DEEP TEST OF ARTICULATION IN HINDI   PICTURE FORM

Deepa (Shankar)

Reg. No. M9603

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" One who knows that the position

Reached by means of Analytical Study,

Can also be attained by Devotional Services,

And who therefore sees Analytical Study

And Devotional Services to be on the same level,
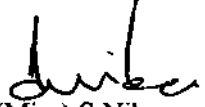
See things as they are"

[Bhagavad – Gita Chapter 5,5.]

TO RESEARCH

CERTIFICATE

This is to certify that the Dissertation entitled: D E E P T E S T OF A R T I C U L A T I O N IN H I N D I -

P I C T U R E F O R M is a bonafide work in part fulfilment for the degree of Master in Science

(Speech and Hearing) of the student with Reg. No. M9603.

Mysore
May 1998

Dr (Miss) S Nikam
Director
All India Institute of Speech and
Hearing , Mysore 570 006

CERTIFICATE

This is to certify that the Dissertation entitled: D E E P T E S T O F A R T I C U L A T I O N I N H I N D I -

P I C T U R E F O R M has been prepared under my supervision and guidance.

Mysore

May 1998

GUIDE

Dr. S. R. Savithri

Reader in Speech Sciences

All India Institute of Speech and

Hearing , Mysore 570 006

DECLARATION

I hereby declare that this Dissertation entitled: D E E P T E S T OF A R T I C U L A T I O N IN H I N D I -

P I C T U R E F O R M is result of my own study under the guidance of Dr. S. R. Savithri, Lecturer in

Speech Sciences, All India Institute of Speech and Hearing, Mysore and has not been submitted

earlier at any University for any other diploma or degree.

Mysore   Reg. No. M9603
M a y 1998

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"You are unique and you are special too,

There is no one else who is quite like you,

W a r m thoughts of you just seem to bring,

A cheerful touch to everything."

To my dearest husband whose patience and care has given this dissertation a beautiful end! Thank you for everything.

Hia, had your artistic hand not existed, you could consider my dissertation also non-existent. Thanks for drawing those beautiful pictures (within minutes) for me!!

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CHAPTER -1

INTRODUCTION

Articulation is a series of overlapping ballistic movements which places varying degrees of obstruction in the path of the outgoing air steam and simultaneously modifies, the size, shape and coupling of the resonating cavities. (Nicolasi, Harryman, and Krescheek, 1978).

Articulation in the simplest form, is a modification of the interrupted air stream (voiced or unvoiced) into different sounds by the movement of articulators such a tongue, lip, jaw, teeth, soft palate etc. Articulation is said to be normal as long as the speech sound produced by the speaker is conveying the meaning intended by him. Normality or abnormality are variable terms which depend on various factors such as the background and experience of the speaker and listener, the geographic location, the age and other factors. Any deviation in correct formulation of phonemes leads to misarticulation. Misarticulation is the incorrect production of the sounds with reference to adult production. The deviances in articulation may be due to factors such as organic abnormalities, emotional conflicts, acoustic and perceptual deficiencies, difficulties in phonetic discrimination, poor motor coordination, poor model, poor environment or it may be functional.

The effects of an articulatory disorder/deviant articulation/misarticulation may not be readily apparent to the listener but they could have far-reaching repercussions on the person's social, emotional well being, occupation and inter-personal relations.

Evaluation of an individuals phonological status involves description of his or her speech sound production system and relating this system to the adult standard of the speaker's linguistic

community. This analysis is often done in the context of an overall communication evaluation that includes assessment of voice quality, fluency of speech, and aspects of language including syntax, semantics, pragmatics and discourse.

Phonological assessment is used to

1. describe the phonological status of an individual and determine if his/her speech sound system is sufficiently different from normal development to warrant intervention,

2. determine treatment direction and strategies to be used in the management of the client,

3. make predictive and prognostic statements relative to phonological change with/without intervention,

4. monitor changes in phonological performance across time and

5. identify factors that may be related to the presence/ maintenance of a phonologic deviancy.

Therefore a speech and language pathologist should be able to differentiate those with normal articulation from the abnormal. This is done by the administration of "A R T I C U L A T I O N T E S T S" , which can be used for detection, assessment, prediction, analysis, interpretation and research. In order to serve the above mentioned purposes, various types of articulation tests have been developed; viz;- screening, diagnostic, predictive and deep tests;-. Screening tests are used to identify the clients who are deviant in articulation. Diagnostic tests are used to evaluate the deviant articulation in detail and predictive articulation test is used to predict whether the child will have deviant articulation or be normal without therapeutic intervention.

Deep test of articulation tests the clients' ability to articulate phonemes in specific phonetic environment. Here, each sound is tested in all the possible phonetic contexts i.e., a sound is deep

tested in a variety of phonetic context as the sound is followed and preceded by each of the other consonants.

The purposes of the deep test of articulation are to permit evaluation of speech sounds as audible end-products of a series of overlapping, ballistic movements and to provide a test long enough to permit observation of the degree of variability present in the speaker's production of the sound.

The deep test of articulation is available in two forms;- viz;-

1. Picture form

2. Sentence form

In the picture form, two different sets of picture cards are used simultaneously to 'deep test' the sound in a variety of phonetic contexts. In the sentence form, two different sets of sentences are used to deep test a variety of phonetic contexts. Currently, deep tests of articulation in picture and sentence form are available in English *{McDonald, 1964),* Kannada *(Rohini 1989- sentence form),* Malayalam *(Maya, 1990-sentence form).* Bengali *(Animesh, 1991 - picture form),* Nepali *(Bhavani 199 5-picture form)* and Tamil *(Sangeetha, 1995 -picture form).* India is a multilingual country and articulation test is language specific. This dynamic variation necessitates the development of articulation tests in various Indian language.

The present study aims and attempts to develop a deep test of articulation - picture form in Hindi language. This would help in identifying specific phonetic environment which are easy for the client and also help in programme therapy which would enhance the progress of the client.

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CHAPTER-II

REVIEW OF LITERATURE

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 an articulation test, then, is to compare the phonemes that are actually used by an individual with the phonemic structure of his language group.

Articulation tests have several *purposes* as follows:

1) Identifying cases with abnormal articulation,

2) Describing the phonemic ability of the individual,

3) Helping in locating causative factors,

4) Studying phonological development,

5) Comparing the effect of the environment and kind of stimulation,

6) Helping in following developmental schedule,

7) Deciding necessity for therapy,

8) Planning and evaluating therapy,

9) Locating and evaluating therapy,

10) Locating sounds that have to be treated first and

11) Finding effectiveness of therapy.

The purpose of articulation test varies and hence the nature and scope of the articulation test inventory varies. If the purpose is to assess the general adequacy of articulation in order to determine whether a child will need speech correction, a screening test can be used. If a detailed description and analysis of articulation is desired in order to determine the direction the speech correction should take, a diagnostic test is needed. McDonald (1964) advises a much more detailed diagnostic test, a 'Deep test' of articulation involving multiple elicitations of every sound in each of its many possible contexts.

The predictive screening tests of articulation are responsible in helping the speech pathologist to predict whether or not a client, having a particular speech defect, will outgrow his/her problem with age. It also helps in deciding if speech therapy is necessary or not.

The screening test is used to assess the general accuracy of the client's articulation. It can test only those sounds and sound clusters which are associated with significant progress in the development of articulation. This has the particular function of sorting out children who are deviant in their articulatory behaviour. The main *advantage* is that it can detect articulation defect in an individual or group situation. The *disadvantages* are that they-

1) do not describe or diagnose the problem,

2) use limited sounds, and

3) some children may make errors which they later correct by themselves.

Diagnostic articulation test helps in thorough examination of the articulatory defect. It not only detects children who need speech correction, but also aid in the evaluation of children already

known to be defective in articulation. It includes all possible speech sounds in the language. It gives information regarding all the sounds that the child misarticulates and also helps in finding out in which position the misarticulation occurs. Deep test of articulation is one of the diagnostic articulation test in which each sound is tested in all possible phonetic contexts. A sound is deep tested in a variety of phonetic contexts, as the sound is preceded and followed by vowels and as the sound is followed and preceded by each of the other consonants. Deep test represents a marked departure from conventional tests of articulation. It is based upon the premise that speech is a continuous process of movements of articulators rather than a series of static positions of the structures. The function of consonants, whether occurring singly or in clusters, is either to release or arrest syllables. The movements of articulators in to and out of a given consonant affects the character of the consonant. In order to analyze the correctnesses of the phoneme, then, it has to be deep tested, ie. it has to be tested in many contexts in which it occurs in running speech.

Deep test of articulation condemns positional classification and identifies phonemes as functioning elements in a syllable to either release, shape or arrest the syllable. Words are made up of one or more syllables with individual sounds appearing as overlapping movements of movement sequences rather than as position in words. The dimension of consonant error inconsistency is probed very thoroughly in this test by sampling consonant production in many phonetic contexts in which the error sound is produced correctly.

The *purpose* of the deep test of articulation are:

1) To permit evaluation of speech sounds as the audible end products, of a series of overlapping ballistic movements and

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2) To provide a test long enough to permit observation of the degree of variability present in the speaker's production of the sound.

Deep tests have several *advantages.* The sentence or picture cards of the deep test may be used following the administration of any of the conventional tests to give information on consistencies and consistencies of errors and to help search for key words and contexts. Emphasis placed on the function of the consonant and the consistency of consonant error in extended speech utterance of the child in many different phonetic contexts thereby providing information which may be secured from more conventional tests which base their results on phonemic production in isolated words. Deep tests can be used in the exploration of phonetic environments in which, consonant production may be correct. As soon as an effective non-sense syllable combination is found, words which contain this phonetic context and related phonetic contexts are quickly utilized in therapy. The test makes a significant contribution in the field of articulation testing and therapy because of the emphasis on consistency of phoneme production and because this is used as a basis for subsequent therapy.

The *disadvantages* of the deep test are as follows:

1) it is very long and laborious,

2) cannot deep test more than two sounds at one meeting,

3) valid results are obtained only for certain speech problems,

4) slow speaking children and children who have difficulty in blending due to multiple misarticulations, Pose problem in   using the test, and

5) many hours are needed to listen to the responses and arrive at a conclusion.

The deep of articulation has two forms. The picture form and the sentence form. In the picture form, two different sets of picture cards are used simultaneously to 'deep test' a sound in a variety of phonetic contexts, as the sound is preceded and followed by vowels, and as the sound is followed and preceded by each of the other consonants.

In spite of many disadvantages, the deep test of articulation has definite advantages over other diagnostic articulation tests. This, necessiates it's inclusion in the assessment of articulation disorders. At present, deep tests of articulation are available in English, Kannada, Malayalam, Bengali, Nepali and Tamil.

Dorsay (1959) was the first one to construct a deep test of articulation of 50 items for /r/. The 50 sentences present /r/ in representative sample of more man 2000 phonetic contexts.

McDonald constructed a deep test in 1964. He constructed a deep test of articulation in English in picture form and sentence form. Given a, y, x, z, b, x is the speech sound of interest, y and z are the immediate contextual environment and a and b are the parts of the broader contextual environment. Co-articulation research using different variables has shown broad context to influence production of a given speech sound (Wang and Fillmore, 1961; Harris, Shery and Lyswaght, 1962; Ohman, 1962; Schwartz, 1967; Daniloff and Moll, 1968; Amerman, Daniloff and Moll, 1970; Curtis, 1970; Moll and Daniloff, 1977).

However, McDonald (1964) cited evidence indicating that phones not immediately adjacent to the target sound have little influence on the correctness of articulation with which that sound is heard. While the co-articulation studies cited did not use correctness of articulation as a dependent

variable, they suggest that phones in broad context might influence the production of a given sound as measured by an articulation test.

Both the picture form and the sentence form assess the production of 13 consonants and the picture test uses nonsense material and the sentence test uses semantically meaningful material. An individual record sheet permits the examiner to determine the percentage of correct productions as well as the phonetic contexts in which correct productions occurred. The tests provide information for a distinctive feature analysis of articulation. They identify correct productions that are valuable starting points for therapy. A comparison of the number of correct responses can be used as an indicator of progress resulting from maturation or speech training.

Picture form: In this test, pairs of pictures are named to make a 'big funny word' out of two little words. The pictures chosen were those which elicited the desired name from 80% of a large group of kindergarten children. Children are given the names for other pictures in a demonstration procedure, and then are instructed to name the two pictures as a bisyllable ie. with no pause between words. The test may be administered as either a spontaneous or imitative test. Although real words are used, the combination results in a non-sense syllable.

Sentence form: Short sentences are employed in this test. Words in the sentences are selected from a primer, first and second grade reading lists and third grade reading lists are used to elicit meaningful connected speech. The test may be administered by having the child read the sentences. Children who cannot read can be asked to repeat the sentences. The length of utterance of most sentences is 4-5 words with few having 7 to 8 words.

The response of each child are recorded in the scoring sheet. From these recordings, the examiner can find out the percentage of correct productions as well as the phonetic context in which correct productions occur. The tests provide information for a distinctive feature analysis of articulation. They identify correct productions that are valuable starting points of therapy. A comparison of the number of correct responses can be used as an indicator of progress resulting from maturation of speech training.

In 1968, McDonald constructed the screening deep test of articulation. This test employs pairs of pictures to elicit ten productions of each of nine commonly misarticulated consonants. It yields a score for each subject. This may be interpreted in terms of the percentage of phonetic contexts in which each tested consonant was articulated correctly. When these scores are plotted on the record form, a phonetic profile may be drawn for each subject tested. The profiles portray the pattern of a child's development of articulatory skill and has potential implications for prognosis, case selection, therapy and evaluation of therapy outcomes. The STDA indicates when further deep testing is needed.

The test pictures are bound in a booklet approximately 4 by 5 inches. The booklet also contains information about how the test is constructed and directions for administration, recording responses and interpreting results. Individual record sheets are available on which the clinician may indicate the child's errors, draw his phonetic profile, summarize pertinent findings, and list recommendations.

The 1976 edition contains norms based on a longitudinal study of 521 children who were tested at the following times:- beginning and end of kindergarten, beginning and end of first grade and

beginning of the second grade, beginning of the third grade. Based on an interpretation of these norms, suggestions are offered for identifying children who are at risk for failure to develop mature articulation.

The future validity studies, in which extreme groups were compared, showed that the STDA identified those children who had normal articulation and those who had significantly defective articulation in conversational speech (McDonald, 1976). Analysis of longitudinal and cross-sectional data suggests that STDA is sufficiently sensitive to detect age related and sex related . differences in the development of consistently correct articulation of the nine consonants tested. The norms of the STDA differ from earlier norms (Templin, 1965), which usually defined the age at which 75% of the children tested produced the sound correctly in the initial, medial and final positions of words. Instead of indicating the age at which a proportion (75%) of children produce a sound correctly, the STDA provides two proportions

(1) The proportion of children at each grade level (K-3) who, without speech training correctly produce each of the nine frequently misarticulated sounds, and

(2) the indicated proportion of the ten contexts in which the sound was tested (McDonald, 1976).

Consistent misarticulation on the STDA, DTA and in conversational speech suggests, that the child is at risk for failure to develop normal articulation without speech training and initiation of speech therapy should be considered.

Zehel and Shelton etal (1972) modified McDonald's /s/ list. In broad context, McDonald tests the /s/ sound in two series of items, designated as lists 1A and IB. In the list 1A, the word 'sun' is preceded by adjacent words in such a way that nineteen different consonants and three vowels are

used as they immediately precede the /s/. Each word pair is said as a single word. In list 1B, the word 'house' is followed by 24 words initiated with twenty different consonants and four vowels. Three lists of items which differ systematically from McDonald's items were designed for this study. They were termed as lists 2, 3 and 4 and each list has A and B subtests. Within the A list, /s/ appears in the initial part of the second word in the word pair and the second word is common to all items. In list B, /s/ appears in the final position of the first word in the word pair, and that word is common to all items. The second word is different for each item, for example 'housepoke' or 'housebook'.

Lists 2A and 2B use the test words 'sun' and 'house' as in McDonald's test. However, the adjacent words were altered. In each adjacent word for list 2A, the sound abutting the /s/ was the same as used by McDonald, but were altered with preceding consonant and vowel. The alteration was intended to change the height and place of tongue for vowels, and the place but not the manner of articulation of consonants. Thus, where possible, high front vowels were changed to low back vowels and vice versa. In each adjacent word for list 2B, the consonant abutting the /s/ was again the same as used by McDonald, but the following vowels or vowel and consonants were altered in the manner described previously. Thus, as an example McDonald's adjacent word 'but' in 'housebut' was altered to 'book'.

List 3A used the adjacent words cup, tub, kite and others, as in McDonald's test, but the test word was altered in the manner previously described. Thus the word 'sun' was changed to 'seek'. List 3B used the adjacent words pipe, bell, tie and others as in McDonald's test but the test word 'house' was altered to 'face'.

Rockman and Elbert (1984) modified McDonald's /s/ list to use in their study on untrained acquisition of /s/ in a phonologically disordered child. Contexts in which /s/ was evoked imitatively were as follows:

Word initial (CV or CVC)	Word final (CVC)	Word medial 2 morphemes (CVC+inflect--ing i,e)	Word medial 1 morpheme (CVSVC)
sell	race	racing	porsum
sit	miss	missing	wrestle
soup	purse	pursy	lesson
sun	mouse	mouses	muscle
scam	ice	vocle	bicycle
soap	toes	tossing	whistle
sign	loose	loosen	listen
seed	pass	passing	failcet
saw	bus	lissing	larso
sad	yes	bossy	recipe

Rohini (1989) constructed a deep test of articulation in Kannada (sentence form). 13 consonants (*/g/* /d/ /d/ /e/ */j/* /n/ /s/ /S/ /n/ /y/ /i/ /l/ /v/) were tested in vowel- consonant and consonant-cluster contexts. 3 to 4 word long meaningful sentences were used with few 7-word sentences. Totally 305 sentences were used to test the phoneme in all possible phonetic contexts, including 108 sentences in cluster contexts. Rohini (1989) tested 120 children in the age range of 5 to 9 years in both sex. The children were required to read the sentence or repeat after the examiner. Each response was computed. The results indicated a maximum correct score of 96.63% at 8 to 9 years of age and the articulatory proficiency increased with age. She found that /I/ and /s/ were the most

difficult phonemes to articulate. Also, it was observed that the vowel environment was easier for children to articulate than consonant environments. Among consonants, consonant cluster environments was more difficult man single sounds. T-test showed no significant difference between males and females within the age groups and no significant difference between the age groups (5-6 years vs 6-7 years; 6-7 years vs. 7-8 years; 7-8 years vs. 8-9 years) in terms of articulatory skills at 0.05 confidence level.

Maya (1990) also developed a deep test of articulation (sentence form) in Malayalam. She used eight key phonemes (/j/ /s/ /s/ /S/ /r/ /l/ /r/ l/) which were most commonly misarticulated by children. Simple meaningful sentences were used. The sentence length was 2-3 words with these target phonemes tested in vowel - consonant and consonant- cluster environments. The test consists of 87 sentences including 27 sentences in which target phonemes were tested in cluster environment. 70 Malayalam speaking children in the age range of 5-8 years (in both the sex) were tested. Each child was instructed to read or repeat the sentence which were read by the examiner and the responses were recorded. Each correct articulation was given a score of one and the total correct response was found out. She reported a maximum score of 95.86% at 7-8 years. T test showed no significant difference between males and females within the age group. However, there was an increase in the total score with the increase of age and /s/ and /S/ were most difficult items to articulate in all the age groups. She also found that /s/ was acquired by Malayalam speaking children only by 5-5.6 years, /r/ by 4.6 to 5 years and /s/ by 4-4.6 years. She opined that this could be the reason why children had difficulty in producing /S/ correctly in the deep test of articulation.

Animesh (1991) developed a deep test of articulation (picture form) in Bengali. He used 11 key sounds /t/ /d/ /k/ /g/ /d/ /c/ /j/ /s/ /r/ /l/ /l/ which were the sounds that were most commonly

mis-articulated in the language. Monosyllabic, bisyllabic and trisyllabic words were used. The words that were chosen were picturable and were of those objects that the child came across every day. The test sounds were tested in all environments of every other test sound. There were two lists of words for each category both initial and final positions. When the children were unable to produce a particular word, they were given a second trial or they were asked to repeat after the tester. When the T-test was administered, it was found that there was no significant difference between males and females as well as between the first list and the second list. However, there was significant difference between the different age groups. The results indicated that the articulation skills increased with age. On the item analysis it was observed that /r/ and /d/ were the most difficult. Voiceless stop consonant environment was the most difficult followed by trill and fricatives. The voiced consonant environment was the easiest. On the basis of the results, the cut off scores were obtained.

Sangeetha (1995) developed a deep test of articulation (picture form) in Tamil. She used 12 key sounds /k/ /g/ /c/ /j/ /t/ /d/ /t/ /d/ /s/ /s/ /r/ /l/ which were the sounds that were not most commonly misarticulated in the language. 33 simple meaningful and picturable words in two lists with these phonemes in the initial and the final position were selected as a measure of eliciting a response from children. On T-test, no significant difference between males and females was found. However, there was significant difference between the different age groups. These results indicated that the articulation skills increased linearly with age. On item analysis, it was observed that /r/, /s/ and /s/ were most difficult. The phonetic environments with trills and fricatives were more difficult to articulate.

Bhavani (1995) developed a deep test of articulation (picture form) in Nepali. She used 13 key sounds /k/ /g/ /c/ /j/ /t/ /d/ /t/ /p/ /b/ /s/ /S/ /r/ /l/ which were the sounds that were most commonly

misarticulated in the language. 27 simple meaningful and picturable words in two lists with these phonemes in the initial and the final position were selected as a measure of eliciting a response from children. On T-test, no significant difference between males and females was found. However, there was significant difference between the different age groups. These results indicated that the articulation skills increased linearly with age. On item analysis, it was observed that /s/ and / / were most difficult. The phonetic environments with trills and fricatives were more difficult to articulate.

Several investigators have used the deep test of articulation to evaluate articulatory performance. Aungst and Frick (1964) in their study to investigate the hypothesis that "consistency of articulation is more directly related to the ability to judge one's own speech productions as correct, incorrect than to the ability to discriminate between paired auditory stimuli presented by another speaker", along with three new tests, used 'deep test' of articulation for /r/ - additional test for discrimination constructed by Dorsay (1959) according to principles suggested by McDonald (1959). Correlation among the tests indicated that the ability to judge one's own speech productions as measured by the deep test is significantly related to the consistency of articulation. Therefore, tests of this ability should prove valuable in diagnosis, therapy and research.

The negligible correlation between the traditional test and the deep test of articulation as reported by Aungst and Frick (1964) in their study does not necessarily indicate that 'external' or 'interpersonal' discrimination ability is unimportant in the development of articulation ability. However, the findings of their study seem to indicate that the traditional speech sound discrimination tests sample an ability which is well established by 8 years of age and is not related to articulation defects which persist after that age.

Zehel, Shelton et al (1972) while studying the influence of broad production as measured by deep tests found that broad context had little influence on the articulation of /s/ phonemes. However, it is difficult to generalize from these data to treatment of the individual. The clinician who wishes to encourage generalization from contexts in which a sound is produced correctly must find contexts suitable for the individual. So persons investigating articulation remediation might consider contexts when selecting words for use and also record information about responses to specific item. In this way, if training is suitably controlled, information about context as a factor in articulation remediation would be gathered as a side benefit.

McReynolds, Kohn and Williams (1975) in their study analyzed the discrimination and production performance of severely misarticulating children. Their performance on the McDonald deep test of articulation and minimal pairs discrimination test was compared to the performance of children without articulation errors. The normal children performed well in production and discrimination. However, the articulatory error children performed poorly on the production test but performed as well as the normal children on the discrimination test. Mowrer and Sundstrom (1988), while describing the process of /s/ acquisition among young children who substituted an interdental fricative for /s/, made use of the deep test of articulation for /s/ and concluded that the deep test of articulation seemed to be a reliable indicator of whether or not /s/ would be acquired within five consecutive months.

The review of literature reveals the importance and necessity of the deep tests of articulation. India being a multilingual country, people speak different languages. Hence, there is a need to develop deep test of articulation in different Indian languages and the present study intends to develop a deep test of articulation *(Picture form)* in Hindi language.

CHAPTER - III

METHODOLOGY

Material: In this deep test of articulation the following 19 key phonemes were selected *[Table I*

Phoneme	Phonetic description
k	Velar voiceless unaspirated plosive
kh	Velar voiceless aspirated plosive
8	Velar voiced unaspirated plosive
c	Palatal voiceless affricate
J	Palatal voiced affricate
t	Retroflex voiceless unaspirated plosive
th	Retroflex voiceless aspirated plosive
t	Interdental voiceless plosive
th	Interdental voiceless aspirated plosive
d	Interdental voiced plosive
dh	Interdental voiced murmured plosive
P	Bilabial voiceless plosive
b	Bilabial voiced plosive
bh	Bilabial voiced murmured plosive
s	Dental voiceless fricative
r	Retroflex voiced trill/flap
1	Retroflex voiced lateral/plosive
h	Glottal fricative
y	Semivowel

Table-I: Phonemes selected for the study.

Simple meaningful and picturable words with these phonemes in the initial and final positions were selected as a means of eliciting a response from the children. Two such word lists were prepared with picturable words in the lists. These words were selected from LKG, UKG, I and II standard books and the pictures (simple line drawings) depicting these words formed the test material. Each phoneme was used in several phonetic contexts as depicted in *Appendix - I* (First list) and *Appendix - II* (Second list). Four simple words were selected and the pictures depicting these served as demonstration items *(Table-II).* All the pictures of the test are in *Appendix - IV.*

Kangi Pankha

Pensil Pẽd

Table - II: Trial picture/word.

Picture arrangement: All the pictures representing words with the key phonemes in final position were placed on the left side and those representing words with key phonemes in the initial position were placed on the right side such that any picture on the left could be combined with that on the left. The first list had 15 pictures on the left and 26 pictures on the right and the second list had 17 pictures on the left and 25 pictures on the right. The pictures represent the words in order as in *Appendix - III.*

Subjects: 30 Hindi speaking normal children (15 males and 15 females) each in the age range of 3.4, 4-5, 5-6 and 6-7 years were selected for the study. They were selected on the criteria that they had normal speech and language as evaluated by a speech pathologist and had no history of any ear discharge. Their mother tongue was Hindi and all of them were from middle-socio-economic status.

Administration: The children were seated comfortably and the test material was placed such that he/she could see the pictures without any difficulty. Children were tested individually in a quiet environment of the Kendriya Vidyalaya Schools at Mysore and Bangalore.

Since the main aim of the deep test of articulation was to find out which articulatory patterns associated with different phonetic contexts result in the correct production of the phonemes being tested, it is imperative that the child produces the words as a continuous movement of articulators i.e. as a continuous syllable. For this purpose, the task of naming the picture was demonstrated to the child. The first two pictures of the demonstration item 'Kangi' and 'Pankha' were shown to them and was uttered as a single word 'Kangipankha' The children were asked to produce a big funny word.

A phoneme was tested at the word initial and final positions. A picture which ended with the target sound was selected. For example, when the phoneme /t/ had to be tested, the stack of pictures on the left side were turned over until the picture with /t/ in final position was exposed. The child was then asked to combine the word on the left and right and say it as one single word. The response was then recorded. Then the picture on the right side was turned over so that the child could be tested for the sound /t/ in the next articulatory environment. The whole procedure was repeated until all the cards had been turned over on the right side and tested with the sound /t/.

After this, a picture with the next target phoneme to be tested was selected. For example if /s/ was to be tested in word final position, then the pictures on the left side was turned over until the picture with /s/ in the final position was exposed. Then all the pictures on the right side were tested with this particular sound /s/. Same procedure was followed until all the phonemes were tested in

all the phonetic contexts. Thus, in list 1, 15 phonemes were tested each in 26 phonetic contexts and in list 2, 17 phonemes were tested each in 25 phonetic contexts. Hence, the tester elicited a total of 390 responses (15x26) for list 1 and a total of 425 (17x25) responses for list 2. In total each child had to give 815 responses and for 120 children the total number of responses obtained were 97800.

During the testing, if the child failed to say the desired word, the examiner prompted the child by uttering the word. The testing was then continued and in the end, the above mentioned picture or context was tested again, thus ensuring the elicitation of spontaneous responses rather than imitative ones.

Recording: Both testing of the sounds in different contexts and recording of the child's responses were done simultaneously. The examiner listened to the child's response and market it on a scoring sheet. Depending upon the child's response, appropriate markings were used. '+' was used for a correct response and '-' was used for an incorrect response. Each '+' was scored '1' and '-' was scored '0'. The total number of correct responses for each child was computed and the percentage of correct responses was determined by the formula:

$$\% \text{ of correct response} = \frac{\text{No. of correct responses}}{\text{Total no.of responses}} \times 100$$

The % of correct responses of all the children in each age group were averaged and a 'T'test was performed to find out the age and sex differences in the performance of children.

CHAPTER IV

RESULTS AND DISCUSSION

I. RESULTS

The results are discussed under the following headings-

(1) Distribution of total score

(2) Distribution of score among subgroups

(3) Item Analysis

(4) Order of difficulty of items

1) Distribution of total score

In part I, the % scores increased from 3 years to 5 years of age and at the age of 5 years, children obtained 100% scores. While in the age group of 3-4 years, boys obtained higher scores than girls, in the age group of 4-5 years, girls obtained higher scores than boys though not significantly.

In part II, at 3 years of age, children obtained 100% scores. *Table III* shows the total score and percent score obtained by children in all the age groups.

Age in years	Sex	Total Score List I	List II	Percent Score List I	List II
3-4	M	389.06	425	99.75	100%
	F	387.46	425	99.34	100%
4-5	M	388.86	425	99.19	100%
	F	389.26	425	99.81	100%
5-6	M	390.00	425	100%	100%
	F	390.00	425	100%	100%
6-7	M	390.00	425	100%	100%
	F	390.00	425	100%	100%

Table-Ill: Total score and percent score of children with the age range of 3-7 years.

T-test indicates significant difference (0.05 level) between the 3-4 years, 4-5 years old children and 5-7 years old children. *Table TV* shows the significant difference in scores between children of various age groups.

AGE GROUP	3-4	4-5	5-7
3-4	-	-	S
4-5	-	-	S
5-7	S	S	-

Table IV: Significant difference between children of various age groups S-significant.

Thus between the groups, low scores was obtained for the younger group and higher scores was obtained in the older group.

2) Distribution of Scores among Sub-groups

List1

3-4 years

Children in this age group obtained a mean score of 388.93 with a percent score of 99.72 Within the group, boys obtained a higher score than girls though not significantly.

4-5 years

Children in this age group obtained a mean score of 389.06, with the percent score of 99.75 Within this group, girls performed better than boys though not significantly.

5-7 years

Children in this age group obtained a mean score of 390.0, with a percent score of 100% . Both the boys and girls performed equally.

In general, the scores increased with age and girls performed better than boys in the age range of 4-5 years. Based on the means the cut off scores can be established.

The cut off for the age groups 3-4, 4-5, 5-6 and 6-7 years will be 99.72, 99.75, 100 and 100 respectively.

List II: Children starting from 3-4 years obtained 100% scores

3) Item Analysis

An item analysis was carried out on the 97800 responses obtained from 120 children. This was done to obtain the information on the items correct/wrong and to list them in the order of difficulty.

The results of the item analysis indicate that, in both boys and girls, the percent of correct response increased as the age advanced from 3-5 years and reached a maximum score at 5-6 years (List II). Based on the percent scores obtained from items analysis, the order of difficulty of items for each age group are presented in *Tables V and VI*.

Item difficulty	Percent response
dh	90.00
gh, d, t, th	93.34
bh, c, g, p, ph, d, kh, t, h, k, j, th, n, j,	96.67
r, s	96.67
kh	96.87
All Others	100.00

Table V: Results of item Analysis in the age group of 3-4 years (Part I).

Item difficulty	Percent response
d,th	90.01
dh, bh, ch,j, s	93.34
j, d, p, s, t, 1, r, th	96.67
All others	100.00

Table VI: Results of item analysis in the age group of 4-5 years (Part I).

4) Order of difficulty of Item

3-4 years

It was observed that for the 3-4 year old children, the easiest phonetic environment were r, jh, n, b, m, v, s, ch, 1, s, s and h and the most difficult environment was - dh.

4-5 years

It was noticed that the easiest phonetic environment were: k, kh, g, gh, c, jh, t, dh, n, ph, b, m, v, and h and the most difficult environments were: d and th.

To *summarize,* the results indicated that-

 1) Articulation skills increased with age till the age of 5 years.

2) The environment with aspiration were more difficult to articulate.

3) Children by 5 years articulated all the phonemes correctly.

II. DISCUSSION

The findings of Wellman (1931), Poole (1934) and Templin (1965) indicated that phoneme development is correlated with age and that some sounds are mastered, earlier than the others. The results of the present study are in congruence with the above in that articulation scores and thus the articulation skill increased with age.

The results of the present study do not indicate a significant difference between the performance of males and females. Roe and Milisen (1942) and Winitz (1969) stated that sex is a minor variable in the development of articulatory skills. Perkins stated that the results were conflicting. Differences in sex reported were small and virtually non-existent in well controlled studies. Rohini (1989), Maya (1990), Animesh (1991) Sangeetha (1995) and Bhavani (1995) also found no significant difference between the performance of males and females within the age group.
The result of the present study is in accordance with the above.

The findings of the present study show that mere are significant differences between the scores of 3-4 Vs 5-7 and 4-5 Vs 5-7 year old children. This agrees with the results of Rohini (1989), Animesh (1991), Sangeetha (1995) and Bhavani (1995) who found that there was significant difference between the articulation scores of these age groups.

The results of the study conducted by Rohini (1989), Maya (1990) Animesh (1991), Sangeetha (1995) and Bhavani (1995) are compared in *Table-VII.*

Age in years	Rohini (1989) Sentence test	Maya (1990) Sentence test	Animesh (1991) Picture test	Sangeetha (1995) Picture test	Bhavani (1995) Picture test	Present Study Part I	Part II
3-4	-			77.3%	89.03%	99.72%	100%
4-5			92.25%	81.89%	97.19%	99.75%	100%
5-6	93.17%	85.8%	94.5%	90.44%	99.19%	100%	100%
6-7	94.19%	95.86%	97.49%	100%	99.95%	100%	100%

Table - VII : Showing the comparison of percentage scores across various studies.

The results of the present study agree with these studies in that the mean percentage of scores increases with age. However, in the present study the 5-6 years obtained 100% scores, which was not the case in the previous studies.

The difference might be because of the material used and exposure to the language. Rohini (1989) and Maya (1990) used sentences, the present study used pictures.

The order of difficulty of items of the present study was compared with that of Rohini (1989), Maya (1990) and Animesh (1991). While Rohini (1989) reported that /s/ and /S/ were the most difficult. Animesh (1991) reported that /d/ and /r/ were the most difficult. Sangeetha (1995) reported that /r/ */s/* and */s/* were most difficult and Bhavani (1995) also reported that /r/ */s/* and /S/ were the most difficult. In the present study */r/* and /s/ were the most difficult. The easiest phoneme in the study of Rohini (1989) and Animesh (1991) were velars and stops and were trills and fricatives in the results of the studies by Sangeetha (1995) and Bhavani (1995). *Table VIII* shows the order of difficulty of items on various studies.

Author	Age Group	Order of difficulty
Rohini (1989)	5-6 years	/g//j//v//d//c////l//r//n/ /d/ /f/ /s/
	6-7 years	/g/ /d/ /c/ /j/ /d/ /r/ /l/ /v/ /y/ /n/ /s/ / / /h/
Maya (1990)	5-6 years	/s/ /j/ /l/ /R/ /r/ /s/ /l/ /s/ /l/ /R/ /s/ /r/ /l/ /j/ /s/ /s/
	6-7 years	/j/ /s/ /l/ /R/ /r/ /s/ /l/ /s/ /l/ /s/ /j/ /R/ /l/ /r/ /s/ /s/
Animesh (1990)	4-5 years	/k/ /g/ /s/ /t/ /l/ /c/ /j/ /d/ /g/ /r/ /d/
	5-6 years	/k/ /s/ /h/ /l/ /c/ /t/ /j/ /d/ /g/ /r/ /d/
	6-7 years	/k/ /l/ /h/ /s/ /t/ /c/ /j/ /d/ /r/ /g/ /d/
Sangeetha (1995)	3-4 years	/l/ /c/ /t/ /s/ /v/
	4-5 years	/l/ /c/ /t/ /s/ /r/
	5-6 years	l/ /c/ /t/ /s/ /r/
	6-7 years	100 percent scores
Bhavani (1995)	3-4 years	/r/ /s/ /S/
	4-5 years	/s/ /r/ /S/
	5-6 years	/s/
	6-7 years	/s/
Present study	3-4 years	/dh/
	4-5 years	*Id lid*
	5-6 years	100 percent scores
	6-7 years	100 percent scores

Table - VIII The order of difficulty of phonemes in various studies.

Based on the results of the present study, the cut off score in percent for various age groups can be obtained which can be used in evaluation *{Table IX).*

Age in Years	Cut off scores
3 - 4	99.72
4 - 5	99.75
5 - 6	100
6 - 7	100

Table - IX: The cut off scores for picture Deep Test of Hindi.

It could be concluded that the present test helps in deep testing articulation in Hindi language on the basis of which therapy can be programmed for patients with phonological disorders.

CHAPTER V

SUMMARY AND CONCLUSION

The deep test of articulation is a diagnostic articulation test which evaluates the phonemes in all possible contexts. It is very useful as a diagnostic and a therapeutic tool. At present, deep tests of articulation are available in English *(McDonald 1964),* Kannada *(Rohini 1989),* Malayalam *(Maya 1990),* Bengali *(Animesh 1991),* Tamil *(Sangeetha 1995)* and Nepali *(Bhavani 1995).* The present study was planned to develop a deep test of articulation *(picture form)* in Hindi language, which would help in identifying specific phonetic environments which are easy or difficult for the client and also help in programming therapy which would enhance the progress of the client.

19 Phonemes were selected - k, kh, g, c, j, t, th, t, th, d, dh, p, b, bh, r, y, 1, s, h. The phonemes were tested in the initial and final position. Meaningful picturable easy Hindi words with the phonemes in initial and final positions were selected and 83 pictures representing the words formed the material. The pictures representing the words with the phonemes in the final position were placed on the left stack and those representing words with the phonemes in the initial position were placed on the right stack.

The study included 30 Hindi speaking *(15 boys, 15 girls)* normal children each in the age range of 3-4, 4-5, 5-6 and 6-7 years. The children were instructed to produce a big and funny word by combining the word depicted by the picture on the left side with that on the right side. Each correct production was scored '1' and incorrect production scored '0'. The total score of each subject was calculated and statistically analyzed. The mean and percent score were calculated. The T-test was performed to find out the significant difference between boys and girls within and between groups.

The results indicated that articulatory skills increased with age. By the age of 5 years children obtained 100% scores which could be attributed to the early development of articulation which may be because of better linguistic exposure. On item analysis, it was observed that /d/, /dh/ and /th/ were the most difficult to articulate. Based on the results, the cutoff score for articulation testing were provided which can be used further *(Table X).*

Age in years	3-4	4-5	5-6	6-7
Cutoff scores	99.72	99.75	100%	100%

Table X - Showing the cutoff Scores.

The present test can be used clinically to deep test articulation in various environments. A therapy program can be made on the basis of these easy to difficult phonetic environments. It also aids in research to find out the co-articulatory effects of preceding and following sounds.

CHAPTER VI

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	k	kh	g	gh	c	ch	j	jh	t	th	d	dh	t	th	d	dh	n	p	ph	b	bh	m	y	r	l	v	s	s	s	h
k	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
kh	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
g	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
c	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
j	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
t	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
th	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
t	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
th	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
d	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
p	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
n	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
b	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
bh	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
y	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
v	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
r	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
l	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+
s	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	-	+	+

Various phonetic contexts as in List I

	k	kh	g	gh	c	ch	j	jh	t	th	d	dh	t	th	d	dh	n	p	ph	b	bh	m	y	r	l	v	s	s	s	h
k	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
kh	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
g	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
c	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
j	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
t	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
th	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
t	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
th	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
d	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
p	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
n	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
b	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
bh	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
y	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
v	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
r	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
l	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−
s	+	+	+	+	+	+	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	−	+	+	−	+	+	−	−

Various phonetic contexts as in List II

APPENDIX III

List I

ai nak (handwritten)

e:nak	(spectacles)	kamal	(lotus) *k nak* (handwritten)
i:kh	(sugarcane)	khargo:s	(rabbit)
jag	(jug) *ʒ ʒ* (handwritten)	ga:y	(cow) *gn* (handwritten)
pã:c	(five)	gho:da	(horse)
su:raj	(sun)	ca:r	(four)
ba:t	(bat) *ba r* (handwritten)	cha:ta	(umbrella)
sa:t	(seven)	jo:kar	(joker)
rath	(chariot)	jha:du	(broom)
amaru:d	(gauvava)	tamatar	(tomato)
ka:n	(ear)	the:la	(wagon)
kita:b	(book)	dho:lak	(drum)
ghar	(house) *h ʒ ʏ* (handwritten)	to:ta	(parrot)
nal	(tap)	tha:li	(plate)
bas	(bus)	darva:ja	(door) *dʒr wadsu* (handwritten)
cu:ha	(rat)	dhanush	(bow)
		pa:ni	(water)
		phu:l	(flower)
		bandar	(monkey)
		bhẽs	(buffalo) *vẽs* (handwritten)
		matar	(peas)
		yajn	(a fire for ritual)
		ladki	(girl)
		~~varsa:~~ (rain)	*baris (rain)* (handwritten)
		salgam	(vegetable root)
		satkon	(hexagon)
		hã:thi	(elephant)

Words (picture form) tested in order as in List I

List II

e:k (one)

bətək (duck)

patang (kite) ﻳﻮﻟﮩﻦ|

cammac(spoon) .ﻟﻮﺷﻤﻤﻮﻟﺲ

u:t̪ʰ (camel)

a:th (eight)

da:nt (teeth)

ha:th (hand)

ca:nd (moon)

sa:p (snake)

tab (tub)

ji:b (tongue)

ca:y (tea) ﻟﺴﺎﻙ

sku:tər (scooter)

na:w (boat)

gilas (glass)

ba:rah (twelve)

ke:la (banana)

kha:na (food)

gədha (donkey)

ghədi (clock)

cəppal (slippers)

chadi (stick)

jəha:j (ship)

jhanda (flag)

to:pi (cap)

dibba (box)

dhakkan (lid)

titali (butterfly)

than (udder)

dəs (ten)

dho:bi (washerman)

na:k (nose)

pərbət (mountain)

phəl (fruits)

bə:l (ball)

bha:lu (bear) √a: ɭu

machali (fish)

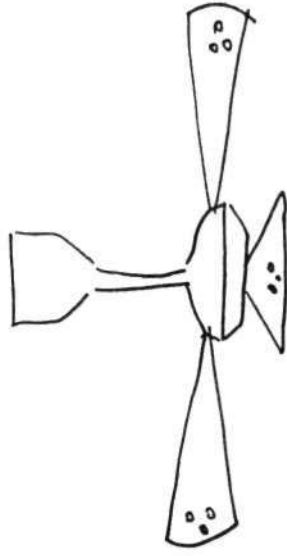re:l (rail tracks)

lait (bulb) ɪa; ɪʈ

se:r (lion)

se:b (apple)

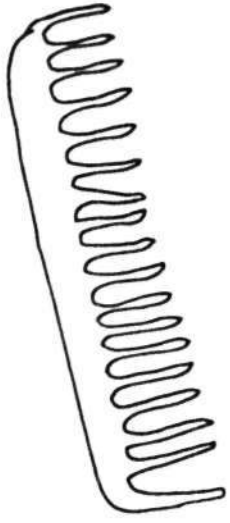Words (picture form) tested in order as in List II
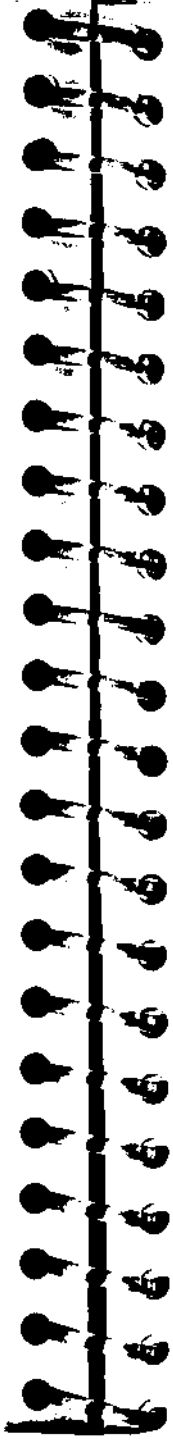
APPENDIX – IV

PHOTO ARTICULATION TEST

PART – I

पंखा

(SAMPLE WORD)

कंघी

JI

(SAMPLE WORDS)

ਰੁੱਖ [ਪ]

(SAMPLE WORD)