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Evagelia P. Koutra, Sofia Athanasiou, Efstathia Karakosta, Nikitas Arnaoutoglou, Eva-Maria Tsapakis, Konstantinos N. Fountoulakis

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RESEARCH ARTICLE

Picture description impairment and neurocognition in schizophrenia: A pilot study

Evagelia P. Koutra,[1] Sofia Athanasiou,[1] Efstathia Karakosta,[1] Nikitas Arnaoutoglou,[1] Eva-Maria Tsapakis,[1] Konstantinos N. Fountoulakis[1,2]

[1] 3rd Department of Psychiatry School of Medicine, Faculty of Health Sciences Aristotle University of Thessaloniki, Thessaloniki, Greece
[2] WHO Collaborating Center on Quality in Mental Health School of Medicine, Aristotle University of Thessaloniki, Thessaloniki, Greece

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---------- **ABSTRACT** ----------

Schizophrenia is also manifested in a pattern of impaired speech traditionally considered to reflect thought disorder. This pilot study aimed to investigate the relationship between language impairment and other neurocognitive impairments and psychopathology. The study included 10 patients with schizophrenia (5 males), aged 45.5±12.48 years. They were assessed with the PANSS, scales of disability, and a neuropsychological battery. The experimental condition included four pictures with concrete everyday life content. The statistical analysis included the calculation of Spearman's rho correlation coefficient. Picture description was significantly correlated with the PANSS G. Non-significant but high correlations included the PANSS N, ratings of disability, and the Graphic Sequence test, the Rey figure, and the Stroop test, but there was a lack of correlation with verbal fluency, abstract thinking, and executive function Despite the small study sample, it could be said that the impaired performance in picture description in patients with schizophrenia is not a consequence of disordered thought alone, but also of the existence of a dysfunctional processing of visual information and a problematic translation of it into meaningful mental images.

KEYWORDS: Schizophrenia; language disorders; formal thought disorder; visuospatial ability; picture description; psychopathology.

Corresponding Author: Konstantinos N. Fountoulakis, 3rd Department of Psychiatry, School of Medicine, and WHO Collaborating Center, Aristotle University of Thessaloniki, University Hospital AHEPA, 1 Stilp. Kyriakidi str, 45110, Thessaloniki, Greece, Email: fountoul@auth.gr

Introduction

Apart from classical positive psychotic symptoms, schizophrenia is also manifested in a pattern of impaired verbal communication.[1] Patients often exhibit flattened prosody and loose semantic associations in their speech that are traditionally considered to reflect thought disorder rather than language impairment per se. The literature supports the understanding that speech disorder in schizophrenia is the direct result of the so-called Formal Thought

Disorder (FTD), which includes disturbances in concept formation, semantic issues like neologisms, and transitions between thoughts, and includes how one perceives, interprets, structures, and responds to information.[2-5] However, problems from basic phonetics to more complex semantic, grammar, and syntactic levels have been reported,[6-10] and a possible relationship with longer duration of illness and severity of both positive[11] and negative symptoms[12-15] has also been proposed.

These impairments were also reported to constitute an endophenotype, as they were frequently observed in healthy relatives of patients and people at high risk.[16-19]Comprehension difficulties also seem to exist, as patients struggle to process linguistic information.[20-23] The neuropathology underlying language disorders in schizophrenia remains unknown.[11,24-26]

Until now, a variety of methods have been used to study language in schizophrenia. Studies on verbal fluency suggest the existence of non-disorder-specific inability to distinguish target signal from competing noise and to maintain cues for production of memory probes as a result of impaired cognitive control, and this manifests in variable ways corresponding to different underlying mechanisms.[27-29]

Spontaneous speech research revealed possible disease-specific problems in the temporal organization of speech.[30,31] Research on picture naming or the description of vague pictures revealed the existence of specific action-naming impairments that could arise from problems in both semantic and postsemantic processes.[32] To our knowledge, there is no attempt so far to investigate the performance of patients in the description of simple pictures with clear and concrete content, in a similar way to the testing of dementia,[33-35] and in a manner closer to everyday life demands.[36-39] Also, the data concerning the relationship of language problems with dysfunction in other neurocognitive domains is inconclusive, given the variety of language problems and the assessment methods.

This pilot study aimed to register a possible impairment in patients with schizophrenia in the description of simple pictures and to investigate the relationship of such an impairment with other neurocognitive impairments and psychopathology. As small-scale pilot studies are exploratory, the findings of this study will be used to develop and formulate a proper research question to design larger-scale future research.

Materials and methods

Participants and procedures

The study included 10 physically healthy outpatients (5 males), aged 45.5±12.48 years (range 19-56), suffering from schizophrenia. To be included in the study, the participants should have a normal IQ, should not suffer from any neurological or other somatic disorder, and should not manifest substance or alcohol abuse at present or in the past. Smoking was allowed. Any medication treatment was not a contraindication to participate in the study.

All participants provided written informed consent to participate in the study. The study was approved by the Ethics Committee of the School of Medicine, Aristotle University of Thessaloniki, Greece (ref number 260/2024)

The research protocol included the gathering of sociodemographic data and the registration of medication. Antipsychotics were transformed into olanzapine equivalents.[40] Half of the patients had a family history of any mental disorder. The variable 'family history load' was calculated as the number of individual persons in the family with any mental disorder (first and second-degree relatives).

Measures

The psychotic symptoms were assessed with the Structured Clinical Interview of the Positive and Negative Symptoms Scale (SCI-PANSS),[41,42] disability was assessed with the Global Disability Scale (GloDiS)[43] and the General Assessment of Functioning (GAF),[44] and the quality

of life was assessed with the visual analog (thermometer type) Quality of Life (QoL) scale.[45] The neurocognition was assessed with a collection of tests that included the random letter test (attention and concentration) and the Graphic Sequence test ,[46] the digit span-backwards and the Trail-making test A and B (working memory and mental speed), copying two- and three-dimensional shapes (visuospatial ability), the clock drawing test (executive functions),[47] copying of the Rey-Osterrieth Complex Figure test (visuospatial perception),[48] word naming (verbal fluency), a variation of the Stroop Test (counting mistakes only; mental inhibition).[49] Three tests are not published, but they are under standardization: a copying of two and three-dimensional scales copying task, a test of encoding strategies, and a story comprehension test (social cognition), while for the digits backwards, TMT A and B, and verbal fluency normative data are currently being collected. For all those tests, normative data are being collected.

Although important alternative theoretical models of the PANSS and schizophrenia exist, including works of our group,[50-52] we chose to use the original PANSS subscales (P-positive, N-negative, and G-general psychopathology).

The experimental condition included four pictures (Pic1-4) with concrete everyday life content, and the subject was asked to describe each of them while observing them. Two had colors, and two were black/white. One in each category had little information, while the other was complex. The description of the pictures is shown in table 1. The first picture is in color and includes a scene of one male adult and three children in a beach, the second is also in color and includes an agricultural scene in the tropics with two female adults around a fire, one male carrying goods, two kids and to farm animals, the third is a simple black and white picture of a small house and a tree, and the fourth is a more complex black and white of a house with two trees and a landscape.

Statistical analysis

The statistical analysis was performed using the IBM SPSS software and included the development of frequency tables and the calculation of Spearman's rho correlation coefficient.

No correction for multiple comparisons was applied since this is a pilot study, with an exploratory purpose on a small study sample.

Results

The basic descriptive statistics of the study sample, including sociodemographic and clinical variables as well as psychopathology and neurocognition, are shown in table 2. In the same table, patients' performance in the description of the four pictures is shown as percentages of the total number of pieces of information from the picture included in the patient's description. Patients performed similarly in the two low-information pictures (Pic1 and Pic3) and better than in the two high-information pictures (Pic2 and Pic4).

The correlations (Spearman's rho) of the performance in the four pictures with all the sociodemographic, clinical, psychometric, and neuropsychological variables are shown in table 3. The study sample was very small (N=10), and the whole study was a pilot one, however, there was a statistically significant result concerning the correlation of the PANSS G with Pic2 and Pic4. Non-significant but high was its correlation with Pic1, and the pattern of correlations suggests that the general psychopathology reduces performance to picture description in a direct relationship with their difficulty (as reflected in the patient's performance).

Correlations equal to or above 0.50 were considered important to further investigate the components determining the patients' performance. Interestingly, age, age at onset, and duration of being ill did not seem to affect performance. A similar pattern with PANSS G was manifested by PANSS N, although the correlations did not reach significance. This was also the

case with disability (especially its severity), as assessed by the GloDiS, except for picture Pic2, which was the most difficult one. A surprise was that the GAF manifested no correlations. Interestingly, Pic2 correlated positively with quality of life (QoL).

Maybe the most important finding of the current pilot study was the lack of correlation between verbal fluency, abstract thinking, and executive function on one side and picture performance on the other. Equally important is the observation that this performance seems to show some correlation with the Graphic Sequence test, the Rey figure, and the Stroop test.

Discussion

The present study is a small-scale pilot study, and its findings should be considered only exploratory and interpreted with caution. It reports that overall, color does not seem to play an important role in the performance of picture description in patients with schizophrenia. On the contrary, the loading with information affects the performance in a non-linear way, since the cognitive demands increase disproportionally. The most robust effect on performance was manifested by general psychopathology and negative symptomatology, as well as by the severity of disability, and especially by the severity of mental disability. No important correlation was observed between picture performance and verbal fluency, abstract thinking, and executive function, and this was a surprise since such a finding was expected as a principal finding from the review of the literature. Instead, picture performance showed some correlation with the Graphic Sequence test, the Rey figure, and the Stroop test, all reflecting attentional processes (frontoparietal attentional network- FAN), and mental imaging in the interaction between the frontal, temporal, and parietal lobes.[46,53-57]

These correlations could imply that the central role in the impaired ability to process and describe a picture in schizophrenia is held by dysfunction at the level of mental imaging that implicates the right parietal cortex as well as the dorsolateral prefrontal cortex (working memory).[58-60] Since the digits backward test does not manifest any correlation, the most probable interpretation could be that there is a severe dysfunction that affects even less demanding tasks in terms of working memory, with subcortical areas playing a major role.[61] Since the Trail Making test does not correlate with performance, the subcortical dysfunction should be specific, not generalized, unrelated to general mental speed, and could lead to local dysfunction of connected cortical areas, maybe because of dysfunctional filters and selection processes.[62,63]

In the literature, the basic theory suggests that thought disorder is conceptualized as thought-language-communication disorder (TLC disorder),[64] but another more elaborate conceptualization includes content thought disorder (CTD), which refers to delusions and disorganized thought (and subsequently speech) and formal thought disorder (FTD), which refers to the disruption of the form (or structure) of thought and unlike hallucinations and delusions, it is an observable, objective sign of psychosis.[26,65,66] FTD is a common core symptom of a psychotic disorder, may include incoherence, peculiar words, disconnected ideas, or a lack of unprompted content expected from normal speech, and may be seen as a marker of severity and as an indicator of prognosis.[67] It is further subdivided into positive formal thought disorder (posFTD; includes pressure of speech, tangentiality, derailment, incoherence, and illogicality) and negative formal thought disorder (negFTD; includes poverty of speech and poverty of content).[65,67] In structured conversations, FTD might be difficult to detect,[3] and research has shown that psychopathology is the prime factor in the shaping of aspects of thought disorder.[2,66] It is FTD specifically that, according to the literature, is behind linguistic problems in schizophrenia, although it seems that linguistic problems in these patients could manifest in a variety of ways, and there is no single clear pattern present.[68]

Although the study sample was small, the current study tends to confirm that psychopathology, especially general psychopathology, and negative symptoms, as well as the

severity of disability, play a major role in the impairment of picture description,[31] but on the other hand, it suggests that in neurocognitive terms, attentional and visuospatial processes rather than language and executive function play a role. This supports the concept that FTD is partially responsible for our findings, but alone, it is not an adequate explanation. An additional important finding is that in our small pilot sample, the performance on tests involving the description of relatively simple images was significantly impaired.

Of the neurocognitive tests found to correlate with picture performance, the Graphic sequence test[46] is a variation of the Alternating Sequences Tests introduced by Luria[69-71] and assesses the ability of the frontal lobes to inhibit inappropriate responses.[72,73] There is a graphic (drawing) version that demands the patient to copy a simple alternation of rectangles and peaks. Impaired patients tend to repeat the same movement or shape and do not alternate with the other component of the pair. The Rey-Osterrieth complex figure is an objective measure of visuospatial function and does not involve semantic cognition.[74] It reflects measures of visual exploration and perception, judgment of spatial relations, visual organization, and set-shifting, as well as design fluency.[48,75,76] It seems related to the metabolic rate of the bilateral temporal-parietal cortex and occipital lobe, and the right frontal lobe,[74,77] while its relationship with executive function, specifically planning and organization seems strong.[78,79]

The error rate of the Stroop test[49] is an index of inhibitory control[80] or an index of impaired working memory.[81] The related brain areas include the anterior cingulate cortex and the dorsolateral prefrontal cortex[82-84] with the cingulate cortex selecting the appropriate response and allocating attentional resources.[84-88]

Conclusion

Again, the study sample was small, and the current study was a pilot one. However, taking together the interpretations of the GST, Rey- Osterrieth figure, and the Stroop test, along with the negative findings for the other neurocognitive tests, a possible early conclusion could be that the impaired performance in picture description in patients with schizophrenia is not a consequence of FTD alone, but the existence of a dysfunctional processing of visual information and a problematic translation of them into meaningful mental images significantly contributes. This neurocognitive process demands distributed and alternating attention, working memory to keep information readily available, and the development of mental images as reflections of external reality perceived through visual input.

The current study is a small pilot study, and therefore, its results and their interpretation should be considered with caution until bigger datasets are available. However, the findings are strong enough to trigger a hypothesis to be tested in future research.

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Table 1: Description and characteristics of the testing pictures

Picture No	Color/BW	Description of content	No of sub-scenes	Information load	No of information elements
Pic1	Color	Seaside scenery, 4 people sunbathing	3	low	24
Pic2	Color	Tropical scenery, 5 people and 2 animals	5	high	34
Pic3	B/W	A house and a treee	1	low	7
Pic4	B/W	Two houses and two trees, a river and a boat with a person on it	3	high	20

Table 2: Descriptive statistics of sociodemographic and clinical variables as well as of psychopathology and neurocognition

	Mean	Min	Max	SD
Age (years)	45.50	19	56	12.48
Paternal age (at delivery)	35.22	28	51	7.41
Maternal age (at delivery)	32.00	24	40	5.63
Olanzapine Equivalents	18.81	1	77	21.26
Total No of episodes	2.50	1	6	1.72
Age at psychosis onset (years)	24.80	7	47	13.29
Age at Most Recent Episode (years)	34.50	7	52	15.76
Duration	11.00	1	42	12.65

Family history load	1.90	0	6	2.33
PANSS P	17.50	8	30	8.06
PANSS N	18.70	9	33	6.95
PANSS G	34.90	20	46	8.03
PANSS Total	71.10	37	97	19.91
GloDiS Everyday Functioning	14.80	6	36	10.46
GloDiS Social and Interpersonal Functioning	6.40	0	14	4.72
GloDiS Severity	11.40	3	24	6.83
GloDiS Mental Disability	7.70	0	18	5.62
GloDiS Total	32.30	9	62	19.98
GAF	53.50	35	85	14.35
QoL Scale	48.50	10	100	26.88
Digits backwards	3.70	3	6	0.95
Trail Making test A	68.60	38	95	20.69
Trail Making test B	175.10	87	311	70.44
Graphic sequence test	9.50	1	14	3.59
Copy a necker cube	6.30	2	12	3.13
Copy a house	8.90	4	13	2.47
Draw a clock (Mendez score)	18.80	14	21	1.87
Rey figure	37.90	27	55	7.81
Verbal fluency	45.60	36	55	6.04
Abstract thinking	36.90	20	50	10.75
Social cognition	20.50	5	30	8.20
Stroop test (mistakes)	3.90	0	23	7.11
Picture description (correct information %)				
PIC1	47.08	25	88	22.99
PIC2	36.47	24	76	15.51
PIC3	48.57	29	100	24.47
PIC4	38.00	15	90	24.63

Table 3: The correlations (Spearman's rho) of the performance in the four pictures with all the sociodemographic, clinical, psychometric and neuropsychological variables.

	Pic1%	Pic2%	Pic3%	Pic%
Age (years)	0.03	0.06	-0.22	0.06
Paternal age (at delivery)	0.22	-0.10	0.37	-0.18
Maternal age (at delivery)	0.09	-0.17	0.25	-0.22
Olanzapine Equivalents	0.10	0.07	0.28	-0.06
Total No of episodes	0.43	0.29	0.12	0.40
Age at psychosis onset (years)	0.00	0.43	0.03	0.17
Age at Most Recent Episode (years)	-0.04	0.20	-0.08	0.08
Duration	0.07	-0.06	0.11	0.08
PANSS_P	-0.26	-0.42	0.03	-0.33
PANSS_N	-0.50*	-0.44	0.09	-0.45
PANSS_G	-0.56*	-0.69**	-0.21	-0.65**
PANSS total	-0.57*	-0.58*	-0.16	-0.57*
Glo.Dis Everyday Functioning	-0.31	0.16	-0.20	-0.34
Glo.Dis Social and Interpersonal Functioning	-0.27	-0.05	-0.27	-0.37
Glo.Dis Severity	-0.57*	-0.39	-0.49	-0.63*
Glo.Dis Mental Disability	-0.49	-0.15	-0.48	-0.56*
Glo.Dis Total	-0.44	-0.11	-0.33	-0.50*

GAF	-0.19	0.01	0.03	-0.23
QoL	0.06	0.51*	0.07	0.15
Digits backward	0.25	0.27	0.23	0.33
Trail Making test A	-0.14	-0.46	-0.09	-0.26
Trail Making test B	-0.25	-0.38	-0.12	-0.27
Graphic sequence test	0.60*	0.25	0.62*	0.49
Copy a necker cube	0.11	0.39	0.43	0.18
Copy a house	0.27	0.27	0.18	0.38
Draw a clock (Mendez score)	0.08	0.11	0.49	0.00
Rey figure	0.15	0.56*	0.26	0.38
Verbal fluency	-0.30	-0.25	-0.02	-0.28
Abstract thinking	0.21	0.21	-0.02	0.34
Social cognition	0.05	0.02	-0.36	-0.01
Stroop test (mistakes)	-0.62*	-0.20	-0.40	-0.45

*not significant but >0.50 in numerical value, ** $p<0.05$

PSYCHIATRIKI

ΕΡΕΥΝΗΤΙΚΗ ΕΡΓΑΣΙΑ

Έκπτωση της περιγραφής εικόνας και νευρονοητική λειτουργία στη σχιζοφρένεια: Πιλοτική μελέτη

Ευαγγελία Κούτρα,[1] Σοφία Αθανασίου,[1] Ευσταθία Καρακώστα,[1] Νικήτας Αρναούτογλου,[1] Εύα Μαρια Τσαπάκη,[1] Κωνσταντίνος Ν. Φουντουλάκης[1,2]

[1] Γ Πανεπιστημιακή Ψυχιατρική Κλινική, Τμήμα Ιατρικής, Σχολή Επιστημών Υγείας, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, Θεσσαλονίκη, Ελλάδα
[2] Κέντρο Συνεργασίας του ΠΟΥ για την Ποιότητα στην Ψυχική Υγεία, Τμήμα Ιατρικής, Σχολή Επιστημών Υγείας, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, Θεσσαλονίκη, Ελλάδα

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---------- **ΠΕΡΙΛΗΨΗ** ----------

Η Σχιζοφρένεια εμφανίζει επίσης μια μορφή έκπτωσης λόγου η οποία παραδοσιακά θεωρείται ότι αντανακλά διαταραχή της σκέψης. Η παρούσα πιλοτική μελέτη στοχεύει στη διερεύνηση της σχέσης μεταξύ της έκπτωσης της γλωσσικής ικανότητας με άλλες νευρονοητικές εκπτώσεις και την ψυχοπαθολογία. Η μελέτη περιέλαβε 10 ασθενείς με σχιζοφρένεια (5 άνδρες), ηλικίας 45,5±12,48 ετών. Εκτιμήθηκαν με την PANSS, με κλίμακα αναπηρίας καθώς και με μια νευροψυχολογική συστοιχία. Η πειραματική συνθήκη περιλάμβανε τέσσερεις εικόνες με σαφές περιεχόμενο από την καθημερινή ζωή. Η στατιστική ανάλυση περιλάμβανε τον υπολογισμό του Spearman's rho Correlation Coefficient.Η περιγραφή των εικόνων σχετιζόταν σημαντικά με τον παράγοντα PANSS G. Μη σημαντικές αλλά υψηλές αριθμητικά συσχετίσεις παρατηρήθηκαν σε σχέση με τον PANSS N, την αναπηρία και τα Graphic Sequence test, Rey figure, και το Stroop test αλλά δεν υπήρχε συσχέτιση με τη λεκτική ευφράδεια, την αφαιρετική σκέψη και τις εκτελεστικές λειτουργίες. Παρά το μικρό δείγμα της μελέτης, θα μπορούσε να ειπωθεί ότι η έκπτωση στην επίδοση της περιγραφής εικόνας σε ασθενείς με σχιζοφρένεια δεν είναι απότοκος μόνο της διαταραχής της σκέψης αλλά επίσης οφείλεται σε μια δυσλειτουργία στην επεξεργασία της οπτικής πληροφορίας και προβληματικής μετάφρασής της σε νοητικές εικόνες με νοηματικό περιεχόμενο.

ΛΕΞΕΙΣ ΕΥΡΕΤΗΡΙΟΥ: Σχιζοφρένεια, γλωσσικές διαταραχές, διαταραχή δομής της σκέψης, οπτικοχωρική ικανότητα, περιγραφή εικόνας, ψυχοπαθολογία.

Επιμελητής συγγραφέας: Κωνσταντίνος Ν. Φουντουλάκης, Γ΄ Πανεπιστημιακή Ψυχιατρική Κλινική, Τμήμα Ιατρικής, Σχολή Επιστημών Υγείας, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, Πανεπιστημιακό Νοσοκομείο ΑΧΕΠΑ οδός Στυλπ. Κυριακίδη 1, 54636, Θεσσαλονίκη, Ελλάδα, Email: fountoul@auth.gr