisting of 60 short stories with three types of endings: a figurative one and its literal and an absurd (meaningless) counterparts. Each figurative domain – metaphor, humor, irony - was split into two sub-domains, i.e., conventional and novel metaphors, intended-to-be-funny and social-norm-violation jokes, simple irony and critical sarcasm, respectively. The main findings are: i) in schizophrenia, figurative language deficit manifests itself in each domain; ii) the most pronounced subdomain-specific impairment has been found for novel vs conventional metaphors and irony vs sarcasm; iii) altered figurative language comprehension was related to diminished cognitive abilities but not to psychopathology symptoms (PANSS) or other clinical characteristics. This may suggest that figurative language impairment, as a specific part of communication deficit, may be regarded as an essential characteristic of schizophrenia, related to primary cognitive deficits but independent of psychopathology.

1. Introduction

During social interactions in everyday language, people with schizophrenia have difficulties understanding figurative expressions, as the real but hidden meaning is different from the literal one (i.e., humor, proverbs, idioms, metaphors, irony, or sarcasm) (Adamczyk et al., 2016; Rossetti et al., 2018; Kircher et al., 2007; Polimeni et al., 2010; Rapp et al., 2013; Varga et al., 2013). Proper understanding of these expressions requires a range of skills, both linguistic and non-linguistic. It is crucial to go beyond the exact literal meaning of the figurative message and take into account the situational context and the theory of mind (ToM), i.e., mental states, goals, and beliefs of another person (Cassetta and Goghari, 2014; Parola et al., 2020; Gibbs, 1999). Recent research

showed that ToM deficits in schizophrenia may affect language comprehension at the semantic-pragmatic processing level, regardless of the IQ level (Gavilán and García-Albea, 2011). Patients with schizophrenia often show a tendency to be overly concrete and to prefer literal meaning, as indicated by studies on the understanding of pragmatic aspects of language, i.e., proverbs, metaphors, humor, and irony (Adamczyk et al., 2016, 2017, 2021; Rossetti et al., 2018; Kircher et al., 2007; Langdon et al., 2002; Rapp et al., 2013; Varga et al., 2013). In general, the reported tendency to use literal language and difficulties in understanding figurative meanings in schizophrenia seem to be mainly related to impaired cognition, i.e., deficiencies in set-shifting and abnormal semantic associations in a given linguistic context (Kuperberg and Caplan, 2003; Polimeni et al., 2010).

* Corresponding author at: Institute of Psychology, Jagiellonian University, Ingardena 6, 30-060 Kraków, Poland.

E-mail addresses: przemyslaw.adamczyk@uj.edu.pl, przemyslaw.adamczyk@mailplus.pl (P. Adamczyk).

<https://doi.org/10.1016/j.scog.2023.100294>

Received 24 July 2023; Received in revised form 22 October 2023; Accepted 23 October 2023

Available online 25 October 2023

2215-0013/© 2023 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Interestingly, recent data indicates that the more detailed characteristics within figurative language subdomains may play an important role in the impairment level. Given the consequently reported metaphor comprehension impairment in schizophrenia (for review, see Rossetti et al., 2018), a recent study showed that people with schizophrenia had more difficulties understanding novel than conventional metaphors (Rapp et al., 2018). Regarding humor, previous studies consistently indicate disturbed joke processing in schizophrenia (Adamczyk et al., 2016; Bozikas et al., 2007; Polimeni and Reiss, 2006; Polimeni et al., 2010), but a difference in the level of impairment may depend on the type of joke (Adamczyk et al., 2017, 2019; Berger et al., 2018; Corcoran et al., 1997; Marjoram et al., 2005). Namely, cartoon jokes requiring ToM were reported as more challenging than, e.g., physical ones (Corcoran et al., 1997; Marjoram et al., 2005). Considering the pragmatic function of spoken jokes, it seems warranted to consider other basic differences in types of humor, such as socially correct (i.e., intended-to-be-funny 'kids jokes') vs violating social norms jokes (i.e. 'adult jokes') (Adamczyk et al., 2017; Berger et al., 2018; Veatch, 1998). At last, irony and sarcasm are other figurative language domains commonly impaired in schizophrenia (Kosmidis et al., 2008; Mo et al., 2008; Rapp et al., 2013; Varga et al., 2013). Comprehension of irony and sarcasm requires similar cognitive processes as comprehension of metaphors and humor, although the ToM abilities and situational context cues are crucial (Mitchley et al., 1998). Thus, given the pivotal role of ToM deficit in schizophrenia (Herold et al., 2002; Mitchley et al., 1998; Varga et al., 2013), it seems relevant to distinguish sarcastic irony and non-sarcastic irony conditions (Filik et al., 2019; Turcan and Filik, 2016; Kreuz and Glucksberg, 1989). The non-sarcastic irony expresses one's appraisal when implying a reversed evaluative utterance within a situational/environmental context. Sarcasm is a specific form of irony that directly targets a specific person to criticise their behaviour, but literally, it sounds like praise (Kreuz and Glucksberg, 1989; Turcan and Filik, 2016). Such conceptualisation is supported by neuroimaging studies showing that processing of sarcastic irony evokes more robust neural activity and recruits a more complex neural network than non-sarcastic irony in neurotypicals (Filik et al., 2019). However, no such differentiation of stimuli in this respect was previously tested in schizophrenia, and only a few studies revealed the generally diminished ability to comprehend irony in schizophrenia (Mo et al., 2008; Rapp et al., 2013, 2014; Varga et al., 2013).

Considering all the above, it should be pointed out that the previous studies on figurative language impairment in schizophrenia usually examined these figurative domains (i.e., metaphors, humor, and irony) separately and often in small ($n < 30$) or limited samples (e.g. only females). Thus, in the current study, we aim to test the specificity of the impairment by testing all major figurative subdomains in the same sample. This enables us to indicate which of the figurative domains is the most problematic to individuals with schizophrenia compared to healthy controls. Additionally, we want to examine the more detailed subdomain characteristics of metaphor (conventional and novel), humor (intended-to-be-funny and social-violation-based jokes) and irony (non-sarcastic irony and critical sarcasm) comprehension impairment. The second aim is to establish relationships between cognitive functioning, severity of psychopathology and figurative language deficit in schizophrenia.

2. Methods

2.1. Subjects

The study included 54 schizophrenia outpatients (SCH) and 54 healthy controls (CON) matched in age and sex (M:F ratio 33:21 in each group) but differing in years of education and work status (for details, see Table 1). The healthy subjects were recruited through local advertisements, and the clinical group was recruited from the Babinski Clinical Hospital in Krakow, psychiatric ambulatories, and Occupational

Table 1
Demographic and clinical data.

Group	SCH (n = 54)		CON (n = 54)		Between-group differences
	mean	SD	mean	SD	
Demographic					
Age	40.46	9.54	40.78	9.57	$p = 0.864^*$
Years of education	14.03	3.48	17.31	2.62	$p < 0.001^*$
Work (months per last year)	3.12	4.82	10.64	3.25	$p < 0.001^{**}$
Clinical (SCH n = 54)					
	Mean	SD	Median	Min	Max
Age of psychosis onset	24.80	6.95	23.0	14	46
Illness duration (years)	15.67	10.18	15.0	1	42
Numbers of psychotic episodes	7.70	14.19	4.0	1	100
Number of hospitalisation	4.37	3.87	4.0	0	18
Antipsychotics dose (chlorpromazine equivalent)	508.98	404.21	400.0	100	2500
PANSS - total	68.41	16.39	67.5	33	109
PANSS - positive ^a	10.94	3.55	10.0	5	21
PANSS - negative ^a	20.13	6.32	21.0	8	32
PANSS - disorganisation ^a	11.85	3.92	12.0	5	23
PANSS - excitement ^a	6.61	2.69	6.0	4	14
PANSS - emotional distress ^a	9.46	3.06	9.0	4	18
PANSS - social amotivation ^b	8.13	2.86	9.0	3	14
PANSS - expressive deficits ^b	14.07	4.71	14.0	6	23

^a PANSS subscales, according to Gaag et al. (2006).

^b PANSS subscales, according to Stiekema et al. (2016).

* t-Test.

** Mann-Whitney test.

Therapy Workshops in Krakow and Lubin, Poland.

All subjects gave informed consent to participate in the experimental procedures, including interview, cognitive screening with Addenbrookes's Cognitive Examination-III (ACE-III; Mathuranath et al., 2000) in the Polish version (Sitek et al., 2017), and additional assessment in the clinical group with the Positive and Negative Syndrome Scale (PANSS; Gaag et al., 2006; Kay et al., 1987). Exclusion criteria included a history of head injuries, seizures, substance dependence, or any current severe somatic illnesses. All clinical subjects were in stable psychopathological condition before the experiment. According to the ICD-10, the clinical group consisted of subjects diagnosed with paranoid schizophrenia (F20.0 $n = 47$), residual schizophrenia (F20.5 $n = 1$), schizophreniform disorder (F20.8 $n = 3$), chronic undifferentiated schizophrenia (F20.9 $n = 1$), schizotypal disorder (F21 $n = 1$) and schizoaffective disorder (F25.0 $n = 1$). All clinical subjects were taking antipsychotic medication, including conventional (1st generation: chlorprothixene, flupentixol, haloperidol, promazine) and atypical (2nd generation: amisulpride, clozapine, olanzapine, risperidone, sulpiride, quetiapine, aripiprazole, lurasidone) antipsychotics. Additionally, 17 clinical subjects were taking antidepressants (escitalopram, paroxetine, sertraline, venlafaxine), five anxiolytics (hydroxyzine), and six mood stabilisers (carbamazepine, lithium, and valproic acid). All were right-handed, and all were native Polish speakers. All participants were remunerated for participation. All participants were Polish native speakers. Procedures were designed following the ethical standards of the World Medical Association Declaration of Helsinki (2013) and approved by the Research Ethics Committee at the Institute of Psychology, Jagiellonian University, Krakow, Poland (decision no. KE/22.2021).

2.2. Materials and procedure

The experimental stimuli for the figurative language comprehension task (FLC) were based on the previous experimental materials to assess comprehension of humor (Adamczyk et al., 2019), metaphor (Adamczyk et al., 2021; Mashal et al., 2014; Rapp et al., 2018), irony (Del Goletto et al., 2016; Rapp et al., 2010, 2014; Varga et al., 2013) and sarcasm

(Filik et al., 2019). The experimental stimuli were written 7-line stories containing a description of the social/situational context and the dialogue between two protagonists (i.e. the setup, consisting of a 6-line text of 50–60 words and 200–250 characters long, completed by one of three possible endings, i.e. punchlines - each four words long). The three punchlines are responses containing A) a figurative expression of a given type from among six types: conventional (MET) and novel (NOV) metaphors; intended-to-be-funny (IFJ) and social violation-based (SVJ) humor; irony (IRO) and critical sarcasm (SAR); along with two control condition punchlines: B) a literal response (LIT) and C) an absurd (meaningless) response (ABS) (see Table 2 for examples). The order of punchlines (A/B/C) was randomized. In total, the FLC included 63 stories: one example and 20 items per domain (split into 10 for each consecutive sub-domain).

Participants were requested to read the stories and choose the figurative one from the three presented endings (punchlines), following the instructions given to each subject as follows (English translation): “*In a moment, you will be asked to read short stories and choose one of the three endings that you think best suits them. The entire test is divided into three parts - tasks. I. METAPHORS - In the first part, your task is to identify endings containing metaphorical expressions, metaphors, or other non-literal expressions that you consider metaphorical and that give full meaning to the whole story. II. HUMOR - In the second part, your task is to indicate the endings that make the story humorous, a joke, or you simply consider them to be the funniest ending. III. IRONY - In the third part, your task is to indicate endings that, in your opinion, contain irony or sarcasm. These are ambiguous statements or criticisms hidden in a seemingly approving statement.*” Each part of FLC – I. metaphors, II. humor, and III. irony - starts with an example, and current task specification was then reminded to the subjects.

The FLC points for correct answers were awarded for each story when the figurative punchline was marked, and the erroneous responses were scored for each LIT or ABS category separately. Therefore, each subject had a total of 60 points (one per test item), distributed among figurative, neutral and absurd categories of endings as per their choice of every answer. Thus, the maximum range of FLC correct responses was 0 to 60 scores, and each subject's accuracy level (number of correct answers) was accompanied by the corresponding number of both types of erroneous answers.

Before the proper experiment, the pre-test screening of the FLC items was performed on the sample of students ($n = 29$; 18 females, 11 males) to assess the comprehensibility of the task and the level of performance in a sample of healthy volunteers (see Table 3). The scores for matching proper figurative meanings to the stories show the ceiling effect, i.e. that the task was well understood and feasible for healthy subjects.

The FLC was performed individually with each participant after an interview and the ACE-III cognitive screening. No time limits were imposed during testing. The mean test performance time was 45 min but varied between 30 and 90 min, with the most extended times observed mainly in the clinical group.

2.3. Statistical analyses

The analyses were performed with tidyverse (Wickham et al., 2019), psych (Revelle, 2022; Revelle and Condon, 2018) and rcompanion (Mangiafico, 2023) packages within the R environment (<https://www.r-project.org/>). The significance level in all analyses was $\alpha = 0.05$. Due to frequent violation of normality assumption and the occasional presence of outliers, non-parametric methods were used, i.e., Wilcoxon signed-rank (Mann-Whitney) and rank-sum tests, and Spearman rank correlation coefficients. To determine the effect sizes of between and within group differences Glass rank biserial correlation coefficient and matched-pairs rank biserial correlation coefficient were computed, with cut-offs of 0.1, 0.3 and 0.5 assumed as indicating small, medium and large effect size, respectively.

3. Results

3.1. Between-group comparison of ACE-III and FLC

SCH subjects differed significantly from CON both in cognitive function assessment (ACE-III) and in figurative language comprehension (FLC), obtaining lower total and all subtest scores (Table 4). Regarding cognitive impairment, the strongest effect sizes were detected in verbal fluency ($r_G = -0.556$) and language ($r_G = -0.51$) subtests. In FLC, the strongest figurative domain effects were found in humor ($r_G = -0.697$) and metaphor ($r_G = -0.695$) compared to irony ($r_G = -0.528$). Moreover, the respective sub-domain specificity of effect sizes was observed, i.e. SVJ $r_G = -0.679 > IFJ r_G = -0.602$; NOV $r_G = -0.685 > MET r_G = -0.503$; and IRO $r_G = -0.506 > SAR r_G = -0.467$.

3.2. Between-group comparisons of FLC error responses

Between-group comparisons showed that compared to the CON, the SCH group made significantly more error responses by choosing the LIT punchline more often in all assessed conditions. Notably, the strongest effect sizes were observed in the case of SVJ ($r_G = 0.606$), IFJ ($r_G = 0.574$) and NOV ($r_G = 0.569$). Regarding the ABS punchline, the SCH group made significantly more such errors in the humor and conventional metaphors, but not irony. At last, the medium effect sizes were observed only for IFJ ($r_G = 0.350$) and SVJ ($r_G = 0.344$) conditions (Table 5).

3.3. Comparisons of within-group FLC scores and errors

Within-group comparisons revealed significantly better comprehension of MET vs NOV in both groups (Table 6). Moreover, the clinical subjects scored lower on IRO than SAR, whereas the difference was insignificantly slight for healthy controls. No significant differences were found in the case of humor scores in both groups. Consecutively, analysis of error responses revealed that the SCH group made more LIT errors in the case of MET < NOV, while the CON group made more ABS errors in such a comparison. Finally, both groups made more ABS errors in the IRO > SAR conditions comparison.

3.4. The relationship between psychopathology and figurative language impairment

Demographic and clinical data of the SCH group were tested for associations with the FLC results with the Spearman rank correlation coefficients. Significant moderate positive associations were found for the indicators of cognitive functioning, i.e., the ACE-III total score, the years of education, and the months of paid job within the last year (Fig. 1). At last, age was negatively correlated with comprehension of SAR.

After controlling for the cognitive skill (ACE-III total score), the number of psychotic episodes, and the chlorpromazine equivalent of neuroleptics, the sole correlation between FLC results and PANSS symptoms was the emotional distress subscale's negative association with FLC total score (Fig. 2).

4. Discussion

In this study, we explored the specificity of figurative language impairment in schizophrenia. To our knowledge, this is the first study in which the same subjects have been tested within three major figurative domains (metaphors, humor, and irony, each divided into two sub-conditions). This is the added value of presented results, as the previous studies on figurative language impairment in schizophrenia usually examined each figurative domain separately, often in small or limited samples. Thus, the methodology used in the present paper allows us to look more deeply into specific aspects of figurative language impairment, composing the image of the global deficit of pragmatic speech

Table 2
Examples of figurative language comprehension test (FLC) stimuli.

Metaphors		English translation
MET – conventional metaphor		
Setup	<p>Michał jechał rano do pracy na rowerze. Przez przypadek potrącił dziewczynę przechodzącą przez ulicę. Dziewczyna upadła na chodnik. Michał zatrzymał się i spytał ją z troską:</p> <p>- Przepraszam, czy wszystko w porządku?</p> <p>Dziewczyna odpowiedziała:</p> <p>- To ja przepraszam. To moja wina...</p>	<p>Michał was riding his bike to work in the morning. He accidentally hit a girl crossing the street. The girl fell to the pavement. Michael stopped and asked her worriedly:</p> <p>- I'm so sorry. Are you okay?</p> <p>The girl replied:</p> <p>- It's me who should apologise. It's my fault...</p>
MET	- Miałam głowę w chmurach.	- I had my head in the clouds.
LIT	- Byłam bardzo zamyślona.	- I was lost in thoughts.
ABS	- Kangury skaczą wysoko hop-hop.	- Kangaroos jump high hop-hop.
NOV – novel metaphor		
Setup	<p>Janek i Kasia wybrali się na wspólne wakacje do Rezerwatu Przyrody. Podziwiając widoki natknęli się na górę śmieci, butelek i innych opakowań. Janek, widząc ten okropny widok mówi do Anny:</p> <p>- To straszne. Co to są za ludzie, którzy tak niszczą przyrodę?</p> <p>Anna odpowiada:</p> <p>- Tak, to naprawdę przerażający widok.</p>	<p>Janek and Kasia went on holiday to the Nature Reserve. Admiring the views, they came across a mountain of garbage, bottles, and another packaging. Seeing this horrible sight, Janek says to Anna: - It's terrible. What kind of people are they who are destroying nature like this? Anna answers:</p> <p>- Yes, it is a frightening sight.</p>
NOV	- Oni mają plastikowe serca.	- They have plastic hearts.
LIT	- To efekt ludzkiej konsumpcji.	- This is the effect of human consumption.
ABS	- Nie lubię zapachu rozmarynu.	- I don't like the smell of rosemary.
Humor		
IFJ – intended to be funny joke		
Setup	<p>W szkole nauczycielka zadaje dzieciom wypracowanie:</p> <p>- Napiszcie teraz pracę na temat: "Jak wyobrażam sobie pracę dyrektora?". Wszystkie dzieci piszą, tylko Jaś złożył ręce i siedzi beczynnie. - Jasiu, czemu nie piszesz? - Nauczycielka pyta się Jasia.</p> <p>Jasio odpowiada:</p> <p>- Proszę Pani.</p>	<p>At school, the teacher asks the children to write an essay:</p> <p>- Now, write a paper on the topic: "How do I imagine the work of a director?". All the children write. Only Johnny has folded his arms and sits idle.</p> <p>- Johnny, why don't you write? - The teacher asks Johnny.</p> <p>Johnny answers:</p> <p>- Ma'am.</p>
IFJ	- Nadal czekam na sekretarkę.	- I'm still waiting for the secretary.
LIT	- Nie wiem o czym napisać.	- I don't know what to write about.
ABS	- Największe ptaki to strusie.	- The largest birds are ostriches.
SVJ – social norm violation joke		
Setup	<p>Rano, żona Jacka Marta, przez roztargnienie pomieszała lekarstwa w szafce. Jacka od rana bolał brzuch, więc Marta dała mu pigułkę i poszedł do pracy. Po godzinie Marta dzwoni do niego: - Kochanie, musisz coś wiedzieć. Przez pomyłkę, zamiast tabletek na biegunkę, dałam Ci moje na uspokojenie.</p> <p>Jack odpowiada:</p> <p>- Wiem o tym dobrze.</p>	<p>In the morning, Jack's wife, Marta, absent-mindedly mixed up the medicines in the cupboard. Jack's stomach hurt in the morning, so Martha gave him a pill, and he went to work. After an hour, Martha calls him: - Honey, you must know something. By mistake, instead of diarrhoea pills, I gave you mine to calm down.</p> <p>Jack answers:</p> <p>- I know that well.</p>
SVJ	- Jestem obsrany, ale spokojny.	- I'm shitting myself but stay calm.
LIT	- Musiałem iść do apteki.	- I had to go to the pharmacy.
ABS	- Pogoda wczoraj była dobra.	- The weather yesterday was good.
Irony		
IRO – simple irony		
Setup	<p>Tomek i Marysia długo zastanawiali się nad najlepszą datą ślubu i wesela. Ostatecznie, wybrali 23 czerwca, kiedy szanse na dobrą pogodę są duże. W dzień ślubu zaczął padać ulewny deszcz, zrobiło się zimno i nieprzyjemnie. Marysia pyta Tomka: - Tomek, zobaczysz jak jest na zewnątrz?</p> <p>Tomek wychodzi, patrzy w niebo i mówi:</p> <p>- Marysiu, wiesz co?</p>	<p>Tomek and Marysia thought for a long time about the best date for the wedding and reception. In the end, they chose June 23, when the chances of good weather are high. It began to rain heavily on the wedding day and became cold and unpleasant. Marysia asks Tomek: - Tomek, will you see how it is outside?</p> <p>Tom comes out, looks at the sky, and says:</p> <p>- Marysia, you know what?</p>
IRO	- Zapowiada się fantastyczna pogoda.	- It looks like the weather will be fantastic.
LIT	- Dziś będzie bardzo nieprzyjemnie.	- Today will be very unpleasant.
ABS	- Samochód ciężarowy waży dużo.	- A truck weighs a lot.
SAR – critical sarcasm		
Setup	<p>Ala, pracuje w urzędzie miejskim. Zasnęła i spóźniła się do pracy. Na jej biurku leży masa zaległych dokumentów, którymi powinna się zająć. Po przyjeździe do biura, zaparza kawę i siada przy biurku.</p> <p>Pierwsze co robi to wyjmuje kosmetyczkę i maluje sobie paznokcie.</p> <p>Paweł, kolega z biurka obok mówi do niej: - Cześć Ala. Masz sporo zaległości.</p>	<p>Ala works in the municipal office. She overslept and is late for work. On her desk lies a mass of outstanding documents that she should take care of. When she arrives at the office, she makes coffee and sits at his desk. The first thing she does is take out her beautician and paint her nails. Paweł, a colleague from the desk next to her, says to her: - Hi, Al. You have much backlog.</p>
SAR	- Uwważaj, nie przepracuj się.	- Be careful, do not overwork.
LIT	- Chętnie Ci trochę pomogę.	- I'll be happy to help you a little.
ABS	- Zmiany klimatu są groźne.	- Climate change is dangerous.

Table 3
Ratings of pre-selective judgment of FLC task.

Healthy volunteers (n = 29)				
	Mean	SD	Min	Max
Demographic				
Age	29.41	11.23	19	55
Years of education	15.79	4.06	10	31
Work (months per last year)	6.45	5.26	0	12
Cognitive screening				
ACE-III TOTAL	97.28	2.70	90	100
Attention	17.72	0.65	16	18
Memory	24.76	1.79	19	26
Verbal fluency	13.03	1.29	10	14
Language	25.96	0.19	25	26
Spatial-visual	15.79	0.56	14	16
Figurative language comprehension task				
FLC TOTAL	56.72	2.12	50	59
METAPHORS	19.17	1.07	15	20
MET	9.86	0.35	9	10
NOV	9.31	1.00	5	10
HUMOR	18.62	1.32	14	20
IFJ	9.41	0.78	7	10
SVJ	9.21	0.94	6	10
IRONY	18.93	1.10	17	20
IRO	9.24	0.79	7	10
SAR	9.690	0.60	8	10

Abbreviations: FLC, figurative language comprehension task; MET, conventional metaphors; NOV, novel metaphors; IFJ, intended-to-be-funny jokes; SVJ, social-violation jokes; IRO, simple irony; SAR, critical sarcasm.

comprehension in schizophrenia.

The presented results provide three main findings concerning figurative language processing in schizophrenia: i) people with schizophrenia have more problems with understanding figurative language globally, irrespective of the domain tested, but with considerable effect sizes indicating that both humor conditions (i.e. IFJ, SVJ) and novel metaphors are the most problematic ones; ii) regarding the specificity of subdomains tested, the more pronounced impairment has been found for novel vs conventional metaphors and irony vs sarcasm, but not in the case of verbal humor impairment; iii) the altered figurative language comprehension was found to be related to diminished cognitive abilities across all examined domains but not to the specific psychopathology symptoms or other clinical characteristics, e.g., illness duration, number of hospitalisation or psychotic episodes.

Table 4
Descriptive statistics and between-group comparisons for ACE-III and FLC.

Measure	SCH (n = 54)					CON (n = 54)					Mann-Whitney test		Effect size
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	p-Level (FDR adjusted)	r _G	
ACE-III TOTAL	89.46	7.39	91.0	68	100	96.67	3.70	98.0	86	100	<0.001	-0.659	
Attention	16.70	1.90	17.5	10	18	17.70	0.72	18.0	15	18	<0.001	-0.337	
Memory	22.63	3.25	24.0	14	26	24.83	1.49	25.0	21	26	<0.001	-0.452	
Verbal fluency	10.52	2.50	11.0	5	14	12.81	1.63	13.0	6	14	<0.001	-0.556	
Language	24.81	1.51	25.0	20	26	25.81	0.73	26.0	22	27	<0.001	-0.510	
Spatial-visual	14.80	1.45	15.0	9	16	15.50	0.88	16.0	12	16	0.002	-0.311	
FLC TOTAL	37.00	14.94	36.0	8	59	54.22	6.30	56.0	28	60	<0.001	-0.710	
METAPHORS	12.00	6.25	12.5	1	20	18.61	2.81	19.0	2	20	<0.001	-0.695	
MET	6.85	3.25	8.0	1	10	9.59	1.34	10.0	2	10	<0.001	-0.503	
NOV	5.15	3.48	5.0	0	10	9.02	1.63	9.5	0	10	<0.001	-0.685	
HUMOR	11.96	5.01	11.0	2	20	17.89	2.33	19.0	11	20	<0.001	-0.697	
IFJ	6.22	2.73	6.0	1	10	8.93	1.24	9.0	5	10	<0.001	-0.602	
SVJ	5.74	2.70	5.0	1	10	8.96	1.40	9.5	4	10	<0.001	-0.679	
IRONY	13.04	5.34	14.0	2	20	17.72	2.14	18.0	11	20	<0.001	-0.528	
IRO	6.04	3.16	6.5	0	10	8.74	1.03	9.0	6	10	<0.001	-0.506	
SAR	7.00	2.46	7.0	2	10	8.98	1.39	9.0	4	10	<0.001	-0.467	

Abbreviations: SCH, clinical group; CON, healthy controls; FDR, false discovery rate; FLC, figurative language comprehension task; MET, conventional metaphors; NOV, novel metaphors; IFJ, intended-to-be-funny jokes; SVJ, social-violation jokes; IRO, simple irony; SAR, critical sarcasm.

4.1. On the figurative language comprehension impairment in schizophrenia

4.1.1. Figurative language – a global deficit of pragmatic communication

First of all, the results of the present paper confirmed the existence of a global deficit of figurative language comprehension in schizophrenia, which is in line with previous studies examining those domains, i.e., metaphor, humor, and irony processing (Adamczyk et al., 2016, 2017; Bozikas et al., 2007; Corcoran et al., 1997; Mossaheb et al., 2014; Mitchley et al., 1998; Mo et al., 2008; Polimeni and Reiss, 2006; Polimeni et al., 2010; Rapp et al., 2013, 2014; Varga et al., 2013). Furthermore, a closer look at the type of erroneous answers shows that although the clinical subjects made more errors of both neutral and nonsensical kinds, they significantly differed from the healthy subjects in the number of neutral punchlines chosen in all six figurative speech subdomains tested. However, the effects were strongest for SVJ, IFJ and NOV conditions. In contrast, for absurd punchlines, significant differences were present for both types of jokes and conventional metaphors but not for irony or novel metaphors.

Taking in the effect sizes for these differences, it may be said that clinical subjects much more often failed to select the figurative (and therefore most fitting) punchline, more often resorting to choosing neutral over nonsensical endings, indicating that they tried to make sense of the stories but did not discover their nonliteral contextual layers. This may stem from a poor ability to inhibit the literal meaning, which, once assessed and activated, contributed to the failure of alternative meaning activation. On the other hand, somewhat rarer choices of the absurd may reflect an intention to make sense but in a more unique and semi-creative way, i.e., finding meaning in the nonsense when they are looking for, e.g. creative metaphoric endings.

In general, the presented results are consistent with a classic study that revealed that people with schizophrenia made more errors, both in misinterpreting literal meanings as figurative and figurative as literal, but mostly making literal misinterpretations rather than metaphorical ones (Chapman, 1960). Furthermore, attenuated processing of figurative language may be regarded as one of the most pivotal characteristics of schizophrenia since the difficulty in understanding metaphorical expressions was found in first-episode patients (Anand et al., 1994), patients in remission (Herold et al., 2002; Mo et al., 2008), or chronic sufferers (Adamczyk et al., 2016; Bergemann et al., 2008), similar to irony and humor (Adamczyk et al., 2016; Mitchley et al., 1998; Mo et al., 2008; Rapp et al., 2014). However, it should be pointed out that despite global disruptions of pragmatic speech comprehension found in a tested population of the clinical sample, some of the schizophrenia individuals

Table 5
Between-group comparisons of FLC erroneous responses.

	SCH (n = 54)					CON (n = 54)					Mann-Whitney test	Effect size
	Mean	SD	Median	Min	Max	Mean	SD	Median	Min	Max	p-Level (FDR adjusted)	r _G
LIT errors												
MET	2.54	2.94	1.0	0	9	0.31	1.13	0	0	8	<0.001	0.457
NOV	3.85	3.84	2.0	0	10	0.46	1.45	0	0	10	<0.001	0.569
IFJ	2.76	2.37	2.0	0	8	0.74	1.07	0	0	4	<0.001	0.574
SVJ	2.89	2.50	2.5	0	9	0.52	0.79	0	0	3	<0.001	0.606
IRO	2.69	3.23	2.0	0	10	0.41	0.77	0	0	4	<0.001	0.411
SAR	2.31	2.20	2.0	0	8	0.61	0.71	0	0	2	<0.001	0.461
ABS errors												
MET	0.67	1.33	0.0	0	7	0.19	0.75	0	0	5	0.006	0.225
NOV	0.96	1.29	0.0	0	5	0.44	0.69	0	0	3	0.063	0.192
IFJ	1.02	1.31	1.0	0	5	0.30	0.66	0	0	3	0.000	0.350
SVJ	1.30	1.66	1.0	0	7	0.43	0.79	0	0	4	0.001	0.344
IRO	1.31	1.68	1.0	0	9	0.81	0.93	1	0	4	0.170	0.143
SAR	0.67	1.32	0.0	0	6	0.41	1.11	0	0	5	0.096	0.143

Abbreviations: SCH, clinical group; CON, healthy controls; FDR, false discovery rate; FLC, figurative language task; LIT; literal punchline; ABS; meaningless punchline; MET, conventional metaphors; NOV, novel metaphors; IFJ, intended-to-be-funny jokes; SVJ, social-violation jokes; IRO, simple irony; SAR, critical sarcasm.

Table 6
Within-group comparisons of FLC scores and errors for both types of sub-conditions of stimuli.

Group	Type of stimulus	Mean difference	Mean (type 1)	Median (type 1)	Mean (type 2)	Median (type 2)	Wilcoxon test p-level (FDR adjusted)	Effect size r _C
FLC scores								
SCH	Metaphors (MET vs NOV)	1.704	6.85	8.0	5.15	5.0	<0.001	0.710
	Humor (IFJ vs SVJ)	0.481	6.22	6.0	5.74	5.0	0.223	0.223
	Irony (IRO vs SAR)	-0.963	6.04	6.5	7.00	7.0	0.002	-0.619
CON	Metaphors (MET vs NOV)	0.574	9.59	10.0	9.02	9.5	<0.001	0.821
	Humor (IFJ vs SVJ)	-0.037	8.93	9.0	8.96	9.5	0.797	-0.054
	Irony (IRO vs SAR)	-0.241	8.74	9.0	8.98	9.0	0.223	-0.261
LIT errors								
SCH	Metaphors (MET vs NOV)	-1.315	2.54	1	3.85	2.0	<0.001	-0.688
	Humor (IFJ vs SVJ)	-0.130	2.76	2	2.89	2.5	0.586	-0.101
	Irony (IRO vs SAR)	0.370	2.69	2	2.31	2.0	0.201	0.272
CON	Metaphors (MET vs NOV)	-0.148	0.31	0	0.46	0.0	0.201	-0.412
	Humor (IFJ vs SVJ)	0.222	0.74	0	0.52	0.0	0.274	0.262
	Irony (IRO vs SAR)	-0.204	0.41	0	0.61	0.0	0.201	-0.373
ABS errors								
SCH	Metaphors (MET vs NOV)	-0.296	0.67	0	0.96	0.0	0.201	-0.292
	Humor (IFJ vs SVJ)	-0.278	1.02	1	1.30	1.0	0.201	-0.308
	Irony (IRO vs SAR)	0.648	1.31	1	0.67	0.0	<0.001	0.722
CON	Metaphors (MET vs NOV)	-0.259	0.19	0	0.44	0.0	0.021	-0.638
	Humor (IFJ vs SVJ)	-0.130	0.30	0	0.43	0.0	0.369	-0.246
	Irony (IRO vs SAR)	0.407	0.81	1	0.41	0.0	0.004	0.634

Abbreviations: SCH, clinical group; CON, healthy controls; FDR, false discovery rate; FLC, figurative language task; LIT; literal punchline; ABS; meaningless punchline; MET vs NOV, conventional vs novel metaphors; IFJ vs SVJ, intended-to-be-funny vs social-violation jokes; IRO vs SAR, simple irony vs critical sarcasm.

presented seemingly intact pragmatic speech skills (i.e., number of erroneous answers at the level of CON mean). This indicates that such characteristics are related to individual differences, such as good cognitive skills (ACE-III), social functioning (outpatients vs inpatients), and/or work status, as can be concluded from previous literature (Adamczyk et al., 2016; Kosmidis et al., 2008; Lee et al., 2009, 2020; San et al., 2007; Polimeni et al., 2010; Tsoi et al., 2008). Therefore, such phenomena warrant further research aimed at those individual differences. Noteworthy, our findings support more profound reflections on the nosological position of schizophrenia and the problem of the extreme heterogeneity of the schizophrenic psychosis spectrum. Deficits

in ToM and difficulties in understanding figurative language are at least partly similar to those observed in people with autism (Graves et al., 2022; Kalandadze et al., 2018; Melogno et al., 2019; Vulchanova et al., 2015). Notably, some people diagnosed with schizophrenia can have some, not always evident, symptoms from a spectrum of autism.

4.1.2. Understanding of metaphors

Secondly, the specificity of subdomain-related levels of impairment has been proved chiefly in the case of conventional and novel metaphors, and such an effect has been found both in CON and SCH groups, i.e., conventional metaphors are more easily recognised than novel

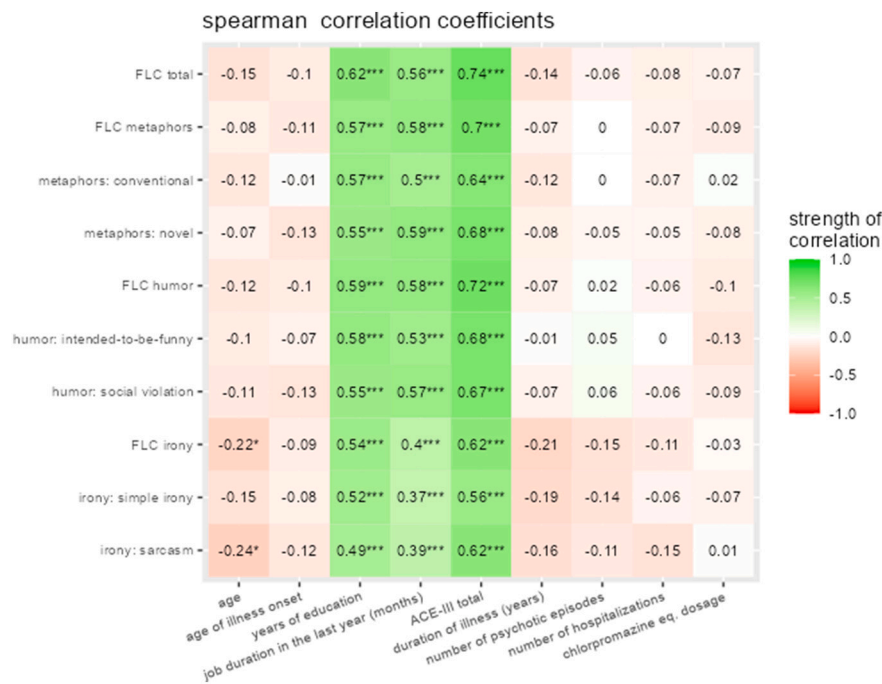


Fig. 1. Spearman rank correlation coefficients for FLC results and demographic and clinical data. Abbreviations: FLC, Figurative Language Comprehension task; ACE-III total, Addenbrooke's Cognitive Examination III total score.

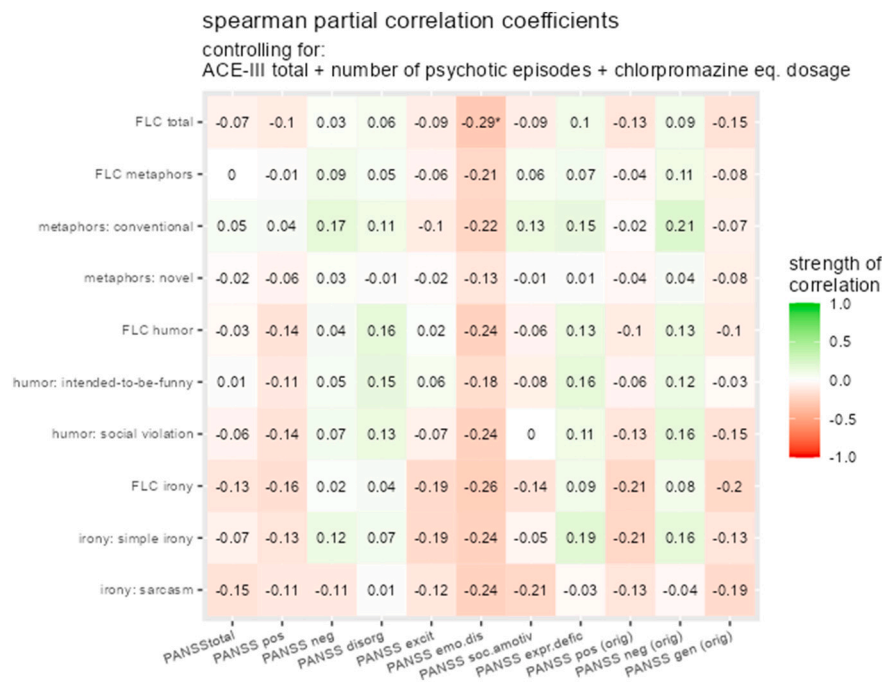


Fig. 2. Spearman rank correlation coefficients for FLC results and symptom severity controlled for ACE-III total score, a number of psychotic episodes, and chlorpromazine equivalent of neuroleptics dosage in the clinical group.

Abbreviations: FLC, Figurative Language Comprehension task; ACE-III total, Addenbrooke's Cognitive Examination III total score; PANSS total, Positive and Negative Symptom Scale total score; PANSS pos, positive symptoms subscale score; PANSS neg, negative symptoms subscale score; PANSS disorg, disorganisation subscale score; PANSS excit, excitement subscale score; PANSS emo dis, emotional distress subscale score (all five subscales identified according to van der Gaag et al., 2006); PANSS soc. amotiv, social amotivation subscale score; PANSS expr. defic, expressive deficits subscale score (both subscales identified according to Stiekema et al., 2016); PANSS pos (orig), positive symptoms subscale' score; PANSS neg (orig), negative symptoms subscale' score; PANSS gen (orig), general psychopathology subscale score (all three subscales identified according to original division by Kay et al. (1987).

metaphors. In line with the presented results, recent research on metaphor comprehension differentiated between conventional and non-conventional metaphors, although both were impaired in

schizophrenia (Adamczyk et al., 2021; Mossaheb et al., 2014; Rapp et al., 2018). Conventional metaphors include culture-based expressions in which fixed meanings are integrated into everyday language and thus

are easier to comprehend than de novo-created meanings of novel metaphors. As novel implications are less familiar and learned after their comprehension, they require active construction and fitting of the meaning to the given context. This makes them more problematic in both tested groups. Rapp et al. (2018) argue that in line with the Graded Salience Hypothesis (Giora, 2004), comprehension of novel metaphors requires semantic mapping of typically unrelated semantic entities, which can be impaired in people with schizophrenia. On the other hand, conventional metaphors are fixed expressions that seem not to rely on these mapping processes and observed impairments in conventional metaphors might be explained as the result of, e.g., unfamiliarity with the stimuli. Thus, considering the specific effect in figurative expressions, it is essential to distinguish between the frequency of the use of the metaphor in everyday language and the individual familiarity with the metaphor, which are not necessarily identical, even in the case of most common conventional expressions (Rapp et al., 2018). This element is lacking in our study and should be counted as a limitation of our results. However, familiarity with metaphors was controlled in another study (Mossaheb et al., 2014), which showed that people with schizophrenia have difficulties recognising and paraphrasing both conventional and novel metaphors in comparison to healthy controls, similarly as in the present study. Moreover, these impairments were associated with cognitive deficits and negative symptoms of schizophrenia (Mossaheb et al., 2014). Our study reveals that both conventional and novel metaphor processing is impaired in schizophrenia but with the subdomain-specific effect evident in the impairment level. Furthermore, our results indicate a positive correlation between impairment and cognitive disabilities but not with psychopathological symptoms.

4.1.3. Differences in ironic and sarcastic utterances comprehension

Interestingly, we found also that both healthy and clinical subjects found sarcasm to be easier to spot than irony, but the significant differences found only for the clinical group (i.e., the lack of the behavioural manifestation of the effect in healthy controls may be related to the roof effect, which is why the difference might have been nonsignificant). This phenomenon may be explained by the consistently critical and personal aspect of sarcasm (i.e., it is usually a criticism veiled as praise and directed toward a person). Sarcasm is possibly easier to identify due to everyone's personal experience with it, which is based on better memory of person-centred ironic remarks that are not emotionally indifferent. Irony, in comparison, is a broader term with varied emotional valence and objects. In the case of schizophrenia, one of the possible explanations of this phenomenon is the more often real-life experience of sarcasm and/or the paranoid sensitivity to perceived neutral comments as hostile or critical, e.g., paranoid bias in a clinical group results in higher sensitivity to such indirect criticism of subjects' behaviour. In general, literature shows that irony comprehension impairment in schizophrenia is related mainly to the ToM deficit, lower IQ, and more severe negative (but not positive) symptoms (Herold et al., 2002; Mitchley et al., 1998; Varga et al., 2013). Apart from ToM cognition, the ability to identify sarcasm was connected to affective prosody and speech melody perception, the impairment of which caused decreased sensitivity in detecting sarcasm and an increased bias toward sincerity in schizophrenia (Leitman et al., 2006). In the present study, we found no correlations with psychopathology but a relationship with cognitive deficiencies.

4.1.4. On humor impairment in schizophrenia

Lastly, in the case of the examined social violation aspects of humor impairment, no specific differences were found in both group. However, the respective sub-domain specificity of effect sizes was observed in the SCH group, indicating that SVJ may be more demanding than IFJ in a social-cognitive manner. Considering humor impairment appears to be one of the most characteristics of schizophrenia, some research suggests that contextual nuances in humorous social situations might be the most difficult to comprehend for people with psychosis (Kant and Norman,

2019; White et al., 2000). Polimeni and Reiss (2006) argue that humor comprehension relies mainly on semantic memory and social acumen, the two characteristics impaired in schizophrenia. Furthermore, cognitive functions such as working memory, verbal fluency, and the ability to sustain selective attention were also indicated to play an essential role in the reception of jokes (Bozikas et al., 2007). Considering humor comprehension impairment and its relation to symptomatology, some researchers point to the pivotal role of cognitive functions (Polimeni and Reiss, 2006; Polimeni et al., 2010; Tsoi et al., 2008), which phenomena has been replicated in our examination. Still, others also indicate the importance of apathy and depression (Tsoi et al., 2008), the severity of disorganisation (Daren et al., 2020; Jáni et al., 2021), or just total psychopathology score (Polimeni et al., 2010). However, such clear symptomatologic relationships have not been replicated in the present results.

4.2. Figurative language and the role of cognition and psychopathology

Data on the relationship between psychopathology symptoms and disturbances in figurative language processing are still ambiguous, and clear conclusions have not been reached yet (Daren et al., 2020; Gavilán and García-Albea, 2011; Jáni et al., 2021; Langdon et al., 2002; Polimeni and Reiss, 2006; Polimeni et al., 2010). Nevertheless, the relationship between pragmatic communication impairment with psychopathological symptoms and the additional influence of antipsychotics on language functions also remains highly unclear (Bambini et al., 2020; Bergemann et al., 2008; Bozikas et al., 2007; Daren et al., 2020; Kircher et al., 2007; Marjoram et al., 2005, 2006; Polimeni and Reiss, 2006; Saban-Bezalel and Mashal, 2017). Thus, in light of the present study, cognitive functioning emerges as the most potent factor related to impairment manifestation. It can be suggested that it is not the level of psychopathology that determines the degree of understanding of figurative language, but this is a primal socio-cognitive communication deficit. The most significant correlations include years of education, working time in the last year, and the level of cognitive functioning assessed with the ACE III scale. On the other hand, emotional distress is the only area of psychopathology that is weakly associated with the overall comprehension score of FLC. This may mean that depression, anxiety, guilt, and tension nonspecifically make it more difficult to correctly understand metaphors (especially conventional ones), irony and humor.

4.3. Figurative language in the clinic – future directions on therapeutic interventions

Finally, some authors suggest that in the therapeutic process, it is worth paying more attention to recovery indicators other than psychopathology. Still, in psychopathology, more attention should be paid to the affective area (Piovan et al., 2016). According to literature (Helldin et al., 2007; Llorca et al., 2009; Peuskens and Gorwood, 2012; San et al., 2007), symptomatic and functional remission in schizophrenia seem to represent two distinct recovery levels, which may or may not overlap. Therefore, as Piovan et al. (2016) suggest, contemporary recovery criteria should go beyond symptom remission and focus on personal and social functioning in various aspects of life. Furthermore, some researchers indicate clearly that such pragmatic language-based interventions (e.g., humor-based intervention) may be helpful in the transfer of linguistic skills into everyday life and improve coping mechanisms that utilise subjects' personal and social resources (Berger et al., 2021). However, the evidence is scarce, and although promising, the effects are still inconclusive (Cai et al., 2014; Gelkopf et al., 1994, 2006; Tsujimoto et al., 2021). Thus, the importance of developing patient-characteristic intervention depending on the duration of illness, neurocognitive and psychosocial functioning, the severity of symptoms, etc., is still an important goal to conquer, and more research and more long-term interventions have to be provided to shed light on the possible benefits in everyday life of these individuals (Berger et al., 2021). By illustrating specific difficulties in comprehension of humor, metaphors,

and irony that are prominent in people with schizophrenia, our findings indicate the relevance of including communication skills training (e.g., recognising, interpreting, or using figurative expressions) in rehabilitation/therapy programs to alleviate social disability associated with the disease.

Even though humor seems to be the most problematic domain for people with schizophrenia, metaphors and irony still play an important role in daily pragmatics.

Finally considering the strong association between figurative language impairment and socio-cognitive functioning revealed in the presented results, the therapeutic and rehabilitation interventions aimed at improving these important communication pragmatic skills should be incorporated as a specific part of sessions into metacognitive and social skills training. More deeply, individual patient-characteristic interventions should be optimized with respect to the most current cognitive, social functioning, language and communication problems to evoke the potential of individual resources in a person-centred therapeutic approach.

On the other hand, figurative language deficits may indicate vulnerability to psychotic impairment and, therefore, serve as a warning cue to implement proper rehabilitation to prevent or limit potential suffering and detrimental effects of the prodromal condition. Yet, such an application requires further research on the prodromal markers of schizophrenia spectrum disorder.

4.4. Limitations

Our findings may serve as a unique pilot study on the comprehension abilities of diverse subtypes of figurative language in the same population of people with schizophrenia. Although our results provide an important insight into the sub-domains specificity of impaired pragmatics, the present study has some limitations that must be pointed out before final conclusions are made.

First, the examined groups were matched in terms of sex and age yet differed significantly regarding years of education and work status. Such differences are related to cognitive deficits and worsened social functioning of people with schizophrenia and may be considered a staple clinical characteristic of the schizophrenia spectrum (Adamczyk et al., 2016).

Secondly, the presented instruction of the FLC task may be more problematic in some clinical cases since two of the three answers were coherent with the story (the figurative and literal one) and the role of e.g. impaired inhibition of the most obvious (literal) ending still warrants further research on this phenomenon and related mechanisms. Additionally, the lack of participants' subjective ratings of stories' comprehensibility, and especially the absence of ratings of e.g. conventional metaphors and jokes' familiarity, as well as assessments of metaphoricality, funniness or irony, should be regarded as a strong limitation of the presented procedure. Another area of concern pertains to the potential interference of language comprehension on participants' responses, and since no other linguistic and social-cognition tests were included in the experimental procedure design, except for cognitive screening by ACE-III, we cannot infer about other linked mechanisms (e.g. ToM abilities) and therefore indicate whether incorrect responses can be attributed to specific socio-cognitive abilities or are related to general language impairments. Thus, more sophisticated research materials, test batteries and expanded procedures would be welcome in future research to answer more detailed research questions on the potential mechanisms related to the impairment manifestation.

Third, the FLC task, even based on the previous experimental stimuli materials and prescreened for its validity in pre-selective judgment in healthy subjects, still lacks the more stringent selection criteria for selected items and no standardization procedures for the task have been undertaken. The issue of construct validity and sensitivity of the FLC task items is most problematic in the case of presented results, especially when considering the whole spectrum of figurative language diversity

and its pragmatic use in daily communication. The FLC materials were created for the needs of the study (selection based on previous experimental protocols), and these were a few examples of phrases/samples from a given subdomain of humor, metaphor and irony. Moreover, regardless of the pre-screening of the task, the FLC task validity was not assessed in any other way (there are no appropriate standardized tools available in this area of figurative language research, and the scope of the study itself did not allow for adding further tools for examining similar content and checking e.g. convergent validity). In general, a lack of standardized methods for a variety of figurative language domain assessments is a serious problem in the field of communication and language research in the clinical population. Therefore, the present study should be regarded as a pilot with preliminary results. Thus, considering the above, the lack of FLC standardization is the most important limitation of our study, and more sophisticated tools would be desired and advisable in future studies on the topic.

4.5. Conclusions

The present study investigated the specificity of figurative language impairment in schizophrenia. In line with the literature, we found the global impairment of figurative meanings comprehension in the clinical group within all three major figurative domains, i.e., metaphors, humor, and irony. Our results strengthen the data indicating the subdomain-specific effects on the level of impairment of comprehension of conventional and novel metaphors, as well as shed some light on the difference between various types of jokes or irony and sarcasm processing deficiencies in schizophrenia. Along with the previous literature, our data confirmed that a tendency to choose literal meanings is the most characteristic of figurative language impairment in schizophrenia. However, the tendency to find sense in meaningless punchlines also should be pointed out as another characteristic. Considering the relationships of figurative language impairment with cognitive deterioration and the severity of psychopathological symptoms, the former emerged as a more important correlate of communication impairment than specific psychosis-related symptoms. This may suggest that figurative language impairment, as a specific part of communication deficit, may be regarded as an essential characteristic of schizophrenia, along with other cognitive symptoms, but independently from individual psychotic symptoms, and should be implemented into therapeutic intervention and rehabilitation programs.

CRediT authorship contribution statement

Przemysław Adamczyk: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Validation, Writing – original draft. **Joanna Biczak:** Data curation, Investigation, Validation, Writing – original draft. **Katarzyna Kotlarska:** Data curation, Investigation, Validation, Writing – review & editing. **Artur Daren:** Formal analysis, Validation, Visualization, Writing – review & editing. **Łukasz Cichoński:** Conceptualization, Project administration, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare no competing interests.

Acknowledgements

We thank the staff of Babinski Clinical Hospital, Occupational Therapy Workshops "WTZ AKADEMIA ŻYCIA" and "WTZ KAMELEON" in Lubin and "WTZ MIODOWA" in Krakow for their help with proceeding with this work, especially to Izabela Kołodziej, Anna Jopp, Magdalena Wojciechowska, and subjects participated in the study.

Role of the funding source

The study was supported by National Science Centre Poland under grant no. 2021/41/B/HS6/02967.

References

- Adamczyk, Przemysław, Daren, Artur, Sulecka, Aleksandra, Bładziński, Piotr, Cichocki, Łukasz, Kalisz, Aneta, Gawęda, Łukasz, Cechnicki, Andrzej, 2016. Do better communication skills promote sheltered employment in schizophrenia? *Schizophr. Res.* 176 (2–3), 331–339. <https://doi.org/10.1016/j.schres.2016.08.015>.
- Adamczyk, Przemysław, Wyczesany, Mirosław, Domagalik, Aleksandra, Daren, Artur, Cepuch, Kamil, Bładziński, Piotr, Cechnicki, Andrzej, Marek, Tadeusz, 2017. Neural circuit of verbal humor comprehension in schizophrenia - an fMRI study. *NeuroImage Clin.* 15, 525–540. <https://doi.org/10.1016/j.nicl.2017.06.005>.
- Adamczyk, Przemysław, Wyczesany, Mirosław, Daren, Artur, 2019. Dynamics of impaired humor processing in schizophrenia - an EEG effective connectivity study. *Schizophr. Res.* <https://doi.org/10.1016/j.schres.2019.05.008>.
- Adamczyk, Przemysław, Jáni, Martin, Ligeza, Tomasz S., Plonka, Olga, Bładziński, Piotr, Wyczesany, Mirosław, 2021. On the role of bilateral brain hypofunction and abnormal lateralization of cortical information flow as neural underpinnings of conventional metaphor processing impairment in schizophrenia: an fMRI and EEG study. *Brain Topogr.* 34 (4), 537–554. <https://doi.org/10.1007/s10548-021-00849-x>.
- Anand, A., Wales, R.J., Jackson, H.J., Copolov, D.L., 1994. Linguistic impairment in early psychosis. *J. Nerv. Ment. Dis.* 182 (9), 488–493. <https://doi.org/10.1097/00005053-199409000-00002>.
- Bambini, Valentina, Arcara, Giorgio, Bosinelli, Francesca, Buonocore, Mariachiara, Bechi, Margherita, Cavallaro, Roberto, Bosia, Marta, 2020. A leopard cannot change its spots: a novel pragmatic account of concretism in schizophrenia. *Neuropsychologia* 139, 107332. <https://doi.org/10.1016/j.neuropsychologia.2020.107332>.
- Bergemann, Niels, Parzer, Peter, Jaggy, Susanne, Auler, Beatrice, Mundt, Christoph, Maier-Brauneder, Sabine, 2008. Estrogen and comprehension of metaphorical speech in women suffering from schizophrenia: results of a double-blind, placebo-controlled trial. *Schizophrenia Bull.* 34 (6), 1172–1181. <https://doi.org/10.1093/schbul/sbm138>.
- Berger, Philipp, Bitsch, Florian, Nagels, Arne, Straube, Benjamin, Falkenberg, Irina, 2018. Frontal hypoactivation and alterations in the reward-system during humor processing in patients with schizophrenia spectrum disorders. *Schizophr. Res.* 202, 149–157. <https://doi.org/10.1016/j.schres.2018.06.053>.
- Berger, Philipp, Bitsch, Florian, Falkenberg, Irina, 2021. Humor in psychiatry: lessons from neuroscience, psychopathology, and treatment research. *Front. Psych.* 12, 681903 <https://doi.org/10.3389/fpsyg.2021.681903>.
- Bozikas, Vasilis P., Kosmidis, Mary H., Giannakou, Maria, Anezoulaki, Dimitra, Petrikis, Petros, Fokas, Kostas, Karavatos, Athanasios, 2007. Humor appreciation deficit in schizophrenia: the relevance of basic neurocognitive functioning. *J. Nerv. Ment. Dis.* 195 (4), 325–331. <https://doi.org/10.1097/01.nmd.0000243798.10242.e2>.
- Cai, Chunfeng, Liping, Yu, Rong, Lan, Zhong, Hanling, 2014. Effectiveness of humor intervention for patients with schizophrenia: a randomized controlled trial. *J. Psychiatr. Res.* 59, 174–178. <https://doi.org/10.1016/j.jpsychires.2014.09.010>.
- Cassetta, Briana, Goghari, Vina, 2014. Theory of mind reasoning in schizophrenia patients and non-psychotic relatives. *Psychiatry Res.* 218 (1–2), 12–19. <https://doi.org/10.1016/j.psychres.2014.03.043>.
- Chapman, L.J., 1960. Confusion of figurative and literal usages of words by schizophrenics and brain damaged patients. *J. Abnorm. Soc. Psychol.* 60, 412–416. <https://doi.org/10.1037/h0043371>.
- Corcoran, R., Cahill, C., Frith, C.D., 1997. The appreciation of visual jokes in people with schizophrenia: a study of “mentalizing” ability. *Schizophr. Res.* 24 (3), 319–327.
- Daren, Artur, Adamczyk, Przemysław, Bładziński, Piotr, Cechnicki, Andrzej, 2020. Humor perception in schizophrenia appears to be related to disorganization syndrome. *Compr. Psychiatry* 96, 152149. <https://doi.org/10.1016/j.comppsych.2019.152149>.
- Del Goletto, Sarah, Kostova, Milena, Blanchet, Alain, 2016. Impaired context processing during irony comprehension in schizotypy: an ERPs study. *Int. J. Psychophysiol. Off. J. Int. Org. Psychophysiol.* 105, 17–25. <https://doi.org/10.1016/j.ijpsycho.2016.04.009>.
- Filik, Ruth, Turcan, Alexandra, Ralph-Nearman, Christina, Pitiot, Alain, 2019. What is the difference between irony and sarcasm? An fMRI study. *Cortex J. Study Nervous Syst. Behav.* 115, 112–122. <https://doi.org/10.1016/j.cortex.2019.01.025>.
- Gaag, Mark van der, Hoffman, Tonko, Remijns, Mila, Hijman, Ron, de Haan, Lieuwe, van Meijel, Berno, van Harten, Peter N., et al., 2006. The five-factor model of the Positive and Negative Syndrome Scale II: a ten-fold cross-validation of a revised model. *Schizophr. Res.* 85 (1), 280–287. <https://doi.org/10.1016/j.schres.2006.03.021>.
- Gavilán, José M., García-Albea, José E., 2011. Theory of mind and language comprehension in schizophrenia: poor mindreading affects figurative language comprehension beyond intelligence deficits. *J. Neurolinguistics* 24 (1), 54–69. <https://doi.org/10.1016/j.jneuroling.2010.07.006>.
- Gelkopf, M., Sigal, M., Kramer, R., 1994. Therapeutic use of humor to improve social support in an institutionalized schizophrenic inpatient community. *J. Soc. Psychol.* 134 (2), 175–182. <https://doi.org/10.1080/00224545.1994.9711380>.
- Gelkopf, Marc, Gonen, Bruria, Kurs, Rena, Melamed, Yuval, Bleich, Avi, 2006. The effect of humorous movies on inpatients with chronic schizophrenia. *J. Nerv. Ment. Dis.* 194 (11), 880–883. <https://doi.org/10.1097/01.nmd.0000243811.29997.f7>.
- Gibbs, Raymond W., 1999. Interpreting what speakers say and implicate. *Brain Lang.* 68 (3), 466–485. <https://doi.org/10.1006/brln.1999.2123>.
- Giora, Rachel, 2004. On the graded salience hypothesis. *Intercult. Pragmat.* 1 (1) <https://doi.org/10.1515/iprg.2004.001>.
- Graves, William W., Levinson, Hillary, Coulanges, Linsah, Cahalan, Shannon, Cruz, Daniel, Sancimino, Catherine, Bal, Vanessa H., Rosenberg-Lee, Miriam, 2022. Neural differences in social and figurative language processing on the autism spectrum. *Neuropsychologia* 171, 108240. <https://doi.org/10.1016/j.neuropsychologia.2022.108240>.
- Heldin, Lars, Kane, John M., Karilampi, Ulla, Norlander, Torsten, Archer, Trevor, 2007. Remission in prognosis of functional outcome: a new dimension in the treatment of patients with psychotic disorders. *Schizophr. Res.* 93 (1), 160–168. <https://doi.org/10.1016/j.schres.2007.01.014>.
- Herold, R., Tényi, T., Lénárd, K., Trixler, M., 2002. Theory of mind deficit in people with schizophrenia during remission. *Psychol. Med.* 32 (6), 1125–1129. <https://doi.org/10.1017/s0033291702005433>.
- Jáni, Martin, Plonka, Olga, Daren, Artur, Bładziński, Piotr, Kalisz, Aneta, Wyczesany, Mirosław, Adamczyk, Przemysław, 2021. The neural substrates of diminished humor comprehension in schizophrenia and its relationship with psychopathology. *Acta Neurobiol. Exp.* 81 (2), 181–190.
- Kalandadze, Tamar, Norbury, Courtenay, Nærland, Terje, Næss, Kari-Anne B., 2018. Figurative language comprehension in individuals with autism spectrum disorder: a meta-analytic review. *Autism Int. J. Res. Practice* 22 (2), 99–117. <https://doi.org/10.1177/1362361316668652>.
- Kant, Leo, Norman, Elisabeth, 2019. You must be joking! Benign violations, power asymmetry, and humor in a broader social context. *Front. Psychol.* 10. <https://www.frontiersin.org/articles/10.3389/fpsyg.2019.01380> (29 December, 2022).
- Kay, Stanley R., Fiszbein, Abraham, Opler, Lewis A., 1987. The Positive and Negative Syndrome Scale (PANSS) for schizophrenia. *Schizophr. Bull.* 13 (2), 261–276. <https://doi.org/10.1093/schbul/13.2.261>.
- Kircher, Tilo T.J., Leube, Dirk T., Erb, Michael, Grodd, Wolfgang, Rapp, Alexander M., 2007. Neural correlates of metaphor processing in schizophrenia. *NeuroImage* 34 (1), 281–289. <https://doi.org/10.1016/j.neuroimage.2006.08.044>.
- Kosmidis, Mary H., Aretouli, Eleni, Bozikas, Vassilis P., Giannakou, Maria, Ioannidis, Panayiotis, 2008. Studying social cognition in patients with schizophrenia and patients with frontotemporal dementia: theory of mind and the perception of sarcasm. *Behav. Neurosci.* 19 (1–2), 65–69. <https://doi.org/10.1155/2008/157356>.
- Kreuz, Roger J., Glucksberg, Sam, 1989. How to be sarcastic: the echoic reminder theory of verbal irony. *J. Experimental Psychol. Gen. U.S. Am. Psychol. Assoc.* 118, 374–386. <https://doi.org/10.1037/0096-3445.118.4.374>.
- Kuperberg, G., Caplan, David, 2003. Language dysfunction in schizophrenia. In: Schiffer, R.B., Rao, S.M., Fogel, B.S. (Eds.), *Neuropsychiatry*, 2nd edn. Lippincott Williams and Wilkins, Philadelphia, pp. 444–466. ([files/kuperberglab/files/kuperbergcaplan_neuropsych_2003.pdf](https://files.kuperberglab/files/kuperbergcaplan_neuropsych_2003.pdf)).
- Langdon, R., Coltheart, M., Ward, P.B., Catts, S.V., 2002. Disturbed communication in schizophrenia: the role of poor pragmatics and poor mind-reading. *Psychol. Med.* 32 (7), 1273–1284. <https://doi.org/10.1017/S0033291702006396>. Cambridge University Press.
- Lee, K.-H., Tsoi, D.T., Woodruff, P.W.R., 2009. The importance of research on humor in patients with schizophrenia. *Psychol. Med.* 39 (2), 348–351 author reply 351–352. <https://doi.org/10.1017/S0033291708004509>.
- Lee, Kate, Sidhu, David M., Pexman, Penny M., 2020. Teaching sarcasm: evaluating metapragmatic training for typically developing children. *Can. J. Experimental Psychol. Rev. Can. Psychol. Experiment.* <https://doi.org/10.1037/cep0000228>.
- Leitman, David I., Ziwich, Rachel, Pasternak, Roey, Javitt, Daniel C., 2006. Theory of Mind (ToM) and counterfactuality deficits in schizophrenia: misperception or misinterpretation? *Psychol. Med.* 36 (8), 1075–1083. <https://doi.org/10.1017/S0033291706007653>.
- Llorca, Pierre-Michel, Lançon, Christophe, Lançon, Sylvie, Bayle, Franck-Jean, Caci, Hervé, Rouillon, Frédéric, Gorwood, Philip, 2009. The “Functional Remission of General Schizophrenia” (FROGS) scale: development and validation of a new questionnaire. *Schizophr. Res.* 113 (2), 218–225. <https://doi.org/10.1016/j.schres.2009.04.029>.
- Mangiafico, Salvatore S., 2023. rcompanion: Functions to Support Extension Education Program Evaluation. Version 2.4.30. Rutgers Cooperative Extension. New Brunswick, New Jersey. <https://CRAN.R-project.org/package=rcompanion>.
- Marjoram, Dominic, Tansley, Howard, Miller, Patrick, MacIntyre, Donald, Cunningham, David G., Owens, Eve C., Johnstone & Stephen Lawrie., 2005. A theory of mind investigation into the appreciation of visual jokes in schizophrenia. *BMC Psychiatry* 5, 12. <https://doi.org/10.1186/1471-244X-5-12>.
- Marjoram, Dominic, Job, Dominic E., Whalley, Heather C., Gountouna, Viktoria-Eleni, McIntosh, Andrew M., Simonotto, Enrico, Cunningham-Owens, David, Johnstone, Eve C., Lawrie, Stephen, 2006. A visual joke fMRI investigation into Theory of Mind and enhanced risk of schizophrenia. *NeuroImage* 31 (4), 1850–1858. <https://doi.org/10.1016/j.neuroimage.2006.02.011>.
- Mashal, Nira, Vishne, Tali, Laor, Nathaniel, 2014. The role of the precuneus in metaphor comprehension: evidence from an fMRI study in people with schizophrenia and healthy participants. *Front. Hum. Neurosci.* 8, 818. <https://doi.org/10.3389/fnhum.2014.00818>.
- Mathurath, P.S., Nestor, P.J., Berrios, G.E., Rakowicz, W., Hodges, J.R., 2000. A brief cognitive test battery to differentiate Alzheimer’s disease and frontotemporal

- dementia. *Neurology* 55 (11), 1613–1620. <https://doi.org/10.1212/01.wnl.0000434309.85312.19>.
- Melgno, Sergio, Pinto, Maria Antonietta, Scalisi, Teresa Gloria, Orsolini, Margherita, Tarani, Luigi, Di Filippo, Gloria, 2019. Reasoning on figurative language: a preliminary study on children with autism spectrum disorder and Klinefelter syndrome. *Brain Sci.* 9 (3), 58. <https://doi.org/10.3390/brainsci9030058>.
- Mitchley, Nicola J., Barber, Joan, Gray, John M., Neil Brooks, D., Livingston, Martin G., 1998. Comprehension of irony in schizophrenia. *Cognit. Neuropsychiatry* 3 (2), 127–138. <https://doi.org/10.1080/135468098396206>. Routledge.
- Mo, Shuliang, Yanjie, Su, Chan, Raymond C.K., Liu, Jianxin, 2008. Comprehension of metaphor and irony in schizophrenia during remission: the role of theory of mind and IQ. *Psychiatry Res.* 157 (1–3), 21–29. <https://doi.org/10.1016/j.psychres.2006.04.002>.
- Mossaheb, Nilufar, Aschauer, Harald N., Stoettner, Susanne, Schmoeger, Michaela, Pils, Nicole, Raab, Monika, Willinger, Ulrike, 2014. Comprehension of metaphors in patients with schizophrenia-spectrum disorders. *Compr. Psychiatry* 55 (4), 928–937. <https://doi.org/10.1016/j.comppsy.2013.12.021>.
- Parola, Alberto, Salvini, Rogerio, Gabbatore, Ilaria, Colle, Livia, Berardinelli, Laura, Bosco, Francesca M., 2020. Pragmatics, Theory of Mind and executive functions in schizophrenia: disentangling the puzzle using machine learning. *PLoS One* 15 (3), e0229603. <https://doi.org/10.1371/journal.pone.0229603>.
- Peuskens, J., Gorwood, P., 2012. How are we assessing functioning in schizophrenia? A need for a consensus approach. *Eur. Psychiatry* 27 (6), 391–395. <https://doi.org/10.1016/j.eurpsy.2011.02.013>.
- Piovan, Cristiano, Gava, Laura, Campeol, Mara, 2016. Theory of Mind and social functioning in schizophrenia: correlation with figurative language abnormalities, clinical symptoms and general intelligence. *Riv. Psichiatr.* 51 (1), 20–29.
- Polimeni, Joseph, Reiss, Jeffrey P., 2006. Humor perception deficits in schizophrenia. *Psychiatry Res.* 141 (2), 229–232. <https://doi.org/10.1016/j.psychres.2005.05.012>.
- Polimeni, Joseph O., Campbell, Darren W., Gill, Daryl, Sawatzky, Breanna L., Reiss, Jeffrey P., 2010. Diminished humor perception in schizophrenia: relationship to social and cognitive functioning. *J. Psychiatr. Res.* 44 (7), 434–440. <https://doi.org/10.1016/j.jpsychires.2009.10.003>.
- Rapp, A.M., Mutschler, D.E., Wild, B., Erb, M., Lengsfeld, I., Saur, R., Grodd, W., 2010. Neural correlates of irony comprehension: the role of schizotypal personality traits. *Brain Lang.* 113 (1), 1–12. <https://doi.org/10.1016/j.bandl.2009.11.007>.
- Rapp, Alexander M., Langohr, Karin, Mutschler, Dorothee E., Klingberg, Stefan, Wild, Barbara, Erb, Michael, 2013. Isn't it ironic? Neural correlates of irony comprehension in schizophrenia. *PLoS One* 8 (9), e74224. <https://doi.org/10.1371/journal.pone.0074224>.
- Rapp, Alexander M., Langohr, Karin, Mutschler, Dorothee E., Wild, Barbara, 2014. Irony and proverb comprehension in schizophrenia: do female patients “dislike” ironic remarks? *Schizophr. Res. Treat.* 2014, 841086 <https://doi.org/10.1155/2014/841086>.
- Rapp, Alexander M., Felsenheimer, Anne K., Langohr, Karin, Klupp, Magdalena, 2018. The comprehension of familiar and novel metaphoric meanings in schizophrenia: a pilot study. *Front. Psychol.* 8 <https://doi.org/10.3389/fpsyg.2017.02251>.
- Revelle, William, 2022. psych: Procedures for Psychological, Psychometric, and Personality Research. <https://CRAN.R-project.org/package=psych>.
- Revelle, William, Condon, David M., 2018. Reliability from alpha to omega: a tutorial. *PsyArXiv*. <https://doi.org/10.31234/osf.io/2y3w9>.
- Rossetti, Ileana, Brambilla, Paolo, Papagno, Costanza, 2018. Metaphor comprehension in schizophrenic patients. *Front. Psychol.* 9 <https://doi.org/10.3389/fpsyg.2018.00670>.
- Saban-Bezalel, R., Mashal, N., 2017. Comprehension and hemispheric processing of irony in Schizophrenia. *Front. Psychol.* 8, 943. <https://doi.org/10.3389/fpsyg.2017.00943>. PMID: 28659841; PMCID: PMC5468428.
- San, Luis, Ciudad, Antonio, Álvarez, Enrique, Bobes, Julio, Gilaberte, Inmaculada, 2007. Symptomatic remission and social/vocational functioning in outpatients with schizophrenia: prevalence and associations in a cross-sectional study. *Eur. Psychiatry* 22 (8), 490–498. <https://doi.org/10.1016/j.eurpsy.2007.06.005>. Cambridge University Press.
- Sitek, Emilia, Barczak, Anna, Senderecka, Magdalena, 2017. Zastosowanie jakościowej analizy profilu wykonania skali ACE-III w diagnostyce różnicowej chorób otępiennych [A Qualitative Analysis of the ACE-III Profile in the Differential Diagnosis of Dementia Syndromes]. Text in Polish, 17, pp. 34–41.
- Stiekema, Annemarie P.M., Liemburg, Edith J., van der Meer, Lisette, Castelein, Stynke, Stewart, Roy, van Weeghel, Jaap, Aleman, André, Bruggeman, Richard, 2016. Confirmatory factor analysis and differential relationships of the two subdomains of negative symptoms in chronically ill psychotic patients. *PLOS ONE* 11 (2), e0149785. <https://doi.org/10.1371/journal.pone.0149785>. Public Library of Science.
- Tsoi, D.T.-Y., Lee, K.-H., Gee, K.A., Holden, K.L., Parks, R.W., Woodruff, P.W.R., 2008. Humor experience in schizophrenia: relationship with executive dysfunction and psychosocial impairment. *Psychol. Med.* 38 (6), 801–810. <https://doi.org/10.1017/S0033291707002528>.
- Tsujimoto, Yasushi, Nakamura, Yuri, Banno, Masahiro, Kohmura, Kunihiro, Tsujimoto, Hiraku, Kataoka, Yuki, 2021. Humor-based interventions for people with schizophrenia. *Cochrane Database Syst. Rev.* 10 (10), CD013367. <https://doi.org/10.1002/14651858.CD013367.pub2>.
- Țurcan, Alexandra, Filik, Ruth, 2016. An eye-tracking investigation of written sarcasm comprehension: the roles of familiarity and context. *J. Exp. Psychol. Learn. Mem. Cogn.* 42 (12), 1867–1893. <https://doi.org/10.1037/xlm0000285>.
- Varga, E., Simon, M., Tényi, T., Zs Schnell, A., Hajnal, G., Orsi, T. Dóczy, et al., 2013. Irony comprehension and context processing in schizophrenia during remission—a functional MRI study. *Brain Lang.* 126 (3), 231–242. <https://doi.org/10.1016/j.bandl.2013.05.017>.
- Veatch, Thomas C., 1998. A theory of humor. *De Gruyter Mouton* 11 (2), 161–216. <https://doi.org/10.1515/humr.1998.11.2.161>.
- Vulchanova, Mila, Saldaña, David, Chahboun, Sobh, Vulchanov, Valentin, 2015. Figurative language processing in atypical populations: the ASD perspective. *Front. Hum. Neurosci.* 9, 24. <https://doi.org/10.3389/fnhum.2015.00024>.
- White, R., Bebbington, P., Pearson, J., Johnson, S., Ellis, D., 2000. The social context of insight in schizophrenia. *Soc. Psychiatry Psychiatr. Epidemiol.* 35 (11), 500–507. <https://doi.org/10.1007/s001270050271>.
- Wickham, Hadley, Averick, Mara, Bryan, Jennifer, Chang, Winston, McGowan, Lucy D'Agostino, François, Romain, Grolemond, Garrett, et al., 2019. Welcome to the Tidyverse. *J. Open Source Softw.* 4 (43), 1686. <https://doi.org/10.21105/joss.01686>.