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Phonological Process in Typical Children Speaking Tulu

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Abstract

The present study aimed to analyse the occurrence and developmental progression of phonological processes in typically developing Tulu-speaking children aged 3.0 to 6.0 years. A total of 45 children were selected from preschools and primary schools in Coastal Karnataka. Speech samples were recorded during natural conversations and analysed for phonological simplification patterns. The results showed that younger children (3.0–3.11 years) frequently exhibited processes such as reduplication, stopping, fronting, cluster reduction, and final consonant deletion. These processes gradually declined with age and were largely absent by 5.0–5.11 years, except for cluster reduction which persisted in some cases. The findings were statistically significant and aligned with previous studies in Indian languages, emphasizing the importance of age-related phonological milestones. This study underlines the need for developing normative data in Tulu to support accurate clinical evaluation of speech development.

Keywords: Phonological processes, Tulu language, speech development, age-related trends, cluster reduction, Indian children, speech-language assessment.

Introduction

Phonology is a branch of linguistics that focuses on how speech sounds are structured and function within different languages (Norquist, 2019). Spoken language may seem like a

continuous stream of sound; the human brain naturally separates it into distinct units called phonemes. Each language follows its own rules for combining and using these sounds. As children grow, they gradually learn to understand and use these sounds accurately through a natural process of speech development.

Speech development in children frequently exhibits phonological processes and predictable patterns of sound simplification that facilitate word production. For example, a child may say "pane" for "plane" (cluster reduction) or "tat" for "cat" (fronting). These patterns are viewed as a normal part of speech acquisition and reflect strategies children use to manage the articulatory and cognitive demands of spoken language (Ingram, 1989; Dodd, Hua, Crosbie, Holm & Ozanne ,2003).

Phonological processes usually follow predictable patterns and tend to disappear as the child matures and gains better control over speech. However, if they continue beyond the expected age, they may indicate a phonological disorder, which is a type of speech sound disorder (SSD). Children with such difficulties may be hard to understand, and their speech may affect their ability to communicate clearly (Shriberg, Tomblin & McSweeny, 1994; Dodd, Hua, Crosbie, Holm & Ozanne, 2003).

Speech sound disorders are common in childhood and can have an impact on communication, learning and social interaction (Harrison, 2009). Children with phonological disorders may have challenges in hearing, processing or organizing sounds in the correct way. Unlike articulation disorders, which usually involve a few isolated sound errors, phonological disorders affect broader patterns across speech (International Expert Panel on Multilingual Children's Speech, 2012).

Phonological processes are observed in many languages, their types and the age by which they are eliminated can vary widely. This is due to differences in each language's sound system, syllable structures and phonological rules (Bernhardt & Stemberger, 1998). Therefore, it is essential to study phonological development in the context of the specific language a child speaks.

Tulu, a South Dravidian language spoken by over two million people in the coastal regions of Karnataka and northern Kerala, has a rich oral tradition and a distinct phonological system including sounds such as retroflexes and aspirated consonants. Despite its large number of

speakers, very little scientific research has explored how phonological development unfolds in Tulu-speaking children.

A substantial body of research has described as Phonological process pattern in children across various linguistic backgrounds as in Kannada (Bhat,1983), Marathi (Desai, 1986) and Malayalam-English bilinguals (Razak,2015) but little is known about how these patterns manifest in the Tulu language. The present study offers insight into how these processes occur within the linguistic context and helps to distinguish typical developmental patterns shaped by language specific influences.

Review of Literature

Phonological processes are systematic, rule-governed simplifications that young children apply to adult speech forms as they develop their speech sound systems. These processes are not random errors but reflect natural strategies that children use to manage the complex phonological demands of adult language while their motor planning, articulatory precision, and auditory discrimination skills are still maturing (Ingram, 1989).

Phonological processes do not indicate a disorder; instead, their presence during early childhood is a hallmark of typical speech development. As children grow, their use of these processes typically diminishes, giving way to more accurate, adult-like speech patterns (Shriberg & Kent, 2003).

The study of phonological processes provides important insights into a child's underlying phonological system and the typical developmental trajectory of speech acquisition. It also serves as a critical diagnostic tool in distinguishing between normal developmental variations and speech sound disorders

Phonological processes can be broadly categorized into the following types:

1. Substitution Processes

These involve replacing one class of sounds with another that is easier to articulate. Examples include:

a) **Fronting**: Substituting a sound produced at the back of the mouth with one produced at the front.
   Example: "tat" for "cat"

Example: “tori” for “kori”

b) **Stopping**: Replacing a fricative or affricate with a stop consonant.
Example: “tun” for “sun”, “do” for “zoo”

Example: “tale” for “shale”

c) **Gliding**: Replacing liquids (/l/, /r/) with glides (/w/, /j/).
Example: “wabbit” for “rabbit”

Example: “maypu” for “malpu”

d) **Deaffrication**: Replacing an affricate (/ʧ/, /ʤ/) with a fricative or stop.
Example: “ship” for “chip”

Example: “shikamma” for “chickamma”

2. Omission or Deletion Processes

These involve omitting one or more sounds, often to simplify syllable structure:

a) **Final Consonant Deletion**: Omission of the final consonant in a word.
Example: “ca” for “cat”
Example: “bapi” for “barpini”

b) **Initial Consonant Deletion** (less typical): Omission of the initial consonant.
Example: “at” for “cat”

Example: “an” for “yan”

c) **Syllable Deletion (Weak Syllable Deletion)**: Omission of an unstressed syllable.
Example: “nana” for “banana”

Example: “mapuṇnu” for “malpuṇnu”

3. Assimilation Processes

In these processes, one sound becomes similar to another sound in the word due to the influence of surrounding sounds:

a) **Velar Assimilation**: “gog” for “dog”, “tura” for “dura”

b) **Labial Assimilation**: “bub” for “bus”, “babe” for “bale”

c) **Nasal Assimilation**: “mom” for “mop”, “mobe” for “moḍe”

Assimilation may be progressive, regressive, or reciprocal, depending on the position and direction of influence.

4. Syllable Structure Processes

These affect the overall shape or structure of the syllable:

a) **Cluster Reduction**: Simplifying a consonant cluster into a single consonant.
Example: “pane” for “plane”
Example: "kula" for “kudla”

b) **Reduplication**: Repeating a syllable in the word.
Example: “wawa” for “water”

Example: “nene” for “neer”

c) **Epenthesis**: Inserting an extra sound, typically a vowel, within a word.
Example: “puhlay” for “play”

Example: “diriishti” for “dirishti”

5. Other Processes

a) Metathesis: Reversing the order of sounds.
Example: “pasghetti” for “spaghetti”
Example: “loko” for “kole”

b) Coalescence: Two sounds merge to form one.
Example: “foon” for “spoon” (fusion of /s/ and /p/ into /f/)

Example: “male” for “bale”

Children undergo a critical period in phonological development between the ages of 3 and 6 where they gradually suppress simplification patterns known as phonological processes. These processes are a natural part of early speech, helping children simplify complex adult sounds until their articulatory precision improves.

For instance, fronting the replacement of sounds made at the back of the mouth (like /k/ and /g/) with front sounds (such as /t/ and /d/) usually fades by about 3.5 years of age. Final

consonant deletion, which involves omitting the last consonant in words (e.g., “ca” for “cat”), is typically resolved between ages 3 and 4.

More complex processes like cluster reduction, where one consonant is omitted from a group of consonants (e.g., “pane” for “plane”), tend to last longer but are generally suppressed by ages 5 to 6. These predictable stages of phonological process suppression provide important developmental milestones, aiding clinicians and researchers in distinguishing typical speech development from possible speech delays or disorders.

Western Studies

Hodson and Paden (1981) explored the phonological processes most commonly associated with unintelligible speech in children, such as cluster reduction, syllable deletion, and stopping. Their study highlighted how these patterns significantly impact a child's ability to be understood and stressed the importance of prioritizing them in intervention. This research played a key role in shaping the Cycles Approach, a widely adopted method in speech-language therapy aimed at gradually improving speech intelligibility.

Stoel-Gammon and Dunn (1985) did a foundational study that detailed typical and disordered phonological development in young children. Their work identified common phonological processes such as stopping, fronting, and cluster reduction, and established typical ages at which these processes are usually suppressed. This study remains influential in providing benchmarks for normal speech sound development and aiding clinicians in distinguishing between typical variation and speech disorders.

Grunwell (1987) provided a comprehensive clinical framework for assessing and classifying phonological processes and speech sound disorders in children. His work systematically categorized common error patterns such as substitution, assimilation, and syllable structure processes, offering clear criteria for identifying phonological impairments. Grunwell emphasized the importance of understanding both the nature and function of these processes within a child’s speech system, which has greatly influenced diagnostic and intervention approaches in speech pathology. His frameworks remain widely used by clinicians to guide assessment, track progress, and tailor treatment plans for children with phonological difficulties.

Roberts, Burchinal and Footo (1990) conducted a longitudinal study examining the decline of phonological processes in typically developing children aged 2½ to 8 years. Their findings showed that most common processes such as final consonant deletion, stopping, and fronting significantly declined by age 4, while others like gliding and cluster reduction persisted slightly longer. The study provided valuable normative data, highlighting typical developmental timelines and helping to differentiate between normal and disordered phonological development.

Dodd, Holm, Hua and Crosbie (2003) conducted a comprehensive normative study analysing speech samples from 684 British English-speaking children aged 3 to 6 years. The study provided extensive data on the typical ages at which individual speech sounds are acquired and the corresponding suppression of common phonological error patterns such as final consonant deletion, cluster reduction, and stopping. Their findings offer valuable benchmarks for understanding typical phonological development and serve as critical reference points for clinicians assessing speech sound disorders. This large-scale study has contributed significantly to the establishment of age-related norms that inform both diagnosis and intervention strategies in paediatric speech pathology.

Gildersleeve-Neumann, Kester, Davis and Peña (2008) investigated the speech sound development of preschool-aged children growing up in bilingual English-Spanish environments. Their study revealed that bilingual children exhibited distinct patterns of phonological development compared to their monolingual peers. Specifically, these children showed variations in the acquisition of consonant clusters and phoneme accuracy, reflecting the influence of exposure to two languages on their phonological systems. The findings underscore the need for clinicians to consider bilingual language backgrounds when assessing phonological development and tailoring intervention strategies, as bilingualism can affect typical developmental timelines and error patterns.

Leenke van Haaften, Sanne Diepeveen, Lenie van den Engel-Hoek, Bert de Swart and Ben Maassen (2020) cross-sectional study involving Dutch-speaking children aged 2 to 7 years to establish normative data on the suppression of phonological processes and milestones in speech sound development. The study identified typical ages at which common phonological error patterns, such as cluster reduction and final consonant deletion, naturally decline in this population. Their findings contribute important cross-linguistic insights into phonological

development, emphasizing both universal and language-specific patterns. This research aids clinicians in differentiating between typical phonological development and speech sound disorders by providing culturally relevant benchmarks.

Fernández-Otoya, Raposo-Rivas, and Halabi-Echeverry (2022) systematically reviewed the use of technology-based interventions to enhance phonological awareness in preschool children. Their analysis highlighted innovative approaches, including interactive software and digital games, that effectively support the development of phonological skills such as sound discrimination, blending, and segmentation. The review emphasized that technology can provide engaging and personalized learning experiences, making it a promising tool for early intervention aimed at reducing phonological errors and promoting speech sound development. This study underscores the growing role of digital resources in advancing phonological therapy and early childhood education.

Tambyraja, Farquharson, and Justice (2023) investigated phonological processing skills, including phonological awareness and rapid automatized naming, in young children to establish benchmarks for typical development and identify markers of speech and language disorders. Their study demonstrated that strong phonological processing abilities are closely linked to successful speech sound acquisition and early literacy skills. The findings provide valuable normative data that can help clinicians distinguish between typical phonological development and children at risk for phonological disorders, informing timely and targeted intervention strategies.

Indian Studies

Bhat (1983) in her earliest studies on phonological development in Kannada-speaking children. The research detailed common phonological simplifications, such as cluster reduction and final consonant deletion, and documented the typical ages at which these processes are suppressed. This pioneering work provided foundational normative data for phonological development in a South Indian language, serving as a key reference for clinicians and researchers working with Kannada-speaking populations.

Desai (1986) investigated phonological process patterns in Marathi-speaking children, identifying common simplifications such as stopping and cluster reduction. The study highlighted the importance of developing language-specific normative data to accurately assess and treat phonological disorders. Desai's work underscored that phonological development

varies across languages, reinforcing the need for culturally and linguistically appropriate clinical assessment tools.

Gupta and Sharma (1990) studied phonological development in Hindi-speaking preschool children, documenting common processes such as final consonant deletion and fronting. Their research provided early normative benchmarks for typical speech sound acquisition in North Indian languages, contributing valuable data to support accurate diagnosis and intervention for phonological disorders in Hindi-speaking children.

Kulkarni (1992) examined speech sound acquisition and phonological error patterns in Gujarati-speaking children. The study provided detailed timelines for the suppression of common phonological processes, such as cluster reduction and stopping, and discussed their clinical implications for speech therapy. This work contributed valuable language-specific data essential for assessing and treating phonological disorders in Gujarati-speaking populations.

Iyer and Rao (1995) analysed phonological processes in Tamil-speaking children, focusing on syllable structure processes and sound substitutions. Their study contributed important normative data on the typical ages of suppression for various phonological processes in Tamil, providing a valuable resource for clinicians assessing speech development and disorders in this linguistic group.

Reddy and Nair (2014) examined phonological processes in Malayalam-speaking children aged 3 to 6 years. Their study identified final consonant deletion and fronting as the most common phonological processes and documented the typical ages at which these processes are suppressed. The findings provide essential normative data that aid clinicians in diagnosing and planning intervention for speech sound disorders in Malayalam-speaking children.

Bailoor, Rai, and Krishnan (2015) investigated the development of phonological processes in typically developing 3- to 4-year-old bilingual children in India. The study focused on Kannada-English bilinguals and identified 14 phonological processes, including fronting, cluster reduction, and final consonant deletion. The researchers found that bilingual children exhibited fewer phonological processes compared to monolingual peers, suggesting that bilingualism may influence the suppression of these processes. This study provides valuable insights into the phonological development of bilingual children in the Indian context, highlighting the need for language-specific norms in speech-language assessment and intervention.

Patil and Kulkarni (2016) studied phonological development of Marathi-speaking children aged 2 to 5 years. The study identified common phonological processes including gliding, stopping, and cluster reduction, with most processes typically suppressed by age 5. This research contributed valuable normative data crucial for clinical assessment and intervention in Marathi-speaking populations.

Sundaresan (2017) investigated phonological process patterns in typically developing Tamil-speaking preschool children aged 3 to 5 years. The study identified common processes such as syllable reduction and stopping, noting that these are generally suppressed by age 5. This research provided important normative data to support clinical assessment and intervention for Tamil-speaking children with speech sound disorders.

Kumar and Verma (2019) focused on phonological acquisition in Hindi-English bilingual children aged 3 to 6 years. Their study revealed that bilingual children exhibited phonological process patterns influenced by both languages, which sometimes led to delays in the suppression of certain processes compared to monolingual peers. These findings highlight the complexity of bilingual phonological development and underscore the importance of considering both languages when assessing speech sound development in bilingual children.

Bailoor, Rai, and Krishnan (2020) conducted a study on Kannada–English bilingual children aged 3 to 4 years, documenting 14 phonological processes, including fronting, cluster reduction, and final consonant deletion. The study found that while these processes were common in early bilingual speech, many were less frequent than in monolingual peers, indicating that bilingualism may accelerate phonological development among typically developing children. This research aligns well with the patterns observed in the present study and highlights the influence of bilingual exposure on phonological process suppression.

Chaudhari and Deshpande (2020) assessed phonological processes in Gujarati-speaking children aged 3 to 7 years. Their study detailed the prevalence and suppression timelines of common phonological errors such as syllable deletion and stopping. The research provided important normative developmental data to support accurate clinical assessment and intervention for speech sound disorders in Gujarati-speaking populations.

Dhinakaran and Karthikeyan (2021) analysed phonological processes in Tamil-speaking children with cochlear implants, identifying 26 different processes. Depalatalization emerged as the most frequent phonological error. The study highlighted the importance of specialized,

targeted speech therapy to address the unique phonological development challenges faced by children with hearing impairments using cochlear implants.

Investigating phonological processes in typical Tulu-speaking children is vital both theoretically and clinically. Since language acquisition is influenced by the phonetic and phonological characteristics of a child's native language, developmental patterns in Tulu-speaking children may differ substantially from those observed in languages with different sound inventories and phonological rules (Kale, 2007).

Given India's linguistic diversity and the scarcity of research on minority languages like Tulu, this study aims to address a significant gap by providing detailed documentation of phonological development in Tulu children. The findings will support the creation of culturally sensitive assessment tools and intervention strategies, thereby improve clinical practice and contribute to the preservation and vitality of the Tulu language and its cultural heritage.

Currently, there is a notable scarcity of research on phonological development in Tulu-speaking children. Most studies on phonological processes have focused on widely spoken languages such as English, Hindi, Kannada, and Tamil, leaving minority languages like Tulu largely unexplored (Bhat, 2010; Kale, 2007).

Clinicians will be equipped with normative data specific to Tulu, enabling more accurate differentiation between typical developmental variations and speech sound disorders, which reduces the risk of misdiagnosis and promotes timely, appropriate interventions (Bernstein & Ratner, 2013). Educators involved in early childhood and language development programs can use these findings to better support language acquisition in Tulu-speaking children through tailored instructional strategies that align with natural developmental patterns (McLeod & Baker, 2017).

For researchers, this study fills a critical gap in literature on underrepresented languages, providing a foundation for comparative studies and advancing knowledge of linguistic diversity in phonological development (Gierut, 1998). Ultimately, the insights gained will facilitate culturally and linguistically informed assessment and intervention approaches, fostering effective communication outcomes and supporting the linguistic heritage of the Tulu community.

By systematically examining phonological processes in Tulu-speaking children, this study not only addresses a critical gap in developmental speech research but also contributes to the advancement of culturally responsive clinical practices. The insights gained will lay the groundwork for developing language-specific assessment tools and interventions, ultimately supporting accurate diagnosis, effective therapy, and the linguistic and cultural preservation of the Tulu-speaking community

Need of the Study

The study focuses on identifying the phonological processes used by typical children speaking Tulu language aged 3 to 6 years, a period for speech and language development. Tulu, a Dravidian language spoken by over a million people in coastal Karnataka and parts of Kerala, remains critically underrepresented in linguistic and clinical research. Despite its rich oral tradition and distinct phonological system, there is a lack of empirical data on how speech develops in Tulu-speaking children. As a result, speech-language pathologists working with this population are often forced to rely on developmental norms from other languages, which may not reflect the specific phonological patterns of Tulu.

The present study was undertaken to bridge that gap. By documenting the types and patterns of phonological processes in young Tulu speakers, the research provides essential language-specific information that can aid in the accurate identification of speech sound disorders.

It also contributes to the broader goal of promoting linguistic diversity in clinical practice by bringing attention to underrepresented languages like Tulu, ensuring they are not only acknowledged, but also accurately understood, valued and supported in both research and clinical decision making.

Methodology

Aim

The aim of the present study was to analyse the phonological processes for spontaneous speech among typical children speaking Tulu

Participants

The study involved 45 typical children aged 3 to 6 years who are native speakers of Tulu. Participants were recruited from [Coastal Karnataka region], where Tulu is widely spoken

For the purpose of developmental comparison, the participants were divided into three age groups with 15 children in each group as follows:

- Group 1: 3.0 to 3.11 years
- Group 2: 4.0 to 4.11 years
- Group 3: 5.0 to 5.11 years

Inclusion Criteria

- Children aged between 3 and 6 years.
- Native Tulu speakers with Tulu as the primary language at home and in daily communication.
- Typical children with no history or diagnosis of speech, language, hearing, cognitive, or neurological impairments.
- Written informed consent obtained from parents or guardians.

Exclusion Criteria

- Non-native or non-primary Tulu speakers.
- Children diagnosed with or suspected of have speech, language, hearing, cognitive, or neurological disorders.
- Children currently undergoing speech or language therapy.

Test Environment

Data collection took place in naturalistic, familiar environments such as the child's home or preschool settings to encourage authentic and comfortable communication. The recording sessions were conducted in quiet rooms with minimal background noise to ensure clarity of the speech samples. A familiar adult (parent, caregiver, or trusted facilitator) engaged the child in casual conversation to elicit spontaneous speech without using any structured tasks, pictures or prompts.

Procedure:

After obtaining written informed consent from parents or guardians, spontaneous speech samples were collected from each child in a familiar and comfortable setting, such as their

home or preschool. This environment helped ensure that the children felt at ease during the recording sessions.

Each child participated in a 5-to-10-minute session, engaging in natural, informal conversations with a familiar adult. All interactions were conducted entirely in Tulu to capture authentic language use.

No structured tasks, prompts or visual aids were used during the sessions. This approach ensured that the speech produced was spontaneous and representative of the children's everyday language.

The conversations were audio recorded using a high-quality digital recorder to capture clear and natural speech. These recordings were then carefully listened to and analysed to identify and document the phonological processes present in the speech of children across the three age groups.

Statistical Analysis

The collected data analysed using IBM SPSS Statistics for Windows, Version 23.0. Quantitative variables were described using mean, standard deviation (SD), and 95% confidence intervals (CI) to summarize central tendency and variability. Group comparisons for quantitative data were performed using Analysis of Variance (ANOVA), followed by the Bonferroni post hoc test to assess pairwise differences where applicable. For categorical variables, the Chi-square test was employed to evaluate associations between variables.

Result and Discussion

The present study aimed to analyze the phonological process in typical children speaking Tulu language. The results obtained are discussed below.

Table 4.1:

Showing Phonological Processes in typical Children Aged 3.0 to 3.11 Years

PHONOLOGICAL PROCESS	3.0 to 3.11 years	
	Count	Row N %
Fronting	15	100.0%
Stopping:	15	100.0%
Gliding:	5	33.3%
Deaffrication	14	93.3%
Final Consonant Deletion	10	66.7%
Initial Consonant Deletion	1	6.7%
Syllable Deletion (Weak Syllable Deletion):	12	80.0%
Velar Assimilation	4	26.7%
Labial Assimilation	3	20.0%
Nasal Assimilation	15	100.0%
Cluster Reduction	15	100.0%
Reduplication:	10	66.7%

From the above table it's clear that fronting, stopping, nasal assimilation and cluster reduction was 100% seen in children. Deaffrication (93.3%) and syllable deletion (80%) were also highly prevalent with Final consonant deletion and reduplication of 66.7%, while gliding was 33.3%. Less frequent processes included velar assimilation (26.7%) and labial assimilation (20%). Initial consonant deletion was rare and occurring in 6.7% children. These findings reflect typical phonological development, where most children still rely on simplification rules to produce words more easily.

Table 4.2:

Showing Phonological Processes in typical Children Aged 4.0 to 4.11 Years

PHONOLOGICAL PROCESS	4.0 to 4.11 years	
	Count	Row N %
Fronting	2	13.3%
Stopping:	15	100.0%
Gliding:	15	100.0%
Deaffrication	2	13.3%
Final Consonant Deletion	0	0.0%
Initial Consonant Deletion	0	0.0%
Syllable Deletion (Weak Syllable Deletion):	3	20.0%
Velar Assimilation	0	0.0%
Labial Assimilation	0	0.0%
Nasal Assimilation	0	0.0%
Cluster Reduction	15	100.0%
Reduplication:	0	0.0%

Table 4.2 shows that, it is clear that stopping, gliding, and cluster reduction was seen in 100% of children. Fronting and deaffrication was seen in 13.3%, and syllable deletion in 20%. Final consonant deletion, initial consonant deletion, velar assimilation, labial assimilation, nasal assimilation and reduplication were not seen (0%). This shows that only a few processes were active at this age.

Table 4.3:

Showing Phonological Processes in typical Children Aged 5 to 5.11 Years

PHONOLOGICAL PROCESS	5.0 to 6.0 years	
	Count	Row N %
Fronting	0	0.0%
Stopping:	2	13.3%
Gliding:	1	6.7%
Deaffrication	2	13.3%
Final Consonant Deletion	0	0.0%
Initial Consonant Deletion	0	0.0%
Syllable Deletion (Weak Syllable Deletion):	1	6.7%
Velar Assimilation	0	0.0%
Labial Assimilation	0	0.0%
Nasal Assimilation	0	0.0%
Cluster Reduction	13	86.7%
Reduplication:	0	0.0%

As per the data in table 4.3, it is clear that most phonological processes had reduced in children showing more mature speech. Cluster reduction was the most common seen in 86.7% of children. Stopping and deaffrication was seen in 13.3% while gliding and syllable deletion was seen in 6.7%. Other processes like fronting, final and initial consonant deletion, assimilation processes and reduplication were not seen (0%).

Table 4.4:

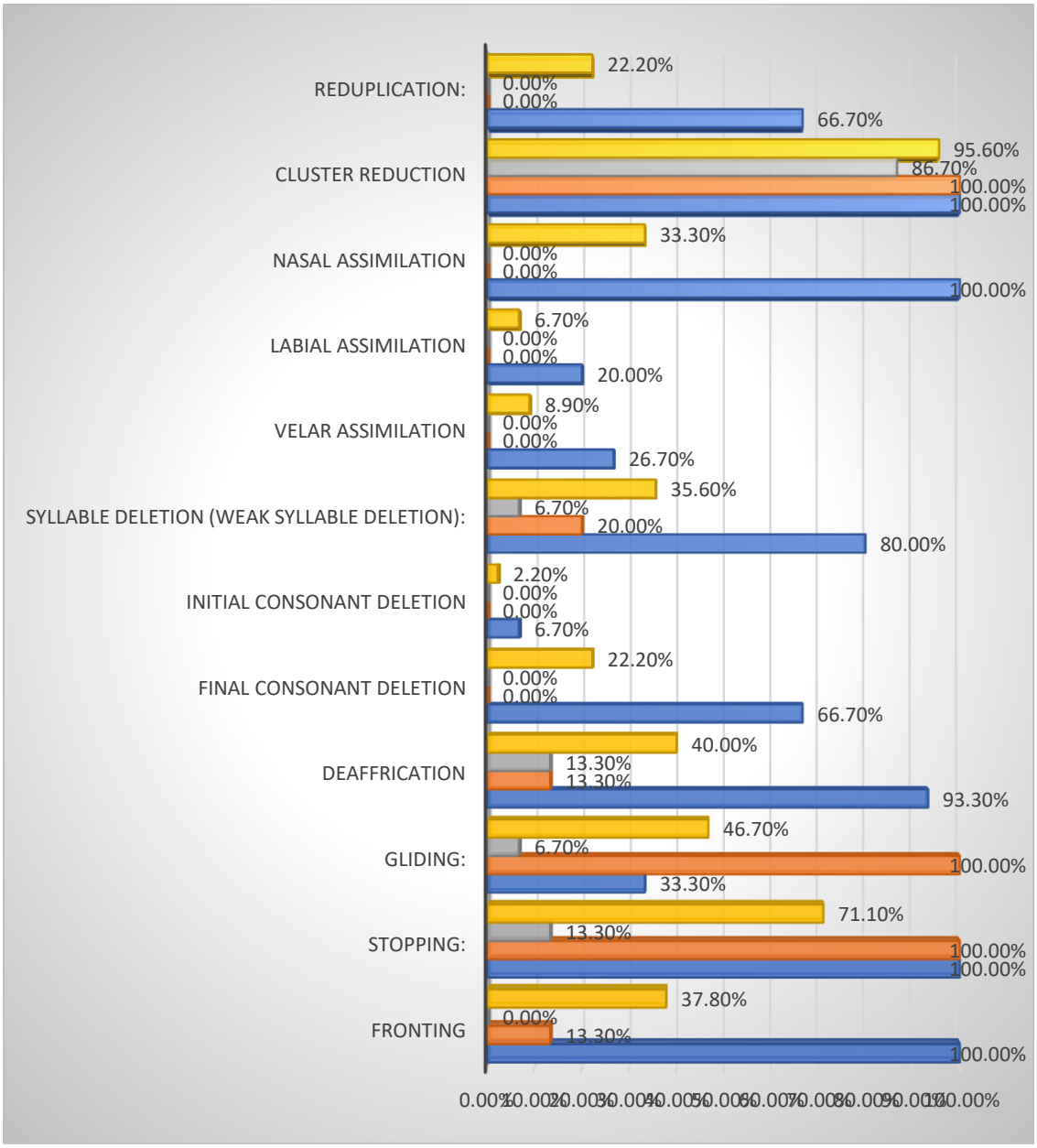
Showing Overall Phonological Processes Observed

PHONOLOGICAL PROCESS	Total	
	Count	Row N %
Fronting	17	37.8%
Stopping:	32	71.1%
Gliding:	21	46.7%
Deaffrication	18	40.0%
Final Consonant Deletion	10	22.2%
Initial Consonant Deletion	1	2.2%
Syllable Deletion (Weak Syllable Deletion):	16	35.6%
Velar Assimilation	4	8.9%
Labial Assimilation	3	6.7%
Nasal Assimilation	15	33.3%
Cluster Reduction	43	95.6%
Reduplication:	10	22.2%

From table 4.4, it is evident that cluster reduction was the most common phonological process, seen in 95.6% of the children. Stopping was also frequent, found in 71.1%, followed by gliding (46.7%), deaffrication (40.0%), and fronting (37.8%). Syllable deletion (35.6%) and nasal assimilation (33.3%) was also present in many children. Final consonant deletion and reduplication was seen in 22.2%, while velar assimilation (8.9%) and labial assimilation (6.7%) were less used. Initial consonant deletion (2.2%) was not used by many children

Graph 4.1:

Showing Phonological Processes in children Across Age Groups



Graph 4.1, shows phonological processes used by children across age groups :

- 3.0 to 3.11 years (blue)
- 4.0 to 4.11 years (orange)
- 5.0 to 5.11 years (grey)
  It also includes the overall total percentage (yellow) for all 45 children.

The graph clearly shows that usage of phonological processes reduces with age. Younger children use more simplification patterns, while older children 5.0-6.0years show fewer errors and attain more adult-like speech. This visual supports the developmental nature of phonological process suppression.

Table 4.5:

Showing Comparison of Phonological Processes in children Across Age Groups

PHONOLOGICAL PROCESS	3.0 to 3.11 vs 4.0 to 4.11		3.0 to 3.11 vs 5.0 to 6.0		4.0 to 4.11 vs 5.0 to 6.0	
Group with Following parameters	p		p		p	
Fronting	0.000	HS	0.000	HS	0.143	NS
Stopping:		NS	0.000	HS	0.000	HS
Gliding:	0.000	HS	0.068	NS	0.000	HS
Deaffrication	0.000	HS	0.000	HS	1.000	NS
Final Consonant Deletion	0.000	HS	0.000	HS		HS
Initial Consonant Deletion	0.309	NS	0.309	NS		HS
Syllable Deletion (Weak Syllable Deletion):	0.001	HS	0.000	HS	0.283	NS
Velar Assimilation	0.032	Sig	0.032	Sig	0.000	HS
Labial Assimilation	0.068	NS	0.068	NS		HS
Nasal Assimilation	0.000	HS	0.000	HS		HS
Cluster Reduction		NS	0.143	NS	0.143	NS
Reduplication:	0.000	HS	0.000	HS		HS

Table 4.5 shows that some phonological processes changed clearly between age groups. Fronting, gliding, stopping, deaffrication, final consonant deletion, syllable deletion, nasal assimilation, reduplication and velar assimilation was used more by younger children and

reduced as they got older. Velar assimilation showed a small but clear change. Some processes like cluster reduction, initial consonant deletion, labial assimilation and gliding (in one comparison) did not change much, and was used by all age groups. Overall, most processes became less as age increased, showing normal speech development.

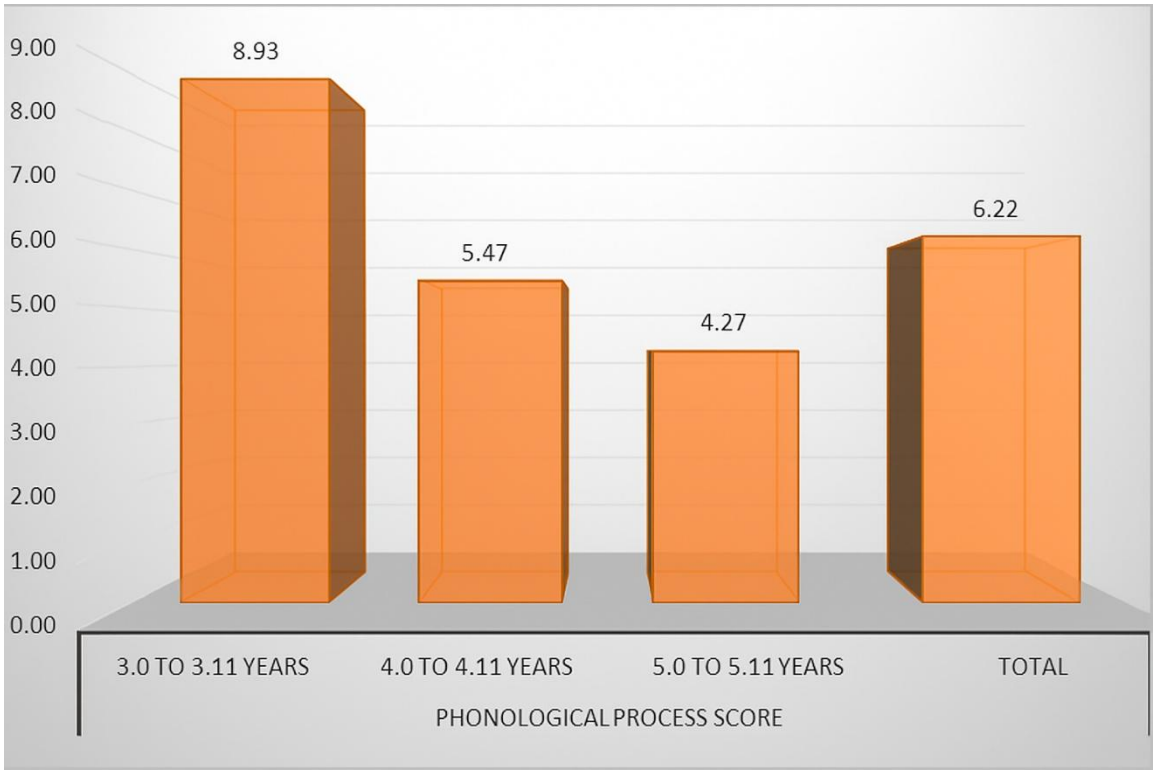
Table 4.6:

Showing Phonological process across age groups

PHONOLOGICAL PROCESS SCORE					
				95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Lower Bound	Upper Bound
3.0 to 3.11 years	15	8.93	1.280	8.22	9.64
4.0 to 4.11 years	15	5.47	0.640	5.11	5.82
5.0 to 6.0 years	15	4.27	0.594	3.94	4.60
Total	45	6.22	2.184	5.57	6.88

Figure 4.2:

Showing Phonological process across age groups



From Table 4.6 and Figure 4.2, it is clear that phonological process scores decreased as age increased. Younger children showed higher scores, which became lower in the middle age group and were the lowest in the oldest group. This shows that as children grow, they use fewer phonological processes, indicating normal speech development**.**

Table 4.7:

Showing comparison of Phonological process patterns across age groups

PHONOLOGICAL PROCESS				
ANOVA Test		Bonferroni Posthoc analysis		
F value	p value	3.0 to 3.11 vs 4.0 to	3.0 to 3.11 vs 5.0 to	4.0 to 4.11 vs 5.0 t0
110.111	0.0001, HS	0.0001, HS	0.0001, HS	0.002, HS

It is clear from the table 4.7 that the use of the phonological process reduced as age increased. Younger children used it the most, and it became less common in the middle and older age

groups. The difference between all age groups was found to be highly significant, showing that this process reduces clearly as children grow older.

Discussion

The performance of children on phonological processes showed a clear age-related pattern with younger children (3.0–3.11 years) demonstrating the highest usage of processes such as fronting, stopping, nasal assimilation and cluster reduction. These simplification patterns notably decreased in the 4.0–4.11 years group and were predominantly absent by 5.0–5.11 years with cluster reduction persisting most consistently. The decline in phonological process scores across age groups was statistically significant reinforcing the maturity of speech with age.

These findings align with typical developmental expectations and resonate with the work of Bailoor, Rai and Krishnan (2020) who studied Kannada–English bilingual children aged 3–4 years. They found frequent use of processes such as fronting, cluster reduction, and final consonant deletion which began to resolve by age four Together, these studies highlight the importance of age-related phonological milestones and inform clinical benchmarks for speech development and intervention.

Summary and Conclusion

Phonological processes are patterns used by typical children to simplify adult speech as their speech and language skills are still developing. These processes are common in early childhood and tend to reduce with age as the child's phonological system matures.

The present study was carried out with the aim of analysing phonological processes in typical children speaking Tulu language. 45 children in the age range of 3.0 to 6.0 years participated in the study and were randomly selected from various preschools and primary schools in the Costal Karnataka regions. Speech samples were recorded using a mobile phone while the children engaged in natural conversation in a quiet and well-lit setting.

The recorded speech samples were then carefully analysed to identify the presence of any phonological processes. The analysis revealed that younger children (3.0–3.11years) exhibited more frequent and varied phonological processes, such as reduplication, stopping, fronting, cluster reduction, and final consonant deletion. As the children grew older, a noticeable decline in the occurrence of these processes was observed, suggesting a clear developmental trend.

These findings are consistent with Indian studies such as Reddy and Nair (2014) in Malayalam-speaking children, Patil and Kulkarni (2016) in Marathi-speaking children, and Sundaresan (2017) in Tamil-speaking children, all of whom reported a reduction in phonological processes with increasing age. Further, the results align with findings from Bailoor, Rai and Krishnan (2020), who documented similar trends in Kannada-English bilingual children and emphasized the influence of linguistic exposure and age on phonological process suppression.

Thus, the results of the present study emphasize the age-related nature of phonological process occurrence in typical children speaking Tulu language. The study also highlights the importance of developing language specific normative data in Indian languages to aid in accurate clinical assessment of speech development.

Clinical implications

The present study provides important clinical insights into the typical phonological processes observed in Tulu-speaking children. By identifying the common and age-appropriate patterns of sound simplification, the findings can help speech-language pathologists distinguish between normal developmental variations and speech sound disorders. This is especially useful in a multilingual country like India, where language specific norms are often lacking. The results of this study can guide clinicians in planning culturally and linguistically appropriate assessments and interventions for Tulu-speaking children. It also highlights the importance of developing standardized tools and resources in regional languages. Additionally, the findings can support early identification and intervention efforts in schools and clinical settings, while also raising awareness among parents and educators about normal speech development in the Tulu-speaking population.

Limitations of the Study

- The sample size was small and may not represent all Tulu-speaking children.
- The study included only a limited age range of children.
- Regional dialect differences in Tulu were not fully considered.
- There were no standardized assessment tools available in the Tulu language.
- Data was collected only through natural conversation, which may have missed some patterns.

- Many children were exposed to other languages, which may have influenced their speech.

Future Directions

- Future research can include a larger and more diverse sample to improve the generalization of results.
- Studies can cover a broader age range to understand phonological development across different stages.
- Regional dialect variations within Tulu can be explored to see their impact on phonological processes.
- Additional speech tasks such as picture naming, repetition or storytelling can be used for more detailed analysis.
- The influence of exposure to multiple languages (like Kannada, Malayalam or English) on Tulu phonology can be studied further.

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