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The profile of WISC-R scores in children with high-functioning autism

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Summary

Objective: The aim of the study was to define the intellectual profile of Polish children suffering from autism. Our study was based on the results of previous research, mostly conducted in English-speaking countries. Although these earlier studies documented the intellectual profile of an autistic child, they also identified some discrepancies and ambiguities. Therefore, we decided to complement the discussion on autism with our data on intellectual functioning of autistic Polish children examined with a translated version of the intelligence test.

Method: The study followed a matching design. From among 191 children with autism and 1400 without this diagnosis, we selected 34 pairs based on gender and age, and not differing by more than 10 points in terms of intelligence quotient. The intellectual profile of the studied children was determined with the WISC-R scale.

Results: As expected, the intellectual profile of children with autism proved more variable than that of healthy controls. Children with autism scored lower on "Comprehension" scale and (at a threshold of statistical significance) on "Object assembly" scale, and achieved higher results on "Information" and "Block design" scales.

Conclusions: The results of our study confirmed the most typical observations from previous research conducted among an English-speaking population of autistic children. Polish autistic children did not differ significantly in terms of their quotients of verbal and non-verbal intelligence. However, the intellectual profile of autistic children showed higher variance compared to normally developing controls. Children with autism are more likely to score the lowest in the "Comprehension" subtest and the highest in the "Block design" subtest.

Key words: autism, intellectual profile, cognitive functioning

Introduction

Autism is a severe developmental disorder which starts in early childhood, and manifests as maladjustment to social interaction, speech and communication disorders, and behavioral disorders. Most (70-75%) children with autism are additionally diagnosed with delayed intellectual development, and only 25-30% of the patients have average or above the average scores of intelligence quotient [1]. Children, whose intelligence quotient amounts to 70 or more are referred to as patients with High--Functioning Autism (HFA) [2]. About 8-30 per 10 000 children suffer from classic form of autism [1, 3], and 36-40 per 10 000 have Asperger's syndrome [4]; however, the prevalence increases up to 60 per 10 000, if the complete spectrum of pervasive developmental disorders is taken into account [3].

WISC intelligence scales are undoubtedly the most popular tests used for the evaluation of school children [5]. Intellectual functioning represents one of the most frequently examined processes among autistic patients. Based on the WISC scores, we can assist parents of children with pervasive developmental disorders in making decisions about further stages of education [2], predict future achievements of their offspring, monitor the progress of the therapeutic process [6], and obtain additional information required for the purposes of differential diagnosis [7, 8].

Consequently, many of the previous studies used the Wechsler Intelligence Scale (WISC) to examine the intelligence of children with pervasive developmental disorders [8].

The spectrum of Wechsler intelligence scales comprises of WISC-R, WISC-III, and WISC-IV. The first, WISC-R, was developed by Wechsler in 1974, and its subsequent adaptations were released after his death, in 1991 and 2003, respectively. Presently we use the 1991 WISC-R scale, which was adapted into Polish. The remaining two tests, WISC-III and currently used worldwide WISC-IV, differ from WISC-R in terms of more recent norms and scale structure [5]. Consequently, we will only refer to those previous studies, which used WISC-R, as they are the only ones to which we can compare our hereby presented findings.

Hundreds of studies dealing with the intellectual functioning of individuals with pervasive developmental disorders were conducted since WISC was implemented into the diagnostic process. Most of them concluded that persons with autism:

- Among verbal scales, score the lowest score in "Comprehension" [9]. and the highest in "Digit span" [10].
- Among performance scales, score the highest score in "Block design" [9] and the highest in "Picture arrangement" and "Coding" [10].

Table 1. **The scores of autistic individuals achieved on the verbal scales of WISC-R**

Verbal scales			
The lowest scores		The highest scores	
Comprehension	[9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22]	Digit span	[11, 14, 15, 16, 17, 18, 22, 23, 24]

table continued on the next page

Verbal scales			
Similarities	[23]	Similarities	[12, 13, 20]

Table 2. **The scores of autistic individuals achieved on the performance scales of WISC-R**

Performance scales			
The lowest scores		The highest scores	
Picture arrangement	[15, 16, 17, 18, 20, 23, 24, 25]	Block design	[9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27]
Coding	[11, 12, 13]		

Although the results of individual studies vary, they all point to two common elements, the highest results in the "Block design" subtest, and the lowest in "Comprehension" [9].

In contrast, the data on verbal and non-verbal intelligence quotients are inconclusive. While a number of studies reported that individuals with autism score higher on performance scales, rather than on verbal scales [10, 12-15, 17, 18, 20, 28], other produced contradicting results, i.e. documented higher scores for verbal scales [11, 23, 29]. Finally, some recent studies using WISC-III[1] reported no differences between the level of verbal and non-verbal intelligence [9, 30, 31].

The aim of our study was to define the intellectual profile of Polish children with High-Functioning Autism. We verified whether the effects reported in previous studies, including mostly the English-speaking population, can also be observed for the intellectual profile of Polish children.

Material

We compared the intellectual profiles among 35 pairs of children. Each pair included a child with High-Functioning Autism, and a gender-, age-, and intelligence level-correspondent child without such diagnosis. In order to identify our target group, we examined 191 children with confirmed autism and 1,400 children without this diagnosis. The group of children with autism included 180 patients, whose diagnosis was established by two independent specialists, and 11 individuals diagnosed by the authors of this paper.

The control group was selected by matching, according to such criteria as gender, age, and global intelligence quotient. The highest acceptable difference of age and intelligence quotient per pair was 1 year and 10 points, respectively. The study was conducted between October 2002 and December 2012.

1 We referred to the results of this study, as despite different structure of WISC-R and WISC-III scales, the distinction between verbal and performance skills remains the same.

Method

The study comprised of three stages: 1) selection of children with High-Functioning Autism, 2) testing the selected group with the WISC-R scale, 3) pairing the autistic children with healthy controls.

Stage 1: Selection

The first stage of the study was carried out among 191 children diagnosed with autism. Based on the medical history taken from parents, and observation of a child's behavior, we identified 44 children who met the two criteria: (1) slight speech delay, (2) data from history and observation suggesting their ability to complete the WISC-R test.

Stage 2: Testing with the WISC-R scale

During the next stage, the group of 44 children with HFA were tested with Wechsler Intelligence Scale for Children (WISC-R). The examination took place at school (n = 1), at home (n = 12), or at the Psychological and Pedagogical Counselling Center (n = 32), in the period between October 2002 and December 2012. The examination was conducted by a psychologist from the Center (n = 36), 3rd year psychology students during their classes supervised by the investigator (n = 1), or the investigator herself (n = 7). Although the large number of examiners may be seen as a cause for doubts, it was dictated by the concerns regarding the consequences of having the WISC-R test repeated by the same examiner at too short intervals.

During this stage, we excluded five children. Four of them achieved global intelligence quotient below 70, and one did not complete the test. In the latter case, all the subscales apart from the "Arithmetic" were completed.

Eventually, the examined group included 38 children with HFA. All of them attended schools, mostly integrated classes. However, eight children attended regular schools.

Stage 3: Pairing with the controls

The control group was selected based on about 1400 WISC-R scores obtained from healthy children between 2002 and 2012. These tests were conducted by 3rd year psychology students within the framework of their course, entitled "The evaluation of intellectual capacity of school children". The pairs were matched based on three criteria: (1) the same gender, (2) difference of age not greater than 12 months, (3) difference of WISC-R intelligence quotient not greater than 10 points.

In the case of 3 children with pervasive developmental disorders, we were unable to find pairs meeting the abovementioned criteria.

The control group comprised of 35 individuals, who were examined by psychology students as a requirement for their credits. None of the children were diagnosed with any disorders classified in DSM-IV or ICD-10.

In the end, both analyzed groups included 35 children each, among them 8 girls and 27 boys. Detailed characteristics of age and intelligence quotient of the compared groups are presented in Table 3.

Table 3. **Comparison of age and intelligence quotients in the two study groups**

	WFA*				Healthy children*				Difference		
	M		SD		M		SD		t	df	p**
age	113.0		29.41		113.3		28.09		-0.26	34	
IQ	97.1		16.40		98.2		16.83		-1.35	34	0.19
verbal	96.8		17.33		99.2		16.06		-1.39	34	0.17
non-verbal	97.9		15.45		97.5		16.90		0.24	34	

*N=35, ** p – two-sided critical area

The compared groups did not differ significantly in terms of age, global intelligence quotient, or the levels of intelligence in verbal and non-verbal subscales. Although the intergroup differences in the global score and non-verbal scale did not reach the threshold of statistical significance, they remained close to this value. However, selecting of a group not differentiated in terms of all three scales would be extremely difficult, due to the fact that speech delay is one of the diagnostic criteria of autism. A more restrictive adjustment for the global intelligence quotient would be reflected by more pronounced intergroup differences in the non-verbal scale, and seeing as the latter is less affected by autism, we considered it a key criterion while comparing the study groups.

Results

In order to identify a HFA-specific pattern of differences between verbal and non-verbal skills, we conducted an analysis of variance according to 2(group) x 2(scale) model. The analysis revealed neither an overall difference between the verbal and non-verbal score $F(1, 34)<1$, nor the modification of this effect resulting from belonging to the criterion or the comparative group $F(1, 34)<1$.

The scores of various WISC-R scales were compared with the T-test for dependent variables. The analysis revealed that, compared to healthy controls, children with HFA scored higher on "Information" scale $t(34) = 2.32$ $p = 0.027$ and lower on "Comprehension" $t(34) = 5.77$ $p = 0.001$. Moreover, the results of two scales differed at a level close to the predefined threshold of statistical significance: compared to healthy controls, children with HFA were characterized by higher scores on "Block design" scale t(34) = 1.88 p = 0.069[2], and lower scores on "Object assembly" scale t(34) = 1.71 p = 0.097.

In order to verify whether the intellectual profiles of children from the analyzed groups represented two distinct patterns or rather a similar pattern differing solely with regards to the abovementioned scales, we conducted a repeated measures analysis of variance according to 2 group x 10 scale model. The analysis revealed both group-independent variance of results on various scales F(9, 26) = 4.357, p = 0.002, Eta2 = 0.6, and the effect of interaction pointing to differences between the intellectual profiles of the studied groups F(9, 26) = 11.629, p = 0.001, Eta2 = 0.8. Greater power of the latter effect supports the hypothesis on the distinctness of the compared profiles.

Table 4. **Comparison of the intellectual profiles of children with HFA and healthy controls**

	WFA*		Healthy children*		Difference		
	M	SD	M	SD	t	df	p**
Information	11.09	3.838	9.54	3.346	2.32	34	0.027
Similarities	10.40	2.648	10.17	3.073	0.36	34	
Arithmetic	9.51	4.604	9.49	3.45	0.04	34	
Vocabulary	8.97	4.127	8.97	2.965	0.00	34	
Comprehension	7.06	3.589	10.86	3.3	-5.77	34	0.001
Picture completion	8.60	3.155	8.86	3.499	-0.35	34	
Picture arrangement	10.74	3.988	9.97	3.356	1.19	34	0.243
Block design	10.89	3.169	9.69	3.261	1.88	34	0.069
Object assembly	8.94	2.743	9.89	2.888	-1.71	34	0.097
Coding	9.03	3.527	9.43	3.475	-0.59	34	

*N=35, ** p – two-sided critical area

In order to characterize the profiles of both groups, the scores of various subscales were compared to one another. In the case of individuals with HFA, the scores for "Comprehension" were the lowest and significantly differed from all the remaining scales. The results for another two scales, "Picture completion" and "Object assembly", proved significantly lower than the scores for "Similarities", "Picture arrangement", "Block design", and "Information". The scores for "Vocabulary" and "Coding" were lower than only three other scales: "Picture arrangement", "Block design", and "Infor-

2 Analogous differences were observed in previously mentioned studies, which enabled us to formulate a directional hypothesis and verify it with one-sided test the results, which should be considered significant at p = 0.035.

mation", and the scores for "Arithmetic" proved significantly lower only compared with "Information". The scores for "Similarities", "Picture arrangement", "Block design", and "Information" did not differ significantly from each other. However, the scores for "Similarities" turned out to be higher than those for "Picture completion" and "Object assembly", and the scores for "Picture arrangement" and "Block design" were also significantly higher than the results of "Vocabulary" and "Coding". Finally, the score for "Information" proved higher than the results for the "Arithmetic" scale.

As expected, the scores of healthy controls showed less varied. The scores for "Vocabulary" proved the lowest, being significantly lower than the results for the "Similarities" and "Comprehension" scales. The scores for "Picture completion", "Coding", "Arithmetic", and "Information" turned out to be significantly lower only compared to "Comprehension". The scores for "Block design", "Object assembly", and "Picture arrangement" did not differ significantly from the results for any other scale. The results for the "Similarities" scale proved significantly higher only compared to the results for the "Vocabulary" scale, and those for "Comprehension" were also significantly higher than the outcomes for the "Picture completion", "Coding", "Arithmetic", and "Information" scales.

Discussion

The results of our study confirmed the most typical observations from previous research on the English-speaking population of children with HFA. Firstly, we did not observe any significant differences between the levels of verbal and non-verbal intelligence of children with HFA. Secondly, the variance of the intellectual profile of children with autism turned out to be higher than that of normally developing children. Thirdly, our findings confirmed the assumption that children with HFA are most likely to score the lowest in the "Comprehension" subtest and the highest in the "Block design" subtest.

Multidimensional character of the WISC test suggests that its results should be interpreted in terms of specific cognitive functions. Synthesis of information represents a common component of "Comprehension", "Object assembly" and "Picture arrangement" subtests, the deficits of which were reported by other authors [op cit.]. It is dysfunction of this cognitive operation which seems to constitute quite common feature of autism. This conclusion is consistent with the fact that individuals with autism spectrum disorders prefer analytical rather than the global mode of information processing [32]; this is also in agreement with higher scores of "Block design" subtest, that requires identification of patterns, i.e. analytical skills. High scores of "Information" scale suggest that due to well-functioning memory, some of autism-related deficits of cognitive apparatus can be compensated by knowledge. Memory seems to be the principal cognitive asset of individuals with autism, as it is also involved during performing tasks included in "Block design" and "Digit span" subtests, both identified by other authors as the strengths of this group of patients. It would be interesting to identify a component of memory which constitutes the main asset of patients with autism. However, answering this question solely on the basis of WISC-R test results would be solely a speculation.

The unique way of cognitive functioning of children with autism should reflected in therapeutic programs developed for this group of patients. Importantly, all deficit behaviors should be counterbalanced by strengths of a child. Therefore, one should build social and verbal behaviors on the basis of well-functioning memory of autistic patients. Furthermore, patients from this group will likely absorb visual-spatial material better than any other type if information. In practical terms this means that a material presented to a child should comprise true objects or their pictures. Noticeably, any social skills should be practiced as a role-playing or involvement in real-life situations. It should be also remembered that analytical character of cognition modulates autism patients' ability to generalize gained knowledge. Consequently, the process of generalization should be planned in detail as an integral part of therapeutic process. Importantly, all new terms should be implemented on many various designations and practiced situations should take place under a number of various conditions.

Obviously, our observations illustrate some expected trends in the scores of WISC-R intelligence tests, rather than constitute an unambiguous diagnostic hint. Thus, it should be remembered that any results differing from those reported above do not exclude the presence of autism in a given patient.

Nevertheless, the knowledge of these most typical tendencies will help us avoid frequently misleading "common sense-based" conclusions. For example, if disorders of speech represent one out of three principal manifestations of autism, one could expect that the verbal intelligence should be lower than the levels of performance intelligence. However, as shown above, both our research and a number of previous studies revealed that such effect is unlikely.

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