EARLY PHONETIC REPERTOIRE AND SYLLABLE STRUCTURES IN TYPICALLY DEVELOPING KANNDA SPEAKING CHILDREN: 12-18 MONTHS

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CHAPTER 1

INTRODUCTION

'Though the ongoing sounds of my child were many; the first time he voiced out at me calling amma could not stop tears of joy rolling down my cheeks'

- A mother

The first word a child says, inscribes a trade mark in the milestones of its journey towards the phonological and subsequent lexical acquisition. In the growing body of research on childhood phonology, more and more evidence is emerging regarding how and to what extent is the rapidity and variety of phonological acquisition in young children. Phonological acquisition in specific refers to the acquisition of speech sound (form and function) within the language system. In contrast to just speech sound acquisition; phonological development implies the acquisition of functional sound system intricately connected to the child's overall growth in language. It also emphasizes the fact that learning to produce a variety of speech sounds is not the same as learning the contrasts between the sounds that convey differences in meaning. Phonological development can never be meaningfully detached from other aspects of emerging language as it represents an integral part of the child's total language acquisition process. Child phonology and further lexical acquisition can be commonly divided into prelinguistic and linguistic acquisition on one hand and phonetic versus phonemic acquisition on the other.

The term prelinguistic implies that sound productions at this level are not entirely linguistic since they often lack a specific referent meaningfully and a well-

definedcommunicative intent. Since the studies and reviews of the 1980's (Locke, 1983; Menn, 1983; Stoel-Gammon & Cooper, 1984; Vihman, Macken, Miller, Simmons & Miller, 1985; Menyuk, Menn& Silber, 1986) a good deal of research has focused on describing the phonetic characteristics of babbling and first words in an attempt to identify predictors of lexical development (Menyuk, Liebergott& Schultz, 1986; Stoel-Gammon, 1992). A large body of literature also demonstrates relationships between the phonetics of babble and early speech as essential pre requisites for establishing a prolific lexicon. Prelinguistic behavior is thought to encompass majorly vocalizations prior to the emergence of first true words, and linguistic development starts with the appearance of the first words at the end of first year of life of the infant. During this period, the infants primary mode of communication includes reflexive crying, vegetative sounds such as grunts, coughs, burps; cooing or gooing sounds, laughter, vocal plays and finally strings of babbled and jargon sequences of sounds (Stark, 1986). It is also found that phonemic contrasts are seen in very young children in their prelinguistic period(Shvachkin 1973). In addition, more general contrasts have been reported to begin at approximately one year of age suggesting that the child's language system starts developing prior to the first spoken meaningful words. Phonological development has been found to begin before its manifestation in the use of the first words. This entire process of perception and production are influenced by the child's developing auditory vocal mechanisms. As the infant begins its journey from primary reflexive crying behaviour to babbling and words, important anatomical structures that are pre requisites to speech sound acquisition develop. Both the structure and function of the respiratory, phonatory, resonatory and articulatory mechanisms advance decisively before any articulatory process for a

particular speech sound occurs. These changes in growth and development progress through infancy into early childhood which is reflected in the transformation from prelinguistic to linguistic sound productions.

1.1 The first fifty word stage

One of the most impressive accomplishments in the field of phonological development is the child's ability to produce speech sounds and combine them to form meaningful words. Around the child's first birthday, a new developmental era begins, ***the linguistic phase***. It starts the moment the first meaningful words are produced which typically earn a remarkable spot in the child's "milestones" scrapbook. Many authors define first words as an entity of relatively stable phonetic forms that is produced consistently by the child in a particular context and is recognizably related to the adult like word form of a particular language (Owens 1996). Children frequently use "invented words" (Locke 1983) in a consistent manner demonstrating that they have meaning for the child. These words used consistently but without a recognizable adult model have been called protowords (Menn 1978), phonetically consistent forms (Dore et al 1976), Vocables (Ferguson 1976) and quasi words (Stoel Gammon & Cooper 1984).

The time of initial production of words is referred to as ***The First Fifty Word Stage***. This stage encompasses the time from the first meaningful utterance at approximately one year of age to the time when the child begins to put two words together at approximately 18-24 months of age. During this stage; there seems to be a large difference between the production and perceptual capabilities of the child. For example, at the end of this stage when children can produce approximately 50 words, they are typically capable of understanding 200 words (Ingram, 1989). This has an effect

on the child's development of semantic meaning system as well as the phonological system.

The course of phonological development during this stage is heavily influenced by the individual words the child is acquiring. Children are not just learning sounds which are used to make up words; rather they seem to learn word units that happen to contain particular sets of sounds. Ingram (1976) called this a ***Presystematic Stage*** in which contrastive words rather than contrastive sounds are acquired. The presystematic stage is related to ***Item Learning*** and ***System Learning*** stages of early phonological development (Cruttenden 1981). In Item learning the child first acquires word forms as unanalyzed units and productional wholes. Only later, after the first fifty word stage does system learning occur during which child acquires the phonemic principles that apply to phonological system in question. The early portion of the item learning stage is known as the ***Holophrastic Period***, the span during which the child uses one word to indicate a complete idea. The link between the object, its meaning, and the discrete sound segments is not firmly established.Many authors have noted phonetic variability and a limitation of syllable structures and sound segments during this stage. Phonetic variability refers to the unstable pronunciations of the child during this first fifty word stage. From their relatively small repertoire of words, it is clear that children do not produce a large array of syllable structures and segmental productions. When syllable structures such as CVCV are present, they are either complete or partial reduplications of their babbled forms.

Mentioned above was a summary of the first type of classification of the phonological developmental pattern; ie, prelinguistic versus linguistic. Another way of classifying, ie phonetic versus phonemic development also needs to be known. The term

phonetic refers to the speech sound production ie articulatory or motor skills involved in the production of speech sounds. The term phonemic refers to the speech sound use ie functions, behaviours or organization of the speech sound system that may be closely linked to the system learning stage of presystematic stage (Cruttenden; 1981).

1.2 Need for the study

The availability of normative oriented data is essential to clinical assessment and further management of related discrepancies of child phonology. The professional working with the population of one to two year old toddlers must be able to determine whether the child is following a typical course of development or is lagging behind in terms of both quality and quantity of speech sound repertoire and thereby make a judgment whether intervention is required. Literature in this purview is in itself abundant with studies on phonological development focusing particularly beyond the age of 3 years but there is a dearth of historical research on early infant phonetic repertoire and syllable structures; specially in the Indian context. Hence, the present study was planned to get comprehensive information on the early phonological repertoire, syllable structure patterns, and further advances in the early first fifty word stage in typically developing Kannada speaking toddlers.

1.3 Aim of the study

To understand the nature, course and various aspects of early phonological development in typically developing native Kannada speaking toddlers of 12-18 months of age.

1.4 Objectives of the study

- To obtain the phonetic repertoire including vowels and consonants, various syllable structures and word shapes
- To analyze the emergence of clusters.
- To analyze the existence and frequency of proto and holophrastic words.
- To compare the above mentioned parameters of phonological development across the two age groups, 12-15 and 15-18 months and across gender.
- To obtain preferential combination of consonants and vowels.
- For cross linguistic comparison of early phonological development with studies in the Indian context and other languages of the world

1.5 Brief Method of the Study

Participants:Twelve typically developing children in the age range of 12-18 months who are native speakers of Kannada were considered for the study. The children were divided into 2 groups with an age interval of 3 months that is, 12-15 months and 15-18 months. Each group included 6 participants. The subjects were identified from immunization centres, neighbouring homes, hospitals and paediatric clinics in Mysore city. Participants were informally screened for history of any medical, speech, language, hearing, cognitive or other motor difficulties. They were selected after a parental interview and an informal assessment of age and appropriate developmental skills based on a checklist ("Remember and Care" department of Prevention of Communication Disorders; AIISH). All the participants selected for the study were ensured to belong to middle socio-economic

classthrough the administration of the NIMH Socio Economic Scale devised by Venkatesan (2011). The purpose and relevance of the current study was explained to each of the parents and their consent was obtained prior to the recording procedure.

Data recording Procedure: The data were recorded in the individual toddler's home in the presence of the mother/caretaker. Audio video recordings of each child wereobtained individually using a high quality digital audio video recorder (Sony Full HD 1080 Handycam). A standard set of toys expected to be familiar to young children of that particular age were used. The verbal responses from each participantaccounting to about 60-70 utterances, were obtained through various stimulation methods provided by the mother or the caretaker during play sessions with the child. In cases where the recording sessions yielded fewer than the minimum set criterion utterances, additional recordings within a couple of days of the session of interest were undertaken to yield the desired amount of utterances.

Data Analysis: The recorded data were edited to eliminate parent's/ others speech and vegetative vocalizations (such as cries, burps and coughs etc) of the child. The child's speech like utterances was retained for analysis. A minimum of 60-70 utterances from around 60 minuterecording were transcribed using broad and narrow IPA. The responses of each subject wereanalyzed sound by sound to identify the various vowels, consonants and their combinations. To examine inter judge reliability and intra judge reliability 10% of the samples of each subject were randomly selected and transcribed and analyzed by the researcher herself and by two other experienced speech language pathologists.

1.6 Implications of the study

- This study will facilitate better understanding of various aspects of early phonological acquisition in Kannada.
- The normative data will aid Speech Language Pathologists in making appropriate diagnostic and therapeutic decisions in the toddler population considering the fact that in the recent years, there has been an increased professional emphasis on the provision of Speech Language Pathology services to even infants as young as one year of age.
- The study will provide normative data on phonological acquisition in Kannada as the existing norms in English and other languages may not prove to be valid since language specificity exists from the early linguistic period itself.
- This study will facilitate cross linguistic comparison of early phonological developmental skills across other Indian Languages as well as with English.

1.7 Limitations of the study

- Due to certain constraints in the methodological procedure and due to time pressure, only twelve participants were involved in the study
- The quantity of the sample was limited to 60-70 utterances from each participant
- The study was a cross sectional investigation; though longitudinal studies are more beneficial in terms of yielding more detailed and accurate information regarding each individual child's phonological developmental trend.

CHAPTER 2

REVIEW OF LITERATURE

Infants enter the world being able to vocalize through crying; and hence cry is the first evident and marked vocalization of the infant. The course of phonological development of the child is thought be dependent on the anatomical growth and maturation of the oral structures and influence of the ambient language. Throughout the first few months of life, the infant's repertoire of sound undergoes a rapid increase in terms of quality and quantity creating a good basement for further phonological lexical development. It takes a child ample of years to progress from the first cries at birth to being able to produce intelligible speech incorporating adult like productions of vowels, consonants, syllable structures and prosody. According to Bleile (2004); there are four phases of speech acquisition

Phase 1: Laying the foundations for speech (0 to 1 year)

Phase 2: Transition from words to speech (1 to 2 years)

Phase 3: The growth of the inventory (2 to 5 years)

Phase 4: Mastery of speech and literacy (5+ years).

2.1 Development of the structure and function of the oral mechanism

There is an inter relationship between the ability to produce intelligible speech and the development of the oro motor, respiratory, neurological and laryngeal systems of the child (Kent, 1976). The development of the oral structure and function begins in the

foetus, starts to approximate the adult like features at six years of age, and is completed by almost 18 years of age (Kent &Tilkens 2007).

The vocal tract of the new born infant differs both in size and shape from that of an adult. The vocal tract of the new born is three times smaller than that of the adult and is considered to be similar to a single tube to facilitate coordination between breathing, sucking and swallowing (Kent &Tilkens 2007; Yandell, 1999). The adult vocal tract is considered to be akin to two tubes, with the oral tube enabling a wide variety of articulations and the laryngeal tube facilitating the coordination between breathing and swallowing.

The shape size and composition of the respiratory system are dramatically modified from infancy to adulthood augmenting and sustaining the physiological requirements of speech sound production. When comparable loudness levels are contrasted; children demonstrate higher sub glottal pressure values than adults. Functional maturation of the respiratory system is especially evident during the period of 3 to 7 years. Changes in the phonatory and the resonatory system from infancy to adulthood are especially impressive as their anatomical and physiological development leads directly to their further secondary function for articulatory processes.

From two to three months onwards the air stream moves more via the oral cavity, and not only via the nasal cavity. This is probably not due to a more active use of the velum muscles, but to the anatomical growth. Because the tongue and the velum are close together, with the jaw and the tongue in rest position, the air stream between the velum and the tongue makes both articulators vibrate, producing back trill-like or fricative-like sounds. This results in a higher amount of velar fricatives and trills during the

cooing/gooing stage. Around three months, the rib cage gets restructured to a more adult-like configuration. From that ageon, infants can produce a higher sub-glottal air pressure, and have better control ofthe duration and fundamental frequency of their utterances by regulating the airpressure. Therefore, one can find longer utterance duration, as well as morevariation in their F0 in this period. At the age of four to six months the anatomy of the oral and pharyngeal areaschanges again. The mandible grows more downward, giving thetongue more space to move and giving the air the possibility to go through the oralcavity, without causing the tongue or velum vibration.

In the same period thehuman larynx descends gradually during infancy,associated with developmental changes of the swallowing mechanism. Thedescending of the larynx contributes physically to an increased independencebetween the processes of phonation and articulation for vocalization. Increased neuromotor control of the intercostals muscles at that age and arelatively smaller tongue compared to the oral cavity as aspects are found to contribute tomore control of several articulators resulting in different types of vocalizations.For instance, the higher air pressure combined with closed or almost closed lipsresults often in a bilabial raspberry. The tongue can also be protrudedbetween the lips (although infants are able to move the tongue to a fronted positionat an earlier age while swallowing), resulting in an inter-labial production.

Around seven months of age, anatomicaland physiological developments make it possible tomove the jaw freely up and down. It is the first oral structure to receive and independent speech motor control capable of augmenting other oral structures movements and thereby speech too. In this period infants start to chew. If the up and down movement is repeated, the result might be babbling; a rhythmic up-

anddownmovement of the jaw, normally during voicing and the reduplicatedbabbling/ canonical babbling/babbling stage starts.Opening of the jaw following a closed posture can be heard as aconsonant-like segment, such as a front plosive, a front glide or a front nasal. Thismovement is done with the jaw, while the lips and tongue are not yet actively involved. When the jaw and lips close, the upper lip is passive and the lower lip moves up. In babblingthe tongue still moves passively up and down together with the jaw. If the tonguetouches the palate, teeth gum, or lips during the upward movement of the jaw, theresult can be heard as a consonant-like segment at the central place of articulation,normally a central stop, a central glide and a central nasal. In theproductions of central consonants as /d/ and /t/ by older children or adults a different tongue movement is noticed as compared to babbling or early words. Normally after thesecond or even third year the tongue is able to move separately from the jaw,which is not possible during infancy.

Skeletal enlargement of the skull and laryngeal areas during childhood occurs in posterior and vertical directions. This allows the velum more room and hence more mobility. The fine tuning and coordination of the lip, mandible, tongue and the velar movements for regular voice and speech production increasingly develop during the first year of life. Thus it can be concluded that the enormous anatomical and physiological changes during the first year of life have an influence on the development of vocalizations as well as various speech sounds and their combinations. Hence, the understanding of pre-speech development and its relationship to early meaningful speech has gained much vitality and has also advanced in the recent years.

2.2 Prelinguistic versus linguistic developments

Some renounced researchers like Jackobson (discontinuity hypothesis) have emphasized a sharp line of separation between the two phases of prelinguistic and linguistic behavior. According to them babbling is seen as a random series of vocalizations with no apparent order of sounds or consistency. They opine the distinction between the two phases to be so complete that; the child might actually undergo a period of complete silence between the end of babbling and the emergence of first true words. However more research in this purview (Oller, Wieman, Doyle & Ross 1976; Oller; 1980; Stark 1980, 1986) have reported babbling not to be a random vocal behavior but rather to be a systematic development in the child's production of speech sounds and also that late babbling and first words are very similar with respect to the sounds used and the ways they are combined in. Phonetic content of babbled utterances exhibits many of the same preferences for certain kinds of phonetic elements and sequences that have been found in the production of meaningful speech by children in later stages of language development(Olleretal 1976).

Similarities between babbling and first words of speech have been reported, which are predominantly occurrence of monosyllabic utterances, low usage of consonant clusters, more of bilabials and frequent occurrence of central, mid –front and low vowels (Kent, 1997). Attempts have been made to correlate the quantity of vocalizations at a certain babbling age to later language performance (Roe 1942). Here quantity was defined as the number of vocalizations during a specific time period. Diversity of vocalizations was measured by:

- The number of different consonantal sounds heard in the babbling of infants
- The number of structured CV syllables
- The proportion of vocalizations containing a true consonant (Vihman& Greenlee, 1987)
- The ratio of consonant like sounds to vowel like sounds (Whitehurst, Smith, Fischel, Arnold, &Lonigan 1991).

  It was found that more consonantal sounds and structure CV syllables were present in babbling period also which continued in the early word stage.

In general; the following facts were acknowledged;

- Predicting less language growth in children with more vocoid babble compared to those with more contoid babble
- Greater babble complexity to reflect greater language growth
- Greater language growth to relate to the increased diversity of contoid productions.

Werner and Kaplan (1963) proposed that the capacities for constructing referential meanings and for expressing meaning phonetically (as acquired during the later babbling and beginning of transition to the first word stages) in word forms are closely interrelated, together constituting the process of symbol formation. Further, they opine that longitudinal productivity with a specific consonant as continued from the babbling stage; provides indirect evidence of a capacity for consistent phonetic patterning, termed as "Vocal Motor Scheme" (VMS) for that consonant. As Stoel-Gammon (1998) notes, "the more often a baby produces the movements that shape the

vocal tract to produce particular sounds and sound sequences, the more automatic those movements become and ultimately the easier it is to execute them in producing words". The VMS concept incorporates frequency and longitudinal stability, and paves way for a new approach to evaluation of the consonant repertoire constituting the child's early speech vocal output.

2.3 Phonological development and Prelinguistic advancements

Infant sounds and their development have been extensively studied from a taxonomic perspective, which describes vocal development in terms of universal and invariant stages (Oller, 2000; Stark, 1980). Stark (1986) has put forth various stages of phonological development encompassing mainly the various distinct stages of the prelinguistic period and furthermore transition stages into the linguistic epoch. To summarize the stages:

Stage1: Reflexive crying and vegetative sounds (birth to 2 months): Encompassing a large proportion of reflexive vocalizations such as cries, grunts, burps that are automatic responses reflecting the physical state of the infant have been mentioned.

Stage2: Cooing and Laughter (2 to 4 months):wherein the child produces cooing or gooing sounds at comfort states has been put forth. Consonantal sounds are produced at the back of the mouth. Early comfort sounds having quasi resonant nuclei are produced during this stage as a syllabic nasal consonant or a nasalized vowel (Nakazima, 1962; Oller 1980). At 16 weeks sustained laughter emerges (Gesell & Thompson 1934).

Stage3: Vocal Play (4 to 6 months): the distinguishing character of this stage being longer series of segments and the production of prolonged vowel or consonant like steady

states. It is during this stage that the infant produces extreme variations in loudness and pitch. In contrast to the previous stages; vowels demonstrate more variations in terms of tongue height and position.

Stage 4: Canonical Babbling (6 months and older): although is a collective term for both reduplicated and non-reduplicated babbling; begins around 6 months of age; most children continue to babble into the time when they say their first words. As described by Stark (1986) reduplicated babbling is marked by similar strings of consonant vowel productions. Slight variations in vowel quality might be present but the consonants will stay the same from syllable to syllable. Non Reduplicated or variegated babbling contains variations of both consonants and vowels from syllable to syllable. Smooth transition between consonant and vowel has been noted. Several studies have suggested that babbling and first words have much in common (BoyssonBardies&Vihman 1991; Davis &McNeilage 1990; Vihman, Ferguson & Elbert 1986). The main characteristics of transition from babbling to first words include:

- Primarily monosyllabic utterances
- Frequent use of stop consonants, followed by nasals and fricatives
- Bilabial and apical productions
- Rare use of consonant clusters
- Frequent use of central, mid front and low front vowels

Stage5: Jargon stage (10 months and older): Overlaps with the first meaningful words. The Jargon stage is characterized by strings of babbled utterances that are modulated primarily by intonation, rhythm and pausing (Crystal 1986). It sounds as if the child is actually attempting sentences but without actual words. As many jargon vocalizations are

delivered with eye contact, gestures and intonation patterns that resemble statement or questions, parents are convinced that the child is indeed trying to communicate something to which often they feel compelled to respond (Stoel Gammon &Menn 1997).

The child's segmental productions towards the end of the canonical babbling stage cannot yet be said to be true vowels and consonants of a particular language system and hence are usually referred to as vocoids and contoids respectively. These terms were introduced by Pike in 1943 to indicate the non-phonemic speech sound productions. Front and center vocoids (e, I and a) were found to be favored over high and back vocoids in children from 13 to 14 months of age (Davis &McNeilage 1990; Kent & Bauer 1985). Several authors have investigated the contoids which predominate the late babbling stage and have revealed a systematic within language occurring consonants to be present more; rather than random sounds out of the language (Locke 1983).

2.4 Starks typology of Infant Phonations

The Stark assessment of early vocal development- Revised is based on a work by Stark (1986), stark, Bernstein and Demorest (1983). This typology includes five levels of development of vocalizations. The first level comprises of reflexive sounds, including quasi resonant nuclei (Q), defined as "faint low pitched grunt like sounds with muffled resonance" (Nathani 2006). Reflexive vocalizations are common between 0 and 6 weeks of age and include fussing and crying.

The second level of the Stark assessment of early vocal development- Revised is called control of phonation. During this level, fully resonant nuclei occur and are defined as "vowel like sounds" that have energy across a wide range of frequencies (not restricted to low frequencies like the Quasiresonant nuclei). Additionally closants (consonant like

segments click or isolated consonants) and vocants (vowel like segments) are produced during the second level.

During the third level, expansion, infants produce isolated vowels, two or more vowels in a row, vowel glide combinations, ingressive sounds, squeals, and marginal babbling. Marginal babbling consists of a series of closant and vocant segments.

The fourth basic level; Cannonical Babbling (6 months and older) is a collective term for both reduplicated and non-reduplicated babbling; that begins around 6 months of age; most children continue to babble into the time when they say their first words. As described by Stark (1986) reduplicated babbling is marked by similar strings of consonant vowel productions. Slight variations in vowel quality might be present but the consonants will stay the same from syllable to syllable. Non reduplicated or variegated babbling contains variations of both consonants and vowels from syllable to syllable. Smooth transition between consonant and vowel has been noted. At the beginning of this stage babbling is used in a self-stimulatory manner; it is not used to communicate with the adults whereas towards the end of this stage it may be used in ritual imitation games with the adults. Mitchell and Kent (1990) assessed the phonetic variation of multi syllabic babbling in eight infants at 7, 9 and 11 months of age and their findings showed that non reduplicated babbling was present from the time the infant began to produce multisyllabic babbling not evolving out of an earlier period of reduplicated babbling and no significant difference existed between the amount of phonetic variations for the vocalizations when the infants were 7, 9 and 11 months old.

The fifth and the final level of the Stark assessment of early vocal development-Revised are titled Advanced Forms. This level typically occurs between 9 and 18 months of age. During this time the children produce complex syllables (VC, CCV, and CCVCetc), jargon and diphthongs. Nathani and colleagues (2006) considered the application of Stark assessment of early vocal development- Revised to 30 infants in a mixed cross sectional and longitudinal design spanning five age ranges from 0 to 20 months of age. They found that as the children increase in age, speech like utterances increased in frequency while non-speech like utterances decreased in frequency. Productions typically associated with Levels 1 and 2 decreased with age, whereas productions associated with Level 4 were rarely produced before 9 months of age. Level 5 vocalizations occurred only 10 percent from 0 to 15 months, but jumped to 20 percent by 16 to 20 months of age.

2.5 Amendments and progressions in babbling

A vital component of the infants speech development is the process of acquiring the coordination of the phonatory and articulatory movements, especially as needed for babbling. Repeated articulatorymovements without voicing are evident at the beginning of babbling, in aphase called the***Jaw-Wags***. At the start ofthe babbling phase, infants might still have some problems with the coordinationof the articulation and phonation, resulting in jaw wags and other types ofvoiceless utterances. Hence predominance of voiceless utterances is considered to be present as compared to the more matured voiced utterances during the babbling as well as its transition into the first word stages.

Vocal abilities of the infant change dramatically and advance rapidly both quantitatively and qualitatively over the first year of life, more during the period nearing their first birthday in terms of varied series of babbled sequences. Vihman and colleagues have demonstrated that the phonetic parameters characterizing early words are also characteristic of prior and contemporaneous babble (Oller, Wieman, Doyle, & Ross, 1976; Stoel-Gammon & Cooper, 1984; Vihman, Simmons, & Miller, 1985). Irwin (1947) conducted a longitudinal study of English speaking infants where he examined the speech sounds of late babbling and onset of early words stage and reported a presence of glottal fricatives even in the early word stage but a decrease in their frequency owing to the increase of bilabial and dental stops following the production of [h]. He further reported that the glottals later decreased to a much larger extent compared to the onset of early word stage suggesting continuity between the late babbling and early words stages.

Developmental change in vocal production across the babbling period is most consistently manifested as an increase in the proportion of vocalizations including a consonant (Lindblom, &Zetterson, 1986) and in the size of the consonant repertoire (Stoel-Gammon, 1988; Stoel-Gammon &Otomo, 1986). Furthermore, numerous studies involving several different languages have demonstrated relative consistency in the particular consonants produced by children in the pre-speech period (Vihman, 1992; Locke, 1983).

Two theoretical approaches have characterized investigation of the acquisition ofspeech production (Vihman, 1996). They are encompassed within the competence/performance dichotomy initially given by Chomsky (1982). The competence related approach is the approach of modern generative phonology that is primarily

devoted to the characterization of innate phonological knowledge specific to humans. The performance-related approach is cantered in phonetics and can be characterized as a predominantly biological or functional approach. Davis and MacNeilage (1995) have proposed the phenomenon of Frame dominance which suggests that the main source of variance in the articulatory component of babbling (7-12 months) and subsequently early speech (12-18 months) is mandibular oscillation. The other articulators namely- lips, tongue, and soft palate's ability to actively vary their position from segment to segment and even from syllable to syllable is extremely limited. The authors hypothesize that consonants made with a constriction in the front of the mouth will be preferably associated with front vowels and consonants made with constriction in the back of the mouth will preferably be associated with back vowels and consonants made with the lips, will be associated with central vowels, ie vowels that are neither front nor back. Davis and Mcneilage (2000) carried out transcriptions of 17 hours of recordings of babbling by fraternal twins in an English/Serbian language environment (1,454 utterances) which were analyzed for basic aspects of articulatory organization, effects of the "twin situation". Predictions were that babbling would be dominated by a "frame" provided by rhythmic mandibular oscillation, for the most part, and were confirmed in the form of consonant-vowel co-occurrence constraints showing little active inter-segmental tongue movement (one subject) and a predominance of "vertical" (mandible-induced) inter-syllabic variegation (both subjects).

Mitchell and Kent (1990) assessed the phonetic variation of multi syllabic babbling in eight infants at 7, 9 and 11 months of age and their findings showed that non reduplicated babbling was present from the time the infant began to produce multisyllabic

babbling not evolving out of an earlier period of reduplicated babbling and no significant difference existed between the amount of phonetic variations for the vocalizations when the infants were 7, 9 and 11 months old. At the beginning of this stage babbling was found to be used in a self-stimulatory manner; and not to communicate with the adults whereas towards the end of this stage it was found to be used in ritual imitation games with the adults indicating to possess a more communicative linguistic intent.

A study by Oller(2000) on prelinguistic phonological categories examined the prelinguistic infant's babbling repertoire of syllables and the phonological categories that form the basis for early word learning, which were noticed by caregivers who interacted with infants. The results revealed that the caregivers reported small repertoires of syllables of their infants. But phonetic transcription with repeated listening of infant recordings, yielded repertoire sizes vastly exceeding those reported by caregivers and naturalistic listeners indicating that the caregivers undermined the infant's actual phonetic performance.

2.6 Transition from babbling to first words

There is an acknowledged synergy between speech sound development and other aspects of language. Research on typical development indicates that communicative capacities exhibited by children during pre-linguistic periods are reliable predictors of subsequent linguistic development. The frequency of vocalizations produced at 6months of life is related to the rate of vocabulary acquisition (Roe, 1942) and the complexity of babbling has been found to be related to a faster acquisition of words (Locke, 1983; Stoel- Gammon & Cooper, 1984; Stoel-Gammon & Dunn, 1985; Vihman, Ferguson, & Elbert, 1986; Stoel-Gammon, 1989; McCune &Vihman, 2001).

Stoel Gammon and Cooper (1984) presented a detailed analysis of early lexical and phonological development in three children. The study covered the period from late babbling through the acquisition of 50 conventional words focused on: (1) the relationship between prelinguistic and linguistic vocalizations; (2) phonological development after the onset of speech; (3) patterns of lexical selection; (4) rate of lexical acquisition; and (5) use of invented words. The findings revealed that children were similar in their prelinguistic utterances;and there was an extensive inter-subject variation and rapid progression after the onset of meaningful speech, particularly in the segmental and syllabic forms of word productions, patterns of lexical selection, rate of lexical acquisition, and use of invented words.

Vihman and McCune (2001)studied longitudinalproductivity criteria (phonetic on one hand and lexical on the other hand) to establish children's phonetic skill. Twenty children werefollowed from age 9 to 16 months, and their level of consistency of vocal patternswas examined in relation to their lexical production, providing a relatively largesampledemonstration of phonetic/lexical relationships at the transition tolanguage. Number of specific consonants produced consistently across themonths of observation predicted referential lexical use at 16 months, whereas thetransition to reference itself signalled the onset of a sharp increase in numbers ofdifferent words produced in a session. The earliest referential speakers exhibitedprior consistency in the production of [p/b], which also predominated in theirwords. Prior use of at least two supra-glottal consonants characterized thereferential group. Children varied in the specific consonants they producedconsistently, and these same consonants, varying according to individual

childrepertoire, characterized nearly all consonant-based words produced by eachchild in both of the final two months of observation.

Vihman et al (2006) assessed the extent of phonetic continuity between babble and words in four Italian children who were followed longitudinally from 0.10 to 2.0 years. Two childrenexhibited relatively rapid and two others exhibited relatively slower lexical growth. Prelinguistic phonetic characteristics, including both (a) consistent use of specific consonants and (b) age of onset and extent of consonant variegation in babble, were found to predict rate of lexical advance and the form of the early words. In addition, each child's lexical profile was analyzed to test the hypothesis of non-linearity in phonological development. All children showed the pattern of phonological advance: ie; there was a relatively accurate first word production followed by lexical expansion, and a decrease in accuracy and an increase in similarity between word forms which were a direct reflection of the production capacities of limited syllable structures comprising a blend of the babbled sounds. This trend was interpreted as reflecting the emergence of word templates, as a first step in the process of phonological organization.

2.7 The impact of language on babbling and subsequent early words stage

It has been an immensely debated topic as to whether babbling is language specific or at least are the babbled sounds in the infant influenced by the ambient language specificity and how is it influenced in a bilingual environment. Language specific characteristics of consonant productions were reported to be found as early as 0.9-0.10 months of age also (Chen & Kent, 2005). Many studies have been conducted with this regard giving different results and subsequent justifications. Oller and Eilers (1982) conducted a study wherein they offered a concrete characterization of how

babbling of Spanish- and English-learning babies was similar. Babbling of a group of Spanish- and another of English-learning infants (12 months of age) was recorded and transcribed by two experimenters, one a primarily Spanish speaker and one a primarily English speaker. Results showed that in spite of gross phonetic differences between the adult phonologies of Spanish and English, babies from both groups produced predominantly CV syllables with voiceless, unaspirated plosive consonants. Vowel productions were also perceived as notably alike. In the light of such similarities, possible differences in babbling of the two groups were concluded to be hard for even sophisticated listeners to notice.

Olleretal (1982) conducted a study to investigate the Babbling Drift Hypothesis (Brown, 1958) which predicted babblingto begin to approximate characteristics of the mother tongue as infants advanceto meaningful speech. In order to investigate this hypothesis, four experiments were conducted in which adult listeners' perception of the babbling of infants from different language backgrounds was tested. In the first two experiments monolingual English and bilingual English-Spanish adults judged the babbling of fourteen 7–10 month-old English and Spanish learning infants. The third and fourth experiments investigated the babbling drift hypothesis with older infants (11–14 months of age). For all experiments conducted during both the beginning and the end of the babbling period, adult judges were unable to identify language background significantly above chance level. Therefore, the findings refuted the babbling drift hypothesis. Bilingual and monolingual judges showed consistently different patterns of judgment with regard to particular infants and utterances. Hence, it was concluded that

the judges were influenced by their biased perception of their language background whichimpeded their success in determining the infants' language environment.

Davis etal (2000) conducted a study wherein transcriptions of 17 hours of recordings of babbling by fraternal twins in an English/Serbian language environment (1,454 utterances) were analyzed for basic aspects of articulatory organization, effects of the "twin situation," and effects of the two ambient languages, English and Serbian. The only prominent ambient language effect was a relatively high frequency of palatal glides (palatals are common in Serbian).

The consonant production of infants from four different linguistic environments (French, English, Swedish and Japanese) were studied which consistently showed language-specific distribution patterns throughout the 0- to 25-word stages (roughly age 0.9 to 1.5) in both babbling and early words (De Boysson- Bardies et al., 1992). French-learning infants produced significantly more labials than Swedish- and Japanese-learning infants, and French-learning infants produced velars which were the least frequent of all the four groups. Swedish-learning infants produced stops significantly more often and nasals significantly less often than that of French-learning infants.In Mandarin language, in contrast to the universal acquisition order of front to back consonants, velar fricatives are acquired earlier than dental and palatal fricatives (Jeng, 1979; Zhu & Dodd, 2000), although velar fricatives seem to occur much less often than dental and palatal fricatives in adult Mandarin language (Cheng,1982). In Cantonese language, late acquisition of [n] is also found (Wong & Stokes, 2001) contrasting the universal acquisition factor and implying a strong influence of the nature of ambient language.

2.8 Phonetic repertoire during the late babbling and first fifty word stages

The next major debated and much explored topic is that which speech sounds (vowels and consonants) are present or not and what are their limitations in the repertoire during the first fifty word stage. The specific speech sounds can be studied under two main sections of vowel inventories and consonantal inventories.

2.9 Vowel inventories

Literature on vowel development indicates the fact that vowels are acquired early in terms of both perception as well as production. But certain authors opine that the acquisition of vowel inventories has been widely neglected in the discussion of phonological development (Bauman & Waengler, 2000) justifying this neglect with the general statement that children acquire all vowels within the age of 3 years (Templin, 1957) with limited information available on the exact development of vowels. Central and front vowels have in general been acknowledged to be the first ones to emerge and further be stabilized (Donegan, (2002).

Veleten (1943) conducted a diary study on the vowel acquisition patterns of her own daughter and found that prior to 21 months of age, her child utilized the vowel [a] and after a rush forward in the vocabulary, the vowel [u] was added.

Irwin(1948) studied the vowel development, based on transcriptions of the vocalizations from 95 English learning infants. He reported the mid-front [E, I] and mid-central (e) vowels to account for 70% of vowel production during the first year. The major trend in vowel developmentnoted in this study was an increasing production of back vowels from age 0.11 to 2.6 years.

Jackobson (1942/1968) and Jackobson and Halle (1956) after studying children from various linguistic backgrounds, reported that the first vowel to be acquired was the vowel [a] followed by /u/ or /i/.

Ingram (1976); worked on the acquisition of vowels using the data from four case studies (Ingram, 1974 &Menn, 1971). He compared the vowels in the first fifty word stage and noted general trends of most children acquiring /a/ followed by /i/ and /u/.

Irwin and Wong (1983) examined the productions of vowels is spontaneous conversations of children from 18-72 months of age. The outcome of their examination was that children had the acquisition of [a], [u], [i:], [i] and the schwa vowel at 18 months of age the criterion of accuracy being set at 70%. By 3 years of age, all the vowels were found to be acquired with no production errors. They reported additional information that at 4 years of age, the accuracy of vowels such as [u] and schwa vowel decreased again to less than 90%.

Analysis of vocalizations by five infants aged 1.1 by Kent and Bauer (1985) showed that central and front vowels [ə, E, æ] are produced most often in V (monophthongs), VV (diphthongs) and CV (vowels with an initial consonant) syllables. Vowel [a] was found more often in CV syllables. These authors concluded the productions of central and front vowels to be more often than back vowels, and low vowels to be more often than high vowels.

Otomo and Stoel Gammon (1992) investigated the childrens vowel inventories (targeting mainly the acquisition of unrounded vowel productions) at the ages of 22, 26 and 30 months respectively. Their result was the corner vowels [i:] and [a] to be mastered early and the vowels [i] and [e] to be the least accurately produced vowels.

Mid-front and mid-central vowels [E, e], often used in babbling before age 0.8, were also reported in first words by age 1.8 in Mandarin speaking infants (Jeng, 1979; Yue-Hashimoto, 1980). Further, the emergence of the contrast of three corner vowels [i,a, u] before age 2 (Jeng, 1979) was reported as a major development during the second year, as few utterances of both [i] and [u] were observed before 1 year of age (Chen, 2005).

2.10 Consonant inventories

Two major studies that have been thought of as pioneers in this topic are those presented by Jackobson (1942/1968) and Jackobson and Halle (1956). After studying several diary reports from children from various linguistic backgrounds, they found that the first consonants are the labials, most commonality /p/ or /m/; these consonants were found to be followed by /t/ and later /k/; fricatives were found to be present only after the respective homorganic stops have been acquired. He further claimed that there were laws of irreversible solidarity, i.e. claims about the distribution of phonological features among the world's languages that not only determine inventories but also dictate what kind of rules are to be expected in acquisition. For example, back consonants presuppose front consonants, and are therefore acquired later. Front consonants are most likely to substitute for back consonants. Similarly stops are acquired before fricatives, voiceless stops before voiced stops and fricatives before affricates. But, Jakobson's work has been widely criticized, mainly because it predicts a universal order of development, whereas the study of acquisition data has revealed a great deal of both inter-and intra-child variation.

Another model that takes both uniformity and variability into account is that of Rice and Avery (1995). They hypothesize inventories to expand systematically and gradually. Structure was reported to be built up, by increasing the number of contrasts in the inventory. Furthermore, elaboration was thought to follow a predetermined path within any particular organizing node, in the Jakobsonian sense that certain phonetic feature present or emerging simply implies the existence of others (i.e. the presence of fricatives presumes the presence of stops), thus accounting for the universality of certain phonetic features. However, certain organizing nodes are first elaborated on, that are attributed to inter-child and cross-linguistic variability. Intra-child variability is explained in terms of variation that is found in the absence of contrast, while in the decrease in the amount of variation presence of contrast is seen.

Although certain similarities have been verified in the consonant inventories, several investigations have pointed to a wide range of variability between individual subjects (Ferguson & Farewell, 1975, Stoel Gammon & Cooper 1984, Vihman 1992, 1986). Ferguson and Garnica (1975) point out that /h/ and /w/ are also among the first consonants to be acquired.

Vihman et al (1986) compared consonants present in the first fifty word inventory of 7 children labeled as Standford to nineteen children labelled as others and it was noted that all children produced words containing /b/ and /m/. Over half of the children in the studies produced /p/, /t/, /d/, /k/, /g/, /ʃ/, /n/, /w/ and /h/.

Phonetic systems of babbling and early speech in English-learning infants are reported to resemble each other in various aspects of consonant development. The frequently occurring consonants – stops and nasals [p, b, d, k, g, m, n, n] – in early words

(produced from 0.10 to 1.2; Waterson, 1978) are a direct consequence of the most frequent sounds [b, t, d, g, m] in babbling (Irwin, 1947), except for [h], which is frequent only in babbling (Mowrer, 1980). The consonant production patterns for each child are consistent in both babbling and early words (Vihman, Macken, Miller, Simmons & Miller, 1985).

Longitudinal findings: the possibility that children follow different paths and strategies in typical speech and language acquisition prompted a shift in focus from the large group studies to longitudinal studies of smaller groups of children. Longitudinal research follows child or a group of children over a specified frame of time. It has the advantage of observing the acquisition process of individual children. But longitudinal research is often limited in that only one child or small group of children is evaluated.

Irwin (1947) conducted a longitudinal study of English speaking infants where he examined the speech sounds of late babbling and onset of early words stage and reported a presence of glottal fricatives even in the early word stage but a decrease in their frequency owing to the increase of bilabial and dental stops following the production of [h]. He further reported that the glottals later decreased to a much larger extent compared to the onset of early word stage suggesting continuity between the late babbling and early words stages. Kent and Bauer (1985) also found that bilabial and apical consonants occurred most often in the consonants produced by infants 1.1 years of age in various utterance patterns (e.g. CV, VCV and CVCV. Further; stops, nasals and fricatives were reported to dominate in consonants produced by infants in the same age range. The authors even concluded that the distribution of consonants in terms of place, manner and

voicing suggests that the voiced bilabial and apical stops [b, d] are the most frequent prevocalic consonants in English-learning infants' vocalizations

The developmental trends just reviewed for English-learning children can also be seen in children from other language environments. These apparent universal trends are: (1) labials and dentals occur more often than velars; and (2) stops and nasals occur more often than fricatives, liquids or glides.

Stoel Gammon (1985) presented a longitudinal investigation that utilized spontaneous speech in aconsiderable number of children. Thirty four children between 15 and 24 months of age were taken for the study. The investigation was undertaken to look at meaningful speech only; therefore subjects were grouped according to the age when they actually began to say atleast ten identifiable words within a recording session. This resulted in three groups of children: group A had ten words at 15 months; group B had ten words at 18 months and group C had ten words at 24 months. The results can be summarized as follows

- A large inventory of sounds was found in the initial than in the final position of words.
- Word initial productions comprised of voiced stops prior to voiceless ones, while the reverse was true for word final productions.
- The following phonemes appeared in atleast 50 % of all subjects by 24 months of age: [h, w, b, t, d, m, n, k, g, f and s] word initially and [p, t, k, n, r and s] word finally.
- The liquid /r/ always was found to be present in the word initial position.

- If the mean percentage of norm consonant production was calculated (Shriberg& Kwaitkowski, 1982), 70% accuracy was achieved. Because there is a large difference between the inventory produced by 2 year olds and that produced by adults, the author states that this accuracy level suggested that children are primarily attempting words that contain sounds within their articulatory abilities.
- The order of appearance of initial and final phonemes was relatively constant across the three groups of children studied. Individual differences in the appearance of phonemeswere in the classes of fricatives, affricates and liquids.

Although individual differences or variablities were observed in this investigation, the systematic following up of children; regardless of their age seemed to reduce the extreme variability noted in cross sectional studies.

Mowrer (1980) reported initial stops and final fricatives to occur frequently in both babbling and early words. This was attributed to the substitution of stops for initial fricatives ([top] for [sop]) and of fricatives or affricates for final stops (as in [bæs] for [bæk]). This unequal distribution alsoreflects sound patterns in babbling, in which stops occur more often thanfricatives in initial position, and conversely fricatives (or continuants) occurmore often than stops in final position (Kent & Bauer, 1985). Developmental continuity has also been reported in aspiration, voicing andgliding. The deaspiration of initial stops in early words ([bEt] for [pEt]) is an outcome of the high frequency of unaspirated initial stops in babbling (Mowrer, 1980).There is prominence of voiced stops in initial position,contrastingly; consonants in final position tend to be voiceless stops, fricatives or nasals inearly words and babbling, as seen in the devoicing

of final consonantsin early words ([bvk] for [bvg]; [fvs] for [fvz]) and the high frequency ofvoiceless final consonants in babbling (Mowrer, 1980; Kent & Bauer, 1985).

Substitution of glides [w, j] for prevocalic liquids [l, r] in earlywords can be correlated with higher frequencies of prevocalic glides than liquids in babbling (Mowrer, 1980). Children reduce consonantclusters into single consonants ([ti] for [tri]) and delete final consonantskeeping CV syllable structures in early words (Mowrer, 1980).This developmental trend results from the higher frequency of CVsyllables than of VC syllables and the scarcity of consonant clusters inbabbling (Kent & Bauer, 1985). The above mentioned patterns of consonantproduction in babbling and early words strongly supportdevelopmental continuity. However, phonetic development if found to comprise bothcontinuous and discontinuous processes.

As to the relative frequency of labials and alveolars, 'labial regression' is considered counter-evidence of continuity in consonant production betweenbabbling and early words (MacNeilage, Davis &Matyear, 1997). Three ofthe four children in MacNeilage et al.'s longitudinal study produced more alveolars in babbling, and three of them produced more labials in earlywords. The ratio of labials to alveolars in early words (2-2.8 years) was greater than that in babbling. This high alveolar frequencyin babbling was interpreted as reflecting biased characteristics of the ambient language.The regression to labialswas thought of as easier production in early words.

Babbling has been thought of as a major predictor of subsequent phonological advancements and lexical expansions in children. Outcome of several studies provides information that deviancy in babbling due to any inherent developmental or acquired

disabilities, further hampers phonological and lexical developments and communicative abilities also (Chapman, 1991)

2.11 Syllable structure and subsequent phonological development

Studies on the acquisition of syllable structure are sparse. Although the statements that children (i) start with CV syllables (ii) reduced consonant clusters, and (iii) often delete final consonants are commonplace in the literature, claims on further development are hard to find. With respect to onset in syllables; the following development has been found for Dutch children (Fikkert 1994): a stage in which onsets are obligatorily present in the child's production forms – resulting in default CV syllables, even when the target syllable is onsetless– onsetless output forms appear. Finally, complex onsets are produced.

Several authors (Ferguson & Farwell, 1975; Ingram 1989) have noted phonetic variability and limited syllable structure and sound segments during the first fifty word stage. Phonetic variability refers to the unstable pronunciations of the child's first fifty words. While this has been well documented (Farewell 1976; Menyuk & Menn, 1979; Stoel Gammon & Cooper 1984), it appears that some productions are more stable than the others. Ferguson and Farewell (1975) call this category of words as Stable forms. The second characteristic of this stage is the limitation of syllable structures and segmental productions utilized. From their relatively small repertoire of words, it would seem logical to conclude that children do not produce a large array of syllable structures and sound segments. Certain syllable types clearly predominate. These are CV, VC and CVC syllables. When CVCV syllables are produced they are full or partial syllable reduplications (Ferguson &Farewell 1975, Ingram 1974, Menn 1971, Stoel Gammon

&Cooper 1984). There are other syllables produced as well but less in frequency. Menn reported productions of the type CCVC, Leopld CCVCV, and Ferguson and Farewell CVCVVC etc. Certain children seem to favour specific types of syllables. Eg: some children evidence CVC structures to a moderate degree from the very beginning of this stage. With others CVC syllables appear only later and do not constitute any major part of the child's phonology until after the first fifty word stage (Ingram 1976).

2.12 Studies on pre linguistic and early linguistic period in the Indian context

Before proceeding towards studies on the course of phonological development in typically developing children in the Indian context (specifically Kannada); it is vital to first equip and get oriented about the normal phonetic aspects of Kannada language.

2.13 Phonetics of Kannada

Kannada known in English as kanarese; is a south Dravidian language spoken in and around Karnataka. Kannada similar to other Dravidian languages is found to comprise of a number of phonological contrasts absent in the phonologies of other languages (Schiffman, 1979). Majority of these contrasts being the existence of retroflex consonants and the contrasts between the short and long vowels. Kannada is also found to exhibit consonantal contrasts borrowed from Sanskrit and other languages specially the aspirated series and vowels such as æand ɔ.

Vowel system of Kannada: the basic Kannada vowel system is believed to comprise of five long and five short vowels. Diphthongs that are present in the standard Kannada phonetic system are [ai] and [au].

Classification of vowels according to tongue height and advancement in Kannada language(Schiffman, 1979)

- High vowels: the high vowels of Kannada are [i] and [u] and long vowels are [i:] and [u:] respectively. [i] Is a high front unrounded vowel which occurs in all positions of initial, medial and final. It is reported to be a more lax vowel in all the positions and even more lax before a geminate cluster. [u] is a high back rounded vowel which researchers report as being in between low-high in the initial and medial positions but high in the final positions (Schiffman, 1979).
- Mid vowels: the mid vowels in Kannada are the front vowels [e], [e:] and the back vowels [o] and [o:].
- Low vowels in Kannada are the [a] and [a:] vowels along with the borrowed vowels [æ and ɔ].

2.14 Classification of consonants in Kannada

Kannada is reported to be a repository of Dravidian consonants with a superimposed system of aspirated consonants and certain sibilants borrowed from Indo Aryan, Urdu and English languages. The consonantal classification as provided by (Schiffman, 1979) according to the place and manner features is as follows

- **Velar consonants**: are [k, kh, g, gh and ŋ]. The first four consonants belong to the class of voiced and voiceless stops and the fifth belongs to the velar nasal respectively.

- **Palatal consonants**: [ʧ, ʤ, ʧh, ʤh and n˜]. The first four consonants belong to the class of voiced and voiceless affricates and the fifth belonging to the class of palatal nasal.
- **Retroflex consonants**: are the [ɖ, ʈ, ɳ], the first two being voiceless and voiced retroflex stops and the next being retroflex nasal sound.
- **Dental consonants:** these are **[**n, t̪, d̪]. The first is a dental nasal sound and the next two are voiceless and voiced dental stops respectively.
- **Labial consonants:** these are [p, b, m]. The first two are voiceless and voiced bilabial stops and the next is a bilabial nasal sound.
- **Other consonants**

  Glides: the Kannada glides are the [j] and [w].

  Sibilants and fricatives: [s, ʃ]

  Lateral and glottal fricatives: [l, r, h]

Studies on the early phonetic repertoire in the Indian context are scanty. However few studies have been attempted in Kannada language. Rupela and Manjula (2006) studied the phonotactic development in 30 Kannada speaking children in the age range of 0-5 years. Results showed that CV syllables were the most commonly occurring syllable shapes compared to VC and CVC. CVC syllables were reported to occur at 12 months and increasing in frequency by 54-60 months. Anjana (2008) established a quantitative and qualitative database on babbling in Kannada in the age range of 6-12 months. The vowel repertoire consisted of /i, e, æ, a, u, o/ and the consonantal repertoire in the entire babbling period included 14 consonants /p, b, m, n, t̪ , d̪ ʈ , ɖ , h, k, g, l, j, v /, with stops and nasals exhibiting the highest frequency of occurrence in all the age groups. The

syllable shapes found were V, CV, CVC, VC and VCV and the mean occurrence of multisyllabic words increased with age.

Shyamala and Basanti's (2003) report on the developmental milestones of language acquisition in Hindi and Kannada revealed that the cardinal vowels/i/, /e/, /a/, /u/, and /o/ first appeared by 6-12 months of age in Kannada followed by the vowels /i/, /i: /, /u/, /u:/, /e/, /e:/ /a/, /a:/ and /o/, /o:/ seen in the toddlers aged between 12-18 months of age. Diphthongs /ou/ and /ai/ were found to be absent in all the participants. Under the place feature of consonants, velars, palatals, retroflex, dentals and labials were reported to be present in all the participants and under the manner feature, stops, nasals, glides, sibilants and fricatives were found to be present. Laterals were reported to be seen only in the oldest participant of the age group.

Sreedevi and Jyothi (2012) conducted a longitudinal study on infants between 3-12 months of age to investigate the phonetic characteristics of babbling in Kannada. Their results revealed the presence of the following seven vowels [æ:] [ɔ̂] [ɔ̂:] [a] [a:] [e] and [e:] in the age range of 11-12 months. The high vowels were found to be relatively sparse in this age range. The diphthongs /əæ:/, /əe:/ and /au/ were reported to be present. Among the consonants, the bilabial and dental plosives followed by the nasals were found in the children's consonantal inventory in the age range of 11-12 months.

In another Indian language, Malayalam, Irfana (2012) conducted a cross sectional study on the early phonetic repertoire in typically developing Malayalam speaking children between the age range of 12-18 months where she subdivided the groups into 12-15 months and 15-18 months respectively. Following observations were reported from her study: regarding vowels [a and i] were the most frequent in the younger age group

and [a and u] the most frequent in the older age group. Most frequent manners of articulation noticed were stops, glides, nasals, fricatives, trills and laterals. On similar lines Alphonsa (2012) conducted a cross sectional study in children aged between 18-24 months; wherein the age range was subdivided into 18-21 and 21-24 months respectively. Her results also revealed similar findings as that of Irfana's (2012) study; but in addition she reported certain salient features regarding the vowel [o] to be the most frequent following [a] in the older age group; and comparatively more frequent occurrences of the front vowels with the palatals (50%) of the times; though it was not most frequent and the relatively more incidence of occurrence of fricatives and sibilants in the older age group.The most prominent syllable structures that were found in common in both the studies were CV, CVCV, CVVCV, CVV, VCV, CVCVCV, VCCV, CCV, CVCVCVCV and VC.

2.15 Clusters during the early linguistic period

Clusters are a vital part of development from the earlier word shapes of CV, VC or CVCV. A consonant cluster is used to refer to the adjacent and simultaneous consonant releases in a syllable. Cluster productions might occur in different word positions such as word initial, medial as well as final positions. Cluster acquisition and its subsequent development occur on a longer duration of time in the due course of phonological development.

Lleo and Prinz (1996) have reported the commencing age of cluster production in German and Spanish speaking children to be around 1.10 years for word initial clusters and 1.5 years for word medial clusters. Emergence of consonant clusters is believed to occur during the phase Ingram (1989) describes as "Word Spurt". Geminate clusters are

believed to be acquired earlier as compared to non-geminate clusters and even substitution of geminate for non-geminate clusters are reported to be a common phenomenon during the phonological acquisition process. A study by Sreedevi (1976) on 2-2.11 year olds revealed the emergence of geminate and homo organic clusters to be earlier as compared to non-geminate clusters.

Greenlee (1974) has stated four stages of cluster acquisition which are as follows:

- Stage1: Deletion of the entire cluster
- Stage2: Reduction of the cluster to one member
- Stage3: Use of cluster with substitution of one or both members of the cluster
- Stage4: Both segments are used appropriately.

2.16 Proto words and Holophrastic words

Literature on proto and holophrastic words are relatively sparse in comparison to other aspects of phonological development. However the researchers in the field of child phonology have reported the occurrence of these to be a common feature in almost all children during their course of phonological development in the beginning of the linguistic stages (Bauman & weangler, 2000). These words are true reflection of the limited and still developing functional speech sound system in children. Children frequently use “invented words” (Locke 1983) in a consistent manner implying an inherent meaning for the child. These words used consistently but without a recognizable adult model have been called protowords (Menn 1978), phonetically consistent forms (Dore et al 1976), Vocables (Ferguson 1976) and Quasi words (Stoel Gammon & Cooper 1984).

Holophrastic words are believed to occur in the item learning stage in the due course of acquisition process. Here in Item learning; the child first acquires word forms as unanalyzed units, productional wholes. Only later, after the first fifty word stage does system learning occur during which child acquires the phonemic principles that apply to phonological system in question. The early portion of the item learning stage is known as the ***Holophrastic Period***, the span during which the child uses one word to indicate a complete idea. The link between the object, its meaning, and the distinct sound segments is not firmly established. Many authors have noted phonetic variability and a limitation of syllable structures and sound segments during this stage. Phonetic variability refers to the unstable pronunciations of the child during this first fifty word stage. From their relatively small repertoire of words, it is clear that children do not produce a large array of syllable structures and segmental productions. When syllable structures such as CVCV are present, they are either complete or partial reduplications of their babbled forms.

CHAPTER 3

METHOD

The present study was conducted to investigate and thereby obtain qualitative and quantitative data on several aspects of phonological development in typically developing Kannada speaking children within 12- 18 months of age. The following method was incorporated in the study to achieve the goals.

3.1 Participants

a) A total of twelve typically developing children in the age range of 12-18 months of age; having Kannada as their native spoken language were chosen randomly as participants in this study. The children were divided into two age groups with an age interval of 3months; ie 12-15months of age and 15 to 18months of age respectively. Each age group comprised of 6 children; 3 boys and 3 girls. Equal number of boys and girls were included in each age group so as to control the variable; as according to Hawkins (1995), females tend to develop articulatory skills earlier and more rapidly than males.

b) The children were recruited from immunization centres, neighbouring homes, hospitals and paediatric clinics in Mysore city. It was ensured after a parental interview through an informal screening procedure using a checklist ("Remember and Care" department of Prevention of Communication Disorders; AIISH) that all the participants were devoid of any speech language, cognitive or hearing impairments and were following a typical developmental trend. The participants were also ensured to belong to middle socio economic status through the administration of the NIMH Socio Economic Scale devised by Venkatesan (2011). According to Smith (1973)

children from a lower socio-economic status would have more articulation and language deficits compared to those of a higher socio-economic status. She also attributed that children from families of a higher socio-economic status have increased speech and language input and higher demands of verbal output. Hence, to control these differences; the middle income families were selected. Criteria for education of both the parents were set up to a minimum of 10^{th}class of formal education standards.

3.2 Materials: Toys and other picture books the children used in their daily play activities were used to elicit vocalizations and utterances from them.

3.3 Data recording procedure: The children were recorded on audio video in their natural settings by the investigator in a fairly quiet room with minimal distractions at the vicinity in approximately 60 min play sessions with their mothers or the care takers. Play sessions included both free play eliciting spontaneous utterances as well as various speech stimulation methods provided by the mother/ the caretakers eliciting verbal responses. Audio video recordings of each child were obtained individually using high quality digital audio video recorders (Sony Full HD 1080 Handycam). Spontaneous verbal responses from the toddlers as well as those vocalizations and utterances obtained through various stimulation methods provided by the mother or caretaker during the play sessions with the child were considered for analysis. No additional play materials were introduced into the environment, so that samples would reflect the infants' typical vocalizations in familiar surroundings. The criteria for the quantity of the samples to be considered for analysis were set to contain a minimum of 60-70 verbal utterances. In cases where the recording sessions yielded fewer than the minimum set criterion

utterances, additional recordings within a couple of days of the session of interest were undertaken to yield the desired amount of utterances.

3.4 Data Analysis: All the recordings were transferred to a computer for segmentation and analysis. The recordings were analyzed using the VLC media player software. The recorded data was subjected to editing to eliminate parent's speech and vegetative vocalizations (such as cries, burps and coughs etc) of the child. The child's speech like utterances was retained for analysis. A minimum of 60-70 utterances from the 60 minute recording was transcribed using broad and narrow IPA. The responses of each subject were analyzed sound by sound to identify the various vowels, consonants and their combinations. In addition, various proto words, true words and holophrastic words existing and developing in the Childs verbal repertoire were analyzed. Results were discussed based on

- The frequency of occurrence of vowels was calculated and these were analyzed and discussed with respect to the dimensions of tongue height and tongue advancement.
- Consonants were analyzed in terms of place; manner and voicing features and the most frequently occurring consonants were also found.
- The most frequently occurring syllable structures were calculated
- Preferential occurrence of certain vowels with certain consonantal types was evaluated.

3.5 Inter judge reliability

To examine the reliability of transcription, inter judge reliability was carried out wherein 10 percent of each speech ample was transcribed by two additional speech

language pathologists in addition to the researcher. A point to point agreement that was obtained between the judges and the investigator was converted into percentage to get reliability index. This resulted in a reliability index of 89 percent was obtained for the entire corpus of speech samples.

3.6 Intra judge reliability

To verify the intra judge reliability, the researcher re-examined 10 percent of each participants obtained data and a point method was used and a reliability index was thereby obtained. It revealed an intra-judge reliability of 94% for the entire speech samples.

As per Olswang's (1987) criteria, a minimum of two or more productions of a vowel/ consonant/ syllable shape each, in a minimum of 3 participants in each age group, was considered as the set criteria for selection of speech sounds for analysis. Usingthe following formulae the frequencies of consonants, vowels, syllable shapes and word shapes were calculated.The mean percentage of occurrence of all the phonological parameters considered was calculated for each age group and gender separately.

$$\%\ \text{of Vowels/Consonants/Consonant clusters} = \frac{\text{No. of occurrences of Vowels/ Singleton Consonants/Consonant Clusters}}{\text{Total no. of phonemes}} \times 100$$

a. Among the vowels, the percentage of occurrence was obtained for the parameters of tongue height and tongue advancement separately.

$$\text{Eg. \% of Vowel /a/} = \frac{\text{No of occurrences of vowel /a/}}{\text{Total no of vowels}} \times 100$$

b. Similarly percentage of occurrence was calculated for different singleton consonants based on manner of articulation, place and voicing features. Analysis was also carried out with regard to preferential occurrence of combinations of vowels and consonants.

c. Consonant clusters were further quantified based on geminate clusters and non-geminate clusters if present.

d. Percentage of occurrence of various syllable structures were calculated using the following formula (as given by Velleman,1998)

$$\%\ \text{of CV/CVC/VC/CVCV/ syllables} = \frac{\text{No. of CV/CVC/VC/CVCV/ syllables}}{\text{Total No. of syllables}} \times 100$$

e. Frequency of occurrence of protowords and holophrastic words: Based on Vihman's procedure (Vihman& McCune, 1994), the criteria for identifying true words based on context was as follows:

1) Determinative context- at least one use that occurs in a context which strongly suggests a word.

2) Maternal identification- the mother identifies at least one instance of the form of the word which either involves acknowledging or rejecting the word choice.

3) Multiple use- the child uses the target form/word more than once.

4) Multiple episodes- more than one episode of use.

3.7 Statistical analysis

Descriptive and non-parametric statistics were used to statistically analyze the data. Mann-Whitney tests were used to carry out across age group and gender

comparisons (vertical comparisons). Friedman test and Wilcoxon Signed Rank tests were used for within group comparisons (horizontal comparisons).

CHAPTER 4

RESULTS

The aim of the present study was to acquire both quantitative and qualitative data on various parameters of phonetic inventories and syllable structures in typically developing Kannada speaking children aged between 12- 18 months. The core objectives of the study were:

- To obtain various parameters of the phonetic repertoire comprising of the frequency of occurrence of vowels (with respect to tongue height and advancement), diphthongs, consonants (with respect to the features of place, manner and voicing), various syllable structures and word shapes in Kannada.
- To obtain preferential combination of consonants and vowels.
- To analyze the emergence of clusters.
- To analyze the existence and frequency of proto and holophrastic words.
- To compare the above mentioned aspects of phonological development across the two age groups considered, 12-15 and 15-18 months and across gender.
- For cross linguistic comparison of early phonological development with studies in the Indian context and other languages of the world

Twelve typically developing children having Kannada as their native language were video recorded and each participantsconsonant and vowel inventory was obtained; which constituted the data of the study. These participants were sub divided into two groups with an age interval of 3 months each; ie 12-15 months and 15-18 months respectively. Both the groups consisted of 6 children each having 3 boys and 3 girls. The recorded data was phonetically transcribed using the standard International Phonetic

Alphabet (2005) which yielded a total of 3005 phonemes in the entire speech corpus of the 12 participants. The transcribed data was then subjected to further statistical analysis using the non-parametricMann- Whitney U test to find if any statistically significant differences existed across the parameters of age and gender, the Wilcoxon Signed Rank test and the Friedman test to carry out within group comparisons. The results will be discussed under the following sections.

- Vowels
- Diphthongs
- Singleton consonants
- Syllable shapes
- Geminate and non-geminate clusters
- Word shapes
- Protowords
- Holophrastic words
- Preferential occurrence of vowels with consonants

4.1 VOWELS

The basic Kannada vowel system consists of five long vowels (a:, i:, u:, e:, and o:) and five short vowel phonemes (a, i, u, e and o). But many other vowels may be found to be present in the Child's repertoire owing to the jargon utterances, emerging phonological system as well as the influence of English loan words. The 9 different vowels that were present in the entire speech corpus of the participants were: ə, a, i, i:, u, u:, æ, e and o accounting to a total of 1905 vowel occurrences. These vowels occurring in isolation, as well as in various mono, bi and multisyllabic utterances

were transcribed using the International Phonetic Alphabet and analyzed for each individual subject. The vowels were then categorized into the following types

- **With reference to tongue height**

  High vowels: [i, i:, u and u:]

  Mid vowels: [e, e;, o and o:]

  Low vowels: [ə, a, a: and æ]

- **With reference to tongue advancement**

  Front vowels: [i, i:, e and e:]

  Back vowels: [u, u:, o and o:]

  Central vowels: [ə, a and æ]

Following this, a mean percentage of all these individual vowels were obtained for each participant (by dividing the frequency of occurrence of each vowel by the entire frequency of vowel repertoire in each child multiplied by 100). A mean percentage and standard deviation of each of the vowels was calculated for the two age groups separately. Table 1 and Fig 1 represent the mean percentage of occurrence of all the vowels present in both the age groups.

Table 1
Mean percentage and standard deviation (in parenthesis) of occurrence of vowels

Vowels	12-15 months	15-18 months	Total
a	33.98 (9.29)	38.21 (9.39)	36.09 (9.17)
i:	7.15 (3.36)	0.85 (1.06)	5.078 (4.21)
u	14.56 (9.37)	13.8 (3.75)	14.27 (7.37)
i	8.05 (2.54)	14.2 (9.74)	11.72 (8.07)
ə	16.85 (6.36)	17.62 (8.35)	17.03 (7.02)
æ	16.46 (6.74)	4.64 (2.15)	11.31 (8.08)
e	13.65 (5.35)	10.04 (6.41)	11.64 (5.91)
o	10.71 (7.50)	5.2 (3.87)	6.77 (5.15)
u:	-	13.195 (2.27)	13.195 (2.27)

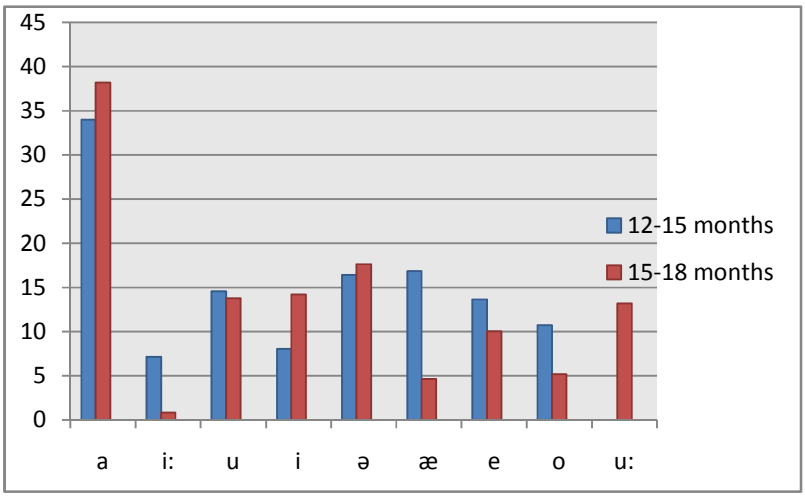

Figure 1,*Mean percentage of occurrence of vowels*

From the data represented in Table 1 and Fig 1 it is evident that the frequency of occurrence of the low-central vowel [a] is most abundant in both the age groups,followed by schwa vowel [ə]. The occurrence of the long vowel [u:] was found only in the higher

age group. Table 2 represents the frequency of occurrence of vowels in the descending order.

Table 2
Occurrence of vowels in descending order

Age Group In Months	Rank Order of Vowels								
12-15 Months	a	ə	æ	U	e	o	i	i:	-
15-18 Months	a	ə	u	u:	i	e	æ	o	i:

4.2 Classification of vowels according to tongue height

The low vowel [a] and the schwa vowel [ə] were highly present in both the age groups with their frequency increased in the higher age group. The low vowel [æ] and the mid vowels [e] and [o] occurred more frequently in the younger age group. The frequencies of high vowels were comparatively lesser than the low and mid vowels in the younger age group; whereas the higher age group had a larger frequency of high vowels than mid vowels. In a nutshell, the low vowels were greatest in their frequency followed by mid and high vowels in the younger age group whereas in the higher age group, the low vowels were followed by the high and mid vowels.

4.3 Classification of vowels according to tongue advancement

According to the dimension of tongue advancement, the central vowel [a] and the schwa vowel [ə] occurred predominantly in both the age groups followed by the back and front vowels. The back vowel [u] was higher in occurrence compared to the front vowel [i] in both the age groups. The low central vowel [æ] occurred more frequently in the younger age group. The frequency of occurrence of mid front vowel [e] and the mid back

vowel [o] were greater in the younger age group. Back vowel [u] and its longer counterpart [u:] occurred more in the older age group as compared to front vowels.

4.4 Comparison of frequency of vowels across age

The vowels [a, i:, u, æ, e and o] occurred in a greater frequency in the lower age group and the vowels [a, I, ə and u:] occurred more in the higher age group. However, the outcome of administering the non-parametric Mann-Whitney U test revealed no statistically significant difference in the frequency of any of the vowels across the two age groups.

4.5 Comparison of frequency of vowels across gender

When the non-parametric Mann-Whitney U test was run for the frequency of vowels across gender, vowels [a] (/Z/= -1.9p < 0.05) and [u] (/Z/= -1.8p < 0.05) showed a significant difference across the two groups of girls and boys; with their higher occurrence in girls as compared to boys.

4.6 Positional differences in the occurrence of vowels

As there have been reports regarding the positional differences in the occurrence of vowels, in terms of certain distinct patterns noticed as positional preferences; it is vital to know the pattern of positional differences in the occurrence of vowels. Table 3, represents the positional differences in the occurrence of vowels.

Table 3
Positional difference of occurrence of vowels in percentage across age groups

Vowels	Positions	12-15Months	15-18 Months
a	I	34.15	46.6
	M	38.53	31.68
	F	31.08	21.68
	I	36.73	50
i:	M	33.33	-
	F	29.9	75
u	I	32.82	28.45
	M	32.68	26.65
	F	34.58	62.6
I	I	82.5	47.87
	M	17.5	25.53
	F	-	45.95
	I	47.2	28.45
ə	M	24.97	26.6
	F	32.25	38.5
æ	I	54.28	45
	M	28.025	9.5
	F	32.34	50.25
e	I	42.76	54.64
	M	30.8	31.2
	F	26.4	46.05
o	I	43.33	64.32
	M	56.66	20.8
	F	-	68.3
u:	I	-	20.5
	M	-	50.7

As seen from Table 3, the occurrence of the low central vowel [a] was greatest in the medial position in the younger age group and in the initial position in the older age group. The high back vowel [u] in the final position, the high front vowel [i] in the initial position and the vowels [i:] and [o] in the medial and final positions were highest for both the age groups. The mid front vowel [e] was more prominent in its occurrence in the initial position for both the age groups. Vowel [æ] was found more frequently in the initial position in the younger age group and in the final position in the older age group.

4.7 Comparison of positional differences of vowels across age

On appropriate statistical analysis, a significant difference was found for the low central vowel [a] in the initial (/Z/= -1.9, $p < 0.05$) and medial positions (/Z/= -1.9, $p < 0.05$) and in the initial positions of the mid front vowel [e] (/Z/= -1.9, $p < 0.05$). In all the above mentioned positions, the older age group had a higher frequency of occurrence.

4.8 Comparison of positional difference of vowels across gender

The results on the administration of the non-parametric Mann-Whitney U test revealed a significant difference for the vowel [i] in the medial position (/Z/= -1.771, $p<0.05$); the frequency of which was larger in girls as compared to boys.

4.9 Comparison of positional difference within age groups

To investigate as to any positional difference or pattern exists in the acquisition pattern of vowels within age groups; non parametric Friedman and Wilcoxon tests were run. Results on administration of these tests in 12-15 months age range revealed significant difference in the vowel [æ] in the final and initial position; with a greater frequency of occurrence in the initial position; for the vowel [e] in the medial and initial

positions and in the final and initial position, with higher occurrence in the initial positions. The sane tests when run on the second age range (15-18 months) revealed significant difference in the initial and final positions for the vowel [a], greater occurrence of frequency in the initial position. Hence, a clear trend of higher occurrence in the initial position was observed most of the vowels.

4.10 DIPHTHONGS

The diphthongs typically present in Kannada language are [ai] and [au]. In addition to these, the phonetic repertoire of the children in this study was found to contain two other diphthongs such as [eo] and [æi] as well.

Table 4
Mean percentage of occurrence of diphthongs

Diphthongs	ai	au	Eo	æi
12-15 months	50.91	43.24	-	26.33
15-18 months	46.2	31.93	12.5	17.7

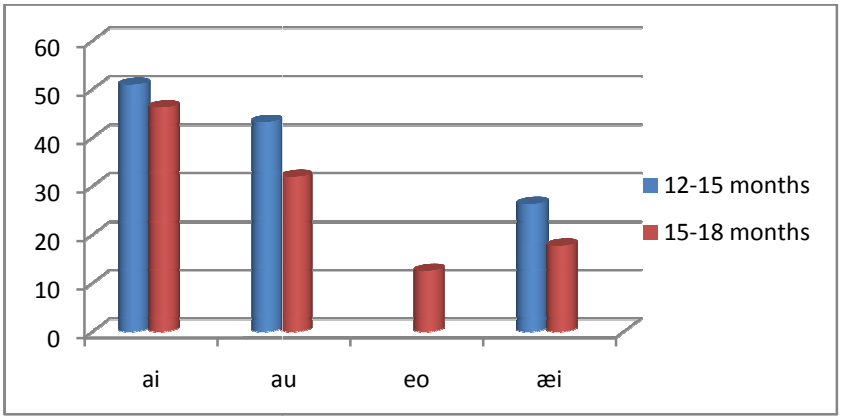

Figure 2, *Mean percentage of occurrence of diphthongs*

As evident from Table 4 and fig 2, the diphthong [ai] was found to be maximally present in both the age groups followed by [au]. The diphthong [eo] was present only in the older age group and [æi] was present in a greater frequency in the younger age group. Table 5, represents the ranking of occurrence of diphthongs in the descending order.

Table 5
Occurrence of diphthongs in descending order

Age group in months	Rank order of Diphthongs			
12-15 months	ai	au	æi	-
15-18 months	ai	au	æi	eo

4.11 Comparisons of the frequency of diphthongs across age and gender

No significant difference in the frequency of occurrence of these diphthongs across age as well as gender was revealed on the administration of the non-parametric statistical tool, the Mann-Whitney U test.

4.12 CONSONANTS

A total of 1100 consonant occurrences were found in the entire speech corpus of the twelve participants and these consonantal speech sounds seen were [p, b, m, n, t̪, d̪, ʧ, ʤ, ɖ, ʈ, ŋ, k, g, j, r, l, w, v, ʃ, s, h, l̪]. All the singleton consonants as per the criteria adopted from the study, which occurred in isolation as well as in mono, bi and multi syllabic utterances were transcribed and analyzed according to the place, manner and voicing features. The frequency of occurrence of the consonant types for all the subjects in the two groups was established. Consonant discussion will be carried out with reference to the place, manner and voicing features.

4.13 Consonants with reference to Place of Articulation

The consonants observed in the children's phonetic repertoire were classified into various places of articulation as follows

- Bilabials
- Dentals
- Labiodentals
- Alveolars
- Palatals
- Retroflex
- Velars
- Glottals

From the raw data obtained, the mean percentage and standard deviation of consonants categorized in their specific places of articulation were calculated for each participant individually. Later, a total mean percentage and standard deviation for the two groups each was obtained for the different places of articulation as shown in Table 6.

Table 6
Mean percentage and standard deviation (in parenthesis) of occurrence of consonants according to place of articulation

Place of Articulation	12-15 months	15-18 months	Total
Bilabial	50.6(13.8)	46.3 (6.3)	48.49(10)
Dentals	34.9(13.5)	29.4 (9.9)	32.19(11.3)
Alveolar	-	7.5 (1.55)	7.5 (1.55)
Palatal	12.95 (2)	8.31 (3.5)	9.86 (3.75)
Retroflex	5.2 (2.26)	6.43 (4.3)	5.94 (3.33)
Velars	6.33 (3.5)	8.7 (0.4)	7.83 (5.26)
Glottals	7.5 (3.2)	4.06 (1.8)	5.62(3.01)
Labiodental	-	5.8	-

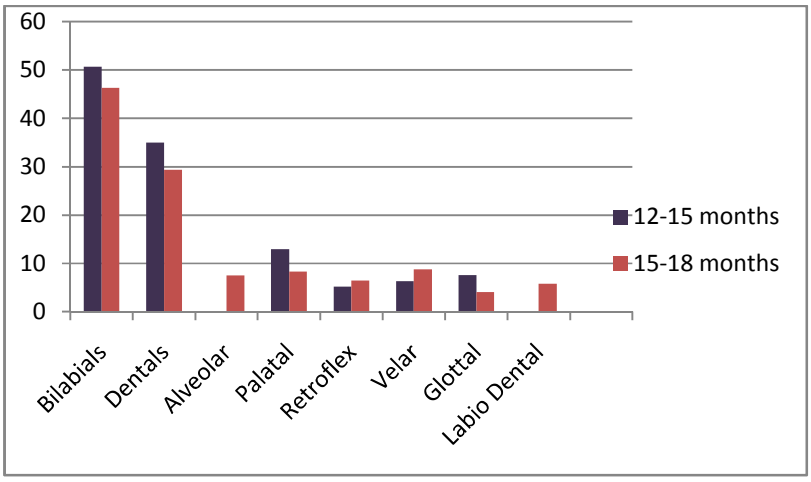

Figure 3, *Mean percentage of occurrence of consonants (Place of Articulation)*

With reference to Table 6 and Fig 3, it is clear that bilabials predominate in both the age groups, followed by dentals although the frequencies of both were higher in the

younger age group. The frequency of palatals and glottals also were superior in the younger age group. Retroflex and velar phonemes occurred in a greater frequency in the older age group. It is also noticeable that alveolars and labiodentals were present only in the older age group. More number of places of articulation was present in the participants of 15-18 months of age. Table 7 depicts the occurrence of consonants in the descending order.

Table 7

Rank order of consonant place of articulation in descending order

Age group	Rank order of Place of Articulation							
12-15 months	Bilabials	Dentals	Palatals	Velars	Glottal	Retroflex	-	-
15-18 months	Bilabials	Dentals	Velars	Palatals	Alveolars	Retroflex	Glottal	Labio dental

4.14 Comparison of consonants with reference to place of articulation across age and gender

The statistical analysis revealed the absence of statistically significant difference with reference to place of articulation across both age and gender.

4.15 Positional differences in the occurrence of consonants

It is essential to find the pattern of positional influence on the consonant acquisition as in certain positions certain consonants are acquired earlier as compared to other positions. Hence mean percentage of occurrence of each consonant with respect to

its place of articulation in different positions were analyzed and tabulated as shown in Table 8.

Table 8

Positional differences in the occurrence of consonants

Place of articulation	Positions	12-15 months	15-18 months
	I	42.28	28.26
Bilabials	M	34.86	44.55
	F	22.08	22.8
Dentals	I	34.2	41.6
	M	48.2	51.3
	F	22.07	10.4
Alveolar	I	20	34.75
	M	30	48.62
	F	50	61
Palatals	I	41.25	53.46
	M	58.75	45.48
	F	-	40.9
Retroflex	I	50	37.5
	M	50	48.55
	F	-	-
Velar	I	71.66	64.86
	M	42.5	41.1
	F	-	-
Glottal	I	49.6	57
	M	50.3	60.5

As can be seen from the Table 8; bilabials had their maximum occurrence in the initial position in the younger age group; and in the medial position in the older age group. Palatals displayed the reciprocal pattern as that of bilabials by occurring

predominantly in the medial position in the younger age group and in the initial position in the older age group. Dentals and glottals appeared maximally in the medial positions for both age groups. Frequency of retroflex phonemes was at par in both initial and medial positions in the younger age group; whereas their frequency was higher in the medial position in the older age group. Velar phonemes had their occurrence dominant in the initial positions for both the age groups.

4.16Comparison of positional differences across age and gender

Results on the non- parametric Mann-Whitney U test revealed significant difference on the frequency of occurrence of bilabial consonants in the initial position across the two age groups, the production frequency being significantly higher for the younger age group in the initial position (/Z/= -2.562; $p < 0.05$).

Gender wise comparison of the same parameters revealed a statistically significant higher frequency of occurrence of bilabials in the final position (/Z/= -2.242, $p < 0.05$) and dentals in both medial (/Z/= -2.739, $p < 0.05$) and final positions (/Z/= -2.000$p < 0.05$), the frequency of all seen higher in boys compared to girls.

4.17 Consonants with reference to the dimension of Voicing

Consonants are typically classified as voiced or voiceless owing to the presence or absence of the voicing feature in them.

Table 9

Mean percentage of voiced and voiceless consonants

Voicing	Voiced	Voiceless
12-15 months	57.81 (8.62)	42.31 (8.34)
15-18 months	56.71 (7.88)	43.21 (7.85)
Total	57.26 (7.90)	42.76 (7.74)

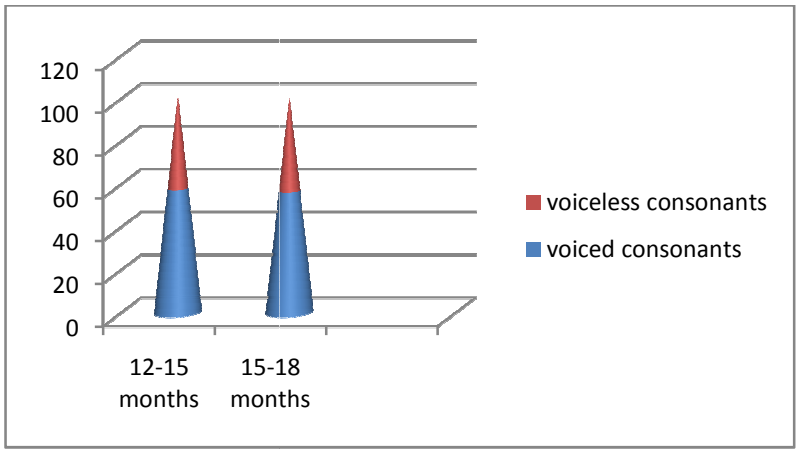

Figure 4, *Mean percentage of voiced and voiceless consonants*

Table 9 and Fig 4 indicate the frequency of voiced consonants to be more in the younger age group and the voiceless consonants to be slightly higher in the older age group.

4.18 Comparison of voicing feature across age and gender

The outcome of statistical analysis revealed that the voicing dimension did not vary significantly across age and gender.

4.19Consonants with reference to Manner of Articulation

The consonants that were found in the entire corpus of children's phonetic repertoire was classified under the following manners of articulation with reference to the classification of Kannada phonemes by Schifman; 1985.

- Stops
- Nasals
- Affricates
- Alveolar Fricatives
- Glides
- Liquids
- Laterals
- Glottal Fricatives

As indicated above, all manners of articulation present in adult spoken Kannada were seen in children's phonetic repertoire as young as 12-18 months of age. However, the frequency of some of the manners of articulation were relatively less and were not produced by all the participants.

Table 10

Mean percentage and Standard Deviation (in parenthesis) of frequency of consonants according to the manner of articulation

Age range	Stops	Nasals	Affricates	Alveolar Fricative	Glides	Glottal Fricatives	Liquid
12-15 months	53.18 (4.3)	32.05(7.9)	3.45(1)	11.5 (1)	11.7	10.82(6.12)	3.4 (1)
15-18 months	51.36 (3)	26.33(5.8)	4.48(2)	3.4 (2.1)	4.8(2)	6.61(6.75)	12.2(5)
Total	52.27 (3)	29.19(7.2)	4.18(1.9)	7.5(5.8)	6.1(3)	8.94(6.38)	10 (6)

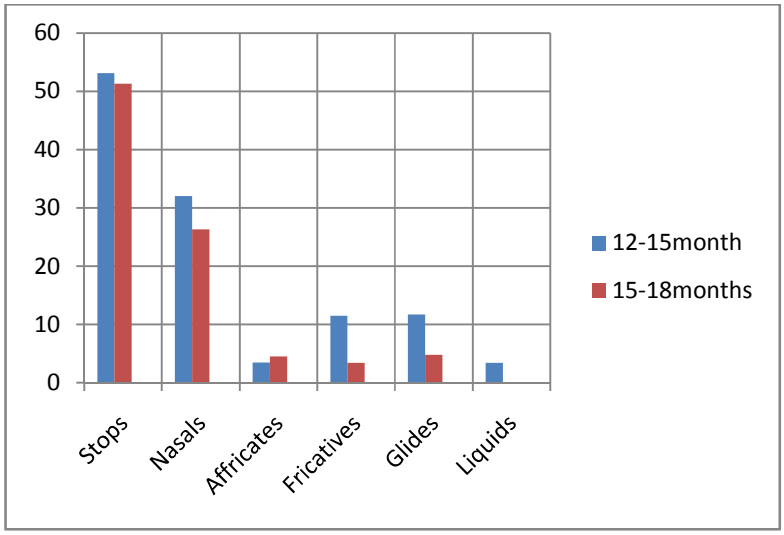

Figure 5, *Mean percentage of manner of articulation*

The frequency of occurrence of consonants across various manners of articulation is shown in Table 10 and Fig 5. As evident; stops and nasals predominate in both the age groups, the frequency of both being higher in the younger age group. Younger age group demonstrates a greater frequency of alveolar fricatives, glides and glottal fricatives. The older age group exhibited higher frequency of affricates and liquids compared to the

younger age group. Table 11 displays the rank order of consonant frequency with respect to the manner feature in the descending order.

Table 11

Consonants according to the manner of articulation in the descending order

Age group	Rank order of Manner of Articulation						
12-15 months	Stops	Nasals	Glides	Alveolar Fricatives	Glottal Fricatives	Affricate	Liquid
15-18 months	Stops	Nasals	Liquid	Glottal Fricatives	Alveolar Fricatives	Glides	Affricate

4.20Comparison of manner of articulation across age and gender

On the administration of the Mann-Whitney U test, no statistically significant difference with respect to manner of articulation was found across both age and gender.

To summarize, the frequency of occurrence of singleton consonants in the phonetic repertoire were discussed under three dimensions of place, manner and voicing features. Under the place feature, bilabials followed by dentals predominated in both the age groups, under the voicing feature; voiced consonants made a higher appearance in both the age groups, though the difference was not statistically significant. Stops and nasals were higher in frequency compared to other manners of articulation in both the age groups. Positional differences yielded a mixed result wherein some of the consonants predominately occurred in the initial position and some in the medial position.

4.21SYLLABLE STRUCTURES

A total of 845 syllables structures were found in the entire data of phonetic inventories of this study and these were: VC, VCV, CVC, CV, VCCV, VCVCV, CVV, CVCCV and CVCVCV. CV syllable shape was found to be maximally present in both the age groups. The CVCVCV pattern was present only in the participants of 15-18 months of age. The syllable shapes CVC, VCCV, CVV and CVCV were more frequently seen in the older age group compared to the younger age group. Table 12 and Fig 6 show the frequency of occurrence of the various syllable shapes present in the participant's phonetic repertoire. The rank order of frequency of occurrence of the different syllable shapes in the descending order is presented in Table 13.

Table 12

Mean and standard deviation of various syllable structures

Syllable Structure	12-15 months Mean (SD)	15-18 months Mean (SD)	Total Mean (SD)
CV	34.7 (2.7)	28.3 (7.7)	31.55 (6.43)
VC	13.7 (8.8)	9.55 (8.2)	12 (8.4)
VCV	18.75 (5.62)	12.71 (5.57)	15.13 (6.9)
CVC	6.75 (2.99)	13.33 (6.42)	9.57 (5.66)
VCCV	13.66 (6.19)	19.2 (6.81)	16.43 (6.80)
VCVCV	18.12 (10.18)	6.42 (5.68)	12.27 (9.86)
CVV	7.73 (5.25)	8.13 (1.80)	7.93 (3.52)
CVCV	6.43 (2.70)	18.00 (1.2)	14.34 (9.04)
CVCCV	6.6 (3.50)	3.18 (2.12)	4.322 (2.97)
CVCVCV	-	4 (7.32)	4.62 (7.32)

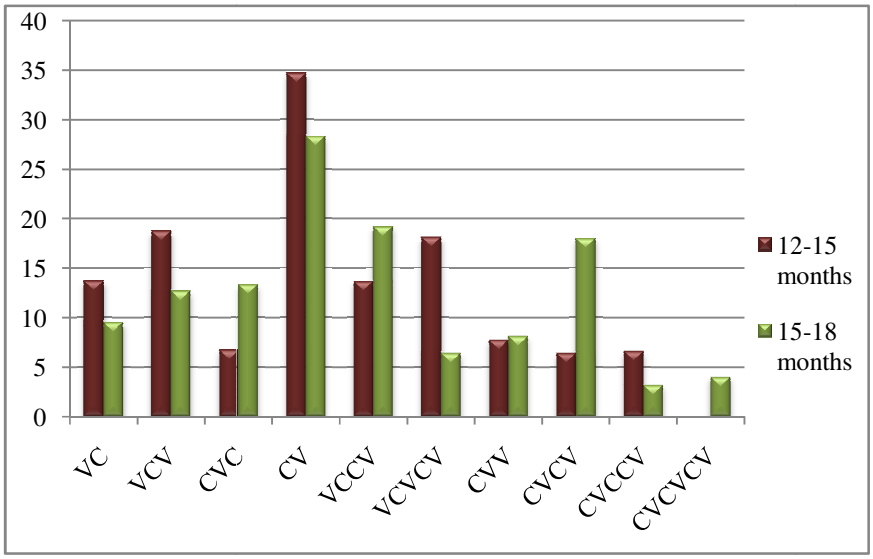

Figure 6, Mean percentage of various syllable structures

Table 13

Occurrence of syllable shapes in the descending order

12-15 months	15-18 months
CV	CV
VCV	VCCV
VCVCV	VCV
VC	CVCV
VCCV	VCVCV
CVV	VC
CVC	CVC
CVCCV	CVV
CVCV	CVCVCV
	CVCCV

4.22Preferential occurrence of Consonants and Vowels

According to the hypothesis of the Frame Content theory (Davis &MacNeilage, 1995) it is believed that the consonants made with a constriction at the front of the mouth (alveolars) will be preferentially associated with the front vowels, those made with the constriction at the back of the mouth (velars) will be associated with the back vowels and those produced with the lip closure (bilabials) will be preferentially associated with the central vowels. To test whether this hypothesis of babbling stage holds good in the first fifty word stage and in our regional language (Kannada), the preferential combination of consonants with the vowels was calculated and the mean for each age group was tabulated as shown in Table 14.

Table 14

Mean of preferential occurrence of consonant types with the vowels

	12-15 months			15-18 months		
Vowels	Bilabials	Coronals	Velars	Bilabials	Coronals	Velars
[a]	**15**	11.2	7.6	**15.8**	14.1	11
[i]	5	**9.3**	-	5.8	**10.5**	5
[u]	8	11	**2.3**	8	10.8	**7.6**

From Table 14, it can be inferred that all the three classes of sounds, namely the bilabials, coronals and velars occurred maximally with the central vowel [a]. Hence, the present study supports one hypothesis of the Frame Content theory which states bilabials occur maximally with the central vowels.

4.23WORD SHAPES

True words were present in all the participants' verbal repertoire although the frequency of them was found to increase in the older age group. The word shapes in the phonetic repertoire of the children's speech samples were categorized to constitute monosyllabic, disyllabic and multisyllabic utterances. The most common true words that were present in most participants' were [amma], [ʈaʈa], [appa], [ba] and [ʈa]. Few of the participants in the older age group were also found to produce complex true bisyllabic and multi syllabic words containing different classes of sounds such as [adʒdʒi], [adʒdʒa], [huduku], [alliɖe], [manejalli], [hogona] [maʈʈenu] [barʈini] etc, though their occurrences were relatively sparse. Appendix 2 shows all the true word productions of the participants. Table 5 represents mean percentage of different word shapes in both the age groups.

Table 15

Mean percentage of various word shapes

Word shapes	Mono syllabic words	Bisyllabic words	Multi syllabic words
12-15 months	10	18.5	-
15-18 months	13.5	22.66	3.8

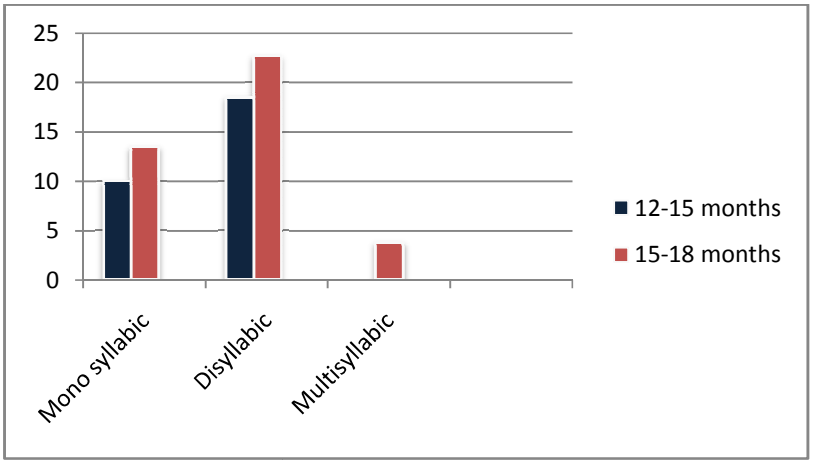

Figure 7,*Mean Percentage of Various Word Shapes*

From the data of Table 15 and Fig 7; it can be inferred that disyllabic utterances followed by monosyllabic utterances predominated in both the age groups. Multisyllabic utterances were found to be present only in the age group of 15-18 months.

4.24CLUSTERS

In all the participants sample geminate clusters were present. These were majorly; [mm], [pp], [t̪t̪], [ɳɳ], [kk] and [ll]. Only [mm], [pp] and [tt] were present in all the subjects in both the age groups with the others being present only in 5 participants across both age groups. The geminate clusters [ʤʤ] and [ʧʧ] were also found in two female participants of the older age group. Non geminate clusters [tr], [br] and [nd] were present only in three children (2 girls and 1 boy) of the older age group.

4.25PROTO WORDS AND HOLOPHRASTIC WORDS

Children frequently use invented words (Locke, 1983) in a consistent manner, thereby demonstrating that they seem to have meaning for the child. These vocalizations used consistently but without a recognizable adult models have been referred to as

Protowords (Menn, 1978), Phonetically Consistent Forms (Dore, 1976), Vocables (Ferguson, 1976), and Quasi words (Stoel Gammon & Cooper, 1984). In the present study too, it was observed that all the participants had at least a few productions of protowords, the frequency being more noticeable in the older age group. Table 16, depicts the various protowords present in each participant's verbal repertoire, most of them indicating basic needs of the child.

Table 16

Protowords present in each participant's verbal repertoire

12-15 months	**Proto words**	**15-18 months**	**Proto words**
1	[mam] (food), [bu] (going out)	1	[mamamam] (food), [lala] (milk), [tachi] (sleep)
2	[ai] (water), [am] (food), [hat] (hitting)	2	[amam] (food), [abbu] (getting hurt), [dudu] (milk), [ush] (toileting)
3	[mamam] (food), [dzidzi] (water) [ai] (there)	3	[bua] (food), [wawa] (for water), [du] (take) [hatta] (hitting)
4	[mamam] (food), [bua] (water) [am] (all fruits), [lili] (there)	4	[atta] (hitting), [amam] (food), [lala] (milk)
5	[tachi] (sleep), [mamam] (food),	5	[mammu] (food), [ada] (there),
6	[am] (food), [pachi] (sleep)	6	[amamam] (food), [appu] (ghee)

4.26 Holophrastic words: The early portion of the item learning stage in the course of phonological development where the child uses a single word to indicate a complete idea is referred to as the ***Holophrastic period*** (Cruttenden, 1981). In the present study also, many holophrastic word productions were observed in all the participants' speech

samples. Table 16 represents the holophrastic words and their conceptual indications of each of the participant.

Table 17

Holophrastic word productions of the participants

12-15 months	**Holophrastic words**	**15-18 months**	**Holophrastic words**
1	[enu] (to indicate all 'wh' questions)	1	[kechi] (for throwing and catching the ball), [mami] (to indicate god and bowing down), [ko] (for give and take), [ila] (to indicate presence and absence)
2	[ʈa] (to ask for and give), [bo] (for all animals)	2	[ɖu] (for give and take), [alla] (for both presence and absence)
3	[pau] (to indicate all animals), [ba] (to indicate come and go)	3	[am] (for all fruits), [ʈara[(for give and take)
4	[am] (for all food items), [aɖu] (for 'this' and 'that')	4	[ha] (to indicate danger, shock and not to touch), [is] (to indicate fish and all animals)
5	[bu] (for going out and coming in)	5	[illi] (to indicate here, and everywhere), [ai] (for falling, getting hurt)
6	[aja] (for both grandparents),	6	[ʈa] (give and take), [ha] (for all electrical appliances)

CHAPTER 5

DISCUSSION

The present study was conducted with the aim of obtaining qualitative and quantitative data regarding the phonetic repertoires in typically developing Kannada speaking children between the age range of 12-15 months and 15-18 months. The results revealed several interesting features of phonological development mainly in terms of wide variety of consonantal and vowel inventory productions, varied and distinct syllable shapes and a repository of true, proto and holophrastic words.

In the present study; low central vowel [a] occurred maximally in both the age groups ie 12-15 months and 15-18 months respectively. This finding is in consonance with a number of other research findings which state that the first vowel to be acquired is usually the central vowel [a] (Jackobson& Halle, 1956; Ingram, 1976; Irwin & Wong, 1983). The predominance of the vowel [a] as compared to the other vowels may be explained by the fact that the lower jaw or the mandible is the primary oral structure to achieve an independent speech motor control process that augments lip closure, tongue placements and subsequent speech production too. The tongue rests on the floor of the jaw and is not capable of independent movements; the low central vowel [a] may be more predominantly produced as the tongue moves passively along with the vertical jaw movements.

The schwa vowel [ə] was occurring in a greater frequency following the vowel [a]. This finding can be augmented by the results of a study by Chen and Kent (2004) on segmental productions in Mandarin learning infants between the age range of 7 months to 1 year 6 months, which reported the prominence of the vowels [e] and [ə] and the

preponderance of low and mid vowels over high vowels. This finding was also partially found in the present study especially in the younger age group where the low and mid vowels were comparatively higher in frequency than the high vowels barring the vowel [u].

The next major vowels seen in both the age groups were the high vowels [i] and [u]. This is also in accordance with the findings of the studies by Jackobson and Halle (1956), Ingram (1974), Leopold (1947), Menn (1971) and Irwin and Wong (1983) where the vowels [i] and [u] were the vowels found to be acquired following the acquisition of the vowel [a]. As the child progresses further in development, the tongue accompanied by the lip muscles start acquiring independent motor control and hence, the high, low, front and back vowels, involving the coordination of the lip and tongue muscles may be thought of as emerging.

The relatively higher occurrence of the back vowel [u] in the younger age group than the front vowel [i] could be correlated with the findings of a study by Buhr (1980) who found the vowel production during the first years of life to favour the low, non-front vowels. In addition, researchers like Stoel Gammon and Dunn (1985) and Vihman (1996) through series of researches opine a high individual variability in the nature of vowel repertoire in the young ages of children. It can also be attributed to the well-developed sucking behavior in infants which involves a coordinated integration of jaw and tongue movements with the corresponding lip protrusion that may augment the production of the rounded vowel [u]. Higher occurrence of vowel [u] is also reported by Anjana (2008) in babbling samples of 11-12 month old infants in Kannada. This finding indicates continuity between late babbling and early word production stages.

In the older age group, the production frequency of [i] exceeded that of [u]. This could be supported by the data from the study by Ingram (1976) who reported the acquisition of [i] following [a] in the first fifty word stage which begins approximately around 18 months of age. In addition, a study by Stoel Gammon and Otomo (1992) revealed the early mastery of the corner vowels [i] and [a] in comparison to other vowels. Chen (2004) reported an increase in the median frequency of the high front vowel [i] from 7 months to 1 year 6 months in Mandarin speaking children. In the Indian context; Shyamala and Basanti's (2003) report on the developmental milestones of language acquisition in Kannada revealed that the cardinal vowels /i/, /e/, /a/, /u/, and /o/ first appeared by 6-12 months of age in Kannada. Irfana (2012) and Alphonsa (2012) conducted similar studies on early phonetic development in Malayalam speaking children between the age range of 12-18 and 18-24 months respectively; and found their vowel repertoires to consist of the vowels [a, I, u, e and o]. An ongoing study by Sushma (2013) has also reported vowel [i] to be more frequent than vowel [u] in children aged between 18-24 months in Kannada. The development of the contrasts of the three major corner vowels [a], [i] and [u] are seen as a major milestone in the vowel development in the second year of life as very few utterances containing these vowels are seen in the first year (Chen, 2005).

The vowels [a] and [u] were found to occur more abundantly in girls compared to boys. This could be thought of as girls generally performing better than boys in majority of verbal and linguistic functions which subsequently occurs as a result of the overall developmental rate and accuracy that is more in girls compared to boys' right from their

prenatal periods. (Winitz, 1969; Maccoby&Jacklin, 1974; McCormack &Knighton, 1996).

In the present study; the vowel [u] was present to a greater extent in the final position in both the age groups. This can be attributed to the fact that in spoken Kannada, the utterances often end with the vowel [u] (Schifmann, 1979) and hence, it can be deferred that the children are progressing towards acquiring the more specific attributes of the ambient language.

The diphthongs found in the present study were [ai, au, æi and eo] with a higher frequency of [ai] and [au]. The phonetics of Kannada language has only the two diphthongs [ai] and [au] (Schifmann, 1979) and the present study also reveals that the children are progressing towards more specific phonetic properties of their ambient language. Higher frequencies of [ai] and [au] were also reported in other studies of early phonological acquisition in the Indian context (Alphonsa, 2012; Irfana, 2012).

Out of the various places of articulation, bilabials followed by dentals predominated in both the age groups of 12-15 months and 15-18 months. This observation has been the most frequent and salient finding in many of the studies on phoneme acquisition. Dating back to the 40's Irwin (1947) through his longitudinal study of English learning children found the emergence of dental and labial stops in the second year of life with a drastic decrease in the occurrence of velars and glottals. Jackobson and Halle (1956); after studying several diary reports from children from various linguistic backgrounds, found that the first consonants were the labials, most commonly /p/ or /m/ to emerge in the childs phonetic inventory. Kent & Bauer (1985) also found that bilabial and apical consonants occurred most often in the consonantal inventories of infants aged

1.1 in various utterance patterns. Vihman (1986) compared the consonant inventories of 27 children during the emergence of the linguistic phase and found the occurrence of bilabial stops in all the children's verbal productions in comparison to other speech sounds. In the present study, bilabials occurred more frequently in the younger age group though the difference in frequency was not statistically significant. A similar pattern was observed by Chen et al (2004) who reported a higher frequency of bilabial phonemes in the younger age group of Mandarin speaking children. From the above stated observations, it is apparent that there is continuity between the babbling and the early linguistic stages, as certain consonantal types predominating in the babbling stage maintain their higher occurrence instances in the early linguistic phase too.

Palatal glide and glottal fricative were also found in greater frequency in the younger age group. Irwin (1947); Ferguson and Garnica (1975); Mowrer (1980) reported that glottals and velars were among the first classes of speech sounds to be acquired prior to the first fifty word stage and their frequency decreased drastically as the stops and dentals emerge. In addition, the phonological process of liquid gliding, where glides substitute liquids; suggest a relatively early acquisition of palatal and labial glides than liquids in the babbling and early words period (Mowrer, 1980).

Retroflex and velars were the next following places of articulation in terms of their greater frequency of occurrence. This finding is in consonance with that of a study by Jackobson and Halle (1956) who report the occurrence of the phonemes [t] and [k] in a greater frequency following the bilabial productions. In a finding by Jeng (1979), back consonants were reported to emerge and occur frequently too around the age of 1.6. In addition; these findings are also in consonance with the finding by Irfana (2012) who

found a similar pattern of developmental progression in the same age range in Malayalam language.

In the present study, two additional places of articulation were seen in the higher age group. This may be attributed to the fact that children are trying to acquire and accommodate more varied types of places of articulation in their verbal repertoire.

With reference to the position of occurrence of consonants, bilabial stops were found to have their maximum occurrence in the initial position in the younger age group. Kent and Bauer, (1985) reported that initial stops and final fricatives to occur with high frequency in both early words and babbling. This unequal distribution of initial stops and fricative endings in early words is shown by the substitution of stops for initial fricatives (stopping process) and of fricatives or affricates for final stops (affrication or frication process, Mowrer, 1980). This unequal distribution also reflects a continuity of sound patterns from babbling to first words, in which stops occur more often than fricatives in initial position, and conversely fricatives (or continuants) occur more often than stops in final position (Kent & Bauer, 1985). In the present study too, the alveolar fricatives were found to occur frequently in the word final position. Though this finding of utterances ending in consonants matches with that of the previous findings, it is contrasting to the phonotactic rules of Kannada. The probable reason for such a finding could be firstly; owing to the influence of borrowed English words the children are frequently exposed to, containing consonantal ending words. Secondly the contribution of jargon, non-meaningful utterances and protowords ending in consonantal productions, indicates the fact that abiding to the rules of phonotactics has not yet been established in early word productions. In addition to these factors, the presence of onomatopoeic sounds in the

children's repertoire might also have contributed to the occurrence of consonants in the final position.

Voiced consonants occurred maximally compared to voiceless consonants in both the age groups. And the frequency of voiceless consonants was higher in the older age group in comparison to that of the younger age group. This finding of higher occurrence of voiced consonants in both the age groups is in correlation with other reports on toddlers (Pike, 1943; Davis &MacNeilage, 1995). Further, the voiced bilabial and apical stops [b, d] are the most frequent prevocalic consonants in English-learning infants' vocalizations (Kent & Bauer, 1985). Augmenting this finding, in a study on frequency of occurrence of phonemes in Kannada speaking adults (Sreedevi, Smitha&Vikas; 2013), it was observed that voiced consonants were more frequent in spoken Kannada.

With respect to manner of articulation, in the present study it was observed that stops and nasals made their most frequent appearance in both the age groups. This is in consonance with the findings of Irwin (1947) who reported a decrease in the frequency of glottal fricatives and maximal occurrence of stops and nasals spanning the early word stage. The reason for this emergence and dominance of stops and nasals during this stage is attributed to the anatomical development of the velum separating from the epiglottis during this stage (Kent &Vorperian, 1995). A universal developmental pattern is that nasals are acquired (age 0.11 to 1.8) prior to fricatives (1.8 to 2.0) and affricates (after 2.2) (Zhu & Dodd, 2000). The present study also follows this pattern as nasals have been found to be in excess followed by fricatives and affricates. The findings of this study with regard to this aspect can be augmented with Indian studies too by Shyamala and Basanti (2003), Anjana (2008), Alphonsa (2012) and Irfana (2012). In addition, glides and glottal

fricatives occurred more frequently than liquids and affricates in the younger age group than the older age group suggesting a continuity of dominance pattern from babbling to first words where glides and glottal fricatives predominate. Whereas, in the older age group these consonants appeared to be regressed and an increase in liquid frequency was observed. Surprisingly, the frequency of fricatives in the younger age group was relatively more in comparison to the older age group. This could be thought of as a result of two factors. Firstly, as put forth by Wellman (1931); a phenomenon of 'reversal' could occur which may partly reflect upon the child's inconsistent productions (i.e., a child may vary between correct and incorrect productions and usage of phonemes depending upon the contextual factors). This factor could have operated in the present study also wherein inconsistent productions depending upon the context may have added to the higher frequency of fricatives in the younger age group. Secondly, a "Salience or Avoidance factor" could also have operated, ie, salience with regard to higher frequency owing to more words of interest for the child containing fricatives, and avoidance with regard to uninteresting vocabulary for the child and involving a complexity of production (Bauman & Waengler, 2000).

Moving on to syllable structures noticed in the present study, the CV syllable shape predominated in both the age groups. This is a developmental trend reported, wherein; the higher frequency of CV syllables than of VC syllables and the scarcity of consonant clusters in babbling are noticed which are continued in the early word stage too (Kent & Bauer, 1985). Mowrer (1980) also reports that the CV syllables are the most prominent ones in the early word stage. Another substantiate for this finding with respect to onset in syllables; is the developmental progression that has been found for Dutch

children (Fikkert 1994): where consonantal onsets were obligatorily present in the child's production forms – resulting in default CV syllables, even when the target syllable was onset-less; onset output forms appear resulting is a consonantal prelude and a vowel end.

Several authors (Ferguson & Farwell, 1975; Ingram 1989) have noted phonetic variability and limited syllable structure and sound segments during the first fifty word stage. Phonetic variability which refers to the inconsistent productions during the first fifty word stage was also noticed in the present study as scattered frequencies of many syllable structures. The feature of stable forms is also noticed during this stage which are the syllable structures produced most often by a child in its verbal repertoire during this stage. In the present study too, the CV syllable structure is the stable form seen across all the participants. Limited syllable structures are the limitations in the diversity of the types of syllable shapes and structures which is also noticed in the present study.

In the present study closed syllables specially, the VC and CVC shapes were present more in the younger group in comparison to the older group and this may be due to the ongoing process of acquisition of phonotactic rules of the Kannada language where closed syllables are not permitted. In addition, in majority of the participants, the words containing geminate clusters in the medial position predominated (eg: /amma/ and /appa/) which may have led to a greater frequency of the syllable shape VCCV. Complex syllable shapes such as CVCCV, CVCVCV and CVCV were also found in a lesser frequency suggesting their emergence. This is in consonance with the earlier findings by the following authors: Ferguson and Farewell 1975, Ingram 1974, Menn 1971, Stoel Gammon and Cooper 1984. A greater diversity was found in the older age group indicating progression in the course of phonological development. These findings

regarding the various syllable shapes are in consonance with the studies in the Indian context by Rupela and Manjula (2006), Alphonsa (2012) and Irfana (2012).

Geminate clusters were found in all the participants' verbal repertoire and the occurrence of non-geminate clusters was very sparse being limited to the participants of older age group alone. This may be attributed to the fact that most of the true words that are in vogue in day to day vocabulary in Kannada; contain geminate clusters and these are the ones achieved earlier compared to the other true words. Rupela and Manjula (2006) also reported that medial geminate clusters were the first to be achieved and the only clusters to be present in 12-18 months of age. The non-geminate clusters present were mainly the onomatopoeic sound expressions that the children are usually fascinated by.

With regard to the preferential occurrence of consonants with vowels, all the consonantal classes, namely the bilabials, coronals and velars were found to occur maximally with the low central vowel [a] and did not follow any preferential pattern of coronals occurring with the front vowels and velars occurring more with the back vowels. On correlating with the Frame Content Hypothesis of the babbling stage by Davis and MacNeilage (1995), only one hypothesis was accomplished here; ie, bilabials occurring maximally with the central vowel [a]. This finding also can support the continuity of the babbling features into the first word stages.

In the present study, bisyllabic utterances exceeded those of monosyllabic and multisyllabic utterances. This is in consonance with the fact that in Kannada language, most of the content and functional words contain the bisyllabic shape. Hence, it is a clear indication that the children are progressing towards more mature forms of the language

specificity in terms of word shapes too. Multisyllabic utterances were found only in the older age group implying the development of complexity with advancement in age.

Protowords and holophrastic words were present in all the participants' verbal repertoire. These result owing to the presence of a larger conceptual framework in children and due to a shortcoming of their existing phonetic repertoire to produce those concepts and words.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Children's phonological development begins right from the time they start their vegetative sounds and reflexive vocalizations up to the stage when they have mastered the productions of all speech sounds of their language and are using those intricately in functional communication.Young children produce their first words towards the end of the first year of their life. There is a gradual progressive transition from babbling to meaningful speech that reflects upon further development and acquisition of the phonological system. Since babbling and meaningful speech overlap in the process of development, it is hard to establish a line of separation between end of one stage and the beginning of the next. Typically developing children enter the first fifty words stage during their first birthday which is characterized by the rapid acquisition of varied vowels, consonants, geminates and non- geminates, syllable structures and word shapes. In the present study, an attempt was made to investigate and obtain data regardingvarious phonetic characteristics of typically developing Kannada speaking toddlers in the age range of 12-15 months.

Speech samples of twelvetypically developing Kannada speaking toddlers in the age range of 12 to 18 months was obtained through video recordingsfrom native Kannada speaking homes in Mysore district. The participants were subdivided into two groups with an inter age interval of 3 months each. That is 12- 15 and 15-18 months respectively, with both the age groups comprising of six subjects each (three boys and three girls in each age group). The recorded data was transcribed phonetically using IPA. The vowels transcribed were analyzed with respect to tongue height and tongue advancement

dimensions. Analysis of consonants was with respect to place, voicing and manner features of articulation. The syllable shapes and word shapes were analyzed from the speech corpus obtained from each subject in both groups. Clusters were analyzed as being geminate or non-geminate. The percentage of occurrences of vowels, consonants, syllable structure, word shapes and positionaldifferences in the occurrence of vowels and consonants were determined. These parameters were statistically analyzed to establish the developmental trend across age and gender. Protowords, holophrastic words and true word were analyzed from the verbatim transcription of each participant. Analysis was further done to determine the preferential occurrence of certain vowels with consonants within syllables. Non parametric statistics was used to obtain the significant difference across age and gender.

Nine vowels and two diphthongs present in the entire speech corpus of the twelve subjects were /a, i, i:,u, u:, æ, o, e, ə, au, ai/. The low- central vowel [a] followed by the schwa vowel dominated in the utterances of all the subjects in both age groups which inturn was followed by high- back vowel [u] in the younger age group and high- front vowel [i] in the older age group. [au] and [ai] were the most frequent dipthongsin both the age groups. The occurrences of vowels showed significantly higher occurrence in female children.

The 22 consonants found in the entire corpus of the twelve subjects were [p, b, m, n, t̪, d̪, ʧ, ʤ, ɖ, ʈ, ŋ, k, g, j, r, l, w, v, ʃ, s, h, l̪]. With respect to the place of articulation; bilabials and dentals were most predominant in both the age groups.Labio-dental /v/ and alveolars appeared only in the older age group. The occurrence of the voiced consonants

exceeded that of unvoiced consonants in both groups. Occurrence of most of the consonants was prominent in initial position followed by medial and final positions.

With respect to manner of articulation, the frequency of occurrence was predominant for stops followed by nasals in both groups. Glides also demonstrated relatively high frequency of occurrence in the younger age group where as it were liquids in the older age group. Fricatives were higher in occurrence in younger group compared to the older group. However, frequency of affricates was limited in both the age groups. Geminate clusters were present in all children and non-geminate productions were limited to three children of the higher age group.

CV Syllable shape was predominant in both the age groups. VCCV and CVCV syllable shapes increased in the older group. Complex syllable shapes like CVCCV and CVCVCV occurred frequently in the older age group. Monosyllabic, bisyllabic and multisyllabic words were found in the samples. Overall, the bisyllabic word shape was most frequent followed by monosyllabic in both the age groups and multisyllabic word shape was present only in the older age group.Proto words, holophrastic words and true words were found in both the age groups, the frequency of proto and holophrastic words being higher than that of the true words.Frequency of true words was greater in occurrence in the older age group. With regard to examining the preferential occurrence of consonants with vowels, bilabials, coronal sounds as well as velars were found to occur maximally with the low central vowel [a] alone.

6.1 Future directions

- A longitudnal study, with recording interval of one week can be planned to accuratly trace the prototype of transitions occurring in the phonetic complexities in the first fifty words stage.
- A more detailed analysis can be considered with more number of samples and more duration of recording to obtain the pattern of acquisition and mastery of the phonemes.
- An acoustic analysis can be undertaken for the samples to establish the vowel traingle and the transition between the vowel and consonant at syllable level using locus equation metric.
- Cross linguistic comparison of phonetic inventory in toddlers can be carried out considering each phonetic parameter in greater detail.

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