

Re - Standardization of Kannada Articulation Test

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Abstract

The present study developed, re-standardized, and validated the test of articulation in Kannada. Specifically photographs were familiarized and a photo articulation test of Kannada was developed. This was administered on 240 typically developing children in the age range of 2-6 years. The effect of age and gender on the articulation abilities in children was investigated. Further the test was administered on 10 clients with misarticulation to find the validity. The results indicated main effects of age and gender on the score of the articulation test. The scores increased with increase in age and girls had significantly better scores compared to boys.

Key words: articulation, re-standardization, misarticulation, validity

Articulation refers to the totality of motor processes involved in the planning and execution of sequences of overlapping gestures that result in speech (Fey, 1992). Articulation errors are typically classified according to the child's age, which translates into stages within this developmental process. A child is said to have an articulation disorder when their error patterns and/or sound acquisition sequence deviate from those seen in most children of their age. The deviances in articulation could be due to organic factors, emotional conflicts, perceptual deficiencies, and difficulties in phonetic discrimination, poor motor coordination, poor model or functional. Evaluation of an individual's articulation involves description of his or her speech sound production and relating this to the normal or standard in the language and community. In order to evaluate the articulation of clients with articulation disorders, tests of articulation are essential. An articulation test is an evaluation that yields information about the nature, number and characteristics of articulatory errors as they occur in a person's speech. It is a technique employed to measure the general phonemic capacity of an individual. The purpose of articulation test is to compare the phonemes that are actually used by an individual with the phonemic structure of his language group. The test of articulation is a basic tool of the speech pathologist.

The purpose of articulation test varies and hence the nature and scope of the articulation test inventory varies. Traditionally, Van Riper and Irwin (1958) define an articulation test as a technique employed to measure the general phonemic capacity of an individual. Articulation tests can be used in screening, diagnosing, predicting articulation disorders or deep testing. Over the years, many investigators have developed and established norms

using various articulation tests as shown in the Tables 1 and 2.

Babu, Rathna and Bettagiri (1972) developed Kannada diagnostic articulation test. It is a four part test with 52 and 49 picturable words in part I and II, respectively. Part III has 10 clusters. Part IV has a reading passage which is administered to subjects who can read. Part I tests 10 vowels in initial position and not in medial and final position as they can be influenced by the consonants preceding them. Part II is similar to Part I but has different words with the same sounds being tested. Phonemes misarticulated in part I are tested in Part II.

Tasneem (1977) standardised the Kannada diagnostic articulation test. However, it has been more than 30 years that norms were established for Kannada articulation test. Children are acquiring proficiency in articulatory skills at an earlier age than would be expected from previously established norms. Recent studies (Roberts, Burchinal & Footo, 1990; Bharathy, 2001; Rahul, 2006; Sreedevi & Shilpashree, 2008) focusing on phonological processes have revealed suppression of most of the processes by the age of 3- 4 years.

Results of an exploratory study on articulation showed that children were acquiring proficiency in articulatory skills at an earlier age than would be expected from previously established norms. These results indicate a need for new normative data consistent with the performance of children seen at the present time (Arlt & Goodban, 1976).

As children of present generation are more exposed to different environments at a very early age due to advancement in technology, education, nurture, awareness, increased speech stimulation, it is very important to re-standardize and validate the test. In this context the present study was planned. *The aim of the study was to develop, re-standardize and*

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Table 1. Age levels for the speech sound development according to different authors in English

Speech sounds	Wellman et al., (1931)	Poole (1934)	Templin (1957)	Mecham (1962)	Sander (1972)	Prather et.al., (1975)	Arlt & Goodban (1976)	Irwin et.al., (1983)	Smit (1990)	Fudala & Reynolds (2000) IP FP	
/m/	3	3 ½	3	3.5	Below 2	2	3	1.5	3	2	2
/n/	3	4 ½	3	3.5	2	2	3	2	3	2	2.5
/h/	3	3 ½	3	3.5	Below 2	2	3	2	3	2	-
/p/	4	3 ½	3	3.5	Below 2	2	3	3	3	2	3
/f/	3	5 ½	3	4.5	3	2-4	3	3	3	3	3
/w/	3	3 ½		3.5	Below 2	2-8	3	2	3	2.5	-
/b/	3	3 ½	4	3.5	Below 2	2-8	3	1.5	3	2	3
/ŋ/	--	4 ½	3	3.5	2	2-8	3	3	7-9	-	4
/j/	4	4 ½	3 ½	4.5	3	2-4		3	4-5	5	-
/k/	4	4 ½	4	4.5	2	2-4	3	3	3.5	3	3
/g/	4	4 ½	4	4.5	2	2-4	3	3	3.5-4	3	3
/l/	4	6 ½	6	5.5	3	3-4	4	3	5-7	5	5.5
/d/	5	4 ½	4	4.5	2	2-4	3	4	3-3.5	3	3
/t/	5	4 ½	6	5.5	2	2-8	3	3	3.5-4	3	4
/s/	5	7 ½	4 ½	5.5	3	3	4	3	7-9	6	6
/r/	5	7 ½	4	5.5	3	3	5	3	8	6	-
/ʃ/	5	4 ½	4 ½	5.5	4	3-8	4	4	6-7	5	-
/v/	5	6 ½	6	5.5	4	4	3 ½	3.5	5.5	5	5
/z/	5	7 ½	7	7.5	4	4	4	3	7-9	6	6
/ʒ/	6	6 ½	7	7.5	6	4	4	3	-	-	-
/θ/		7 ½	6	5.5	5	4	5	4	6-8	5.5	-
/d/		7	4	4.5	4	4		4	-	-	-
/ʃ/		6 ½	4 ½	5.5	4	3-8	4 ½	3	5	5	1.5

"-" indicates the sound not acquired; Empty space indicates speech sounds not tested (IP: Initial position, FP: final position)

Table 2. Age levels for the speech sound development according to different Indian authors

Speech sounds	Tasneem (1977)(Kannada) *75%	Usha (1986) (Tamil) *75%	Padmaja (1988) (Telugu)*75%	Arun Banik (1988)(Bengali) *90%	Maya(1990) (Malayalam) *75%	Prathima(2009) (Kannada) *90%
/m/	3	3	2.6	2.5	3-3.6	3-3.6
/n/	3	3	2.6	2.5	3-3.6	3-3.6
/ŋ/	-	-	-	2.5	3-3.6	3-3.6
/p/	3	3	2.6	2.5	3-3.6	3-3.6
/f/	-	-	2.9	-	3-3.6	
/h/	-	-	2.6	3	3-3.6	-
/k/	3	3	2.6	2.7	3-3.6	3-3.6
/b/	3	3	2.6	2.5	3-3.6	3-3.6
/d/	3.6	3	2.6	3	3-3.6	3.6-4
/g/	3	3	2.6	3	3-3.6	3-3.6
/r/	4.6	-	3.9	4	3.7-4	-
/s/	3	3	3.3	-	3.6-4	3-3.6
/ʃ/	5.1	6	3.6	3	5-5.6	3.6-4
/tʃ/	3.7	3	2.6	3	3-3.6	3-3.6
/t/	-	3	2.6	3	3-3.6	3-3.6
/v/	-	3	2.6	-	3-3.6	3-3.6
/l/	3	3	2.6	3	3-3.6	3-3.6
/j/	3	3	2.6	3	3-3.6	3-3.6

*criteria for the sound to be considered as acquired. "-" indicates sound not met the criteria

validate the test of articulation in Kannada (Kannada is one of the major Dravidian languages of India, spoken predominantly in the state of Karnataka. Native speakers are called Kannadigas, number roughly 38 million, making it the 27th most spoken language in the world. It is one of the scheduled languages of India and the official & administrative language of the state of Karnataka. (Kannada (n.d) *In Wikipedia Online. Retrieved from <http://www.wikipedia.com>*). Specifically photographs were familiarized and a photo articulation test of Kannada was developed. This was administered on 240 typically developing children in the age range of 2-6 years. The effect of age and gender on the articulation abilities in children was investigated. Further the test was administered on 10 clients with misarticulation to find the validity.

Method

The study was conducted in two phases. Phase I included development of Kannada diagnostic articulation test and phase II included standardization of the test.

Phase I: Construction of Diagnostic articulation test in Kannada

A list of four hundred and eighty five words having all phonemes in all naturally occurring positions in Kannada (initial and medial) were given to three judges to check the familiarity of words on a three point familiarity rating scale as follows: Very familiar ($> 95\%$); Familiar ($90 \leq 95\%$); Unfamiliar ($75 \leq 90\%$).

Out of 485 words, 259 words were rated very familiar, 219 words were rated familiar, and 7 words as unfamiliar. 259 words which were rated as very familiar, picturable, and unambiguous were photographed and were again given for familiarity rating to extract final 114 picturable words. The final test material (Kannada Diagnostic Photo Articulation Test) comprised of a total of 114 words which were divided into two parts. Part I consisted of a total of 52 words with 10 vowels, 2 diphthongs in initial position, 19 consonants in initial and medial position and /ŋ/ and /l/ in medial position. Part II consisted of a total of 62 words with 10 vowels, one diphthong (/ai/) in initial position, 19 consonants in initial and medial position, /ŋ/ and /l/ in medial position and eleven clusters in naturally occurring positions. Appendix I shows the words of the Kannada diagnostic photo articulation test.

Phase II: Re-standardization of Kannada diagnostic articulation test

Subjects: 240 typically developing children (15 males and 15 females in each age range) in the age range of 2 to 2.6 years, 2.6 to 3 years, 3 to 3.6 years,

3.6 to 4 years, 4 to 4.6 years, 4.6 to 5 years, 5 to 5.6 years, and 5.6 to 6 years participated in the study. They were selected based on the teachers/parental interview and the informal screening for speech, language, hearing, cognitive or any other motor difficulties.

Material: Kannada diagnostic photo articulation test was used for the study. The test was re-standardized by administering it on two hundred and forty pre-school and school going children in the age range of two to six years.

Procedure: The photographs were presented visually one after the other through the use of laptop and the children were instructed to name the photograph. Oral responses were audio recorded using the same laptop.

Data transcription and Scoring: The data obtained from all the 240 children was transcribed using broad and narrow IPA transcription. All the responses of each child were analyzed sound-by-sound on a response sheet. A score of 1 was given for each correct response, 0.75 for distortion, 0.5 for substitution and 0 for omission.

Reliability: Six children (3 boys and 3 girls) in each age group were re-tested within 8-15 days for test-retest reliability.

Validity: Validity of test was checked by administering the test on ten subjects with misarticulation. The responses were audio recorded and later transcribed and compared to the scores of typically developing children without misarticulation.

Data analyses: Phonemes which were produced correctly by 90% of the children in each age group in the initial and medial positions for both part I and part II were identified. The order of acquisition of speech sounds was determined and is given in Appendix II.

Statistical analyses: A commercially available SPSS version 16.0 was used for all statistical analyses. The test was scored on the basis of the frequency of correct responses. The data was statistically treated by obtaining the mean and standard deviation. A two-way MANOVA and paired t-test was carried out to find the significant difference in articulatory scores across age groups, across gender within the group, as well as between the sub parts of the test and also to check the interactions among gender and age group.

Results

The results indicated main effects of age and gender on the score of the articulation test. The scores increased with increase in age and girls had significantly better scores compared to boys. Also, within gender the main effect of age was observed. Figure 1 shows the scores in boys and girls.

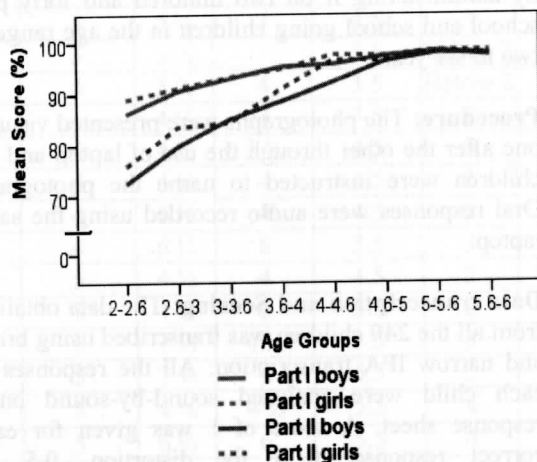


Figure 1. Mean percent score in part I and II in boys and girls.

The mean scores increased from 2 years to 6 years of age in both part I and II. However, children obtained higher score in part I compared to part II. Girls had higher scores compared to boys. Results indicated no significant interaction between age * gender for any part of the test. Figures 2 – 4 shows the raw scores in both genders.

Results of paired t-test showed significant difference between part I and II in the age groups of 2 - 4 years (with 6 month age interval); in boys at $p < 0.01$ and in the age groups of 2 to 3.6 years in girls ($p < 0.01$). It was also observed that most of the vowels, diphthongs, semivowels, dentals, bilabials were acquired by more than 90% the children in the age range of 2.6 to 3 years. However, another salient observation was that the glottal fricative /h/ was not mastered even by 75% of the children by 6 years. Appendix III shows cut off scores of Kannada diagnostic photo articulation test.

Test-retest reliability: Cronbach's coefficient reliability test showed an α of 0.947 for part I and 0.972 for part II, respectively. The overall correlation coefficient was 0.970. All correlations were high and significant.

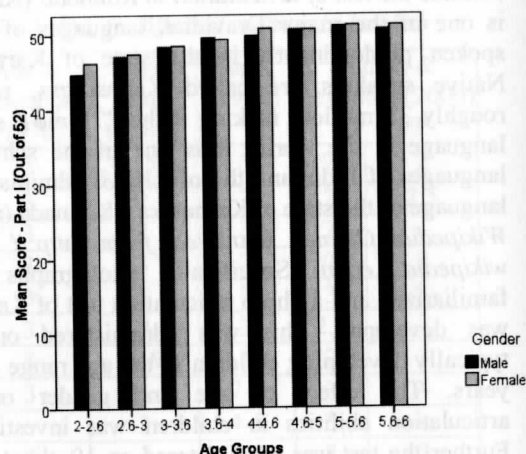


Figure 2. Raw scores on part I in boys and girls.

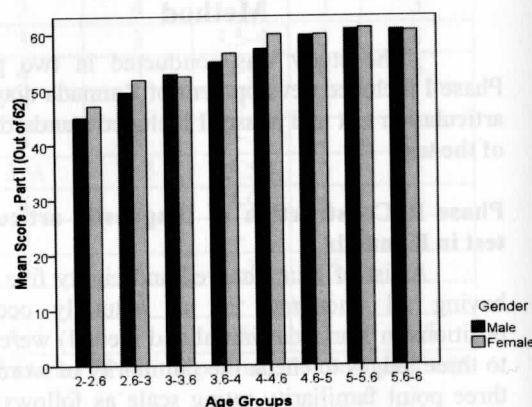


Figure 3. Raw scores on Part II in boys and girls.

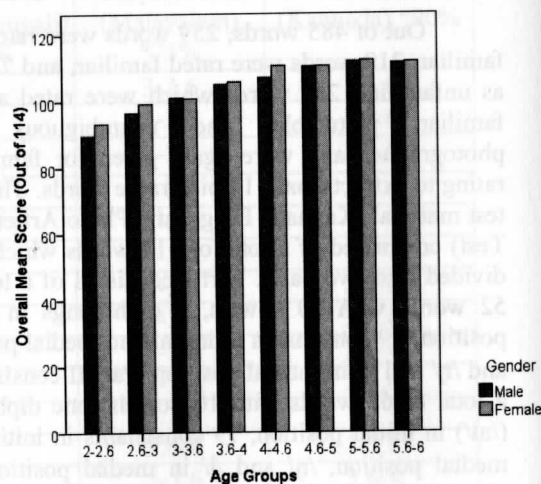


Figure 4. Overall scores in boys and girls.

Table 3. Comparison between the scores obtained for subjects with misarticulations and the average scores of typically developing children (total, Part I, Part II)

Sl. No.	Subjects with misarticulation Age in years (Gender)	Score obtained (score of typically developing children) Total raw score	Score obtained (score of typically developing children) Part I raw score	Score obtained (score of typically developing children) Part II raw score
1.	4.0 (F)	82.75 (110.45)	41.25 (50.3)	41.50 (58.55)
2.	4.9 (M)	93.50 (112.03)	46.00 (50.65)	47.50 (59.79)
3.	4.9 (M)	82.50 (112.03)	42.25 (50.65)	40.25 (59.79)
4.	6.3 (M)	97.75 (111.53)	45.00 (50.93)	52.75 (60.59)
5.	6.9 (F)	90.75 (111.53)	45.75 (50.93)	45.00 (60.59)
6.	7.3 (F)	99.75 (111.53)	47.50 (50.93)	52.25 (60.59)
7.	9.0 (M)	95.00 (111.53)	43.00 (50.93)	52.00 (60.59)
8.	9.3 (M)	102.75 (111.53)	47.50 (50.93)	55.25 (60.59)
9.	15. (M)	105.50 (111.53)	48.00 (50.93)	57.50 (60.59)
10.	16 (M)	96.25 (111.53)	46.75 (50.93)	49.50 (60.59)

Validity: Scores obtained by the misarticulation cases were much lesser than that of normal children as shown in Table 3. Thus, the test can differentiate normal children from misarticulation cases.

Discussion

The results revealed several interesting points. *First of all, results indicated that the scores significantly increased with increase in age in both boys and girls and in both parts.* These findings are in agreement with those of Wellman et al., (1931), Poole (1934), Templin (1957), Tasneem (1977), Usha (1986), Padmaja (1988) and Arun Banik (1988). It is evident that because of the increasing maturity of all motor skills, articulation skill increases as age increases.

Second, girls scored significantly higher than boys in both parts of the test. The result is in consonance with that of Templin (1963) who reported that "in articulation development, girls consistently are found to be slightly accelerated; in all instances the differences are relatively small and often are not statistically significant". In the present study, the difference between boys and girls was significant. The result is also in consonance with those of Usha (1986), Arun Banik (1988), and Maya (1990). However, it is not in consonance with those of Padmaja (1988) and Tasneem Banu (1977), and Prathima (2009).

Third, some sounds were acquired earlier than the others. It was generally observed that all the vowels and most of the consonants except /r/, /h/, /l/, /ʃ/, and /s/ were acquired by the age of 3-3.6 years. The results of the present study were compared with the earlier studies (Wellman et al., 1931; Templin, 1957 in English and Tasneem, 1977; Usha, 1986 in

Tamil; Padmaja, 1988 in Telugu and Prathima, 2009 in Kannada) to observe whether the order of acquisition was similar. The present study revealed that some sounds were acquired earlier than others. At the outset it appears that the age of acquisition of different speech sounds in Indian languages are relatively faster compared to Western studies. However this observation needs to be interpreted with much caution because all the reported studies in the western context that are available are carried out from early thirties to the seventies or so.

Fourth, the results indicated good test-retest reliability and the test was valid to differentiate typically developing children from atypical children. A definite pattern in the acquisition of articulation was found. All the vowels and diphthongs were found to have been acquired by 90% of the children by the age of 2 years. Most of the consonants were acquired by the age of 2.6 years; except /ʃ/, /ɖ/, /t/, /d/, /ŋ/, /r/, /l/, /ʃ/, /s/, /h/, /l/ and clusters.

Among boys, most of the consonants were acquired by 90% of the children by the age of 3.6- 4 years. However, /r/ and /h/ were exceptional, in that /r/ was acquired by 90% of the children in initial position and not in the medial position and /h/ was not acquired even by 75% of the children by the age of 6 years. Among girls, most of the consonants were acquired by the age of 3 years except /ʃ/, /ɖ/, /t/, /d/, /ŋ/, /r/ and /h/ in both the positions tested. Among the clusters only /sk/ was acquired.

Another salient feature observed was that, the children in the present study seemed to acquire most of the sounds at a younger age compared to the earlier reports in English and Kannada. The early articulatory acquisition in the present study compared to earlier report by Tasneem Banu (1977) may be attributed to the cultural differences or a

change in norms, over years because of greater exposure to speech environment.

Conclusions

It can be concluded that Kannada Photo Articulation test is useful as a diagnostic tool and also to aid in prescribing the nature of speech correction required. It is recommended that a detailed phonological process analyses be done with the data collected. It is time that all articulation tests in Indian languages are re-standardized. Speech samples of children below two years of age can be recorded and analyzed for phoneme acquisition. India is a multilingual country where people speak more than one language. Therefore, the effect of bilingualism and multilingualism on acquisition of phonology is warranted. The present study was restricted to elicitation of phoneme in only one context. Deep test can be developed to investigate the correct articulation of phoneme or otherwise in several phonetic contexts.

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Appendix I

Kannada Diagnostic Photo Articulation Test: Part I

Sl. No.	Phoneme Tested	Position (Initial [I] or Medial [M])	Stimulus in Kannada	IPA
1.	a	I	ಅಜ್ಜ	/adʒdʒɪ/
2.	a:	I	ಆನೆ	/a:ne/
3.	i	I	ಇಲಿ	/ili/
4.	i:	I	ಈರುಳ್ಳಿ	/i:rUllɪ/
5.	u	I	ಉಂಗುರ	/uŋgura/
6.	u:	I	ಊಟ	/u:ʈa/
7.	e	I	ಎಲೆ	/ele/
8.	e:	I	ಎಳು	/e:lu/
9.	ai	I	ಐದು	/aiɖu/
10.	o	I	ಒಂಟೆ	/oŋʈe/
11.	o:	I	ಓಲೆ	/o:le/
12.	au	I	ಔಷಧ	/auʃad̪a/
13.	k	I	ಕತ್ತರಿ	/kattari/
14.	k	M	ಬೆಕ್ಕು	/bekku/
15.	g	I	ಗಡಿಯಾರ	/gaɖija:ra/
16.	g	M	ಮೂಗು	/mu:gu/
17.	tʃ	I	ಚಪಾತಿ	/tʃʌpa:ʈɪ/
18.	tʃ	M	ಬಾಚಣಿಗೆ	/ba:tʃaŋige/
19.	ɖʒ	I	ಜಿಂಕೆ	/ɖʒinke/
20.	ɖʒ	M	ಪೂಜಾರಿ	/pu:ɖʒa:ri/
21.	t̪	I	ಟೋಪಿ	/t̪o:pi/
22.	t̪	M	ಚಿಟ್ಟೆ	/t̪itt̪e/
23.	ɖ̪	I	ಡಾಕ್ಟರ್	/ɖ̪a:kt̪ar/
24.	ɖ̪	M	ಅಂಗಡಿ	/aŋgaɖi/
25.	ŋ	M	ಕಣ್ಣು	/kaŋɳu/
26.	t̪	I	ತಟ್ಟೆ	/t̪att̪e/
27.	t̪	M	ಕೋತಿ	/ko:ti/
28.	ɖ̪	I	ದಾರ	/ɖ̪a:ra/
29.	ɖ̪	M	ಕುದುರೆ	/kuɖ̪ure/
30.	n	I	ನಲ್ಲಿ	/nalli/
31.	n	M	ದೇವಸ್ಥಾನ	/devast̪a:na/
32.	p	I	ಪೂರಿ	/pu:ri/
33.	p	M	ಕಪ್ಪೆ	/kappe/
34.	b	I	ಬಾಗಿಲು	/ba:gilu/
35.	b	M	ಕಬ್ಬು	/kabbu/
36.	m	I	ಮನೆ	/mane/
37.	m	M	ಎಮ್ಮೆ	/jamme/
38.	j	I	ಯಕ್ಷಗಾನ	/jakʃaga:na/
39.	j	M	ತೆಂಗಿನಕಾಯಿ	/tenginak̪oi/
40.	r	I	ರೈಲು	/raɪlu/
41.	r	M	ಮರ	/mara/
42.	l	I	ಲೋಟ	/lo:ʈa/
43.	l	M	ಹಲ್ಲು	/hallu/
44.	v	I	ವಿಮಾನ	/vima:na/
45.	v	M	ಕಿವಿ	/kivi/

46.	ʃ	I	ಶರ್ಫ	/ʃarʃu/
47.	ʃ	M	ಬ್ರಹ್ಮ	/braʃ/
48.	s	I	ಸೇಬು	/se:bu/
49.	s	M	ಮೀಸೆ	/mi:se/
50.	h	I	ಹಾವು	/ha:vu/
51.	h	M	ಸಿಂಹ	/simha/
52.	l	M	ಬಳೆ	/baʃe/

Kannada Diagnostic Photo Articulation Test: Part II

Sl. No.	Phoneme Tested	Position (Initial [I] or Medial [M])	Stimulus in Kannada	IPA
1.	a	I	ಅಡಿಗೆಮನೆ	/aɖigemane/
2.	a:	I	ಆಸ್ಪತ್ರೆ	/a:spatre/
3.	i	I	ಇರುವೆ	/Iruve/
4.	i:	I	ಈಳಿಗೆಮಣಿ	/i:ʃigemane/
5.	u	I	ಉಯ್ಯಾಲೆ	/ujja:le/
6.	u:	I	ಊರು	/u:ru/
7.	e	I	ಎರಡು	/eraɖu/
8.	e:	I	ಎಣೆ	/e:ɳI/
9.	ai	I	ಐವತ್ತು	/aivattu/
10.	o	I	ಒಂದು	/o:ndu/
11.	o:	I	ಓಡು	/o:ɖu/
12.	k	I	ಕಾರು	/ka:ru/
13.	k	M	ಸೈಕಲ್ಲು	/saikallu/
14.	g	I	ಗಾಳಿಪಟ	/ga:ʃpata/
15.	g	M	ಕಾಗೆ	/ka:ge/
16.	ʃ	I	ಚಕ್ಕುಲಿ	/ʃakkuli/
17.	ʃ	M	ಮಂಚ	/manʃa/
18.	ɖ	I	ಜಡೆ	/ɖaɖe/
19.	ɖ	M	ಸೂಜಿ	/su:ɖʒI/
20.	t	I	ಟೋಮೋಟೋ	/tomo:to/
21.	t	M	ಕಿಟಕಿ	/kitʃki/
22.	ɖ	I	ಡಬ್ಬಿ	/ɖabbi/
23.	ɖ	M	ಕನ್ನಡಕ	/kannadaka/
24.	ɳ	M	ಗಿಣಿ	/giɳi/
25.	t	I	ತಬಲ	/tabala/
26.	t	M	ಕತ್ತೆ	/katte/
27.	ɖ	I	ದೋಸೆ	/do:se/
28.	ɖ	M	ಗೋದಿ	/go:ɖI/
29.	n	I	ನಾಯಿ	/na:ji/
30.	n	M	ಮೀನು	/mi:nu/
31.	p	I	ಪೆನ್ನು	/pennu/
32.	p	M	ಚಪ್ಪಲಿ	/ʃappoli/
33.	b	I	ಬಸ್ಸು	/bassu/
34.	b	M	ದಿಂಬು	/diɳbu/
35.	m	I	ಮೂರು	/mu:ru/
36.	m	M	ಅಮೆ	/a:me/
37.	j	I	ಯಂತ್ರ	/jantra/
38.	j	M	ಕಡಲೆಕಾಯಿ	/kaɖalekaɳI/

39.	r	I	ರಂಗೋಲಿ	/rango:ll/
40.	r	M	ಸರ	/səra/
41.	l	I	ಲಂಗ	/langa/
42.	l	M	ಗೋಲಿ	/go:ll/
43.	v	I	ವೀಣೆ	/vi:ɳe/
44.	v	M	ಹೂವು	/hu:vu/
45.	ʃ	I	ಶಂಖ	/ʃənkə/
46.	ʃ	M	ಗಣೇಶ	/gəɳe:ʃa/
47.	s	I	ಸೀರೆ	/si:re/
48.	s	M	ಹಸು	/hasu/
49.	h	I	ಹುಲಿ	/hull/
50.	h	M	ಬಾಳೆಹಣ್ಣು	/ba:lehaɳɳu/
51.	ɭ	M	ಕೋಳಿ	/ko:ɭl/
52.	st	I	ಸ್ತಾಂಪು	/ʃta:mpu/
53.	st	M	ಪೋಸ್ಟ್‌ಬಾಕ್ಸ್	/po:stba:ks/
54.	sku	I	ಸ್ಕೂಟರ್	/sku:tər/
55.	ske	M	ಬಿಸ್ಕೆಟ್	/bɪsket̪tu/
56.	dra	I	ದ್ರಾಕ್ಷಿ	/d̪rakʃɪ/
57.	dra	M	ಚಂದ್ರ	/tʃənd̪ra/
58.	rʃɪ	M	ಕುರ್ಚಿ	/kurʃɪ/
59.	kra	M	ಚಕ್ರ	/tʃakra/
60.	ble	I	ಬ್ಲೇಡು	/ble:ɖu/
61.	kʃa	M	ಆಟೋರಿಕ್ಸ್	/a:t̪orikʃa/
62.	skru		ಸ್ಕ್ರೂ	/skru/

Appendix II

Kannada Diagnostic Photo Articulation Test

Ordered (according to age)

Part I

Sl. No.	Age range in years	Phoneme Tested	Position (Initial [I] or Medial [M])	Stimulus in Kannada	IPA
1.	2-2.6	a	I	ಅಜ್ಜಿ	/adʒdʒi/
2.		a:	I	ಅನೆ	/a:ne/
3.		i	I	ಇಲಿ	/ili/
4.		i:	I	ಈರುಳ್ಳಿ	/i:ruʃʃi/
5.		u	I	ಉಂಗುರ	/uŋgura/
6.		u:	I	ಊಟ	/u:ʈa/
7.		e	I	ಎಲೆ	/ele/
8.		e:	I	ಎಳು	/e:ʃu/
9.		ai	I	ಐದು	/aiɖu/
10.		o	I	ಒಂಟೆ	/oŋʈe/
11.		o:	I	ಓಲೆ	/o:le/
12.		au	I	ಔಷಧ	/auʃaɖa/
13.		k	I	ಕತ್ತರಿ	/kattari/
14.		k	M	ಬೆಕ್ಕು	/bekku/
15.		g	I	ಗಡಿಯಾರ	/gaɖiʃa:ra/
16.		g	M	ಮೂಗು	/mu:gu/
17.		t	I	ತಟ್ಟೆ	/ʈaʈʈe/
18.		t	M	ಕೋತಿ	/ko:ʈi/
19.		d	I	ದಾರ	/ɖa:ra/
20.		d	M	ಕುದುರೆ	/kuɖure/
21.		n	I	ನಲ್ಲಿ	/nalli/
22.		n	M	ದೇವಸ್ಥಾನ	/devaʃʈa:na/
23.		p	I	ಪೂರಿ	/pu:ri/
24.		p	M	ಕಪ್ಪೆ	/kappe/
25.		b	I	ಬಾಗಿಲು	/ba:giʃu/
26.		b	M	ಕಬ್ಬು	/kabbu/
27.		m	I	ಮನೆ	/mane/
28.		m	M	ಎಮ್ಮೆ	/jamme/
29.		j	I	ಯಕ್ಷಗಾನ	/jakʃaga:na/
30.		j	M	ತೆಂಗಿನಕಾಯಿ	/tengiŋakoi/
31.		v	I	ವಿಮಾನ	/vima:na/
32.		v	M	ಕಿವಿ	/kivi/
33.	2.6 - 3	l	I	ಲೋಟ	/lo:ʈa/
34.		l	M	ಹಲ್ಲು	/hallu/
35.	3 - 3.6	ɖ	I	ಜಿಂಕೆ	/ɖʒiŋke/
36.		ɖ	M	ಪೂಜಾರಿ	/pu:ɖʒa:ri/
37.		ɖ	I	ಡಾಕ್ಟರ್	/ɖa:kt̪ar/
38.		ɖ	M	ಅಂಗಡಿ	/aŋgaɖi/
39.	3.6 - 4	ʃ	I	ಚಪಾತಿ	/ʃapa:ti/
40.		ʃ	M	ಬಾಚಣಿಗೆ	/ba:ʃaŋʒige/
41.		t̪	I	ಟೋಪಿ	/ʈo:pi/
42.		t̪	M	ಚಿಟ್ಟೆ	/ʃiʈʈe/
43.		ŋ	M	ಕಣ್ಣು	/kaŋŋu/

44.		r	I	ರೈಲು	/railu/
45.		r	M	ಮರ	/mara/
46.		l	M	ಬಳೆ	/baɭe/
47.		ʃ	I	ಶರ್ಪು	/ʃartu/
48.		ʃ	M	ಬ್ರಾಫ್	/braɪf/
49.		s	I	ಸೇಬು	/se:bu/
50.		s	M	ಮೀಸೆ	/mi:se/
51.	4 - 4.6	NIL			
52.	4.6 - 5	NIL			
53.	5 - 5.6	NIL			
54.	5.6 - 6	NIL			

Part II

Sl. No.	Age range in years	Phoneme Tested	Position (Initial [I] or Medial [M])	Stimulus in Kannada	IPA
1.	2-2.6	a	I	ಅಡಿಗಮನೆ	/aɖigəmane/
2.		a:	I	ಆಸ್ಪತ್ರೆ	/a:spatre/
3.		i	I	ಇರುವೆ	/Iruve/
4.		i:	I	ಈಳಿಗೆಮಣೆ	/i:ɭigəmaɳe/
5.		u	I	ಉಯ್ಯಾಲೆ	/ujja:le/
6.		u:	I	ಊರು	/u:ru/
7.		e	I	ಎರಡು	/eraɖu/
8.		e:	I	ಎಣೆ	/e:ɳI/
9.		ai	I	ಐವತ್ತು	/aivattu/
10.		o	I	ಒಂದು	/o:ɳdu/
11.		o:	I	ಓಡು	/o:ɖu/
12.		k	I	ಕಾರು	/ka:ru/
13.		k	M	ಸೈಕಲ್ಲು	/salkallu/
14.		g	I	ಗಾಳಿಪಟ	/ga:ɭpaɖa/
15.		g	M	ಕಾಗೆ	/ka:ge/
16.		t	I	ತಬಲ	/tabala/
17.		t	M	ಕತ್ತೆ	/katte/
18.		ɖ	I	ದೋಸೆ	/ɖo:se/
19.		ɖ	M	ಗೋದಿ	/go:ɖI/
20.		n	I	ನಾಯಿ	/na:ji/
21.		n	M	ಮೀನು	/mi:nu/
22.		p	I	ಪೆನ್ನು	/pennu/
23.		p	M	ಚಪ್ಪಲಿ	/tʃappali/
24.		b	I	ಬಸ್ಸು	/bassu/
25.		b	M	ದಿಂಬು	/diɳbu/
26.		m	I	ಮೂರು	/mu:ru/
27.		m	M	ಆಮೆ	/a:me/
28.		j	I	ಯಂತ್ರ	/jantra/
29.		j	M	ಕಡಲೆಕಾಯಿ	/kaɖalekaɳI/
30.		v	I	ವೀಣೆ	/vi:ɳe/
31.		v	M	ಹೂವು	/hu:vu/
32.	2.6 - 3	l	I	ಲಂಗ	/langa/
33.		l	M	ಗೋಲಿ	/go:ɭI/
34.	3 - 3.6	ɖ	I	ಜಡೆ	/ɖɖaɖe/
35.		ɖ	M	ಸೂಜಿ	/su:ɖɭI/
36.		ɖ	I	ಡಬ್ಬಿ	/ɖabbɭI/

37.		ɖ	M	ಕನ್ನಡಕ	/kannadaka/
38.	3.6 - 4	ʃ	I	ಚಕ್ಕುಲಿ	/ʃakkull/
39.		ʃ	M	ಮಂಚ	/manʃa/
40.		t̪	I	ಟೊಮೋಟೋ	/tomo:to/
41.		t̪	M	ಕಿಟಕಿ	/kitʌkl/
42.		ŋ	M	ಗಿಣಿ	/giɲi/
43.		r	I	ರಂಗೋಲಿ	/rango:li/
44.		r	M	ಸರ	/səra/
45.		l̪	M	ಕೋಳಿ	/ko:l̪l/
46.		ʃ	I	ಶಂಖ	/ʃankə/
47.		ʃ	M	ಗಣೇಶ	/gaɳe:ʃa/
48.		s	I	ಸೀರೆ	/si:re/
49.		s	M	ಹಸು	/hasu/
50.	4 - 4.6	sku	I	ಸ್ಕೂಟರ್	/sku:tər/
51.		kra	M	ಚಕ್ರ	/ʃakra/
52.		ble	I	ಬ್ಲೇಡು	/ble:ɖu/
53.	4.6 - 5	st	I	ಸ್ತಾಂಪು	/sta:mpu/
54.		st	M	ಪೋಸ್ಟ್ ಬಾಕ್ಸ್	/po:stba:ks/
55.		ske	M	ಬಿಸ್ಕೆಟ್	/bIskettu/
56.		kʃa	M	ಆಟೋರಿಕ್ವಾ	/a:to:rikʃa/
57.		skru		ಸ್ಕ್ರೂ	/skru/
58.	5 - 5.6	dra	I	ದ್ರಾಕ್ಷಿ	/drakʃl/
59.		dra	M	ಚಂದ್ರ	/ʃəndra/
60.	5.6 - 6	NIL			

Appendix III

Cut off scores of the Kannada Diagnostic Photo Articulation test

Age group in years	Part I		Part II	
	Mean %	Raw score	Mean %	Raw score
2 – 2.6	87.51	45.50	74.15	45.97
2.6 – 3	90.89	47.26	81.65	50.62
3 - 3.6	93.17	48.45	84.71	52.52
3.6 – 4	95.11	49.45	89.79	55.67
4 – 4.6	96.73	50.3	94.44	58.55
4.6 – 5	97.41	50.65	96.43	59.79
5 – 5.6	98.38	51.15	98.18	60.87
5.6 – 6	97.94	50.93	97.72	60.59