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The Intellectual Status of Blind and Partially Sighted Children in Croatia Assessed by WISC-IV During Educational and Vocational Guidance: Basic Findings and Relevant Factors

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Abstract: The intellectual status of blind and partially sighted children in Croatia has not been systematically researched for almost three decades, despite the change in assessment instruments and institutional support forms. The aim of the research was twofold: (1) to elucidate how developmental, health, and social support factors determine the choice of WISC-IV for intellectual assessment of this population in educational/vocational guidance, (2) to analyze basic findings of the conducted assessments at each WISC-IV subtest. The study was conducted on 102 blind and partially sighted children (51 girls, 34 blind) aged 12 to 16, as part of the regular assessment at Center Vinko Bek. Partially sighted and blind with residual functional vision were tested by all subtests, while the rest of the blind participants were tested only by verbal comprehension (VC) and working memory (WM) subtests. The favorable ratio of blind and partially sighted participants, the fact that the blind with residual functional vision manage to solve all subtests, and mostly quality social support suggest the use of WISC-IV for intellectual assessment of this population. Unfavorable circumstances are the dominant presence of visual impairment from birth, additional health difficulties and late professional help. In the VC subtests both groups show significantly lower values than the norms with moderate deviation (the weakest performance on the Comprehension subtest), while on the WM subtests they achieve a result equal (Digit Span) or moderately lower than the norms (Letter-Number Sequencing). In perceptual reasoning and processing speed subtests the blind show significantly lower while the partially sighted moderately lower scores than the norm. Only the performance of the partially sighted in the Block Design subtest statistically equals that of the sighted population. The findings are interpreted in the context of previous research and developmental, health and social support specifics.

Key words: blind and partially sighted children, WISC-IV, developmental and medical specifics, social support

INTRODUCTION

The intellectual status of blind and partially sighted children in Croatia has not been evaluated since 1991 (Stančić) or systematically researched since 1973 (Stančić & Ljubešić, 1973), despite the changes in assessment instruments and forms of institutional and social support. The change in these circumstances, but also the increment of symbolic content in everyday life during the last 45 years (through technology and education) asks for new insights and the possible revision of blind and partially sighted children's cognitive status in Croatia (especially, when taking into account the consequences on the quality of life of this population).

Nevertheless, there are many problems that accompany cognitive testing of the visually impaired. They still don't have the same opportunity as sighted persons in psychological assessment, rehabilitation and professional orientation (Johnson, 1989). Services for visually impaired people have made very limited use of standardised tests as those tests are almost exclusively paper based. In addition, tests developed for sighted people are not always appropriate for use with the blind and partially sighted people as they use pictures and images which are inaccessible to people with visual impairment and as a result they fail to assess nonverbal skills and therefore have limited use in assessing general intellectual functioning (Reid, 1995, 1997). Although it is a common practice to adapt existing tools made for sighted people when testing the ability of those who are visually impaired, those tools are not designed to assess the unique aspects of their cognitive functioning. As reported by Tobin and Hill (2011), visually impaired persons are often at a disadvantage compared to their fully sighted peers as the absence of vision in early childhood may reduce access to information, resulting in gaps in their experience and understanding. For these reasons, it is not entirely satisfactory to use psychometric tests for sighted children as they contain test items which are biased towards visual imagery, visual memories, and visual search. On the other hand, skills that are being assessed by those tests are sometimes different for blind and sighted users and they often rely on visual interpretation of pictures. As psychometric tests are mainly standardised on the sighted population, it is hard to say if the skills used to complete the test are the same for sighted and visually impaired people (Atkins, 2011). Furthermore, in case of task failure, it is quite impossible to determine if this is due to the lack of vision or lack of required skills.

In order to assess a person with a visual disability, it is likely to be necessary to make adjustments to standardised test administration procedures or use alternate forms of materials, or both. However, such changes to a test cannot be made without affecting its reliability and validity. Moreover, when the test results are used for recruitment purposes, they can potentially disadvantage the candidates who face all the mentioned setbacks (Atkins, 2011). As the standardization process guarantees that results are valid and comparable, even when acceptable adjustments are made in order for a test to be applied for a visually impaired person, the test administrator cannot validate the results as the test was taken under non-standard conditions.

In spite of the limitations that go with using standardised tests for sighted people to test the intelligence of visually impaired individuals, the verbal scales of the Wechsler Adult Intelligent Scale (WAIS) and Wechsler Intelligent Scale for Children (WISC) were found to be widely accepted as measures of verbal ability with these clients. Not only that they require no adaptation for visually impaired clients but they also allow a comparison between visually impaired individuals and fully sighted ones. Tillman (1967) compared the performance of blind and sighted children on the verbal WISC and found that blind children performed almost the same as sighted children on subtests of Arithmetic, Information and Vocabulary, but scored less on subtests of Comprehension and Similarities. Blind children obtained the highest score on the Digit Span subtest. Similar results were found by Smits and Mommers (1976) who showed that on Information, Arithmetic, Similarities and Vocabulary subtests, blind children performed almost the same as sighted children. Moreover, the blind group did better than the sighted one on Digit Span subtests but scored lower on Comprehension subtests.

In the study conducted by Vander Kolk (1982) the average performance of the visually impaired sample on verbal subtests was even slightly higher than the one of the sighted sample used to norm the WAIS. Fully blind participants scored higher on Similarities and Digit span, while the average score was more than one point lower than the norms on Arithmetic. Partially sighted subjects were very close to the sighted norms on all subtests except Similarities, where they scored somewhat higher. The distinction was also made between adventitiously blind persons and congenitally blind persons, and the former group performed better than both congenitally blind and the general norms on Arithmetic.

In order to better understand the intellectual performance of visually impaired people we have to take into account relevant developmental, medical factors and factors of social support that can influence that performance. For example, if the visual impairment is followed by additional developmental difficulties, it is possible that those difficulties additionally influence the cognitive development and performance of blind people. Mukaddes et al. (2007) compared two groups of blind children – non autistic and autistic and found a significant difference between them in terms of (among others) intelligence level.

Another important correlate to the intelligence of blind people is early intervention. As visual impairment can seriously disrupt infant and early development, causing significant delays and difficulties in motor, cognitive, language and social domains, early intervention should be a priority. Distinguished authors in the field used to say that "the main goals of early intervention in the field of visually impaired children are: to preserve and optimize residual visual function, to improve perceptual processes, to reduce disability, favoring the acquisition of new adaptive functions, to prevent effects secondary to the handicap, and to promote overall development" (Fazzi et al., 2005). Since the 1970s, early support and counselling for parents of visually impaired children has been proceeding and it has had an unquestionable impact on general developmental patterns of both children with visual impairment and their caregivers (Perez-Pereira & Conti-Ramsden 1999, as cited in Dale & Salt, 2007).

Relating to peers is also very important for a child's development and results in various developmental benefits as it requires various social skills. As other children, children with visual impairments also enjoy playing and interacting with their peers and exploring the environments (D'Allura, 2002). Therefore, attending kindergarten, which is the main source of social interaction for children, can also better their cognitive performance.

As children learn the majority of information visually, age of onset of blindness can also affect the intellectual performance of visually impaired people. Miller et al. (2007) used haptic test to assess intelligence of visually impaired participants. In their research they found that participants who had become visually impaired more recently completed haptic tasks more quickly and accurately than congenitally blind individuals, which leads to the conclusion that visual experience is related to performance on the test.

Additionally, family and school support can also play an important role in the child's development, especially in the development of visually impaired children. Weiner (1991, as cited in Kef et al., 2000) conducted a study of the social support networks of blind and visually impaired young adults in the United States. He showed that the most important sources of support for that group were family and friends, with a great dependency on family for social support. Social support for children and adolescents protects them from negative effects on their mental health and improves their well-being, self-esteem and self-assurance which can also lead to cognitive improvement.

In this research we will examine the intellectual ability of blind and partially sighted children in the Republic of Croatia with contemporary intellectual tests, by using a more descriptive level of analysis, as well as to determine whether the obtained results have been influenced by relevant developmental, medical and factors of social support such as additional developmental difficulties, early intervention, attending kindergarten, age of onset of visual impairment and family and school support.

The assessment approach was somewhat wider then in earlier studies, primarily because of the educational orientation purpose of testing, which led to the additional inclusion of some non-verbal WISC-IV tests and related interesting results.

In order to include previously mentioned factors affecting blind and partially sighted children's intellectual status, but also the differences in health status and social support of these two visually impaired groups, our research has two main goals that we try to achieve by testing the related hypotheses.

The first aim was to clarify which developmental, medical and social support factors determine the choice of WISC-IV for the intellectual assessment of blind and partially sighted children in career guidance for secondary education. The related hypothesis (H1) was that developmental-biological specificities, additional developmental difficulties of predominantly biological origin, and available social support of blind and partially sighted children will mostly justify the use of WISC-IV (with minimal adaptation of instructions and timing) to assess the intellectual status of that population.

The second aim was to present and interpret the basic findings of the intellectual assessment of blind and partially sighted children using the WISC-IV subtests, administered as part of the regular assessment at the Integration Department at the Center for Education and Rehabilitation (CER) Vinko Bek. The related hypotheses were:

- H2: Blind and partially sighted children will achieve significantly lower scores in the Verbal Comprehension (VC) subtests relative to population norms.
- H3: Blind and partially sighted children will achieve results that are equal to, or better than population norms, in Working Memory (WM) subtests.
- H4: Partially sighted children will achieve significantly lower results in subtests of Perceptual Reasoning (PR) and Processing Speed (PS) relative to population standards, while blind children (with remaining functional vision) will be able to deal with them partially at best.
- H5: Blind and partially sighted children will not differ from each other on VC and WM subtests, while the partially sighted will perform significantly better in subtests of PR and PS.

– H6: Blind and partially sighted children will show a specific performance profile on WISC-IV subtests

METHOD

The research was carried out as a retrospective study of the results of systematic intellectual evaluation of blind and partially sighted children who were mostly in the final grade levels of their primary education. The majority of them were continuously followed by the Center for Education and Rehabilitation *Vinko Bek*. This institution has been known as a resource center for education and rehabilitation of persons with visual impairment in Croatia. Results were collected from February 14th, 2010 to October 22nd, 2015.

Participants

A total of 102 pupils (51 females), aged 12 to 16 (84% aged 14-15), were tested. A third of those tested (n = 34) were blind, and the remaining participants were partially sighted. Almost all were followed by CER *Vinko Bek* (an integration and psychosocial support program) and attended regular primary schools. Of all participants, 80.2% were examined for the first time.

In the categorization of blind and partially sighted persons, two definitions of blind persons were observed: persons with (1) visual acuity up to 0.05 or with the best correction up to 0.25 with a narrowing of the field of vision to 20 degrees or less, or with (2) concentric narrowing of the visual field of both eyes to 5-10 degrees around the correction point. On the other hand, partially sighted are people with visual acuity in the dominant eye with or without correction up to 0.4.

Instruments

Different WISC-IV subtests (Wechsler, 2009) were used to assess the intellectual status of blind and partially sighted children, depending on the degree of visual impairment.

For partially sighted persons, ten basic subtests were used: three from verbal comprehension, three from perceptual reasoning, two from working memory, and two from processing speed.

For completely blind persons, three verbal comprehension and two working memory subtests were used (with additional administration of ITVIC test, which is not in the scope of this research; Dekker, Drenth & Zaal., 1989) and for the blind with remaining functional vision, additional non-verbal subtest Block Design was used. Exceptionally, if they could see, another two nonverbal subtests were added – Picture Concepts and Matrix Reasoning).

For a blind or partially sighted child with an indication of arithmetic difficulties, an Arithmetic subtest was also attempted.

For all participants, an educational rehabilitator or psychologist administered a *Short Scale of Family and School Support Quality* composed of 2 questions with 5 point scale answers expected: from 1 (substandard support) to 5 (quality support).

Medical and other documentation of institutional monitoring of the child was used to determine additional relevant factors of intellectual status (e.g., kindergarten attendance, receiving professional support, age of onset of visual impairment, degree of visual impairment, presence and type of additional developmental difficulties of predominantly biological origin).

Procedure

All data was collected individually as blind and partially sighted pupils showed up for educational assessments and professional guidance. Determination of intellectual status, examined by the WISC-IV, was carried out exclusively by employed psychologists at the CER *Vinko Bek*, who have many years of experience working with this population and have a harmonised approach to the assessment. The assessments were carried out during working hours of up to 1.5 hours for the partially sighted, and in a shorter time for blind persons (due to the fewer number of subtests applied, but variable given the additional developmental difficulties of predominantly biological origin). The testing was carried out in isolated offices of psychologists and appropriate lighting and other testing conditions were taken into account, as well as previous experience of persons with visual impairment and the related necessary justified adjustments.

The WISC-IV subsets were carried out using the standard procedure (Wechsler, 2009), with several adjustments in specific tasks throughout 6 subtests which aimed to balance the initial position of visually impaired persons with the position of persons with normally developed vision in terms of understanding the task. As such, we list these adjustments, which are agreed upon by the Croatian psychologists dealing with the assessment of persons with disabilities (Section for the Psychology of Developmental Disabilities, Croatian Psychological Society).

Block Design subtest: If the participant is solving a task longer than the standard time limit, he or she is allowed twice as long a time limit but given a minimum number of points. In fact, the visually impaired have up to 10 times slower visual perception compared to the normal seeing population, which is why, for example, the visually impaired have twice the available time to take tests on the graduation exam in Croatia. On the other hand, in the ITVIC-intelligence test for visually impaired children (Dekker at. al. 1989), participants are given 5 times longer response time for tasks of the same type (but tactile) as in the WISC, and their points are not reduced.

Picture Concepts and Matrix Reasoning subtests: With the standard instruction, the participant is asked if he or she does not see a picture well enough to recognize what is shown. The participant is then told what is in the picture (term) and he/she continues to solve the task on his own. Some participants ask for 1-3 pictures.

If the subject does not perceive colors, in tasks where colors are necessary to find a solution, it is shown and appointed by pairing what elements they paint, so the subject can perceive it in equal brightness and continue to solve the task on his own.

Similarities and Vocabulary subtests: In order to express sensitivities for the limitations and prevent motivational decline of the blind or the subjects who do not see colors, the following adjustments are made in those tasks in which the color experience is required. For example, in the *Similarities subtest* task, the prompt says, “Even though you can’t see, can you tell me what they’re like red and blue?” On the other hand, the Vocabulary subtest task says, “Even though you can’t see, can you tell me what *transparent* means?”

Comprehension subtest: For the third, fifth, and sixth task, the blind and often partially sighted participant does not have the necessary visual experience or capability that enables accurate resolution in the task. Therefore, the text of the task is adjusted so that the wording of the question “What should you do if you see...?” reads “What should a person who sees do...?”

RESULTS

In order to test the hypothesis that (a) developmental-biological specifics of visually impaired people, (b) additional developmental difficulties of predominantly biological origin and (c) available social support for blind and partially sighted children mostly justify the use of WISC-IV (with minimal adaptation of instructions and timing associated with the change in scoring) for assessment of the intellectual status of that population, the values of these factors in the observed sample of the blind and partially sighted children were statistically analyzed. It was considered whether they suggest the selection of WISC-IV as the right choice for their intellectual assessment.

Within the developmental-biological specifics, the available data were (1) the ratio of the number of blind to partially sighted children in the sample, (2) the percentage of blind children who solved tests that required visual perception (so-called predominantly nonverbal tests), (3) visual acuity, (4) age of onset of visual impairment.

The ratio of the number of blind to partially sighted *children of 1:2* in favor of the partially sighted ones, supports the use of WISC-IV in the cognitive assessment of this population because the partially sighted ones managed to solve, at least partially, all WISC-IV subtests. Thus, it is possible to get the same complete picture of the intellectual status of most pupils with visual impairment as of the sighted population (however, it should not be forgotten that the same complete picture of that status was obtained for several blind pupils with residual functional vision). This ratio shows time stability as within the observed 5 years (with the exception of the year 2015 from which only 6 results were entered) it has not significantly changed ($\chi2 = 1.55$; df=5; $p = 0.907$).

The percentage of blind children who predominantly solved the nonverbal test (i.e., solved more than 2 tasks in the subtest) ranged from 14.7% (two subtests of processing speed) to 32.4% (*Block Design* subtest). This percentage was made up of blind students with residual functional vision and it points out that, although with a low score, this category of people with visual impairment also manage to solve all types of WISC-IV tasks. In this regard, WISC-IV to some extent comprehensively assesses the intellectual status of blind children as well, which justifies its application to this population.

Visual acuity, as expected, is lower in blind and partially sighted children (due to the very definition of their health status), and in this sense it is a contraindication for the use of all WISC-IV subtests that have clear visual-perceptual requirements. The average percentage of visual acuity of the blind children ($M = 0.018$) is ten times lower than the percentage of visual acuity of the partially sighted ones ($M = 0.207$), and the standard deviation of the blind children ($SD = 0.023$) is 5 times lower than the standard deviation of the partially sighted ones ($SD = 0.108$) (see Figure 1.). That difference is statistically sig-

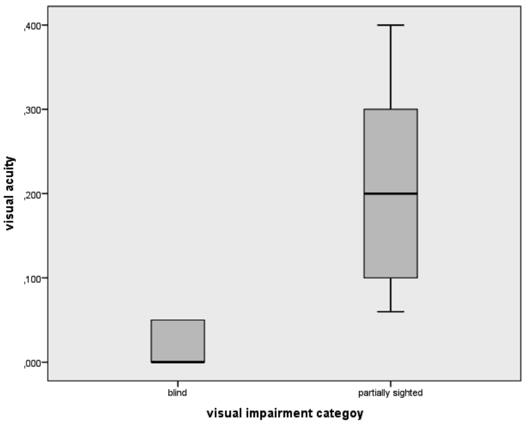

Figure 1. Comparative Box-plot presentation of visual acuity of blind and partially sighted children examined within the educational-orientation assessment in CER Vinko Bek from 2010 to 2015.

nificant (for standard deviation: $F = 51.585$; $df1 = 33$; $df2 = 67$; $p < 0.001$; for arithmetic means: $t = -13.843$, $df = 78.078$; $p < 0.001$), but the question is how much can this difference act in dominantly auditory WISC-IV subtests? A visual representation of the differences between the blind and partially sighted children in this defining feature is visible in the Box-plot representation shown below.

The age of onset of visual impairment is markedly asymmetrically distributed, and for 95% of both blind and partially sighted children the impairment was already noticed at birth (the median value of the age of onset of visual impairment is 0 in both groups). This fact indicates a longer period of disability and thus possible greater cognitive consequences of impairment, and possibly greater difficulties with the application of the WISC. However, earlier detection of impairment also means earlier start of interventions and social support, so this possible developmental-biological contraindication for the use of the WISC should be observed in the context of the beginning of medical and social support.

The type and frequency of additional developmental difficulties of predominantly biological origin were analyzed only after re-categorization of a large number of very specific and often low-frequency dysfunctions (see Appendix) into broader groups of developmental difficulties, due to the feasibility of inferential statistical procedures and related conclusions. The distribution of these difficulties was carried out into 6 categories and it was found that 53% of both blind and partially sighted children have some of the observed difficulties. It is important to emphasize that some of them represent combinations of less frequent difficulties that occurred together. Almost 2/3 of these difficulties refer to different organic brain damage, plus two cases of autism that

Table 1. Distribution of blind and partially sighted *children* assessed in CER *Vinko Bek* from 2010 to 2015 with regard to additional developmental difficulties of predominantly biological origin

			Belonging to the category of blind or partially sighted		Total
			blind	partially sighted	
Category of additional developmental difficulties of predominantly biological origin	without additional difficulties	f	1	3	47
		% within the blind or partially sighted variable	41.2%	50.0%	47.0%
	organic brain damage and autism	f	14	18	32
		% within the blind or partially sighted variable	41.2%	27.3%	32.0%
	predominant somatic syndromes and combination with speech problems	f	2	3	5
		% within the blind or partially sighted variable	5.9%	4.5%	5.0%

Category of additional developmental difficulties of predominantly biological origin	motor impairment caused by metabolic disease	f	2	1	3
		% within the blind or partially sighted variable	5.9%	1.5%	3.0%
	hearing and speech problems	f	1	5	6
		% within the blind or partially sighted variable	2.9%	7.6%	6.0%
	a combination of organic brain damage and inappropriate socialization	f	1	3	4
		% within the blind or partially sighted variable	2.9%	4.5%	4.0%
	a combination of organic brain damage, somatic syndromes, and sensorimotor problems	f	0	3	3
		% within the blind or partially sighted variable	0.0%	4.5%	3.0%
Total		f	34	66	100
		% within the blind or partially sighted variable	100.0%	100.0%	100.0%

occur in combination with these organic impairments, followed by hearing and speech problems – alone or in combination with the predominant somatic syndromes.

For two children there were no data about additional developmental difficulties.

It is important to notice that the prevalence of additional developmental difficulties of predominantly biological origin does not differ between blind and partially sighted children ($\chi^2 = 5.727$; df = 6; p = 0.454), and the fact that half of them have some of these difficulties does not suggest an unequivocal answer to the justification for applying the WISC to this population. On the other hand, the diversity of developmental difficulties of predominantly biological origin suggests the use of an individually administered test such as the WISC-IV.

Available social support was assessed with (1) age of onset of professional assistance, (2) kindergarten (non)attendance, (3) family support quality and (4) school support quality.

Average age of onset of professional assistance for blind children (Mdn = 6.5 years) is a year and a half lower that the one of partially sighted children (Mdn = 8 years) and testing these differencea by parametric (t = -2.663, df = 93; p = 0.01) as well as a nonparametric (Willcoxon z = -3.052; p = 0.02) test indicates a significant difference (distributions are significantly positively asymmetric in both groups). Those results indicate an average of 7 years of institutional follow-up of blind and partially sighted children before WISC testing, which is a favorable circumstance for the application of this complex test, given the degree of collaboration required during the testing.

Kindergarten attendance before entering the school system is significantly more frequent for blind children (66,7%) then for partially sighted ones (25%) as shown using t-test for proportions ($t = 3.656$; $df = 81$; $p < 0.01$). However, a significant percentage of partially sighted children were deprived of the developmentally stimulating environment that most healthy children have, and this fact implies difficulties in solving every test of intellectual ability, including the WISC-IV.

The assessment of the quality of family and school support in the examined sample of blind and partially sighted children is summarized in the following table.

Primarily due to the ordinal scale of assessment, but also because of significant deviation from the norm, the evaluation of family and school support quality is not shown with arithmetic means, but for greater accuracy of its values it is useful to point out their range – from 3.77 (quality of family support for partially sighted children) to 4.34 (quality of school support for blind ones). These values indicate mainly high-quality family and school support for both groups of children with visual impairments, that represent a stimulating developmental environment and good support for any form of cognitive assessment, including the WISC-IV. The uniformity of support for blind and partially sighted children was confirmed by a nonparametric rank sum test: (1) for family support $z = -0.741$; $p = 0.459$, (2) for school support $z = -1.566$; $p = 0.523$.

Table 2. Median values (Mdn) and semi-interquartile range (q) of the quality of family and school support for blind and partially sighted children.

	Blind	Partially sighted
Quality of family support	Mdn=4, q=1	Mdn=4, q=0.5
Quality of school support	Mdn=4, q=0.5	Mdn=4, q=0.5

The justification for using WISC-IV (with minimal adaptation of instructions and timing associated with the change in scoring) to assess the intellectual ability of blind and partially sighted children in the process of educational orientation supports the finding of another statistical analysis, independent of developmental-biological specifics, additional developmental difficulties and social support of this population. It is the absence of significant positive transfer between multiple applications of WISC-IV on this population. For 19.8% of blind and partially sighted children who had previously been tested 1 or 2 times with the WISC (with an interval of several years), no statistically significant higher result was found compared to the ones that have not been tested before. In particular, repeated measurements ANOVA with an additional independent variable between the groups – blind and partially sighted – showed that the effect of the ordinal number of measurements, regardless of the type of visual impairment, was not statistically significant on 5 predominantly verbal WISC-IV tests (where this effect could have been tested for both groups of children). In particular, the relevant outcomes of ANOVA were in the range from $F = 0.015$; $df1 = 1$, $df2 = 95$; $p = 0.903$ (for Similarity subtest) to $F = 1.455$; $df1 = 1$, $df2 = 95$; $p = 0.231$ (for *Comprehension* subtests).

In order to show the performance of blind and partially sighted children on verbal com-

Table 3a. Descriptive statistics for scaled scores of blind and partially sighted children in the *Similarities subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	32	2	7.5	4.19	7	7	1	15	56.1	-0.17	0.943	32	0.094
partially sighted	67	1	7.6	3.95	8	3.5	1	14	52.3	-1.43	0.918	67	< 0.001

Legend: CV= coefficient of variance; z-asim= z-statistic of asymmetry test; SW-test= Shapiro-Wilk normality test

Table 3b. Descriptive statistics for scaled scores of blind and partially sighted children in the *Vocabulary subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	32	2	7.6	4.94	8.5	4.875	1	18	65.1	0.10	0.925	32	0.028
partially sighted	67	1	7.05	4.45	7	4.0	1	17	63.2	0.60	0.936	67	0.002

Table 3c. Descriptive statistics for scaled scores of blind and partially sighted children in the *Comprehension subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	32	2	6.2	3.60	6	2.75	1	13	58.1	0.12	0.943	32	0.093
partially sighted	67	1	6.5	4.25	6	4.0	1	15	65.8	0.85	0.929	67	0.001

Table 3d. Testing the difference in the performance of blind and partially sighted children in VC subtests relative to the corresponding normative values of scaled results ($\mu = 10$)

	Blind			Partially sighted		
Subtest name (scaled scores)	t	df	P	t	df	p
Similarities	-3.179	33	0.003	-5.070	66	<0.001
Vocabulary	-2.883	33	0.007	-5.432	66	<0.001
Comprehension	-6.433	31	<0.001	-6.811	66	<0.001

prehension (VC) subtests as well as to test the assumption that both groups will achieve significantly lower scores compared to norms (H2), we calculated the relevant descriptive statistics in three VC subtests and tested the measures of central tendency in relation to norms.

From the information presented in Tables 3a-3c it is visible that (1) score distributions generally deviate from the normal distribution (Shapiro-Wilk test is not significant only for a small sample of blind children with low statistical power) but not due to asymmetry (z-asim < 1.96), (2) the relative variance is quite large (CV is twice the value of the optimal 20-30%) and together with a noticeable range of results (max-min values from 12 to 17 scale scores) indicates a good differentiation of tested children with visual impairment (i.e., their significant heterogeneity), (3) the average score is lower than the norm ($\mu = 10$) by 1.5 scale points (blind participants in the *Vocabulary subtest*) to 4 scale points (both groups of participants in the *Comprehension subtest*) – expressed in median measures of the central tendency (in arithmetic mean measure where deviation ranges from 2.4 to 3.8 scale points).

Findings from Table 3d clearly confirm that the lower scores of blind and partially sighted children in the VC subtests at the population level differ from the norms (i.e. from the sighted population), showing (1) that the difference is most significant for *Comprehension subtest,* (2) while in all VC subtests the differences are more pronounced for partially sighted, primarily due to the higher statistical power of these tests (the sample is twice as large, and the corresponding arithmetic means do not differ that much from those of blind children).

In order to test the hypothesis that blind and partially sighted children in working memory (WM) subtests achieve results equal to or better than population norms (H3) and to present those results, the same descriptive statistics were calculated and analogous t-tests, as in the case of VC subtests, were performed.

Findings from Tables 4a-4b show that (1) with the exception of performance of partially sighted children on *Digit Span subtest,* results of visually impaired children in *Digit Span* and *Letter-Number Sequencing subtests*

Table 4a. Descriptive statistics for scaled scores of blind and partially sighted children in the *Digit Span subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	33	1	11	4.74	10	5	3	19	43.1	0.52	0.918	33	0.016
partially sighted	67	1	9.8	3.97	9	3	1	18	40.3	0.48	0.974	67	0.183

Table 4b. Descriptive statistics for scaled scores of blind and partially sighted children in the *Letter-Number Sequencing subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	33	1	6.0	4.02	6	4.25	1	14	66.25	0.17	0.895	33	0.004
partially sighted	67	1	6.5	4.17	7	4.5	1	14	64.1	-0.34	0.891	67	<0.001

Table 4c. Testing the difference in the performance of blind and partially sighted children in WM subtests relative to the corresponding normative values of scaled results ($\mu = 10$)

	Blind			Partially sighted		
Subtest name (scaled scores)	t	df	P	t	df	p
Digit Span	0.960	33	0.344	-0.339	66	0.736
Letter-Number Sequencing	-5.636	32	<0.001	-6.852	66	<0.001

are not distributed normally but are neither asymmetric, (2) relative variance (from 40% to 66%) and the range of results (from 13 to 17 scale scores) indicate great heterogeneity of children with visual impairment and high differentiation of this population, (3) average values of results in *Digit Span subtest* deviate minimally from the norms (with the blind group showing slightly better performance than the norms and the partially sighted one slightly below the norms), and the average results in the *Letter-Number Sequencing subtest* show significantly lower values than the norms (3-4 scale scores).

Whether these average deviations are different from the norms can be seen from the data in Table 4c, which show that the performance of blind and partially sighted children in the *Digit Span subtest* is in line with the norms, while the performance in the *Letter-Number Sequencing subtest* is significantly lower than the norms.

In order to show the ability of perceptual reasoning (PR) and processing speed (PS) of blind and partially sighted children and to test the hypothesis that visually impaired children achieve significantly lower results than normative population in subtests of PR and PS, while blind students (with the remaining functional vision) at best partially solve these subtests (H4), descriptive statistics of the two examined groups in the corresponding subtests are presented and the deviation of their average scaled results from population norms is tested ($\mu = 10$).

Descriptive statistics of all three subtests of PR (Table 5a-5c) show that the corresponding distributions deviate from the normal

Table 5a. Descriptive statistics for scaled scores of blind and partially sighted children in the *Block Design subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	34	0	3.4	5.26	0	3.5	0	15	154.1	3.15	0.682	34	< 0.001
partially sighted	68	0	9.1	4.67	11	3.375	0	19	51.4	-1.85	0.908	68	< 0.001

Table 5b. Descriptive statistics for scaled scores of blind and partially sighted children in the *Picture Concepts subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	34	0	1.9	3.76	0	0.875	0	12	193.6	4.37	0.578	34	<0.001
partially sighted	68	0	6.9	3.98	7	3.75	0	14	57.5	-0.91	0.926	68	<0.001

Table 5c. Descriptive statistics for scaled scores of blind and partially sighted children in the *Matrix Reasoning subtest*

	N										SW-test		
	valid	missing	M	SD	Mdn	q	min	max	CV	z-asim	statistic	df	p
blind	34	0	2.1	4.25	0	1	0	15	203.6	5.12	0.563	34	<0.001
partially sighted	68	0	7.3	4.42	7.5	4.0	0	14	60.8	0.20	0.929	68	0.001

Table 5d. Testing the difference in the performance of blind and partially sighted children in PR subtests relative to the corresponding normative values of scaled results ($\mu = 10$)

	Blind			Partially sighted		
Subtest name (scaled scores)	t	df	P	t	df	p
Block Design	-7.307	33	<0.001	-1.610	67	0.112
Picture Concepts	-12.506	33	<0.001	-6.364	67	<0.001
Matrix Reasoning	-10.849	33	<0.001	-5.103	67	<0.001

distribution (Shapiro-Wilk test is statistically significant at a level lower than 0.1%). For blind participants, this deviation is clearly determined by positive asymmetry, while for the partially sighted group the distributions are not significantly asymmetric. Relative variance (CV) for the blind children is artificially increased due to extremely low average values, so these subtests can differentiate partially sighted ones significantly better (the range of results is larger for *Block Design* and *Picture Concepts subtests*, while CV for all three subtests shows the value twice that of the optimal value). With the exception of the *Block Design subtest* of partially sighted children, the average values of both groups in all PR subtests are significantly lower than the norms, especially for blind children whose zero median values indicate that most of them did not even try to solve the test. These deviations from the norms were tested by t-test (Table 5d) and on a population level it was proven that only partially sighted children in the *Block Design* subtest do not achieve values lower than the norms.

Descriptive statistics of the scaled results of the *Coding* and *Symbol Search* subtests show that (1) the corresponding distributions deviate from the normal distribution in both groups of children with visual impairment, where part of this distribution deviation of the blind group is certainly produced by strong positive asymmetry, (2) two PS subtests distinguish very well partially sighted children, and

Table 6a. Descriptive statistics for scaled scores of blind and partially sighted children in the *Coding subtest*

	N		M	SD	Mdn	q	min	max	CV	z-asim	SW-test		
	valid	missing									statistic	df	p
blind	34	0	1.4	3.53	0	0	3	17	250.4	7.84	0.466	34	<0.001
partially sighted	68	0	5.4	3.58	6	3.375	0	13	66.4	0.41	0.944	68	0.004

Table 6b. Descriptive statistics for scaled scores of blind and partially sighted children in the *Symbol Search subtest*

	N		M	SD	Mdn	q	min	max	CV	z-asim	SW-test		
	valid	missing									statistic	df	p
blind	33	1	0.9	2.27	0	0	0	9	256.9	6.76	0.454	34	<0.001
partially sighted	67	1	4.6	3.57	5	3.375	0	12	77.5	1.23	0.913	68	<0.001

Table 6c. Testing the difference in the performance of blind and partially sighted children in PS subtests relative to the corresponding normative values of scaled results ($\mu = 10$)

	Blind			Partially sighted		
Subtest name (scaled scores)	t	df	P	t	df	p
Coding	-14.169	33	<0.001	-10.593	67	<0.001
Symbol Search	-23.456	33	<0.001	-12.478	67	<0.001

significantly weaker blind children (whose CV is artificially high due to low M values, but all other measures of variability are obviously lower than in partially sighted group), (3) average values of blind and partially sighted children in these two PS subtests are significantly lower than the norms ($\mu = 10$), especially for blind children whose zero median values indicate that most of these children did not solve any task.

Although extremely low average scores of blind and partially sighted children were expected to deviate significantly from the population norms of sighted children, the data in Table 6c unequivocally confirm this expectation.

After comparing the performance of blind and visually impaired children with the norms of the sighted population of children, the similarities and differences of these two groups of students were analyzed (H5).

Although the two groups of children are not equally numerous and most distributions deviate from the normal one, the dominant homogeneity of variances and sample sizes greater than 30 justify the use of Independent Samples t-test to test differences between the results of all core WISC-IV subtests and the additional *Arithmetic* subtest.

From the data in Table 7, it is clear that blind and partially sighted children do not differ in the success of solving any VC and WM subtest as well as Arithmetic subtest. But the rest of Table 7, along with the data in Tables 5a-5c and Tables 6a and 6b, unequivocally indicate that the partially sighted children perform significantly better on the PR and PS subtests.

Table 7. Results of testing the differences between blind and partially sighted children in performance on 10 core WISC-IV subtests and additional *Arithmetic* subtest.

	t-test results of blind and partially sighted children		
WISC-IV Subtest name	t	df	p
Similarities	0.145	99	0.885
Vocabulary	0.594	99	0.554
Comprehension	-0.316	97	0.753
Digit Span	1.065	99	0.289
Letter-Number Sequencing	-0.510	98	0.611
Arithmetic	0.802	70	0.425
Block Design	-5.547	100	<0.001
Picture Concepts	-6.071	100	<0.001
Matrix Reasoning	-5.645	100	<0.001
Coding	-5.319	100	<0.001
Symbol Search	-5.541	100	<0.001

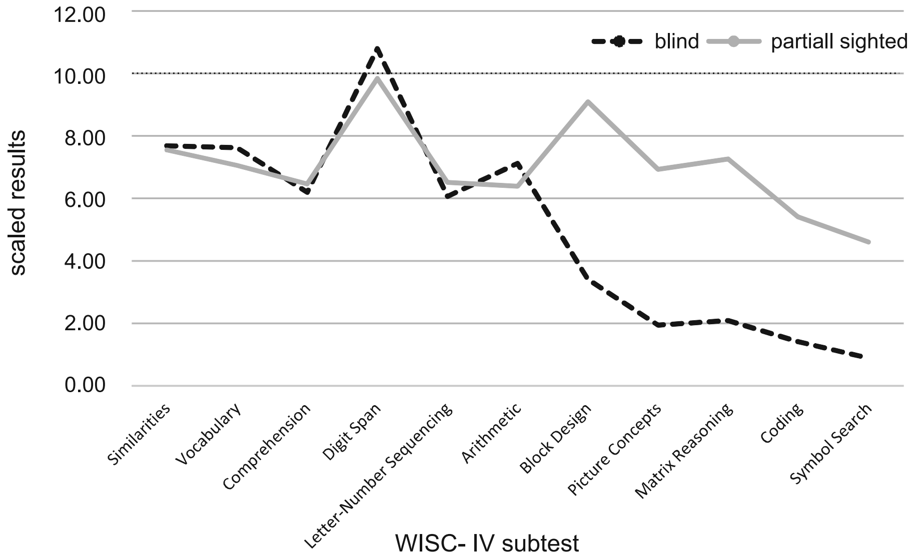

Figure 2. Specific profile of intellectual abilities of blind and partially sighted students in the final grades of primary school in Croatia, derived from the average results of these two populations on 11 WISC-IV subtests.

Taking into account all previous findings, it is possible to conclude that blind and partially sighted children show a specific performance profile on individual subtests of the WISC-IV (H6), that is primarily determined by visual-perceptual limitations of two groups, but also partly reflects additional developmental difficulties, as well as developmental-biological specifics and social support for members of that population. Using the average values of all 11 applied WISC-IV subtests, the specific profile of final grades primary school students with visual impairment can be presented as following.

DISCUSSION

With regard to the first research problem, it can be said that use of an earlier version of the WISC in the assessment of the intellectual status of blind and partially sighted school-age children in Croatia (Stančić & Ljubešić, 1973), as well as the WISC-IV representation in other international studies of cognitive functioning (Mommers, 1976; Tillman, 1967; Vander Kolk, 1982), strongly suggests the use of this instrument in assessing the intellectual status of blind and partially sighted school children in contemporary Croatian educational circumstances, although with minimal adjustment of instructions and time limit in several tasks. In order to check if there are additional specifics that would challenge the appropriateness of the application of the WISC-IV in the modern Croatian population of blind and partially sighted school children, the available data on developmental-biological, medical, and social support factors was analyzed.

The ratio of blind and partially sighted children, which proved to be stable over time, shows that 2/3 of the population of visually impaired students is actually partially sighted and that 2/3 of that population manages to solve almost all types of WISC-IV tasks – which justifies full use of the WISC-IV for the assessment of the intellectual status of children with visual impairment. Even more so because an additional 15% of blind children (who have preserved remains of functional vision) also manage to solve at least partially all types of the WISC-IV tasks.

However, the fact that the visual acuity of this population is from 5 (in the partially sighted) up to 50 times lower (in the blind) than in the normal population, and that at the same time the results on the WISC-IV subtests are not much lower than the norm is quite surprising since visual perception occupies over 80% of the human perception necessary to communicate with the world. Such finding suggest several hypotheses: (1) that visual acuity — although important in visual intelligence tasks — has a smaller role than the functional use of vision; (2) that people with visual impairments develop special ways to build the mental representations needed to solve a wide range of intellectual problems and use them in an equally specific way; (3) that visual perception in previous models of performance on intelligence tasks has an overestimated role. Before commenting these hypotheses, it is important to point out that *functional use of vision* is defined as the effective use of impaired vision or visual abilities in everyday situations and the process of acquiring knowledge and skills and is the result of a combination of visual acuity and visual perception and can be improved by visual training (Košćec, 2007). Although the simultaneous acceptance of all these hypotheses is not excluded, psychologists-practitioners in this field emphasize the value of the first one. According to their experiences, visual acuity of blind people from 0.02 to 0.05 can produce good cognitive performance if these people have good functional vision developed through experiential learning, visual training, and compensatory skills. On the contrary, partially sighted people with a visual acuity of 0.1 may have lower functional vision than blind people and will be equal in cognitive performance, or even weaker than those people.

Although functional vision and compensatory skills are developed through experiential learning and are therefore somewhat positively related to the duration of visual impairment, sole duration of visual impairment – which is longer at a lower age of impairment occurrence – has a dominant negative impact and has the opposite effect: withholding of quality visual data in the early developmental period significantly impairs mental representations and all other components of the cognitive structure and processes of the individual. In this sense, the data of the zero median age of visual impairment occurrence of the measured population does not support the use of PR and PS WISC-IV subtests, but also any other standard psychodiagnostic instrument of this (visual) type, for the assessment of the intellectual status. However, it is a reality that cannot be avoided but only mitigated by the intervention.

Similarly, it is impossible to avoid the effects of additional developmental difficulties of predominantly biological origin, which are present in 53% of assessed pupils with visual impairment (equally for the blind and partially sighted) and makes it difficult to apply any test to assess intellectual status, including the WISC-IV. However, the author of the WISC-IV states that the test (although intended for the general population of children aged from 6 to 16 years) applies to children with motor, language, or sensory developmental difficulties, with certain modifications (Wechsler, 2009). Likewise, the author states that: (1) modification should be shaped by psychologists who assess a child's intellectual (and general) status based on a clinical assessment of the effect of the modification on outcomes; (2) any modification to the standard test application procedure and scoring instructions should be recorded and taken into account in the interpretation of results; (3) although some modifications question the comparison of related outcomes with norms, such tests provide very valuable qualitative and quantitative data on a child's strengths and weaknesses in cognitive functioning (Wechsler, 2009).

In Croatian clinical practice, the WISC-IV is used in full whenever possible (and for children with developmental disabilities, possibly in two time slots), and partially only if specific developmental difficulties prevent its full use. This approach is also applied to children with visual impairment.

The aggravating circumstances of intellectual assessment, but also of the intellectual development of blind and partially sighted children, that can be avoided are (a) a rather late age of starting professional support for the blind (Mdn = 6.5 years) and visually impaired children (Mdn = 8 years) and (b) relatively low percentage of kindergarten attendance by blind (66.7%) and visually impaired children (25%) in Croatia. In fact, according to psychologists from the CER *Vinko Bek*, at the time of the study, there was no systematic early intervention in Croatia, nor early parental support, while the preparatory group for the CER *Vinko Bek* kindergarten was still in development. However, already during the study, the work in this area was intensified, so the data on the beginning of professional support is quite heterogeneous: some children were monitored from early childhood and through the preschool period, some came for a team assessment just before starting school, and some came only when vision was significantly decreased, or completely lost during schooling and/or when their parents were ready for professional help. A similar process of progress and heterogeneous approaches existed with the inclusion of blind and partially sighted children in kindergarten. Except for the blind and partially sighted children from rural areas, where going to kindergarten is rare, there are three groups of reasons why children with visual impairment did not attend kindergarten in a significant percentage: (1) objective health reasons (surgeries and eye treatment with longer and more complex recovery, more sensitive health of children, additional developmental difficulties of predominantly biological origin, more difficult separation, delay in psychomotor development and independent functioning), (2) hyperprotectiveness of parents, (3) unpreparedness of kindergartens to accept a blind child under 5 years of age (too large groups of children, prejudices towards inclusion, insufficient staff). Today, inclusive practice for blind and partially sighted children in kindergartens is different: (1) with the support of CER *Vinko Bek*, many children are included at the age of 3, and some even in nurseries; (2) some children with visual impairments have also been identified in kindergartens; (3) children with multiple disabilities are included in small special educational groups, but also in regular ones, with a third educator or assistant.

Finally, consideration of the social support factors noted in the research clearly supports the application of a complex intellectual assessment instrument such as the WISC-IV, both directly (in terms of organizational actions required for testing and parental motivation of the child to assessment procedures) and indirectly (all material and immaterial forms of support to the intellectual development of a blind and partially sighted child conducted in the family and the school environment). Particularly, in both blind and partially sighted children, family support, as well as school support, was assessed mainly as high quality

(Mdn = 4), although in blind children family support varied somewhat more.

Responding to the second research problem (to present and interpret the basic findings of the intellectual assessment of blind and partially sighted children using the WISC-IV subtests) we shall organize according to four ability indices of the WISC-IV, closely related to five previously outlined hypotheses.

Considering the verbal comprehension index (VCI) of blind and partially sighted pupils, the insight into the data Table 3a-3c clearly suggests that (1) this index is lower than the norm, (2) the deviations from the norm are the largest in the *Comprehension* subtest, (3) the deviations from the norm are on average uniform for the blind and partially sighted through all three subtests, therewith blind showing slightly better results in the *Vocabulary* and the partially sighted in *Similarities*. Since all deviations from the norms in the VCI sub-tests are statistically significant (Table 3d), it can be said that the results are only partially in line with the findings of previous research, primarily in terms of lower results on the *Vocabulary* subtest (Mommers, 1976; Stančić & Ljubešić, 1973; Tillman, 1967). Previous research almost systematically indicates how the blind and partially sighted achieve results equal to the sighted population on the *Vocabulary* subtest (Mommers, 1976; Stančić & Ljubešić, 1973; Tillman, 1967), while some research indicates even better results than the norms in the *Similarities* subtest (Vander Kolk, 1982). Lower results of blind and partially sighted pupils in Croatia compared to previous international research can be explained by differences in research method (earlier research used an older and less demanding version of the WISC, samples are smaller, participants' age only partially comparable), but also possible differences in social support factors and in the relevant characteristics of blind and partially sighted participants. Namely, due to many organizational and material circumstances, early intervention in Croatia is shorter than in more developed countries (Poljan, 2011; van Dijk et al., 2002; Gringhuis, Moonen & van Woudenberg, 2002), it is not carried out often enough in continuity and is not sufficiently available in all parts of Croatia due to the spatial distance and overload of our experts. Similarly, additional specific preschool programs (habilitation programs) are not available in most parts of Croatia, and the problem of quality professional support occurs in blind and partially sighted children integrated into regular kindergarten and primary school: educational groups and classrooms are too large, and therefore educators/teachers have a harder time providing support for a child with a disability despite the existing education and continuous consultations and supervision with experts in the field (Nenadić, 2007: Poljan, 2017). The same problem of availability occurs with the psychological support provided to the family. A comparative study of the case of Celeste and Grum (2010), comparing the social integration of a 5-year-old blind boy from Slovenia with a blind girl of 4 and a half years from the USA can be cited as an argument for the existence of these differences in professional and social support of developed and transition countries. The research states that a girl from the USA started receiving professional help at the age of 4 months, which is significantly earlier than the children in this research sample, while a boy from Slovenia had to seek professional help in Austria due to the unavailability of such early intervention in Slovenia. Besides, he regularly attended a medical intervention program consisting of physiotherapy and play therapy. The girl from the USA was admitted to the early intervention program at the age of 4 months, and from the age of 6 months, a certified teacher for children with visual impairments and a licensed orientation and mobility instructor had worked with her. In addition, she regularly participated in the local "Gymboree" program (structured motor and social activity), and subsequently in group swimming lessons, "girl scouts" activities, and piano lessons. Both participants at the age of 3 began attending an inclusive preschool program (Celeste & Grum, 2010).

Relevant features of the compared WISC-IV results of blind and partially sighted children are certainly additional developmental difficulties of predominantly biological origin, about which there is no data in the mentioned international research (Mommers, 1976; Tillman, 1967; Stančić & Ljubešić, 1973; Vander Kolk, 1982), and are present in 53% of the Croatian sample. These difficulties, combined with certain forms of cultural deprivation of a small number of blind Roma children, can be an additional reason for the lower results of the conducted research, compared to the previous ones. However, it should be noted that there are individuals among Croatian pupils with visual impairments with extremely high results (above 15), for whom competent psychologists report that they are well habilitated, they have been provided with quality parental and professional support from an early age, have age-appropriate social interactions and experiences, have excellent auditory memory, read a lot, follow various content over the Internet and consequently have a large amount of general information, rich vocabulary and largely compensate for the lack of vision. Systematically lowest scores in the *Comprehension* subtest are attributed to tasks involving possible behavior in social situations, that are not so close to many blind and partially sighted people because the hyperprotective attitude of their parents and surroundings generally produces less age-appropriate social experiences and knowledge required in these tasks.

Results analysis of the subtests *Digit Span* and *Letter-Number Sequencing* does not give an unambiguous conclusion about the ability of working memory (i.e., WMI) of blind and partially sighted pupils in Croatia. Namely, on the *Digit Span* subtest, blind and partially sighted pupils achieve results equal to the norms (although blind with an obvious tendency to higher results), while on the *Letter-Number Sequencing* subtest the results of both groups of pupils are significantly below the norms. Regarding the *Digit Span* subtest, such findings are mostly consistent with previous research (Mommers, 1976; Stančić &Ljubešić, 1973; Tillman, 1967; Vander Kolk, 1982), although those studies also indicate significantly superior performance of the blind compared to the sighted population. That can be explained by the presumption that, in general, blind people can concentrate better, because there is no interference from visual stimulation and often have better auditory memory, because they are more focused on it due to their lack of vision. The reason why this superiority was not expressed in Croatian blind pupils is probably the great performance variability of these pupils (CV = 43%, min = 3, max = 19), that is a consequence of great heterogeneity in additional developmental difficulties of predominantly biological origin, but also social support. On the other hand, comparative data for the *Letter-Number Sequencing* subtest are not available. But this subtest is significantly more demanding than *Digit Span* because it requires sequencing of two independent contents (letters and numbers), while *Digit Span* is sequencing only one (numbers). These additional requirements particularly worsen the performance of children with organic cerebral dysfunction and/or attention deficit disorder, represented in the observed sample (Table 1), who have great difficulty in this more complex sequencing.

The results of partially sighted, but also blind pupils with a residual functional vision on the PR and PS subtests are probably the greatest contribution to the research of intellectual abilities of that population because these tests are rarely used in that population (Barsingerhorn et al., 2018; Huurneman et al., 2014; Pel et al., 2011). In the conducted research, these WISC-IV subtests are justifiably applied with regard to the purpose of testing – educational and professional guidance, within which it is extremely important to assess the maximum capacities of blind and partially sighted children, to advise them a realistic professional perspective. The results in the PR subtests (*Block-Design, Picture Concepts, Matrix Reasoning*) are expectedly lower than the norms, although not to a high extent for the partially sighted (blind pupils show values ranging from $M_{Picture\ Concepts} = 1.9$ to $M_{Block\ Design} = 3.4$, and partially sighted pupils show significantly higher values $M_{Picture\ Concepts} = 6.9$ to $M_{Block\ Design} = 9.1$), and medial values show that only blind pupils with the residual functional vision approach to solving these PR subtests (Mdn = 0 for all three subtests). The results of Table 5d confirm a significantly lower performance compared to the norms for both groups of pupils in all subtests, except on the *Block Design* subtest of partially sighted pupils (t = -1.61; df = 67; p = 0.112). It is interesting that exactly partially sighted pupils achieve higher results on subtests of perceptual reasoning (common average on all three subtests is 7.77) than on sub-tests of verbal comprehension (common average on all three subtests is 7.02), probably because they have a greater cognitive capacity, but often do not like to work longer on the text due to fatigue, poor technique and speed of reading, which is why they express themselves less verbally and have a poorer vocabulary. For this finding, it is difficult to find comparative empirical data in previous research, which is not surprising because scientific research assumes that to solve figural tasks it is necessary to have a healthy visual perception and therefore for such tasks they do not test people who have 5 to 50 times lower visual acuity. That is not the case with clinical and counselling testing, which in principle are not entered into with assumptions, but rather exploratory (with the aim of getting to know the individual and his cognitive potential, in order to advise future engagements in existing aggravating circumstances).

Scaled scores of blind and partially sighted pupils on PS subtests (*Coding, Symbol Search*) are the lowest below the norm of all WISC-IV subtests, especially in blind children (blind children show average values lower than the norms for 9.1 scaled units in *Symbol Search* subtest, while partially sighted children show average values lower than the norm for 5.4 scaled units in the same subtest). Zero medial values of blind children in this subtest again suggest that only blind children with residual functional vision try to solve it, while, on the other hand, the relatively largest variability of results (compared to other subtests) indicates great heterogeneity of research participants possibly caused by additional developmental difficulties of predominantly biological origin, to which processing speed tests are very sensitive. The obtained, statistically significant deviations (Table 6c) are mostly in line with the available findings on the processing speed of blind and partially sighted people (Barsingerhorn et al, 2018; Huurneman et al, 2014; Pel et al, 2011), but it is difficult to assess the degree of compliance because PS subtests *Coding* and *Symbol Search* were not used in the corresponding research.

It is significant that it is precisely on the PS subtests where the deviations of visually impaired people are the highest from the norms, although these tasks are cognitively less demanding than, for example, the tasks of PR subtests. This finding can be explained by the fact that the relatively largest part of performance on the PS subtests relates to visual perception (which is why the tasks are easy for a healthy population), that is significantly impaired in the blind and partially sighted. Namely, in specific PS tasks, visual impairment is accompanied by slower visual search of various types of symbols, and weaker visual-motor coordination and speed of writing symbols in a certain place. Precisely because of the deficit of these functions (or abilities) there is a slower speed of reading and solving written tasks in school, so the application of PS subtests is necessary for educational guidance procedures to advise teachers on whether it is necessary, and to what extent blind and partially sighted pupils need more time to solve written assignments.

Although when comparing the performance of blind and partially sighted pupils with the norms of all subtests VC, WM, PR, and PS, differences between blind and partially sighted pupils were implicitly revealed, the difference between these two groups on these subtests was not explicitly commented. The data in Table 7 point to a fairly simple pattern of differences between blind and partially sighted children in terms of intellectual abilities assessed by the WISC-IV: there are no differences in verbal comprehension and working memory abilities (including the additional *Arithmetic* subtest, which is applied when there are indications of problems in that segment of intellectual functioning), while the abilities of perceptual reasoning and processing speed are significantly closer to the norms in partially sighted children, although still below. Such findings are fully in line with expectations, because visual perception is not crucial for the abilities inherent in VCI and WMI (and therefore significantly better visual acuity of the partially sighted is not expressed), while in the abilities of PRI and PSI, it plays a significant role. Another interesting fact that points to the specificity of the intellectual functioning of blind and partially sighted people stems from the fact that, despite the largest deviations of both groups from the norms in PS subtests (in which the relative share of visual perception is the largest), the biggest difference between these two groups is on PR subtests (Table 7). Offering a systematic explanation of this specificity requires additional analyses that are outside the scope of this study, but the possible reasons for its occurrence could be multiple: (1) blind with low residual visual acuity and associated functional vision are possibly perceiving pictorial testing material globally, without including all details on which greater success on PR subtests depends; (2) the visual experience of blind people (through everyday life and education) is less than that of the partially sighted (they encounter less visual tasks) and rely more on intact sensory channels (auditory and tactile-kinesthetic); (3) given the fact that cerebral visual impairment in Croatia is diagnosable only for few years (Poljan, 2018) it can be speculated (because for the observed sample of blind and partially sighted, these data do not exist) that a higher proportion of these impairments in the blind is due to the fact that most of them are born prematurely (in whom this impairment occurs more frequently), and it significantly complicates perception (in particular spatial relationships) reduces performance on, for example, subtests *Block Design* and *Matrix Reasoning*.

The exact specificity mentioned above, with the findings that the blind and partially sighted show the weakest performance on PS measures, or that the partially sighted achieve even better results on PR subtests than on VC subtests, clearly suggests the validity of the last research hypothesis (H6): Blind and partially sighted children will show a specific performance profile on WISC-IV subtests. This profile is visible from Figure 2 and, in addition to the mentioned specifics, indicates clear general tendencies: (1) partially sighted, except for significantly weaker PS, generally show moderately poor performance in all abilities tested by WISC-IV, which in some WM measures (*Digit Span*) and PR (*Block Design*), even reaches normal values; (2) the blind, with the exception of one normally developed measure WM (Digit Span), systematically show lower performance on WISC-IV indicators of intellectual ability, with this failure being moderate in subtests VC and WM, and pronounced in subtests PR and PS.

The obtained specific profile should certainly be seen in the context of the specific age of the examined sample of blind and partially sighted children, but also additional developmental difficulties of predominantly biological origin and professional help and social support that over time becomes better and more available in Croatia.

CONCLUSION

Developmental-biological specifics, additional developmental difficulties of predominantly biological origin, and available social support to blind and partially sighted pupils in Croatia, although in a divided manner, still predominantly suggest an assessment of the intellectual status of this population with the WISC-IV. In fact, the use of WISC-IV is supported by (1a) a favorable ratio of blind and partially sighted, (2a) the fact that 15% of blind people with residual functional vision manage to solve all WISC-IV subtests, (3a) mostly quality family support, and (4a) mostly quality school support to this population. On the other hand, unfavorable circumstances for the use of WISC-IV are (1b) the dominant presence of visual impairment from birth, (2b) a significant percentage (53%) of additional developmental difficulties of predominantly biological origin in blind and partially sighted pupils, (3b) relatively late age of starting to receive professional care for blind and partially sighted children, (4b) the relatively late inclusion of blind and partially sighted in preschool programs - although condition (1b) limits PR and PS subtests only, and conditions (3b) and (4b) improve significantly over time. However, if the action of these aggravating circumstances can be avoided to a somewhat greater extent by some other instrument of intellectual assessment (and in full it cannot with certainty), it is unlikely it will reach the metric properties and comprehensiveness of the WISC-IV. This is confirmed by previous applications of WISC (VC and WM) "verbal subtests" in assessing the intellectual status of visually impaired persons, while the addition of "non-verbal subtests" (PR and PS) in this study provides additional (rarely used) insight into cognitive capacity of that population.

The basic findings of the intellectual assessment of blind and partially sighted children by WISC-IV during regular educational and vocational guidance procedures in Croatia (dominant age 14-15 years) show that blind and partially sighted pupils show statistically significant lower values than norms in VC subtests, but with moderate deviation (with the weakest performance on the *Comprehension* subtest), while on WM subtests they achieve a result equal to the norms (for *Digit Span*), or moderately lower than the norms (for *Letter-Number Sequencing*). On the other hand, in the PR subtests, blind and partially sighted pupils show different results: the blind achieve significantly lower while the partially sighted achieve moderately lower results than the norm, whereas the performance of the partially sighted on the *Block Design* subtest is statistically equal to one of the sighted. In both PS subtests, blind and partially sighted pupils show differently low results compared to the norms (in favor of the partially sighted), but in these subtests, both groups achieve relatively the lowest results. When conclusions on the average higher values of the visually impaired in PR than in the VC, on the largest difference between the blind and visually impaired in PR, and on the largest deviation of both groups from the norms in PS are added to these findings, it becomes obvious that blind and partially sighted children in Croatia show a specific performance profile on the WISC-IV. This profile is only partially in line with previous research (primarily in the field of VC and WM), which can be explained not only by methodological arguments (difference in sample size, age and gender structure, different versions of WISC) but also relevant factors which are generally not described in previous research: developmental specifics, additional developmental difficulties of a predominantly biological nature, and variable social support. The observed specifics are a stimulus for new research that will not only provide insights valuable for a better adaptation of blind and partially sighted people to the requirements of their reality but also the role of visual perception in broad dimensions of intellectual functioning of the general (sighted) population: verbal comprehension, working memory, perceptual reasoning, and processing speed.

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Intelektualni status slijepe i slabovidne djece u Hrvatskoj procijenjen WISC-om-IV tijekom obrazovanja i profesionalne orijentacije: osnovni nalazi i relevantni čimbenici

Sažetak: Intelektualni status slijepe i slabovidne djece u Hrvatskoj nije sustavno istraživan gotovo tri desetljeća, usprkos promjeni instrumenata procjene i oblika institucionalne potpore ovoj populaciji. Cilj istraživanja bio je dvojak: (1) pojasniti kako razvojni, zdravstveni i čimbenici socijalne potpore određuju izbor WISC-IV za intelektualnu procjenu ove populacije tijekom obrazovnog/profesionalnog usmjeravanja, te (2) analizirati osnovne nalaze provedene procjene po pojedinim pod-testovima WISC-IV. Istraživanje je provedeno na102 slijepih i slabovidnih (51 djevojčica, 34 slijepih) starosti 12 do 16 godina, u okviru redovne procjene Centra *Vinko Bek*. Slabovidni i slijepi sa sačuvanim funkcionalnim vidom testirani su na svim pod-testovima, dok su preostali slijepi testirani samo na pod-testovima verbalnog shvaćanja (VS) i radnog pamćenja (RP). Povoljan omjer slijepih i slabovidnih, činjenica da slijepi s ostatkom funkcionalnoga vida uspijevaju rješavati sve pod-testove, te uglavnom kvalitetna obiteljska i školska potpora, sugeriraju korištenje WISC-IV za intelektualnu procjenu ove populacije. Nepovoljne okolnosti za korištenje WISC-IV su dominantna prisutnost vidnog oštećenja od samog rođenja, prisutnost dodatnih, pretežito zdravstvenih poteškoća te kašnjenje s profesionalnom potporom. Rezultati slijepih i slabovidnih u pod-testovima VRS statistički su niži od normi, ali umjerenoga odmaka (najniži u pod-testu *Razumijevanje*), dok su u pod-testovima RP jednaki normama (*Raspon pamćenja brojeva*), ili umjereno niži od normi (*Pamćenje nizova slova i brojeva*). U pod-testovima perceptivnog rasuđivanja i brzine obrade informacija rezultati su drugačiji: slijepi postižu značajno niže, a slabovidni umjereno niže rezultate od normi, pri čemu je jedino izvedba slabovidnih u pod-testu *Slaganje kocaka* statistički jednaka videćima. Dobiveni nalazi tumače se u kontekstu prethodnih istraživanja i razvojnih, zdravstvenih te specifičnosti društvene potpore.

Ključne riječi: slijepa i slabovidna djeca, WISC-IV, razvojne i medicinske specifičnosti, društvena potpora

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APPENDIX

Table 8. Representations of individual additional developmental difficulties in pupils with visual impairment assessed in CER Vinko Bek from 2010 to 2015

Additional developmental difficulty	f	%
No additional difficulties	42	41,2
Organic brain damage type 1	15	14,7
Organic brain damage type 2	10	9,8
Reduced intellectual development	5	4,9
predominant somatic syndromes	4	3,9
motor impairment caused by metabolic disease	3	2,9
Hearing problems	3	2,9
Speech problems	1	1,0
Combination of the organic brain damage type 2 and reduced intellectual development	4	3,9
Combination of the reduced intellectual development and social deprivation	1	1,0
Combination of the predominant somatic syndrome and speech problems	1	1,0
Combination of the organic brain damage type 1 and reduced intellectual development	1	1,0
Combination of the organic brain damage type 2, reduced intellectual development, and inappropriate socialization	1	1,0
Combination of the organic brain damage and hearing problems	1	1,0
Combination of organic brain damage type 1 and inappropriate socialization	1	1,0
Combination of the organic brain damage type 2 and predominant somatic syndromes	1	1,0
Combination of the organic brain damage type 1, reduced intellectual development and inappropriate socialization	1	1,0
Combination of hearing problems and speech problems	2	2,0
Combination of the organic brain damage type 2 and motor damage caused by metabolic disease	1	1,0
Combination of the organic brain damage type 2 and autism	1	1,0
Combination of the organic brain damage type 1 and autism	1	1,0