17. Bankson-Bernthal test of phonology: Reliability and validity study for Turkish language

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Abstract

Articulation and phonology tests based on standardized picture naming are widely used in the assessment of speech skills of children with hearing loss. Aim of this study is to conduct norm, validity and reliability study by adapting The Bankson-Bernthal Test of Phonology (BBTOP), which is a suitable phonological test for clinical use, into Turkish. The word list of the test was created and illustrated in accordance with the language rules of Turkish consonants, at the initial and final of the word positions, from objects recognizable by children. The study was conducted on children aged 3-9 years old (36-119 months), 208 girls and 233 boys (n = 441) and analyzed accordingly. The internal consistency coefficient of the test was obtained as α = .87 for consonants and α = .74 for phonological processes. The reliability analysis of the BBTOP, the correlation value of consonants was r = .87 and the correlation value of phonological processes was r = .80. Factor analysis has been made for "Construct Validity". Factor loadings were found to be 3 factors for phonological processes and 8 factors for consonants in the validity analysis between the scores; correlation between word score and consonants score was r = -.93, correlation between word score and phonological processes score was r = -.87, correlation between consonants score and phonological processes score was r = .84. BBTOP is a valid and reliable assessment tool and suitable for the assessment of children speaking standard Turkish with articulation and phonological disorders.

Keywords: Phonological assessment, articulation, phonology, phonological development, Turkish BBTOP

Bankson-Bernthal fonoloji testi: Türkçe geçerlilik ve güvenilirlik çalışması

Öz

Çocuklarda dil ve konuşma gelişimini etkileyecek bir problem, bu becerilerin kazanılmasını olumsuz etkiler. Dil ve konuşma probleminin varlığı klinik değerlendirmelerle tespit edilir. Çocukların artikülasyon ve fonolojik becerilerinin değerlendirilmesinde en sık kullanılan araçlarından birisi resimleri isimlendirme temeline dayanan standardize testlerdir. İşitme kayıplı çocukların konuşma becerilerinin değerlendirilmesinde standardize artikülasyon ve fonoloji testleri yaygın olarak kullanılmaktadır. Ancak, ülkemizde bu türden testlerin sayısı olduça sınırlıdır. Bu çalışmanın amacı, klinik kullanıma uygun bir fonoloji testi olan The Bankson-Bernthal Test of Phonology (BBTOP) (Bankson-Bernthal Fonoloji Testi/BBFT) testini Türkçe'ye uyarlayarak norm

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çalışmasını gerçekleştirmek, geçerlilik ve güvenilirlik çalışmasını yapmaktır. Testin sözcük listesi, Türkçe'nin ünsüzlerinin dil kurallarına göre, sözcük başı ve sonu pozisyonlarında, çocuklar tarafından tanınabilir nesnelerden oluşturulmuş ve resimlendirilmiştir. Çalışma, 3-9 yaş arasında, 208 kız ve 233 erkek (n = 441) çocuk ile gerçekleştirilmiş ve analiz edilmiştir. Testin iç tutarlılık katsayısı ünsüzler için α = .87 ve fonolojik süreçler için α = .74 olarak elde edilmiştir. BBFT'nin ünsüzler ölçeğinin iki yarı güvenirliği (iç tutarlılık anlamında) analizinde korelasyon değeri r = .87 fonolojik süreçler ölçeğinin ise r = .80'dir. Yapı geçerliliği analizlerinde faktör yükleri fonolojik süreçler için 3 faktör ve ünsüzler için 8 faktör bulunmuştur. Puanlamalar arası geçerlilik analizlerinde; sözcük puanı ile ünsüzler puanı arasındaki korelasyon r = –.93, sözcük puanı ile fonolojik süreçler puanı arasındaki korelasyon r = –.87, ünsüzler puanı ve fonolojik süreçler puanı arasındaki korelasyon r = .84 bulunmuştur. BBFT, standart Türkçe konuşan, artikülasyon ve fonolojik problemi olan çocukların değerlendirilmesine uygun geçerli ve güvenilir bir değerlendirme aracıdır.

Anahtar kelimeler: Fonolojik değerlendirme, artikülasyon, fonoloji, fonolojik gelişim, Türkçe BBFT

1. Introduction

Phonology is a subfield of linguistics that studies the structure and systematics of sound samples in human language. It examines sounds in terms of their functions in communication. While studying the sound systems of language, phonology identifies these sounds and tries to find the system of rules that exist in the articulation of words (Vardar, 1998; Akmajlan, Demers, Farmer & Harnish, 1997).

The smallest significant unit of sound is the phoneme. It is meaningful because the signals altered with a change in the meaning of the word. In English (American) there are 40-66, in Turkish (Turkey) there are 37-38 phonemes (Smiley & Goldstein, 1998; Aksan, 2000).

Children acquisition the ability to production words by forming syllables through repeating the phonemes which they hear, then combining syllables into the words. Sentences are formed by combining words. Any delay in this process for any reason makes the transition to the next stage difficulty (Alpöge, 1991; Taşer, 1995).

The deviation of the phonemes or phonemes from normal production within the word is an indication of a problem. Young children make mistakes in their sound production. Yet, up to what age should these errors be considered normal? The answer to this question can be obtained by phonological evaluation, hence many methods, which have been developed by battery field specialists, have been presented for clinical use.

In clinical practices, tests used in the assesment of children's articulation and phonological skills have a very important value in identifying, classifying and defining the errors made by children. Phonological evaluation is part of the diagnostic comprehensive assessment. Results of the assessment also provide guidance for treatment process (Hodson, 1992; Kent, 1999; Williams, 2001).

Data collection for phonological measures for children in a clinical setting focuses on structured, partially controlled or uncontrolled conversation or elicitation (picture naming), which are dynamic or static (Grunwell, 1992; Wolka & Meislerb, 1998; Glaspey & Stoel-Gammon, 2007).

The basis of the effective approach to speech disorders in children is the correct assessment of the child's speech and vocal system (Williams, 2001). According to Hedge (2001:83), the aims of the assessment are:

1. To evaluate the individual's articulatory performance in single word and conversational speech,
2. To evaluate the existence of phonological processes that will help to detect inaccurate articulation examples,
3. To evaluate the performance of the child in the light of developmental norms,
4. Misarticulated speech.
5. To determine potential treatment targets,
6. To evaluate the effects of treatment with repeated measurements.

It is important to create a phonetic inventory. Because, the inventory can be used as a basis for determining the suitability of the child's sound productions to the speech development, determining goals for testing excitability, and/or selecting goals, or determining treatment goals in a phonological model (Eisenberg & Hitchcock, 2010).

Decisions regarding diagnostic procedures in assessment children's speech production are multidimensional; application time, being easy to use and executable, and most importantly, its validity and reliability (Wolk & Meisler, 1998).

There are 3 analysis methods related to articulation and phonological development in clinical studies: phonetic inventories, error patterns, and acquisition of consonant clusters with consonants. A comprehensive assessment of speech sound may include a standardized single word test, additional single word test, linked speech sampling, phonological analyzes and excitability testing, and discrepancy testing. In addition, analysis of dialect and second language are important in the diagnosis and treatment of disorders (Bleile, 1996; Hedge, 2001; Macrae, 2016).

In articulation and phonological evaluation analysis methods, the age range usually starts from the age of 3. This is because the celebrities were fully acquired by the age of 3 (Eisenberg & Hitchcock, 2010). In order to evaluate the phonological skills, it is necessary to know the age ranges in which the sounds that make up the child's mother tongue are acquired.

Symbolization reflects the phonological units of targeted production. According to the source of Ball and Local (1996), Buckingham and Yule stated that without good phonetics, good phonology cannot be mentioned. In a disorder involving phonological simplification (e.g. completing the fusion of certain phonological units), accurate phonetic description, which enables to analyze the phonetic differences between patients, is very important. Researchers have shown some problems with the open transcription of distorted speech data. While instrumental phonetics is used for clinical data, impressionistic transcription is used in phonological disorders. However, instrumental phonetics is not preferred by clinicians as it is expensive (Perkins, 1971; Demirezen, 1992; Ball & Local, 1996; Smiley & Goldstein, 1998).

The Bankson-Bernthal test of phonology

The Bankson-Bernthal Test of Phonology (BBTOP), which have been designed to be used in the evaluation of the phonology of preschool and school-age children by speech-language clinicians and

was the subject of the study, was developed by Nicholas W. Bankson and John E. Bernthal in 1990. It was applied by in a sample group of 1070 children between the ages of 3-9. The time constraints in the working environment has been disappointing in the procedures required for the analysis of phonological processes. This resulted in the clinicians' choice of target solutions rather than sound inventories and analysis of individual sound segments. BBTOP, which allows the determination of commonly used phonological processes with partial analysis capability, was designed to provide a structure for taking a phonological sample. BBTOP is a quick and easy test. The application time is 10-15 minutes. The procedures for phonological processes analysis are particularly suitable for preschool children who demonstrate intelligibility problems. These children are difficult to adapt to the test, have minimal verbal expressions and therefore difficult to understand. Clinicians need evaluations to help identify the sound tracks and phonological processes that children produce incorrectly. It is also very important for clinicians that these can be done quickly. BBTOP has been developed for use by speech-language clinicians. For Consonant Inventory or Phonological Process Inventory, it requires the skill of scoring the child's production and phonetic transcription. Identification of phonological processes can be accomplished by phonological examples or the correct classification of phonological processes. The BBTOP is designed to produce the child's consonant sounds and identify the error examples associated with these parts. The test provides a system for comparing a child's phonological behavior with other children. BBTOP is designed for preschool and primary school age children. It can also be given to older children with severe phonological and articulation problems. Pictures made with simple and colorful, age-appropriate printing materials were used to obtain target words. The test is standardized based on measuring the phonological performance of children between the ages of 3-9 and their comparison with their peers. For children older than 9 years, the norms did not apply. Because the vast majority of children dominate all sounds at the age of 8. The interpretation of the test requires the practitioner to understand how the phonological productions examined by the test relate to the different scores. The practitioner has to convert the raw scores into scores shown on the scale and into normalized scores such as percentile ranking and standard score (Bankson & Bernthal, 1990).

2. Materials and methods

2.1. Individuals

Research was carried out in Ankara, capital of Turkey. The number of the sample size was calculated by taking 5 times the number of items in the scale (78x5 = 390) (Gürbüz & Şahin, 2017), and 500 children were included by using quota sampling in the assessment, and 59 children were excluded from the sample as they were found not suitable for the norm study as a result of the evaluations made according to the test results. As a result, analyzes were conducted based on normally developed 208 girls and 233 boys (N = 441) between the ages of 3-9 (36-119 months).

Due to the norm study in the sample selection, a total of 9 preschool education institutions and primary schools were determined in different districts of the city where children at different socio-cultural and economic (lower, middle, upper) levels receive educational services, which are not difficult to access, public and private. In the preschool period, a total of 18 children, 3 years old (6 children), 4 years old (8 children) and 5 years old (4 children), were included in the study as a group who did not receive education. Children attending preschool education (3-6 years old) and primary education (7-9 years old) were selected from educational institutions by using quota sampling method according to age and gender.

In this study, a test was applied to children in accordance with the pre-evaluation criteria. Since hearing loss, academic failure, and developmental delay negatively affect articulation and phonation skills, children who were considered normal as a result of the following evaluations in the preliminary evaluation were included in the study. In addition, the analysis of the differences between the practitioners was provided by another practitioner by applying this test to 60 children with the same characteristics.

2.2. Evaluations for selection criteria

2.2.1. Information form

It is a form developed to obtain demographic information about children and information about factors that may affect articulation. The content of the form includes name and surname of the child, gender, date of birth, school name and infectious diseases, age of beginning to speak, family structure, parents' place of birth, educational status, monthly income of the family, relative marriage, presence of a disabled person in the family, number of siblings, education of siblings. Information on the condition and gender was included. The form was filled by the parents. In case, the parents could not be reached, the file information of the child was consulted.

2.2.2. Development assessment and academic success

The development of children between the ages 3-6 who attend preschool institutions, was evaluated using the scan scale, "Denver II Standardization of Turkey". Information about the academic achievement of children attending primary schools was obtained from their teachers.

2.2.3. Hearing Screening

Hearing screening was performed using the Interacoustics (PA2) brand pediatric screening audiometer. For evaluation with the scanning device; the auditory stimulus protocol was used at 16 cm and 50 cm distances, at 20 dB intensity and at 500, 1000, 2000 and 4000 Hz during the applications, as there was not enough silence in the school environment, the performance of children to hear the sound at a distance of 50 cm was negatively affected. In this study, the child's responses to the measurements at this distance were not taken into account.

2.3. Testing equipment's and methodology

For the implementation of this study, while determining schools and preschool education institutions, the criteria of ease of access, education and economic level of parents and daily education time at school were taken into account. Official permissions were obtained from the Ministry of National Education, General Directorate of Social Services and Child Protection Agency, General Directorate of Social Insurance Institution and managers of private institutions.

2.4. Assessment of articulation skills

In study, Bankson-Bernthal Phonology Test (BBTOP) was used to evaluate children's articulation skills. This test was developed by Nicholas W. Bankson and John E. Bernthal (1990) in the United States of America and normalized on the basis of measuring children's phonological performance and comparison with their peers by applying a sample group of 1070 children aged 3-9 years (Burl, 1994).

The average duration of the test is 10-15 minutes. In U.S. cases, the number of words is 80, and it includes 23 consonants in English. In this test, vowels were not evaluated in the target vocal group. The picture booklet consisting of pictures representing each word, the registration form and the test user manual are the necessary materials for the application of the test (Bankson & Bernthal, 1990).

The application has been conducted in a quiet environment, with the child and the practitioner sitting side by side or opposite each other. After the child is told what to do, the picture of the target word is shown to the child and "What is this?" and then child is expected to say the target word by asking the question. If the child has difficulty, he/she is provided with hints to say the word of the picture. If the child still does not know, the practitioner becomes a model and the child is asked to repeat. Scoring is done by giving “1” point for the word the child knows and “0” points for the word he/she cannot produced.

BBTOP was adapted to Turkish by Yonca Berk-Giray (MS, CCC-SLP) (Giray, 2002). In our research, which we started in order to carry out the normalization study of the test, the registration form was revised. Consonants and consonant clusters were determined according to the position of the initial and final of the word. The number of target words (with 1, 2 and 3 syllables) is 78 for 21 consonants in Turkish. Words are chosen from objects that can be recognized by children. The recognizability of the objects was measured by showing the pictures to 10 children between the ages of 3-9. The pictures that were hardly recognized by the children were redrawn in a more recognizable way and they were shown to the children again and given their final shape. In addition, the pictures were shown to the experts of the subject and their opinions were taken.

The registration form was re-prepared based on the Turkish word list, phonetic transcription and 21 consonants in Turkish (Kılıç, 2017). Phonetic transcriptions were made by using the phonetical alphabet (IPA) and using the "impressionist transcription" method.

On the front page of the registration form consisting of 10 pages; information about the child, summary of data, profile of BBTOP and confidence ranges; word list, child's production and consonant letter list on pages 1, 3, 5 and 7; phonological processes take place on pages 2, 4, 6 and 8. The last page consists of the summary of the initial consonants, the summary of the final consonants and the summary of the phonological processes, in which the total error production examples at the end of each page are summarized.

2.5. Administration of the test

Information about the tests to be conducted to the children was given first to the administrators and classroom teachers of the selected schools. Later, the practitioner was introduced to the children and information was given about the applications. The assessment was introduced to the children as a game and was conducted in a quiet classroom as much as possible.

For BBTOP, booklets containing pictures of each word were placed in front of the child and given directions, “Here are some pictures. I want you to tell me the name of these pictures. If you don't know, I will help you”. The name of the objects that the child could not remember or could not know were tried to be reminded by giving simple hints. Hints used for each word have been prepared to help users and to provide the application standard. If the child cannot make the naming despite the clues,

the administrator has become the model. Verbal rewards were given to children during the application of the test.

2.6. Scoring the test

The total number of correct words was found by giving "1" point to each correct word production of the child and "0" point to their incorrect production. In the child's error production, the column of the consonant with which the error was made is circled and the total of the errors made in the columns at the end of each page is recorded. Then, these records were transferred to the last page of the registration form and scoring was finalized.

2.7. Defining articulation samples

Incorrect articulation examples of the children for each target word are listed in order to make phonological process analysis. As a result of the applications of the test, a total of 960 error patterns from 78 words were obtained.

2.8. Evaluation of Consonant

For 21 consonant words in Turkish, the articulations according to word initial, word final and consonant clusters (word initial and word final positions of consonants) were extracted and coded for each child. The number of correct words and the number of correct words in total were calculated for each page of the registration form. In addition, the consonants in words substituted for the error production of consonant clusters and their sums were removed for analysis by age and gender.

According to the Turkish linguistic rules, /b dʒ d g/ consonants are not included at the end of the word and /ɣ/ is not at the beginning of the word, and /h/ consonant is not included in the word list because it cannot be given with concrete objects at the final of the word.

2.9. Statistical Methods Applied

SPSS 25 statistical program package (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.) have been used to evaluate output of this study. In the analysis of variables, mean ± standard deviation and median (maximum-minimum) percentage and frequency values were used. Reliability and validity analyzes were made for the BBTOP form. Cronbach alpha (α) coefficient was used for reliability analysis. Cronbach alpha (α) coefficient was used for reliability analysis. Factor analysis was used for validity analysis. Compliance with factor analysis was evaluated with Bartlett's test of sphericity, and the adequacy of the number of samples was evaluated with Kaiser-meyer-olkin sampling adequacy statistics. BBTOP form was determined as a single factor structure as a result of varimax rotation method. Factor loadings and the summability of factors were evaluated with the Tukey summability test. For the significance level of the tests, $p < .005$ and $p < .001$ values were accepted.

3. Results

3.1. Demographic characteristics of children

As a result of the statistical analysis of this study, a total of 441 children, 208 girls and 233 boys between the ages of 3-9 were tested and the distribution of genders by age is presented in Table 1.

Table 1. Percentile distribution of gender by age

Ages / Gender	3 (N=62)	4 (N=67)	5 (N=65)	6 (N=62)	7 (N=62)	8 (N=63)	9 (N=60)
Female	50	50.7	41.5	48.4	50	50.8	38.3
Male	50	49.3	58.5	51.6	50	49.2	61.7

3.2. Phonological process findings

960 error production samples were obtained from the children included in the study. Analysis of the phonological processes seen in each of the error production samples, 24 phonological processes suitable for statistical analysis were determined. These are: 1. Assimilation, 2. Voicing, 3. Devoicing, 4. Alveolarisation, 5. Affrication, 6. Anaptyxis, 7. Velarisation, 8. Glottalisation, 9. Alveo-palatalisation, 10. Dentalisation, 11. Labio-dentalisation, 12. Rhotacism, 13. Cluster simplification, 14. Final consonant loss, 15. Soft-g loss, 16. Gemination, 17. Bilabialisation, 18. Semivowelisation, 19. Lateralisation, 20. Vowel Lengthening, 21. Metathesis, 22. Epenthesis, 23. Nasalisation, 24. Initial consonant loss.

As a result of the analyzes, the processes that are common in the younger age group but rarely seen in the older age group and the processes that are seen frequently or equally in all age groups were not included in the test form. Nine phonological processes that show the difference between individuals best were selected and included in the test form. These processes: 1. Assimilation, 2. Alveolarisation, 3. Alveo-palatalisation, 4. Dentalisation, 5. Affrication, 6. Semivowelisation, 7. Lateralisation, 8. Cluster Simplification, 9. Final consonant loss. Percentile distributions of the determined 24 phonological processes in all children were ranked from lowest to highest (Table 2.).

In our study, it was determined that children did not make any mistakes in two of the 78 target words (4th and 68th) in the evaluation of error production samples. These words; The 4th target word is (ball) "top" and the 68th target word is (man) "adam". Also, the following examples of faulty articulation could not be explained phonologically. These are: (chain) /zindʒir/→[idʒil], (umbrella) /ʃɛmsijɛ/→[ʃɛpi], (radio) /radjo/→[ja: da], (eye glass) /gɸzlyk/→[gyʒ], (umbrella) /ʃɛmsijɛ/→[ʃɛmʃɛk]

3.3. Measurement score findings

On the last page of the test form, the measurement scores that will be used to convert the "raw score" into measurement score in the phonological processes, summary of the initial and final consonants are standardized according to the Stanine 9 scale.

Standard scores are categorized based on the original test. The total scores were obtained by summing the scores, and weighting was made according to frequency after categorization. Total scores were found by adding the weighted scores. According to this; 0 no errors; 1 measurement point for 1 or 2 errors; 2 measurement points for 3 errors; 3 measurement points for 4 errors; 4 measurement points were obtained for 6 errors.

Table 2. Percentile of phonological processes by age

		PHONOLOGICAL PROCESSES											
		Assimilation	Voicing	Devoicing	Alveolarisation	Alveo-palatalisation	Dentalisation	Labio-dentalisation	Affrication	Epenthesis	Velarisation	Glottalisation	Bilabialisation
AGES	3	90	26	95	35	63	34	7	31	5	48	2	32
	4	84	52	100	18	55	15	11	12	1	73	3	22
	5	75	55	97	15	55	6	3	11	6	68	2	11
	6	71	31	89	0	50	2	11	11	6	45	0	3
	7	47	19	76	0	32	0	8	9	5	21	0	2
	8	29	37	17	14	0	0	2	2	0	38	2	2
	9	27	43	87	2	12	0	0	8	0	42	2	0

		PHONOLOGICAL PROCESSES											
		Semivowelisation	Lateralisation	Rhotacism	Cluster Simplification	Final Consonant Loss	Soft – g Loss	Gemination	Vowel Lengthening	Metathesis	Epenthesis	Nasalisation	Initial Consonant Loss
AGES	3	89	66	0	79	50	79	13	90	50	32	15	6
	4	57	40	0	55	54	72	7	90	54	49	15	4
	5	25	38	6	31	42	52	3	72	54	65	11	0
	6	6	21	8	5	11	23	2	32	66	82	2	0
	7	2	6	3	2	13	23	0	31	44	84	2	0
	8	0	2	0	3	6	10	2	16	56	75	2	0
	9	0	3	0	0	22	5	0	25	30	45	0	0

Measurement scores are shown in Table 3 for initial and final consonants and in Table 4 for phonological processes.

Table 3. Initial and final consonants measurement score

Initial consonants

Raw Score Over Consonants

b	dʒ	tʃ	d	f	g	ɣ	h	ʒ	k	l	m	n	p	r	S	ʃ	t	v	j	z	ss
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1-3			1-3				1-2		1				1						1	1-2
																					3
		1-5			1-4		1-5			2-3		1-2	1-2	2-4		1-4		1-2		2-5	4-5
1+			1+						1-5		1+				1-4		1-2		1-3		6+

Final consonants

Raw Score Over Consonants

b	dʒ	tʃ	d	f	g	ɣ	h	ʒ	k	l	m	n	p	r	S	ʃ	t	v	j	z	ss
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1+																		1		1-2	1-2
								1	1	1				1						3-5	3
		1-3		1-3		1-2							1+		1-2	1-3		2-4	1-5		4-5
								2	2-8	2-5		1-4		2-4							6+

Table 4. Phonological processes measurement scores

Phonological processes

Raw Score Over Consonants

Measurement Score	Assimilation	Alveolarisation	Alveo-palatalisation	Dentalisation	Affrication	Semivowelisation	Lateralisation	Cluster Simplification	Final Consonant Loss
0	0	0	0	0	0	0	0	0	0
1	1-2		1			1-4	1	1-2	
2		1	2			5-6	2	3	
3	3		3	1	1	7-8	3	4	1
4	4+	2+	4+	2+	2+	9+	4+	5+	2+

3.4. Creating percentage and standard score findings and norm tables

The obtained scores were converted into z scores in the unit standard normal distribution and their percentage equivalents were found. The z-scores were normalized by converting them to a score with an average of 100 and a standard deviation of 15.

3.5. BBTOP Validity findings

In order to determine the structural validity of the BBTOP, content validity and structure validity analyzes were made. When errors made in consonants are examined in terms of "Content Validity", the use of all consonants can be considered as evidence of content validity. Factor analysis has been made for "Construct Validity". Factor loadings were found to be 3 factors for phonological processes (Table 5.) and 8 factors for consonants (Table 6.) (Büyüköztürk, 2002). The difference between ages in the scoring of the test can be considered as "Criterion Group Validity".

In the analysis of validity between scoring, correlations between word score, consonant score and phonological processes were calculated by calculating Pearson correlation value. According to this; correlation between word score and consonants score r = -.93 (p< .001), correlation between word score and phonological processes score r = -.87 (p<.001), correlation between consonants score and phonological processes score r = .84 (p < .001), correlation between consonants score and word score r = -.93 (p< .001), correlation between phonological processes score and word score r = -.87 (p< .001), correlation between phonological processes score and consonants score it was found that r = .84 (p< .001).

3.6. BBTOP Relaibility findings

The reliability analysis of the consonants (word initial and word final) and subscales of the BBFT test was performed by calculating the Cronbach's alpha (α) value and the half reliability Pearson correlation value. Accordingly, in the split-half reliability (meaning internal consistency) analysis of the consonants scale, the correlation value was r = .87 and the coefficient was α = .87. In the split-half reliability analysis of the phonological processes scale, the correlation value was r = .80 and the coefficient was α = .74. The rater reliability findings were obtained as r = .98 for the consonants score and the phonological processes score.

Table 5. Factor analysis for construct validity in phonological processes.

	Factor		
	1	2	3
Assimilation	0.68*	0	0
Alveolarisation	0.46	0.64*	0.33
Alveo-palatalisation	0.58*	0.46	-0.38
Dentalisation	0.52	0.16	0.61*
Affrication	0.46	0.67*	0.31
Semivowelisation	0.69*	-0.23	-0.27
Lateralisation	0.54*	-0.28	0.12
Cluster Simplification	0.83*	-0.04	-0.14
Final Consonant Loss	0.32	-0.08	0.51*

* Values greater than or equal to .40

Table 6. Factor analysis for construct validity in consonant

Factor							
1	2	3	4	5	6	7	8

Initial b	0.39	0.72*	-0.08	0.02	0.13	0.05	0.05	-0.07
Final b	0.14	-0.08	-0.09	-0.26	0.63*	0.23	-0.12	0.1
Initial dʒ	0.59*	-0.04	-0.47	-0.22	0.03	0.23	0.03	0.08
Final dʒ								
Initial tʃ	0.61*	0	-0.51	-0.06	-0.05	0	0.06	0.02
Final tʃ	0.56*	-0.05	-0.42	0.03	0.01	0.04	0.22	0.14
Initial d	0.02	-0.02	0.05	-0.07	-0.04	-0.16	-0.09	0.87*
Final d								
Initial f	0.53	0.57*	-0.09	-0.04	-0.21	0.12	-0.12	-0.11
Final f	0.42*	-0.12	0.16	0.03	-0.11	-0.08	0.37	0.03
Initial g	0.58	0.38	0.05	0.42	0.07	-0.19	-0.13	0.04
Final g								
Initial ɣ								
Final ɣ	0.30*	-0.26	0.1	0.23	-0.05	0.18	-0.2	-0.21
Initial h	0.45	0.26	-0.17	-0.18	0.46*	0.04	-0.16	0.08
Final h								
Initial ʒ	0.55*	-0.08	-0.15	0.19	0.05	0.09	-0.09	0.09
Final ʒ	0.3	-0.24	0.06	0.37	0.05	0.52*	0.1	-0.03
Initial k	0.52*	0.49	0.26	0.43	0.16	-0.15	-0.08	0.04
Final k	0.28	0.14	0.32	0.53*	0.26	-0.27	0.11	0.12
Initial l	0.61*	-0.133	0.29	0.03	-0.11	-0.19	-0.03	0.06
Final l	0.52*	-0.25	0.15	0.06	-0.14	-0.22	-0.2	-0.18
Initial m	0.47	0.49*	0.14	-0.12	-0.3	0.21	-0.22	0.05
Final m								
Initial n	0.41	0.15	0.09	-0.09	-0.244	0.07	0.49*	0.05
Final n	0.39	-0.05	0.41*	-0.3	-0.322	0.16	-0.04	0.21
Initial p	0.33	0.46*	0	-0.05	-0.19	0.34	-0.08	0.01
Final p	0.50*	-0.15	-0.22	0.12	-0.16	-0.24	-0.15	-0.05
Initial r	0.67*	-0.4	0.17	0.03	-0.13	0	-0.06	0.04
Final r	0.64	-0.37	0.03	-0.07	-0.24	-0.12	-0.11	-0.06
Initial s	0.66*	-0.05	0.21	-0.31	0.37	-0.1	0.16	-0.15
Final s	0.56*	-0.31	0.28	-0.27	0.38	-0.1	0.12	-0.09
Initial ʃ	0.59*	-0.09	-0.39	0.07	0.01	-0.06	0.02	0
Final ʃ	0.56*	-0.17	-0.49	0.1	-0.19	-0.08	-0.17	-0.07
Initial t	0.35	0.50*	0.2	0.04	0.13	-0.05	0.06	-0.12
Final t								
Initial v	0.40	0.24	0.38	0.45*	-0.23	0.24	-0.03	-0.02
Final v	0.16	-0.16	0.03	0.45	0.06	0.49*	0.14	0.13

Initial j	0.49*	0.31	-0.18	-0.07	0.03	-0.23	0.05	0.01
Final j	0.13	0.13	-0.12	0.11	-0.16	0	0.55*	-0.05
Initial z	0.75*	-0.06	0.05	-0.24	0.28	-0.02	0.03	-0.01
Final z	0.25	-0.27	0.18	0.22	0.199	0.51*	-0.1	0.02
Initial Consonant Cluster	0.88*	-0.24	0.09	-0.07	-0.07	-0.06	-0.03	0.06
Final Consonant Cluster	0.77*	-0.35	0.12	0.08	-0.04	-0.06	0.02	0.05

*Values equal to or greater than .30

4. Discussion

In study, in order to evaluate the articulation skills of children, the word inventory, consonant inventory and norm tables of the Bankson-Bernthal Phonology Test were prepared, measurement scores were calculated, validity and reliability analyzes were made.

Evaluating each phoneme with its position at the initial, medial and final of a word is one of the "traditional evaluation" methods, and words are presented through pictures, word lists, sentences or exemplified speeches. These assessments show what articulatory errors are and how often they occur. Phonetic inventory, which is another source of information, gives the summary of the sounds produced correctly or incorrectly (Bleile, 1996; Haynes & Pindzola, 1998; Williams, 2001). It is a test suitable for these features in BBTOP.

The majority of individuals diagnosed with articulation disorders are children. Therefore, the appropriateness of the tests used in the assessment of articulation skills to children is valuable in clinical practice (Silverman, 1984). In our study, BBTOP, which is used to assessment the articulation skills of children aged 3-9, is a test that meets the clinical need in terms of the age group applied.

Studies have found that children make fewer mistakes in vowels and more in consonants. Because, less articulatory movements are needed in the production of vowels compared to consonants (Silverman, 1984; Bleile, 1996). For these reasons, the consonant phoneme list is used in the BBTOP.

With the Bankson-Bernthal Phonology Test, 24 phonological processes observed in Turkish-speaking children and the usage characteristics of 21 consonants in Turkish were revealed.

As a result of the analysis, it has been determined that the BBTOP can be used in children to evaluate the phonological processes and the articulation of consonants in the word.

The findings revealed that the Bankson-Bernthal Phonology Test, which was adapted to Turkish, was used in clinical applications, and its validity (r values > .80, p< .001 significant at significance level) and reliability (α = .87 for consonants, α = .74 for phonological processes) (Seçer, 2015; Gürbüz & Şahin 2017).

The study will provide a written profile on the determination of the pathological limit of articulation and phonological skills of children between the ages of 3 and 9 whose mother tongue is Turkish, and approaches to the treatment of pathology.

5. Conclusion

In study, 441 children between the ages of 3-9 were evaluated with the Bankson-Bernthal Phonology Test. BBTOP is a norm-based test consisting of 78 words that evaluates the production of consonants and consonant clusters at the initial and final positions separately using the word inventory, consonant inventory and phonological processes inventories, and gives the results with standard deviation values. Recognizable pictures for each word were prepared in the form of a book (two copies), to take children's word productions. Registrations are made on the 8-page registration form and scored on this form. A user manual has been prepared to provide users with ease of use and scoring measurement charts.

As a result of study, it was found that BBTOP is a valid and reliable test with a material and registration form suitable for clinical use.

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References

Akmajlan, A., Demers R.A., Farmer, A. K., Harnish, R. M. (1997). *Linguistics: An Introduction to language and communication*. The MIT Press.

Aksan, D. (200). *Language in all aspects: linguistics in its main lines*. Ankara: Türk Dil Kurumu.

Alpöge, G. (1991). *Child and language: Use of adjectives in Turkish and their analysis in terms of child's development*. Ankara: Yapı Kredi.

Ball, M. J., & Local, J. (1996). *Current developments in transcription*. M. J. Ball & M. Duckworth (Eds). Advances in Clinical Phonetic. Vol. 6. USA: John Benjamins Publishing Company.

Bankson, N. W., & Bernthal, J. E. (1990). *Bankson Bernthal test of phonology manual*. Symbolixs Tools for Language & Cognition.

Bleile, K. M. (1996). *Articulation and phonological disorders*. London: Singular Publishing.

Burl, N. T. (1994). ASHA rewiews: Materials. Bankson-Bernthal Test of Phonology. *ASHA*, Vol. 36, Issue 5, 53.

Büyüköztürk, Ş. (2002). Faktör analizi: Temel kavramlar ve ölçek geliştirmede kullanımı. *Kuram ve Uygulamada Eğitim Yönetimi*, Sayı:32, 470-478.

Demirezen, M. (1992). Sesbirim çözümlemesinde temel ölçütler. *Gazi Eğitim Fakültesi Dergisi,* Vol: 8, No: 3, 15-28.

Eisenberg, S. L., & Hitchcock, E. R. (2010). Using standardized tests to inventory consonant and vowel production: a comparison of 11 tests of articulation and phonology. *Language, Speech, and Hearing Services in Schools*, Vol. 41, 488–503.

Giray, Y. (2002). Verbal interview about BBTOP, February.

Glaspey, A., & Stoel-Gammon, C. (2007). A dynamic approach to phonological assessment. *Advances in Speech Language Pathology*, 9 (4), 286-296.

Grunwell, P. (1992). Processes of phonological change in developmental speech disorders. *Clinical Linguistics and Phonetics*. Vol. 6, NOS 1-2, 101-122.

Gürbüz, S., & Şahin, F. (2017). *Research methods in social sciences*. 4 th ed. Ankara: Seçkin.

Haynes, W. O., Pindzola, R. H. (1998). *Diagnosis and evaluation in speech pathology*. Allyn-Bacon.

Hedge, M. N. (2001). *Hedge's pocket guide to assessment in speech-language pathology*. Singular-Thomson Learning.

Hodson, B. W. (1992). Clinical forum: Phonological assessment and treatment applied phonology: constructs, contributions, and issues. *Language, Speech, and Hearing Services in Schools*, Vol. 23, 247-253.

Kılıç, M. A. (2017). The extrinsic and intrinsic allophones of the turkey Turkish phonemes: the stratificational transcription model. *International Periodical for the Languages, Literature and History of Turkish or Turkic,* Volume 12/7, 195-214. doi: http://dx.doi.org/10.7827/TurkishStudies.11354

Macrae, T. (2016). Comprehensive assessment of speech sound production in preschool children. *Perspectives of the ASHA Special Interest Groups*, SIG 1, Vol. 1 (Part 2), 39-56.

Perkins, W. H. (1971). *Speech pathology*. Saint Louis: The C.V. Mosby Company.

Seçer, İ. (2015). *Practical Data Analysis with SPSS and LISREL: Analysis and Reporting*. Ankara: Anı.

Silverman, F. H. (1984). *Speech language pathology and audiology: An Introduction*. A Bell-Howell Company.

Smiley, L. R., & Goldstein, P. A. (1998). Language delays and disorders: From research to practice. Singular Publishing Group INC.

Taşer, S. (1995). *Speech training with examples* (5 th Ed.). Papirüs, Ankara.

Vardar, B. (1998). *Glossary of annotated linguistic terms* (2 nd Ed.), ABC: İstanbul.

Williams, A. L. (2001). *Phonological assessment of child speech*. D. M. Ruscello (Ed.). Tests and measurement in speech language pathology. Butterworth-Heinrmann, Boston.

Wolk, L., & Meisler, A. W. (1998). Phonological assessment: A Systematic comparison of conversation and picture naming. *Journal of Communication Disorders,* 31, 291-313.