STUDY OF PHONOLOGICAL PROCESSES OF 2-3 YEARS OLD HINDI SPEAKING NORMALCHILDREN

Registration No. L0480009

A Dissertation Submitted in part fulfillment of
Master's Degree (Speech Language Pathology)
University of Mysore,
Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING '
MANASAGANGOTHRI
MYSORE - 570 006

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Dedicated to my papa, mummy,

Siddhartha, Bhabhi,

Kunal,

Didi and Bijay ji

Certificate

This is to certify that the dissertation entitled ***"Study of phonological processes in 2-3 year old Hindi speaking normal children*** " is the bonafide work done in part of the degree of Master of Science (Speech and language pathology) of the student (Register No. L0480009).

Prof. M. Jayaram
Director

All India Institute of Speech and Hearing
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Mysore- 570 006

Mysore

May 2006

Certificate

This is to certify that the dissertation entitled ***"Study of phonological processes in 2-3 year old Hindi speaking normal children "*** has been prepared under my supervision and guidance. It is also certified that this has not been submitted earlier in any other University for the award of any other Diploma or Degree.

N. Sreedevi
Guide

Mysore
May 2006

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Mysore- 570 006.

Declaration

I here by declare that this dissertation entitled ***"Study of phonological processes in 2-3 year old Hindi speaking normal children"*** is the result of my own study and has not been submitted earlier in any other University for the award of any other Diploma or Degree.

Mysore
May 2006

Register No. L0480009

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My dear ***papa,*** *you are a man with patience, love and caring attitude. I have learned so many things from you. I'll always love you.*

My dear cute ***mamma****, you are a role model for me and you are such a beautiful person by heart that I have always admired you as an angel. Today I would like to thank you for your great patience and caring behavior.*

Dear ***Siddhartha,*** *my brother and best friend you are the person to whom I would like to thank for innumerable reasons….. Be with us always. I miss you a lot.*

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Dear ***Kunal,*** *You will never change. Same serious and still naughty brother. For me you will be always a small and cute guy, I love you…*

Dear ***Gouri shankar patil,*** *Bhai we have shared fun, laughter and a lot of things together, your sweet memories will be always with me in my heart.*

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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). It is an integral part of human communication system, is also a mechanism to control and mediate one's actions, thoughts and behaviors.

Learning to communicate through language is one of the early challenges that children face. The task is complicated in that four types of skills must be acquired more or less simultaneously: syntax (syntax structure) semantic (word and contextual meaning), pragmatics (language used) and phonology (speech sounds and sequencing). These abilities are obviously interrelated and a child's communicative problem may result from inadequacy in more than one. It is possible, however, to assess and to focus intervention upon each area separately and in this sense, phonology is a distinct area with which speech language pathologist must deal.

Phonology refers to the speech sound systems of a language and includes the study of how speech sounds are classified and organized and how they are used contrastively in a given language. Phonology encompasses all aspects of the sound system including speech production and perception. Articulation which refers to the actual movements of the articulators during speech production is subsumed under the generic term phonology. Phonological structure has two components, a limited

repertoire of sounds (phonemes) representing various classes (based on physiological and acoustic characteristic) and a set of phonotactic rules defining how these phonemes can be arranged in syllables (Hodson and Paden, 1991).

By the time most children have acquired a vocabulary of approximately 25 words, they demonstrate an emerging phonological system. Children cannot, of course, immediately learn the entire array of phonemes or the complicated set of sequence patterns of the language they will eventually use. They progress gradually from mastery of the simpler sounds and arrangement to the more complex ones just as vocabulary limitations often cause a young child to call all adult males “Daddy”, and limited rules of grammar may result in the child saying “ball mine” for “that’s my ball”, restricted phonologies may result in production such as / tʌ / for both truck and sun. Developmental phonologists have observed that a young child usually makes these substitutions and omissions in predictable ways. Thus even the child’s technique for copping with speech inadequacies is systematic.

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 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. 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.

Hodson and Paden (1981) defined Phonological process as regularly occurring deviation from standard adult speech patterns that may occur across a class of sounds, a syllable shape or syllable sequence. In short, processes are description of regularly occurring patterns observed in child's speech, which operate to simplify adult targets. Literature reports that there are more than forty such different processes operating during children's phonological development (Hodson, 1980).

Taylor and Hoard (1978) define phonology as "the science of speech sounds and sound patterns". These authors note that each language has its own set of sound patterns, which is (1) the set of sounds used by a certain language, (2) the acceptable arrangement of these sounds to form words, and (3) the various processes by which sounds are added, deleted, or changed. As Oller (1975) explicitly put it; the sort of substitutions, deletions and additions, which occurs in child language, are not merely random error on the child's part, but are rather the result of a set of systematic tendencies.

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

Need for the study

1) Research on phonological development is abundant in Western languages but limited in the Indian scenario. However, there have been some studies in several Indian languages which have focused on phonological development in age range of three to five years. 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
2) 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. Therefore the present study plans to track the phonological processes from two to three years in native Hindi speaking children.
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

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

Aim of the study

To analyze the types of phonological processes occurring in Hindi speaking normal children in the age range of 2 -3 years**.**

Implications of the study

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

Limitations of the study

- Equal number of boys and girls are not considered in the study
- 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.
- All the phonemes of Hindi are not considered

REVIEW OF LITERATURE

Phonological development refers to the acquisition of speech sound form and function with in the language system. It implies the acquisition of a functional sound system intricately connected to the child's overall growth in language (Bauman-Waengler, 2004). Speech sound development refers primarily to the gradual articulatory mastery of speech sound forms within a given language. The child's language development is commonly divided into pre-linguistic behavior, vocalizations prior to the first true words and linguistic development, which starts with the appearance of these first words. The following is an over view of the pre-linguistic stages of production described by Stark (1986).

Stage 1: Reflexive crying and vegetative sounds (birth to 2 months).

This stage is characterized by a large proportion of reflexive vocalizations. Reflexive vocalizations include cries, coughs, grunts, and burps that seem to be automatic responses reflecting the physical state of the infant.

Stage 2: Cooing and laughter (2- 4 months)

During this stage, cooing or gooing sounds are produced during comfortable states. Although these sounds are sometimes referred to as vowel - like, they also contain brief periods of consonantal elements that are produced at the back of the mouth.

Stage 3: Vocal play (4- 6 months)

Although there is some overlap between stage 2 and 3, the distinguishing characteristics of the stage 3 include longer series of segments and the production of prolonged vowel or consonant like steady states. It is during this stage that the infant often produces extreme variations in loudness and pitch.

Stage 4: Canonical babbling (6 months and older)

At the beginning of this stage, babbling is used in a self – stimulatory manner; it is used to communicate to adults. Towards the end of this stage, babbling may be used in ritual imitation games with adults (Stark, 1986). Although Canonical babbling- the collective term for reduplicated and non-reduplicated babbling stages- usually begins around 6 months of age, most children continue to babble into the time when they say their first words. Stark (1986) describes reduplicated and non reduplicated, or variegated, babbling as follows; Reduplicated babbling is marked by similar strings of consonant vowel productions. There might be slight quality variations in the vowel sounds of these strings of babbles, but the consonant will stay the same from syllable to syllable. An example of this is [əmama]. Nonreduplicated or variegated babbling demonstrates variation of both consonants and vowels from syllable to syllable.

Stage 5: Jargon stage (10 months and older)

This babbling stage overlaps with the first meaningful words. The jargon stage is characterized by strings of babbled utterances that are modulated primarily by intonation, rhythm, and pausing, (Crystal, 1986). It sounds as if the child is actually attempting sentences but without actual words.

First Fifty Words

Around the child's first birthday, a new development era begins: the linguistic phase. It starts the moment first meaningful word is produced. Children frequently use "invented words" in a consistent manner. These vocalizations are used consistently but without a recognizable adult model and are referred to as phonetically consistent forms or vocables or proto-words or quasi words. The time of initial production of words is usually called the first fifty word stage. The child begins to put two words together at approximately 18-24 months. The child produces approximately 50 meaningful words before the two word stage begins.

Studies based on acquisition of speech sound production

The pattern of acquisition of phonology in children (Templin, 1957) is as follows:

- In the early years, diphthongs, vowels, consonants, double consonant blends triple consonant blends are produced in most to least accurate order.
- The consonants are produced in the following order - nasals, plosives, fricatives and semi vowels.
- The voiceless consonant elements are produced more accurately than voiced ones.
- By eight years, all children produce all the sounds correctly.

Several researchers like Poole (1934), Templin (1957), and Wellman, Mengurt, and Bradbury (1931) and Goodban (1976), Prather, Hedrick, and Kern (1975) and Sander (1972) were interested in gathering normative data based on large number preschool children as shown in Table 1.

Table 1: Acquisition of speech sounds by various studies

Phonemes	Wellman (1931)	Poole (1934)	Templin (1957)	Sander (1972)	Prather (1975)	Arlt (1976)
m	3	31/2	3	Before 2	2	3
n	3	4 ½	3	Before 2	2	3
h	3	3 ½	3	Before 2	2	3
p	4	3 ½	3	Before 2	2	3
f	3	5 ½	3	3	2-4	3
w	3	3 ½	3	Before 2	2-8	3
b	3	3 ½	4	Before 2	2-8	3
ŋ	-	4 ½	3	2	2	3
j	4	4 ½	3 ½	3	2-4	
k	4	4 ½	4	2	2-4	3
g	4	4 ½	4	2	2-4	3
l	4	6 ½	6	3	3-4	4
d	5	4 ½	4	2	2-4	3
t	5	4 ½	6	2	2-8	3
s	5	7 ½	4 ½	3	3	4
r	5	7 ½	4	3	3-4	5
tʃ	5	-	4 ½	4	3-8	4
v	5	6 ½	6	4	4	3 ½
z	5	7 ½	7	4	4	4
3	6	6 ½	7	6	4	4
θ	-	7 ½	6	5	4	5
dʒ	-	-	7	4	4	4
ʃ	-	6 ½	4 ½	4	3-8	4 ½
0	-	6 ½	7	5	4	5

Grunwell (1982) presented the development data in a different form. She used the seven stages outlined by Crystal, Fletcher and Garman (1976) for grammatical development, and specified the sounds that might be expected at each stage (Table 2).

Table 2: Phonological Development at various stages (Grunwell, 1982)

Stage1 (0; 9-1; 6)	**Stage-II (1; 6-2; 0)**	**Stage-III (2;0-2; 6)**	**Stage-IV (2; 6-3; 0)**	**Stage-V (3;0-3; 6)**	**Stage-VI (3; 6-4; 0)**	**(4;0-4; 6)**	**Stage-VII (4;6 <)**
Nasal	m,	m,	m		m,		m,
Plosive	p, b	p, b	p, b		p, b		p b
Fricative			f,		f		f ,v
Approximant	w	w	w		w		w
	n	n,	n		n,		n
Labial	t ,d	t ,d	t ,d		t ,d		t ,d
			s		s, z		s ,z
			(l)		l (r)		l ,r
		(n g)	n g		n g		n g
Lingual		(k g)	k g		k g		k g
		h	h		h		h

Table 3 shows the age at which consonants are usually produced and consonants usually mastered as given by Stoel-Gammon and Dunn (1985).

Table 3: Age of customary production and mastery of consonant phonemes

Sl No.	**Age**	**Consonants customarily produced**	**Consonants mastered**
1	Before2.0	p, b, m, n, w, h	-
2	2.0	t, d, k, g, n	-
3	3.0	f, s, r, l, j	-
4	4.0	v, z, ʃ, ts, d	P, m, n, w, h
5	5.0	Θ, ð	b, d, k, g, f, j
6	6.0	ʒ	t, ŋ, r, l
7	7.0	-	Θ, ʃ, ts, d
8	8.0	-	v, ð, s, z

Common clusters which are the combination of two or more consonants in the initial or final position are generally developed late in the phonological system. In

general, two member clusters are acquired earlier than three member clusters. Table 4 shows the age of mastery of consonant clusters given by Stoel- Gammon and Dunn (1985).

Table 4: Age of mastery of consonantal clusters

Sl No.	Age	Initial clusters	Final clusters
1	4.0	pl, bl, kl, gl pr, br, tr, dr, kr tw, kw sm, sn, sp, st, sk	mp, mpt, mps ŋ k, lp, lt rm, rt, rk pt, ks, ft
2	5.0	gr, fl, fr, str	lb, lf rd, rf, rn
3	6.0	skw	lk, rb, rg, rθ, rdʒ, rst, rt, nt, nd, nθ
4	7.0	spl, spr, skr sl, sw, θr, fr	sk, st, kst, lθ, lz, dʒd
5	8.0	-	kt, sp

In India many studies have been carried out on speech sound acquisition in children (Table 5). The systematicity of child phonology became more clearly understood when theorists began to consider that sounds are composed of groups of distinctive features (Chomsky & Halle, 1968**;** Jackobson, Fant, & Halle, 1952) when various word forms were observed to be the output of the same phonological rules (Crompton, 1975; Smith.1973).

Table 5: The age of acquition of various speech sound in different Indian languages

Sl No	Sounds	Tasneem Banu (1977) Kannada	Usha (1986) Tamil	Padmaja (1988) Telugu	Arun Banik (1988) Bengali
1	m	3	3	2.6	2.5
2	n	3	3	2.6	2.5
3	h	+	+	2.6	3
4	p	3	3	2.6	2.5
5	f	+	+	2.9	+
6	b	3	3	2.6	2.5
7	ŋ	+	+	+	2.5
8	y	3	3	2.6	2.5
9	k	3	3	2.6	2.7
10	g	3	3	2.6	3
11	l	3	3	2.6	3
12	d	+	3	2.6	3
13	t	+	3	2.6	3
14	θ	3	+	+	3
15	s	3	3	3.3	+
16	r	4.6	+	3.9	4
17	c	3.7	3	2.6	3
18	u	+	3	2.6	+
19	j	3	3	2.6	3
20	ʃ	5.1	6	3.6	3

Note: "+" means sounds was not tested or reported

Some researchers have been interested in describing and explaining how the process of phonological development occurs in children and no one theory has been accepted as a complete account. A number of phonologists have described phonological development, some having closely followed a single child over the developmental years (e.g., Smith, 1973), others having evaluated sizable numbers of children at various

stages of development (e.g., Preisser, Hodson, & Paden, 1988). Ferguson and Garnica (1975) divided the modern theories into 4 groups.

1) Structuralist theory (Jackobson, 1941 and Moskowitz, 1970)

Jackobson (1941/1968), who has been called the father of child phonology, proposed the first major theory to account for phonological development. He described it as an orderly progression following structural laws that apply no matter what language the child is acquiring. This theory holds that there is a general order of sound development, although the exact age of sound acquition may vary from child to child, and sounds are learned based on their sound features such as vowels vs. consonants etc.

2) Behaviouralistic theory (Mowrer, 1952 and Olmsted 1971)

This theory postulates that language is learned in response to the environment through the child's imitation of adult speech and reinforcement of his or her attempts. They have been widely accepted because they are in accord with the explanations of the learning of the other skills.

3) Natural theory (Stampe, 1969)

He identified common strategies by which children reduce a very complex adult language model to a simpler level, e.g., Young children whose system do not yet include the features [+ continuant] and [+ strident] often use stop consonants in place of fricatives. This theory is based on the premise that the normally developing

child attempts to reproduce the adult model, but because of immature motor abilities, the child's productions are simplified compared to adult phonological patterns.

4) Prosodic theory (Waterson, 1971)

This theory holds that children initially perceive adult speech in terms of whole units of meaning rather than individual phonemes, and earliest learned sounds are based on the inputs that the child receives.

Phonological feature acquisition

Menyuk (1968) examined consonant development of children from a distinctive feature viewpoint based on Jackobson, Fant, and Halle (1963) system (Table 6). Using spontaneous speech samples, she analyzed the use of the following features by preschool children: gravity, diffuseness, voicing, continuacy, stridency, and nasality. And she suggested that the + nasal and + voiced features may be acquired early because of their "on-off" nature. The velopharyengeal port is either open or closed for nasal and non nasal sounds; the vocal folds either vibrate or they do not for voiced and voiceless sounds. Another early learned feature, + grave, carries a maximum distinction between the + and – contrasts.

Table 6: Rank order of feature acquition (Menyuk, 1968 & Prather, Hedrick & Kern (1975)

Menyuk (1968)	Prather et al (1975)
+ nasal	+ nasal
+ grave	+ grave
+ voice	+ diffuse
+ diffuse	+ voice
+ strident	+ continuant
+ continuant	+ strident

Phonological processes

With in the last decade, the study of phonological development has shifted from examining the mastery of individual sounds to the acquition and ordering of the phonological system. According to natural phonology, there seems to be a time frame during which normally developing children do suppress certain processes. This approximate age of suppression is helpful when determining normal versus disordered phonological system and can be used as guidelines when targeting remediation goals.

General Classification of natural phonological processes: Phonological process can be grouped into two functionally distinct categories: Whole word process, which simplify words or syllable structure and segmental contrast within a word (generally through reduction or assimilation), and segmental substitution process, which involve substitution for specific segments or segment types (regardless of syllable or word position). Various classification systems of phonologic processes have been devised but

they share commonalities (Hodson 1980; Ingram 1981; Khan 1985, Shriberg and Kwiatkowski 1980; Weiner 1987). The phonological processes can be broadly described on the basis of occurrence of the phonological process present during the production of consonants and vowels. According to Grunwell (1985), phonological processes can be categorized into three major categories:

1) Syllable structure processes
2) Substitution processes
3) Assimilatory processes and others

1) Syllable Structure Processes

Syllable structure processes are changes in the make up of syllable of the standard adult word form. Weiner (1979) reported that the foremost common syllable structure processes are Weak syllable deletion, Cluster reduction, Deletion of final consonant, and Glottal replacement. Other processes include Diminutization, epenthesis, doubling, and glottal replacement.

Weak Syllable Deletion: In Weak syllable deletion the unstressed syllable of a multisyllabic word is omitted. This process is also referred to as “unstressed syllable deletion” and syllable reduction. There is a strong tendency for children to preserve a final syllable, whether it is stressed or not, presumably because final position is perceptually salient. Most often affect an unstressed syllable (“weak syllable deletion”) and can be targeted for stressed syllable deletion, especially if it is the first of three or more syllables.

Examples: Potato: [teto], Banana: [nænə]

Consonant deletion: Most often affects final consonants, though initial and medial consonants may also be omitted. FCD occurs when the final consonant in a word is omitted. This process is also referred to as "open syllable"

Examples:

1) Word initial position
Pen: [en], Man: [æn]

2) Word final position:
Spoon: [spo], Boat: [bo]

Cluster Reduction: Like other reduction process, cluster reduction alters syllable structure, but it is also closely related to the segment substitution processes in that the specific consonants omitted are typically those difficult to produce as singleton consonants. Cluster reduction is the process in which one of the consonant of a consonant cluster is omitted. The deleted consonant can be sonorant or an obstruent and it is one of the longest lasting processes.

Examples: Smoke: [mok], Break: [bek]

The actual form of reduction differs according to the type of target cluster. The most common reduction patterns are described as:

a) In /stop + Liquid/cluster, the stop is usually maintained and the liquid deleted. Example, Blue: [bu], Bread : [bɛd]
b) In postvocalic cluster composed of /liquid + stop/ or /liquid +nasal/, the liquid is usually deleted. Example, Bark: [bɑk], Milk : [mɪk]
c) In /s + stop/ and /s+ nasal/ cluster, /s/ is usually deleted. Examples are, Skip:

[kɪp] Snow: [no]

d) Most clusters are reduced by deleting one member and maintaining the other, some initial clusters are reduced to single sound that was not a member of target cluster, commonly occurring.

Example: Tree: [fi]

Cluster reduction can be divided into three subcategories as:

- Total cluster reduction (TCR), this involves the reduction of all members of the cluster.
- Partial Cluster Reduction (PCR), this occurs when some of the cluster members are deleted but others remain.
- Cluster substitution (CS), this occurs when there is a substitution of a cluster member. Cluster substitution is sometimes treated, as a form of partial cluster reduction. The member that is typically deleted or substituted tends to be the marked member of the cluster. Unmarked cluster member can also be deleted.

Examples:

Target	Form	Cluster Reduction
Tree	[i]	TCR
Tree	[ti]	PCR
Tree	[twi]	CS

Diminutization: It is the process of adding / i / or consonant plus / i / to a word. The resultant word is considered as immature speech pattern.

Example: Hat: [hæti], Dog: [dɑgi]

Epenthesis: Epenthesis refers to the addition of a vowel. Often /ə/, to a word the addition commonly occurs between two consonants of a consonant cluster and after a final voice stop.

Examples: School: [səkʊl], Black: [bəlæk]

Doubling: Stoel-Gammon and Dunn (1985) defined "doubling is the process as repetition in a word". Although some writers view use of reduplication as a developmental stage that all children pass through, others maintain that reduplication, like other phonological processes, represents an individual strategy characterizing the speech of some but not all children at some developmental point. In reduplication, usually a monosyllabic word, resulting is multisyllabic word. This process is similar to the process of reduplication which has been categorized as a harmony or assimilation process.

Examples: Ball: [baba], Bed: [bɛbɛ]

Coalescence: Coalescence has been divided into two different ways. Khan (1982) characterized this process as producing multisyllabic word with fewer syllables than the standard form from both syllables retained. Example is [mɛn] for "melon" which contains the /m/ from the first syllable and /n/ from the second. Hodson (1980) has a slightly different description of coalescence in that she used the term for the use of one consonant, which share features of the two consonants of a cluster. She provided the example of [fok] for "smoke" in which /f/ has the stridency of /s/ and the labialness of /m/.

Glottal Replacement: Glottal replacement is the process of substituting a glottal stop for a consonant. Weiner (1979) hypothesized that it serves as a marker for an omitted consonant.

Examples: Bath: [bæʔ], Fishing: [fɪʔɪn]

2) Feature Contrast/Substitution Processes

Weiner (1979) labeled this process as "feature contrast" and Stoel –Gammon and Dunn (1985) as "substitution process". In either case these processes involve replacing one sound by another sound without being influenced by surrounding phonemes. These substitutions generally are of one class of phonemes. These processes affect liquids, stops, fricatives, affricates, nasals and glides, and occur in the speech of normally developing children.

Stopping: Stopping is a commonly used process and this has been described in slight variations by phonologists. Hodson (1980) defined it as "substitution of stops ……for other consonants..." and also reported that it frequently occurs with the process of stridency deletion. Weiner (1979) stated it "occurs when fricatives are replaced by homorganic stops". Khan (1982) described it as "the use of stops for fricatives and affricates. Edwards and Shriberg (1983) indicated that stopping refers to fricatives, affricates, liquids and glides being replaced by stops or characterized another way, "strengthened to become stops" and also reported that it is particularly common in word- initial fricatives.

Examples: Kiss : [kɪt], Juice : [jut]

Fronting: Fronting refers to the replacement of a target phoneme with another phoneme, which is articulated or produced anteriorly to the target. Of commonly found substitutions, velar fronting is the only one to affect stops in English, and it is, no doubt, the first common substitution process to be outgrown. Fronting occurs much more frequently than corollary process of "backing" (Hodson 1980).

Examples: Sheep: [tip], Cow: [tau]

Backing: Backing occurs when a target sound is replaced with another sound whose place of articulation is posterior to it.

Examples: Go : [toe], Tub: [kub]

Affrication: Affrication occurs when an affricate replaces a fricative. Hodson (1980) reported that children seems to use this process when they are developing continuant sounds and they are learning to differentiate between stops and continuants.

Examples: Sun: [tsʌn], Show: [tʃo]

Deaffrication: Deaffrication is the process of replacing an affricate with a non affricate.

Examples: Chair: [ʃɛð], Jump: [zʌmp]

Palatalization: Palatalization occurs when a sound is produced as a palatal rather than as a non palatal. This occurs on sibilants and clusters (Hodson, 1980).

Examples: Soup: [ʃup], Cream: [tʃim]

Depalatalization: Depalatalization is the process of reversal of palatalization in that a palatal consonant is replaced by nonpalatal sound.

Examples: Mash: [mæs], Jam: [dzæm]

Gliding: Gliding refers to use of glide /w, j/ for another consonant. The process of gliding, which plays a role in acquisition of stop + liquid clusters persist considerably longer. Gliding occurs frequently on prevocalic liquids /r, l / in singletons and clusters, and sometimes on fricatives. A glide for fricative occurs primarily in children with deviant phonology (Weiner, 1979).

Examples: Rain: [wen], Red: [wed]

Vocalization: Vocalization is the process in which a vowel is substituted for a syllabic consonant (/ ɪ, ɜ, ð, m, n /).

Examples: Bottle: [bado], Car: [kau]

Denasalization: Denasalization occurs when a nasal is replaced by a stop that has the same articulatory placement, i.e., a homorganic stop. Weiner (1979) noted that this process occurs more frequently in word initial and medial positions than in the word final position.

Examples: Man: [bæn], Make : [bek]

Neutralization: Neutralization occurs when several different phonemes are replaced by one sound. This process may appear on both consonants and vowels. Weiner (1979) reported that vowels are often replaced with / ʌ /, / ə /, or / ɑ /. He further stated one couldn't predict which consonant will replace which particular group of sounds, since different speaker shows different preferences.

Example: Juice: [ju]

3) Assimilation or Harmony Processes

Assimilation or harmony process occurs when a sound is changed to become more similar to another sound in the word or when a syllable in a word is changed to become more like another syllable in the word. The influence of one sound or syllable upon another syllable or sound in a word can be from left to right or from right to left.

Progressive assimilation occurs when a sound in word is influenced by preceding sound and regressive assimilation is the case when a sound is influenced by later sound.

According to Hodson (1980) regressive assimilation occurs more commonly than progressive assimilation. She also noted that "assimilation may occur even if the 'influencing' phoneme is omitted in the production." Several types of assimilation appear in the speech of children and these can be classified as consonant, voicing, and syllable assimilations or harmony. All of these processes have been noted in the speech of children who are developing normally.

Consonant Assimilation or Consonant Harmony: **Smith (1968)** suggested that consonant harmony is the "part of a universal template which the child has to escape from in order to learn his language." In some children, however, it is rare, and when it is used, it often enters the child's lexicon as a simplification of words produced earlier in a form closer to adult model. The use of consonant harmony can be taken to reflect the child's effort to systematize his or her word production. More specifically, consonant often provides a way of avoiding difficult segments (such as liquids and fricatives) or allowing the child to produce new segments or longer words by reducing overall complexity. Various forms of consonant assimilation occur both in "progressive" and "regressive" and "full" or "partial" forms, including labial assimilation, velar assimilation, alveolar assimilation and nasal assimilation.

Labial Assimilation: It occurs when a non labial sound is changed to a labial in the presence of a labial sound either preceding or succeeding the effected consonant in the

standard word. An example of progressive labial assimilation and regressive assimilation are [bop] for “boat” and [w ʌ m] for “thumb” respectively.

Velar Assimilation: Velar assimilation occurs when a non velar consonant is replaced by velar consonant in the environment of a velar consonant in the target word. Examples of progressive and regressive velar assimilations are

[kok] for “comb” and

[kek] for “take” respectively.

Alveolar Assimilation: Alveolar assimilation refers to the case when a non alveolar sound is changed to alveolar consonant in the presence of an alveolar sound in the adult standard. Examples of progressive assimilation and regressive assimilation are [dædɪ] for “doggie” and [tæt] for “cat” respectively.

Nasal Assimilation: Nasal assimilation occurs when a non- nasal sound is replaced by nasal sound in the presence of nasal sound in the target word. Example of progressive nasal assimilation is [non] for “nose” and regressive assimilation is [nʌn] for “sun”. These are the most frequently reported types of consonant assimilation, in terms of place and manner of articulation. Weiner (1979) mentioned that other types of manner of assimilation also occur, including stop assimilation and fricative assimilation, which operate similarly.

Voicing Assimilation: Two types of voicing assimilation are commonly reported, i.e. prevocalic voicing and final consonant devoicing .prevocalic voicing refer to voicing to an unvoiced consonant when it precedes a vowel. Example include [big] for “bib” and [dæg] for “lag”. Post vocalic devoicing is changing a voiced obstruent at the end of a word to a voiceless obstruent. It is hypothesized that this occurs because of the silence following the word and thus is an assimilation of silence (Ingram, 1976).

Syllable Harmony: Syllable harmony or assimilation refers to the repetition of all or part of a syllable. This process is also termed as reduplication, which can occur in “complete” and “partial” forms. Examples of complete reduplication and partial reduplication are [wawa] for “water” and [baba] for “bottle” respectively.

4) Miscellaneous processes

Metathesis / Migration: Metathesis is generally considered to be the process of reordering or reversing consonants in a word. Edward and Shriberg (1983), however, differentiated between the process of metathesis and migration. Metathesis is characterized by the reversal or transposition of two sounds while migration involves the movement of a phoneme from one position in the word to another position.

Examples: (Edward and Shriberg, 1983).

Metathesis	Migration
Spaghetti : [pʌsgɛtɪ]	Snow : [noz]

Articulatory Shifts: Hodson (1980) identified some processes which she labeled articulatory shifts in which there are "minimal shifts in, place of articulation, while, manner, of articulation is same." These processes are what we often think of as "normal developmental misarticulation" and, as Hodson indicated, these shifts alone seldom greatly affect the intelligibility. There are four types of articulatory shifts, first substitution of /f, v, s, z/ for / θ, ð /. Examples include [fɪŋk] for "think" and [maus] for "mouth". A second type is frontal lisp which is producing /s/ and /z/ and sometimes/ ʃ, ʒ, ʦ, ʤ / with protruded tongue .i.e., with tongue placement being too far forward. Third type is dentalization of / t, d, n, l / in which these phonemes are produced with a tongue protrusion. The fourth type of articulatory shift pattern is lateralization in which air is emitted laterally through the teeth rather than medially. This occurs primarily on the sibilants.

Idiosyncratic patterns: Individual children sometimes use processes, which are unique to their phonological system. Stoel-Gammon and Dunn (1985) presented a table that illustrates and describes seven of the more frequently mentioned idiosyncratic processes in English (Table 8).

Table 7: Idiosyncratic processes (Stoel -Gammon and Dunn, 1985)

Processes	Description
Atypical cluster reduction	Deletion of the member that is usually retained:[ren] for "train" and [sap] for "stop"
Initial consonant deletion	Deletion of singleton consonant in the initial position of a word Example is [ep] for "tape"
Glottal replacement	Substitution of a glottal stop for a consonant, usually in medial or final position [læʔð] for "ladder"
Backing	Substitution of a velar consonant for a more anterior consonant Example is [pæk] for "pat"
Fricatives substituted for stops	Substitution of affricative consonant for a stop consonant. Example is [sænd] for "candle"
Stops substituted for glides and	Substitution of a stop consonant for glide consonant. Example is [bɪl] for "will"
Sound preference	Substitution of one consonant for several other consonants, in an operable pattern. Substitution of [f] for most initial fricatives and affricates and for initial stops in /stop +r/ clusters

Vowel Patterns in Child Phonology

Although the emphasis of research on phonological developments and disorders has been on consonants, some studies have focused on the development of the vowel system (Pollack and Keiser, 1990; Stoel-Gammon and Herrington, 1990; Reynolds, 1990). They posited that vowel errors would fall into one of three subtypes

- Feature changes, in which vowel features (height, frontness, and roundness) change its value.
- Complexity changes, which involves changes in diphthongal nature of vowels.
- Vowel harmony, in which a vowel changes to become more like another vowel in the same word.

Schane (1973) describes vowel epenthesis, vowel deletion, vowel harmony, vowel coalescence, vowel shift and vowel neutralization.

1) Feature Changing Processes

Vowel backing*:* In this process a vowel is replaced by a more posterior vowel.

Example: æ : [ɑ]

Vowel Lowering: In this process a central vowel replaces a high vowel.

Example: ɪ : [ɛ]

Vowel unrounding: Rounded vowel is produced without rounding.

Example: ɔ : [a]

2) Complexity Changes

Diphthongization: A monothong is replaced by a diphthong

Example: ɑ : [æ]

Diphthong reduction /monothongization: Here a diphthong is produced as a monothong.

Example: aɪ: [a]

3) *Vowel Harmony*

Complete vowel harmony: In this process one vowel is changed so that both vowels in the word are the same.

Example: Teddy: [tɛdɛ]

Tenseness Harmony: Lax vowel becoming tense when there is tense vowel in the same word.

Example: Money: [meni]

Height Vowel harmony: A vowel is replaced with a vowel that is closer in the production to the height of another vowel in the same word.

Example: Basket : [bɛskɪt]

Consonant Vowel Harmony: A vowel is changed due to the presence of neighboring consonant.

Example: Mol: [mɔl]

The phonological processes identified by various researchers are presented in Table 8 (a) and 8 (b).

Table 8 (a): Classification of phonological processes by various authors

Weiner (1979)	**Shriberg & Kwiatkowski (1980)**	**Hodson (1980)**
Syllable structure process deletion of Final consonant **Cluster reduction:** Initial stop +liquid Initial Fricative +Liquid Initial /s/ clusters Final /s/ clusters Final Liquid + stop Final nasal + stop Weak Syllable Deletion Glottal Replacement **Harmony Processes** Labial assimilation Alveolar assimilation Velar assimilation Prevocalic voicing Final Consonant Devoicing Syllable Harmony **Feature contrast processes** Stopping Gliding Fricatives Affrication Fronting Denasalization Glide of liquids Vocalization	1 Final Consonant Deletion 1. Velar Fronting: Initial Final 3 Stopping: Initial Final 4 Palatal Fronting Initial Final 5 Liquid Simplification Initial Final 6 Assimilation Progressive Regressive 7 Cluster Reduction Initial Final 8 Unstressed Syllable Deletion	**Basic phonological processes** syllable Reduction Cluster Reduction Prevocalic Obstruent Singleton omissions Post vocalic Obstruent Singleton Omission Stridency Deletion Velar deviations Miscellaneous phonological processes Prevocalic Postvocalic devoicing' glottal Replacement Backing Fronting Affrication Deaffrication Palatalization Depalatalization Coalescence Epenthesis Metathesis **Sonorant Deviations** Liquid /l/ Liquid/r/ Nasals Glides Vowels **Assimilations** Nasals Velar Labial Alveolar Articulatory Shifts Substitution of /f, v, s, z,/ for /.../ Frontal lisp Dentalization of /t, d, n, l / Lateralization **Other pattern**

Table 8 (b): Classification of phonological processes by various authors

Ingram (1981)	**Grunwell (1985)**	**Dean et al. (1990)**
Deletion of final Consonant 1. Nasals 2. Voiced stops 3. Voiceless stops 4 Voiced fricatives 5 Voiceless fricatives Reduction of Consonant Cluster 6. Liquid 7. Nasals 8. /s/ Clusters Syllable deletion & reduplication 9. Reduction of disyllables 10. Unstressed Syllable deletion 11. Reduplication Fronting 12. Of palatals 13. Of velars Stopping 14. 0f initial voiceless fricatives 15. Of initial voiced fricatives 16. Of initial affricates Simplification of Liquids and Nasals 17. Liquid gliding 18. Vocalization 19. Denasalization Other substitution Processes 20. Deaffrication 21. Deletion of initial consonants 22. Apicalizattion 23. Labialization Assimilation Processes 24. Velar assimilation 25. Labial assimilation 26. Prevocalic voicing Devoicing of final consonant	Structure simplifications Weak syllable deletion Pretonic Postonic Final Consonant Deletion Nasals Plosives Fricatives Affricatives Clusters-1 -2+ Vocalization /l/ other C Reduplication Complete Partial Consonant Harmony Velar Alveolar Labial Manner Other S.L Cluster Reduction Plosives + approximants Fricatives + approximants /s/ + plosive /s/ + nasal /s/ + approximants /s/+ plosive + approximants Systematic Simplifications Fronting Velars Palato-Alveolars Stopping: /f/ /v/ /θ/ /ð / /s/ /z/ / / /t/ /dʒ/ /l/ /r/ Gliding:/r/, /l/ Fricatives Context Sensitive Voicing WI and WF Voicing Voicing WW Devoicing WF Glottal Replacement: WI WW WF Glottal Insertion	**Systemic processes** Velar fronting Palato- Alveolar Fronting Stopping of Fricatives Stopping of Affricatives Word Final Devoicing Context Sensitive Devoicing Liquid Gliding Fricatives Simplification (θ f : ð v) Backing of Alveolar Stops (Unusual/Atypical process) **Structure Processes** Final Consonant Deletion Initial Cluster Reduction/deletion Initial Consonant Deletion (Unusual/atypical process)

Suppression of phonological processes

According to natural phonology, there seems to be a time frame during which normally developing children do suppress certain processes. This approximate age of suppression is helpful when determining normal versus disordered phonological system and can be used as guidelines when targeting remediation goals.

Becker (1982) studied 10 monolingual Spanish children aged four years and found that deaffrication, /r/ deficiencies, cluster reduction, epenthesis, weak syllable deletion and alveolar assimilation to be the most used processes in these children. Later Martinez (1986) reported tap/trill deficiencies and consonant sequence reduction, deaffrication, stopping, affrication, fronting, assimilation, and sibilant distortion in three-year-old Spanish children. Locke (1983) outlined three stages in the processes of phonological acquition. During *pragmatic stage* child begins to recognize that sounds can convey information to others and start sometime before the first year, shows the child's knowledge of the function of speech. During *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.

Dyson (1988) and Newman and Creaghead (1989) reported that in SAE (South American English) speaking children at the age of 3 years acquire a core set of phonemes consisting of /m/, /n/, /p/, /b/, /d/, /t/, /g/, /k/, /w/, /l/, /r/, /j/, /f/, /s/ and /h/. During this period of phoneme acquition children's speech often includes the

phonological processes of final consonant deletion, unstressed syllable deletion, reduplication, consonant harmony, stopping, fronting, gliding and context sensitive voicing. But according to Ferguson, Menn, Stoel Gammon, 1992; Grunwell, 1987; Locke, 1983; by the age of 3 years, unstressed syllable deletion, final consonant deletion, consonant assimilation, reduplication, velar fronting and prevocalic voicing begin to disappear from typically developing child's speech. Processes, which persist beyond the 3 years of age, include cluster reduction, epenthesis, gliding, vocalization, stopping, depalatalization and final consonant devoicing.

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 errors pattern were stopping, gliding, vowel deviation, epenthesis, substitution of /l/ for /r/ and sibilant distortions. Topbas (1997) studied the phonological acquition 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 where as in English, /r/ is usually replaced by /w/ or /j/ a gliding process. The suppression of processes as observed by some researchers are summarized in Table 9.

Table 9: Age of suppression for several processes (Smith, 1993; Lowe, 1996; and Khan & Lewis, 2002)

	2:0	3:0	4:0	5:0	6:0	7:0	8:0	9:0
Labialization……..]								
Aveolarization……]								
Affrication…….]								
De affrication…….....]								
Vowelization……]								
Derhotacization……]								
Denasalization……]								
Epenthesis……..]								
Consonant cluster substitution…….....]								
Voicing changes								
Context sensitive…….]								
Initial voicing…….]								
Final Devoicing……...]								

Stewart (2003) took spontaneous speech sample of 8 children of 2 years of age of AAE (African American English) speaking children in playful condition and sample was audio and video recorded. These children used 18 phonological processes as identified by ISPA (Interactive System for Phonological Analysis). Each process was calculated by using the total number of occurrences divided by the total number of opportunities for that process to occur. This calculation yielded a percentage for each process for all the participants. The process most frequently used were cluster reduction (77%), final consonant deletion (41%), stopping of affricate (25%), gliding of liquid (24%), and vowelization of /r/ (22%).

Studies on Indian languages

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 10 below.

Table 10: Shows the phonological processes in Indian studies

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 (2001)	Kannada	5-6yrs	Stridency deletion, deaspiration, and retroflex deletion
4	Sreedevi et al (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

Assessment Methods Based on Phonological Processes

There are varieties of published phonological assessment instruments discussed in the literature. Although clinicians often use a particular tool, it is well recognized that no one test is appropriate to evaluate all the clients. A practical consideration in selection of assessment procedure is the time factor involved. Some of the phonological assessments discussed in literature are briefly highlighted in Table 11.

Table 11: Characteristics of the published phonological assessment tools

Basis of comparison	**Hodson (1980, 1986)**	**Khan-Lewis (1986)**	**Bankson and Bernthal (1990)**	**Lowe (1986)**
Name of the test	Assessment of phonological processes-Revised (APP-R)	The Khan-Lewis Phonological Analysis (KLPA)	Bankson-Bernthal Test of Phonology (BBTOP)	Assessment Link b/w phonology & articulation (ALPHA)
Stimuli	3-dimensional; objects	Picture from the Goldman - Fristoe Test of articulation	Pictures	Pictures
Elicitation procedures	Object naming	Picture naming	Picture naming	Sentence imitation
Sample size transcription	50 single word	44 single words	80 single words	50 single words
NO. of processes	30 deviations	12 developmental & 3 non developmental processes	10 most frequently occurring processes	11 most frequently occurring processes
Target population	Children with multiple articulation errors.	Normal and phonological disordered children	Normal and phonological disordered children	Normal and phonological disordered children
Total Time	App. 50 min.	App. 35 min	App. 30 min	App. 10-15 min
Frequency of occurrences	Calculation for 10 basic deviations	Freq of each of 15 processes	Freq of each of 10 processes	Freq of each of 15 processes

Although there is undoubtedly much more to be learned as phonologists observe large numbers of children, two significant principles already have emerged; (a) children progress by gaining insights into basic characteristics of the sound system and thus are enabled to add phonemes and sequences to their repertoires. (b) these basic characteristics include not only place and manner features, such as velar and strident, but, equally important, rules for syllable shapes and sequences, such as CVCV and CCCV.

To conclude the review, it can be stated that the phonological approach takes advantage of the systematic nature of speech deviations. Rather than focusing on individual sound errors and perfecting speech sound segments, the phonological approach is directed towards more basic components of the child's system.

METHOD

The aim of the present investigation was to study the patterns of the phonological processes exhibited by native Hindi speaking normal children. This was done by analyzing recorded speech samples and identifying various phonological processes.

Objectives of the Study

- To study the normal phonological development in 2-3 years old Hindi speaking children.
- To study the phonological processes which are occurring in two age groups and to identify those processes which are suppressed by 3 years of age.
- To compare the phonological patterns across the two age groups.

Subjects

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:

2.0-2.6 years (4 boys and 10 girls)

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

socioeconomic 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
6) Normal oral speech mechanism and
7) 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 bisyllabic and except a few trisyllabic ones. The word list had 24 consonants (k, k^h, g, g^h, ts, ts^h, dʒ, $dʒ^h$ t, θ, d, d, , n, p, f, b, b^h, m, r, l, v, s, ʃ, and h), six vowels including diphthongs (*a*, *a*:, ɪ, 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). These specific phonemes were considered as they had high frequency of occurrence in Hindi (Ohala, 1991). 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'X6' size. These picture cards were arranged in random order. The test words were selected on the basis of

1) Easy to produce i.e. bisyllabic or trisyllabic
2) Picturable
3) Regularly used in functional day to day 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 is 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 with in 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 63% among the four judges for the 2.0-2.6 years group and 55% 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 analysed to 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 and 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

The present study intended to study the various phonological processes occurring in the age range of 2.0 to 2.6 and 2.6 to 3.0 years old Hindi speaking normal children. 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 12 shows the mean percentage and standard deviation of correct responses produced by the 14 subjects each in the two age groups.

Table 12: The Mean and SD of percentage of correct responses in 2.0-2.6 and 2.6-3.0 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 analyse 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

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 number of occurrence of each process in all the subjects of lower and higher age groups are provided in Tables 13 and 14 respectively.

Table 13: Distribution of different phonological processes in 2.0-2.6 year group

Sl No.	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

Table 14: Distribution of different phonological processes in 2.7-3.0 years

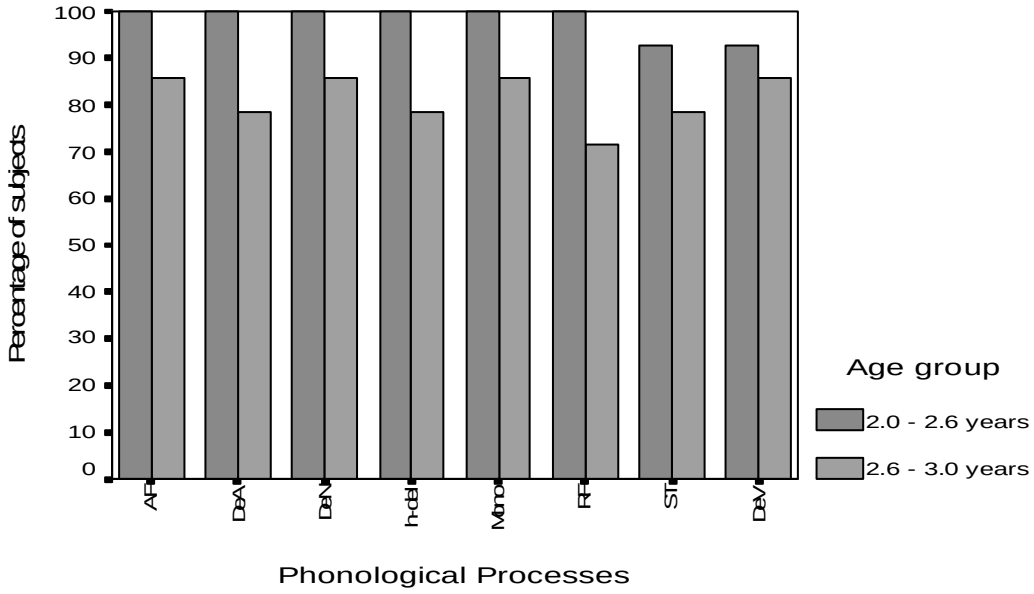
Sl No.	PRO	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14
1	RF	-	-	13	11	14	18	19	12	-	-	14	15	10	8
2	DeA	10	10	8	-	-	11	10	12	8	7	8	9	-	8
3	St	2	1	6	3	-	6	5	5	1	11	9	-	-	9
4	FR	2	-	-	-	1	11	9	-	-	-	8	-	1	-
5	ICR	6	-	9	-	8	8	6	-	-	10	8	2	-	-
6	FCR	2	6	-	3	3	-	3	6	3	-	3	-	2	4
7	AF	12	7	9	6	8	12	12	12	-	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

Symbols used:

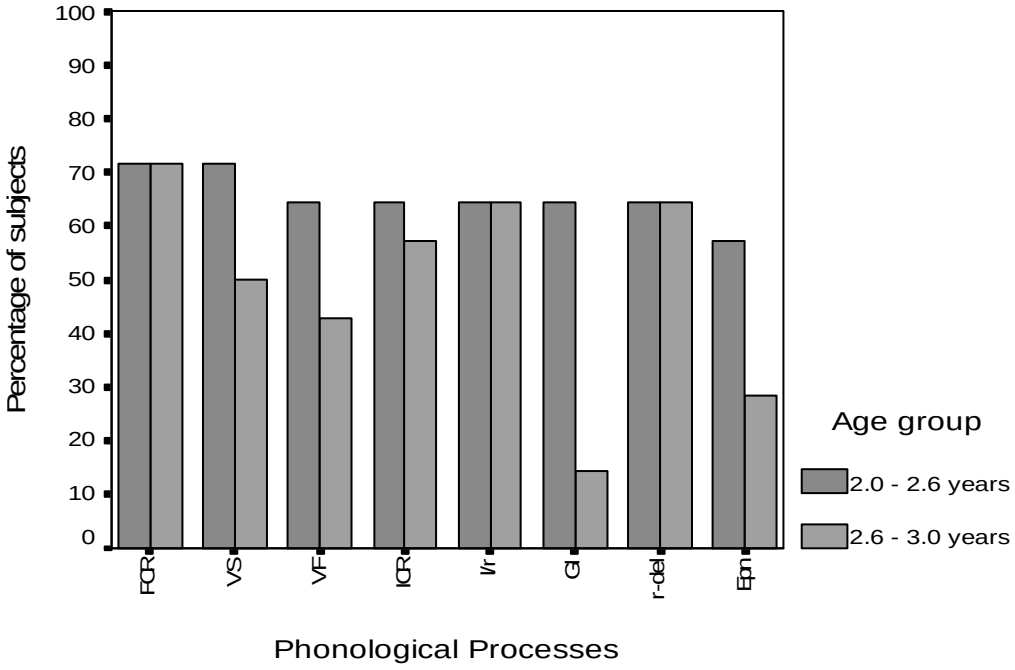
RF: Retroflex Fronting
FR: Fronting
ICR: Initial Consonant Reduction
AF: Affrication
NS: Nasal substitution
ICD: Initial Consonant Deletion
Epn: Epenthesis
GL: Gliding
Vs: Vowel Shortening
VL: Vowel lowering
Mono: Monothongization
St: Stopping
BK: Backing
FCR: Final Consonant Reduction
Den: Denasalization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

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

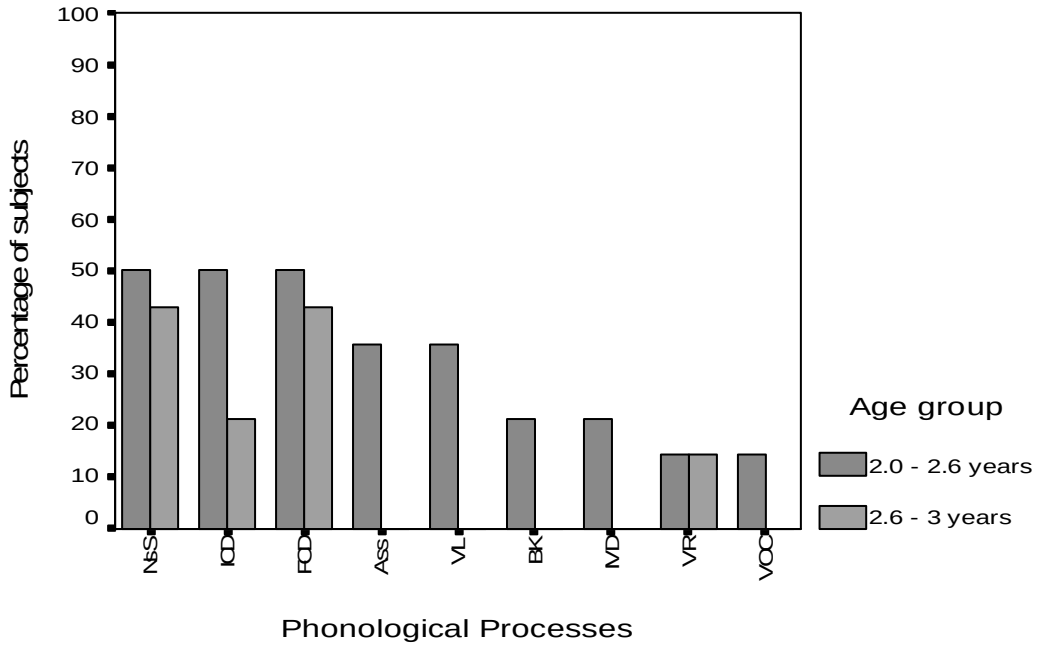
Graph 1: Percentage of subjects who exhibited different phonological processes in the two age



Graph 2: percentage of subjects who exhibited different phonological processes in the two age groups



Graph 3: Percentage of subjects who exhibited different 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 15.

Table 15: Percentage of subjects exhibiting different Phonological processes in 2.0 – 2.6 years and 2.6- 3.0 years

Sl No.	Phonological Processes	No. of subjects Exhibiting the process (2.0- 2.6 Yrs)	Percentage of subjects Exhibiting the process (2.0- 2.6 Yrs)	Phonological Processes	No. of subjects Exhibiting the process (2.6- 3.0 Yrs)	Percentage of subjects Exhibiting the process (2.6- 3.0 Yrs)
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 sustitution	9	64.29
11	Vvelar 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	-	-	-

After the percentage of subjects exhibiting each process was calculated, these processes are classified into 3 major categories (Table 16). This was done on the basis of the method used by Ramadevi (2006). The classification is as follows:

1) First category, comparing of phonological processes occurring in 20% or less than 20% of the subjects. These are considered as occasionally occurring processes.

2) Second category comparing of phonological processes occurring in more than 20 % and less than 60% of the subjects. These are considered as frequently occurring phonological processes.

3) Third category, comparing of phonological processes occurring in more than 60 % of the subjects. These are considered as phonological processes occurring most of the time.

Table 16: Categorization of phonological process based on percentage of subjects exhibiting the processes

Sl No.	(2.0-2.6 Years)			(2.6-3.0 Years)		
	Percentage of subjects exhibiting the processes			Percentage of subjects exhibiting the processes		
	Less than 20%	20-60%	More than 60%	Less than 20%	20-60%	More than 60%
1	VOC	IVD	RF	VR	ICD	RF
3	VR	BK	DeA	GL	FCD	DeA
4		VLw	AF		NeS	AF
5		Ass	DeN		Epn	DeN
6		FCD	/h/ del		VS	/h/ Del
7		ICD	Mono		VF	Mono
8		NeS	St		ICR	St
9		Epn	DeV			DeV
10			FCR			FCR
11			VS			l/r Sub
12			VF			/r/ Del
13			ICR			
14			l/r Sub			
15			GL			
16			/r/ Del			

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.

The frequently occurring processes or 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 were 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 in 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]

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. / sʌnp /: [tsʌnp]

4) Denasalizatin (DN): This was seen in 100 % and 86 % of the lower and higher age groups respectively.

Eg. / ɑːnk /: [ɑːk]

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. / kʰaːnɑː/ : [kɑːnɑː]

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 un common in Indian languages. Therefore it is acquired late and /h/ deletion is seen.

E.g. : / hɑːti/: [ɑːti]

6) 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]

7) 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] - IPA

8) Devoicing (DeV): 92% and 86 % of the subjects of the lower and higher groups evidenced this process.

Eg. : / bæg/ : [bæk]

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 : / tastri/: [tasti] ipa

It was observed that the clusters /rf/ and /ksi/ were produced correctly by 29% of the subjects in both the age groups.

10) 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]

11) 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]

12) Velar Fronting (VF): This feature was noticed in 64% and 43% respectively in younger and older age groups.

Eg. : / naːk/ : [naːt]

13) /r/ Deletion: In both the age groups 64 % of the children had this feature and as said earlier /r/ is a complex phoneme and hence deleted during in 2-3 years of age.

Eg: /kaː r/: [kaː]

14) 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]

15) Epenthesis (Epn): This feature was present in 57% and 29 % of the two age groups respectively.

Eg. / plet/ : [pəlet]

16) 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]

17) Final Consonant Deletion (FCD): Seen in 50 and 43 percent of the two age groups respectively.

E.g, : /baːl / [baː]

18) 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. Initial Consonant Deletion, 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 salient 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]

19) Assimilation (Ass): This process was present only in the younger age group (35%). Mostly labial and velar assimilations were observed.

Eg. Labial and velar egs

20) Vowel lowering (VL): Was a process found only in younger age group for 35% of the subjects.

E.g., : /swetər/ : [swatər]

21) Backing (BK): This process was also seen only in younger age group for 21%.

Eg. /daːnt / : [daːnk]

22) Initial vowel deletion (IVD): Was seen in 21 % of the subjects in younger age group.

E.g. : /anaːr/ : [naːr]

23) Vowel shortening (VS): This was seen in 71 % and 50 % subjects of the two age groups.

E.g., : / ʊnt / : [unt]

24) Vowel Raising (VR): Found in 14% of the subjects in both the age groups

E.g. : / tsəmats / : [tsəmets]

25) Vocalization (VOC): This process was seen in 14 % of the subjects only in the younger age group

E.g., : / 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 5 phonological processes namely, retroflex fronting, deaspiration, /h/ deletion, gliding, and initial consonant deletion were significantly higher in 2- 2.6 years old group compared to 2.6 -3.0 years old group at 0.05 level . There was no significant difference noticed in the percentage of the subjects exhibiting other processes across the two age groups.

Another salient finding was that 5 phonological processes such as backing, assimilation, vocalization, vowel lengthening and initial vowel deletion were operational only in the speech of younger age group, this means to say that these 5 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 raising 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 raising. 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. This finding is in consonance with several earlier reports (========).

An attempt was also made to classify the phonological processes observed in this study under the three major categories as suggested by Grunwell, 1985. This classification is provided in Table 17.

Table 17: 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 indicates that though there are lot 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.

SUMMUARY AND CONCLUSIONS

With in the last decade or so, the study of phonological development has shifted from examining the mastery of individual sounds to the acquition and ordering of the phonological system. According to natural phonology, there seems to be a time frame during which normally developing children do suppress certain processes. This approximate age of suppression is helpful when determining normal versus disordered phonological system and can be used as guidelines when targeting remediation goals.

In the present study an attempt was made to study the different phonological processes occurring in the age range of 2-3 year old Hindi speaking normal children. Totally 28 children, 14 each in the age groups of 2.0 -2.6 and 2.6 -3.0 years were considered as subjects for the study. The target material included most frequently used bisyllabic and a few tri syllabic words in Hindi incorporating 24 consonants, 6 vowels and 5 consonant clusters in both initial and final positions of simple words. Totally there were 70 test words. These 70 words were picturized and presented to the subjects one picture card at a time. The elicited target words were audio recorded and later analyzed for identifying the various phonological processes operating in the speech of children.

Statistical analysis revealed that the mean percentage of correct responses was higher in the older age group. Children of both age groups demonstrated a wide array of phonological processes. The lower and higher age groups evidenced 25 and 20 phonological processes respectively. With the advancement of age from 2.0 -3.0 years, some of the processes were suppressed and while others persisted. The decrease in the usage of processes can be attributed to following reasons such as, increase in phonetic knowledge and refining articulating gestures. The processes were categorized based on the percentage of subjects exhibiting them. In both age groups some 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 baking, vocalization, assimilation, vowel lowering and initial vowel deletion were not present in the higher age group. Hence it can be stated that these processes are suppressed by 2.6 years or so.

To conclude it can be said that during the course of phonological development, children evidence simplification of several phonological patterns which are quite systematic in nature. These simplifications lessen remarkably as their speech production nears adult target. The present study also reiterates the fact that these phonological simplifications are language specific and this warrants establishment of phonological norms in our own languages. The findings of the present study are applicable in screening the phonological skills of a young Hindi speaking child.

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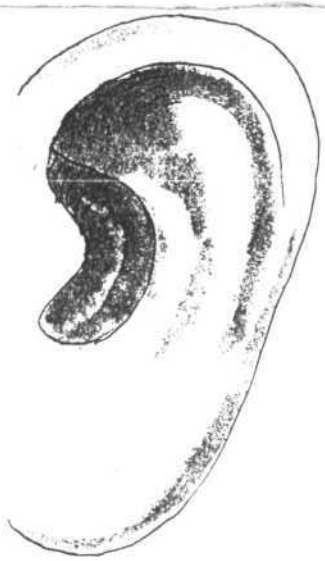
APPENDIX



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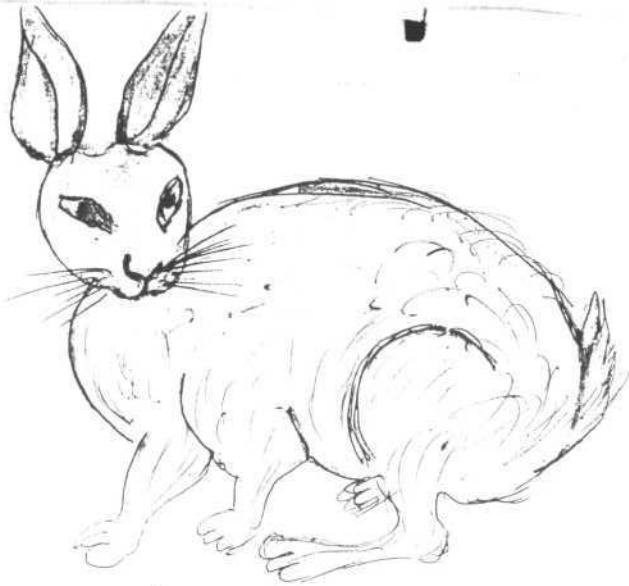

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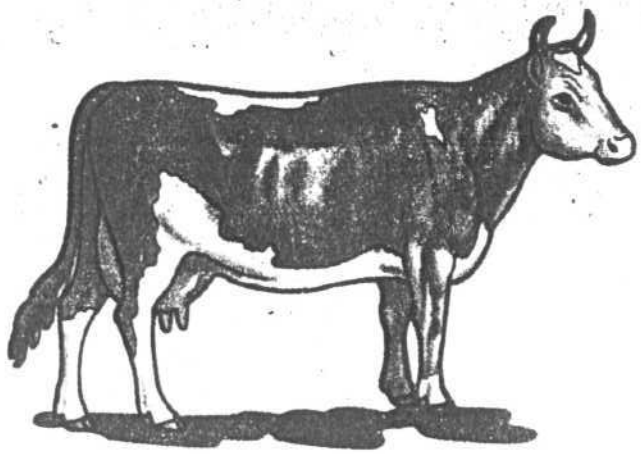

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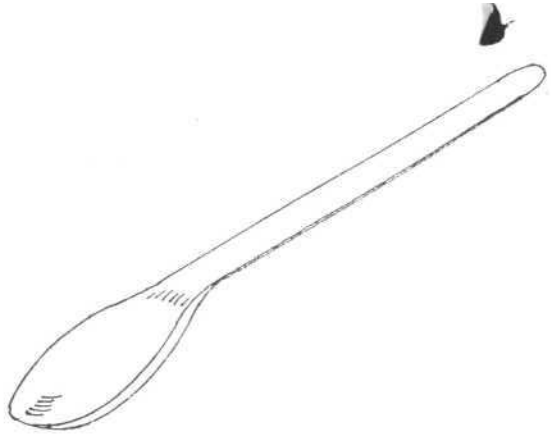

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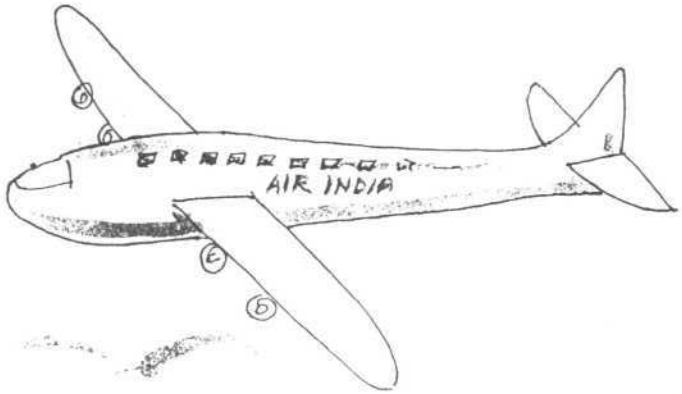

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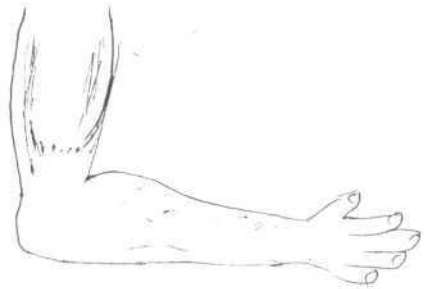

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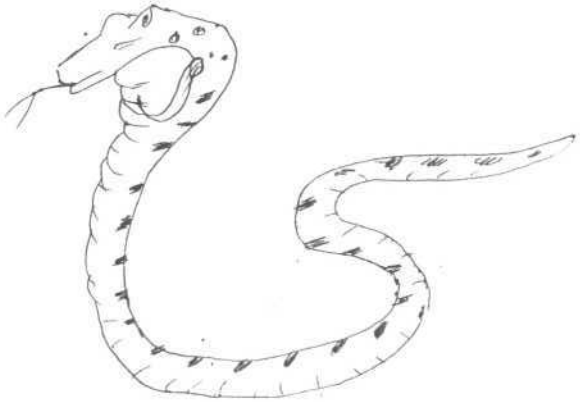

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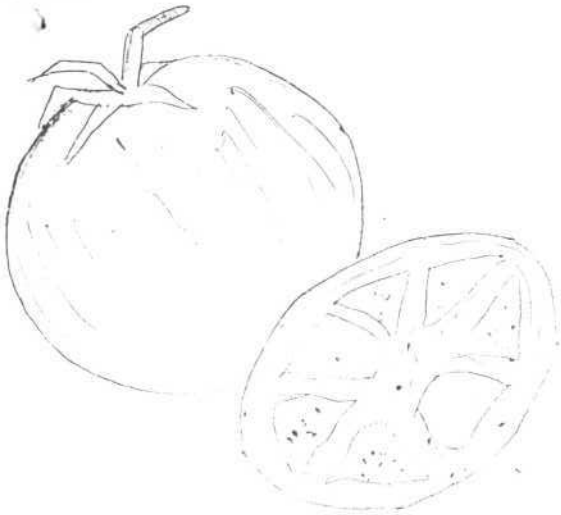

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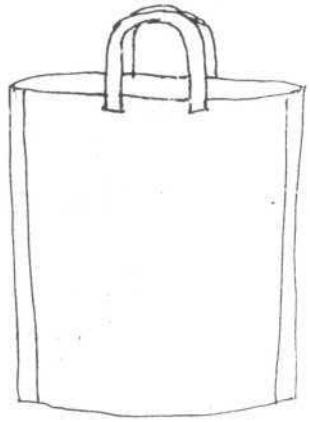

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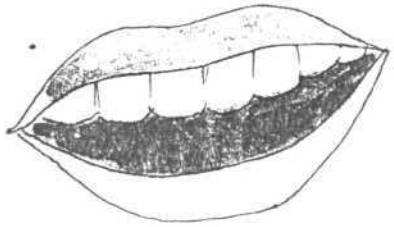

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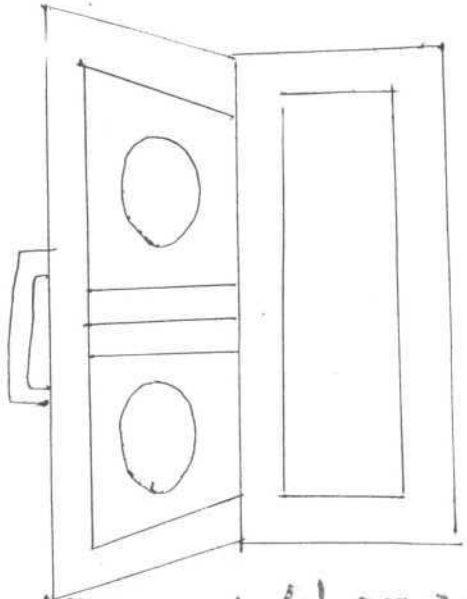

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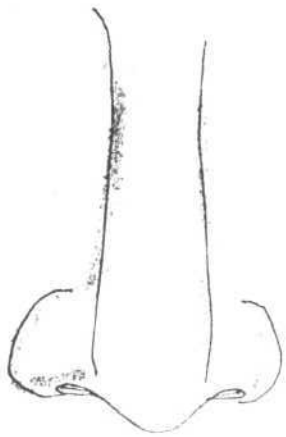

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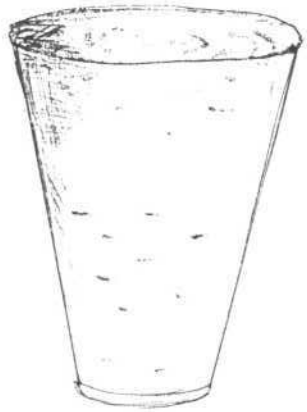

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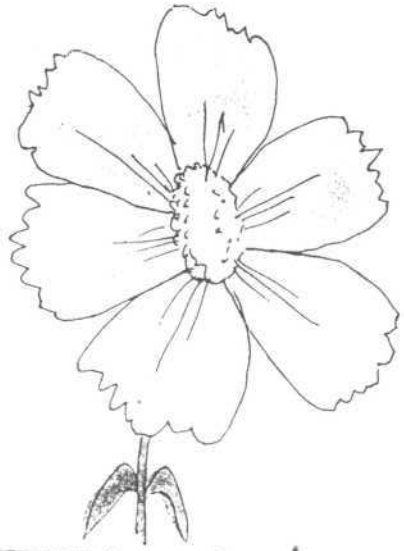

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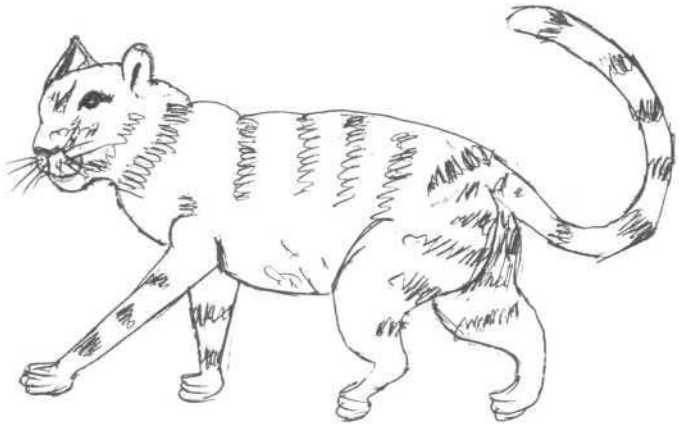

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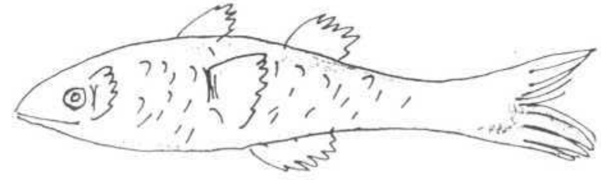

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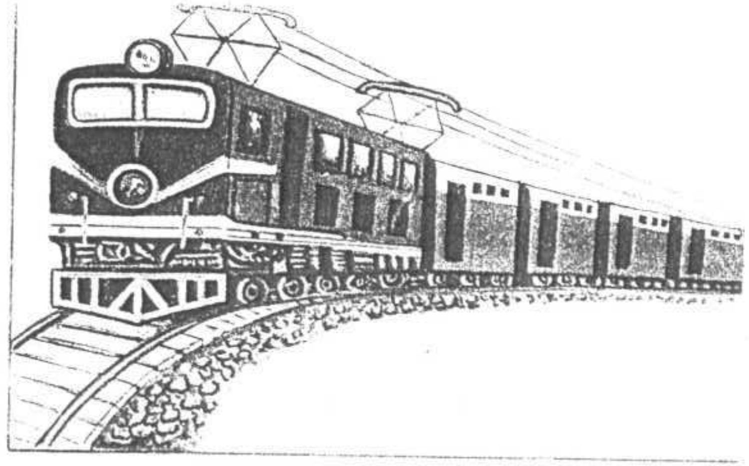

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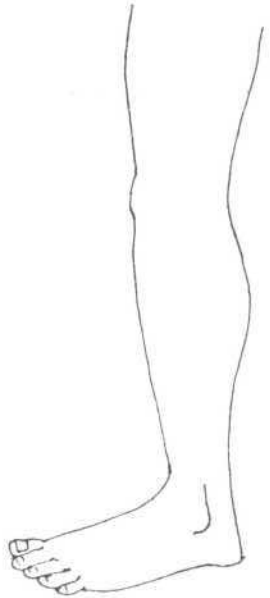

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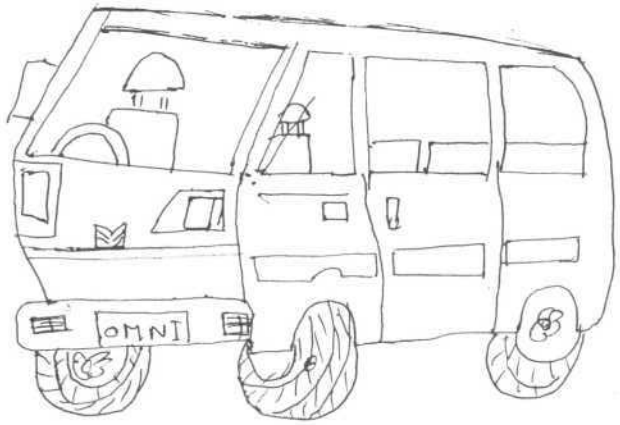

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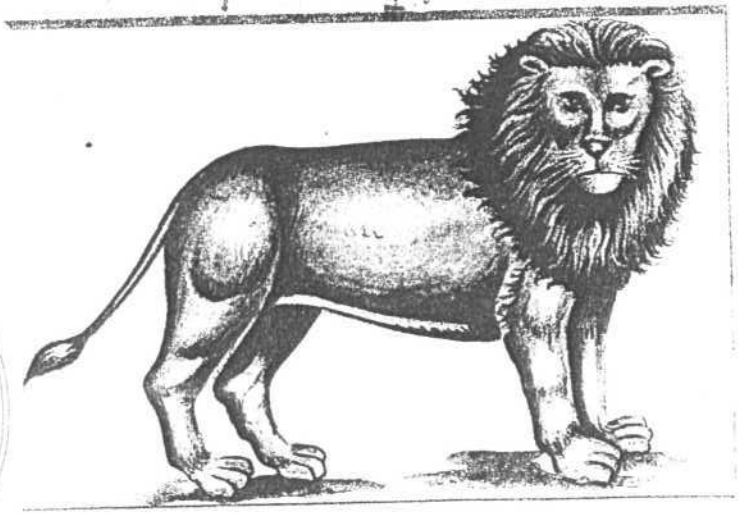

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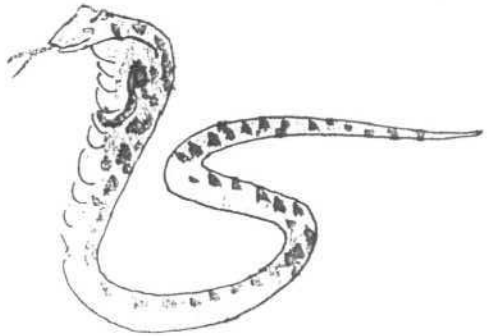

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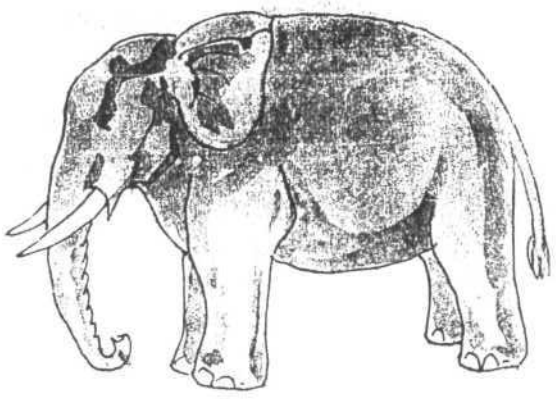

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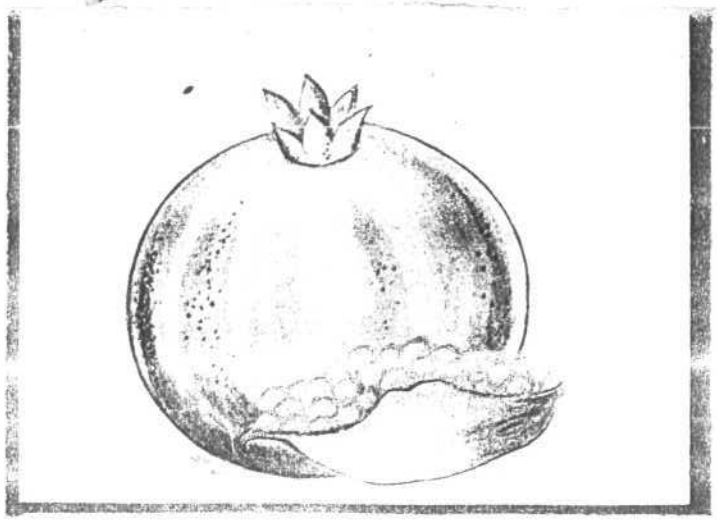

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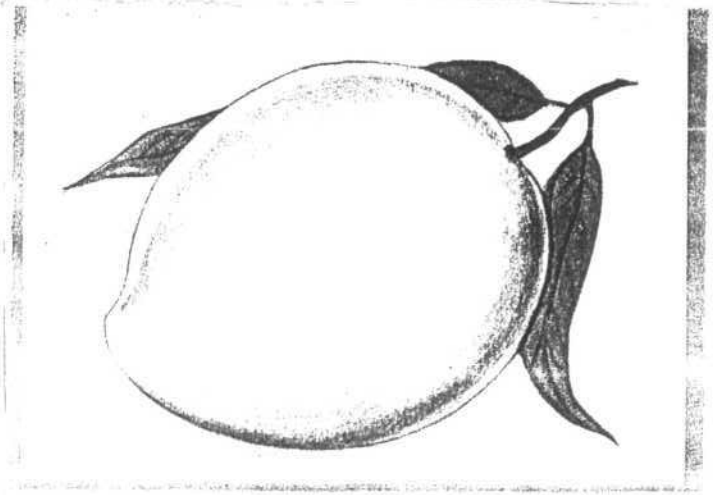

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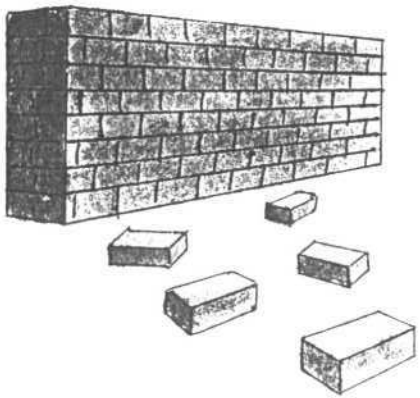

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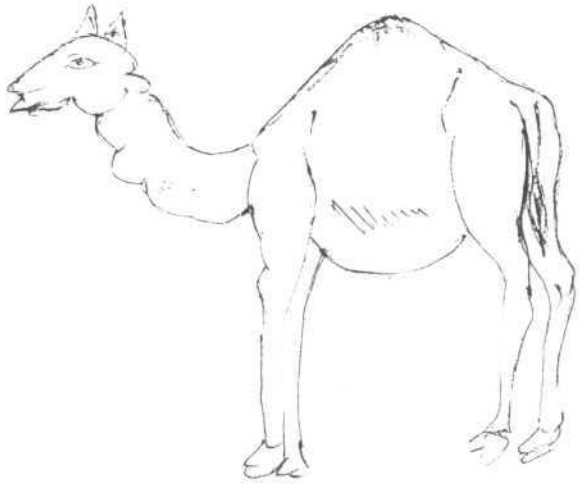

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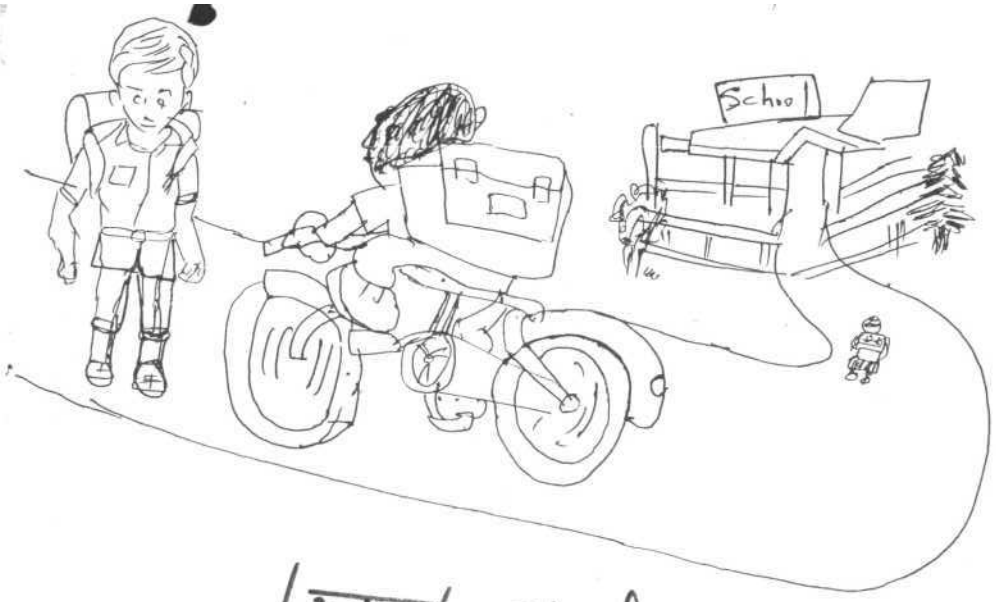

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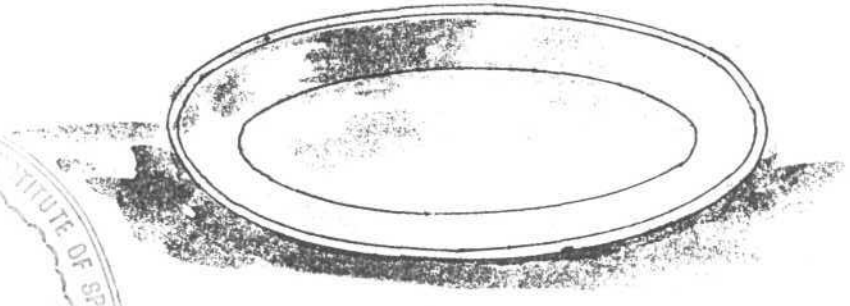

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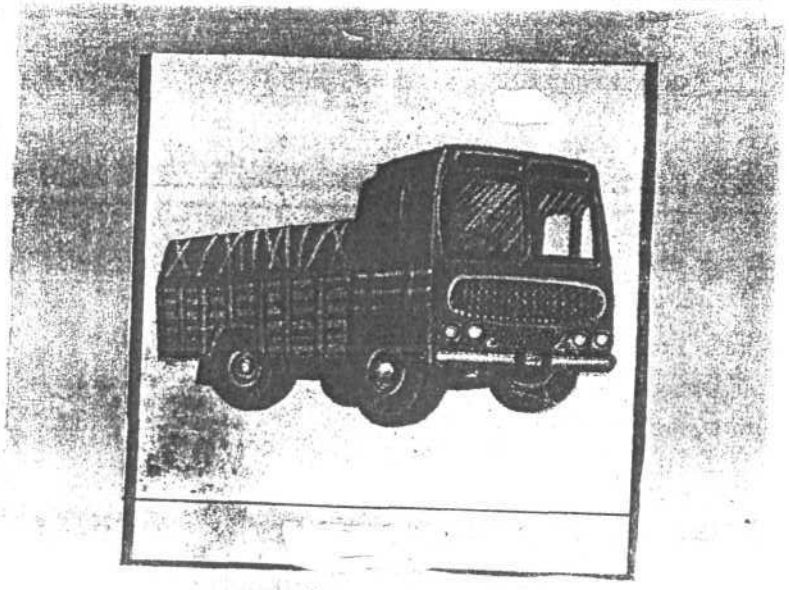

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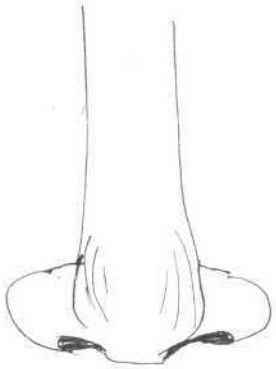

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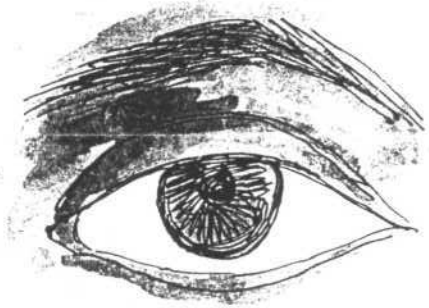

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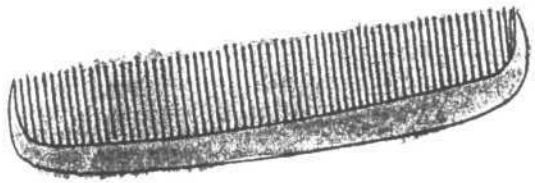

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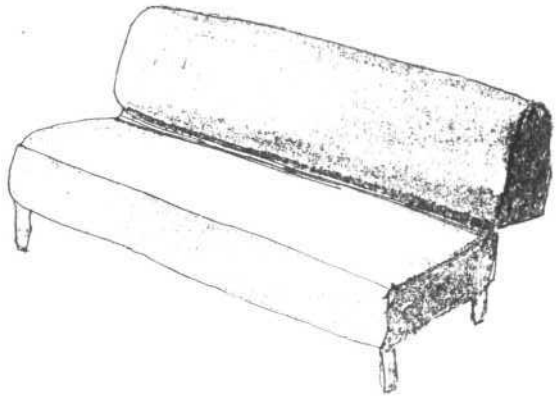

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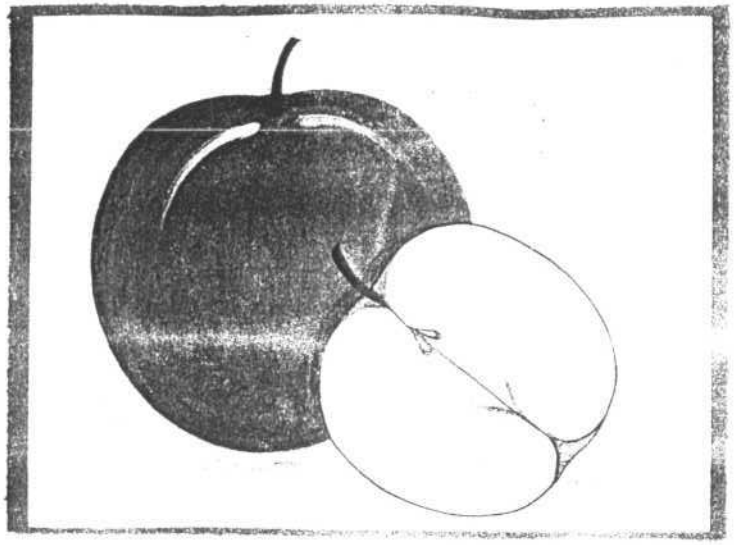

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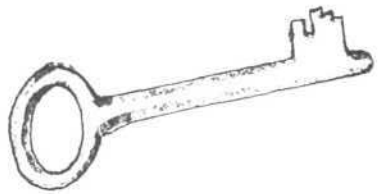

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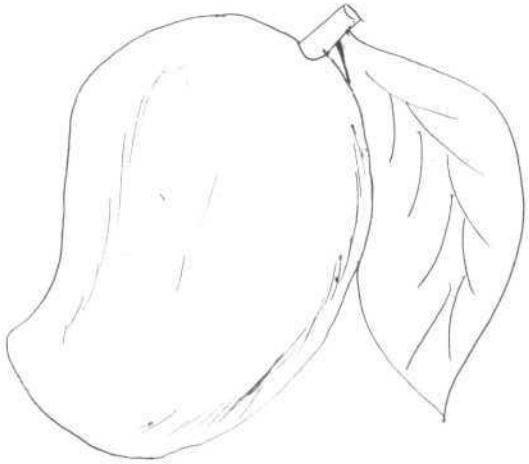

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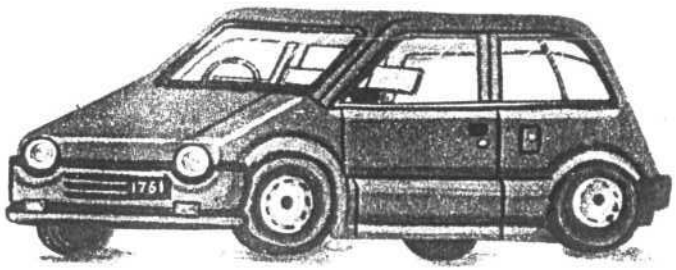

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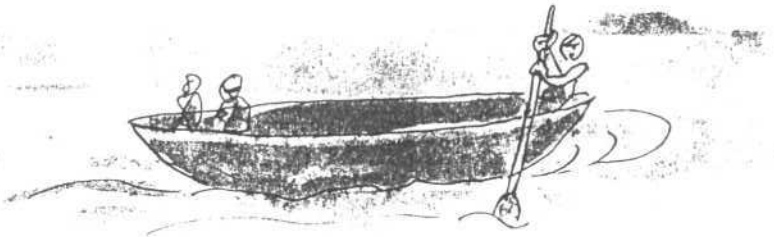

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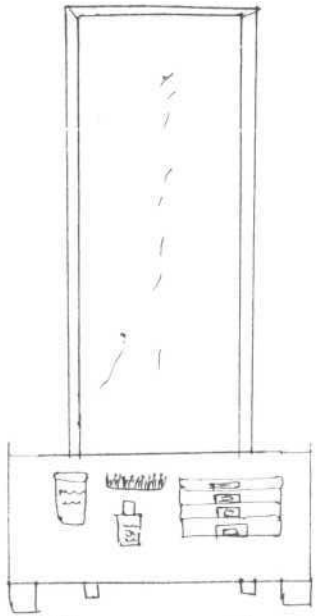

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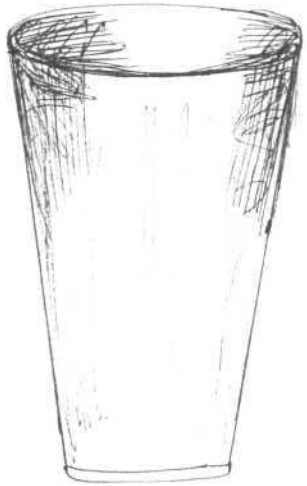

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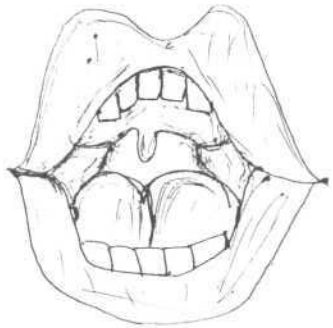

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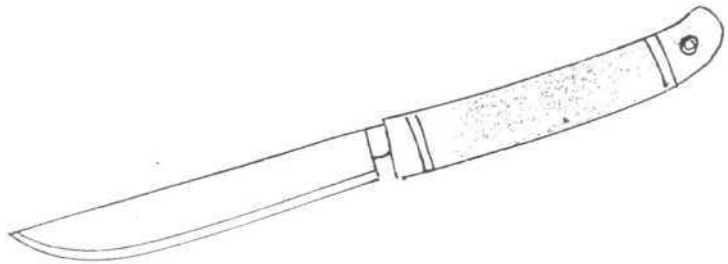

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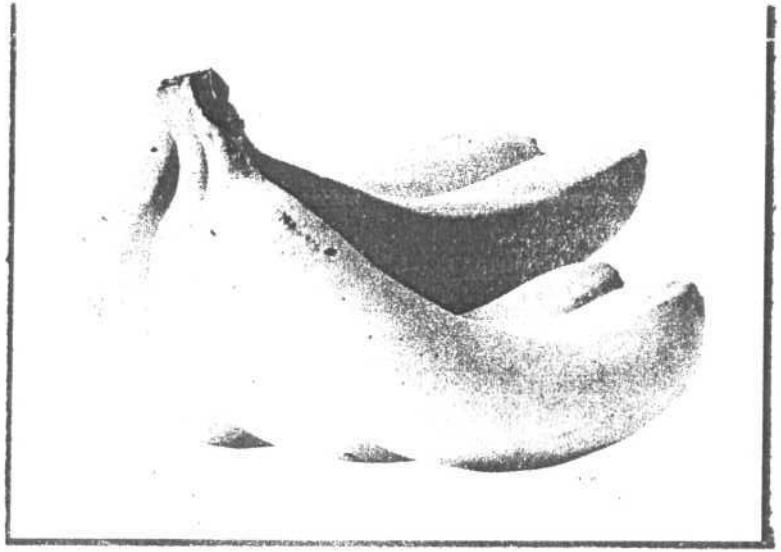

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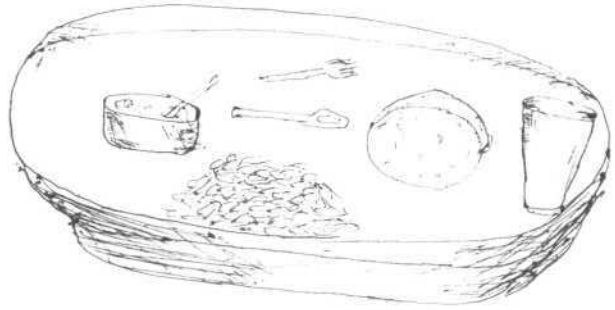
/भागो/ : /bʰa:go/

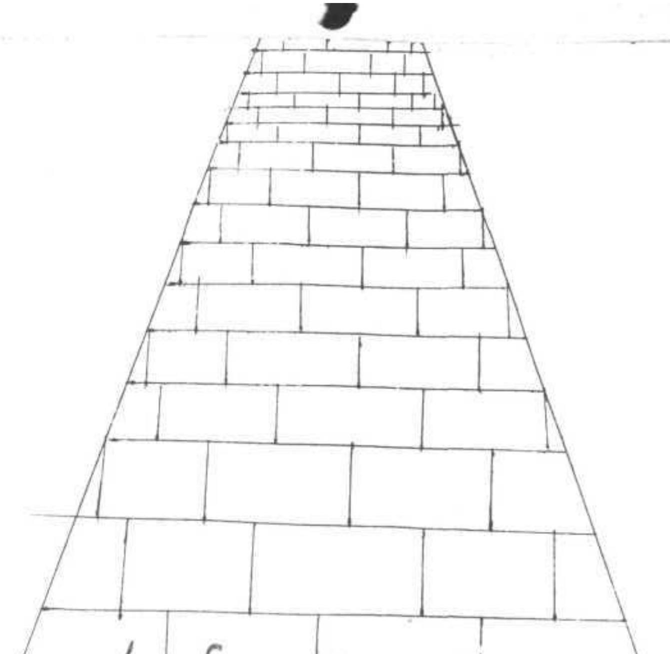
/कप/: /kʌp/



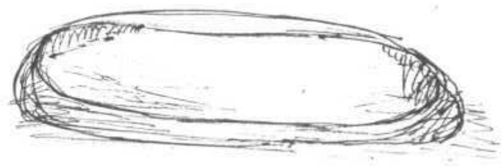
/खाना/: /kʰa:na/

/बर्फ/ : /bɛɤf/

/शर्ट/ : /ʃɜɤʈ/



/फर्श/ : /fɛɤʃ/



/तस्तरी/ : /t̪əst̪ɾi/