DEVELOPMENT OF PHONOLOGICAL PROCESSES OF 3-4 YEARS OLD NORMAL TAMIL SPEAKING CHILDREN

Barathry(R)
(REGISTER NO. M 9905)

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ALL INDIA INSTITUTE OF SPEECH AND HEARING
MANASAGANGOTHRI, MYSORE - 570006.

MAY 2001

Dedicated to
Durgaparameshwari
&
My Dear Appa, Amma

Certificate

This is to certify that the dissertation entitled *"Development Of Phonological Processes Of 3-4 Years Old Normal Tamil Speaking Children"* is the bonafide work done in part fulfillment of the degree of Master of Science (Speech and Hearing) of the student (Register No. M 9905).

Mysore

May 2001

Director

All India Institute of Speech & Hearing
Mysore - 570006.

Certificate

This is to certify that the dissertation entitled *"Development Of Phonological Processes Of 3-4 Years Old Normal Tamil Speaking 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 Diploma or Degree.

Guide

Mysore
May 2001

M. Pushpavathi

Mrs. M. Pushpavathi,
Lecturer, Department of
Speech Pathology,
All India Institute of
Speech & Hearing
Mysore - 570006.

Declaration

I hereby declare that this dissertation entitled *"Development Of Phonological Processes Of 3-4 Years Old Normal Tamil Speaking Children"* is the result of my own study under the guidance of Mrs. M. Pushpavathi, Lecturer, Department of Speech Pathology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier in any other University for the award of any Diploma or Degree.

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CHAPTER 1

INTRODUCTION

"Communication", is the process of exchanging information and ideas. Human communication involves a rich tapestry of information conveyed through elements of movements, emotional expression and vocalizations. Spoken language is one form of communication that enables humans to convey information with specificity and details. Thus, *"speech "*, has been defined as a system that relates meaning with sound (Boone, 1993).

Meaning itself arises in language. A *"language"*, is an arbitrary system of signs or symbols used according to presumed rules to convey meaning within a linguistic community. Speech is one of the modality for the expression of language .However speech has special importance because it is the primary, first learned modality for normal language users. Speech is a system, which is consistently and usefully relates the meanings of a language with the sounds by which the language is communicated. At the outset of adult like vocal production, sometimes called the babbling period, the vocalization of children exposed in different languages are virtually indistinguishable (Atkinson, MacWhenney and Stoel 1968). Babies learning languages as different as English and Spanish (Thevenenn, Eclers, Oiler and Lavoie, 1985) or French and Chinese (De Boysson - Bardies, Sagart and Durand, 1984) cannot be reliably distinguished, based on tape recordings, by adult judges speaking one of these languages. Francescato(1968) suggested that two hypothesis are possible:

Either all children, of all languages, at the beginning of their linguistic activity share the *"same"* language, or Every child, of every language, speaks from the beginning of its own language.

Children in different language environment draw on the same 'universal' repetitive of syllables, shapes and sounds. At the same time, it seems that each child creates, out of these universal syllable shapes and sounds, a unique subset of sound preferences and patterns as he/she develops a phonological and communicative system of his/her own. Gradually these unique or idiosyncratic patterns accommodate to and finally are replaced by the adult systems to which the child is exposed. Thus the child's speech undergo gradual changes before reaching the target.

The acquisition of a phonological system entails learning both the *'phonetic'* and *'phonological'* features of a language. Children must not only learn to articulate sounds and sound sequences correctly (phonetic mastery), they must also use these sounds in accordance with the phonological patterns of the adult language (phonological learning) .In many instances the two aspects of acquisition are not in synchrony, with phonological learning preceding phonetic mastery.

It is of interest to the phonologists to discover universal or universal tendencies of sound systems of languages. This is attempted by studying the commonly occurring patterns in phonological inventories, phonological acquisition and phonological changes. One fact about phonological development on which linguists of virtually all theoretical persuasion can agree is the

systematic nature of the child's simplification and restructuring of adult words (Macken and Fergusen 1981).

As Oiler (1975) explicitly put it; the sorts of substitutions, deletions and additions which occur in child language are not merely random errors on the child's part, but are rather the result of a set of systematic tendencies.

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

"A phonological process is a mental operation thai applies in speech to substitute for a class of sounds or sound sequences presenting a common difficulty to the speech capacity of the individual, an alternative class identical but lacking the difficult property."

Thus the normally developing children do not exhibit processes that interferes significantly with intelligibility. The processes used by unintelligible children have also been reported as to occurring in normally developing children, but at younger age.

Need for the Study

Phonological development has great reliance for the clinical population to determine whether a child is phonologically disordered and needs professional help.Hence a good understanding of normal phonological development is essential.

The period of phonemic development that roughly corresponds to 1 year 6 months to 4 years is the most relevant as this is the period in which the child establishes the basis of the system. At the end of this period, the child is expected to suppress most of the simplifying processes. Thus by the time a child is 3 years 6 months to 4 years old one can with reasonable confidence determine whether any intervention is required. Each language has its own set of unique features. Phonological differences may also occur in the speech of individuals within cultures.

Therefore, it is very important to understand the general characteristics of the phonological process, in order to understand the normal phonological development to determine a delay / deviance in phonological development in the speech and language disordered child.

Considering the issues mentioned above an attempt is made to delineate the phonological processes in 3-4 years normal Tamil speaking children.

The objectives of this study are:

> To study the normal development of phonological processes in 3-4 years old Tamil speaking children.

> To study the phonological processes which are occurring in different age groups namely 3.0 - 3.4; 3.5 - 3.8; 3.9 - 4.0

> To compare the development of phonological processes across the three age groups namely, 3.0 - 3.4; 3.5 - 3.8; 3.9 - 4.0.

CHAPTER 2

REVIEW OF LITERATURE

Phonology

The study of speech sounds and sound patterns used to create words is called *"phonology"*. Phonology is the domain of both linguistics and speech language pathologists. Phonology is a relatively new term. In the past, much of the information about speech sounds, their classification, production and perception was included under phonetics and articulation.

Currently, phonetics and phonology involve similar problems. Generally phonetics focuses on the production, perception and classification of speech sounds. Phonology is primarily concerned with the broader rules and processes that govern the patterns of sound, their acquisition and use.

A *"phoneme"* is a group of speech sounds. Phonemes are important for meaning. When a phoneme in a word is changed, often the meaning is changed. For example: the two words */kit/* and */bit/*, mean different things precisely because of the different initial phonemes represented by the letters 'k' and 'b', the other phonemes of the two words are the same.

The phonemes are combined to form syllables and words. Each language has certain permissible combination of phonemes that form words. Other combinations may be uncommon or non-existent. By observing the ways in which phonemes are normally combined in a language, phonologists device rules of

phoneme combination. Because phonemes help to form syllables and words, they are the building blocks of speech. In a narrower sense, speech is the production of phonemes; articulated sounds and syllables .

Table 1 : *Classification of Consonants by Manner, Voicing and Place.*

Place of articulation	**Phonetic Symbol and Key Word**	**Manner of Articulation**	**Voicing**
Bilabial	:/p/ (pay)	Stop	-
	/b/ (bay)	Stop	+
	/m/ (may)	Nasal	+
Labial / Velar	/ʍ/ (which)	Glide (semivowel)	-
	/w/ (witch)	Glide (semivowel)	+
Labiodental	*lfl* (fan)	Fricative	
	lvl (van)	Fricative	+
Linguadental (interdental)	/θ/ (thin)	Fricative	-
	/ð/ (this)	Fricative	+
	ltl (two)	Stop	-
	/d/(do)	Stop	+
	/s/ (sue)	Fricative	-
Lingua-alveolar	/ z/ (zoo)	Fricative	+
	/ n/ (new)	Nasal	+
	/l/ (Lou)	Lateral	+
	/ɾ/ (butter)	Flap	+
Linguapalatal	/ʃ/ (shoe)	Fricative	-
	/ʒ/ (rouge)	Fricative	
	/tʃ/ (chin)	Affricate	-
	/dʒ/ (gin)	Affricate	+
	/j/(you)	Glide (Semivowel)	+
	/r/(rue)	Rhotic	+
Linguavelar	*(k)* (back)	Stop	-
	/g/ (bag)	Stop	+
	/n/ (bang)	Nasal	+
Glottal (Laryngeal)	/h/ (who)	Fricative	-
	/ʔ/ -	Stop	+(-)

Acquisition of Speech Sound Production

1. Vowels are acquired before consonants. Before age 3, children use most of the vowels.
2. Among the consonants the nasals (m,n and ŋ)are acquired the earliest. They are generally mastered between 3 and 4 years of age.
3. Stop consonants are mastered earlier than fricatives. Most stops are mastered between 3.0 and 4.5 years of age. Among the stops /p/ may be mastered at the earliest.
4. Glides (/w/, /j/) are also mastered earlier than fricatives. Glides are mastered between the ages of 2 and 4 years.
5. The liquids (/v/, /l/) are mastered relatively late (between the ages of 3 and 5 years).
6. Fricatives and affricates are mastered later than stops and nasals. The fricative *lfl* is mastered earlier than other fricatives (around age 3). The fricatives /θ/, /ð/, /dz/, /s/ and /z/ are mastered the last (between the ages of 3 and 6 years).

The norms clinicians use are mostly based on the studies of Wellman, Case, Mengurt and Bradbury (1931); Poole (1934) Templin (1957); Sander (1972); and Prather, Hedrick and Kern (1975). Sander's study is a reanalysis of some published studies. More recent studies include those of Stoel-Gammon (1985) and Preisser, Hodson and Paden (1988).

Frequently used norms are presented below :

Table 2: *Age (Years-Months) at which children mastered the phonemes in five studies*

Phonemes	Wellman et al. (1931)	Poole (1934)	Templin (1957)	Sander (1972)	Prather et al.(1975)
m	3	3-6	3	Before 2	2
n	3	4-6	3	Before 2	2
h	3	3-6	3	Before 2	2
p	4	3-6	3	Before 2	2
f	3	5-6	3	3	2-4
w	3	3-6	3	Before 2	2-8
b	3	3-6	4	Before 2	2-8
		4-6	3	2	2
j	4	4-6	3-6	3	2-4
k	4	4-6	4	2	2-4
g	4	4-6	4	2	2-4
l	4	6-6	6	2	2-4
d	5	4-6	4	2	2-4
t	5	4-6	6	2	2-8
s	5	7-6	4-6	3	3
r	5	7-6	4	3	3-4
	5		4-6	4	3-8
v	5	6-6	6	4	4
	5	7-6	7	4	4
	6	6-6	7	6	4
		7-6	6	5	4
			7	4	4
		6-6	4-6	4	3-8
		6-6	7	5	4

Source:*Introduction to Communicative Disorders by M.N.Hegde,1991, Austin,TX.*

Table 3: *Age of customary production and mastery of consonantal phonemes*

Age	Consonants Customarily produced	Consonants Mastered
Before 20	p, b, m, n, w, h	
2:0	t, d, k, g, n	
3:0	f ,s, r, l, j	p, m, n. w, h
4:0	v. z, ʃ. tʃ. d	b. d, k. g. f, j
5:0	θ. ð.	
6:0	ʒ	t, ŋ. r, l
7:0		θ. ʃ. tʃ. d
8:0		v. ð. s. z

Source : *Normal and disordered phonology in children by Stoel-Gammon and C Dunn, 1985, Austin, TX:*

Norms are based on statistical averages that apply to large groups of children. Therefore, norms are useful only as broad guidelines. Norms are of little help in predicting the performance of an individual child. Studies have shown that individual children vary tremendously in their articulatory skills. Some children produce most speech sounds correctly by the age of 2 or 3 years. Others continue to master various sounds even at the age of 6 or 7 years. However, the sounds that are acquired last -the fricatives and the affricates- are misarticulated frequently.

Consonant Clusters:

The combination of two or more consonants in the initial or final position is generally a late development in the phonological system. It has been noted (Templin, 1957) that certain clusters develop earlier than others. In general two member clusters are acquired earlier than three member clusters.

Table 4: *Age of mastery of consonantal clusters*

Age	Initial Clusters	Final Clusters
4:0	pl, bl, kl, gl	mp. mpt, mps, ŋk
	pr. br, tr, dr, kr	lp. lt rm, rt, rk
	tw, kw	pt, ks
	sm, sn, sp, st, sk	ft
5:0	gr, fl, fr, str	lb.lf
		rd, rf,.rn
6:0	skw	lk
		rb, rg, rd, rst, rt
		nt, nd, nθ
7:0	spl. spr. skr	sk, st, kst
	sl, sw	lθ lz
	θr, ʃr	dʒd
8;0		kt, sp

Source : *Normal and disordered phonology in children by Stoel-Gammon and C Dunn, 1985, Austin, TX:*

Patterns of Acquisition

In recent years, the attention has shifted from the acquisition of single phonemes to the acquisition of sound patterns and processes underlying such patterns. Researchers believe that the misarticulation of a normally developing child are not random mistakes but show certain patterns. Children's errors are a way of simplifying the adult model of correct articulation. Such attempts at simplification are called phonological processes, *e.g, A* normally developing child may omit a syllable not stressed by adults. A child may say *"jama"* instead of *[il]pajama "* because the /pa/ syllable is usually not stressed in the adult speech. This is an example of an *'unstressed syllable deletion process'*.

Researchers have discovered many phonological processes by analyzing normal as well as disordered speech. However, the different age levels at which the processes appear have not been clearly identified .The phonological processes are currently used in the analysis of misarticulations.

An assumption made by many phonologists and Speech - Language clinicians is that phonological processes are also rules that children use in simplifying difficult articulatory responses. The fact that the child's misarticulations show patterns may not necessarily mean that the child is using a rule.

Researchers have described many phonological processes that explain errors of articulation (Hodson,1980; Ingram, 1976, 1981 ; Shriberg and Kwiatkowski, 980 ; Stoel-Gammon and Dunn 1985, Weiner, 1979).

Patterns of Erroneous Production:

When the production of children's speech are analyzed, clear systematic patterns are found in their erroneous approximation to adult target words. The errors are quite similar across children and across languages. This suggests that all children develop similar organization patterns in their phonologies. One of the most common ways of describing these error patterns in children has been with reference to phonological processes. Process analysis is probably the simplest and most economical way of describing the differences. The phonological processes described by Stampe (1969, 1973) and Donegan and Stampe (1979), are innate simplification tendencies.

The Natural phonology model emphasises that humans are born with an innate system of natural phonological processes such as *'consonant cluster simplification'* and *'stopping of fricatives*'. These processes reflect natural restriction in the human speech capacity and result in systematic simplifications of adult forms by children. Stampe described processes as mental operation that are gradually suppressed or limited as children acquired the phonological system. Several researchers disagree with Stampe and do not attribute psychological reality or explanatory power to processes (Grunwell, 1983; Ingram, 1981; Stoel-Gammon and Dunn, 1985). The general consensus is that processes provide a good descriptive device for the relationship between the adult targets and the children's erroneous production. It is generally agreed that children's simplification patterns fall into the following three groups.

Common Phonological Processes

Phonological processes are categorized in to 3 groups.

1. Syllable structure,
2. Substitution,
3. Assimilation.

Much of the developmental information for description comes from Ingram (1989). Prater and Swift (1982) and Haeslig and Madison, (1986).

(1) Syllable Structure Processes

Syllable structure processes describe sound changes that affect the syllable structure of the child's production of an adult target word. These processes modify

the syllabic structures of the target word. These processes are most frequently seen in younger children with MLU between 1 and 4 morphemes (Prater and Swift, 1982). There are different syllable structure processes identified which can be described as follows:

> *Cluster Reduction (CR)*

It is a phenomenon where clusters are made simple. Consonant clusters are reduced by one or more members.

eg, Street -> /trit/, /tit/, /it/

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

a) In /stop + liquid/ cluster, the stop is usually maintained and the liquid deleted.
eg, Blue-> /bu/. Breads--> /bɛd/
b) In post-vocalic cluster composed of /liquid + stop/ or /liquid + nasal/ the liquid is usually deleted
eg. Dark-> /dak/, Milk-> /mrk/.
c) In /s+stop/ and /s+nasal/ cluster, /s/ is usually deleted.
eg. Skip-> **/kIp/,** Snow -> /no/
Smith (1973) reported that some children go through a stage in the production of /s+nasal/ cluster in which the /s/ is deleted and the nasal is produced as voiceless segment.

d) Clusters composed of /nasal + Obstruent/ are usually reduced in one of two ways. If the obstruent is voiced, it is deleted, if the obstruent is voiceless, the nasal is deleted.
eg. Mend ->- /men/. Bump -> /b^p/, Hand-> /hæa/, Ant -> /æt/

e) Whereas, most clusters are reduced by deleting one member and maintaining the other, some initial clusters are reduced to a single sound that was not a member of the target cluster, commonly occuring examples are

e.g. Truck -> /fæk/, Swing /fiŋ/->
Tree -> / fi / , Sweep -> / fip /

Cluster reduction can be subdivided into total, partial and substitution.

- *Total cluster reduction (TCR)* involves the deletion of all members of the cluster.
- *Partial cluster reduction (PCR)* occurs when some of the cluster members are deleted but others remain.
- *Cluster substitution (CS)* 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 members can be deleted or *e.g.*

Target	*Form*	*Cluster reduction*
tree	[i]	TCR
tree	[ti]	PCR
tree	[twi]	**CS**

Dyson & Paden (1983), report that in normally developing children cluster reduction is most common for clusters containing /*s*/ & /z/, liquid segments or strident segment. Haelsig and Madison (1986),report 7% occurence of cluster reduction in the total responses of ten 5 year old children. Applying the 20% criteria, the process of cluster reduction is not likely to occur beyond 4 years of age, but in comparison to most natural processes it is suppressed late in phonological development.

Greenlee (1974) & Ingram (1989) report that clusters tend to develop following four stages. They used target word "play".

Stage 1 : Deletion of entire cluster [ey]

Stage *2* : Reduction of cluster to one member [pey]

Stage *3* : Use of cluster with substitution for one of the members [pwey]

Stage *4* : Correct articulation [pley]

> *Deletion of final consonant (DFC)*

As with most processes, the name describes the sound change. Deletion of final consonant or consonant cluster such that the final form of the word ends with a vowel

e.g. Boat -> /bo/, Mop -> /ma/

When final consonant deletion occurs consistently it can create homophoneme forms that make a child's speech highly unintelligible.

e.g. Cap, Cab, Cat -> /kæ/

Final consonant deletion is common in children between the age of 1.6 and 3.0 but rare beyond 3 years of age (Ingram, 1989).

> *Weak syllable deletion (WSD)*

Weak syllable deletion occurs when the unstressed syllable of a multisyllabic word is omitted. This process is also referred to a *"unstressed syllable deletion"* and *"syllable reduction"*.

e.g. Potato -> / teto /, About -> /bæʊt/

In some cases segments from different syllables are coalesced into a single syllable.

e.g. Pacifier -> /pæf/, Balloon -> /bun /

This process seldom occurs in children with normally developing sound systems after age 3. Haelsig and Madison (1986) observed its occurence in the speech of 41/2 and 5 year old children, but if criterion of 20% occurrence were applied the sound changes would not qualify as processes.

> ***Reduplication (RD)***

Reduplication also called doubling described by Stoel-Gammon and Dunn (1985) as repeating a syllable of a word making it into a polysyllabic form.

e.g. Go -> /gogo/, Walk -> /wak wak/.

This process is often accompanied by the final consonant deletion.

e.g. Ball -> /baba/, Dog -> /dada/.

Most classification systems categorize reduplication as a syllable structure process, but some consider it an assimilatory process. Reduplication may be total or partial. Total reduplication occurs when all of a syllable is repeated. Partial reduplication occurs when only part of the syllable is repeated.

Ingram (1989) described reduplication as an early process of acquisition associated with the first 50 words. Lleo (1990) reports that reduplication may disappear after the 50 word stage but reappear when child begins production of trisyllables at or about 3 years of age. Lleo suggests that use of reduplication

simplifies the mental representation and storage, so more complex patterns (trisyllable) can be produced.

> *Diminutization*

It is a special form of partial reduplication. Stoel-Gammon and Dunn (1985) describe it as adding an /i/or consonant plus /i/ to a word.

e.g. Dog -> /dogi /, No -> /nodi /.

> *Epenthesis (Epn)*

Khan (1985) describes epenthesis as a process that results in the insertion of a schwa between two consonants. He also points out that epenthesis might involve insertion of consonant but the most common occurrence is a vowel between two consonants. This process usually occurs in one of two environments.

(a) In the production of an initial cluster.

e.g. Blue -> /bəlu/, Green -> /gərin/

(b) After final voiced stop.

e.g. Big -> /bigə/, Bib -> /bibə/

Khan notes that the insertion of a vowel between two consonants, functions to simplify the cluster but does not include the processes under cluster reduction as all members of the cluster are retained.

Stoel-Gammon and Dunn (1985) note that vowel also can be added in word final position and that this seems to occur as the first stage of voicing contrast between stops in that position.

> *Coalescence*

It is a process in which segments that are present in two syllables are combined in to one

e.g. Pacifier -> /pæf/

Where the /p/ is retained from the first syllable and the *lil* from the third

e.g. Banana /bænæ->

Khan (1982) characterized this process as producing multisyllabic words with fewer syllables than the standard form, with elements from both syllables being retained.

e.g. Melon -> /mɛn/ which contains the /m/ from the first syllable and */n/* from the second syllable. Hodson (1980) has a slightly different description of coalescence in that he used the term for the use of one consonant which combines the features of the two consonants of a cluster

e.g. Smoke -> /fok/. In which */f/* has the stridency /s/ and labialness of /m/.

e.g. Plane - /ten/. In which the *l\l* has the alveolar placement of the /t/ and the stop manner of the /p/.

(2) Substitution Processes

Weiner (1979) labeled the next group of phonological processes as feature contrast processes, whereas Stoel-Gammon and Dunn (1985) labeled them as substitution processes. In either case these processes involve replace one sound by another sound with out being influenced by the surrounding phonemes. The

substitution, generally are one class of phonemes. These processes affected liquid, stops, fricatives, affricates, nasals and glides and occur in the speech of normally developing children.

The names of these processes typically reflect the replacing sound class. Thus in stopping we find sounds are replaced with stops and in fronting we find that the replacing sounds are made more anterior than the adult target. The substitution processes are grouped according to the target phoneme they affect.

> *Stopping (st)*

One of the most common substitution processes is stopping. Stopping has been described in slight variation by phonologists.

Hodson(1980) defined it 'as *substitution of stop for other consonant.'*

Weiner (1982) stated that '*it occurs when fricatives are replaced by homo-organic stop.'*

Khan (1982) described it as *"the use of stops"* for fricatives and affricates.

Dyson and Paden (1983) defined stopping as *'the replacement of a continuant phoneme by a stop, affricate or nasal and or the replacement of an affricate by a stop or nasal. '*

Hodson and Paden (1983) describe stopping as *"primarily affecting fricatives, but also note that sonorants nasal, liquid and glides can be stopped.'*

Ingram (1989) described stopping as the replacement of fricative or affricates with stop consonants. The most frequently seen form of stopping is the replacement of fricatives and affricates with stops. Stopping is commonly used process. Hodson

(1980) reported that it frequently occurs with the process of stridency deletion. Edward and Shriberg (1983) reported that it is particularly common in word-initial fricative.

e.g. Soap -> /top/, Juice -> /dut/

Stopping is more often on prevocalic consonants than postvocalic (Dyson and Paden, 1983). It appears to operate most effectively in normally developing children with MLU between 1 and 4.99 (Prater and Swift, 1982).

> ***Stridency Deletion (StD)***

A process that is closely associated with stopping is stridency deletion. This process occurs when a strident sound (f, v, s, z, ʃ, tʃ, dʒ) is either deleted or replaced with a non strident sound. Stridency deletion typically occurs through stopping though it is possible for stopping to occur without stridency deletion. *(e.g.* Stop replacing /θ/). Both stopping and stridency deletion are very common in the speech pattern of phonologically disordered children. Hodson and Paden (1983) noted that the most unintelligible children omit the strident sound while children with severe problem use non strident substitutes

e.g. Soap -> /op/ or /top/.

> ***Deaffrication (DeA)***

Deaffrication is a process that evolves the substitution of a fricative for an affricate.

e.g. Jump -> /z ^mp/ Cheers -> /siz/.

The fricative may or may not be homo-organic (same place) to the affricate. There appears to be some confusion concerning the status of deaffrication. Some authors list it as a common process and others as an idiosyncratic process. Robert, Burnchinal and Footo (1990) indicate that deaffrication occurs more frequently than some common processes. Deaffrication is usually suppressed prior to 4 years of age.

> *Fronting (Fr)*

Fronting refers to the replacement of a target phoneme with another phoneme which is articulated or produced anteriorly to the target

Two forms of fronting have been identified in the research literature- velar and palatal. Velar fronting involves the replacement of a velar consonant (k, g,) by more anterior consonant (typically alveolar).

eg. Sheep -> /tip/. Cow -> /tau/.

Palatal fronting (Sometimes called *'depalatalization*') is the replacement of a palatal by a sound made further forward in the mouth (Howe, Knutson and Monson, 1985). In this process, a palatal consonant is replaced by a nonpalatal

e.g. Mases -> /mæs/, jam -> /dæm/.

Stoel-Gammon and Dunn (1985) stipulate that depalatalization is the substitution of an alveolar fricative for a palatal fricative or an alveolar affricate for a palatal affricative. Khan (1985) makes similar distinction for palatal fronting, indicating that this results in the forward production of palatal consonants.

Lowe, Knutson and Monson (1986) screened 1048 children between the ages of 31 and 54 months for the presence of fronting. They observed fronting in 6% of the preschooler's with velar fronting occurring more frequently than palatal fronting which rarely occurred after the age of 42 months.

> *Gliding (GI)*

The replacement of liquid by glides is called gliding

e.g. Rain -> /wen/, Green -> /gwin/

Gliding is most commonly seen in 3 and 31/2 year old children. Haelsig and Madison (1986) observed gliding in older children aged 41/2 and 5 years but not at a frequency high enough to qualify as a process. There is a greater incidence of gliding for prevocalic *Irl* than /l/ (Dyson and Paden. 1983). Stoel-Gammon and Dunn (1985) indicate that substitution pattern for /l/ may sometimes be controlled by the following vowel. The /l/ is substituted by /j/ before front vowels and by /w/ else where. The most common substitute for /r/ is the /w/.

Gliding is a common process in the speech of phonologically disordered children. Hodson and Paden (1981) list it as one of the most common processes observed in the speech of unintelligible children. The /l/ appears to develop first followed by suppression of gliding for /*x*/.

Weiner (1979) reported that gliding of fricative occurs primarily in children with deviant phonology.

> *Vocalization (Vc)*

In Vocalization a full vowel is substituted for syllabic liquid or nasal, vocalization (vowelization) affect syllabic consonants.

eg. Car -> /kau/, Bottle -> /bado/

The typical vowel substitution are /o/, / / and /a/. Stoel - Gammon and Dunn (1985) note that vocalization can also affect non syllabic consonants and list rhotic dipthongs as examples. Vocalization was the most frequently occuring substitution process in the Prater and Swift (1982) study of process development. They noted that the process was used, actually when MLU was less than five morphemes but some use of vocalization was still observed in group 6 which had an upper MLU of 6.90 morphemes.

> *Affrication*

Affrication occurs when an affricate replaces a fricative

e.g. Sun -> /tsʌn/, Show -> / tʃo /

Hodson (1980) reported that children seem to use this process when they are developing continuous sounds and are learning to differentiate between stops and continuants.

> *Palatalization*

Palatalization occurs when a sound is produced as a palatal rather than as a nonpalatal.

e.g. Soup -> /ʃ up/, Cream -> /tʃ im/

Hadson (1980) reported that this process most frequently occurs on siblants and cluster.

> ***Neutralization***

Neutralization occurs when several different phonemes are replaced by one sound. This process may appear on both vowels and consonants.

Weiner (1970) reported that vowels are often replaced with / /, /ʌ/ or / /.

He further stated that one can not predict which consonant will replace a particular group of sounds.Different speakers show different preferences

eg. A child who replaced all prevocalic fricatives and affricate with /j/ such that sun was pronounced as /jʌn/ and 'juice' as /ju/.

(3) Assimiatory Processes

Assimilation is the process in which a sound becomes similar to (or is influenced by) another sound in the word (Ingram, 1989). Assimilation or harmony processes occur 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. Assimilation can be total or partial. Assimilation can also be categorized as:

'continuous', (the sound that changes and the one that influences the changes, are adjacent to one another) and *'non-continuous',* (at least one segment separating the sound that changes and influencing segment). Non-continuous consonant assimilation is some time given the special name of *'Consonant Harmony'* and Bernthal and Bankson (1989) equate it with *'partial reduplication'.*

Assimilation can be *'progressive'* (affected segment follows the one that influences it) or *'regressive'* (affected segment precedes the one that influences it).

eg. Progressive Assimilation Coat -> /kok/, Kiss -> /kik/.

Regressive Assimilation Rock -> /gɑk/ , Zip -> /bip/.

Grunwell (1986) notes that assimilation process causes a structural simplification. Vihman (1978) comments that consonant harmony is common in child phonology. Leonard, Miller and Brown (1980) reported on the speech patterns of eight language disordered children, noting that assimilation typically affected consonants not in the children's productive repertoires.

Assimilatory processes are the following :

> ***Velar Assimilation*** *(VeA)*

Velar Assimilation occurs when a non velar consonant is replaced by velar consonant in the environment of a velar consonant in the target word.

Progressive velar assimilation Comb -> /kok/, Kiss -> /kik/

Regressive velar assimilation Take -> /kek/, Rock -> /gɑk/

> ***Labial Assimilation (LbA)***

Labial assimilation occurs when non labial sound is changed to labial in the presence of a labial sound either preceding or following the affected consonant in the standard word. The most common form occurs when alveolars changes to labials. This assimilation also is typically non contiguous and regressive though progressive form have been observed

eg. Progressive labial assimilation -> Boat -> /bop/,

Pocket -> / pɑp ∂ p /

Regressive labial assimilation -> Thumb /wʌm/>

Zip -> /bip/

Prater and Swift (1982) reported that this process was observed to occur in all six MLU groups in their study. This would reflect an age range from 1-4 years

> *Nasal assimilation (NsA).*

Nasal Assimilation occurs when a non nasal sound is replaced by a nasal sound in the target word

Eg. Progressive nasal assimilation Nose -> /non/,
Mat -> /man/
Regressive nasal assimilation Sunny -> /nʌni/,
Done -> /nʌn/

Stoel-Gammon and Dunn (1985) describe this process as the assimilation of a non-nasal to a nasal consonant. Place of articulation of the affected consonant may also be assimilated.

> *Alveolar Assimilation*

Alveolar assimilation refers to the case when a non alveolar sound is changed to an alveolar consonant in the presence of an alveolar sound in the adult standard.

eg. Progressive alveolar assimilation -> Doggi -> /dædi/
Regressive alveolar assimilation -> Cat /tæt-/>

Weiner (1979) however mentioned that other types of manner assimilation also occur, including stop assimilation and fricative assimilation which operate similarly to the assimilation processes described above.

> *Voicing Assimiation*

Two types of voicing assimilation are commonly reported.

1. *Prevocalic Voicing (Prv)*

Ingram (1981) describes this process as the changes of voiceless obstruent (fricative, affricate or stop) into a voiced one when preceding a vowel within same syllable. What seems to be happening is the voicing of the vowel influences the voicing feature of the preceding consonant.

e.g. Pig -> /big/, Tag -> /dæg/ .

Prater and Swift (1982) reported that prevocalic voicing was used primarily by subjects with MLU of less than four morphemes under 3 years of age.

2. Post Vocalic Devoicing

It is changing a voiced obstruent at the end of word to a voiceless obstruent.

eg. Bag -> /bæk/, Made -> /met/

Ingram (1989) indicates that the assimilation is, to the silence following the end of the word. The devoicing however, is as likely due to the complex of aerodynamic condition that exist in the production of word-final obstruents

Ingram (1989) adapted data from Velten (1943) to derive the following stages for the suppression or final consonant devoicing

Stage *1* : Devoicing of final consonant

Stage *2 :* Lengthening of vowel before voiced consonants and devoicing of those voiced consonants.

Stage *3* : Loss of the process of final consonant devoicing .

IDIOSYNCRACTIC/UNUSUAL PROCESSES

Processes that never occur, or occur only rarely in normal child phonology are called unusual or idiosyncratic processes (Stoel-Gammon and Dunn, 1985). Individual children some times use processes which are unique to their phonological system.

A list of unusual processes are given below based on the description from, Hodson (1980), Stoel - Gammon and Dunn (1985), Dodd (1989), Roberts, Burnchinal and Footo (1990), Leonard and Mc Gregor (1991).

> *Atypical Ouster Reduction (ACR)*

Stoel-Gammon and Dunn (1985) describe ACR as deletion of the member that is usually retained

e.g. Stop -> /s ɑp/, Play -> */le/.*

> *Initial Consonant Deletion (ICD)*

Dodd (1989) defined ICD as the deletion of word initial consonant or cluster so that the initial sound is a vowel.

e.g. Tape -> /ep/, Star -> /ɑr/

> *Medical Consonant Deletion (MCD)*

Dodd (1989) described MCD as the deletion of intervocalic consonants

e.g. Beetle -> /bio/.

> *Backing of Stops (BkS)*

Dodd (1989) stipulated this as the replacement of front consonants by phonemes made posterior to the target phoneme (typically velars)

e.g. Toe -> /ko/

> ***Apicalization (Apl)***

Robert, Burchinal and Footo (1990) describe Apl as a labial replaced by an apical (tongue tip) consonant

e.g. Bow -> /do/

> ***Glottal Replacement (Git)***

Stoel - Gammon and Dunn (1985) describe Glt as substitution of a glottal stop for a consonant usually in medial or final position

e.g. Fishing -> /fiʔm/, Bath -> /bæʔ/

Werner (1979) hypothesized, that it serves as a marker for an omitted consonant. Khan (1982) reported that this process is less frequently seen in the speech of the normally developing child.

> ***Backing of fricatives (BkF)***

Dodd (1989) defined BkF as the replacement of fricatives with fricatives that are made in a more posterior position.

e.g. Suit -> /ʃut/.

> ***Medial Consonant Substitution (MCS)***

Dodd (1989) defined MCS as the replacement of intervocalic consonants with one or more phonemes.

e.g. Butter - /bʌjə/.

> ***Denasalization (DeN)***

Dodd (1989) stipulated that DeN is the substitution of nasal consonants by a homo organic nonnasal

eg. Smoke -> /bok/, No -> /do/.

Weiner (1979) noted that this process occurs more frequently in the word initial and medial position than in the word final position.

> ***Devoicing of Stops (DeVI)***

Dodd (1989) describes devoicing of stops as replacement of voiced stop with a voiceless phoneme (usually a stop) in word initial position.

e.g. Daddy /tædi/>

> ***Fricative Replacing Stops (FRS)***

Stoel - Gammon and Dunn (1985) describe this process as substitution of a fricative consonant for a stop consonant

e.g. Bat -> /bæs/

> ***Stop Replacing Glides (SRG)***

Stoel - Gammon and Dunn (1985) describe this process as substitution of a stop consonant for a glide

e.g. Yellow -> /dɛlo/

> ***Metathesis (Met)***

Roberts, Burchinal and Footo (1990) describe metathesis as the reversal of position of two sounds, the sounds may or may not be adjacent.

e.g. Most -> /mots/, Elephant -> /ɛfələnt/

> ***Migration (Mgr)***

Leonard and Mc Gregor (1991) described Migration as the movement of a sound from one position in a word to another position.

e.g. Soap -> /ops/.

> ***Sound Preference substitution*** *(SPS)*

Dodd (1989) describe this process as a replacement of groups of consonants by one or two particular consonants .

e.g. /s/, /z/, /ʃ/, /dʒ/ → /t/

> ***Articulatory shifts***

Hodson (1980) identified some processes which she labeled as articulatory shifts in which there are minimal shifts in place of articulation while the manner of articulation generally remains the same. The first type of articulation shift is substitution of

/ f, v, s, z / for / θ, d /

eg. Think -> /fink/, Mouth -> /mɔ̃us/

A second type is frontal lisp, while produce / *s*/ and / z / and sometimes /j. z, tʃ, dʒ/ with a protruded tongue. Dentalization of /*t,* d, n, 1/ is the third type in which these phonemes are produced with tongue protrusion. The fourth articulatory shift pattern is lateralization in which air is emitted laterally through the teeth rather than medially.

Robert. Burchinal and Footo (1990) point out that for some of their normally developing subjects (45 normally developing subjects between the age 21/2 and 8years) the unusual processes *(e.g:* deletion of medial consonant and deaffrication), were more common than some of the processes labeled common (reduplication and syllable deletion). Part of the confusion may be in the

categorizing of the process e.g. Roberts, Burchinal and Footo (1990) categorize deaffrication as an unusual process, but Dodd and lacano (1989) list it as a developmental process. Judging from the Roberts, Burchinal and Footo (1990) study, categorization of a developmental process may be more appropriate.

Edwards (1992) points out there may be some clinical value to differentiating between normal and idiosyncratic processes. Dodd, Hambly and Leahy (1989) compared a group of children with only developmental processes with children who use both unusual and development processes. The result showed that the group varied in two ways.

a. The group having only developmental processes pronounced words in the same way in imitation ,picture naming and spontaneous naming task. The group of unusual patterns ,made the fewest errors in imitation, more with picture naming and the most errors occurred in spontaneous speech.

b. When given a forced choice task of choosing phonological legal nonsense words *(eg*. Thipi) or illegal words (thlipi) as names for animals, the group using unusual processes showed no preference. The group using developmental processes preferred the phonologically legal name. This suggests a difference in the underlying phonological knowledge of the two groups.

Leonard (1973) suggested that the speech of children using deviant processes may be more resistant to change without direct intervention. Leahy and Dodd (1987) observed that while the phonological system of normal children

improve steadily over time, systems of disordered children who exhibit unusual processes show little change in the number and types of errors made.

Leonard, Schwartz, Swanson and Loeb (1987) investigated some conditions that appear to promote unusual phonological behavior. They suggested 3 conditions in which unusual patterns may occur.

1. The child uses the sound appearing in the adult surface form, but in contexts that may be problematic, an unusual pattern is adopted.
2. In most contexts the child uses a substitution for the sound appearing in the adult surface form. For the renaming contexts the child adopts an unusual pattern.
3. The child never uses the sound appearing in the adult surface form and does not use a substitution for them (Omission with no substitution). As a result, an unusual pattern is adopted.

Using nonsense words as stimuli. Leonard, et al. (1987) stimulated the three conditions described above. They predicted that normally developing children would tend to use unusual patterns as sound changes more often when the stimuli approximate condition 3. The results were true to prediction, however there were a greater number of unusual sound changes associated with condition 1& 2 than expected. In another study, Leonard et al. (1987) used children with specific language impairment (SLI) as subjects. This group demonstrated a significantly larger percentage of unusual sound patterns as showing a mean percentage of 47.7 % compared to only 27.67 % for the normally developing children. The SLI

children showed about the same number of errors for each of the conditions. The type of condition did not have an apparent influence on the production of unusual sound errors. Leonard et al. (1987) interpreted the SLI results as indicating limited "ability to identify phonetic regularities among words and to adopt production pattern that take advantage of these regularities ". This finding supports the finding of Dodd, Hambly and Leahy (1989) study reported earlier, in which children using unusual processes showed no preference between phonologically legal and illegal nonsense words.

Co-occurrence of Processes

Often children's production contain more than one process.

The processes occurring in:

e.g. In , Speak ->[bi] : Consonant cluster reduction, Final consonant deletion, Prevocalic voicing.

In, Sock -> [g⊃k] : Stopping velar assimilation, Prevocalic voicing.

In, Cherry-> [d∈wi] : Fronting, Stopping, Prevocalic voicing, Liquid gliding.

When the words have more than one simplification process, there might be cases in which we have to assume a particular ordering of the processes is in effect.

eg. If the target word "sick" is produced as /ki/, it can be concluded that the child has applied the processes of stopping, velar assimilation and final consonant deletion. The application of stopping and velar assimilation must come before the deletion of the final consonant, because the deletion of the final consonant could

remove the necessary agent for velar assimilation. Also, only stops as obstruents are allowed in velar place of articulation .

Thus, the following deviation is suggested:

Underlying for /sɪk/
Stopping
Velar assimilation /tɪk/
Deletion of final consonant /kɪk/
/kɪ /
Phonetic representation [ki]

In other instants, multiple processes may not be in a dependency relationship eg. One of the common realization of the word Black is [bæ] . This shows the process of consonant cluster reduction and final consonant deletion. However, these two processes do not need to apply in a specific order, as either order would account for the child's production.

CLASSIFICATION OF PHONOLOGICAL PROCESSES

Most of the assessment procedures have essentially similar processes in their frame work as given in **table 5**:

Table 5 : ***Classification of Phonological Process by various authors***

Weiner (1979)	Shriberg &Kwaitkowski (1980)	Hod son (1980)
Syllable Structure Process Deletion of final consonant	1. Final Consonant Deletion	*Basic Phonological Processes* Syllable reduction
Cluster reduction:	2. Velar fronting:	Cluster reduction
Initial stop -liquid	initial	Prevocalic obstruent
Initial fric -- liquid	Final	Singleton omissions
Initials/ clusters	3. Stopping:	Postvocalic obstruent
Final/s - stop	Initial	Singleton omissions
Final liquid -stop	Final	Stridency deletion
Final nasal - stop	4. Palatal fronting;	Velar deviations
Weak Syllable Deletion	Initial	Miscellaneous Phonological Processes
Glottal Replacement	Final	Prevoicing
Harmony Processes	5. Liquid Simplification:	Postvocalic devoicing
Labial assimilation	Initial	Glottal replacement
Alveolar assimilation	Final	Backing
Velar assimilation	6 Assimilation:	Stopping
Prevocalic voicing	Progressive	.Affrication
Final consonant devoicing	Regressive	Deaffrication
Syllable Harmony	7. Cluster Reduction:	Palatalization
Feature Contrast Processes	Initial	Depalatalization
Stopping	Final	Coalescence
Gliding fricatives	8. Unstressed syllable Deletion	Epenthesis
Affrication		Metathesis

Fronting Denasaiization Gliding of liquids Vocalization.		***Sonoma deviations*** Liquid /l/ Liquid/t ɤ/ Nasals Glides Vowels ***Assimilations*** Nasal Velar Labial Alveolar ***Articulmory Shifts*** Substitutions ot'f v s z. for/ θ ð/ Frontal lisp Dentalization of /t d n l Lateral ization ***Other patterns***

Ingram (1981)	**Grunwell (1985)**	**Dean et al. (1990)**
Deletion of Final Consonant 1. Nasals 2. Voiced stops 3. Voiceless slops 4. Voiced fricatives 5. Voiceless fricatives *Reduction of Consonant Cluster* *6.* Liquids 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, of 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. Dearfrication *21.* Deletion of initial consonants 22. Apicalization 23. Labialization *Assimilation processes* 24. Velar assimilation 25. Labial assimilation 26. Prevocalic voicing 27. Devoicing of final Cons.	***Structural Simplifications*** Weak Syllable Deletion: prelonic postonic Final Consonant Deletion: nasals plosives fircatives affricatives clusters- 1 -2+ Vocalization: /l/ other C Reduplication: complete partial Consonant Harmony: velar alveolar labial manner other S.L duster Reduction: Posive - approx. Fricative - approx. /s/ + plosive /s/ + nasal /s/ + appros. /s/ + plosive - approx. *Systemic Simplifications* Fronting: Velars Palato- alveolars Stopping: f/ v/ θ/ ð s/ z/ / □ / /t□ / /dz/ / l / /r/ Gliding: /r/ /l/ fricatives Context sensitive Voicing	***Systemic Processes*** Velar Fronting Palato .Alveolar Fronting Stopping of Fricatives Stopping of Aflricatives Word Final Devoicing Context sensitive voicing (i.e.. WI) Liquid Gliding Fricative Simplification (θ□ f; ð□ v) Backing of Alveolar stops (Unusual atypical process) ***Structural Processes*** Final Consonant Deletion Initial Cluster Reduction, Deletion Initial Consonant Deletion (Unusual/atypical process)

	WIland WF Voicing WI Voicing WW Devoicing WF Glottal Replacement: WI WW WF Glottal Insertion.	

The number *of* processes used in these assessment procedures *is* vastly different. While Hodson (1980) mentioned 40 processes, Weiner uses 16 and Shriberg & Kwiatkowski(1980) use only 8. This is due to the fact that some procedure separate the processes in greater detail while others treat them more generally .Another factor contributing to the discripency of the number of processes is the limitation of the definition of processes to natural phonological processes. Shriberg & Kwiatkowski (1980),for, e.g. include only processes that are attested to in some phonological phenomenon other than normal phonological acquisition. Among these phenomena are historical changes, dialect variations and slips of tongue.

Chronology of Processes

The simplification processes described above do not disappear in child speech at the same time different processes have varying permanence in developing phonologies. Although, there are not many studies focusing on age norms.

Stoel-Gammon and Dunn (1985) divided processes in to two categories and give the following picture.

Processes Disappearing by 3 years	**Processes persisting after 3 years**
Unstressed syllable deletion	Cluster reduction
Final consonant deletion	Epenthesis
Velar fronting	Gliding
Consonant harmony	Vocalization
Reduplication	Stopping
Prevocalic voicing	Depalatalizarion
	Final devoicing

Another, chronology of processes is offered by Grunwell **(Table 6**).

Table 6 : ***Chronology of Phonological Processes***

	2;0-2;6	2;6-3;0	3;0-3;6	3;6-4;0	4;0-4;6	4;6-5;0	5;0 -->
Weak Syllable Detection	———	———	———	———			
Final Consonant Detection		———	———	———			
Reduplication							
Consonant Harmony							
Cluster Reduction (initial)							
Obstruent + approximant		———	———	———			
/s/ + consonant		———	———				
Stopping							
/f*l*							
/v/		———	———	———			
/ θ /		———	———	———	———	———	———
/ ð /		———	———	———	———	———	———
/sl							
/zl		———	———	———			
/ ʃ /		———	———				
/ tʃ . *dzl*		———	———	———	———	———	———
Fronting /k,g,ŋ/		———	———				
Gliding r/—• [w]		———	———	———	———	———	———
Context-Sensitive Voicing	———	———	———	———	———	———	———

Source : From clinical phonology (p.229), by P.Grunwell, 1987 (2nd Edition). Baltimore : Williams & Wilkins. Reprinted by permission.

The solid black line across an age band indicates that almost all children at this age will demonstrate use of the process. A broken line indicates that at that

age, an appreciable number of children will not be using the process or will be using it variably.

The above mentioned accounts share many things. Stoel-Gammon and Dunn (1985) separate the two types of fronting, velar fronting and Palatal fronting (depatalization) whereas Grunwell (1987) differentiates types of CR and stopping for individual fricatives and affricates. Additionally, there is a great deal of overlap in terms of the age at which a particular process disappears.

Hodson and Paden (1981) noted in children between 4 and 5 years of age, use few phonological processes that have a significant effect on intelligibility. They observed devoicing of final obstruents, production of anterior strident phonemes to replace nonstrident interdentals, liquid deviations, tongue protrusions, depalatalization, nasal assimilation, labial assimilation, velar assimilation and metathesis.

Dyson and Paden (1983), studied five processes in 40 normally developing 2 year olds over a 7 months period. They noted that gliding was most frequently used, followed by cluster reduction, fronting, stopping and final consonant deletion. Gliding was more common on /r*l* than on the /l/ and fronting of palatals more frequent than that of velars. Stopping of liquids occurred almost as frequently as stopping of strident and final consonant deletion was most apt to occur with nasal and strident

Haelsig and Madison (1986), evaluated phonological processes exhibited by 3,4,5 year old children and 50 English speaking children (25 male, 25 female)

ranging in age from 2:10 to 5:2 were taken with no history of speech, language delay or disorder. They used phonological process analysis (PPA, Weiner,1979) to evaluate the processes. The result showed that the processes of cluster reduction, weak syllable deletion, glottal replacement, labial assimilation and gliding of liquids were used by 3 and 31/2 years old children. These processes should be expected in children's speech at or under the age of 3. Weak syllabic deletion and cluster reduction were prominent in the speech of 41/2 and 5 year old children.. This study found that the greatest reduction in use of the phonological processes occurred between 3 and 4 years of age.

Bankson and Bernthal (1990) analyzed the speech samples of 1000 children between ages 3 and 9 years, and found that liquid gliding, stopping, cluster reduction, vocalization and final consonant deletion among the process that persist longest in children. Khan and Lewis (1986) reported similar results with an addition of velar fronting to this list. Robert, Burchinal and Footo (1990) noted that the most commonly occurring processes in children between 21/2 and 4 years old are deletion of final consonants, cluster reduction, fronting, stopping and liquid gliding.

Norms from the assessment links between phonology and articulation (ALPHA) by Lowe (1986) indicate that sound changes associated with stridency deletion, stopping, gliding, vocalization and cluster reduction still occur in some children between 6 and 7 years of age.

> **Between Word Processes**

The emphasis of phonological process description has traditionally been on sound changes at the word level. However multiword productions should also pose problems for the child acquiring the sound system. Stemberger (1988) suggests that "the extra complexity of multiword utterances would prove difficult in certain ways and lead to the rise of phonological processes that involve two or more words". Stemberger refers to these as between word processes.

Most of the research on between word processes has focused on the operating of consonant harmony across words (Donahue 1986, Matthei 1989). Stemberger (1988) describes several additional between word processes that occurred in his daughter's speech including vowel deletion, doubling of [illegible], nasal assimilation and word-initial deletion.

> **Multiple Processes**

Children frequently apply more than one phonologic process when producing a single word, rather than using only one process per word.

Target	Form	Processes
Glove->	/k^b/:	Cluster reduction, velar fronting and stopping

In general research on the phonological processes indicate that there was a possibility of more than one processes to occur in a child's production. The processes may be applied to different positions in the same word or to the same sound change.

Completion of the phonetic inventory

During the age of 1.6 - 4 years most basic phonological patterns are established, but the child's phonological system is far from being completed. A number of features still remain to be developed. During the stage between ages 4 and 7 years, certain contrasts such as fricatives and affricates are stabilized. At the end of this period, the child is capable of producing all of the sounds. However, the child will have difficulty with longer records such as "*thermometer", "vegetable"* and they may not match adult targets.

Although the phonological processes described above have been well documented, little research has been directed towards determining the age or age range at which the various processes are present in the speech of normally developing children. The findings of various longitudinal studies involving single subject or small groups of children and a few cross-sectional studies with larger subject population (Crary et a1, 1981; Hodson and Paden, 1981). provide a broad picture of the use of phonological processes at various chronological ages. Although there is considerable individual variation, phonological process occurrence can be divided into major categories, processes that disappear by the age of 3;0 and those that persist beyond 3;0.

Phonological Process Common to Phonological Disorder

For many years, children with articulation ,phonologic disorders with no basis were classified as exihibiting "Functional articulation disorder". These

children comprising the over whelming majority of children with articulation disorders who had no obvious organic basis to their disorders and were therefore presumed to have speech errors due to faulty learning of the sound system. Children with functional articulation disorder were treated as a homogenous group even though some authors on the heterogeneity found within this class (Mc Nutt and Hanayan, 1984) familial and a possible genetic basis has been suggested to account up to 40 % of children with phonologic disorders of unknown etiology (Lewis 1997).

Hodson and Paden (1981) evaluated the speech errors of 60 normally developing children (ages between 4 and 5 years) in comparison to 60 unintelligible children (ages 3-8 years). The processes most prevalent in the unintelligible children's speech included cluster reduction, stridency deletion, stopping, liquid deviation (gliding and vocalization) and assimilation (labial and nasal). Secondary to these processes were velar fronting or omission, backing, final consonant deletion, syllable reduction, prevocalic voicing and glottal replacement. Hodson and Paden noted that while all of the unintelligible children showed processes of cluster reduction, stridency deletion, and stopping these processes were evident in fewer than five of the intelligible children.

Stoel-Gammon and Dunn (1985) compared error patterns from eight studies (not including Hodson and Paden 1981), on phonologically disordered children. The most frequently occurring processes they noted were deletion of final consonant, cluster reduction, weak syllable deletion, stopping, velar and

palatal fronting, gliding, vocalization, assimilation (nasal, labial, velar) prevocalic voicing, final consonant deletion.

Differences in Use of Processes.

Grunwell (1987) observed that many of the processes used in phonological disabilities are also used in normally developing children. The difference between the groups however appears to be in the use of those processes. She classifies these difference as persisting *normal processes, chronological mismatch, unusual idiosyncratic processes, variable use of processes and systematic sound preference.*

Leonard (1985) specifically defined unusual phonological processes that had been previously identified in the speech of children with phonological disorders who did not have identifiable physical, physiological, or auditory deficiencies. Three categories of phonological behavior are identified, the third of which will not be considered in this discussion as it mainly deals with subphonemic phenomenon such as Voice onset time.

Leonard's two other categories of unusual phonological behaviors are

1. Salient but unusual sound changes with readily detectable systematicity.
2. Salient but unusual sound changes with less readily detectable systematicity.

1. These are atypical substitution patterns, such as

- Early sounds replaced by late sounds
- Additions to adult forms, such as additional consonant adjunction
- Use of sounds absent from the model language and
- Use of sounds absent from natural language.

2. These are essentially assimilative or structural changes, some of which have been identified in previous assessments as typical of normal phonological development. Leonard (1985) cites examples of older children who continue to exhibit such patterns in their pronunciation systems. These are

- Assimilations, both reduplications and consonant harmony
- Metathesis and
- Syllable structure deletions, such as posttonic weak syllable deletion and within word consonant deletion.

Thus, this framework for a developmental diagnosis has led to the identification of three potential developmental differences (Grunwell, 1985)

- Delayed
- Uneven
- Deviant

With reference to the diagnostic indicators provided by a phonological process analysis, five characteristics of disordered phonological development can be identified (Grunwell, 1981b. 1985, 1987, 1988; Stoel-Gammon and Dunn, 1985)

- Persisting normal processes
- Chronological mismatch
- Unusual processes
- Variable use of processes
- Systematic sound preference

Persisting normal processes are normal phonological processes that remain in a child's pronunciation patterns long after the age at which they would be expected to have been "suppressed," such as fronting of velars present in the speech of a child of 3;6-3;9. If the processes evidenced in a data sample are all normal and are homogeneous in terms of their chronology, then it is clear that a child's

phonological development is delayed to a greater or lesser extent, depending on his or her age, or is "arrested" at a particular stage of development.

Chronological mismatch is the co-occurrence of some of the earliest normal simplifying processes with some patterns of pronunciation characteristic of later stages in phonological development, such as fronting of velars and the development of word initial clusters present in the speech of a child aged 3;6 - 3;9. Such uneven progress is suggestive of disrupted or literally "dis-ordered" development.

Unusual processes are apparently simplifying patterns that have been rarely attested in normal speech development or that appear to be different from normal developmental processes and may, therefore be idiosyncratic. As indicated above, this definition is carefully constructed so as not to exclude the possibility that a child who subsequently exhibits normal developmental achievements might display apparently unusual patterns for a short period of time.

Variable use of processes occurs when more than one simplifying process routinely operates with the same target type of structure, so that the child's realizations are variable and unpredictable: Pie [bal], Pour [po]. This variability is potentially progressive in that ,it entails the possible development of target contrast. Variability is abnormal when it is not potentially progressive.

Rake [le k], rabbit [abt], ring [w], red [o∈1]

Systematic sound preference Occurs when one type of consonant is used for a large range of different target types. Often several different processes can be

identified as resulting in a massive reduction of the phonological contrasts in a child's system; the processes "conspire" to "collapse" the adult system of contrasts to the one phone the child prefers to use in his or her pronunciation patterns (i.e, what might be called a "favorite articulation"):

- Fronting and voicing of /k/;
- Fronting of /g/;
- Stopping of /δ, z, , d /;
- Voicing of /t/;

Cluster reduction involving these targets; the co-occurrence of all these processes thus results in systematic sound preference for [d].

The resultant massive lack of contrasts is clearly indicative of a severe phonological learning disability in a child who has developed in other aspects of language such as the lexicon and grammar beyond the earliest stages of language development. These processes only co-occur normally up to about 2.6 years.

These characteristics are most frequently applied in clinical diagnosis when there are no co-occurring anatomical or physiological conditions. However, as Ingram (1976) and Grunwell (1990) demonstrate, phonological process analysis is amenable to other applications. In addition, as children are developing pronunciation patterns in the context of an identifiable disability, there is likely to be an interaction between the normal pattern of development and the effects of the anatomical and / or physiological condition. For example, there is an identified tendency of backing in "cleft palate speech," which is the opposite of "normal fronting of velars"; alongside this tendency it is likely that children with repaired cleft palate will continue to evidence patterns of normal immaturities such as

stopping of fricatives and affricates and gliding of liquids (Russell and GrunwelL 1993).

Phonological Processes in the Disordered Population:

Most articulation studies have focused on children in the normal range of intelligence. Speech errors are of course, not limited to the "normal child". Investigators such as Lewald (1932) Sirkin and Lyons (1941), Sachs (1951), Schlanger (1953), Schlanger and Gottsleben (1957), and Tarjan et al.(1961) have reported that over 50 % of the mentally retarded subjects in the samples they tested evidenced speech defects.

Bodine (1974) and Smith (1974) studied the phonological processes present in the speech of Down syndrome children and identified the following as occurring most frequently cluster reductiin,, assimilation (nasal, labial and velar), fronting, final consonant deletion, stopping, vocalization, liquid deletion and gliding.

Linda Mackay (1982) studied speech samples of 20 mentally retarded children between the ages of 10 years and 15 years. They were analyzed for the purpose of identification of systematic patterns. Liquid deletion and Cluster reductions were the most prevalent phonological processes. Postvocalic obstruent omission, deviations of other sonorants (glides and nasals) velar deviations, stridency deletion, stopping and / θ, ð / deviation were demonstrated less frequently.

Generative studies of a hard of hearing child (Oller and Kelly, 1974) and of normally hearing, language-delayed children (Oller, 1973; Compton, 1970 ; Ingram, 1972) have reported finding phonological systems that have much in common with that of younger normal children.

Oiler (1978) studied the phonology of a 6 year old hearing impaired child. The results stated that the phonological substitutions and deletions of this hearing impaired child are basically the same in kind as those found in the speech of younger normals. These studies, suggests that the hearing loss has merely delayed the childs phonological development.

The speech production of 19 hearing impaired children between 5-12 years of age were examined for errors related to phonological process categories. For comparison, the subjects were divided into groups of 9 with profound and 10 with moderate-severe hearing loss. There was a significant relationship between hearing loss and phonological errors. Seven phonological processes were evident in at least 33% of obligatory contexts. Prevalent processes included final consonant deletion and cluster reduction. The most prevalent deficiencies included /r/ and /l/ phonemes. Subjects with profound hearing losses produced more over all as well as more errors in each phonological process category. Subjects with profound hearing loss frequently deleted entire clusters, whereas subjects with moderate to severe hearing losses did not, (Meline,T. 1997).

[Edward (1993) studied the phonological processes in an autisic child. The case report provides a detailed phonological investigation of the speech of an 8

year old autistic boy. Three approaches were used for evaluation of speech : delayed imitation, object naming and a connected speech sample. Phonetic inventory analysis revealed that stops, nasals and glides were generally present, whereas fricatives, affricates and the liquid /r/ were absent. These were also positional restrictions on the use of specific sounds. This information together with a phonological process analysis, revealed (a) the existence of several phonological processes that are common in normal development (b) the persistence of several phonological processes, *eg.* Velar fronting, beyond the expected age (c) The occurrence of some unusual sound changes *e.g.* Extensive glottal replacement and segment coalescence (d) evidence of "chronological mismatch" (Grunwell 1981) and (e) restricted use of contrasts (Ingram, 1976). The subjects use of phonological processes resulted in extensive homonymy, which together with process interaction and the use of jargon, resulted in severely reduced intelligibility. This child appeared to be acquiring this phonological system in atleast a partly unique way, showing some typical patterns as well as some patterns that rarely appear in normally developing children.'

VOWEL PATTERNS IN CHILD PHONOLOGY

Although the emphasis of research on phonological developments and disorders has been on consonants, some recent studies have focussed on the development of the vowel system (Pollack and Keiser, 1990 ; Stoel-Gammon and Herrington, 1990 ; Reynolds, 1990). Linguists have long been aware of processes

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

Pollack and Keiser (1990) evaluated 15 phonologically disordered children for the presence of vowel errors. They posited that the errors would fall into one of three subtypes (a) feature changes, in which vowel features (height, frontness, roundness) changes its value, (b) complexity changes, which involves changes in dipthongal nature of vowels, (c) vowel harmony ,in which a vowel changes to become more like another vowel in the same word. They noted most errors were feature changes followed by complexity changes. Harmony processes were rare.

Feature. Changing Processes

> *Vowel Backing*

The feature changing process is a vowel being replaced with a more posterior vowel *eg.* /æ/→ /a/

> *Vowel Lowering*

This sound change occurs when a vowel is replaced with a vowel made with a lower tongue height. *e.g,* /ɪ/ → /ɛ/

> *Centralization*

Replacement of a vowel with a central vowel typically the schwa or stressed form *e.g.* /e/ → /^/

> *Vowel Unrounding*

A vowel that is normally rounded is produced without the rounding

e.g. /ɔ/ → /a/ .

Pollack and Keiser(1990) stated that other forms of feature changing processes include vowel fronting, raising, tensing, laxing and raising, these occurred with less frequency than those previously described more fully.

Complexity Changes

V *Diphthongization*

A Monophthong vowel is produced as a Diphthong *e.g.* /a/ → /aɪ /

> *Diphthong Reduction*

A vowel that is normally produced as a Diphthong is reduced to a Monophthong *e.g.* /aɪ/ → /a/

Vowel Harmony

> *Complete vowel harmony*

In this sound change one - vowel is changed so that both vowels in the word are the same *e.g.* /ɔfis/ → /ɔfɔs/

> *Tenseness Harmony*

Lax vowel becoming tense when there is another tense vowel in the same word *e.g.* /kʊki/ → /kuki/

> ***Height Vowel Harmony***

Vowel is replaced with a vowel that is closer in production to the height of another vowel in the same word *e.g.* /himæn / → /himɪn/

Consonant Vowel Harmony

Vowels changes due to the presence of a neighboring consonant

e.g. /mol/ → /mɔl/

Mackay (1987) note that dipthongization is common in the speech of deaf children. Reynolds (1990) described a tendency for vowels to be replaced with a more open vowel when preceding nasal and of vowel lowering and backing preceding the dark *ill.*

Other form of vowel -harmony suggested by Pollack and Keiser include frontness vowel harmony and rounding vowel harmony. These were not observed in the subjects of their study.

CROSS LINGUISTIC COMPARISIONS OF PHONOLOGICAL ACQUISITION

The similarities and differences in the development patterns of children from various language backgrounds have been examined. The order and rate of acquisition of phonemes and the developmental phonological error process have been described.

Pye, Ingram and Lest (1987) studied five children learning Quiche, a Mayan language. They found that the children early phonetic inventories included sounds (eg. /tʃ, l/) which were not acquired until later by nature English speaking children. Similarly. Timenez (1987) and Acevedo (1988) found that Mexican American Spanish-speaking children acquired /t/ and /l/ much earlier than English speaking children.

Mowrer and Burger (1991) carried out a comparative study of Xhosa-speaking children aged 2:0 to 6:0. They found that Xhosa-speaking children mastered the 20 phonemes shared by Xhosa and English earlier than English

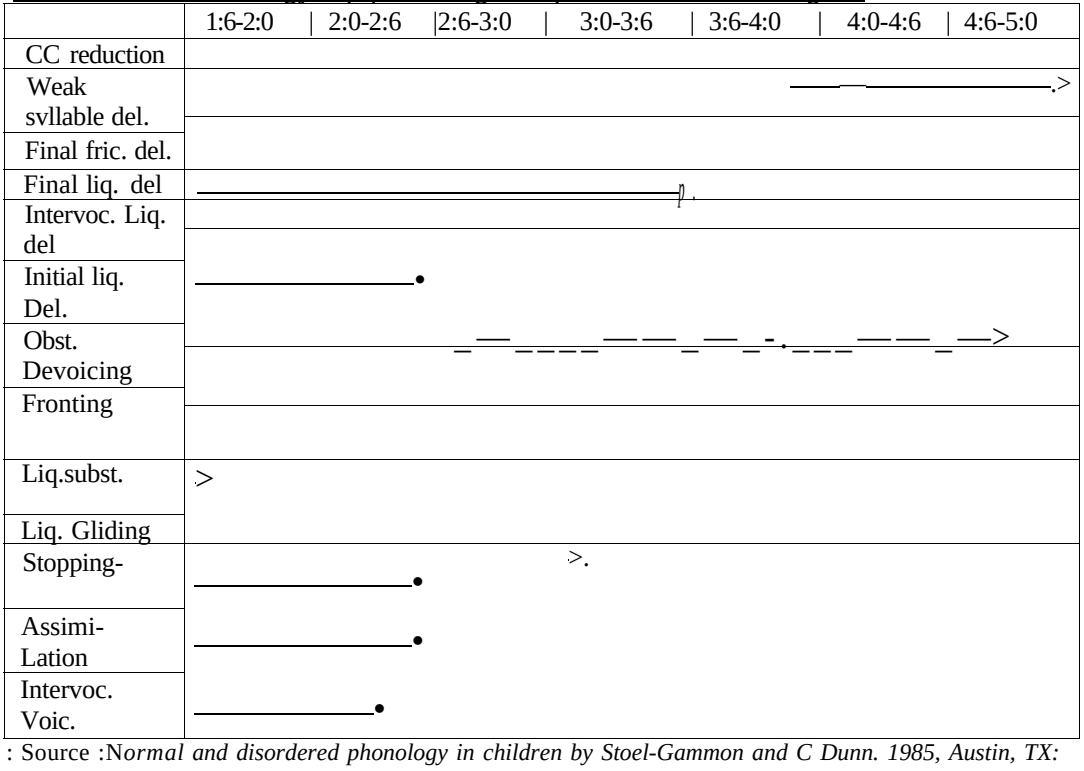
speaking children. The Xhosa children had mastered 31 of the 41 consonants by 3.0, including some affricates (eg. Ts, tʃ) and clicks. The Xhosa-speaking children also made fewer errors on stops and fricatives than the English speaking group. However, the two groups were shown to use similar substitution patterns for fricatives, affricates and liquids. The sounds acquired last and most frequently misarticulated by xhosa-speaking children (eg. / s, ʃ, r /) were the same phonemes English, German and Swedish children found difficult.

So and Dodd (1995) compared the phonological acquisition of Cantonese speaking children with that of English speaking children . It was found that the order of consonant acquisition was similar to English speaking children. The Cantonese children's acquisition was more rapid. Specific phonological processes used by Cantonese children were also identified. For *e.g.* Same two year olds affricated /s/ (*e.g.* /patʃi/ for /pɔ̀si/ ; [tʃoej] for /soej/). This pattern should be unusual in English speaking children who acquire affricates later than fricatives. The more common developmental error for English - speaking children involves stopping of affricates (eg [top] for /tʃɒp/). In contrast while some Cantonese two year olds, deaffricated /ts/ (eg [siw] for /tʃiw/), affrication of /s/ was much more common.

The phonology of children is universal. The developmental patterns of phonology are also observed in many other languages. There is not much information on the chronology of processes in different languages. However the

chronology provided for Portugese by Yavas and Lamprecht (1988) reveal certain similarities to the pattern found in English. There is a most striking difference observed between the English and the Portugese data regards stopping. Whereas, this process is classified as a late process in English, the Portugese data reveal that it disappear quite early. This difference between the two examples is probably due to the fact that Portugese does not have the two late acquired fricatives, **(table** 7).

Table 7 : *Chronology of phonological processes in Portugese*



: Source :N*ormal and disordered phonology in children by Stoel-Gammon and C Dunn. 1985, Austin, TX:*

Although there are some language specific processes, they are shared by language and the age at which they disappear differ. For eg. Cluster reduction is late process in Portugese whereas processes such as assimilation, consonant harmony and content sensitive voicing are early processes. It should be remembered that these chronological accounts are merely broad generalizations

and many children show different patterns. There are also some patterns that are language specific and the generalization may apply in a different sequence substitutes for the targets /l/ and /r/ illustrate this point well. While English-speaking children reveal errors such as /r/ -> /w/ and /l/ -> /w/ or /j/. The situation is different in Italian, /r/ is substituted by /x/ or /n/ and /l/ is substituted by /r/ or /n/ (Bonoleni and Leonard. 1991). In Swedish, we see the substitution /x/ -> /h/ and /l/ -> /j/ (Nettelbladt 1983).

Analyzing all of the above, Leonard (1995) gives a phonological explanation for each on the basis of the sensitivity to patterns of ambient languages. More specifically the explanation for Italian stresses the very limited occurrences of /w/ and /j/ and the alveolar nature of the target /l/ and /r/. Thus the substitute is either the other alveolar liquid or another alveolar sound. /n/ which shares many of the same features. The unusual looking glottal /h/ substitution in Swedish is accounted for by reference to /x/ which is velar in Southern Swedish dialect. Thus what might appear as a highly unusual substitution may have a well grounded explanation when the specific ambient language patterns and the nature of sounds are considered.

The phonological acquisition of 129 monolinguial Pulonghua speaking children aged 1.6 - 4.6 was described phonological processes used by the children were identified. Two of these processes syllable - initial consonant deletion and backing, would be considered atypical error patterns in English whereas these

were the continuous processes in putonghua - (Modern standard chinese).(Hua,2000).

In general the research on the normal use and suppression of phonological processes indicates that most children, regardless of the language being learned, use the common processes early in their development of sound system. The rate at which processes are suppressed varies between children but the greatest rate of process suppression occurs between 21/2 and 4 years of age.

Indian Studies

India is a multilingual country. Over 1652 languages are spoken here. The saliency of the components in the language system determine the order of acquisition. Adequate research is required in order to provide the normative data for each language to determine a delay / deviance in phonological development in the language disordered child. So there are few studies in Indian languages where the phonological processes are identified..

Sameer (1998) used the iMalayalam articulation test on 30 children in the age range of 3-4 years Malayalam speaking children. The results stated the persisting processes in these childrenwere, cluster reduction. Deletion of final consonant,Epenthesis, Apicalization and Affrication. Decreasing processes were the deaffrication. stopping, stridency deletion, fronting, reduplication, palatalization, atypical with reduction, medical consonant deletion, backing of fricatives, denasalized and articulatory shifts.

Sunil (1998), conducted a study on 3-4 year old Kannada speaking normal children and results indicated that children used several phonological processes during the speech sound production and these processes tend to persist even after 4 years of age. The results also showed that as age advanced from 3 - 4 year some phonological processes persisted (fronting and cluster reduction) while some other phonological processes decreased (medal consonant deletion, final consonant deletion and affrication).

Jayashree (1999) studied 30 children's in the age group of 4-5 years Kannada speaking children. She used the Kannada articulation test as test stimuli. The results were cluster reduction, fronting, stopping were found to be the persisting processes whereas, the metathesis, epenthesis prevocalic voicing, palatalization were decreasing processes.

These studies shows that there are universal tendencies in children's phonological acquisition. However, language specific features play an important role in determining the phonological development of the children of a given language.

Thus these chronological accounts are merely broad generalization and many children show different patterns. There are also some patterns that are language specific and the generalization may apply in a different sequence.

ASSESSMENT

Most assessment instruments attempt to identify the nature and deviation of phonological process acquisition. Apart from these some tests differentiate between developmental and unusual processes.

Weiner (1979) developed "Phonological process Analysis" (PPA). It is especially useful in assessing speech of the unintelligible child. The phonological process analysis is most appropriate for children between the age of 2 and 5 years. 136 stimuli are used, and PPA elicited from action pictures that sample words both single words and in the context of sentences. Procedures for elicitation involves, delayed imitation and sentence recall.

Shriberg and Kwaitkowski (1980) developed "Natural Process Analysis" (NPA). It is a procedure for analyzing continuous speech samples for the presence of eight phonological processes. The sample is collected during different activities *(eg.* Narrating a story using picture in a book, talking about interests and experiences, comments on arrangement of small objects and figures). Natural process analysis provides information on what processes are being used, what stage in development the processes are in and what phonetic contexts, if any influence the occurrence of the process.

Ingram (1981) developed " Procedures for the phonological Analysis of Children's Language" (PPACL). It can analyze a wide range of phonological processes. It would be most appropriate for children displaying multiple articulation errors.

Lowe (1986) developed " Assessment Link between phonology and Articulation" (ALPHA). ALPHA was designed for administration to children 3 years of age and older. The ALPHA provides scores for percent of occurrence of processes, percentile rank, standard score, standard deviation profile and total number of processes.

Hodson (1986) developed a test called " Assessment of Phonological Process-Revised" (APP-R). It is unique in its use of 50 objects, pictures and body parts to elicit 50 utterances. The APP-R was not designed to identify phonological disabilities ,but to identify priorities in the treatment of unintelligible children, It has been administered to children as young as 3 year old. The APR-R is structured to score over 40 phonological processes. The APR-R derives a frequency of occurrence score, percentage of occurrence severity interval and composite deviancy score.

Khan and Lewis (1986) developed a test named "Khan-Lewis Phonological Analysis" (KLPA). 44 words from the Goldman-Fristoe test of articulation-sounds in words subtest are used as input for phonological process analysis. The KLPA is designed for preschool children. It provides measures of developmental phonological processing rating, speech simplification rating and percentage of occurrence score for individual processes or for total processes.

In recent years several computer software packages have been designed which are capable of performing various phonological analysis on speech. The simplest package may be the "Computer Analysis of Phonological Processes"

(CAPP) (Hodson 1985) ,which accepts as input only the consonants of the 50 words in Hodson's APP-R (1986) and provides a single page of output which includes the percent of occurrence of 10 basic phonological processes, a phonological deviancy score and a suggested treatment objective.

Bankson and Berathal (1990) developed " Bankson-Bernthal test of phonology" (BBTOP). It was designed for preschool and early elementary age children. There are 80 stimulus words elicited using picture naming format. It provides summary chart for initial and final consonants and phonological processes.

The clinical application of a phonological process analysis has been especially useful in evaluating children with multiple articulation error (Cray 1980a; Werner 1979). The speech sample for process analysis may be obtained using a variety of procedure, including imitation, citation from labels or conversational speech. Walsh (1979) indicated strong agreement among delayed imitation, phrase imitation, naming and spontaneous speech procedures in identifying the most prominent process in children's speech.

. Phonological process analysis emerged to meet the demand for a more comprehensive means of assessing children who exhibit multiple speech sound production errors. Result obtained from a complete process assessment can provide examiners with a profile of the underlying rules a child uses and can serve as a basis for planning remediation.

"Stimulus used for Phonological assessment": A CONTROVERSIAL ISSUE

The goal of phonological assessment procedures is to obtain a speech sample that reflects the child's abilities in varying contexts and situations in order to optimize assessment and treatment. The methodological issue of weather to assess phonological behavior using single word naming (Citing) and spontaneous conversation (talking) is debated (Berntal and Bankan, 1993; Morison and Shriberg, 1992; Shriberg and Kwiatkowski, 1980; Stoel-Gammon and Dunn, 1985).

Decisions regarding diagnostic procedures revolve around multiple dimensions, including time efficiency, ease of use and administration of the procedure and perhaps most importantly reliability and validity of the procedure in assessing a child's speech production.

Clinicians and researchers alike have long been familiar with general strengths and weakness of the two methods of speech elicitation. The major strengths of single word naming are

(a) It is usually simple and relatively easy to administer.

(b) Because of a predetermined word list and back of confounding factors from the phonetic environment, it is easy to determine the target word and easy to transcribe, especially in the case of a highly unintelligible child.

(c) A predetermined word list provides control over the speech samples *(i.e.* the list can be especially designed to elicit sounds in a variety of word position and phonetic contexts)

(d) Single word naming facilities comparison between children or in one child longitudinally, because data are based on single measure. The major weakness often described is that naming may over estimate a child's true abilities and thus fail to reflect his/her performance in real life communication (DuBois and Bernthal. 1978; Faircloth and Faircloth. 1970; Ingram, 1976; Smith and Ainsworth, 1967; Stoel-Gammon and Dunn, 1985).

In contrast to single word naming spontaneous conversation tests the childs performance in the most real life natural communication. This method is further strengthened by the availability of phonetic contexts which are thought to be important in phonological assessment. Typically, traditional articulation tests have not adequately taken into account the influence of phonetic context.

However, inspite of these important advantages spontaneous conversation has several weaknesses that may limit the clinicians full use of this assessment method. In a clinical setting, childrern may simply be unwilling to co-operate, may be too shy to engage in spontaneous conversation or may have behavioral complication which make it impossible. Moreover, speech output from a highly unintelligible child may be difficult to transcribe or it may be difficult for the clinician to determine the target word. Children may also deliberately avoid certain sounds with which they know that they have difficulty, or avoid certain phonetic contexts. Finally the sample will be different both between and within children. This can pose problems in research and make it more difficult for a

clinician to evaluate a child's performance systematically over time, thus limiting prognostic and treatment outcome evaluations.

Numerous studies have compared procedures for eliciting speech in an attempt to establish the optimal sampling method (eg. .Andrews and Fry, 1986; DuBois and Bernthal, 1978; Faircloth and Faircloth. 1970; Healy and Madison, 1987; Kelin, 1984; Morreson and Shriberg, 1992; Orr. Blodgett and Miller. 1983; Shanks Sharpe and Jackson, 1970; Siegel, Winity and Conkey, 1963; Simmons, Blodgett and Muller, 1983; Smith and Armsworth, 1967; Watson, 1989). Early investigations focused on comparing the different single word elicitation methods (eg. Shanks, Sharpe and Jackson, 1970) and determining weather or not techniques requiring a spontaneous response differ from those using limitation to elicit a response *(e.g.* Siegel, Winity and Conkey, 1963; Smith and Ainsworth, 1967). More recent studies have focused on determining weather or not results of sampling methods requiring a single word naming response differ from connected speech samples *(e.g.* Andrews and Fey).

In essence, most studies have found that generally more articulatory, phonological errors occur in conversation than in naming *(e.g.* Andrews and Fey, 1986; Dubois and Bernthal, 1978; Faircloth and Faircloth, 1970; Healy and Madison, 1987; Kelin. 1984; Morrison and Shriberg, 1992; Orr, Blodgett and Miller, 1983; Watson, 1989). Furthermore, certain error types have been found to occur more frequently in spontaneous conversation than in naming. These include cluster reduction, final consonant and initial consonant deletion syllable deletion,

assimilation, coalescence, neutralization and stopping *(e.g.* Andrews and Fey, 1986; DuBois and Bernthal, 1978; Dyson and Robinson, 1987; Healy and Madison, 1987; Kelin, 1984; Paden and Mors, 1985; Paynter and Sum's, 1979). Some studies however have identified the same phonological processes regardless of the elicitation method, including assimilation cluster reduction, gliding of liquids, medial consonant deletion, fronting of palatals, stopping and vocalization (DuBois and Bernthal, 1978; Keaney, Prather, Mooney and Jeruzel, 1984: Kelin, 1984; Paden and Moss, 1985; Simmons, Blodgett and Muller, 1983).

Although more articulatory errors generally occurred in conversation, severity ratings have been found to be equivalent or poorer when based on citation forms (Andrews and Fey. 1986; Dubois and Bernthal, 1978; Faircloth and Faircloth, 1970; Healy and Madison, 1987; Kelin, 1989; Summons Blodgett. Miller, 1983; Johnson, Winney and Pederson, 1980).

From these findings, it is difficult to draw conclusion regarding the superiority' of one method over the other. One problem in interpreting the results of these studies is the use of various assessment procedures for naming, thus making it difficult to compare across studies. Moreover, many of the naming procedures used have been limited with respect to phoneme selection (particularly consonant clusters) phonetic environment and syllable structure. That is to say, allthough several studies have attempted to systematically compare naming and spontaneous conversation, few studies have employed an extensive picture naming

task (PNT) that adequately controls for phonetic environment while providing in depth phonological analysis.

Musler and Wolk (1998) conducted a study to systematically compare two methods of speech elicitation for phonological assessment, conversation and picture naming. Subjects were 13 male, phonologically impaired children (aged 2 to 5.11 years. All were English speaking and had received no prior speech and language therapy. The children's performance was assessed on a conversational speech task (CST) and a 162-item picture naming task (PNT) using three levels of phonological analysis. The CST and PNT generally yielded similar sound error patterns and severity measures on the two tasks were highly correlated. However, the PNT yielded more phonological errors. It is suggested that both methods of speech elicitation are useful clinical tools for assessment. However, to obtain a thorough sample of a child's speech output, an extensive - well designed PNT may tap the child's phonological system more deeply, may be more efficient in some cases and may represent a good index of phonological ability.

In conclusion, conversational speech has often been referred to as the "ideal" method of elicitation because it represents the child's natural connected speech and allows for influence of phonetic context. Although this may be true, a carefully designed picture naming task may tap the child's phonological system more deeply and provide the clinician / researcher with maximum control over the speech sample to obtain a richer body of data. In addition, we face the conflict of the "ideal world" versus practical constraints in clinical and research settings. Both

transcription and data analysis may be easier and more efficient using naming therefore, an extensive picture naming task may provide a good sample of phonological behavior while avoiding difficulties inherent in the collection and transcription of conversational speech.

CRITERIA FOR IDENTIFICATION OF PROCESSES

Different criteria have been suggested by various authors, but no uniform guidelines is adopted by the profession. Mc.Reynolds and Elbert (1981) demonstrated the effects of applying different criteria, noting that the application of criteria significantly changes what sound patterns qualify as processes. In their report they suggested that a particular sound change should have possibility of occurring four times and be used atleast 20% of the time to qualify as a process. Most other studies only stipulate that a particular sound change occur and make no demands on its frequency.

Test instruments such as ALPHA (Lowe, 1986) rely on normative data to determine if a process should be targeted for intervention but ,other that meeting the pattern sound change described by the process description, no quantitative criteria are used. Thus if a particular sound change occurs even once a phonological process is identified.

It is clear from the review that most children use different phonological processes during the acquisition of sound system (Stampe, 1969; Dyson and Paden, 1983; Stoel-Gammon and Dunn; 1985, Haelsig and Madison, 1986; and Robert, Burchinal and Footo, 1990). Various authors have listed different phonological processes, all of which are not occurring in all children. The rate at which processes are suppressed varies between children. The greatest reduction in the use of the phonological processes occurs between 3 and 4 year of age (Haelsig and Madison, 1986).

Hence based on this view and due to limited studies in Indian Languages the present study is aimed to analyze the phonological processes of 3 to 4 years old Tamil speaking children using me picture naming task.

CHAPTER3

METHODOLOGY

AIM

The aim of this present study was to obtain the normal development data of phonological process in 3 to 4 year old children with no history of speech and language problem.

OBJECTIVES OF THE STUDY

- To study the normal development of phonological processes in 3-4 years old Tamil speaking children.
- To study the phonological processes which are occurring in different age group namely 3.0 - 3.4years; 3.5 - 3.8 years; 3.9 - 4.0years (i.e,3 years to 3 years 120 days;3 years 121 days to 3 years 240 days; 3 years 241 days to 4 years).
- To compare the development of phonological processes across the three age groups namely, 3 - 3.4years; 3.5 - 3.8 years; 3.9 - 4.0 years.

Subjects

30 children, whose age range from 3-4 years (chronologically) served as subjects for this investigation. 10 subjects were selected in each group of three in 4 months interval, namely;

1. 3.0-3.4 years
2. 3.5 -3.8 years
3. 3.9-4.0years.

Subjects were selected by contacting day care providers, in play school at Chennai. The socio economic status variable was controlled. Other subject criteria included monolingual Tamil speaking familiay, normal hearing acuity, normal general functional abilities and no significant birth complication.

Assessment Tool

The Tamil articulation test (Usha. 1986) was used for the study. The test consists of 66 words .It tests for ten vowels and twenty five consonants in all positions, except for s, b,vj which occurs only in the initial and medial position and 1l which occurs only in the medial and final position.

Procedure

Before testing .the clinician had an informal interaction with the subject in-order to build rapport.

- Each subject was tested individually.
- The picture was shown one at a time
- The responses were recorded on a Sony digital taperecorder with unidirectional microphone.
- The elicitation of target words was achieved by the examiner showing the picture to the child and asking "What is this ?". In the instances when spontaneous utterances could not be elicited, questions were asked related to the item to which the target word is expected to be the answer.
- If the child failed to identify the target word an imitation task was used.

Analysis

- The recorded samples were later transcribed using broad transcription.
- Analysis was done separately for age group, from 3-4 years, within age group range(3:0-3:4 years, 3 :5 -3:8 years,3:9-4:0 years) and across the different age group.
- If a particular sound change occurred even once the process was considered.

- For reliability of the results, two more judges who were qualified speech pathologists and also native speakers of Tamil listened to the audiotapes and transcribed the samples.
- The correlation co-effiecients and the probable error was calculated for the obtained results.
- The results and discussion follows this chapter.

Reliability

The examiner analyzed the subject's responses. A total of fifteen processes were identified from the analyzed samples. In order to check the reliability of the results, two more judges who were qualified speech pathologists and also native speakers of Tamil transcribed the samples and identified the processes. The interjudge correlation co-efficients was calculated using Karl Pearsons product moment correlation ,for each subgroup, namely 3:0 -3:4; 3:5-3:8; 3:9-4:0years, and the probable error was also determined for the correlation co-efficients to confirm the strength of correlation.. The values were as given in the table 8, 9, and 10 respectively.

It was found that there was a high correlation between the judges. The correlation co-efficients were above 0.84 among the judges and the probability of errors was approximately 0.04 thus confirming the power of correlation.

Therefore from the above results it could be said that the results obtained in this study, are reliable.

Table 8: ***Correlation Co-efficients and the Probability error among the judges for the age group: 3:0 - 3:4.years.***

Judges	***CC***	**PE**
I, II	0.9200	0.039
II , III	0.8500	0.048
III. I	0.8700	0.043

C.C: Correlation Co-efficient, P.E: Probability error

Table 9: ***Correlation Co-efficients and the Probability error among the judges for the age group: 3.S-3.***

Judges	**C C**	**PE**
I, II	0.9516	0.017
II , III	0.94306	0.020
III, I	0.9360	0.023

C. C ." *Correlation Co-efficient. P. E : Probability* ***error***

Table 10: ***Correlation Co-efficients and the Probability error among the judges for the age group: 3:9 - 4:0years.***

Judges	***C.C***	**PE**
I, II	0.9360	0.024
II, III	0.8478	0.051
III, I	0.9292	0.026

C.C : Correlation Co-efficient .P.E : Probability error

CHAPTER 4

RESULTS AND DISCUSSION

This study was conducted on 3-4 years old normal children to assess the development of phonological processes. It involved 30 children inclusive of both sexes who had Tamil as their mother tongue.

A qualitative analysis was done and the results of the study have been discussed under the following sections.

(1) Normal development of phonological process in the age range of 3-4 years:

Table 11: ***Normal development of phonological processes in the age range of 3-4 yrs***

SUBJECT NO:	USD	CR	E	G	STL	STF	NA	VA	M	ICD	FCD	B	F	DA	AFF
1	✓	✓	✓	✓	✓	-	✓	✓	-	✓	-	✓	-	✓	-
2	-	✓	-	✓	-	-	-	✓	-	✓	-	-	-	✓	✓
3	✓	✓	✓	✓	-	✓	-	✓	-	✓	✓	-	✓	-	-
4	-	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓
5	✓	✓	✓	-	-	✓	✓	✓	-	✓	-	-	-	-	✓
6	-	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	-	✓	-
7	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓
8	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-
9	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	-	-	✓
10	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	✓	✓	✓
11	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-	-	✓	-	-
12	-	✓	✓	-	✓	✓	✓	✓	-	-	-	✓	-	-	-
13	✓	✓	✓	-	✓	✓	-	✓	-	✓	-	✓	-	✓	✓
14	-	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	✓	-	✓
15	-	✓	✓	-	-	-	✓	-	-	✓	-	-	-	-	✓
16	✓	✓	✓	✓	✓	-	-	✓	-	✓	✓	-	✓	✓	✓
17	-	✓	✓	-	-	-	✓	✓	-	✓	-	-	-	✓	✓
18	✓	✓	✓	-	-	✓	✓	✓	-	✓	-	-	✓	✓	-
19	-	✓	✓	-	-	-	✓	✓	-	✓	✓	-	✓	✓	-
20	✓	✓	✓	✓	-	-	✓	✓	-	-	-	✓	✓	✓	-
21	✓	✓	✓	-	-	-	-	✓	-	✓	-	✓	-	✓	-
22	-	-	✓	✓	-	-	-	✓	-	-	-	✓	-	-	-
23	✓	✓	✓	-	✓	-	-	✓	-	✓	-	✓	✓	✓	-
24	-	✓	-	-	-	-	-	✓	-	-	✓	-	-	-	-
25	-	✓	✓	-	✓	✓	-	✓	-	-	-	✓	-	-	-
26	-	-	-	-	✓	✓	✓	✓	-	-	✓	✓	-	-	-
27	✓	-	✓	✓	-	-	✓	-	-	✓	-	-	✓	-	-
28	-	✓	-	✓	-	-	-	✓	-	-	-	-	-	-	-
29	-	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-
30	-	✓	✓	-	-	-	-	✓	-	-	-	-	-	-	-

USD – Unstressed syllable deletion CR-Cluster reduction E-Epenthesis
G-Gliding STL-Stopping of liquids STF-Stopping of fricatives NA-Nasal Assimilation VA-Voicing Assimilation M-Metathesis ICD-Initial consonant deletion FCD-Final consonant deletion B-Backing F-Fronting DA-Deaffrication AFF-Affrication

A total of 15 different processes have been found to be significantly occurring in the age group of 3-4 years old Tamil speaking children. These are the most commonly occurring processes among these children, (as given in table 11.), however the frequency of occurrence differed across the age groups. From the results of this study it was found that the common phonological processes exhibited by these children were similar to the findings of Grunwell (1987) and Stoel and Gammon (1985), except for final devoicing. Processes such as the Cluster Reduction, Epenthesis that were seen in Malayalam language as reported by Sameer (1998) were also found in the Tamil speaking children. Even as the age advanced from 3-4 years, Cluster Reduction, Epenthesis, Voicing Assimilation persisted. This is because clusters are acquired at a later age and the acquisition of phonemes is not completed by 4 years of age and may persist till 4.0-4.6 years as reported by Grunwell (1987). All the younger age group children (3-3.4) exhibited Cluster Reduction.

However, a gradual emergence of cluster was evident. These children followed a hierarchal progression in producing clusters, i.e. from Total Cluster Reduction -> Partial Cluster Reduction->Correct production (by some children of 4 years). This kind of a developmental sequence was also reported by Greenlee (1974) and Ingram (1989).

Unstressed syllable deletion, Gliding, Stopping of Liquids, Stopping of Fricatives, Nasal Assimilation, Initial Consonant Deletion, Final Consonant

Deletion, Deaffrication were found to decrease as the age advanced from 3-4 years.

This provides an evidence that as age increases the child's phonetic inventory nears completion progressively thus leading to a decrease in the usage of phonological processes, this supports the view of Bernthal and Bankson (1993)who reported the same.

Stopping of liquids, which was considered to be an infrequent process by Grunwell (1987) did occur frequently in children of the younger age group. This supports the findings of Sameer (1998) who reported Stopping of Liquids as a common process in the age group of 3-4 years, particularly in the younger age groups in Malayalam. Usha Dalvi (1986) reported that laterals in Tamil are not produced consistently till the age of 6 years and may be due to this acquisitional constraint a frequent Stopping of Liquids was seen in these children.

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 the salient features related to language differences. Processes reported to be unusual to one language may be usual process in another language. This supports the view of Hua, (2000).

Multiple phonological processes were also noticed in this study. Many children exhibited more than one process when they produced some target words. Thus it can be said that some processes decreased as the age advanced from 3-4 years and some process do persist even after 4 years of age. This supports the

statement of Yavas(1997) that by 4 years the child establishes the basics of the phonological system and at the end of 4 years the child is expected to suppress most of the simplifying processes.

2) Phonological Processes across various age groups, namely 3:0 - 3:4 years; 3:5 - 3:8 years; 3:9 - 4:0 years.

(a) Phonological Processes in 3:0 - 3:4 years:

Table 12a : ***Phonological process which are occurring in the age group of 3:0 - 3:4 years***

SUBJECT NO	USD	CR	E	G	STL	STF	NA	VA	M	ICD	FCD	B	F	DA	AFF
1	✓	✓	✓	✓	✓	-	✓	✓	-	✓	-	✓	-	✓	-
2	-	✓	-	✓	-	-	-	✓	-	✓	-	-	-	✓	✓
3	✓	✓	✓	✓	-	✓	-	✓	-	✓	✓	-	✓	-	-
4	-	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-	✓
5	✓	✓	✓	-	-	✓	✓	✓	-	✓	-	-	-	-	✓
6	-	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	-	✓	-
7	✓	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓
8	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-
9	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	-	-	✓
10	✓	✓	✓	-	✓	✓	✓	✓	-	✓	✓	-	✓	✓	✓

The most commonly occurring processes were Cluster Reduction, Epenthesis, Stopping of Liquids, Stopping of Fricatives, Nasal Assimilation, Voicing Assimilation, Initial Consonant Deletion, Unstressed Syllable Deletion, Final Consonant Deletion, Affrication. This can be due to the influence of earlier acquired sounds over the later developing sounds ,for eg. in Tamil all the nasals and vowels are acquired by 3 years (Usha, 1986). This may explain the increased use of nasal assimilation and voicing assimilation in this age group

Gliding, Backing, Fronting and Deaffrication were observed less frequently.. Metathesis was seen only in 2 children in this age group. This contradictes the findings of Sameer (1998) who reported metathesis as frequently occurring process in the age group of 3:0-3:4 years in Malayalam language. As stated by Dobrich (1991) the usage of simplified words occur mainly in the earliest stage of language development. The present study also confirms the usage of processes to be more in children at the earliest stages of phonological development.

(b) Phonological Processes in 3:5 - 3:8 years:

Table 12b : *Phonological process which are occurring in the age group of 3:5 - 3:8 years*

SUBJECT NO	USD	CR	E	G	STL	STF	NA	VA	M	ICD	FCD	B	F	DA	AFF
1	✓	✓	✓	✓	-	✓	✓	✓	-	✓	-	-	✓	-	-
2	-	✓	✓	-	✓	✓	✓	✓	-	-	-	✓	-	-	-
3	✓	✓	✓	-	✓	✓	-	✓	-	✓	-	✓	-	✓	✓
4	-	✓	✓	-	✓	✓	✓	✓	-	✓	-	-	✓	-	✓
5	-	✓	✓	-	-	-	✓	-	-	✓	-	-	-	-	✓
6	✓	✓	✓	✓	✓	-	-	✓	-	✓	✓	-	✓	✓	✓
7	-	✓	✓	-	-	-	✓	✓	-	✓	-	-	-	✓	✓
8	✓	✓	✓	-	-	✓	✓	✓	-	✓	-	-	✓	✓	-
9	-	✓	✓	-	-	-	✓	✓	-	✓	✓	-	✓	✓	-
10	✓	✓	✓	✓	-	-	✓	✓	-	-	-	✓	✓	✓	-

The processes used in the age group of 3.0 - 3.4 showed a marked decline when children enter the age of 3.5. However these processes yet persist, though less in number as compared to the previous age group, till the age of 3.8 years.

The persisting processes were the Cluster Reduction, Epenthesis, Nasal Assimilation, Voicing assimilation, Deaffrication ,Initial consonant deletion,

Affrication. This may be due to the fact that Clusters, Fricatives and Affricates are sounds that are acquired later (by 4.0), as reported by Grunwell (1987), in the phonetic inventory of the child.

Initial consonant deletion which is considered to be an unusual process in the western literature, as reported by (Hodson, 1980 ; Dodd, 1989 ; Leonard and Mc Gregor, 1991), was found to be a commonly occurring process in this age group. Languages differ with respect to the relative frequencies of usage of various phonemes, word length and consonant cluster (Mines, Haanson and Shoup, 1978;Cassidy and Kelly, 1991). Hence the characteristics of the sound system of the child's native language may also account for many target selection phenomena. On the basis of this view of Scarborough (1991) the above findings can be justified.

The Unstressed Syllable Deletion, Gliding, Stopping of Liquids, Stopping of Fricatives, Final consonant deletion, Backing, Affrication are processes that starts decreasing in this period. There is a marked decline in the usage of Final Consonant Deletion. This finding supports the results of Grunwell (1987) where he stated that Final Consonant Deletion disappears by 3:3-3:6 years. The emergence of fricatives and appropriate use of liquids (though not consistently) may explain the reduction of Stopping of Fricatives and Stopping of Liquids in some children. However. Gliding of liquids was yet used by a few children.

Metathesis was not observed in this age group which was present in children in the previous age group, therefore it could be a process that is occurring in much more earlier stages of development or could be a rare process.

Fronting, was increased in these children though there is no proper underlying explanation that can be attributed to this, it is assumed that it could be due to restricted number of words and the small sample considered for study. If taken a more comprehensive word list or large number of subjects, may be a linearity of the processes could be observed.

(c) Phonological Processes in 3:9 - 4:0 years:

Table 12c : *Phonological process which are occurring in the age group of 3:9 - 4:0 years*

SUBJECT NO	USD	CR	E	G	STL	STF	NA	VA	M	ICD	FCD	B	F	DA	AFF
1	✓	✓	✓	-	-	-	-	✓	-	✓	-	✓	-	✓	-
2	-	-	✓	✓	-	-	-	✓	-	-	-	✓	-	-	-
3	✓	✓	✓	-	✓	-	-	✓	-	✓	-	✓	✓	✓	-
4	-	✓	-	-	-	-	-	✓	-	-	✓	-	-	-	-
5	-	✓	✓	-	✓	✓	-	✓	-	-	-	✓	-	-	-
6	-	-	-	-	✓	✓	✓	✓	-	-	✓	✓	-	-	-
7	✓	-	✓	✓	-	-	✓	-	-	✓	-	-	✓	-	-
8	-	✓	-	✓	-	-	-	✓	-	-	-	-	-	-	-
9	-	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-
10	-	✓	✓	-	-	-	-	✓	-	-	-	-	-	-	-

In this age group Cluster Reduction, Epenthesis, Voicing Assimilation, were processes occurring frequently and the others such as the Unstressed Syllable Deletion, Gliding, Stopping of Liquids, Stopping of fricatives, Nasal Assimilation, Initial Consonant Deletion, Final Consonant Deletion, Fronting and Deaffrication were least occurring processes.

Usha, D. (1986) reported that fricatives were not acquired till age of 6 years which contraindicated the Western studies where fricatives are said to be acquired by 4.5 years (Templin, 1957). She justified it by stating that the late acquisition of /s/ is due to the phonetic system of Tamil, which originally does not include /s/ and it's a borrowed sound. However in the present study it was observed that the emergence of fricatives was by 3.9-4.0, hence there was decline in the stopping of fricatives. This may be due to the increased influence of Western languages, in Indian languages. Though there are native words in the Tamil language English words are used commonly nowadays *e.g. school, soap, shampoo, shoe, scale, purse etc.*

A marked decrease in initial consonant deletion was seen. Whereas, the other persisting processes declined gradually. Affrication had totally declined in these children. Thus, it was found that most of the processes were suppressed by the end of 4 years.

3) Comparison of Phonological processes occurring across the different age groups

Table *13* *: Comparison of Phonological processes occurring across the different age groups*

AGE(In Years)|USD	CR	E	G	STL	STF	NA	VA | M | ICD	FCD	B	F	DA	AFF
3.0-3.4 | 6	10	8	4	7	**8**	8	**10 | 2 | 10**	6	3	3	5	6
3.5-3.8 | 5	10	10	3	4	5	8	**9 | - |8**	2	3	6	6	5
3.9-4.0 | 3	7	6	3	3	2	2	**8 | - | 3**	2	5	*2*	3	

It was found that cluster reduction, Epenthesis, Voicing assimilation persisted even at 4 years of age. This could be because children had not yet acquired all speech sounds. Acquisition of clusters is not complete by 4 years of age. The epenthesis was seen as a co-occurring process with cluster reduction. This study is in agreement with Khan (1985).

Epenthesis. Cluster Reduction, Unstressed Syllable Deletion, Gliding, Nasal Assimilation, Voicing Assimilation, Deaffrication, Initial Consonant Deletion, Backing, Affrication were found equally in age group of 3.0-3.4 and 3.5-3.8. These processes markedly declined in the later age group (i.e. 3.9-4.0). This may be due to the fact that the child's phonetic knowledge and the refinement of articulatory gestures increases as age increases. Metathesis considered as an uncommon processes, as compared to other developmental processes, was seen only in the age group of 3.0 - 3.4 years and it disappeared by the time the child entered 3.5 years. This supports the findings of Robert, Footo (1990) who found Metathesis to be a rare process in his study of phonological processes in the age group of 2:5 years to 8 years.

Assimilatory processes were seen in all age groups. Viham (1978) studies correlate with these findings. Voicing assimilation and nasal assimilation were predominant in the first two groups. There is a marked decrease in the usage of nasal assimilation in the later age group i.e. 3.9-4.0 years. However voicing assimilation yet persisted in them.

Final consonant deletion was common in the age group of 3.0-3.4 and it faded away by 3.5-3.8 and 3.9-4.0. This is in agreement with Ingram (1989) in which he stated that it is a process which is rare beyond 3 years of age .

Unstressed Syllable Deletion, Stopping of Liquids, Initial Consonant Deletion are processes that linearly decreased across all three age groups. Processes such as Fronting, Deaffrication had increased in the middle age group

children (3.5-3.8). This finding could not be supported by any previous study. Affricaion was present only till 3.8 years and disappeared by 4 years.

To conclude the results of this particular study, every child tend to use phonological processes during the acquisition of speech sounds and some phonological processes tend to persist even after 4 years. By the end of 4 years there are very few processes that persist in children and this may be due to the earlier acquisition the phonological system in Tamil (Usha,1986), which may be attributed to the culture differences.

It is evident from the current study, that as young children attempt word production it is constrained with respect to their phonological characteristics. Several hypothesis can be put forth to explain why children are biased towards attempting words with only one syllable, words without Consonant clusters and words with or without particular phonemes.

First, the articulatory or perceptual difficulty of certain targets may lead to their avoidance (Olmsted 1971, Schwartz, Leonard, Loeb and Swamon, 1987). For *e.g.* The frequency of attempts at a particular phoneme has been found to correlate with the accuracy of that phonemes pronunciation (Olmsted, 1971). Similarly, longer words may be inherently harder to hear and say, than monosyllabic once and clusters may be more difficult than singleton consonants (and indeed are mastered at an older age : Templin, 1957).

Second, variation in the speech input to which children are exposed may contribute to selectional biases (Waterson, 1971, Ferguson and Farwell, 1975,

Menyiek and Menn, 1979). In particular this might account for individual differences that have been observed in children in terms of avoidance and preference pattern.

Third, the characteristics of the sound system of the child's native language may also account for many target selection phenomena. Languages differ with respect to the relative frequencies of usage of various phonemes, word lengths and consonant clusters *(eg.* Mines, Hanson and Shoup, 1978 ; Cassidy and Kelly, 1991). Differences in the target selection would be consistent with differences between languages in the relative frequencies of certain phonemes. While previous research has begun to provide a consistent picture of phonological development with respect to common phonological processes used, there is a clear need for studies that examine the use of uncommon processes by children whose speech is considered to be developing normally.

Previous studies of phonological processes account for the majority of errors produced by young children (Ingram, 1976). Studies of children whose phonological development is considered disordered have found that these children frequently use certain uncommon processes or idosyncraric processes, in addition to a higher incidence of common processes (Dunn and Davis, 1983 ; Hodson and Paden, 1981, Leonard, 1985). It appears necessary to examine the incidence of these uncommon processes in the repertoire of non-speech disordered children before their true significance in the diagnosis of speech disorders can be understood.

While the presence of these unusual processes is often interpreted as evidence that a child's phonological system is delayed or deviant some researchers are suggested that these idiosyncratic or uncommon processes may also be found to some degree in children whose phonological development is considered normal (Hodson and Paden, 1981; Stoel-Gammon and Dunn, 1985).

Two alternative explanations are possible, it could be that children use uncommon processes often whose phonological development is classified as disordered, but are used rarely by children developing a normal phonological system. Alternatively, it may be that all children use these processes at some point in their development, but children with speech disorders persist in their use, longer than children exhibiting normal development. In order to address these issues a study of phonological development in normally developing children should provide an indication of these uncommon processes.

Based on this review of past studies, a need for further large-scale studies of phonological pattern to validate the findings of smaller scale studies is needed. Thus it is proposed that phonological analysis is a very essential tool in clinical diagnosis, for attempting to label a deviant/delayed pattern of phonological acquisition. This study delineates the fact that a need for developmental account of phonological processes is necessary and it also proves that the saliency of the components in a language determines the order of acquisition.

CHAPTER 5

SUMMARY AND CONCLUSION

The identification and remediation of phonological processes is found to be efficient in clinical programs. Phonological processes refer to phonetic / phonemic changes in speech that occur for classes of sounds or sound position, not just for individual phonemes. The concern here is not in determining the child's underlying awareness of the alternation of the adult form, but rather in identifying the developmental trend in children's phonetic inventory. This would provide a basis in identifying surface patterns for remediation process.

An attempt was made to provide an account of the development of phonological processes occurring in the age of 3-4 years Tamil speaking children.

For this purpose, 30 children in the age group of 3-4 years were taken to study the normal development of Phonological processes in them. They were subgrouped into 3 as 3:0-3:4 years, 3:5-3:8, 3:9-4:0 years to see the developmental trend in each subgroup and also compare the Phonological processes occurring across the different age groups. The picture form of TAT was used to elicit the target words. The subjects were asked to name the picture, which was recorded on to a sony digital tape recorder . These responses were transcribed and analyzed by 3 judges in order to get reliable results. The correlation coefficient was calculated which showed a high correlation. On calculating the PE, it confirmed the power of correlation.

It was seen that all the children used phonological processes during the acquisition of speech. However, the frequency of usage of different phonological processes were different among the different age groups.

It is also seen that as age advanced from 3-4 years. There is a decrease in the use of processes. There is an increased usage of phonological process in the earlier age group. In children of 3:0-3:4 there were more number of processes and the frequency of usage was also more. The most commonly occurring processes were Cluster reduction, Epenthesis, Stopping of liquids, Stopping of fricatives, Nasal Assimilation, Voicing Assimilation, Initial Consonant Deletion, Unstressed Syllable deletion. Final Consonant Deletion and Affrication. The less frequently occurring processes were Gliding, Backing, Fronting and Deaffrication. Metathesis was observed only in a very few children.

In children of 3:4-3:8 years there was a marked decline in some processes , however a few processes yet persisted. The persisting processes were the Cluster reduction, Epenthesis, Nasal Assimilation, Voicing Assimilation, Initial Consonant Deletion, Affrication and Deaffrication. The Unstressed syllable deletion, Gliding, Stopping of liquids, Stopping of fricatives, Final consonant deletion, Backing, Affrication are processes that were decreasing

In the age group of 3:9-4:0, Cluster reduction, Epenthesis, Voicing Assimilation were frequently occurring processes. Unstressed syllable deletion, Gliding, Stopping of liquids, Stopping of fricatives, Final consonant deletion ,

Initial consonant deletion, Nasal assimilation, Fronting and Deaffrication were least occuring processes.

They decrease in the use of processes as an increase in age can be attributed to

1. Increase in the phonetic knowledge of the child
2. Refinement of use of articulatory gestures.
3. Mastery of sounds at each age , leading to increase in phonetic inventory.

However the order of acquisition would differ across languages, due to specific features that are salient to that language, frequency of usage of various phonemes, word length and culture variation. Therefore it is very essential to have an account of the developmental processes for every language in children, at least till the age of 3-4 years, as its considered to be the period where the child establishes the basis of the phonological systems and at the end of this period, the child is expected to suppress most of the simplifying processes.

It will also help us to understand the normal phonological development to determine a delay / deviance in phonological development in the language disordered child, which would help in planning effective training programs.

Limitation of the study

Though the variables such as socioeconomic status, monolingualism were controlled .dialect variations did persist in children. Certain words were more subjected to dialect variations e.g. tʃavɤ, dappa.

Influence of western language i.e., English did exist. The word in the test were influential too e.g. ɔrəndy, kəɾ, ʃirt.

Sample size, due to technical limitations a large sample size was not taken. Hence results can not be generalized to entire population, however it would give a significant knowledge about the development of the Phonological process in Tamil.

Suggestions

During the administration of the test, it was observed that the word list in TAT can be modified in a way that it taps the phonological system of the child appropriately. Words that are subjected to dialect variation and words influenced by other languages can be restricted.

Therefore a thorough, extensive, well-designed picture naming task may be more efficient to represent a good index of phonological ability.

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APPENDIX 1
PHONEMICS IN TAMIL

1.1 "Phonemes"

There are twenty nine phonemes in the Modern Literary Tamil. They are divided in to three groups, namely 1. *Vowels 2. Aytam* and *3. Consonants.*

1.2. Vowels

The Vowels are as follows :

There are ten vowels, five short and five long. As shown in the diagram, the short vowels have their corresponding long ones.

1.3. *Ay tarn*

There is a phoneme called aytam which is peculiar to Tamil. In Tamil writing system the phoneme is symbolised as. ஃ /h/ It is rather difficult to treat this along with other consonants. The peculiarity of this phoneme will be discussed when dealing with the occurrence of phonemes.

1.4. *Consonants*

The consonants are as follows

	Labial	Labio-Dental	Dental	Post-Dental	Retroflex	Palatal	velar
Stop	p		t	t	t		k
Affricate	-	-	-	-	-	c	-
Nasal	m	-	n	n̪	n	ñ	n
Lateral	-			i	!	-	-
Frictionless							
Continuent	-	-	-		!	_	-
Trill	-		-	r	-	-	
Fricative	-	v	-	-		v	-

1.6.Occurrences of phonemes

The Vowels occur initially, medially and finally as shown below.

Vowels	Initially	Medially	Finally
i	✓	✓	✓
ī	✓	✓	✓
e	✓	✓	-
ē	✓	✓	✓
u	✓	✓	✓
ū	✓	✓	✓
o	✓	✓	✓
ō	✓	✓	✓
a	✓	✓	✓
ā	✓	✓	✓
ai	✓	✓	✓
au	✓	✓	✓

The aytam occurs between a short vowel and a stop consonant *eg.,* ehku 'steel'.

The following table shows the occurrences of the consonants.

consonants	*initially*	*medially*	*finally*
p	✓	✓	-
t	✓	✓	-
ṯ	-	✓	-
ṭ	-	✓	-
k	✓	✓	-
c	✓	✓	-
m	✓	✓	✓
n	✓	✓	✓
n̲	-	✓	✓
ṉ	-	✓	✓
ñ	✓	✓	✓
ṇ	-	✓	-
i	-	✓	✓
l̲	-	✓	✓
ḷ	-	✓	✓
r	-	✓	✓
v	✓	✓	✓
y	✓	✓	✓

1.6. *Clusters*

The clusters may be broadly classified in to two, viz, 1. ***Two consonant clusters and*** *2. Three consonant clusters.*

1.6.1. *Two consonant clusters*

	p	t	ṭ	t̤	k	c	m	n	n̲	n̤	ṉ	ṉ̤	l	l̤	l̲	r	v	y
p	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
t	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ṭ	✓	-	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
t̤	✓	-	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
k	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
c	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
m	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
n	-	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
n̲	✓	-	✓	-	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	-
n̤	✓	-	-	✓	✓	-	✓	-	-	✓	-	-	-	-	-	-	-	-
ṉ	-	-	-	-	-	✓	-	-	-	-	✓	-	-	-	-	-	-	-
ṉ̤	-	-	-	-	✓	-	-	-	-	-	-	✓	-	-	-	-	-	-
l	✓	-	-	-	✓	✓	-	-	-	-	-	-	✓	-	-	-	✓	✓
l̤	✓	-	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-	✓	-
l̲	✓	✓	-	-	✓	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	-
r	✓	✓	-	-	✓	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	-
v	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓	-
y	✓	✓	-	-	✓	✓	✓	✓	-	-	✓	-	-	-	-	-	✓	✓

1.6.2. Three Consonant clusters

In the case of three consonant clusters the first member is y,r or l, the second member is a nasal or a stop and the third member is a nasal (when preceded by a nasal) or a stop. The following formula summarizes this.

$$Ccc = \left\{ \begin{matrix} y \\ r \\ j \end{matrix} \right\} + \left\{ \begin{matrix} S+S \\ N+S \\ N+N \end{matrix} \right\}$$

C : Consonant. S:Stop. N:Nasal.

The following table gives a detailed account of the three consonant clusters.

First member		m	n	n̲	n̤	ṉ	ṉ̤	p	ṭ	t̤	t̤	k	c
y	m	✓	-	-	-	-	-	✓	-	-	-	-	-
	n	-	✓	-	-	-	-	-	✓	-	-	-	-
r	n̲	-	-	-	-	-	-	-	-	-	-	-	-
	n̤	-	-	-	-	-	-	-	-	-	-	-	-
l̲	ṉ	-	-	-	-	✓	-	-	-	-	-	-	✓
	ṉ̤	-	-	-	-	-	-	-	-	-	-	✓	-
	p	-	-	-	-	-	-	✓	-	-	-	-	-
	t	-	-	-	-	-	-	-	✓	-	-	-	-
	ṭ	-	-	-	-	-	-	-	-	-	-	-	-
	t̤	-	-	-	-	-	-	-	-	-	-	-	-
	k	-	-	-	-	-	-	-	-	-	-	✓	-
	c	-	-	-	-	-	-	-	-	-	-	-	✓

Since 'r* and 'j* can not be preceded by a single short syllable in Tamil, the structural gaps are found in the case of rmm. mn. mn. lmm. lnn. and lnn.

Source: Kothandaraman, A Grammar Of Contemporary Literary Tamil, International Institute Of Tamil Studuies,Chennai