Study of Phonological Processes of 2-3 Years Old Hindi Speaking Normal Children

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Abstract

Phonological processes are regularly occurring deviation from standard adult speech patterns that may occur across a class of sounds, a syllable shape or syllable sequence. This study analyzes the types of phonological processes occurring in Hindi speaking normal children in the age range of 2 -3 years. The present study included a total of 28 normal subjects in the age range of 2-3 years which was further divided into two age groups i.e., 2.0-2.6 years (4 boys and 10 girls) and 2.6-3.0 years (3 boys and 11 girls). A list of 70 simple Hindi words which commonly occur in the utterances of normal young children were selected for the study. The word list had 24 consonants (k, kʰ, g, gʰ, ts, tsʰ, dʒ, dʒʰ t, θ, d, d, n, p, f, b, bʰ, m, r, l, v, s, ʃ, and h), six vowels including diphthongs (a, a:, I, ʊ, e, and aʊ) and five consonant clusters in initial (sk, sn, pl, tr, and sw) and final positions (rf, rs, rt, ks, and tr). In both age groups processes like retroflex fronting, affrication, stopping etc occurred in more than 60% (most frequently occurring) of the subjects. Processes like final consonant deletion, epenthesis, nasal substitution etc were seen in 20-60% (frequently occurring) of the subjects studied. Few vowel processes occurred in less than 20% (occasionally occurring) of the subjects. The study also revealed that processes like backing, vocalization, assimilation, vowel lowering and initial vowel deletion were not present in the higher age group.

Introduction

Language is a rule based system of symbolic communication involving a set of small unit (syllables or words) that can be combined to yield an infinite number of larger language forms (phrases and sentences). Over the years the study of phonological development has shifted from the analysis of individual speech sound errors toward the analysis of phonological processes that are rule governed simplifications of adult speech. The concept of phonological process was first introduced by Stampe (1973). According to him learning of sound system requires suppression of a number of innate simplifying processes and simultaneously increasing number of contrast sounds. The phonological process analysis is fast emerging as a popular technique to meet the demand for a more comprehensive means of assessing children who exhibit multiple speech sound production.

According to David Stampe (1969, 1979) the pattern of speech that is its phonological organization is governed by certain universal "phonological processes". He claims that there is a universal set of natural phonological process which is innate. Thus "a phonological process is a

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mental operation that applies in speech to substitute for a class of sounds or sound sequences presenting common difficulties to the speech capacity of the individual, an alternative class identical but lacking the difficult properties". Locke (1983) outlined three stages in the processes of phonological acquisition. During *pragmatic stage* child begins to recognize that sounds can convey information to others and sometime start before the first year and shows the child's knowledge of the function of speech. During the *second stage* child begins to use attention, storage and retrieval and pattern matching. This stage begins generally at around 12 months. The third stage is called *systematic stage* which includes the time during which the child's system moves toward the adult phonological system.

Paulson (1991) studied 30 normal children of Mexican descent in the age range of two to five years. She found that the 2 year old used phonological processes most frequently and the 4 year old least often. Her subjects used syllable reduction, consonant sequence reduction, prevocalic singleton omission, strident deficiencies, lateral deficiencies, /r/ deficiencies and substitution and miscellaneous error patterns were stopping, gliding, vowel deviation, epenthesis, substitution of /l/ for /r/ and sibilant distortions. Topbas (1997) studied the phonological acquisition in Turkish children and reported that from a cross linguistic perspective the phonological patterns exhibited coincide broadly with universal tendencies, although some language specific pattern were also evident. In Turkish /l/ was substituted by /r/, i.e. liquid realization of another liquid whereas in English, /r/ is usually replaced by /w/ or /j/ a gliding process.

The literature on phonological processes is mostly from the western studies and is inadequate in Indian languages. Therefore we know relatively little about the phonological development in Indian languages. However in the recent past a number of such studies have been attempted in several Indian languages focusing on the normal phonological process usage and these have been briefly reviewed in the Table 1 below.

Table 1: Various phonological processes observed in Indian languages

Sl No	Author	Language	Age group	Common Processes
1	Sunil (1998)	Kannada	3-4 yrs	Fronting, cluster reduction, initial consonant deletion, and affrication
2	Jayashree (1999)	Kannada	4-5yrs	Fronting, cluster reduction, and stopping
3	Ramadevi (2002)	Kannada	5-6yrs	Stridency deletion, deaspiration, and retroflex deletion
4	Sreedevi, Shilpashree & Jayaram (2005)	Kannada	2-3yrs	Retroflex fronting, trill deletion, depalatalization, deaffrication, stopping, cluster reduction etc.
5	Sameer (1998)	Malayalam	3-4yrs	Cluster reduction, final consonant deletion, epenthesis, and deaffrication
6	Bharathy (2001)	Tamil	3-4yrs	Epenthesis, cluster reduction, gliding, nasal assimilation, voicing, deaffrication and fronting
7	Ranjan (1999)	Hindi	4-5yrs	Cluster reduction, partial reduplication and aspiration
8	Santosh (2001)	Hindi	3-4 yrs	Cluster reduction, epenthesis, fronting, gliding, metathesis, nasalization etc

Need for the study can de justified as (1) Research on phonological development is abundant in Western languages but limited in the Indian scenario. As each language has its own set of sound system and rules the phonological patterns evidenced in English and other Western languages may not hold good in the Indian context, (2) As early identification and intervention is the need of the hour there is an unquestionable call for studies that examine the phonological patterns at a still younger age which is a crucial period in phonological development and (3)

Knowledge of phonological development has great significance in the clinical population to determine whether a child is phonologically disordered and needs intervention. Since each language has its own set of unique features it becomes imperative to study the phonological processes operating in each language.

Objectives of the study

1. To delineate the phonological processes in 2.0-2.6 and 2.6-3.0 years old native Hindi speakers.
2. To compare the various phonological processes across the two age groups and to identify those processes which are suppressed by three years of age.
3. To compare the percentage of subjects using various phonological processes across the groups.

Method

Subjects

The present study included a total of 28 normal children in the age range of 2 -3 years which was further divided into two age groups: 2.0-2.6 years (4 boys and 10 girls) and 2.6-3.0 years (3 boys and 11 girls). All subjects were native speakers of Hindi and some of them were attending play school. The subjects were selected from Delhi and Haryana region. The socio-economic status variable was controlled. A checklist was used to eliminate those children with any developmental delay. Children who participated in the study had

(1) Hindi as their native language, (2) No known reported difficulties in behavioral and/ or intellectual functioning, (3) No known reported neurological illness or trauma, (4) Bilateral normal hearing (as reported), (5) No evidence of oral muscular weakness and (6) Normal oral speech mechanism and had no history of any intervention for speech and language problems.

Test Material

A list of 70 simple Hindi words (spoken in Haryana and Delhi regions) which commonly occur in the utterances of normal young children were selected for the study. All the target words were bi-syllabic except a few tri-syllabic ones. The word list had 24 consonants (k, kh, g, gh, ts, tsh, dʒ, dʒh, t, θ, d, d, , n, p, f, b, bh, m, r, l, v, s, ʃ and h), six vowels including diphthongs (ɑ, ɑ:, I, ʊ, e, and aʊ) and five consonant clusters in initial (sk, sn, pl, tr, and sw) and final positions (rf, rs, rt, ks, and tr). To prepare the test material initially around 250 meaningful simple Hindi words were selected. This list was checked for familiarity by five adults (three kindergarten teachers and two parents of young children) who were native speakers of Hindi. After the most familiar words used by children were identified this word list was further scrutinized to select the picturable and unambiguous words. Finally a total of 70 target words were chosen which had the selected phonemes of Hindi in the initial and final positions. The target words were pictuarized in color on white cards of 4'x 6' size. These picture cards were arranged in random order. The test words were selected on the basis of (1) Easy to produce i.e. bi-syllabic or tri-syllabic (2)

Picturable (3) Regularly used in day to day functional life (4) Match with the general core vocabulary for the children (5) Unambiguous etc

Procedure

Speech samples were collected at home or play school environment. Subjects were seated comfortably and rapport was built up with the child before eliciting the target speech sample. Each child was presented with the picture cards one after another and was asked "What is this"? The response of the child was tape-recorded. In the instances when spontaneous utterances could not be elicited questions were asked related to the test item to which the target word was expected to be the answer. Maximum attempts were made to obtain the spontaneous production of all the target words. In case they failed imitation was used for elicitation of response. In this way all the target words were recorded within duration of approximately 45 minutes for each subject. The speech of all the subjects were audio-recorded onto a digital voice recorder (Cenix Digital recorder, Model VR-P 240) through a collar neck microphone placed at approximately 10 centimeters away from child's mouth.

Identification of Phonological Processes

The experimenter along with three other speech language pathologists who were native speakers of Hindi transcribed the recorded speech sample of all the 28 subjects using broad transcription (IPA, 1996). The transcribed data of all the four judges were subjected to inter judge reliability using "Equality of Proportion". The inter judge reliability was found to be 83% among the four judges for the 2.0-2.6 years group and 85% of inter judge reliability was present for 2.6-3.0 years group sample. Then the sample of each subject was analyzed for identifying the phonological processes operating in the child's speech. The identified phonological processes were grouped into three major categories i.e., syllable structure processes, substitution/feature contrast processes and assimilatory processes.

Analysis and comparison

The recorded speech sample of each child i.e. 70 words were used for analysis. Each word uttered by the subjects was analyzed sound by sound and syllable by syllable. The phonological process was identified by analyzing the whole word and not just the target phoneme in the word. Later the various processes were categorized under the 3 major categories in the two age groups studied. Appropriate statistics was applied to calculate the percentage of subjects in the two groups using a particular phonological process. Here a deliberate attempt was made to calculate the percentage of subjects using a particular process and not the frequency of occurrence of each process in the two age groups. This is because Hodson and Paden (1991) state that percentage figures are computed easily for all phonological processes whose opportunities can be counted as they occur relatively in large numbers. However it is inappropriate to determine percentages for phonological processes that have only a few opportunities of occurrence. Deriving percentages for phonological processes that have fewer than 10 opportunities for occurrence may yield rather skewed results which may give a false impression regarding the importance of the percentage score. Therefore in the present study it was decided to calculate the percentage of subjects using a particular process in the two groups separately.

Results and Discussion

In the present study phonological processes were abundantly observed in both the age groups. However out of the 70 target words the subjects produced some of the target words correctly. Table 2 shows the mean percentage and standard deviation of correct responses produced by the 14 subjects each in the two age groups.

Table 2: The Mean and SD of percentage of correct responses in 2.0- 2.6 and 2.7-3.0 age groups

Age	Average percentage	SD
2.0 – 2.6 Years	34	8.03
2.6 – 3.0 Years	44	11.81

The mean of correct responses in 2.0 -2.6 years group was 34% and 44% in 2.6 -3.0 years age group. Hence as expected the older age group had higher number of correct responses compared to the younger group. Mann Whitney Test was used to statistically analyze the difference in mean percentage between the two age groups. The analysis revealed a 'p' value of .02 at 0.05 level, indicative of significant difference in the correct responses between the lower and the higher age groups.

Qualitative analysis

Table 3: Distribution of different phonological processes in 2.0-2.6 year

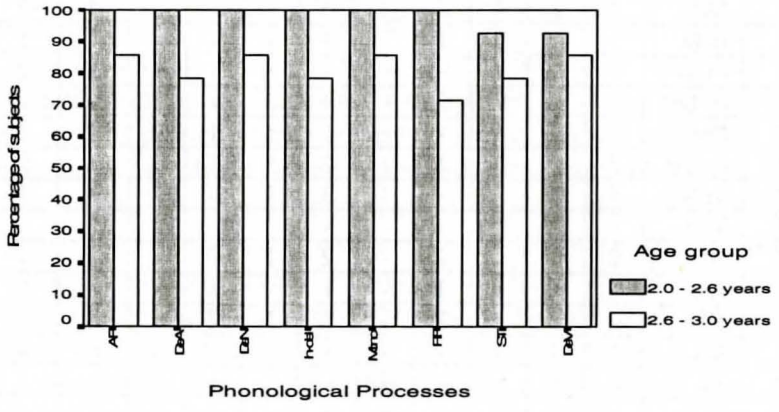
SlNo.	PRO	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
1	RF	9	8	13	8	11	15	16	9	6	7	11	12	9	5
2	DeA	10	10	8	6	7	11	10	12	8	7	8	9	5	8
3	St	4	1	8	3	-	6	9	5	1	11	12	1	1	9
4	VF	2	-	1	-	1	11	9	4	-	8	8	-	1	-
5	BK	-	-	-	-	-	1	-	-	-	1	1	-	-	-
6	ICR	6	-	9	-	8	8	6	5	-	10	8	-	-	-
7	FCR	5	4	3	5	-	3	-	3	2	-	2	4	-	1
8	AF	12	7	9	6	8	12	12	12	3	9	13	5	5	2
9	DeN	5	2	8	5	5	4	6	4	4	7	5	2	5	5
10	NS	-	1	1	-	-	-	3	1	1	6	-	-	-	4
11	DeV	2	2	4	3	1	6	-	4	3	4	3	2	2	5
12	ICD	-	-	2	1	-	1	-	1	-	1	1	-	-	5
13	FCD	-	-	1	-	-	-	3	1	-	5	2	2	-	6
14	/r/ Del	2	4	-	2	-	4	3	-	1	6	-	1	3	-
15	Epn	1	-	-	-	-	1	1	1	2	-	2	2	-	1
16	/h/ del	2	2	2	1	1	2	1	1	1	1	3	1	2	2
17	l/r Sub	4	3	-	-	1	3	1	-	-	4	3	-	2	4
18	Voc	-	-	1	-	-	-	-	-	1	-	-	-	-	-
19	GL	2	1	-	2	-	2	1	-	-	4	1	-	2	1
20	Ass	-	-	-	1	-	1	-	1	-	-	3	-	2	3
21	VS	2	-	1	2	-	3	1	2	1	2	3	1	-	-
22	VR	1	-	1	-	-	-	-	-	-	-	-	-	-	-
23	VL	2	1	-	-	1	-	-	1	1	-	-	-	-	-
24	IVD	-	-	1	-	-	-	-	-	-	1	-	-	1	-
25	Mono	3	1	3	1	1	3	3	2	1	3	2	2	2	3

The recorded responses obtained were analyzed qualitatively. Each word uttered was analyzed for the phonological process involved. The whole word was analyzed and not just the target phoneme in the word. Analysis of the data revealed a total of 25 phonological processes in the younger group and 20 processes in the higher age group. The distribution of the phonological processes or rather the numbers of occurrence of each process in all the subjects of lower and higher age groups are provided in Tables 3 and 4 respectively.

Table 4: Distribution of different phonological processes in 2.7-3.0 years

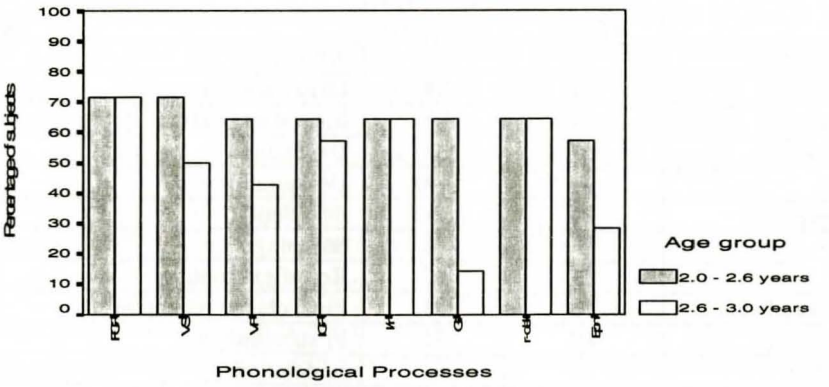
Sl. No	PRO	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
1	RF	-	-	13	11	14	18	19	12	-	-	14	15	10	8
2	DeA	10	10	8	-	-	11	10	12	8	7	8	9	-	8
3	St	2	1	6	3	-	6	5	5	1	11	9	-	-	9
4	FR	2	-	-	-	1	11	9	-	-	-	8	-	1	-
5	ICR	6	-	9	-	8	8	6	-	-	10	8	2	-	-
6	FCR	2	6	-	3	3	-	3	6	3	-	3	-	2	4
7	AF	12	7	9	6	8	12	12	12	-	9	13	5	5	-
8	DeN	5	-	8	5	5	4	-	4	4	7	5	2	5	5
9	NS	-	1	1	-	-	-	3	-	1	6	-	-	-	4
10	DeV	2	2	4		1	6	-	-	3	4	3	2	2	5
11	ICD	-	-	-	-	-	1	-	-	-	1	-	-	-	5
12	FCD	-	-	1	2	-	-	3	-	-	5	2	2	-	6
13	RD	1	4	6	-	-	4	3	6	-	-	-	1	3	-
14	Epn	1	-	-	1	-	-	-	1	2	-	2	-	-	-
15	/h/ del	-	2	2	1	1	-	1	1	1	1	3	1	-	2
16	l/r del	3	1	-	-	-	-	2	1	-	2	-	3	1	1
17	GL	-	1	-	2	-	2	-	-	-	-	-	-	-	-
18	VS	2	-	1	-	-	3	-	-	1	3	-	1	-	-
19	VR	1	-	1	-	-	-	-	-	-	-	-	-	-	-
20	Mono	3	1	-	1	1	-	3	2	1	3	2	2	2	3

F: Retroflex Fronting; **St:** Stopping; **FR:** Fronting; **BK:** Backing; **ICR:** Initial Consonant Reduction; **FCR:** Final Consonant Reduction; **AF:** Affrication; **Den:** Denasalization; **NS:** Nasal substitution; **Dev:** Devoicing; **ICD:** Initial Consonant Deletion; **FCD:** Final Consonant Deletion; **VOC:** Vocalization; **Epn**: Epenthesis; **GL**: Gliding; **Ass:** Assimilation; **Vs:** Vowel Shortening; **VR:** Velar Fronting; **VL:** Vowel lowering; **IVD:** Initial Vowel Deletion;**Mono:** Monothongization

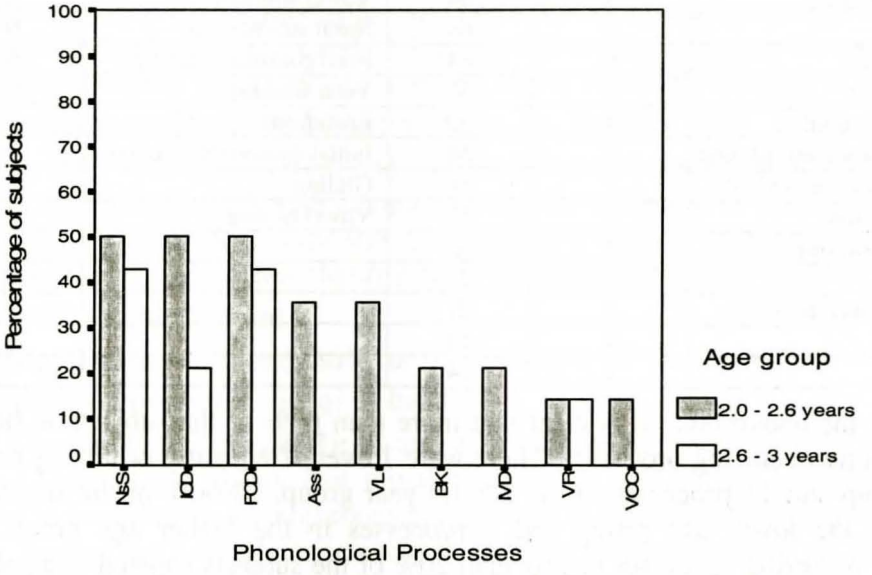


Graph 1: Percentage of subjects exhibiting phonological processes in the two age groups

Graphs 1, 2 and 3 indicate the comparison in percentages of subjects showing different phonological processes across the two age groups.



Graph 2: Percentage of subjects exhibiting phonological processes in the two age groups



Graph 3: Percentage of subjects exhibiting phonological processes in the two age groups

In this study the percentage of the subjects using a particular phonological process was calculated and not the number of occurrences of each process. Percentage of subjects exhibiting different phonological processes in 2.0-2.6 years and 2.6-3.0 years is provided in Table 5.

After the percentage of subjects exhibiting each process was calculated these processes were classified into 3 major categories (Table 6). This was done on the basis of method used by Ramadevi (2006). The classification is as follows: 1) First category consisting of phonological processes occurring in 20% or less than 20% of the subjects. These were considered as occasionally occurring processes. 2) Second category consisting of phonological processes occurring in more than 20% and less than 60% of the subjects. These were considered as frequently occurring phonological processes. 3) Third category consisting of phonological processes occurring in more than 60% of the subjects. These were considered as phonological processes occurring most of the time.

Table 5: Percentage of subjects exhibiting phonological processes in 2.0-2.6 and 2.6-3.0 years

Sl No.	Phonological Processes	2.0- 2.6 years		Phonological Processes	2.6- 3.0 years	
		No. of subjects	Percentage of subjects		No. of subjects	Percentage of subjects
1	Retroflex fronting	14	100	Affrication	12	85.71
2	Deaspiration	14	100	Denasalization	12	85.71
3	Affrication	14	100	Monothongization	12	85.71
4	Denasalization	14	100	Devoicing	12	85.71
5	/h/ deletion	14	100	Deaspiration	11	78.57
6	Monothongization	14	100	/h/ deletion	11	78.57
7	Stopping	13	92	Stopping	11	78.51
8	Devoicing	13	92	Retroflex fronting	10	71.43
9	Final cluster reduction	10	71	Final cluster reduction	10	71.43
10	Vowel shortening	10	71	l/r substitution	9	64.29
11	Velar fronting	9	64	/r/ deletion	9	64.29
12	Initial cluster reduction	9	64	Initial cluster reduction	8	57.14
13	l/r Substitution	9	64	Vowel shortening	7	50.00
14	Gliding	9	64	Nasal substitution	6	42.86
15	/r/ Deletion	9	64	Final consonant deletion	6	42.86
16	Epenthesis	8	57	Velar fronting	6	42.86
17	Nasal substitution	7	50	Epenthesis	4	28.52
18	Initial consonant deletion	7	50	Initial consonant deletion	3	21.43
19	Final consonant deletion	7	50	Gliding	2	14.29
20	Assimilation	5	35	Vowel raising	2	14.29
21	Vowel lowering	5	35	-	-	-
22	Backing	3	21	-	-	-
23	Initial vowel deletion	3	21	-	-	-
24	VR	2	14	-	-	-
25	VOC	2	14	-	-	-

From the above table it is clear that more than 60% of the subjects in both groups had many frequently occurring processes. There were 15 very frequently occurring processes in 2.0-2.6 year group and 11 processes in the 2.6-3.0 year group. 20-60% of the subjects exhibited 8 processes in the lower age group and 7 processes in the higher age group. Similarly the occasionally occurring processes or less than 20% of the subjects showed two processes each in both groups. These processes which were evident in the two age groups studied have been discussed below. Examples are also provided for each process which was exhibited by the subjects of the present study in Hindi.

1. **Retroflex Fronting (RF):** 100% of the subjects in the lower age group and 71% of the higher age group showed this process. Earlier research in Hindi (Ranjan, 1999; Santosh, 2001), Kannada (Ramadevi & Prema; Sreedevi et. al. 2005), Malayalam (Sameer, 1998) etc have also reported that RF is a frequently occurring process. This is a very frequent process in Indian languages as the frequency of occurrence of retroflex is high in these languages. In western studies we do not come across RF because retroflex as a place of articulation is absent in them especially in English. Retroflex is a difficult sound to produce as it involves the tongue to curl back and touch the palate. Therefore we find that retroflex sounds are most often fronted by a dental sound. *Example*: / təmatər/:[təmatər]
2. **De aspiration (DeA):** This process was also highly prevalent in both the groups. It was present in 100% of 2-2.6 year old children and 79% of 2.6-3.0 years old children.

Aspiration is phonemic in Hindi even in colloquial usage. Hence the subjects must be still in the process of acquiring aspiration to use it phonemically. *Eg.* / kʰa:na:/: [ka:na:]

3. **Affrication (AF):** Affrication was seen in 100% of the subjects in 2-2.6 year group and in 86% of 2.6-3.0 year group. Generally affricates are learned before fricatives. Children in this study i.e., between 2-2.6 years, none of them have achieved frication and among children between 2.6-3.0 years 2 subjects have produced frication correctly. Therefore they are in the period of learning fricative production and hence affrication is seen in most of them. *Eg.* / sanp /: [tsanp]
4. **Denasalizatin (DN):** This was seen in 100 % and 86% of the lower and higher age groups respectively. *Eg.* / a:nk /: [a:k]
5. **/h/ Deletion (/h/ del):** was evident in 100% and 79% of the subjects in the lower and higher age groups respectively. Phoneme /h/ is a glottal sound. Glottals are uncommon in Indian languages. Therefore it is acquired late and /h/ deletion is seen. *E* / ha:ti/: [a:ti]

   Monothongization (Mono): Simplification of a diphthong was present in all (100%) the 14 subjects in the lower group and 85% in the higher group. As per the research reports vowels are mastered by 3 years of age and hence this simplification of diphthongs to monothongs are seen between 2-3 years of age. *Eg.*/aʊrat/: [orat]
6. **Stopping (St):** Was seen in 92% and 79% in lower and upper age groups respectively. This is a salient finding because stopping or the simplification of a fricative by a stop is reported as a major process in the western studies even after 3 years of age. Contradictory to this the present study shows that fricatives are acquired by some subjects as early as 2-2.6 years. *Eg.*/ sa:np/:[ta:np]
7. **Devoicing (DeV):** 92% and 86% of the subjects of the lower and higher groups evidenced this process. *Eg.* / bæg/ : [bæk]
8. **Initial Cluster Reduction (ICR):** 64 and 57 percent of the subjects in the study had this process. Though this shows that initial clusters are still in the learning period ICR occurred in less number of subjects compared to FCR which supports the earlier research reports. Among the 5 initial clusters tested relatively /pl/ and /tr/ were produced correctly compared to /sw/, /sn/ and /sk/. *Eg.* :/sku:l/ : [ku:l]
9. **Final Cluster Reduction (FCR):** 71% of the subjects in both the groups showed this process. This is in consonance with Stoel-Gammon and Dunn (1985) who reported that mastery of final position clusters occurs only around 4 years of age. *Eg.* / təstri/: [təasti]

   It was observed that the clusters /rf/ and /ksi/ were produced correctly by 29% of the subjects in both the age groups.
10. **Substitution of l/r:** In both the groups 64% of the subjects showed this process. This has been frequently reported in other Indian studies also. Both /l/ and /r/ are liquids and /l/ is easy to produce and acquired earlier. This results in usage of lateral for trill. *Eg.* / kursɪ/ : [kulsɪ]
11. **Velar Fronting (VF):** This feature was noticed in 64% and 43% respectively in younger and older age groups. *Eg.* : / na:k/: [na:t]

12. **/r/ Deletion:** In both the age groups 64% of the children had this feature and as said /r/ is a complex phoneme and hence deleted during in 2-3 years of age. *Eg.* /kaː r/: [kaː]
13. **Gliding (GL):** This was seen in 64% of lower group and 14% in higher group. Here a glide /j/ or /w/ was used in place of trill which is common in English. *Eg.* : / rel /: [jel]
14. **Epenthesis (Epn):** This feature was present in 57% and 29% of the two age groups respectively. *Eg.* / plet/ : [pəlet]
15. **Nasal Substitution (NS):** Found in only 50 and 43 percent of the younger and older groups respectively. As nasal sounds are acquired early relatively less number of subjects showed this feature. *Eg.* / naːk /: [tak]
16. **Final Consonant Deletion (FCD):** Seen in 50 and 43 percent of the two age groups respectively. *Eg.* /baːl / [baː]
17. **Initial Consonant Deletion (ICD):** This was present in 50% and 21% in the age range of 2.0- 2.6 and 2.6 -3.0 years respectively. ICD which was considered to be an unusual process by Dodd (1989) was found to be a common process in these children. This may be due to features related to language differences. Processes reported to be unusual to one language may be a usual process in another language (Hua, 2000) *Eg.* /təmatər/: [matər]
18. **Assimilation (Ass):** This process was present only in the younger age group (35%). Mostly labial and velar assimilations were observed. *Eg.* /saːnp/: [paːnp]
19. **Vowel lowering (VL):** Was a process found only in younger age group in 35% of the subjects. *Eg.* /swetər/ : [swatər]
20. **Backing (BK):** This process was also seen only in 21% of younger age group.

    Eg. /daːnt /: [daːnk]
21. **Initial vowel deletion (IVD):** Was seen in 21% of the subjects in younger age group.

    Eg. /anaːr/: [naːr]
22. **Vowel shortening (VS):** This was seen in 71% and 50% subjects of the two age groups.

    Eg. : / ʊnt /: [unt]
23. **Vowel Raising (VR):** Found in 14% of both the age groups. *Eg.* : / tsəmats /: [tsəmets]
24. **Vocalization (VOC):** This process was seen in 14% of the subjects only in the younger age group. *Eg.* : / kar / : [kau]

After obtaining the percentage of subjects exhibiting the various processes the statistical technique 'equality of proportion' was used to test the following hypothesis: the percentage of children exhibiting phonological processes in lower age group is greater than in higher age group at 0.05 level. The statistical test reveled that only five phonological processes namely retroflex fronting, deaspiration, /h/ deletion, gliding and initial consonant deletion were significantly higher in 2- 2.6 years old group as compared to 2.6 -3.0 years old group at 0.05 level . There was no significant difference noticed in the percentage of subjects exhibiting other processes across the two age groups. Another salient finding was that five phonological processes such as backing, assimilation, vocalization, vowel lengthening and initial vowel deletion were operational only in the speech of younger age group suggesting that these five processes are suppressed by the age of 2.6 years.

It was also found that among the 6 vowel processes noticed only monothongization, vowel shortening and vowel rising were present in both the age groups. Among these three processes percentage of subjects showing monothongization was considerably higher followed closely by vowel shortening and then vowel rising. However there was no significant difference between the two age groups for these three processes. The other three vowel processes i.e., vowel lowering, initial vowel deletion and vocalization were absent in 2.6 -3.0 group (refer table 14). From this observation we can say that vowels are almost mastered by 3 years of age and the processes involving vowels are suppressed by this age during normal phonological development. An attempt was also made to classify the phonological processes observed in this study under the three major categories as suggested by Grunwell, 1985 which is provided in Table 7.

Table7: Classification of phonological process exhibited by subjects in the present study

Syllable structure processes	Substitution processes	Assimilatory processes
Cluster reduction	Retroflex Fronting	Velar assimilation
Initial consonant deletion	Deaspiration	Labial assimilation
Final consonant deletion	Stopping	
Epenthesis	Velar fronting	
/h/ deletion	Backing	
Vocalization	Affrication	
/r/ deletion	Nasal substitution	
Denasalization	Gliding	
Initial vowel deletion	Devoicing	
Monothongization	Vowel shortening	
	Vowel raising	
	l/r substitution	

The results of this study indicate that though there are lots of individual variations in speech patterns among young children. There are specific patterns or strategies which can be predicted during the course of normal phonological development. However in order to generalize these observations phonological processes need to be studied in larger groups of subjects.

Implications of the study

1) Provides an overview of the emerging and suppressing patterns of different phonological processes in Hindi as early as 2-3 years of age.
2) Aids in early intervention and remediation which can be used as an index of phonological disability.
3) Serves as a basis for planning phonological remediation.

Limitations of the study

1) Equal number of boys and girls are not considered in the study.
2) Since the subjects involved were very young (2-3 years) it was not always possible to elicit all the target words from a few subjects.
3) All the phonemes of Hindi are not considered.

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