

Investigation of Turkish Nonword Repetition List for 3-9 Years Children

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Abstract

The purpose of this study was to develop the Turkish Nonword Repetition (NWR) List and to assess the verbal working memory performances of typically developing children between 3-9 years. Study group consists of 84 girls and 108 boys with a total of 192 children who are attended to private and state preschool institutions as well as state primary schools in Ankara. NWR List consists of 36 words with a total of 210 phonemes. The results showed that the number of correct phonemes increase with age. Besides, age and the number of one to four syllables and consonant cluster nonwords had averagely positive significant relationship. This research adds to our knowledge of language development as it highlights that NWR processes can be applied at an early age of 3.

Keywords: Working memory, nonword repetition, number of correctly produced phonemes

Introduction

It is stated that in the basis of differences in grammatical processing skills there is verbal working memory/ phonological loop/phonological working memory and other components related to working memory (Alloway, Rajendran, & Archibald, 2009; Baddeley, 2003; Montgomery, 2000; Montgomery & Evans, 2009). Not being able to recall the verbal input or not being able to process it, may be effective in creating difficulties in learning of new language skills or comprehending language.

The “verbal working memory” component in Baddeley’s (2003) working memory model is especially important in explaining language acquisition. Verbal working memory allows the listener to transform the acoustic vocal signal into phonetic representations and allows retaining these representations in short term memory. Storing the verbal input phonetically allows the listener to process the input quickly and allows new phonetic representations to be more permanent in long term memory. Difficulties in working memory are seen frequently in developmental language impairments such as specific language impairment (SLI) (Archibald & Gathercole, 2006, 2007; Engel, Santos, & Gathercole, 2008).

Findings of the relationship between working memory and language comprehension impairments makes the evaluation of working memory performance in language impairment very important. As a variable predicting language comprehension, in the evaluation of verbal working memory, different procedures such as digit numbers, sentences or word repetitions are used (Montgomery, 2004; Montgomery and Evans, 2009). However, evaluations using “nonword repetition” are shown to be providing more closely related results to language development, and more sensitive measurements (Gathercole & Adams, 1993; Gathercole & Pickering, 2001).

Nonword repetition (NWR) requires the repetition of unfamiliar structures resembling words containing similar phonetic orders and requires the usage of the section used in temporarily storing phonetical representations (Laws & Gunn, 2004). Therefore, as it is based on cognitive processing, compared to other measurements such as repetition of numbers and sentences, it provides a more

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sensitive measurement especially in phonological loop. Since it does not allow using the vocabulary in long term memory, it is also prevented supporting of new phonetic forms by the long term memory (Archibald & Gathercole, 2007). It has been shown that nonword repetition provides a clinically sensitive measurement in identification of children with language impairment (Dollaghan & Campbell, 1998; Gathercole & Pickering, 2001; Hick, Botting & Conti-Ramsden, 2005; Montgomery, 2000, 2003; Weismer & Evans, 2002). It is discovered that individuals having difficulty in NWR also have problem learning the phonetic forms of language, and there is a strong relationship between NWR and speed of learning phonetic forms of new words (Archibald & Gathercole, 2007)

Studies evaluating developmental sensitivities of NWR state that there is an interaction between age and correct repetition mean in nonword repetition (Reuterskiold-Wagner, Sahlen, & Nyman, 2005). In the study of Spanish nonword repetition for the purpose of developing the nonword repetition list, between the ages of 3 and 5, is shown that there is a relationship between word length and age, as age increases, correctly repeated nonword number is increases, and as word length increases, the number of correctly repeated nonword is decreased (Ebert, Kalanek, Cordero, & Kohnert, 2008).

In Turkish Literature, some procedures have been developed to evaluate the phonological memory skills of children of 9-15 years and adults. In the study by Güngüt (1992), visual and auditory recall and nonword repetition processes are used for evaluate the memory capacity of children with mild mental retardation and typically developing individuals.. In the Kesikçi and Amado study (2005), 15 nonwords with 4 syllables has been created to measure phonological memory of children between the ages of 7 and 11 who has reading difficulties. There is only one study to develop a Turkish Nonword Repetition test. In the study of Kaçar (2011), a list has been created consisting of 15 nonwords resembling real words and 15 nonwords not resembling real words. In the study, 120 children took place, children of 4-8 years who has specific language impairment matched to their receptive language ages to children between ages 3 and 7 who show typical development. In the analyses, it has been shown that the test statistically discriminate the groups.

In literature, it is stated that storage and process capacity of working memory increases approximately at age 10 (Montgomery, 2002, 2003; Archibald & Gathercole, 2006). Besides in a study to determine the phonological working memory of children under age 4, it is discovered that phonological working memory of children of 2 years 10 months can be evaluated (Gathercole & Adams, 1993). Therefore it is thought that developing a Turkish NWR list for children between the ages of 3-9 and stating the performance of different age groups are important for analysis of different language skills and working memory, and identification of children with language impairments at early periods. The aim of this study is developing a nonword repetition list not resembling real words and analyzing the performances of children of 3-9 ages with typical development in the procedure of nonword repetition.

Method

Study Group

The study group of the research consists of 192 children of 3-9 years of age who attend private or state preschools and state elementary schools in Ankara. The distribution of children regarding age and gender is in Table 1. The mean age of children in study group is 5.8 (S=1.98). In the study group, 84 of those children are girls and 108 of them are boys. According to chi-square test results (n=192), the differences between the children's chronological age and gender distribution show are not significant ($p=.532$; $p>.05$). The native language and the only language used in the homes of all of the children is Turkish. By their teachers, in the general development of the children, intelligibility of their speech and their auditory skills are confirmed not having any problems. None of the children in the study has taken a language and speech therapy due to a problem in their language or speech development. Moreover, the articulation skills of children are determined to be age accurate using Ankara

Articulation Test (AAT) (Ege, Acarlar, & Turan, 2004). Children's parents were informed about the study and their verbal consents were taken.

Table 1.

Distribution of children by age and gender.

Age	Girl	Boy	Total
3.00	12	20	32
4.00	18	12	30
5.00	11	15	26
6.00	12	14	26
7.00	11	20	31
8.00	10	16	26
9.00	10	11	21
Total	84	108	192

Data Collection Tools

In the research, to determine the performances of verbal working memory of the children of 3-9 years, developed nonword repetition list is used. Nonword repetition list contains 36 words. In creating the list, representing phonemes equally numbered at the beginning, middle and end of the word and Turkish syllable structure and syllable number measures are taken into consideration. Words in the database of Turkish SALT (Systematic Analysis of Language Transcripts) (Acarlar, Miller, & Johnston, 2006) used frequently by 70 children of ages 4-6 are taken into consideration. At first a word pool of 1839 meaningful words has been created using SALT database. From this list, 64 words have been determined from the 153 words consisting of 1-4 syllables which the children used more than 10 times. In the word samples of the children, words containing consonant clusters are encountered (bank, park, kurt), 3 words containing consonant clusters are taken in the list.

While the word list was turning into nonword list, first stage was to change the first phoneme of a word then phonemes in the middle and in the end of the word were changed into phonemes not found in the word. In the nonwords created Turkish syllable rules are considered, thus "b, c, d, g" consonants were not placed in the end of the nonword. 5 experts of which two are linguistics specialists, one is a child development specialist and two are special education specialists are consulted if the words created resemble real words and if the created nonwords are compatible to Turkish Language rules. According to expert opinions, words containing "ğ" in the middle and end of the word are excluded because they create auditory difficulties, two words including "l" and "r" fluent consonants that were not in the original list were added to every syllable group. Besides a four syllable nonword was taken from nonwords used in a study by Baydık (2002) that aims to compare the word reading strategies of first grade students who has reading difficulties and who does not have reading difficulties. In the revised list with the expert opinions taken into account, total of 36 nonwords were used, which are: 8 words with 1 syllable, 8 words with 2 syllables, 8 words with 3 syllables, 9 words with 4 syllables and 3 words containing consonant clusters. In the words in the list, a total 210 phonemes exist.

Determined nonwords were vocalized and recorded by a male speaker in a studio with the purpose of isolating words from environmental sounds. Studio recording was transferred to computer and a 4 second pause was added after each word to allow repetition of words. Recording was transferred from computer to a digital sound recording device (Model no: Sony Icd-px720)

Procedure

Children in the study group were taken into evaluation in a quiet room in their schools individually. In the application, a digital sound recording device was used so that the children could listen and repeat the words and to eliminate the negative effects of environmental noises, sound isolation headphones (Model no: Sony MDR-7509HD) was used. Moreover for reliability analyses

between observers and recording of the words children repeats, sound recording device and collar microphone, and to note the repetitions of children, a NWR test form was used.

Before starting the implementation, children were allowed to examine the materials used and, researcher gave information about headphones, recording devices and the application itself. First with all children, a trial session was performed with 3 words that are not used in NWR test. Words used in trial session were spoken out loud by the researcher in order for children to learn repeating, and children were asked to repeat. 2 children who could not repeat 2 out of 3 words used in the trial session were not taken into study. Children who succeeded the trial session were given the instruction; "Now we will do the same practice with headphones. I will put on the headphones, when I press this button, you will hear some words from the headphones. I want you to repeat the words as soon as you hear them." Headphones and collar microphone was put on the children and recording of the list was played to them. Words repeated correctly and wrongly were marked in the related section in the form. Wrongly repeated words were recorded as they were repeated during the application and after the application, they were compared using the recordings and form. Dollaghan and Campbell (1998) study, in evaluations using nonword repetitions, does not take addition and distortion of sounds as errors because the target phoneme is not disappeared. In this study, similarly, addition and distortion of sounds are not considered errors. However, phoneme substitution or omission are considered errors.

Reliability between observers and internal consistency

To calculate the reliability between observers, a second researcher listened 30% of the records. Second researcher, listened randomly selected recordings and marked the recordings on another form. Later, the reliability between two researcher's data were calculated using: "Agreement / (Agreement + Disagreement) x100" formula. The reliability was found as 92.4%. Forms were revised according to disagreements by the two researchers, recordings were re-listened by the first researcher and by the views of two researchers, and forms were marked as they agreed together on answers. Correctly produced phoneme number (CPPN) coefficient is calculated as .81

CPPN related to NWR test list, phoneme mistakes, syllable numbers and consonant groups distributions are calculated. To calculate CPPN in NWR test list, numbers of correctly produced phonemes are divided to total phoneme number (210 phonemes).

To determine the phoneme mistakes' distributions related to syllable numbers in words in NWR list, mistakes made in 1 to 4 syllable words were divided to total 1-4 syllable word number (33 words).

To determine the distribution of phoneme errors related to words with consonant clusters in NWR list, mistake numbers made in consonant cluster words were divided to total consonant cluster word number (3 words).

To determine the relationship between all of these measures and age, Pearson Correlation Coefficient analysis is used. As it is determined that the variables are distributed normally, to determine if correctly produced phonemes number obtained from NWR test differ by the syllable number of the words, Analysis of Variance (ANOVA) and to determine the source of the difference, Tukey Test were used. Significance of the data were determined according to $p < .01$ value. In calculation of their effect magnitude, eta square (η_p^2) method is used. Partial eta square value is interpreted as small for $\eta_p^2 \leq 0.01$, medium for $\eta_p^2 = 0.06$ and large for $\eta_p^2 = 0.14$ (Kittler, Menard, & Phillips, 2007).

Results

In Table 2, CPPN and average of CPPN according to all ages, standard deviations, minimum and maximum received point's descriptive statistical information. The mean of CPPN is seen as directly proportional to age. In table two, as age increases, correctly produced quadrisyllabic word (QSW) number is increased. Despite some age group means decrease, MSW, DSW, TSW, CCW increases with age.

Table 2.

Total Correctly Produced Phonemes Number and Syllable Related Correctly Produced Phoneme Number Averages According to Age, Standard Deviations and Minimum – Maximum Values

	AGE	CPPN	MSW	DSW	TSW	QSW	CCW
Age 3	Mean	170.75	4.75	2.21	2.21	2.81	1.78
	SD	16.22	1.75	1.38	1.23	1.89	.90
	Min-Max.	136- 194	1-7	0-5	0-4	0-7	0-3
Age 4	Mean	178.50	5.50	2.03	3.16	4.03	2.53
	SD	11.79	1.38	1.18	1.39	1.95	.73
	Min. –Max.	150- 199	3-8	0-5	1-6	0-8	1-3
Age 5	Mean	186.30	6.11	2.34	3.03	4.69	2.38
	SD	8.24	1.07	1.05	1.37	1.66	.75
	Min. –Max.	168-200	4-8	1-5	1-6	2-7	1-3
Age 6	Mean	187.19	5.92	2.73	3.57	4.80	2.42
	SD	8.33	1.38	1.04	1.20	1.81	.80
	Min. –Max.	168-199	2-8	1-5	1-6	1-8	1-3
Age 7	Mean.	194.03	6.58	3.25	4.80	5.70	2.67
	SD	7.78	.95	1.15	1.53	1.73	.59
	Min. –Max.	174-204	5-8	0-5	2-7	1-8	1-3
Age 8	Mean	194.06	6.34	3.23	4.61	6.11	2.76
	SD	9.80	1.16	1.21	1.52	1.77	.51
	Min. –Max.	159-206	5-8	1-6	1-7	2-9	1-3
Age 9	Mean	197.09	6.47	3.28	4.90	6.66	3.14
	SD	5.60	1.07	.90	1.48	1.42	.91
	Min. –Max.	180-206	4-8	2-5	2-7	3-9	2-7

*CPPN: Correctly produced phonemes number, MSW: Correctly produced monosyllabic word number, DSW: Correctly produced disyllabic word number, TSW: Correctly produced trisyllabic word number, QSW: Correctly produced quadrisyllabic word number, CCW: Correctly produced words with consonant cluster.

Pearson Correlation Coefficients for every measurement from NWR test are in Table 3. It is found that ,CPPN, words with 1-4 syllables and words with consonant groups have a moderate direct proportion to and significant relation with age (respectively $r=.63$; $r=.41$; $r=.41$; $r=.60$; $r=.56$; $r=.40$). Highest positive relationship with CPPN is between correctly produced 3 and 4 syllable nonword numbers (respectively, TSW-CPPN= .86; QSW-CPPN= .92). It is found that, the relationship between monosyllabic, disyllabic and consonant cluster words and CPPN are moderately positive and significant (respectively, MSW-CPPN= .61; DSW-CPPN=.61; CCW-CPPN=.65), the relationship between quadrisyllabic and trisyllabic nonwords is highly positive and significant (QSW-TSW=.75). It is seen that consonant cluster words and trisyllabic and quadrisyllabic words have a moderately positive and significant relationship (respectively CCW-TSW=.57; CCW-QSW=.58).

In table 3, it is seen that incorrectly produced phonemes number (IPPN), incorrectly produced consonants (IPC) and incorrectly produced vowel (IPV) and age have a negative moderate relationship (respectively; $r=-.62$; $r=-.62$; $r=-.41$) and errors were decreased as age increased. Incorrectly produced phonemes, incorrectly produced consonants and vowels and CPPN have a highly negative and significant relationship (respectively, IPPN-CPPN= .98; IPC-CPPN=.98; IPV-

CPPN=.73). This finding states that as one measure increases, the other one decreases. As a result, as CPPN increases, children's mistakes decrease or as children's mistakes increase, CPPN decreases. Relationship between incorrectly produced phonemes number and IPC and IPV is highly positive and significant (respectively, IPC-IPPC= .93; IPV-IPCC=.74).

Table 3.

Correlation Between Chronological Age and Nonword Repetition List Measurements

(n=192)	1	2	3	4	5	6	7	8	9	10
1. Age	-	-	-	-	-	-	-	-	-	-
2. CPPN	.63**	-	-	-	-	-	-	-	-	-
3. IPPN	-.62**	-.98**	-	-	-	-	-	-	-	-
4. IPC	-.62**	-.92**	.93**	-	-	-	-	-	-	-
5. IPV	-.41**	-.73**	.74**	.66**	-	-	-	-	-	-
6. MSW	.41**	.61**	-.63**	-.58**	-.43**	-	-	-	-	-
7. DSW	.41**	.61**	-.61**	-.63**	-.52**	.41**	-	-	.-	-
8. TSW	.60**	.86**	-.88**	-.85**	-.64**	.49**	.48**	-	-	-
9. QSW	.56**	.92**	-.93**	-.84**	-.73**	.51**	.48**	.75**	-	-
10. CCW	.40**	.65**	-.64**	-.63**	-.42**	.32**	.41**	.57**	.58**	-

** $p < .01$

IPPN: Incorrectly produced phonemes number; **IPC:** Incorrectly produced consonants; **IPV:** Incorrectly produced vowel

ANOVA results according to nonword syllable numbers, CPPN, IPC, IPV and IPPN according to age are seen in Table 4. One-Way ANOVA results supporting correlation analysis show that CPPN has a significant change according to age [$F(6-185) = 23.25, p < .01$]. Tukey Test, conducted to determine at which age the difference existed, revealed that sequential ages have no difference, but age 3 and ages 5, 6, 7, 8 and 9 and age 4 and ages 7, 8, 9 have a difference in between. It is seen that calculated effect values of CPPN, IPC, IPV and IPPN for age groups are high (respectively .43; .19; .39; .41).

Analysis of variance results show that there is a significant change in 1, 2, 3, 4 syllable words and consonant cluster words according to age [respectively; $(F(6-185)) = 8.865, p < .01$; $(F(6-185)) = 7.116, p < .01$; $(F(6-185)) = 18.885, p < .01$; $(F(6-185)) = 16.618, p < .01$; $(F(6-185)) = 7.652, p < .01$]. Tukey Test shows that every syllable level, there is no difference between sequential age groups, difference exists in the youngest and oldest age groups. Calculated effect magnitude for age groups for 1, 2, 3, 4 syllable words and consonant cluster words are determined to be high (respectively .22; .18; .38; .35; .19).

In total incorrectly produced phonemes, it is found that there is a significant change in IPC and IPV according to age. [$F(6-185) = 22.065, p < .01$; $[F(6-185)] = 20.431, p < .01$; $[F(6-185)] = 7.605, p < .01$]. Tukey Test shows that there is no difference between sequential age groups, differences in incorrectly produced phonemes, consonants and vowels exist between ages 3 and 5, 6, 7, 8, 9 and ages 4 and 7, 8, 9. Only age group 5 and 9 has a difference between incorrectly produced consonants.

Table 4.

ANOVA Results for The Number of Correctly Produced Phonemes, the Number of Correctly Produced Phonemes According to Syllable Number, Incorrectly Produced Consonant, Vowel and Total Number of Phonemes According to Age ANOVA Results

		Sum of Squares	df	Mean Square	F	p	η_p^2	Significant Group Differences (Age)
CPPN	Between Groups	15448.59	6	2574.766	23.252	.000**	.43	3.00-5,6,7,8,9 ages 4.00-7,8,9 ages
	Within Groups	20485.72	185	110.734				5.00-3 ages 6.00-3 ages 7.00-3,4 ages
	Total	35934.31	191					8.00-3,4 ages 9.00-3,4 ages
MSW	Between Groups	131.39	6	21.898	8.865	.000**	.22	3.00-5,6,7,8,9 ages
	Within Groups	456.98	185	2.470				
	Total	588.37	191					
DSW	Between Groups	170.96	6	28.493	7.116	.000**	.18	3-8,9 ages 4-7,8,9 ages
	Within Groups	740.71	185	4.004				
	Total	911.67	191					
TSW	Between Groups	1153.20	6	192.200	18.885	.000**	.38	3-5,6,7,8,9 ages 5-9 ages
	Within Groups	1882.79	185	10.177				
	Total	3036.00	191					
QSW	Between Groups	2848.32	6	474.720	16.618	.000**	.35	3-5,6,7,8,9 ages 4-7,8,9 ages
	Within Groups	5284.76	185	28.566				
	Total	8133.08	191					
CCW	Between Groups	40.01	6	6.669	7.652	.000**	.19	3-7,8,9 ages
	Within Groups	161.24	185	.872				
	Total	201.25	191					
IPPN	Between Groups	14117.36	6	2352.893	22.065	.000**	.41	3-5,6,7,8,9 ages 4-7,8,9 ages
	Within Groups	19727.76	185	106.637				
	Total	33845.12	191					
IPC	Between Groups	6000.206	6	1000.034	20.431	.000**	.39	3-5,6,7,8,9 ages 4-7,8,9 ages 5-9 ages
	Within Groups	9055.044	185	48.946				
	Total	15055.250	191					
IPV	Between Groups	312.543	6	52.090	7.605	.000**	.19	3-6,7,8,9 ages 4-7,9 ages
	Within Groups	1267.08	185	6.849				
	Total	1579.62	191					

*p<.001

Standard deviation and means of correctly repeated words in the NWR test list by the children in the study group are seen in Table 5. Words in the table are given without changing the word order in the NWR test. It is seen that trisyllabic and quadrisyllabic words' correct repetition averages are lower than consonant cluster words and monosyllabic and disyllabic words. However, in four of the disyllabic words, (Silö, Jopus, Çeriv, Pümeş) correct repetition means decrease due to the phonemes' arrangement in words.

Table 5.

Correct Repetition Means and Standard Deviation Values of the Words in NR Test List.

NonWord	Mean	SD	Correct Repetition Total	NonWord	Mean	SD	Correct Repetition
							Total
Şım	.85	.35	164.0	Pasındar	.91	.28	176.0
Teç	.63	.48	121.0	Cöpez	.65	.47	125.0
Silö	.14	.34	27.0	Üskedav	.31	.46	60.0
Kışgımayak	.47	.50	91.0	Füs	.71	.45	138.0
Inke	.20	.40	39.0	İbeşül	.69	.46	134.0
Yidikbet	.35	.48	69.0	Tüşk	.73	.54	142.0
Öfit	.63	.48	121.0	Ocaza	.90	.29	174.0
Çeriv	.11	.32	23.0	Harlumbova	.44	.49	85.0
Pümeş	.05	.22	10.0	Ayunhay	.38	.48	74.0
Nuk	.75	.43	144.0	Zof	.79	.40	152.0
Umatpakı	.60	.48	117.0	Bekezivyen	.58	.49	112.0
Gikobanu	.18	.38	35.0	Banç	.82	.37	159.0
Rit	.45	.49	88.0	Hajık	.77	.42	148.0
İşçetmep	.21	.41	42.0	Las	.85	.34	165.0
Dah	.84	.35	163.0	Vosungüfü	.42	.49	82.0
Endaiti	.77	.42	148.0	Yent	.92	.26	178.0
Jopus	.13	.33	25.0	Elisretik	.60	.48	117.0
Tambukaça	.76	.42	147.0	Mondukto	.81	.38	157.0

Discussion

In the study to develop the NWR list and analyze the performances of children of 3-9 in NWR process, the relation between NWR and age is analyzed. Most of the studies in literature analyzing the clinical value of NWR focuses on children of ages 8-12 (Güngüt, 1992), however especially in researches highlighted the importance of early diagnosis in specific language impairment, it is stated that measurements at the age of 3,5 can be an important predictor of the future language function (Weismer & Evans, 2002). In this aspect, the research is important as it shows that verbal working memory can be used at an early age of 3 by assessing with nonword repetition.

There are studies in literature suggesting evaluations using nonword repetition yield age dependent results (Ebert, Kalanek, Cordero, & Kohnert, 2008; Montgomery & Evans, 2009; Reuterskiold-Wagner, Sahlen, & Nyman, 2005; Stokes & Lee, 2009). In a study by Thal, Miller, Carlson and Moreno Vega (2005), it is shown that nonword repetition tests' psychometric features are suitable for age group 4 and it is shown that age 4 group performed worse than age 6 group in correctly produced phonemes number and different syllable level of correct repetition means. Chiat and Roy (2007) conducted a study to determine the psychometric sensitivity of the test by comparing preschool repetition test performances of children with typical development and children with language impairments who are between the ages of 2 and 4. It is seen that in children with typical development, age is effective on performance and sequential ages have a significant difference between them. When age groups and nonword syllable numbers are compared, correctly repeated 1-4 syllable nonwords averages are seen as increased with age. In the research, it is seen that as age increases, CPPN average

increases. As age increases, incorrectly produced consonant and vowel numbers decrease, generally as syllable numbers increase, correct repetition averages of words decreases (Table 5). Besides, as there is a significant change between 1-4 syllable words and consonant cluster words with age and the difference existing between the oldest and youngest age groups, it suggests that as words get longer, recalling words gets harder, in other words verbal working memory storage process gets harder. In the limited studies in the literature with young age groups, the increase of mistakes with the increase of syllables is explained with working memory capacity and harder recalling of longer words. Moreover, it is stated that working memory capacity increases until age 10 (Archibald & Gathercole, 2006; Ebert, Kalanek, Cordero, & Kohnert 2008; Montgomery, 2002, 2003). In this study, especially quadrisyllabic words' correct repetition averages increase with age is consistent with these studies and suggests a developmental progress. Children of ages of 6-7-8 and 9 have more correct repetitions than children of ages 3-4 and 5, this supports that the list developed provides an age sensitive measurement. Researches show that verbal working memory capacity continues development in mid-childhood and between the ages 4 and 11, the extent of memory doubles or triples (Alloway et al., 2006; Gathercole & Pickering, 2000; Magimairaj & Montgomery, 2012). In this respect, the nonexistence of significant results between successive age groups can be attributed to working memory capacity's developmental change by age, and the list provides a more sensitive measurement for ages of 4-6. However more comprehensive researches are needed to verify this finding.

In a research by Gathercole and Adams (1993), when the performances of 1, 2, 3 syllable nonword repetition list of children of ages 2 and 3 analyzed, it is determined that disyllabic words' correct repetition mean is lower than trisyllabic words' means. In similarity, in this research, disyllabic nonwords' correct repetition mean is lower than 3 and 4 syllabic words' means. It is thought that this situation stems from phonemes and their placement in words different than 3 and 4 syllable words and consonants gained later in development (such as "l", "v", "r" and "j") and their placement in disyllabic words in the list. In the research, when mistake types were analyzed, children are made assimilation between consonants or consonants and vowels. For example; instead of "Pümeş", using "Bümeş", instead of "Jopus", using "Copus". Especially mistakes in disyllabic words may stem from children using assimilation processes similar to children with typical development. In a study by Acarlar and Ege (1996), it is stated that as age increased, phonological process usage is decreased, however, assimilation process usage continues after age 3. From the results taken from AAT standardization sample developed by Ege, Acarlar and Turan (2004) it is stated that in Turkish, fluents such as /l/ and /r/ are late acquired phonemes and their correct production depends on sequential phonemes and word length (Ege, 2010). It is thought that as some nonwords developed from real words in the study are not suitable to Turkish syllable structure (for example; Silö), this is effective in disyllabic words' correct repetition mean being lower than 3 or 4 syllable words' mean. Moreover, it may be suggested that as disyllabic words' correct repetition means are lower than 3 and 4 syllable words, a revising of the word list with another study is needed. In future studies, evaluations with a list with more words which are suitable to Turkish syllable structure will contribute to literature.

In children with typical development and specific language impairments, it is stated that working memory and vocabulary have a positive relationship, and working memory skills affect vocabulary development and vocabulary knowledge may support current memory performance (Archibald & Gathercole, 2007; Gathercole & Adams, 1993; Montgomery, 2002). In this study, it is thought that accuracy percentages of nonword repetitions may be affected vocabulary variety, and may have contributed in the difference in accuracy means between age groups.

As the study group of the research is limited to children with typical development, a comment cannot be made on using NWR list to discriminate children with language impairments. In the literature, especially in determining the specific language impairment, nonword repetition is stated to provide a sensitive measurement and children with language impairments has a lower performance than children with typical development in nonword repetition (Archibald & Gathercole, 2006;

Dollaghan & Campbell, 1998; Gathercole & Pickering, 2001; Hick, Botting, & Conti-Ramsden, 2005; Montgomery, 2003; 2004). In this study, as the relationship of NWR with age is high, it is thought that it has the potential to differentiate children with typical language development and children with language impairment, and it can be used as a supportive procedure to other evaluation processes especially in assessing verbal working memory of children between the ages 4 and 6. The findings from the study, allows the comparison NWR list's total correctly produced phonemes number (CPPN) and correctly produced phonemes number relative to the syllable number with the averages of the children that are in the study group of the research. Therefore, it is thought that the study, if conducted in comparison groups of differing language skills, will provide important contributions in the field of early diagnosis of language impairments.

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