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Sentence Imitation Task to Understand Phonological Representations in Preschool Children

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ABSTRACT

Background: The term phonological representation is widely used to describe the storage of phonological information about words in long-term memory (Sutherland & Gillon, 2005). The organization of sounds within a word plays an important role, along with the sounds included in defining the structure of a word (Valleman, 2002). Linguistic abilities of children with language impairment, as well as typically developing children, can be found using sentence imitation tasks (Botting & Faragher, 2001, Ebert, 2014; Priya, 2017)
Method: 240 typically developing Malayalam speaking children in the age range of 3-5 years were selected from several preschools in Kerala. They were further subdivided into four age groups separated by six months (≥3;0-≤3;6; 3;6-≤4;0; 4;0-≤4;6 and 4;6-≤5;0years). There were 60 participants in each group (30 males and 30 females). The participants were administered, a sentence imitation test in Malayalam, developed and validated by the authors. 20 sentences in Malayalam with a mean length of utterance ranging from 4 to 7 morphemes were used as target sentences.
Results: Results revealed a significant effect of age on the total scores obtained on syllable shapes and word shapes. Except for bisyllables, the total number of words produced by the participants increased with age. Likewise, the total number of syllables and the number of syllable shapes produced increased with age, except for Vowels and Vowel Consonants.
Conclusion: Poorly developed phonological representations make it difficult for young children to imitate word or syllable shapes in sentences. Compared to spontaneous speech tasks, administering sentence imitation tasks requires lesser time and hence can be included in the assessment of speech sound disorders in young children. Hence, phonotactics in sentence imitation has an important role in understanding phonological representations in young children. This study aimed to investigate the phonological representations in Malayalam-speaking preschool children aged 3.6 to 5.0 years through a sentence imitation task.

Keywords: Word shapes, syllable shapes, sentence imitation, phonotactics, phonological representations

1. INTRODUCTION

The process of encoding phonological information into long-term memory is known as 'phonological representation' (Sutherland & Gillon, 2005). In addition to the individual sounds that make up a word, the way these sounds are organized within the word plays a crucial role in communication (Valleman, 2002). This organizational structure, known as the phonotactic level, refers to the arrangement of the word's constituent parts. Research has shown that studying

phonotactics provides a deeper understanding of phonological characteristics compared to focusing solely on individual sounds (Valleman, 2002).

Several researchers have studied the phonotactic patterns in different Indian languages during developmental years, such as Telugu (Neethipriya, 2007), Kannada (Priya, 2016), and Hindi (Shilaja & Manjula, 2011). In a related study, Priya and Manjula (2013) explored the phonotactic abilities of Kannada-speaking children aged 3 to 5 years, analyzing word shapes and syllable shapes. The research involved a sentence imitation task with typically developing children within this age range. The findings revealed that children aged ≥3;0 - <3;6 years demonstrated significant differences compared to other age groups. Specifically, children in the youngest age group tended to simplify tri- and polysyllabic structures into bisyllables. The impact of age was notable in word shapes such as Consonant Vowel (CV) and Consonant Vowel Consonant (CVC), while it was not as pronounced in Vowel Consonant (VC) and Vowel (V) shapes. Interestingly, no significant differences were found between children aged ≥3;6 - <4;0 years and ≥4;0 - <4;6 years, or between children aged ≥4;0 - <4;6 years and ≥4;6 - <5;0 years. However, notable distinctions were observed between children aged ≥3;6 - <4;0 years and ≥4;6 - <5;0 years concerning CV but not CVC structures.

The assessment of connected speech samples to understand children's phonological knowledge is widely acknowledged by researchers. Instead of using single-word utterances, sentence imitation tasks are a useful technique for comprehending phonological concepts. Sentence imitation tasks have been employed to study the linguistic abilities of both children with language impairments and typically developing children. Through verbal imitation tasks, researchers have concluded that, in children with Specific Language Impairment (SLI), linguistic representations and storage capacity cannot be easily separated. Furthermore, they have found that children's ability to imitate sentences depends more on their understanding of morphosyntax and lexical phonology than on semantics or prosody.

Investigating how phonological representations are processed is critical, as it provides evidence of an individual's abilities in both oral and written communication. The role of sentence imitation in comprehending phonological representations has garnered significant attention. However, most research has focused on articulatory or phonetic deficits. Analyzing word and syllable forms in sentence imitation across the developmental years of children can shed light on the accessibility of phonological representations in children. A child's phonological representations may be underdeveloped, preventing them from producing complex syllables or word forms. Such traits may not be evident in spontaneous speech tasks. Utilizing phrase imitation tasks can facilitate the analysis of repeated utterances in terms of the phonotactic structures present."

Research indicates that several developmental disorders, such as dyslexia, speech sound disorder, and specific language impairment, are associated with deficient phonological representations. Therefore, the main objective of this study is to understand phonological representations in Malayalam-speaking preschool children by comparing and analyzing word shapes and syllable shapes. Malayalam is a language spoken in the Indian state Kerala. It has about 52 phonemes including vowels, consonants and diphthongs. The study aims to identify the role of word and syllable forms in sentence imitation among typically developing preschool-aged children (3-5 years) to gain a deeper insight into their fundamental phonological representations. Additionally, the study seeks to examine and evaluate the impact of age on word and syllable forms during a sentence repetition task among typically developing Malayalam native speakers aged 3-5 years.

2. METHOD

2.1. Participants

A total of 240 normally developing Malayalam-speaking children aged 3-5 years were selected from various preschools in Kerala. They were further divided into four age groups, each separated by six months (3;0–3;6; 3;6-4;0; 4;0–4;6; and 4;6–5;0 years). Each group consisted of 60 children (30 males and 30 females). Individuals with a background of delayed development, sensory issues, and behavioral or neurological problems were not included in the study. The exclusion criteria were applied through the administration of the WHO Ten Questions Disability Screening Checklist (Singhi, Kumar, Malhi & Kumar, 2007). An informed written consent was obtained from the caregivers of all participants. The research methodology adhered to the ethical guidelines established by the ethical committee for bio-behavioral research at All India Institute of Speech and Hearing, Mysuru.

2.2. Test Stimuli

The researcher developed 40 sentences using vocabulary typically spoken by children aged 3 to 5 years. The sentences had a mean length of utterance ranging from 4 to 7 morphemes. Five native adult speakers (Speech language pathologists with a minimum of 5 years clinical experience) evaluated the sentences for their familiarity and appropriateness for children aged 3 to 5 years. A two-point rating scale was used for appropriateness, where 1 indicated the sentences were appropriate, and 2 indicated they were inappropriate. For familiarity, a three-point rating scale was used, with 1 representing the most familiar, 2 for familiar, and 3 for not familiar. The final selection of stimuli comprised sentences that were considered both appropriate and familiar. Twenty sentences were chosen as the final stimuli.

The shortlisted sentences were audio recorded by a typical native adult female speaker of Malayalam in a sound-treated room. The stimuli were recorded using Avid Pro Tools software with the AKG P420 microphone. The adult speaker recorded each sentence three times in a random order and in a neutral tone using a unidirectional microphone placed at a distance of 6 inches from the mouth. The recording was digitized at a sampling rate of 44,100 Hz. The recorded sentences were played to the same 5 native adult speakers of Malayalam, and the best recording was selected from the three tokens. Sentences that were selected by three or more out of five listeners as the best from the three tokens were chosen as the target stimulus.

Five native adult speakers listened to the recorded sentences and were asked to choose the best recording out of three samples for each sentence. The sentences that received three or more votes as the best recording were selected as the final target stimuli.

The researcher analyzed the 20 selected target stimuli to assess their syllable and word structure. The final 20 target stimuli were examined for syllable and word shapes. They consisted of 53 words with 22 bisyllables, 18 trisyllables, and 13 polysyllables (four syllables = four, five syllables = three, and six syllables = three). Additionally, the 20 sentences comprised 161 syllables with the syllable shape distribution as, 12 Vowels (V), 116 Consonant Vowel (CV), 8 Vowel Consonant (VC), and 25 Consonant Vowel Consonant (CVC) patterns.

The experiment took place in a home environment within a calm and noise-free room. Participants were provided with auditory stimuli through headphones connected to an HP laptop. Their responses were recorded using a SONY digital voice recorder. The children were instructed to repeat the sentences as they were presented. Additionally, before the actual test, two practice trials were conducted to familiarize the children with the process.

2.3 Administration

The test was conducted in a home setting in a quiet room. The audio recorded stimuli were presented to the participants through headphones from an HP laptop by means of PRAAT software. A digital voice recorder

was used to record the participants' responses. Children were instructed to repeat the sentences one by one as they were presented. Before the test was given, there were two practise trials.

2.4. Data Analysis

The utterances were counted for the number of words produced by each participant. The sentences were divided into various word shapes- bisyllables, trisyllables, four syllables, five syllables and six syllables, and were analysed for various syllable shapes such as VC, CV, V and CVC.

Inter-judge reliability was checked by having three qualified speech-language pathologists analyse the repeated samples of 10% of children in each age group. A reliability analysis was carried out and good inter-judge reliability (Cronbach's alpha = 0.9) was obtained for word and syllable shapes.

3.RESULTS

Kolmogorov-Smirnov test of normality ($p > 0.05$) revealed normal distribution for the data of word and syllable shapes in all groups. However parametric and non-parametric analysis was done as non-normal distribution ($p < 0.05$) was identified for a few word and syllable shapes. Mean, median, and standard deviation were performed on the total scores of participants, both within individual age groups and across all age groups for various word shapes and syllable shapes and is shown in the Table 1 and 2

Table 1. Mean, Standard Deviation (SD) and Median for various word shapes across age groups

Age (in years)								
Word Shapes	**(>3; - ≤3;6)**		**(>3;6-≤4;0)**		**(>4;0-≤4;6)**		**(>4; -≤5;0)**	
	Mean(SD)	**Median**	**Mean(SD)**	**Median**	**Mean(SD)**	**Median**	**Mean(SD)**	**Median**
Two syllables	28.72(3.09)	29	28.07(2.44)	29	24.52(1.91)	25	24.3(1.6)	24
Three syllables	7.9(1.88)	8	10.12(2.84)	9	13.13(1.67)	13	13.53(1.67)	14
Four syllables	2.13(1.67)	2	4.22(1.33)	4	5.1(1.36)	5	5.55(1.23)	6
Five syllables	1.97(0.69)	2	2.67(0.8)	3	3.15(0.71)	3	3.57(1.09)	4
Six syllables	0.92(0.67)	1	1.42(0.96)	2	1.55(0.83)	2	2.15(0.73)	2
Total	28.72(3.09)	3	28.07(2.44)	4	24.52(1.91)	5	24.3(1.6)	6

Table 2. Mean, Standard Deviation (SD) and Median for various syllable shapes across age groups

Age (in years)								
Syllable Shapes	**(>3; - ≤3;6)**		**(>3;6-≤4;0)**		**(>4;0-≤4;6)**		**(>4; -≤5;0)**	
	Mean (SD)	**Median**	**Mean (SD)**	**Median**	**Mean (SD)**	**Median**	**Mean (SD)**	**Median**
V	9.17(2.08)	9	8.58(2.08)	8	8.72(2.07)	9.00	8.87(2.21)	9.00
CV	70.58(9.41)	69	78.63(9.09)	78	93.93(6.41)	95	101.55(5.9)	101
VC	10.87(1.88)	10	5.48(1.31)	6	5.77(1.25)	6	6.35(1.29)	6
CVC	15.3(2.28)	15	18.95(3.18)	19	21.78(2.34)	21	23.27(2.04)	23
Total	9.17(2.08)	13	8.58(2.08)	12	8.72(2.07)	15	8.87(2.21)	16

3.1. Influence of age on word and syllable shape

Statistical methods were utilized to analyze the collected data, encompassing both descriptive and inferential approaches. The outcomes underscored a noteworthy correlation between age and the total scores achieved in syllable shapes and word shapes. With the exception of bisyllables, the number of words produced by participants increased as their age advanced. Likewise, the total number of syllables and the number of syllable shapes produced increased with age, except for V and VC

Regarding word shapes, age had a significant influence on trisyllables, four syllables, five syllables, and six syllables, but not on bisyllables. The Kruskal-Wallis H test indicated that age significantly impacted the use of trisyllables, four syllables, five syllables, and six syllables, but not bisyllables. The Mann-Whitney U test, which facilitated pairwise comparisons, revealed distinctions between children in the youngest age group (≥3;0-<3;6 years) and

those aged ≥3;6-<4;0 years, ≥4;0-<4;6 years, and ≥4;6-<5;0 years for all word shapes. Conversely, no significant differences were observed between children aged ≥3;6-<4;0 years and those aged ≥4;0-<4;6 years, as well as between those aged ≥4;0-<4;6 years and ≥4;6-<5;0 years.

The study revealed that younger children tend to simplify their speech by using bisyllabic utterances instead of trisyllabic or polysyllabic ones, likely because bisyllables are easier for them to produce. This suggests that younger children might struggle with accessing complex phonological representations, which makes retaining the target sentence's word shapes challenging.

Regarding syllable shapes, the influence of age was significant for syllable structures CV and CVC, but not for V and VC. Mann-Whitney U test for pairwise comparisons indicated that children aged >3;0-≤3;6 were significantly different from the other three age groups in terms of CV and CVC syllable shapes. However, no significant differences were observed among children aged ≥3;6-<4;0 years, ≥4;0-<4;6 years, and ≥4;6-<5;0 years regarding syllable shapes. Therefore, it was concluded that children tend to grasp most word shapes and syllable shapes after reaching the age of 3;6 years, potentially due to improved access to phonological representations as they grow older.

Furthermore, children aged ≥3;0-<3;6 years were significantly distinct from all other age groups in the study, both in terms of word shapes and syllable shapes. This suggests a developmental trend in the phonotactic skills of children. These findings align with a similar study by Priya (2017) involving Kannada-speaking children aged 3-5 years.

In summary, the study suggests that younger children's phonological development involves simplification of speech structures, while older children show a greater ability to handle more complex word and syllable shapes. These results have implications for understanding the developmental trajectory of phonological skills in children.

DISCUSSIONS

Insufficiently developed phonological representations can create challenges for young children when attempting to replicate word or syllable shapes within sentences. The study's findings corroborate existing literature that underscores the significance of sentence imitation tasks for discerning phonological representations in young children. Analyzing word and syllable shapes in imitated sentences offers insights into the phonological representations present in preschool-aged children. Given the correlation between underdeveloped phonological representations and developmental disorders, integrating sentence imitation tasks into assessment and treatment protocols for children can be advantageous for their rehabilitation.

In comparison to tasks involving spontaneous speech, the administration of sentence imitation tasks requires less time, making them suitable for evaluating speech sound disorders in young children. Consequently, the role of phonotactics in sentence imitation becomes pivotal in comprehending phonological representations among the younger demographic. This approach holds promise in shedding light on the intricate phonological development of young children and its implications for clinical practice.

Declaration by Authors

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