PHONETIC CHARACTERISTICS OF VOWELS IN BABBLING

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Abstract

Children continually fascinate adults with their incredible daily developments. One of the most impressive accomplishments is the child's ability to produce speech sounds. In human speech, vowel is the sonority peak of a syllable and it is the most crucial element in human language. During babbling vowels exceed the number of consonants produced for most children. Vocalic development has been less extensively studied than consonant development, mainly because vocalic utterances are very difficult to transcribe reliably and thus not easy to arrive at a valid developmental profile. Therefore, recent studies on vowel development, especially in the first year, employ both perceptual transcription with high-quality recording and transcribing equipment and acoustic analysis. The purpose of the study is to examine the phonetic characteristics of vowels in 6 typically developing infants in the age range of 4 to 5 months from native Kannada speaking homes. Participant selection is based on the parent case history report. Each child is visited at home, in the fourth month of infant's age. Audio and video recording sessions of 30 minutes for all the infants are carried out in the presence of the mother using a digital video recorder (Sony Handy cam DCR DVD 908). The recorded data are transcribed phonetically using International Phonetic Alphabet (Broad phonetic transcription method). Inter judge-reliability of phonetic transcription is evaluated by two speech language pathologists for 10% of the selected samples. The transcribed vocalizations are then analyzed for their frequency of occurrences with respect to tongue height, tongue advancement and lip rounding. The qualitative and quantitative data obtained would help to gain an insight regarding what is normally expected of an infant at the early stage of communication development and aid the Speech Language Pathologists in making appropriate clinical decisions.

One of the most impressive accomplishments is the child's ability to produce speech sounds and the ability to combine those sounds to form words. The study of babbling has grown substantially in recent years and much is now known about the acquisition of speech and language in the early years of life. Although children do not produce speech until they are approximately one year old, the development of the ability to produce speech sounds begins in early infancy, and the important developments in speech sound production occur throughout the first year of life. Babbling is an important first phase of development towards adult speech production ability. It begins at a stage where consonant and vowel sequences conform to rhythmic patterns perceived as speech-like in timing (Oller, 1980).

Empirical studies demonstrate that vocal development in infancy follows an orderly sequence (Koopmans-van Beinum & van der Stelt, 1986). Stark (1980) proposed a five-level model in which infants progressed from reflexive sounds (e.g., cry and discomfort sounds) to cooing (i.e., the voluntary productions of comfort sounds in the velar area), to vocal play (i.e., sounds showing increased control of phonation and articulation), to reduplicated babbling (i.e. repeated production of canonical syllables such as /di/di/di/di/) to single words and nonreduplicated babbling (i.e., productions of phonetically varied, adult like syllables such as /dibu/dibu/). Knowledge of typical speech development is essential in order to identify the differences in early vocal development when a disorder is present (e.g. loss of hearing), and to understand when developmental processes are influenced by a second language. In human speech, vowel is the sonority peak of a syllable and it is the most crucial element in human language (Maddieson & Ladefoged, 1995). Vowels exceed the number of consonants during babbling for most children. Unfortunately, there is not an abundance of documented research examining vowel development during these first 12 months. Vowels have been less extensively investigated, because they are particularly difficult to transcribe reliably and, thus not easy to characterize. Lieberman (1980) reported inter-transcriber reliability of 73 percent for the vowels produced by children aged about 3 to 14 months. He used spectrographic analysis for a single child as a supplement to phonetic transcription and reported little change in average formant frequency values over the period investigated. However, the various vowels transcribed for four months showed considerable overlap in formant frequencies. In a study of 10 month old infants' vowel productions

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drawn from four linguistic communities-Arabic, Chinese, English, and French, De Boysson-Bardies, Sagart, Halle and Durand (1989) found that the categories of front-low and mid-central vowels accounted for the vast majority of vowels from all four groups. According to Irwin (1947, 1948), the vowels /ɛ, Λ, I/ were most prominent during first 2 months, followed by /æ, U, u, a, e, i/ and during the period of 2-5 months the vowels /ə, o/ emerged. He reported that vowels continue to outnumber consonants during this period. Several researchers have suggested that the quantity and the diversity of vocalizations do indeed play a role in later language development. An intensive study of this acquisition process is extremely important for the Speech-language pathologist since one of the primary responsibilities of the Speech-language pathologist is to distinguish normal from disordered phonological development in a particular child and to base treatment on that distinction. Speech-language pathologists, especially those in early intervention services, are often confronted with children who are still within the babbling stages of development. Therefore, knowledge of the babbling stages, that includes characteristics and approximate ages of occurrence, would be helpful in assessment and early intervention process. Lack of Indian studies in this domain provides the motivational rationale for the present study. Hence the aim of the present investigation was to study the phonetic characteristics of vowels in the babbling stage of 4-5 months old typically developing infants from native Kannada speaking homes.

Method

Participants: Six typically developing infants [3 males (M1, M2, and M3) and 3 females (F1, F2 and F3)] in the age range of 4-5 months from native Kannada speaking homes were considered in the study. It was ensured that all the participants had exposure only to Kannada language**.** Also the children did not have history of any medical, speech, language, hearing, cognitive or any other motor difficulties. The participants were selected after a parental interview and an informal assessment of age appropriate skills based on checklists (Developed by Department of Prevention of Communication Disorders (POCD), AIISH).
The participants selected belonged to middle socio-economic class.

Procedure: Each infant was visited at home during 4-5 months of infant's age. 30 minutes of audio and video recording was carried out when the infant was in a comfort state using a digital video recorder (Sony Handy cam DCR DVD 908). The recording was carried out in a quiet environment in a semi-structured manner where the experimenter was a passive observer. Parents were instructed to interact with the infant naturally. The parent-infant interaction and the use of toys were used as elicitation techniques.

Data analysis: The recorded data was edited to eliminate the parent's speech and the non-vegetative vocalizations (such as cries, burps, and coughs) to retain the infant's utterances which were transcribed phonetically using International Phonetic Alphabet (Broad phonetic transcription method). Inter judge-reliability of phonetic transcription was evaluated using point to point agreement by three transcribers (2 SLPs and a linguist) for 10% of the samples. The selected samples for each subject were analyzed according to the parameters under investigation after transcribing the required data.

Results and Discussion

The recorded data of 6 infants was phonetically transcribed using IPA (broad transcription method) for individual vowel types in the following categories and their descriptions are provided in Table 1.

1. Vowels classified according to tongue height – high, mid and low vowels.

2. Vowels classified according to tongue advancement – front, central and back vowels.

3. Vowels classified according to the duration of its production - short and long vowels.

4. Vowels classified according to lip rounding – rounded and unrounded vowels.

5. The frequency of occurrence of each of the individual vowel types for all the participants was established.

Table 1*: Description of vowels in Kannada*

	Short	Long
High front unrounded	/i/	/i:/
Mid front unrounded	/e/	/e:/
Low front unrounded	/æ/	/æ:/
Low central unrounded	/a/	/a:/
Mid central unrounded	/ə/	/ə:/
High mid central unrounded	/ɛ/	/ɛ:/
Mid back unrounded	/o/	/o:/
High back rounded	/u/	/u:/

Source: Upadhyaya (1972). Kannada Phonetic Reader. Volume 1 of CIIL phonetic reader series.

Note: /æ/, /ə/ and /ɛ/ occur primarily in loan words and in some rare instances in native Kannada words.

Mean values and standard deviations of the vowel types are classified according to tongue height and tongue advancement parameters and are presented in Table 2. Figure 1 represents the mean percentage of occurrence of vowels in all the six participants.

Table 2*: Mean of occurrence and standard deviations (in parenthesis) of vowels*

Vowels	Mean (SD)
[æ]	2.333 (2.732)
[æ:]	9.833 (9.641)
[ə]	10.33 (6.801)
[ə:]	15.5 (14.85)
[a]	1.666 (2.065)
[a:]	2.5 (2.880)
[i]	-
[i:]	-
[u]	-
[u:]	0.166 (0.408)
[e]	1.666 (2.338)
[e:]	19.16 (31.83)
[ɛ]	0.333 (0.816)
[ɛ:]	3.166 (4.215)
[o]	-
[o:]	-

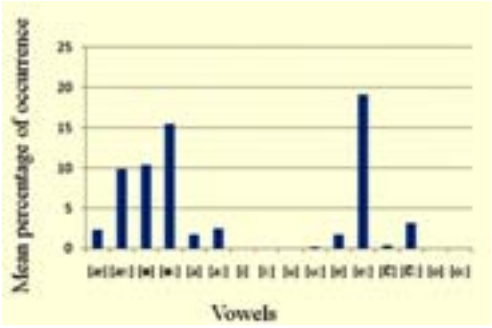

Figure 1: *Mean percentage of occurrence of vowels*

From Table 2 and Figure 1, it can be noted that overall, the mid-front long vowel [e:] and mid-central long vowel [ə:] dominated the utterances of all the infants followed by low-front long vowel [æ:] and mid-central short vowel [ə]. The occurrence of the low-front short vowel [æ], low-central short vowel [a] and mid-front short vowel [e] were comparatively low. On examining the developmental trend in babbling between the participants, the mid-front vowel [e], low-front vowel [æ] and mid-central vowel [ə] made their appearance more during this period of 4-5 months of age of the infants.

Vowels classified according to tongue height

According to tongue height dimension of the vowels, the frequency of occurrence of [e:] was more among the mid vowels. The low vowel [æ] dominated the utterances compared to the other low vowel [a]. The high back vowel [u] appeared in one participant (M3) and high front vowel [i] did not appear in this age group. This result is in agreement with the study of MacNeilage and Davis (1990) who reviewed studies of vowels in babbling in twenty-three infants reported a tendency for mid and low and front and central vowels to be preferred across languages. This apparent preference for 'lower left quadrant' vowels also appeared in the analysis of a large database produced by six English-learning infants (Davis & MacNeilage, 1995).

Vowels classified according to tongue advancement

According to tongue advancement dimension, reflecting on all the front vowels together, the vowel [æ, e] made more frequent appearances compared to the other front vowel [i]. The central vowel [ə] made predominant appearances than [a]. The back vowel [u] made its appearance in one participant (M3) in one instance and [o] did not appear in this age group. This finding is in agreement with the results of the study by Irwin and Curry (1941) where front vowel /ɛ/ represented 31.3% and back vowel /u/ consisted of 9% of all the vowels.

Vowels classified according to lip rounding

According to lip rounding dimension, unrounded vowels made predominant appearances [æ, e, ə]. The rounded vowel [u] was produced by one participant (M3) in only one instance and [o] did not appear during 4-5 months of age.

In the present study, the occurrence of vowels showed wide variability. According to the tongue height dimension, low vowel [æ] predominated in two participants (M1 and F3) and mid vowel [e] in one participant (F1). Variability in the production of vowels during babbling has been well documented in the literature. Davis and MacNeilage's (1995) longitudinal study with 6 infants (3 males, 3 females) from monolingual English-speaking homes revealed much individual variability in the use of vowels. According to the tongue height dimension, mid vowels, particularly [ə and e] predominated in 3 participants, while high vowels, particularly [u and i], appeared only in the remaining 3 participants. In relation to tongue advancement, front vowels, particularly [æ], predominated in 4 participants, and the mid vowels [e, ə], predominated in the remaining two. In the present study, few vowel transitions, diphthongs and VCV (Vowel-Consonant-Vowel) syllable shapes were also observed. Participants M1, M2, and M3 produced vowel transitions like [əæ], [əe]. Diphthongs [au] and [ai] were

produced by M2 and F2 respectively. Aspirated like [e] and [ə] were produced by M2 in some instances. Few consonant syllable shapes like [əgə], [əgu] were produced by F3. Bilabial trill and glottal stop made their appearance in M3.

Conclusions

Babbling is an important milestone of early communication which can serve as a predictor of later language ability. It is also an important milestone in the development of articulation and phonological skills. Babbling lies at the juncture of pre-linguistic and linguistic phonological development. In the present study, an attempt was made to analyze the phonetic characteristics of vowels in typically developing infants from native Kannada speaking homes. The vowel repertoire during 4-5 months of infant's age mainly consisted of [æ, ə, a, e,]. The occurrence of high-front long vowel [eː] and mid-central long vowel [əː] was consistently the highest across all the participants. The occurrence of the high-front vowel [i] and high-back vowel [u] were low in this age range and the mid-back vowel [o] did not appear in any of the infants. Overall, according to tongue height dimension, mid and low vowels dominated the utterances than high vowels. According to tongue advancement dimension, front and central vowels dominated utterances than back vowels. In lip rounding dimension, unrounded vowels dominated over rounded vowels. Considering vowel length, long vowels were more prevalent in the infant utterances than short vowels. The implication of this investigation is that qualitative and quantitative data obtained would help to gain an insight regarding what is normally expected of an infant at the early stage of communication development and aid the Speech Language Pathologists in making appropriate clinical decisions considering the fact that at present, communication rehabilitation services are sought for even infants younger than one year of age. However this study is confined only to the early vowel production of 4-5 month old infants from native Kannada speaking homes.

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