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Šikić, Nada.; Vrca, Anđelko; Božićević, Dubravko; Tudorić, Neven

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# Some Ethnologic Factors of Speech Comprehension Disturbances

N. Šikić<sup>1</sup>, A. Vrca<sup>2</sup>, D. Božičević<sup>3</sup> and N. Tudorić<sup>4</sup>

<sup>1</sup> Hearing and Speech Rehabilitation Center, Polyclinic »SUVAG«, Zagreb, Croatia

<sup>2</sup> Department of Neurology, University Hospital »Dubrava«, University of Zagreb, Zagreb, Croatia

<sup>3</sup> Private neurological practice, Zagreb, Croatia

<sup>4</sup> Department of Pulmology, University Hospital »Dubrava«, University of Zagreb, Zagreb, Croatia

## ABSTRACT

*Disturbances of speech comprehension were analyzed in a prospective study of 97 children, aged from 23 to 77 months. Pregnancy, birth and early psychomotor development were normal for all the children and no focus of neurological deficit was found. A tonal audiometer did not detect any auditory disturbances, and psychological testing with non-verbal tests showed normal mental functioning for the age. In this group of selected subjects, family and personal case histories were taken. In addition, a detailed neurological physical examination, standard EEG and auditory evoked potentials, and a psychiatric examination were performed during several appointments. The results showed that disturbances in speech comprehension were more frequent in boys, and that in 13.4% of cases it was caused by pervasive developmental disturbances and in 41.24% of cases by external stimulating factors of speech development (pedagogy, social and emotional stimulation and growing up in a multilingual community). The study emphasizes the importance of non-verbal methods for the study of speech and the use of auditory evoked potentials.*

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## Introduction

Speech comprehension disturbances in children usually manifest in late speech ability, with frequent emotional sensitivity, insufficient motor skill, hyperactivity and concentration disturbances. Later, during the school period, difficulties in

understanding teaching programs are frequent. Linguists refer to this disorder as »Specific Language Impairments« or SLI. SLI can be manifested as a variety of comprehension and expressive problems in absence of cognitive and sensory deficits.

When children adopt speech patterns, such speech is not the result of their own creativity. Consequently, parents may recognize the problem very late<sup>1</sup>.

Obviously, expression of described difficulties in individual children is of different magnitude. Thus, some children end up in institutions, which are inappropriate for rehabilitation, and the problems worsen. On the other hand, within the group of children with insufficiently developed speech, several clinical entities are concealed: disturbance of verbal expression, disturbance of speech comprehension, insufficient mental development, social and emotional deprivation, insufficient pedagogic stimulation, growing up in a multilingual community, peripheral and central auditory damage, pervasive developmental disorders etc.

The aim of this study was to discover the most reliable model for determination of speech comprehension disturbances in children with insufficiently developed speech. The purpose was also to determine the incidence of known causes of speech development disturbances in the examined group of children with disturbances of speech comprehension, such as neurotic factors, growing up in a non-stimulating environment (pedagogic or social deprivation, and emotional deprivation)<sup>2</sup>.

Prompt recognition of specific disturbances in speech comprehension offers the possibility of carrying out specific rehabilitation methods. The period in which rehabilitation success can be expected is limited.

## Subjects and Methods

### *Subjects*

The sample consisted of 97 subjects diagnosed and rehabilitated in the Polyclinic for Rehabilitation of Hearing and Speech of the Diagnostic Department of

the Polyclinic »SUVAG«, Zagreb. During the period 1995-1999 all subjects had been referred to our institution for treatment by a pediatrician because of insufficiently developed speech.

During the first appointment with the specialist in logopedics insufficiently developed speech or delayed speech development was diagnosed. In all subjects testing with a tonal audiometer revealed normal hearing. Psychological testing by the application of standard non-verbal techniques (Reynell, Leitter R) showed intellectual functioning within boundaries normal for the age in all subjects. In all cases pregnancy, birth and early psychomotor development had been normal.

The selected group of subjects was subjected to the following examination:

*Anamnestic examination* consisted of the following data: a) data on family history (speech disturbances in the family, the existence of mental or neurological diseases, genetically induced diseases); b) data on personal history of the subject (course of pregnancy and birth, early psychomotor development, speech development, emotional development, diseases suffered during the period, the existence of trauma of the neurocranium or convulsive crises, or any other loss of consciousness, social behavior within the group of children).

Anamnestic (history) data were graded from 0–3, as follows: 0 – normal pregnancy, birth and psychomotor development; 1 – pregnancy maintained by resting; 2 – prolonged birth, child born vital; 3 – during the first year the child was given developmental gymnastics until development of spontaneous walk within 14 months of age.

*Examination of hearing* by auditory evoked potentials were graded from 0-3, as follows: 0 – normal hearing from receptor to cortical level; 1 – asymmetric hearing responses, absolute latencies still

within normal limits; 2 – prolonged interval of the conduction of the acoustic signal along the brain stem; 3 – lack of highest cortical responses.

*Neurological examination* was performed for all subjects. All subjects without a focus of neurological deficits were included. Many of them had mild global deviations with regard to motor development, i.e. insufficient motor skill, attention and concentration disturbances, psychomotor anxiety or communication disturbances.

Data obtained by the neurological examination were graded from 0–3, as follows: 0 – normal neurological status for the age; 1 – mild motor disturbances in development; 2 – motor disturbances accompanied by hyperkinetic syndrome; 3 – psychomotor disturbances accompanied by communication disturbances.

*Electroencephalographic examination.* For all subjects a native electroencephalogram was recorded while awake. It was frequently repeated and performed with the following technical provocation: intermittent photostimulation and hyperventilation or with partial sleep deprivation.

Data obtained by the electroencephalograph were graded from 0–3, as follows: 0 – normal finding; 1 – dysrhythmically changed finding; 2 – focally changed finding; 3 – paroxysmal-dysrhythmically changed finding.

*Communication disturbances.* A psychiatrist in our institution on the basis of several appointments performed assessment of primary and secondary communication disturbances with the subjects, alone, in a group of children and in communication with parents.

Data obtained on the basis of the psychiatric exploration were graded from 0–3, as follows: 0 – no significant communication disturbances found; 1 – mild communication disturbances; 2 – behavioral disturbances in which non-verbal

form of co-operation could be established; 3 – communication with the subject was not possible even after three appointments in different conditions.

*External stimulating factors.* Data obtained from the parents or guardian were graded from 0-3, as follows: 0 – the subject lives in a stimulating environment; 1 – lack of pedagogic stimulating methods of upbringing; 2 – lack of social stimulation; 3 – the subject lives in a multilingual environment.

In 25 subjects computerized axial tomography of the brain was performed, and in 37 subjects MR of the brain was performed and the findings were normal in both examinations. The examinations were performed in 62 subjects, i.e. 63.9%, and were not included in the statistic analysis. All findings of the neuroimaging examination were normal.

#### *Analysis of data*

During statistical analysis multiple regression analysis was used for all the examined variables. Kolmogorov-Smirnov test of correlation was used to test the mutual correlation of individual variables within the group.

The examined variables were: sex, chronological age, mental age, level of verbal expression, level of speech comprehension, history data, neurological status, electroencephalographic finding, auditory evoked potentials, communication disturbances and external stimulating factors.

Multiple regression analysis of the examined data was used to test the reliability of our hypothesis of the dependence of inadequate speech comprehension with chronological age, mental age, level of verbal expression, neurological status, electroencephalographic recording, auditory analysis, behavioral disturbances and external stimulating factors.

After confirmation of the correlation of variables within the groups, correlation between insufficient speech comprehension and the other variables was tested by multiple linear regression analysis.

Examination of all variables showed that they were uniformly distributed, which enabled presentation of samples by the use of descriptive statistics. As the results showed no significant differences with regard to the sex of subjects, we presented the interpretation of results for female and male subjects together.

Distributions of the relative frequencies of the examined variables were examined in percentages, which can affect speech comprehension in children with the syndrome of insufficient speech development.

## Results and Discussion

The results of this study show (Table 1) that with regard to chronological age disturbances in speech development were most frequently found in subjects aged around four years<sup>3</sup>. With regard to sex, 76 boys and 21 girls were examined, i.e. 78.35% were male and 21.65% female (Table 2). In the literature other studies showed a significantly greater number of male children with disturbances in verbal development, most frequently 2:1, and in our study a greater number of boys was found with disturbances in speech development.

The mental age of all subjects, obtained by the arithmetic mean, was 45.91 months (Table 1). The lowest mental age was 21 months, and the highest 74 months with standard deviation 11.04 and normal distribution was determined.

Delayed chronological age was 4.09 months, which shows the normal intellectual development of the selected group. This data is important as it indicates the normal intellectual functioning of sub-

jects by application of non-verbal techniques, in relation to age. Multiple regression analysis showed that mental age, after verbal expression, is the second most important factor for assessment of speech comprehension. The beta obtained was 0.032.

The level of verbal expression was calculated by arithmetic mean for all subjects, and was 32.33 months, with standard deviation of 10.65. The lowest value of verbal expression was 6 months and the highest 65 months. This indicates that in the examined group verbal expression significantly lagged behind chronological age, on average 2.7 years. This, with the application of verbal techniques, classified these subjects in the category of mentally insufficient development. Verbal expression is definitely the most important factor for evaluation of the level of speech comprehension; the beta obtained by multiple regression analysis was 0.000.

The level of speech comprehension, calculated by arithmetic mean was 29.26 months, with standard deviation of 10.85. The lowest obtained value was 3 months and the highest 53 months. Delayed mental age of the subjects was 16.65 months. As the average age of the subjects with disturbances in verbal expression was 4 years, then the delay with regard to speech comprehension represents significant data, because it amounts to a delay of almost one year and a half behind the chronological age. By multiple regression analysis (Table 3) the level of speech comprehension in combination with the other examined factors showed coefficient determination of 0.798, which indicates that with probability of almost 80% disturbances in speech comprehension can be determined by using selected parameters: chronological age, mental age, level of verbal expression and level of speech comprehension ( $p = 0.0013$ ). This determined group of subjects was subjected to

**TABLE 1**  
BASIC STATISTIC PARAMETERS WITH THE TEST OF DISTRIBUTION

Variable	X	SD	Kolmogorov-Smirnov test			
			Min.	Max.	Max D	Test norm.
Chronological age	51.28	11.60	23	77	0.040	0.166
Mental age	45.91	11.04	21	74	0.054	0.166
Level of verbal expression	32.33	10.65	6	65	0.041	0.166
Level of speech comprehension	29.26	10.85	3	53	0.061	0.166

**TABLE 2**  
DISTRIBUTION OF RELATIVE FREQUENCIES IN PERCENTAGES

Variable	Categories			
	0	1	2	3
Sex	78.35	21.65	–	–
History data	30.93	37.11	17.53	14.43
Neurological status	19.59	27.84	35.05	17.53
EEG	17.53	35.05	27.84	19.59
Auditory evoked potentials	19.59	34.02	27.84	18.56
Communication disturbances	41.24	25.77	19.59	13.40
External stimulating factors	58.76	23.71	11.39	6.19

**TABLE 3**  
MULTIPLE REGRESSION ANALYSIS OF USED INSUFFICIENT SPEECH COMPREHENSION  
DIAGNOSTIC CRITERIA

Multiple correlation coefficient	Coefficient of determination	Standard error of prognosis	F	Df1	Df2	Q
0.894	0.798	0.449	3.465	9	87	0.0013

further analysis in an attempt to ascertain the most frequent etiological factors, and the following data were obtained (Tables 2 and 4):

*Anamnestic data*

The following results were obtained by analyzing data from the history of the subjects: in 30.93% of subject's pregnancy, birth and psychomotor development was normal. In 27.84% of subjects the pregnancy had been maintained by resting. In 17.53% of subjects the birth had been prolonged. 14.43% of subjects underwent developmental medical gymnastics during the first year of life. In 69.07% of subjects problems had occurred during

pregnancy and birth. Subjects with greater complications during pregnancy and birth were excluded from the study.

*Neurological status*

Normal neurological status was determined in 19.59% of subjects. Mild motor disturbances in development were registered in 27.84% of subjects. In 35.05% of subjects motor disturbances were accompanied by hyperkinetic syndrome. In 17.53% of subjects psychomotor disturbances were accompanied by marked disturbances in communication. In 80.42% of subjects disturbances in psychomotor development were registered, of which 52.58% were behavioral disorders.

**TABLE 4**  
CORRELLATION OF USED PARAMETARS WITH INSUFFICIENT SPEECH COMPREHENSION  
DIAGNOSTIC CRITERIA

Predicted variables	Correlation with diagnostic criteria	Partial correlation	Standard regression coefficient	Determination of predictor in percentages	Error of regression coefficients
Chronological age	0.651***	-0.059	-0.144	-9.354	0.111
Mental age	0.776***	0.117	0.295*	22.932	0.137
Level of verbal expression	0.882***	0.575	0.748***	65.987	0.088
History data	-0.238*	0.019	-0.024	0.575	0.062
Neurological status	-0.138	-0.004	-0.006	0.081	0.073
EEG	-0.240*	0.017	0.025	-0.602	0.069
Auditory evoked potentials	-0.175	-0.027	-0.038	-0.667	-0.068
Communication disorders	-0.128	0.034	0.053	-0.674	0.075
Social stimulating factors	-0.021	-0.094	-0.113*	0.238	0.058

\* p < 0.01; \*\*\* p < 0.0001

*Examination of hearing by auditory evoked potentials*

Although in all subjects a prior tonal audiometer showed normal hearing, the findings of auditory evoked potentials were as follows: normal hearing, from receptor to cortical level was found in 19.59% of subjects. Asymmetric auditory responses were determined in 34.02% of subjects. Prolonged period of the acoustic message along the brain stem was registered in 27.84% of subjects, and lack of cortical responses was found in 18.56% of subjects. Thus, despite normal hearing determined by a tonal audiometer, central auditory disturbances were found in 80.42% of subjects.

*Electroencephographic examination*

The following results were obtained: Only 17.53% of subjects had a normal EEG finding, 35.05% had a dysrhythmically changed EEG finding, 27.84% had a focally changed finding and 19.59% diffusively paroxysmal dysrhythmically chan-

ged EEG finding. Changed EEG finding was registered in 82.48% of subjects.

*Disorders in communication*

In the opinion of the psychiatrist, only 41.24% of the subjects did not have significant disturbances in communication. Mild disturbances in communication were found in 25.77% in the form of hyperkinetic syndrome. Disturbances in behavior were found in 19.59% of subjects, in whom non-verbal communication could still be established. Disturbances in communication which made verbal or non-verbal contact completely impossible, was found in 13.40% of subjects, and psychiatric exploration confirmed a diagnosis of pervasive developed disturbance.

*External stimulating factors*

Data on stimulating environment in which the subjects lived were obtained in 58.76% of subjects. Lack of pedagogic stimulation was registered in 23.71% of subjects (overworked parents, non-atten-

dance of a nursery or similar, many hours spent watching television etc.). In 11.34% of subjects data indicates a systematic lack of social communication (growing up in institutions for homeless children until the age of three years). Growing up in a multilingual community was recorded in 6.19% of subjects (most frequently when parents work abroad and use the Croatian language at home, while children attend children's nurseries etc. where a foreign language is spoken). In 41.24% of cases subjects lived in non-stimulating environments during the period of intense verbal development.

Very likely neurophysiological immaturity is the reason for these disorders, and all the examined factors in different magnitudes can contribute to the different expression of disturbances in speech comprehension<sup>4</sup>. This neurophysiological immaturity which was manifested in the changed EEG finding in 82.41% of subjects, changed auditory evoked potentials in 80.41%, changed neurological examination in the form of disturbances in motor and psychomotor development in 80.41%, we were unable to explain by the other examined parameters: disturbances during pregnancy, birth and early psychomotor development, or absence of external stimulating factors<sup>5-7</sup>.

Some authors have described these problems within one family, and it was considered that the deficit is transferred autosomally dominantly, which would clearly indicate the genetic basis of the disturbances<sup>1</sup>. Other authors believe that the deficit can be found within auditory perception, because early apprehension of language and language structures can be destroyed by slight damage in the region of the transfer of auditory information from the receptor in Corti's organ to the cortical level<sup>8,9</sup>. Some authors consider that the deficit is located within the cortical representation of hearing itself<sup>10,11</sup>, and consequently analysis and

synthesis of the received sounds are destroyed, which should form them into thought. This information is valuable for topodiagnosics, although again it does not provide insight into the reason for their existence<sup>12</sup>.

## Conclusions

On the basis of an analysis of the results of this study the following can be concluded:

1. Disturbances in speech comprehension were significantly more frequent in boys.
2. In 80% of the subjects the disturbances had a neurological basis in the form of insufficient motor and psychomotor maturity and insufficient neuro-physiological maturity.
3. In 41.24% of cases the examined external stimulating factors (pedagogic, social and emotional stimulation, growing up in a multilingual community) were not stimulating for speech development.
4. In 13.40% of the subjects the examined parameters were found in the case of pervasive developmental disorders.
5. All children with marked disturbances in verbal development should be subjected to analysis, which must include psychological testing with the application of non-verbal techniques of examination.
6. Apart from the standard hearing test, an examination with auditory evoked potentials should also be performed.

This paper should contribute to a body of knowledge concerning the factors associated with language delay in children in Croatia. It is important to develop local norms and address factors related to the incidence of specific language impairment in children in order to identify and treat these children.



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N. Šikić

*Hearing and Speech Rehabilitation Center, Polyclinic »SUVAG«,  
Ljudevita Posavskog 10, 10000 Zagreb, Croatia*

## NEKI ETIOLOŠKI FAKTORI SMETNJI RAZUMIJEVANJA GOVORA U DJECE

### SAŽETAK

Poremećaji razumijevanja govora u djece analizirani su prospektivnom studijom koja je obuhvatila 97 ispitanika u dobi od 23-77 mjeseci. Obradena su djeca rođena iz uredne trudnoće, poroda kao i ranog psihomotornog razvoja bez nađenih fokalnih deficita. Tonskom audiometrijom utvrđen je uredan periferni sluh, psihološkim testiranjem (primjenom neverbalnih testova) intelektualne funkcije primjerene dobi. Detaljno su obrađeni anamnestički podaci ispitanika i iskazi njihovih obitelji. Sve ispitanike je pregledao neurolog, psihijatar, učinjen je standardni EEG te slušni evocirani potencijali. Dobiveni rezultati pokazuju značajno češću pojavnost smetnji u dječaka, a kod 13.4% ispitanika nađene su smetnje koje imaju elemente pervazivnog razvojnog poremećaja. U 41.24% slučajeva nalazimo izostajanje vanjskih stimulirajućih faktora (pedagoških, socijalnih i emocionalnih stimulirajućih faktora ili rast u mnogojezičnoj zajednici). Ispitivanje ukazuje na važnost provođenja neverbalnih tehnika ispitivanja djece s poremećajima u razvoju, te upotrebu slušnih evociranih potencijala.