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Cognitive Abilities and Language Comprehension in Preschool Children with Perinatal Brain Lesion

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A B S T R A C T

Perinatal brain lesion is a risk factor for development, making parents of such children particularly worried about consequences it may have on the child's cognitive and language development. Although literature findings on the outcome of perinatal brain lesion are inconsistent, most of the studies have found a positive general outcome, but also subtle deficits that affect the child's academic success. Since language comprehension and cognitive abilities influence learning abilities at school, we wanted to know how six-year olds who were selected based on pathological ultrasonographical findings (ischemic or hemorrhagic brain lesion) would perform on subtests of Wechsler battery (WISC) and language comprehension measures (Reynell Developmental Language Scale and Peabody Picture Vocabulary Test), compared with controls. The second issue we investigated was whether in children who suffered a perinatal brain lesion cognitive abilities predicted the level of language comprehension in the same way as in children without perinatal brain lesion. The relation between cognitive and linguistic abilities is still a controversial one, and a different relation would mean that these two groups of children have different structure of abilities probably due to perinatal brain lesion. Forty children who suffered a perinatal brain lesion and forty age-matched children without perinatal risk factors were examined. Our results showed that the groups differed more in linguistic than in cognitive variables. Also, the two groups showed different relation patterns between cognitive abilities and language comprehension. Cognitive abilities were statistically significantly associated with language comprehension in children who suffered a perinatal brain lesion, while this association was not statistically significant within the control group. Since a number of participants with perinatal brain lesion had language difficulties, it is presumed that they rely on cognitive abilities in order to overcome and compensate for language shortcomings.

Key words: *perinatal brain lesion, language and cognitive outcome, language comprehension, Croatian language*

Introduction

Neurodevelopmental risk factors, including perinatal brain lesion, are on the rise and contribute to the trend of growing percentage of children with learning difficulties. This trend has been recognised since the 1990s[1–3]. When initial developmental difficulties in the area of language and speech development and motor skills are overcome, longitudinal research shows that difficulties of children with perinatal risk continue into their adolescent years[4–6]. Among the group of prematurely born children with brain lesion, 10% of them have motor impairments, whereas as many as 50% of children experience difficulties that are manifested when they reach school age, in the form of learning difficulties or behavioural problems[7].

Follow-up of children with perinatal risk who showed neurological deviations in the perinatal and postnatal period is rare. It has been revealed that this group has problems with reading, writing and mathematical skills which compels them to use more professional support when in their school years (from psychologist, speech and language pathologist, special teacher) in comparison to their peer group[3].

Also, on a sample of the Croatian population, it was proved that this population was very heterogeneous and that in some subjects, consequences of perinatal brain lesion persisted until adolescence[8]. Difficulties often remain unrecognized until the child starts school and they begin to adversely affect the child's success at school.

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In their study, Westmacott et al.[9] showed that children who suffered a unilateral brain lesion, although not differing on the Wechsler scales of intellectual ability from the control group with typical development at preschool age, in their early school years exhibited differences in comparison to children with typical development, and this in the Full Scale IQ, Working Memory and Processing Speed, but not in Verbal IQ or Performance IQ.

It is because of the untimely recognition of the said difficulties that modern studies point to the importance of recognizing risks for learning difficulties before the start of formal education, and the special attention is drawn to the significance of inadequate reading pre-skills[1,10]. The ever more emphasis is now put on the importance of the threat posed by perinatal lesion for academic success, of which all professionals working with children should be aware, and on the importance of early intervention.

Despite numerous information provided by interdisciplinary research, clear and unequivocal interpretations of the influence that the perinatal brain lesion has on individual segments of the child's development are still missing. As a result of the maturation and plasticity processes, functional recovery following the perinatal brain lesion is frequent, although with heterogenous outcomes, since they depend on various factors such as: degree of central nervous system maturity at the moment of lesion, size and site of lesion and presence of epilepsy[11]. It is believed that the general neurodevelopmental outcome with uncomplicated hemorrhages that leave no structural lesions has a more favourable prognosis and vice versa[12]. More severe brain lesions such as complicated hemorrhages, periventricular leukomalacia and combined forms of brain lesions are linked with lower cognitive abilities, multiple difficulties and serious shortcomings in neuropsychological profiles[12].

Cognitive and linguistic abilities of children with perinatal brain lesions

Cognitive abilities of children with brain lesion may range from normal cognitive development all the way to intelectual deficits, and factors contributing to such outcomes have not been sufficiently researched so far[13–21].

Some of the factors influencing the cognitive outcome of individuals with lesions also include the time of lesion, site and size of lesion, presence of epilepsy, and integrity of brain areas surrounding or contralateral to the lesion and consumption of seizure medication[22–24]. The different IQ levels reported for children with early lesions may also reflect the fact that IQ deficits in children with early lesions vary as a function of age. Bates et al.[25] showed a significant negative correlation between IQ and age at test in children with early lesions.

There are well-known findings that prematurely born children[26–27], as well as children with unilateral inborn and acquired cerebral lesion attain a higher verbal than nonverbal intelligence quotient at IQ tests, and this finding does not depend on the side of the brain affected by the lesion.

Apart from global intelligence measures, literature also describes specific cognitive difficulties experienced by children with perinatal brain lesion, namely in the area of attention, perceptual-motor integration, visual perception, perceptual speed, spatial organisation, constructive abilities, working memory, short-term and long-term memory[16,17,28–30].

Kolk and Talvik[31] established that children with left-sided brain lesions had significant delay in phonological and language functions, while children with right-sided brain lesions performed more poorly in visual and spatial skills and in somatosensory functions. Difficulties were also present in the area of sociocognitive abilities and executive functions. Namely, children with perinatal brain lesion tested at the age of 12 months had worse scores at tests measuring inhibition and working memory, and joint attention[20]. Linguistic abilities of children with perinatal brain lesion are often cited as an example of the efficiency of the plasticity process, unlike the limitations of the same processes in the motor system[11]. It is a well-known fact that perinatal brain lesion has a far more favourable outcome for the linguistic development in childhood when compared to effects of a stroke on language in adulthood[17].

Specifically, as a rule, no differences in linguistic abilities associated with a damaged left or right hemisphere were found, which is explained by asymmetric language organisation[32]. Furthermore, it is thought that following the focal brain lesion in the left hemisphere, the intact areas of the left hemisphere and/or homologous areas in the right hemisphere begin to »strengthen«[33]. The initial bilateral nature of linguistic functions stimulates the said pattern[34].

The cohort with perinatal brain lesion shows deviations in the early phase of (pre)linguistic development, which is manifested by the later and weaker onset of babbling, use of gestures, language comprehension and production[20,35], but also as a trend of disproportion between language comprehension and production[36].

Although the child's environment often has the impression that after a slower pace of early language development, further development runs its typical course, follow-up of the group with perinatal brain lesion shows a general typical pattern of linguistic abilities, but also some departures from all language components: a weaker lexical variety, a bigger number of mistakes in grammatical markings and a lower index of syntactic development[37]. The exposure to more complex language tasks reveals subtle deficits in the language processing such as a slower time of reaction, working memory deficits, and deficits in phonological and narrative memory[38].

Furthermore, individual differences between subjects point to the heterogenous outcomes in the segment of linguistic abilities and the complexity of interpretating relations between neurobiological, cognitive and environmental impacts.

As a conclusion, it may be said that most of these studies were performed on the convenience, small and very heterogeneous samples of children as regards risks and outcome. This study covers the part of the population with neurodevelopmental risk factors who are clinically inconspicuous as they belong to the part of the population with the so-called favourable outcome.

Aim of the research

The aim of the research is to analyze linguistic and cognitive abilities of children who suffered a perinatal brain lesion established by the repeated ultrasonographical findings and who belong to the group with a favourable outcome because of the further course of their development. They have not been diagnosed with intellectual difficulties, sensory impairments or cerebral palsy. The research is motivated by the question whether children with the so-called favourable outcome overcome the effects of perinatal lesion by the time they reach school age, and whether the lesion constitutes a risk factor for academic learning.

Testing of language comprehension and receptive vocabulary has been chosen because it represents variables that, at preschool age, have a prognostic value for academic success[39–41].

The second goal of the research is to check whether it is possible to predict the degree of development of the chosen linguistic variables – language comprehension and the scope of receptive vocabulary – on the basis of cognitive variables. This question is also of theoretical importance, as it touches upon the old controversy about the relationship between linguistic and cognitive abilities in the sense, »which comes first, thought or language« (p. 103)[42].

Materials and Methods

Subjects

The research was conducted on two samples of subjects who were on average six years old, at the moment when none of the children had yet started school. In Croatia, children are required to attend school the year they turn six by April 1, and since the research focuses on the question whether there are consequences on cognitive and linguistic abilities at the time children must start compulsory education, the age of six was intentionally chosen (typically developing subjects, Mean=5.92, Median=6.02, SD=0.32; subjects with perinatal brain lesion, Mean=5.87, Median=6.0, SD=0.35).

The sample of subjects with perinatal brain lesion was selected from the population of children at neurodevelopmental risk followed up in two Zagreb hospitals. The children were chosen by a neuropediatrician on the basis of information obtained from their medical anamnesis. The criterion was the establishment of deviations on the ultrasound scan at newborn age, which resulted in the diagnosis of perinatal brain lesion (periventricular--intraventricular hemorrhage or periventricular leukomalacia), and the child was included in a neuropediatric follow-up (Table 1).

TABLE 1
ULTRASOUND FINDINGS OF CHILDREN WHO SUFFERED PERINATAL BRAIN LESION

Type and grade of perinatal brain lesion	Frequency of lesion
PV-IVH I	3
PV-IVH I-II	1
PV-IVH II	9
PV-IVH II-III	12
PV-IVH III	3
Total PV-IVH	28
PVL II	6
PVL III	3
Total PVL	9
Combination of PV-IVH and PVL	3

PV-IVH – periventricular hemorrhage-intraventricular hemorrhage
PVL – periventricular leukomalacia

Only those children who in the subsequent follow-up were found to have no motor, sensory and intellectual impairments were sampled (their IQ had to be above 80). 40 subjects were selected for the sample, 22 boys and 18 girls. The control group of subjects was comprised of 40 subjects matched for age and gender with the subjects with perinatal brain lesions. They were selected from the population of two Zagreb kindergartens, and had no perinatal risk factors or language disorders. These subjects underwent no neonatal ultrasound testing, as this was not warranted by any medical indications. Parents of all the children were informed about the purpose of the survey and gave their informed consent.

Measuring instruments

Measuring instruments are cognitive and language tests usually used for clinical or research purposes owing to their sound metric characteristics, and there is a general agreement that they provide a valid and reliable evaluation for children from the Croatian population as well.

General cognitive abilities were assessed using Raven's Progressive Matrices[43]. The second scale that was used for the assessment of cognitive abilities was the verbal scale chosen from The Wechsler Intelligence Scale for Children (WISC)[44], developed by that has been applied in Croatia for years in its adapted version since 1972[45]. Five verbal scales were applied:

- orally administered arithmetic questions (A)
- similarities – asking how two concepts are alike (S)
- questions about social situations or common concepts (C)
- general knowledge questions (I)
- children are orally given sequences of numbers and asked to repeat them, either as heard (DS1) or in reverse order (DS2).

All tasks are done without using pencil and paper.

Among language tests, two were selected, both measuring language comprehension: the Croatian version of The Peabody Picture Vocabulary Test-PPVT-III (Peabody)[46], measuring an individual's receptive vocabulary, so as to determine acquisition of concepts named by words, and the Croatian adaptation of the (Reynell)[47] which constitutes a parameter of language comprehension including the understanding of sentences of various length and complexity. The said tests require no verbal replies, but the child shows his or her level of language comprehension by providing nonverbal answers (pointing to or arranging miniature figures at command). Both tests examine abilities that are prerequisites for academic progress.

Methods of data analysis

Data were processed by multivariate methods for data processing (SPSS 15= for Windows). Basic statistical parameters were calculated for each sample of subjects (minimum and maximum score, mean and standard deviation). All variables were tested for normality of the distribution (Kolmogorov-Smirnov test). The differences were tested by means of the variance analysis or by non-parametric statistics for variables deviating from normal distribution. Regression analysis determined prediction of cognitive variables for language comprehension (Reynell) and the scope of vocabulary (Peabody).

Results and Discussion

Both the scores of children with the medical history of perinatal lesion and the scores of the controls have normal distribution in all tests except on Digit Span where distributions are asymmetric. Therefore, data on these asymmetric variables are presented through median and nonparametric statistics (Table 2). Since there are no Croatian norms, and no recent studies of larger samples of subjects in the Croatian population either, the achieved scores will not be compared to norms. But, the research was also conducted on the control group of subjects which enables comparison to subjects who suffered perinatal brain lesion. The results represent raw scores but the only exception are WISC subtests which are converted from raw scores into standard scores (Table 2). The profiles are very much alike: both samples of subjects are mildly better in Comprehension and Information than in Arithmetic and Similarities.

Table 2 shows results for both groups of subjects on all nine applied measuring instruments. Basic statistical data show several systematic characteristics in the comparison of results: (1) group of children with perinatal brain lesions has systematically worse results compared to controls (2) group with perinatal brain lesion is more heterogeneous as it has systematically larger measures of dispersion of scores compared to control groups, with the exception of Peabody Picture Vocabulary Test (3) differences between groups are significantly bigger on language tests than on cognitive tests. On both the Reynell

TABLE 2
BASIC STATISTICS AND ANALYSIS OF VARIANCE FOR THE GROUPS OF TYPICALLY DEVELOPING CHILDREN AND CHILDREN WITH PERINATAL BRAIN LESION

		MIN	MAX	M	SD	Analysis of variance-p
Peabody picture vocabulary test	Typically developing group	66	116	90.68	13.232	.000*
	Perinatal brain lesion group	46	102	71.47	12.926	
Reynell developmental language scales	Typically developing group	60	67	63.53	1.797	.000*
	Perinatal brain lesion group	56	65	60.35	2.627	
Raven's Progressive Matrices	Typically developing group	13	32	21.53	4.314	.000*
	Perinatal brain lesion group	13	27	19.30	4.274	
Wisc information	Typically developing group	7	20	11.93	2.411	.000*
	Perinatal brain lesion group	5	16	10.35	2.797	
Wisc comprehension	Typically developing group	7	18	11.90	2.274	.002*
	Perinatal brain lesion group	4	17	10.95	2.611	
Wisc arithmetic	Typically developing group	7	17	11.60	2.437	.000*
	Perinatal brain lesion group	5	18	10.00	2.746	
Wisc similarities	Typically developing group	5	15	10.80	2.323	.011*
	Perinatal brain lesion group	5	17	10.23	2.887	
		Median	25 percentile	75 percentile	IQR	Kruskal Wallis test
Wisc digit span	Typically developing group	5	5	6	1	.000*
	Perinatal brain lesion group	5	4.25	6	1.75	
Wisc digit span – backwards	Typically developing group	2	2	3	1	.000*
	Perinatal brain lesion group	2	0	3	3	

*$p<0.05$, MIN – minimum result, MAX – maximum result, M – mean, SD – standard deviation, IQR – interquartile range

and the Peabody test, differences between the average values of groups exceed a standard deviation of 1, which was not obtained on any of the WISC subtests (Table 2). Furthermore, the differences are statistically significant on all measures (Table 2). Nonparametric statistics shows that the differences between the groups are also significant for the two variables (digit span, digit span backwards) with asymmetric distributions (Table 2). These results indicate that although children with perinatal lesions have a favourable developmental outcome in terms of general functioning (average results on WISC subtests), and show no conspicuous general cognitive and linguistic consequences, their scores are still statistically lower than those of their peers. Distributions of results of both groups show partial overlapping, which means that in the group with the anamnesis of perinatal lesion only a number of subjects has more poorly developed abilities important for the academic success in comparison to their peers from the control group. From the practical point of view, these results warn that perinatal lesion has certain long-term effects even in children with favourable outcome, and that this needs to be detected on time, since some children will require additional forms of support in school. These effects are particularly manifested in the highest forms of cortical activity which include language comprehension as well.

Therefore, one of the practical implications of this research is the information that as early as in their preschool years, these children not only should be monitored for their language progress, but stimulating conditions for their linguistic development should be created systematically, using the step-by-step method. And this before all means talking in a simple way about things the child is interested in, speaking more slowly and choosing a simpler vocabulary, and doing anything that makes the child more active in communication. The fact is that adults communicate less with children who talk less, and so the opportunities to enrich their language input are missed. In other words, deficits noted before starting school and which will hinder academic learning did not develop at that time, but have been gradually created throughout the preschool years. The only way to reduce them is to enrich the language input and to create conditions in which the child will communicate more actively. As the studies show, those are situations in which the child does not have the impression that he or she is drilled, but that this is a free exchange of information or play. Parents of our young subjects informed us that they had frequently been encouraged to have a very directing and lecturing approach to their child which is professionally considered as an suboptimal way of stimulation[35].

However, the studies show that in the early developmental phases the approach that follows the child's interest proves to be much more efficient and as such, not commanding or imposing.

The next question of the study is focused on the issue of the correlation between linguistic and cognitive variables. It has been assumed that all cognitive abilities do not influence in the same way on the development of language comprehension, and that all WISC subtests in each of the groups do not predict language comprehension in the same way either.

Therefore, the coefficient of multiple correlation with the group of cognitive variables measured by WISC subtests was calculated in each group of subjects for each of the language comprehension tests, thus acquiring the function of the criterion variable.

As the results of multiple regression show, multiple regression coefficients are not statistically significant for the control group of subjects, neither for the Reynell nor for the Peabody test (Tables 3). In contrast to this, statistically significant multiple correlations were obtained in the sample of children with perinatal brain lesions for both of these tests (Table 3). Regression coefficients are indicators of partial participation of certain predictor variables in the definition of criteria. This reveals that digit span backwards is responsible for language comprehension measured by the Reynell test for correlating predictor variables to the criterion (Table 4). This WISC subtest is an indicator of working memory. The role played by the working memory in language development is well known[48–50], and children with limited working memory acquire language at a slower pace and initially require a more focused input. After they acquire language they process it successfully even with their limited abilities of working memory, unless the sentences are too long or too complex in structure.

This is why we are not surprised that it is the reverse memory span that is responsible for the multiple correlation between predictors and criterion, amounting to as much as 0.7, or rather, almost 50% of covariability between WISC subtests as predictors (Table 3) and Reynell

TABLE 3
RESULTS OF REGRESSION ANALYSIS FOR THE LANGUAGE COMPREHENSION AND RECEPTIVE LANGUAGE FOR BOTH GROUPS OF SUBJECTS

	Language comprehension (Reynell developmental language scales)			Receptive language (Peabody picture vocabulary test)		
	R	R^2	P	R	R^2	P
Typically developing group	.518	.268	.091	0.31	0.1	.713
Perinatal brain lesion group	0.7	0.49	.001*	0.74	0.54	.000*

*$p<0.05$, R=multiple correlation coefficient, R^2 – coefficient of determination

TABLE 4
COEFFICIENTS IN THE REGRESSION ANALYSIS FOR THE LANGUAGE AND FOR RECEPTIVE LANGUAGE FOR BOTH GROUPS OF SUBJECTS

		Language comprehension (Reynell developmental language scales)			Receptive language (Peabody picture vocabulary test)		
		Standardized coefficients	T	P	Standardized coefficients	T	P
Wisc information	Typically developing group	.122	.666	.510	.028	.138	.891
	Perinatal brain lesion group	.270	1.767	.087	.378	2.603	.014
Wisc comprehension	Typically developing group	–.185	–1.178	.247	.077	.440	.663
	Perinatal brain lesion group	.031	.211	.834	.049	.356	.724
Wisc arithmetic	Typically developing group	–.373	–1.867	.071	–.044	–.199	.843
	Perinatal brain lesion group	.131	.712	.481	.191	1.095	.281
Wisc similarities	Typically developing group	.273	1.509	.141	–.032	–.159	.875
	Perinatal brain lesion group	–.023	–.148	.883	.291	2.008	.053
Wisc digit span	Typically developing group	.344	1.784	.084	.220	1.030	.310
	Perinatal brain lesion group	.067	.422	.676	–.033	–.218	.829
Wisc digit span-backwards	Typically developing group	.155	.847	.403	.149	.735	.468
	Perinatal brain lesion group	.407	2.266	.030	.095	.558	.580

as a criterion may be explained by working memory variations (Table 4).

In a situation where the criterion was the success at the Peabody test, the multiple correlation is even higher (0.74), and the variables responsible for correlation are Similarities and Information subtest (Tables 3, 4). This result is also logical since the scope of the receptive language and the number of concepts acquired by the child corresponds to that measured in the two said subtests. In Similarities, the child needs to answer what makes some concepts alike, whereas Information is a general knowledge test. Both are connected with conceptual development and receptive vocabulary.

The question is posed why these relations, being so logical, are present in the sample of children with perinatal lesions, but not in the control group. It is assumed that the obtained results once again point to the complexity of controversy about the correlation between cognitive and linguistic abilities. It is possible that a different brain functional state in subjects with perinatal brain lesion results in a different correlation between cognitive and linguistic variables.

Conclusions

At the time before they start school, children with a favourable developmental outcome following perinatal brain lesion, as a group, show statistically worse results from their peers, on both cognitive and language tests. It has to be emphasised that despite the significant difference between the two groups on cognitive tests, the group who suffered perinatal brain lesion does not show developmental delay. However, this group has larger dispersion of results, among which some children pose no risk for academic success, unlike those from the lower range of the score distribution who are at risk.

Therefore, the practical implication of the research is that a general impression of a favourable developmental outcome in some children masks their deficits. They are bigger in linguistic than in cognitive variables. The only way to reduce the deficits and to prevent difficulties at school is to provide adequate support as early as in preschool years and for some children in their school years. If the support is provided early in development, the more favourable the consequences will be.

It is well known that the debate about "which comes first cognition or language" is old and still rather unsolved. In reference to the research question whether the cognitive development predicts language comprehension, the results give a positive answer for subjects with perinatal brain lesions, but not for control subjects for whom multiple regression coefficients were statistically insignificant. In-between extreme scholars' views in the favour of cognition[51] or in the favour language[52] there is a neutral one that presumes that cognition and language are intertwined. Therefore, current results can be explained with two of the hypotheses: 1) the relationship between language and cognition is simultaneous and mutually supportive and 2) the relationship between language and cognition changes throughout development or with the task[53]. So, the assumption that subjects with perinatal lesions master their mother language in a somewhat different way, supporting with their cognitive abilities more intensely and over longer period of time than their peers from the general population therefore seems justified. Their early language processing is probably obstructed by subtle deficits which they then compensate for by their more general cognitive abilities. Unfortunately, there is no contemporary research on the

relations between language and cognition in children with perinatal brain lesions that could confirm our findings.

On the other hand, insignificant results in a typically developing group of children do not necessarily point to no connection between cognitive and language variables but to low predictive value of cognitive parameters for language comprehension at this test and in this point in development.

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KOGNITIVNE SPOSOBNOSTI I JEZIČNO RAZUMIJEVANJE U PREDŠKOLSKE DJECE KOJA SU IMALA PERINATALNO OŠTEĆENJE MOZGA

SAŽETAK

Perinatalno oštećenje mozga je rizični čimbenik za različite aspekte razvoja, a roditelji osobito strahuju za moguće posljedice na djetetov kognitivni i jezični razvoj. U literaturi se navode neujednačeni rezultati u pogledu ishoda, no pretežu rezultati koji govore o općem povoljnom ishodu, ali i o finim nedostacima koji utječu na akademsko napredovanje. Kako su jezično razumijevanje i kognitivne sposobnosti važan čimbenik školskog učenja zanimalo nas je kakve

rezultate na subtestovima Wechslerove baterije WISC i Reynell ljestvice jezičnog razvoja postižu šestogodišnjaci kojima je u perinatalnom razdoblju ultrazvučnom pretragom utvrđena ishemijska ili hemoragijska ozljeda mozga u usporedbi s kontrolnim vršnjacima. Drugi problem ovog rada odnosio se na pitanje predviđaju li kognitivne sposobnosti uspješnost u jezičnom razumijevanju na isti način u djece s perinatalnim ozljedama mozga kao i kod ispitanika bez neurorazvojnih čimbenika rizika. Pitanje odnosa kognitivnih i jezičnih sposobnosti je još uvijek kontroverzno, a dobijemo li različite međuodnose, oni bi govorili o drugačijoj strukturi sposobnosti koju povezujemo s perinatalnom ozljedom mozga. Ispitano je 40 ispitanika s perinatalnim ozljedama mozga i 40 djece iste kronološke dobi rođene bez perinatalnih čimbenika rizika. Rezultati pokazuju kako se navedene skupine više razlikuju u jezičnim negoli u kognitivnim varijablama. Nadalje se uočavaju različiti obrasci povezanosti kognitivnih sposobnosti i jezičnoga razumijevanja kod navedenih skupina ispitanika. Kognitivne sposobnosti su se pokazale statistički značajno povezanima s jezičnim razumijevanjem kod perinatalno rizičnoga uzorka što nije bio slučaj kod ispitanika urednoga razvoja kod kojih ne postoji statistički značajna povezanost između kognitivnih i jezičnih parametara. Kako su kod dijela ispitanika s perinatalnom ozljedom mozga utvrđene jezične teškoće, pretpostavlja se da se ovi ispitanici »oslanjaju« na kognitivne sposobnosti s ciljem olakšavanja i nadomještanja jezičnih nedostataka.