

Preliminary Study of the Phonological Development in Three- and Four-Year-Old Bulgarian Children

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Abstract—The article presents the results of a research of phonological processes in three- and four-year-old children. A test, created for the purpose of the study, was developed and conducted among 120 children. The study included three areas of research - at the level of words (96 words), at the level of sentence repetition (10 sentences) and at the level of generating own speech from a picture (15 pictures). The test also gives us additional information about the articulation errors of the assessed children. The main purpose of the research is to analyze all phonological processes that occur at this age in Bulgarian children and to identify which are typical and atypical for this age. The results show that the most common phonology errors that children make are: sound substitution, elision of sound, metathesis of sound, elision of syllable, elision of consonants clustered in a syllable. Measuring the correlation between average length of repeated speech and average length of generated speech, the analysis does not prove that the more words a child can repeat in part “repeated speech”, the more words they can be expected to generate in part “generating sentence”. The results of this study show that the task of naming a word provides sufficient and representative information to assess the child's phonology.

Keywords—Articulation, phonology, speech, language development.

I. INTRODUCTION

THE discussion of the topic of phonetics and phonology of the Bulgarian language is an integral part of the topic of the language system. "Language is a tool, a means (instrument) of communication (communication), which has a sign character and which serves to analyze human experience in a specific way in each human community through units (morphemes, words, sentences) having meaning content and sign expression" [1].

Reference [2] defines phonology through the lens of psycholinguistics and notes that phonology as part of the language system deals with the building blocks of language, that is, the rules for ordering the sequence of sounds existing in language. Phonology can be divided into two levels - segmental and suprasegmental, while the segmental level deals with speech sounds, the suprasegmental level deals with the larger parts - syllable, word, phrase.

Reference [3] argues that phonological acquisition is a complex process that undergoes changes and develops particularly rapidly between the ages of 1.6 and 4. Phonological disorder is one of the sound disorders with the highest incidence in children. Children with phonological disorder during the acquisition of speech sounds resort to strategies that are called phonological processes. The purpose of their use is to deal with

the complexity of segment and/or syllable structure that they do not yet know and cannot control in their production.

Reference [4] defines the syllable as a sound containing a vowel and can be spoken independently, freely on a single exhaled beat. Reference [5] refers to a syllable as a part of human speech that consists of a vowel, a combination of vowels, or a combination of vowels and consonants and states that a syllable is the building block of a word. Reference [4] defines that as the smallest and simplest building unit of speech, and within its boundaries phonemes are grouped into structures that aid in the perception and awareness of phoneme opposition. The syllables in English are closed and open, depending on the location of the vowel phoneme. By their composition, syllables may contain one or more than one vowel. e.g. [4]. Words can be monosyllabic, consisting of one syllable, or those consisting of more than one syllable - bisyllabic, trisyllabic. Children produce consonant + vowel (CV) syllables at the earliest stage of speaking [6]. The presence of the syllable in the earliest language development is evidence that the syllable has a place as a separate unit (with its own field of action) in phonological theory. Reference [7] notes that a syllable always consists of a single nucleus, noting that there may be a consonant sound or a combination of consonants in front of or behind it. According to [8] the lengths of Bulgarian words range from one to seven syllables. She notes that in a sample of adult spontaneous speech, about 60% of words were disyllabic, suggesting a higher frequency of disyllabic than other word lengths. Stress can occur on any syllable, but generally there is only one stressed syllable per word. Consonants occur in initial, middle, and final positions in a word. Sequences of two to four consonants are possible; the majority of clusters are biconsonant clusters at the beginning of words.

Reference [5] explains the syllable structure as the only obligatory element is the nucleus, which together with the coda form the rhyme. An onset and coda are segments that are optional. The definition [5] gives is that a syllable is a segment of speech that is continuous, consisting of a vowel, diphthong or consonant, with or without preceding and following consonant sounds.

At the suprasegmental level, accent is also considered, which organizes the sound composition of a word and has a distinctive function. Each word has an accent that is realized together with one of the phonemes. In Bulgarian language accent can be mobile, force and free. Moreover, it could be major and minor, there are words with two accents [4], [9].

References [9] and [5] point out that sounds in human

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language are combined in a speech chain, and during this process changes occur at the articulatory or acoustic level, depending on the surrounding sounds. These changes are known as positional or combinatorial phonological changes, some of which are universal, while others do not occur in all languages, and some of which occur systematically and have become part of the phonological system of a language. According to [5] such processes are assimilation, metaphony, dissimilation, haplogy, metathesis, prosthesis, palatalization, epenthesis, elision, vowel sound reduction, and desonorization. The consonant system of consonants in literary Bulgarian consists of 39 phonemes. They are classified according to the four differential features commented upon:

- localization (by place of onset);
- modality (mode of formation)
- sonority (the opposition voiced - voiceless)
- palatality (hard/soft)

Bulgarian is an East-South Slavic language with 22 basic consonants and 17 palatalized variants. The present study uses error pattern analysis to describe systematic errors in children. These errors reflect a transformation from basic to superficial phonological representations. References [5] and [9] define these processes as:

- Assimilation is a phonetic change in which one sound is partially or completely assimilated to the consonant with another in the syllable or word. There are several types of assimilation - regressive and progressive, partial or complete, contact and distant [9].
- Metaphony affects the vowel sounds in the language and is the modification of a vowel following a vowel in a following syllable. It refers to assimilatory changes.
- Vocal harmony: The root vowel determines the vowels in affixes. It is a form of progressive assimilation.
- Dissimilation is a term characterizing discrimination, differentiation, and is a phonetic change that is the opposite of assimilation. Dissimilation is phenomenon in which two identical or close consonant sounds become separated. It occurs less frequently than assimilation.
- Haplography is dissimilatory disappearance in which one of two identical syllables is dropped. Haplogy could be correlated with elision.
- Metathesis is a phonetic phenomenon in which two sounds change places. The reason for this change is also easier articulation.
- Prosthesis is the appearance of a new sound (most often a vowel) at the beginning of a word. It occurs before difficult to pronounce combinations of consonants.
- Palatalization or softening means a change in which the voicing of a hard consonant moves to the hard palate.
- Epenthesis is a phonetic phenomenon expressed by the insertion of one or more sounds inside a word.
- Elision is the omission of a sound.
- Vowel sound reduction consists of matching the sound of broad and narrow unstressed vowels.
- Desonorization is a process in which a voiced consonant is pronounced as voiceless.
- Sandhi appears when the final and initial sounds of two

adjacent words are subjected.

- Iotation is occurrence of a semivowel j between two vowels or before a vowel at the beginning of a word. They are a kind of epenthesis or prosthesis;
- Labialization is the replacement of a non-labial sound by a labial one;
- Delabialization is characterized by the replacement of a labial sound by a non-labial one.

Reference [10] defines phonological disorders as a consequence of primary gnosis, cognitive-linguistic failure. As a result, the entire phonemic organization of language suffers, and speech is characterized by unstable and unstable errors, as well as inconsistent sound substitutions. The author describes a disorder of phonological production and justifies the low quality of children's production through poor phonological control, reinforcing the claim that errors in their production decrease with imitation. Difficulties are in the updating of phonological chains, resulting in numerous sound substitutions, as well as the absence of words. According to the same author [10], the speech of children with phonological disorders is highly incomprehensible to others, accessible only to those closest to him in the social circle. Children's production is characterized by: a large number of misgenerated consonant sounds, highly unintelligible speech, complete and inconsistent sound substitutions, phonemic disorders are more in connected speech and not so much in isolated pronunciation of words and phonemes. In addition, omission, distortion, addition, and interchange of sounds and syllables, syllable reduction, grammatical failure, phonemic gnosis disorders, and impaired rhyming ability occur [11].

Reference [12] argues that multisyllabic words provide important data in assessing a child's speech and literacy capacity, especially after the age of 5.

Reference [13] defines phonological processes as processes of syllable structure, which occur through the deletion or expansion of one or more sounds in a syllable, processes of substitution, which consist of the replacement of sounds in which phonemes change in place or manner of constitution and processes of assimilation, where a sound or sound families are changed to assimilate with another sound in a word [14].

Reference [15] argues that phonological processes can be divided into three categories: syllable processes that change the structure of a syllable by taking away a sound, adding a sound, moving a sound, or a combination of the above; substitution processes, where one sound is replaced by another, changing the manner and place of voicing; the processes of assimilation, which are also known as the processes of harmony, as one sound is changed to become more like or the same another sound in the word.

Reference [16] explains phonological development as a gradual process of acquiring mature speech patterns.

There is a real interest in the study of phonetic and phonological processes in languages. Phonological processes (also called error patterns) are a commonly used measure to describe a child's phonological system [17].

It is generally agreed that phonological processes are the most effective analysis for determining the relationship

between a child's production and that of adults [18]. Reference [19] explains that in the United States, individual words are typically used to elicit phonology in preschoolers (in 91.7% of studies). For the purpose of studying these phonological processes, two ways of investigating them are applied - by analyzing the phonological processes and by the percentage of correct consonants, which appears to be a good indicator of phonological ability [20].

Reference [21] draws attention to the importance of the differential diagnosis of phonological delay and phonological disorder, and to the role of cognitive processes that explain the causes that lead to making certain types of errors.

Reference [22] studied the prevalence of specific language disorder in Bulgarian children and found that 5.89% of the sample studied had such a disorder, with 4.64% of them having a phonological disorder.

Reference [23] shows that speech sound disorders occur in the population of preschool children and their frequency is between 3 and 6%, and the accuracy of children's production increases with age and the number of error patterns decreases. The prevalence of speech disorders in an Australian cohort was 3.4% in the 4-year-old children [23].

Phonological disorder is prevalent among children aged 3-8 years and 11 months and is associated with the linguistic organization of speech sounds [24].

Reference [25] reports a research on phonology in preschool children using normative data derived from word-level production (single word production). Reference [26] established the close relationship between phonological development and the acquisition of lexical and morphosyntactic features of language by tracking the acquisition of the phonological system.

Phonetics and phonology are two different concepts that define and distinguish two different aspects, on the one hand that of speech and on the other hand that of the linguistic behavior of the individual, but they are interrelated and complementary due to the fact that we could not separate the material content of speech sound from its linguistic function. Phonology is often defined as the systematic organization of the sounds of human language. For some researchers, this includes aspects of both phonology and the systematic structural properties of the sound system; for others, phonology is seen as separate from phonology and autonomous from it [27].

II. EXPERIMENTAL DETAILS

A. Study Design

A test, created for the purpose of the study, was developed and conducted among 120 children to analyze the phonology and articulatory development of the children. The test covers all Bulgarian constant phonemes. The aim is to distinguish children with typical phonological development from those with delayed phonological development. The test analyzes children's results at three levels: first - naming nouns from picture, second - repeating sentences and third - generating spontaneous speech.

- "Subtest 1 - picture naming" consists of 96 nouns, high

frequency, visually presented by pictures. Picture stimuli consist of words with different length, syllabus structure and cover specific phonemic segments and consonant clusters.

- "Subtest 2 - repeating sentences" is a task to repeat sentences with changing length and complexity. It includes ten sentences and the aim is to measure the maximum repeated phrase and also to analyze the phonological and articulatory errors, made by the child at word level.
- "Subtest 3 - generating sentences" includes 15 pictures of activities where children should generate spontaneous speech. This task gives the opportunity to extract target words. These target words give information about phonology and articulatory errors as well as help researchers for the peculiarities in the production of the child's own, spontaneous speech.

B. Participants

This study is part of a larger study related to the present topic. The number of participants in the present study is 120 children, their age between 3 and 4 years old. Children have no intellectual, sensory, emotional-behavioral disorders, speak Bulgarian as their native language and attend a kindergarten. There are 63 boys and 57 girls in the group of children aged 3-4 years.

C. Statistical Analysis

The SPSS version 23 is used for statistical analysis. Descriptive analysis is used to describe the study population, and the results are expressed in numbers, percentages, means, and standard deviations. Association between categorical variables is assessed using either Chi-square or corrected Chi-square. The level of significance used for the statistical analysis is $P < 0.05$.

III. RESULTS

The average time for children to complete this test was 16.22 min. Children aged 3-4 years knew on average 80 words from "Subtest 1- picture naming" with the lowest score being 48 and the highest score being 96 known words.

On average, children in the 3-4 age group made 12.92 mistakes and every child made at least one phonological error in "Subtest 1 - picture naming". Maximum number of phonological errors was 39, and according to the results of the analysis, only one child made the maximum number of phonological errors.

- Massively, children of this age concentrated in the range between 6 and 22 phonological errors on Subtest 1 with a mean of 12.92 errors and a standard deviation of 8.40 with a sample size of $N = 120$.

As a summary of the phonological processes, we could note:

- Elision of stacked consonants in a syllable is the most common phonological error made by the target population. 93% of the children made at least one phonological error of this type.

Of all the subtests administered, the word-level test stands out with the highest number of phonological errors of the

"elision of stacked consonants in a syllable" type. In the other two tests the errors were sporadic - the result of random phenomena occurring.

TABLE I
SUBTEST 1 – COMMON ERRORS

Phonology errors	Number
Sound substitution	2
Elision of sound	1,6
Elision of syllable	1,3
Metathesis of sound	1
Elision of consonants clustered in a syllable	3,4

- Elision of sound is among the top five phonological errors made by children at the word level for "Subtest 1 - picture naming". Sound elision errors were mainly made in the middle of the word or at the beginning of the word and were not as typical at the end of the word. Of all the subtests administered, the word-level test stands out for having the highest number of phonological errors of the "sound elision" type. In the other two tests, errors were sporadic - the result of random phenomena occurring. More than half of the phonological errors made at the word level were mid-word sound elision errors.

About 40% of the phonological errors of the sound elision type made at the word level are at the beginning of the word. Approximately 73% of the children in the target population make at least one error of this type (sound elision). In the remaining two subtests, errors were sporadic - the result of random phenomena occurring.

- Elision of syllable – 76 % of the children in this age group made this error. Approximately 47% made it once. Syllable elisions were mainly made in the middle of the word.
- Sound substitution scores - Among one of the most common phonological errors in children between the ages of 3 and 4 is substitution. Approximately 80% of children this age made at least one such error on Subtest 1.
- Sound metathesis occurs most often in children in the youngest age group and with increasing age the errors increase in direct proportion. 60% of the children made one or more errors.

Children in the target population made almost no phonological errors at the sentence repetition task – Subtest 2. The mean number of errors was 0.2228 with 91% of children making no phonological errors. It is quite understandable and explainable that the average number of errors for the youngest 3-4 year old is the highest (0.8036 with 75% of them not making a single phonological error). The statistical results obtained show that children aged 3-4 should not make more than 3 phonological errors on this subtest. Making even one additional error may signal the presence of a phonological problem.

For children aged 3-4 years, the errors that were made were substitution (0.10), sound elision (0.11), syllable elision (0.10), assimilation (0.6), and elision of stacked consonants within a syllable (0.23). Massively, children of this age clustered between 0 and 2 phonological errors on Subtest 2 with a mean of 0.80 errors and a standard deviation of 1.71 for a sample size of N = 120.

TABLE II
SUBTEST 2 – COMMON ERRORS

Phonology errors	Number
Sound substitution	0,10
Elision of sound	0,11
Elision of syllable	0,10
Assimilation	0,6
Elision of consonants clustered in a syllable	0,23

Subtest 3: The aim of this task is to analyze the errors of the children while they generate own speech from a picture, the results obtained are due to the target words extracted from this subtest. Overall, the children in the target population made a relatively small number of phonological errors at Subtest 3 compared to the Subtest 1 - the mean number of errors was 1.0110 with 51% of the children not making a single phonological error. It is quite understandable and explainable, because of their age and the inexperience they have in the process of speaking, for the average number of errors of the youngest 3-4 year old to be the highest (2.3 with 81% of them making at least one phonological error). Children at this age are concentrated in the range between 0 and 4 phonological errors on Subtest 3 with a mean of 2.3 errors and a standard deviation of 2.83 with a sample size of N = 120.

TABLE III
SUBTEST 3 – COMMON ERRORS

Phonology errors	Number
Sound substitution	0,12
Elision of sound	0,20
Elision of syllable	0,73
Metathesis of sound	0,24
Elision of consonants clustered in a syllable	0,98

The obtained statistical results indicate that children aged 3-4 years should not make more than 5 phonological errors on this subtest. Making even one additional error may signal the presence of a phonological problem.

For children aged 3-4 years, the errors that were made were substitution (0.12), sound elision (0.20), sound metathesis (0.24), syllable elision (0.73), and elision of stacked consonants in a syllable (0.98).

Results for the Whole Test Mass children of this age clustered between 0 and 20 phonological errors on the Whole Test with a mean of 14.15 errors and a standard deviation for a sample size of N = 120. The test classified the children according to their phonological skills at 5 levels: excellent phonological level - 0-4 errors; good level - 5-9 errors, normal level - 10-14 errors; acceptable level - 15-25 errors below normal - 25+ errors. The test classified 18,6% of children with phonological development below normal level.

In terms of articulation, 10% of the children showed an articulation disorder of the sigmatism type. All children pronounce the L sound bilabially, but given their maturity this is not taken into account at this stage.

There was a statistically significant mean correlation between the number of phonological errors in Subtest 1 and Subtest 2 - Pearson's $r = 0.367$, sig. = 0.000 (the correlation

coefficient is statistically significant/valid at the 0.05 level). This means that we can expect the number of phonological errors in Subtest 2 to increase in direct proportion to the increase in phonological errors in Subtest 1. The converse statement is also valid. Also, there was a statistically significant strong relationship between Subtest 1 and Subtest 3 - Pearson's $r = 0.736$, $\text{sig.} = 0.000$ (the correlation coefficient is statistically significant/valid at the 0.05 level). This means that we can expect the number of phonological errors in Subtest 3 to increase in direct proportion to the increase in phonological errors in Subtest 1. The converse statement is also valid. We would expect that the number of phonological errors in Subtest 1 would increase in direct proportion to the increase in the number of phonological errors in Subtest 3.

Probably due to the relatively good performance of the children in the study population in Subtest 2 and Subtest 3, no statistically significant relationship between these two subtests is demonstrated - Pearson's $r = 0.078$, $\text{sig.} = 0.139$ (the correlation coefficient is statistically significant/valid at the 0.05 level). This means that the overall phonological performance in Subtest 2 cannot provide strong indications of their performance in Subtest 3. Conversely, children's overall phonological performance in Subtest 3 cannot provide strong indications of their performance in Subtest 2.

IV. CONCLUSION

Sufficiently informative about children's phonological development is Subtest 1, the noun naming task and appears to provide comprehensive information about the phonological processes. The repetition task appears to be the easiest of the three subtests and does not provide data for the phonological system of the children. Subtest 3 task is more useful for information about the child's prosodic, grammatical and syntactic skills. This study provides an opportunity for future research. The ability to make early diagnosis and prevention is very valuable for researchers of language development in infancy. Good diagnosis is also linked to the possibility of clear and accurately planned therapy that leads to good outcomes in its wake.

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