PHONOLOGICAL ANALYSIS OF LANGUAGE PRODUCTION IN PRESCHOOL CHILDREN

Tsvetomira BRAYNOVA

South-West University "Neofit Rilski", Bulgaria
E-mail: tsvetomira.braynova@swu.bg, ORCID ID: 0000-0001-5667-5988

Miglena SIMONSKA

South-West University "Neofit Rilski", Bulgaria
E-mail: miglena_simonska@swu.bg, ORCID ID: 0000-0003-0655-6125

ABSTRACT: The paper presents an analysis of the phonological features of preschool children. The article aims to find patterns of typical and atypical errors. A method was created to conduct the study, which includes three levels of research - at the level of words, sentence repetition, and generating one's speech by picture (spontaneous speech). The results show that children's most common phonological errors are as follows: sound substitution, elision of sound, metathesis of sound, elision of syllable, and deletion of consonants clustered in a syllable. The data obtained from the noun generation task was informative enough about the phonological development of the children being studied. The repeated speech task was accessible for the children and of little value in analyzing the phonological processes. The sentence generation task provides sufficient information about sentence structure, prosody, rate, and force of speech. The test serves a diagnostic and therapeutic purpose. The diagnostic analysis is clear and informative enough to create a therapeutic program based on the examination results. Subsequently, it could be applied for re-testing to measure the progress in the child's output. In addition, the average time children take to administer the whole test is less than 18 minutes, which is an additional positive aspect of the test. The ultimate goal is to standardize this test to assist clinicians in establishing norms by examining Bulgarian-speaking children and assessing their phonological development.

KEYWORDS: assessment, language, phonology, phonological processes, phonological errors, articulation, speech-language development

1. Introduction

Phonological ontogenesis is essential for the child's speech and language development. The child masters the physical production of sounds from his mother tongue and phonological rules concerning the distribution, matching, and change of sounds in different sound contexts (Стоянова, 2011). Phonology, as part of the language system, defines the functioning of speech sounds in language and studies the function of phonemes in speech, their role in language, distribution, and compatibility. Children with phonological disorders exhibit sound production delays without apparent motoric, structural, sensory, cognitive, or neurologic causes (Storkel, 2018). Phonological disorders are among the most common disorders in children, as the data for its distribution varies between 7 and 11% for children aged 5 (Law et al., 2000). They influence a child's speech understanding and implicit knowledge of the language sound system. Phonological processes describe a child's phonological system (Dodd et al., 2003).

There are few tools for articulation and phonology studies in the practice of Bulgarian speech therapists. These are: "Study of articulation and phonology in childhood" (Георгиева, 2004). "Test to study the phonological development in children" (Ignatova et al., 2015), and "Protocol for evaluation of articulation in children in preschool and primary school age" (Тодорова, 2018). Boyadzhieva-Deleva (Бояджиева-Делева, 2019) approved a test to study articulation and phonology in 80 children and presented DAF (Diagnostics of articulation and phonology) - the first and foremost purpose of the test is the diagnosis of articulation in children over five. However, the application of the second version of the test to a wide range of patients in the last few years - children in the age group 3-5 years, adolescents, and also adults, shows that it can be used safely in cases where more in-depth study of phonetic pronunciation is needed (Бояджиева-Делева, 2023). The main difference between the proposed test and DAF is that the current test is oriented toward phonology detection, unlike DAF, whose main application area is an in-depth (intensive) diagnosis of articulation. Globally, there are various tests to study language development in childhood, which include the study of articulation and phonology, based on normative data, enabling the assessment of the communicative skills of children at preschool age (Babatsouli 2019; Bérubé & Macleod, 2022; Clausen & Fox-Boyer, 2021; DeVeney, 2019; Eisenberg

& Hitchcock, 2010; Gray, 2004; Gregg & Yairi, 2012; Ingram & Ingram, 2001; Kirk & Vigeland, 2014; Sasisekaran, 2014). Cohen и Anderson (2011) report phonology studies in children at preschool age using normative data derived by single word production (by naming). When analyzing children's phonology, it is necessary to examine the level of words and the conversation process (Stoel-Gammon,1988). Stoel-Gammon & Williams (2013) use a list of words, with their main focus being on the models of phonological errors in a child's speech. They clarify that researchers and therapists can get a relatively good idea of a child's phonology system by using the data of spontaneous trials and tests on the level of words. Stoyanova (Стоянова, 2014) describes the order of appearance of the segments in the Bulgarian language, based on universal tendencies described in scientific sources, as well as from phonological processes in early speech acquisition – substitution, elision, epenthesis, metathesis, reduplication, etc., and specifies that when generating a specific word few phonological processes can be combined. The author determines the close connection between phonological development and the acquisition of language's lexical and morphosyntactic characteristics, tracking the sound system's absorption. Phonological processes are integral to children's analysis, description, and speech therapy. Their study provides an alternative way of investigating and treating the presence of many mispronounced sounds that the child pronounces in isolation but does not use appropriately in a given context. Delays in vocabulary and grammatical development may also be present in children with impaired phonology. Jesus et al. (2015) explain that children with phonologically based speech sound disorders are among the most prominent groups referred for speech-language therapy services. And this is no coincidence, knowing that the phonological component is part of the language system humans use to communicate. Tsenova (Ценова, 2004) defines phonological disorders as a cognitive-linguistic deficit that distorts the entire phonetic organization of language, resulting in speech rife with errors. Typical and atypical phonological development is associated with using strategies to simplify more complex or still-in-the-process of mastering speech sounds. Although some phonological processes are expected in phonological acquisition, they should gradually disappear with age. Few phonological processes persist beyond the age of 6, with cluster reduction among the most common (Ceron, Gubiani, Oliveira, Gubiani & Keske-Soares, 2017). Children's speech production abounds in many mispronounced consonant sounds, reduced speech intelligibility, and phonetic disorders. There are also substitutions, omissions, and additions of sounds and syllables, reduction of syllables, grammatical errors, and difficulties in rhyming (Ценова, 2017).

2. Methods

The picture-naming method elicited children's phonology. Due to the lack of appropriate standardized tests of Bulgarian phonology, a picture-naming task was developed for this study. The method covers Bulgarian constant phonemes /r, l, s, h, ts, sh, g, h, k, d, f, c, p, b, m, n, t, d/.

The study aims to distinguish between children with a typical and delayed phonological development. The test methodically analyses children's results at three levels: naming nouns from pictures, repeating sentences, and producing spontaneous speech.

„Subtest 1 – nouns" consists of 96 nouns visually presented by pictures. Picture stimuli comprised words with different lengths and syllabus structures, thus covering specific phonemic segments and consonant clusters. Each image is given to the child in the assessment. The child is asked to nominate the object spontaneously. If there are no responses or the response does not match the target pronunciation, the examiner has to read the target word and ask the child to imitate the word verbatim.

„Subtest 2 – repeating sentences" is a task for repeating ten sentences with changing length and complexity. The aim is to measure the repeated phrase and to analyze the phonological and articulatory errors.

„Subtest 3 – generating sentences" includes 15 pictures of activities for generating spontaneous speech. The task allows the extraction of targeted words. The following analysis of the pronounced words will provide data about phonological and articulatory errors and help evaluators gather information about the peculiarities of producing spontaneous speech in children.

This is a pilot study conducted in February – March 2021. The number of participants meeting the criteria for analysis is fifty six (56). Twenty-four (42.9%) are boys and thirty-two (67.1%) – girls. The age of the participants (in months) is between 63 and 74. The data is analyzed via the SPSS statistic program. All children attend kindergarten, and their mother tongue is Bulgarian. Children with

disabilities and deficits were not included in the experiment, i.e., the participants have no intellectual, neurological, sensory, or emotional-behavioral disorders, and there is no information about depriving environmental factors. The included children were not diagnosed with a language disorder and were not working with a speech-language therapist at the time of the survey. The survey was conducted on the territory of Blagoevgrad - the University Practice Center for Speech and Language Therapy at South-West University "Neofit Rilski." This scientific methodology can also be used to detect changes in the phonological system during therapy, i.e., to re-evaluate after the initiation of treatment. In addition, the test makes it possible to create an articulation assessment of the child during the conduction of the test.

Results

It was necessary to set up a norm in the phonology analysis to analyze the results of the conducted study. When children were asked to name nouns from a picture, their most common error is was sound substitution (98.6 points), followed by deletion of sound (66.4 points), omission of a syllable (48.3 points), deletion of consonants clustered in a syllable (48.3 points) and metathesis on sound level (35.8 points).

Table 1. Total Phonological Errors

N	Valid	56
	Missing	0
Mean		**5,3036**
Std. Deviation		7,56047
Minimum		0,00
Maximum		41,00

The average total score of the examined children in the phonology level was 5,30. A total of 26,8% didn't make any phonological errors.

The lowest score, 41 points, means the child made 41 phonology errors.

The analysis shows that 50 (89,3%) of the children who participated in the test fall within the norm. Six of them (10,7%) have results under the norm.

The same analysis was conducted to determine the norm in articulation analysis. All children (100% of the extract) showed a disorder of the type bilabial lambdacism—partial in a firm position.

On level "subtest 2 – repeated speech," children had to repeat ten sentences with different numbers of syllables.

Table 2. The average length of repeated speech

		The average length of repeated speech (words)	The average length of repeated speech (syllables)
N	Valid	56	56
	Missing	0	0
Mean		4,3625	8,9357
Std. Deviation		0,58202	1,11786
Minimum		1,10	3,00
Maximum		4,50	9,20

The data from Table 2 shows that the length of repeated speech in children from the studied group varies between 1,10 – 4,50 words or 3,00 – 9,20 syllables in a sentence. The average length of repeated speech in examined children is 4,36 words or 8,94 syllables per sentence. The errors that children made in this subtest on word level were the omission of sounds (23 points), sound substitution (7 points), the elision of syllables (7 points), and the omission of consonants clustered in a syllable (7 points).

Table 3. The average length of repeated speech in children with phonological disorders

		The average length of repeated speech (words)	The average length of repeated speech (syllables)
Norm	Mean	4,4960	9,1920
	N	50	50
	Std. Deviation	0,01979	0,03959
	Minimum	4,40	9,00
	Maximum	4,50	9,20
Under norm (phonology disorders)	Mean	3,2500	6,8000
	N	6	6
	Std. Deviation	1,43492	2,75681
	Minimum	1,10	3,00
	Maximum	4,50	9,20
Total	Mean	4,3625	8,9357
	N	56	56
	Std. Deviation	0,58202	1,11786
	Minimum	1,10	3,00
	Maximum	4,50	9,20

Table 3 shows the average length of repeated speech in children with phonology disorders (3,25 words or 6,80 syllables). It is less than the average length of speech in children within the norm (4,50 words or 9,19 syllables). It is clear from this analysis that the maximum size of the phrase in children with phonology disorders is shorter than in children who fall within the norm.

„Subtest 3 – generating sentences" aims to study speech generation when looking at a picture.

Table 4. The average length of generated speech

		The average length of generated speech (words)	The average length of generated speech (syllables)
N	Valid	56	56
	Missing	0	0
Mean		5,4179	11,8083
Std. Deviation		1,66098	2,95302
Minimum		1,53	5,13
Maximum		10,20	20,47

Generated speech in children from the examined group varies between 1,53 – 10,20 words or 5,13 – 20,47 syllables (table 5).

The average length of generated speech in the examined group is 5,42 words or 11,81 syllables.

The most common errors at a target level elicited by their speech were speech substitution (9 points), elision of sounds (16 points), elision of syllables (23 points), and elision of consonants clustered in a syllable (16 points).

Table 5. The average length of generated speech in children with phonology deficiency

		The average length of generated speech (words)	The average length of generated speech (syllables)
Norm	Mean	5,6373	12,1813
	N	50	50
	Std. Deviation	1,55790	2,77168
	Minimum	3,33	8,13
	Maximum	10,20	20,47
Under norm (phonology disorders)	Mean	3,5889	8,7000
	N	6	6
	Std. Deviation	1,43754	2,76639

	Minimum	1,53	5,13
	Maximum	5,67	13,07
Total	Mean	5,4179	11,8083
	N	56	56
	Std. Deviation	1,66098	2,95302
	Minimum	1,53	5,13
	Maximum	10,20	20,47

Table 5 shows the average length of speech generated by children with phonological disorders (3,59 words or 8,70 syllables), which is less than the average length of speech by children within the norm (5,64 words or 12,18 syllables).

The data shown provoked us to measure the correlation between the average length of repeated speech and the average size of the generated speech.

Table 6. Correlation analysis 1.

		The average length of repeated speech (words)	The average generated speech (words)
The average length of repeated speech (words)	Pearson Correlation	1	0,412**
	Sig. (2-tailed)		0,002
	N	56	56
The average length of generated speech (words)	Pearson Correlation	0,412**	1
	Sig. (2-tailed)	0,002	
	N	56	56

**. Correlation is significant at the 0.01 level (2-tailed).

The conducted correlation analysis shows a statistically significant, directly proportional connection between the average length of repeated speech (measured in words) and the average length of generated speech (measured in words).

The level of significance sig. = 0.002 <0.01 and Pearson Correlation = 0.412 (average in strength direct proportional connection). That means the more words a child repeats in the part "repeated speech", the more words he/she is expected to generate in the part "generating a sentence."

Table 7. Correlation analysis 2.

		The average length of repeated speech (syllables)	The average length of generated speech (syllables)
The average length of repeated speech (syllables)	Pearson Correlation	1	0,401**
	Sig. (2-tailed)		0,002
	N	56	56
The average length of generated speech (syllables)	Pearson Correlation	0,401**	1
	Sig. (2-tailed)	0,002	
	N	56	56

**. Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis shows a statistically significant, directly proportional, average-in-strength connection between the average length of repeated speech (measured in syllables) and the average length of generated speech (measured in syllables).

The level of significance sig. = 0.002 <0.01 and Pearson Correlation = 0.401 (average in strength direct proportional connection). This means that the more syllables the child can repeat in the part "repeated speech", the more syllables they can be expected to generate in the part "generating sentences".

The average time to complete the test was between 9 and 18 minutes. 14.3% of the children were faster (up to 9 minutes), and for 14.3% it took 18 minutes to complete it.

Discussion

After the phonology analysis of children between five and six years old, it is noticeable that six of their results fall under the test norm. Children with disordered phonological development need more time to complete the assessment than children in the norm.

These children who delay their phonological development need speech and language therapy. This will prevent negative consequences in their future growth. This method can be used for prevention and error diagnostics in children's speech on phonological and articulatory levels, as well as for preparation of appropriate speech and language therapy and subsequent re-evaluation of its application.

The results obtained at the articulatory level, which is the topic of discussion, are worrying. All children are diagnosed with bilabial lambdacism. Additional research needs to be performed with more children.

The proposed test for noun naming is sufficiently informative about the phonological processes children use and detects six children with phonological disorders. Thus, children use phonological processes that are typical of younger age. On repeated speech tasks, children with impaired phonology do worse than usual, which is expected.

Also, the correlation analysis shows that the more syllables of repeated speech the child can produce, the more syllables we expect the child to make in spontaneous speech.

Conclusion

The starting point is essential for all types of assessments and diagnostic methods—the norm. It is the base needed to create a valid and reliable tool for assessing phonological processes in Bulgarian children. As a result, the test is used to distinguish children with typical development from children with disturbed phonological systems.

Good planning and proper evaluation of phonology and articulation can reach the best therapeutic interventions. This is of significant importance for the direction of effective therapy in childhood. Phonological development is a long process that children go through in language acquisition. As age progresses, phonological processes decrease until around 4-5 years of age, when this area is mastered. With the help of this test, we can investigate in detail exactly which phonological processes the child is using, and we can plan and apply appropriate therapy that purposefully works on the deficits of the children.

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