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The assessment of chosen psychometric features of B-CATS test battery in schizophrenia – preliminary report

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Summary

Aim. The assessment of cognitive impairment in schizophrenia proves helpful in the diagnosis of disease, identification of individuals at risk for adverse outcome and choosing the most adequate treatment. It is also a valuable complement of the psychiatric diagnosis. For this reason, there is a great need for a practical well-validated instrument to measure cognitive deficits that can be administered and interpreted easily in a clinical setting. The aim of the study was to verify the reliability, validity and practicality of the Brief Cognitive Assessment Tool for Schizophrenia (B-CATS) in a clinical setting.

Methods. 68 psychotic patients were included in the study during their stay in a psychiatric ward. A double measurement was conducted. Test-retest assessment included tests of B-CATS battery (TMT part B, Category Fluency, Digit Symbol Test). To evaluate the intensity of psychopathological symptoms the PANSS was performed. SLOF, GAF, GARF, SOFAS were used to assess functioning of the subjects.

Results. The B-CATS is characterized by a satisfactory relative stability. The absolute stability should be seen as sufficient in case of one test: Fluency. The diagnostic validity of the battery is satisfactory. B-CATS is easy to administer and "friendly" for the patient.

Conclusions. B-CATS is a brief and practical instrument that can provide clinicians with meaningful data regarding the global cognitive functioning of the psychotic subjects.

Key words: schizophrenia, neurocognitive assessment, B-CATS

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Introduction

Cognitive deficits constitute one of the main features of schizophrenia and they are slowly becoming an important target of pharmacological treatment and rehabilitation. Recent years witnessed an increase in the usage of neurocognitive tests in schizophrenia research [1]. Popularity of neuropsychological assessment stems from separation of a cognitive dimension as the main target of pharmacological treatment and a search for 'pro-cognitive' antipsychotics [2]. It is well known that the presence and seriousness of the cognitive impairments play an important role among the factors conditioning the prognosis of the illness [3, 4]. It results also in devising numerous cognitive rehabilitation therapy programs and non-pharmacological strategies aimed at improving the cognitive functions among people diagnosed with schizophrenia. In the view of the development of the pharmacological, rehabilitation and psychotherapeutic interventions aimed at improving cognitive functioning, the lack of a proper tool, which would be simple to interpret and to apply in clinical conditions in Poland, is a serious obstacle. In the below mentioned article we present one of such tools, mainly, the B-CATS test (Brief Cognitive Assessment Tool for Schizophrenia).

Currently used tools – a brief overview

Currently we are in possession of modern cognitive batteries, often computerized, which allow for objective assessment of the efficiency of various cognitive abilities. Among the batteries which comprise of a vast spectrum of cognitive functioning measurement in schizophrenia we can differentiate *Neuropsychological Assessment Battery* [5], MATRICS *Consensus Cognitive Battery* [6, 7] and a fully computerized *CogTest Battery* [8], the last of which are also available in Polish version. Further battery which is enjoying a wide popularity in Poland is the *Vienna Test Battery* [9]. Each of the above mentioned test batteries allows for a detailed assessment of numerous cognitive functions such as: attention and vigilance, working memory, verbal and visual learning, reasoning and problem solving, speed of processing, executive functions, perceptual organization.

One can also differentiate brief tools of cognitive assessment used among schizophrenia patients to which we can include B-CATS battery. Among other tests of this sort we could enumerate the following: *Repeatable Battery for the Assessment of Neuropsychological Status* [10], *Brief Assessment of Cognition in Schizophrenia* [9, 11] available also in Polish version or a 15-minute *Brief Cognitive Assessment* [12] which has been selected on the basis of experts' decision. Each of the above mentioned tools demonstrates a strong correlation with the composite score of extensive neuropsychological batteries and, therefore, it constitutes an alternative in the case of a general overview of the functioning of the patient.

The practice of cognitive functioning measurement in schizophrenia is based mainly on simple tools from the point of view of practical application, and directed at the assessment of the working memory and executive functions. The analysis of the articles placed in the PubMed database in years 1995-2004 conducted by Mosiołek et al. [1] points to the fact that among the tools most widely used to conduct cognitive functions

assessment we could enumerate: The Wisconsin Card Sorting Test *(*WCST*), verbal fluency tests, The* Wechsler Memory Scale *(*WMS), The Stroop Test, Continuous Performance Test *(*CPT*),* Trail Making Test *(*TMT*) Parts A and* B, Rey Auditory Verbal Learning Test *(*RAVLT*).*

Brief Cognitive Assessment Tool for Schizophrenia (B-CATS)

The aim of the authors of B-CATS was an empirical selection of tests which would meet all of the three following criteria: the results of which would optimally reflect the cognitive functioning level of the patient, their practical implementation would be simple and performance time would fall within 12 minutes. In the process of construction of B-CATS battery, the tests included in the contents of comprehensive neuropsychological batteries used in three extensive clinical studies including 1134 patients were considered. Ultimately, three tests were included in the B-CATS battery: the Trail Making Test (part B), Verbal Fluency: names of animals, fruits and vegetables, and Digit Symbol Test (subtest of the WAIS-R non-verbal performance scale). The tests presented above strongly correlate (between 0.73 to 0.82) with the global score of the extensive batteries of cognitive tests conducted among schizophrenia patients [13]. Hurford et al. [13] suggest a possibility of shortening the time of administering the whole battery of tests through a limitation of Category Fluency to the names of the animals. In two out of three clinical researches, to which the authors of the battery referred, solely this form of fluency assessment was used. Taking into consideration the fact that in Polish clinics it is the most popular version of verbal fluency assessment of the participant, we have decided to use the proposed shorter version of the B-CATS battery in our research.

Aim of the research

The aim of the research was an assessment of the chosen psychometric features of the B-CAT. The following indicators were examined: (1) reliability of the battery (test-retest method), (2) criterion validity (correlations between demographic data, mental state and functioning assessment scales of the patient) and (3) practical application of the tool in ward conditions.

Methods

Patients

68 patients (43 men and 25 women) took part in the research. 62 of them were admitted to the open ward specializing in treatment of the first episode of psychosis, while 6 participated in a occupational therapy program. There were 62 patients diagnosed with paranoid schizophrenia (F20.0) and 6 patients with psychotic symptoms, who were diagnosed with a different illness after a thorough examination (F20.8, F20.9, F29, F25.2, F31.2, F92.8). Mean age of the participants was 27.7 years of age (SD = 6.6, min = 18, max = 45) and duration of illness was less than 6 years (M = 5.8, SD = 5.3, min < 1, max = 26). Mean value computed for the number of episodes was

2.5 (SD = 1.6). Education level computed in years was 13.9 (SD = 2.8). 16 people were hospitalized due to the first psychotic episode. Patients were treated with second--generation antipsychotics in the majority of cases.

13 participants (19%) in the studied group were employed, the rest of them: were receiving disability pension (n = 24, 35%), were studying (n = 6; 9%), were unemployed (n = 4; 6%) or were financed by the members of their families (n = 14; 21%), there were seven missing data (10%). Two people were married. 22 participants (32%) had a head injury and 14 patients (21%) attempted a suicide at least once. 34 participants (50%) had at least one member of the family with diagnosed mental illness or other mental disorder. 33 participants (49%) disclosed in the interview at least one addiction (in most cases it was an addiction to nicotine).

Procedures

The participants were informed about the aim and the study and asked for their consent. Subsequently, in a brief interview demographic data and basic information about illness history and other aspects of patients' functioning were collected. The next step of the procedure was conducting neuropsychological tests included in the B-CATS battery. The following tests were conducted: (1) Trail Making Test, part B, (2) Verbal Category Fluency (names of animals), (3) Digit Symbol Test (subtests of the Wechsler non-verbal performance scale WAIS-R). The sequence of the tests was not rotated. After the end of the meeting the following aspects of functioning of the patients were assessed: general functioning (GAF scale), social functioning (SOFAS, SLOF scales) and relational functioning (GARF scale). The psychiatrist completed the PANSS scale. In case of 50 participants (73%), part of the procedure (without the tests measuring the level of functioning of the patients: GAF, GARF, SOFAS, LOF) was repeated. 18 people (27%) were assessed once. Mean value computed for the time between sessions was 41 days (SD = 19.7).

Material

B-CATS comprises of the following tests:

1. Verbal fluency (*Controlled Oral Word Association Test, COWAT)* is a brief clinical trial assessing the patient's ability to generate words, speed of processing and various memory processes. The results of verbal fluency tests are believed to be a valid indicator of executive functions efficiency [13]. In our research the patients were asked to enumerate animals (semantic fluency). The duration of the task was 60 seconds. The result is measured with the number of words [14, 15].
2. The Trail Making Test part B *(TMT)* constitutes a component of the Halstead-Reitan test battery and serves assessment of the efficiency of attention processes, visuospatial aspects of the working memory and cognitive plasticity, i.e. the ability to switch attention between stimuli of different nature, which is perceived to be one of the aspects of the executive function [16]. The test enables to assess the pace of mental performance of the participant. The task of the participant is to connect the points alternately marked by numbers and letters of the alphabet ranging from

the smallest number and from the letter A subsequently, according to the alphabetical order. The time of task completion constitutes the result; the lower the score the better the cognitive ability of the participant [15, 17].

3. Digit Symbol Test is one of the subtests of the non-verbal scale of the Wechsler Adult Intelligence Scale WAIS-R (PL). It measures the learning ability and psychomotor efficiency of the participant, engages attention functions and evaluates the speed of processing. It involves matching 10 numerical symbols to their equivalents of signs similar to letters of the alphabet. The result is measured by the number of correctly matched symbols [18].

The following tools were used in order to assess patients' functioning:

1. *Global Assessment of Functioning* scale (GAF) which is a brief ordinal scale enabling the clinician to assess the general level of psychological, social and occupational functioning of the individual within the range from 0 to 100 points [19-21].
2. *Social and Occupational Functioning Assessment Scale* (SOFAS), constituting a modification of the GAF scale, concentrates solely on the social and occupational functioning of the individual. Similarly, it defines 10 sections and the functioning of the patient is assessed on a scale ranging from 0 to 100 points [19-21].
3. *Global Assessment of Relational Functioning* scale (GARF), which also constitutes a modification of the GAF scale, defines a numerical result denoting the level of functioning of the participant on a scale ranging from 0 to 100 points. The scale is aimed at directing the assessment of the level of functioning of the patient in relations which constitute his basic support groups, which are mostly family relations [19-21].
4. *Level of Functioning* scale (SLOF) is based on a semi-structured clinical interview including 9 questions that belong to 4 areas. Four subscales were identified: Social Contacts, Work, Symptomatology, Functioning. The sum of the results of the above mentioned subscales constitute a total score [22].

Positive and Negative Syndrome Scale (PANSS) was used to assess the severity of the symptoms of the illness. PANSS is a clinical scale allowing for assessment of psychopathological symptoms among the schizophrenia patients. The positions of the scale constitute three subscales: positive symptoms, negative symptoms and general psychopathology [23].

Results

Reliability of the B-CATS

In order to verify the reliability of the B-CATS battery a double measurement was conducted. The results aiming at the evaluation of the reliability using the absolute and relative stability assessment method of the administered tests (test-retest method) are presented in table 1.

Table 1. **Reliability of the B-CATS tool assessed with the test-retest method: analysis with Student's t-test for dependent data and Pearson's r correlation of the results of B-CATS scales in the measurement 1 and 2.**

B-CATS	Measurement 1		Measurement 2		Difference between 1st a 2nd measurement				Correlation between 1st a 2nd measurement		
	M	SD	M	SD	t	df	p	d Cohen	r	df	p
TMT	92.4	37.9	75.7	28.0	4.38	46	0.000	0.64	0.73	45	0.000
Fluency	17.8	6.4	18.0	6.3	0.31	47	0.758	0.04	0.73	46	0.000
Digit Symbol Test	44.3	9.9	48.6	12.7	2.84	47	0.007	0.41	0.61	46	0.000

M – arithmetic mean, SD – standard deviation, t – value of Student's t-test, df – degrees of freedom, p – level of significance, d Cohen – effect size, r – correlation coefficient

Additionally, due to a large variance in terms of intervals between the first and the second assessment (94 days), the Pearson's r correlation analysis was performed between the length of intervals between the assessments expressed in days and the result difference in a particular test between the first and the second measurement. The analysis did not demonstrate any significant correlations between the length of the interval measured in days and (1) the change in the TMT (part B), $r(45) = -0.02$, $p > 0.05$, (2) the Fluency test, $r(46) = -0.16$, $p > 0.05$, (3) the Digit Symbol Test, $r(46) = -0.24$, $p > 0.05$.

As an additional element we performed an analysis of correlation between TMT, Fluency and Digit Symbol in the first and second measurement. TMT test scores correlated significantly with Fluency test scores ($r(66) = -0.35$, $p < 0.01$) and Digit Symbol Test scores ($r(65) = -0.32$, $p < 0.05$) in the first measurement. Performance in Fluency test and Digit Symbol Test were also significantly correlated ($r(65) = 0.36$, $p < 0.01$). In the second measurement, we found significant correlations between scores of TMT and Digit Symbol tests ($r(45) = -0.45$, $p < 0.01$) and between scores of Fluency and Digit Symbol tests ($r(46) = 0.46$, $p < 0.001$)

Diagnostic validity of the B-CATS

Diagnostic (criterion) validity of the B-CATS tool was analyzed in terms of three group of variables: (1) demographic data and the course of illness, (2) severity of the psychopathological symptoms and (3) the level of functioning of the patient.

Student's t-test for independent data was used in order to verify the difference between men and women in the results of B-CATS across measurements. The analysis indicates that solely the results of the TMT performed in the first measurement were different between the two groups. It took significantly longer for women to complete the test ($M = 122$, $SD = 72$) than men ($M = 89$, $SD = 40$), $t(32.72) = 2.1$, $p < 0.05$, d Cohen = 0.36. The statistical analyses searching for a correlation between the results of B-CATS in both measurements and the variables such as age, years of education, marital and professional status, occurrence of mental illnesses among the family, head injuries and addiction did not show any significant relations.

Table 2. **Spearman's rho correlation between the B-CATS results obtained in the measurement 1 and 2 and chosen data relating to the course of the illness.**

B-CATS	Measurement	Course of illness							
		Length of illness (in years)		No. of hospitalizations		No. of psychotic episodes		Suicidal attempts	
		rho	p	rho	p	rho	p	rho	P
TMT	1	0.18	0.15	-0.10	0.42	0.16	0.28	0.16	0.21
	2	0.44	0.002	0.11	0.44	0.46	0.006	0.32	0.04
Fluency	1	0.10	0.42	0.09	0.49	-0.16	0.29	0.05	0.72
	2	0.06	0.67	0.13	0.37	-0.20	0.25	0.04	0.83
Digit Symbol Test	1	-0.17	0.18	-0.04	0.74	-0.14	0.36	0.25	0.85
	2	-0.55	0.000	-0.52	0.000	-0.59	0.000	-0.13	0.44

rho – correlation coefficient, p – level of significance

Table 2 presents Spearman's rho correlation coefficients referring to correlations between the B-CATS results obtained in the assessment 1 and 2 and the indicators relating to the course of illness, such as illness duration expressed in years, number of hospitalizations, number of psychotic episodes and suicidal attempts. Table 3 presents Pearson's r correlation coefficients referring to a relation between the B-CATS results obtained in the assessment 1 and 2 and the psychopathological symptoms assessed with PANSS (measurement 1). Finally, table 4 presents Pearson's r correlation coefficients relating to the relation between the level of functioning of the patients in the first measurement and the results of the cognitive tests conducted in the first and second measurements.

Table 3. **Pearson's r correlation between B-CATS results obtained in the measurement 1 and 2 and a measurement with the use of a scale to assess the intensification of psychopathological symptoms PANSS.**

B-CATS	Measurement	PANSS Measurement 1							
		Positive symptoms		Negative symptoms		General symptoms		Total	
		r	p	r	p	R	p	r	P
TMT	1	0.37	0.02	0.3	0.06	0.31	0.05	0.38	0.01
	2	0.28	0.12	0.47	0.008	0.02	0.91	0.25	0.17
Fluency	1	-0.17	0.30	-0.51	0.001	-0.28	0.07	-0.39	0.001
	2	-0.36	0.04	-0.66	0.000	-0.42	0.02	-0.58	0.000
Digit Symbol Test	1	-0.26	0.11	-0.23	0.15	-0.11	0.51	-0.21	0.19
	2	-0.22	0.23	-0.31	0.09	-0.23	0.20	-0.31	0.09

r – correlation coefficient, p – level of significance

Table 4. **Pearson's r correlation between B-CATS results obtained in the measurement 1 and 2 and a measurement using the following scales of social functioning GAF, GARF, SOFAS and SLOF.**

B-CATS	Measurement	Measurement 1							
		GAF		GARF		SOFAS		SLOF	
		r	p	r	p	r	p	r	p
TMT	1	-0.42	0.001	-0.27	0.07	-0.41	0.002	-0.30	0.03
	2	-0.29	0.07	-0.34	0.06	-0.30	0.05	-0.14	0.37
Fluency	1	0.37	0.006	0.22	0.15	0.37	0.005	0.34	0.01
	2	0.52	0.000	0.29	0.01	0.40	0.006	0.39	0.01
Digit Symbol Test	1	0.34	0.01	0.18	0.25	0.43	0.001	0.49	0.000
	2	0.47	0.002	0.46	0.007	0.58	0.000	0.56	0.000

r – correlation coefficient, p – level of significance

Practical application of B-CATS

The patients included in the research as well as the researchers conducting the tests were asked to voice their opinion on the presented battery of tests. The tests were assessed as 'easy' by the patients, who eagerly consented to retake the tests at the end of their stay at the hospital ward. The instruction used did not leave any doubts and after the test completion the participants declared a low level of weariness.

From the researchers' point of view, the B-CATS battery did not raise any concerns. Preparation, administration and scoring of the tests were assessed as simple and little time consuming. Administration of the tests lasted in between 6 to 10 minutes. Observations made during the test administration and quantitative analysis of the participant's performance provided valuable information enabling a more precise assessment of the mental state of the patient and facilitated the adjustment of a therapeutic intervention.

Discussion

The arrangement of the results shows that only one of B-CATS tests (Fluency) are characterized by a satisfactory absolute stability measured by a test-retest method, whereas the absolute stability of both TMT and Digit Symbol Test is unsatisfactory as the tests are prone to the effect of learning. In the second assessment the participants completed the tasks significantly better than in the first measurement. Similar effect were obtained in the research by Mak et al. [24]. In the control group, which was not subjected to a cognitive training, the TMT (part B) completion time significantly shortened from 86.2 seconds (SD = 37.7) to 76.1 (SD = 27.5). It means that the TMT may be useful in the individual and one-time assessment, whereas the evaluation of the changes in cognitive functioning (e.g. during rehabilitation) requires comparison with the control group or making adjustments on the learning effect. Assessment

of the covariance of three tests of the discussed battery between measurement 1 and 2 points that all of them have a satisfactory relative stability. Therefore, each of the battery tests reflects the abilities of the subject, remaining relatively independent of random factors related to the situation or to the patient.

Analyses relating to the reliability of the B-CATS brought ambiguous results, as only the Fluency scale turned out to posses absolute and relative stability, which denotes its satisfactory reliability. Yet, the results obtained should be treated with a certain degree of caution. Firstly, the subjects participated in an extended treatment program during their stay in the psychiatric ward. Secondly, the assessments were separated by fairly long time interval, lasting mean 41 days. Finally, there was a considerable difference in terms of the interval period – from 10 to 104 days. Yet, there are certain premises which suggest that the influence of those factors could have not been very disturbing. We know that the traditional psychiatric rehabilitation programs, which do not take into consideration cognitive rehabilitation, have little influence on the level of cognitive functioning [25]. Moreover, an additionally conducted analysis did not prove that the length of the interval between the test administrations correlated significantly with the learning effect.

Correlation between TMT, Fluency and Digit Symbol tests results in the first and second measurement showed to be low but statistically significant in almost all cases (there were no relation between TMT and Fluency tests in the measurement 2). Low values of correlations indicate low internal coherence between the three tests. This outcome is in congruence with the results obtained by Cuestai et al. [26]. It suggests that among patients with psychosis these three tests do not constitute a coherent whole. That is why the use of a composite score of the battery may raise doubts.

The analysis of the relations between the B-CATS and the demographic variables has shown only one significant result. Men outperformed women in terms of TMT scores. This result is consistent with the reports from the researches described in literature [27]. Women achieve worse results in working memory tests (TMT measures the efficacy of working memory). At the same time, a connection between the B-CATS and the other demographic variables was not proven, although the differences in the cognitive task performance level, depending on age of the participants, their level of education or professional status have a reflection among the studies conducted by other authors [28]. The lack of such an effect in the researched group can be explained by a small differentiation in terms of the analyzed demographical data.

Searching for connection among the B-CATS results and the variables referring to the course of illness a correlation was obtained in case of two tests (TMT, Digit Symbol Test). People with longer illness duration and with history of larger number of psychotic episodes obtained worse results when performing tests. The presence of suicidal attempts (which suggests more severe decompensation) correlated with lower score in the first test, while worse performance in the latter was observed among subjects hospitalized more often. The direction of correlation is logical and coherent with the results obtained by other authors [28]. It is worth noticing that there is a lack of significant correlations in case of a first measurement, usually made shortly after the hospital admission. Therefore, intensification of cognitive impairment at the moment of hospital admission of the patient seems to denote the possibilities

and limitations of the patients to much smaller extent and is a much poorer reflection of the character of their functioning outside the ward than in case of the assessment performed at the end of the treatment.

The obtained results showed the covariance between the cognitive abilities of the patient (Fluency and TMT) and the intensification of the negative symptoms, positive symptoms and the total PANSS scores. There was also a correlation between the intensification of the general symptoms and the performance in Fluency test. It should be noticed that although the cognitive performance level correlated with symptoms of various groups, its correlation with negative symptoms was the strongest. This kind of the relation between the results of the neuropsychological assessment and the psychopathological picture is coherent with the conclusions of other authors [29]. The depth of the cognitive deficit shows insignificant or no correlation with the intensification of the positive symptoms [28, 30]. Yet, there is data confirming the connection (which in many publications is low) between the level of cognitive functioning and the intensification of the negative symptoms [10, 31]. It is worth noticing, that the strongest connection with the psychopathological symptoms was discovered in case of verbal skills. The result suggests the importance of the communicative competences/verbal abilities in the assessment of the psychopathology of the patient.

In this research the cognitive deficits are connected with the level of social and occupational functioning. We noted numerous correlations for each test and each functioning scale. The highest correlation was obtained for the Digit Symbol Test. The relation between the cognitive deficits and the social functioning of the patients has its reflection in the literature [32-34].

Summing up, obtained profile of correlations of the tests' results with the demographic variables, psychopathological symptoms and the level of social functioning points to the fact that the B-CATS is characterized by a satisfactory criterion validity. One should notice that the group was heterogeneous concerning the number of psychotic episodes, the course of illness and treatment, what constitutes the limitation of the study. This fact diminishes the internal validity of the study, however, it increases its external validity (it means that the study may accurately depict the results that one might expect in Polish clinical setting).

The usefulness of the presented battery does not raise major concerns. The tests are practical, easy to prepare and assess. The administration does not require any further training from the clinician. The tests are popular and easily accessible in the clinical practice.

Conclusions

1. B-CATS battery is characterized by a satisfactory relative stability. Satisfactory absolute stability was obtained only in the case of Verbal Fluency.
2. The test battery presented above is characterized by a satisfactory diagnostic validity.
3. B-CATS is easy to conduct and 'friendly' for the patient.
4. The assessment of the cognitive functioning of the patients seems to be a valuable complement of the clinical evaluation as a brief measurement of the patient's general cognitive functioning deficit level.

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