DEEP TEST OF ARTICULATION IN TAMIL - PICTURE FORM

A DISSERTATION SUBMITTED AS PART FULFILMENT FOR THE FINAL YEAR M.Sc. (SPEECH AND HEARING) TO THE UNIVERSITY OF MYSORE, MYSORE

ALL INDIA INSTITUTE OF SPEECH AND HEARING: MYSORE 570 006

MAY 1995

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Dearest Nishant

One of God's greatest miracles is to enable ordinary people to do extra ordinary things.

Thanks for being such an extra ordinary YOU.

CERTIFICATE

This is to certify that the Dissertation entitled: **DEEP TEST OF ARTICULATION IN TAMIL - PICTURE FORM** is a bonafide work in part fulfilment for the Degree of Master in Science (Speech and Hearing) of the student with Reg.No.M9317.

Mysore
May 1995

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>

C E R T I F I C A T E

This is to certify that the Dissertation entitled: **DEEP TEST OF ARTICULATION IN TAMIL - PICTURE FORM** has been prepared under my supervision and guidance.

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DECLARATION

I hereby declare that this Dissertation entitled: **DEEP TEST OF ARTICULATION IN TAMIL - PICTURE FORM** is the 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 Univrsity for any other Diploma or Degree.

Mysore
May 1995

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TABLE OF CONTENTS

	Page No.
INTRODUCTION	1 - 6
REVIEW OF LITERATURE	7 - 27
METHODOLOGY	28 - 36
RESULTS AND DISCUSSION	37 - 50
SUMMARY AND CONCLUSION	51 - 54
BIBLIOGRAPHY	55 - 58
APPENDIX I AND II	

LIST OF TABLES

		Page No.
I	Phonemes selected for the study	28
II	Phonetic contexts selected for the study	30
III	Trial Pictures/words	31
IV	Word list	32
V	Average and percent scores	37
VI	Significant difference between articulation Scores	38
VII	Order of difficulty of phonemes	41
VIII	Item analysis results of various age groups	43-44
IX	Order of difficulty of phonetic environments	45
X	Comparison of percentage scores across various studies.	48
XI	Order of difficulty of phonemes in various studies.	49
XII	Cut-off score for Picture Deep Test in Tamil	50
XIII	Percentage score that can be used as cut-off score for different age groups	53

LIST OF FIGURES

PAGE NO.

1. Total scores obtained by different age groups 37 a
2. Percentage of items correct in various age groups 37 b
3. The percent scores for males and females of different age groups 39 a

CHAPTER I

INTRODUCTION

'It was humiliating but good advice, I got from my English teacher. After my last oral report, he quoted Shakespere in his written critique, "Mend your speech a little, lest it mar...your future". I guess I have been pretending that others do not notice my slushy /s/ I didn't think it was obvious'.

Stan College Sophomore.

Articulation can be defined as a series of overlapping ballistic movements which place varying degrees of obstruction in the path of the outgoing air-stream and simultaneously modify the size and the shape of the coupling of the resonating cavities (Nicolosi, Harryman and Krescheck, 1978). Articulation is the process by which the outgoing air-stream is divided into distinguishable speech sounds. When we articulate we bring two things together to modify the expelled breath. The articulators we use are the lips, teeth, tongue hard palate, soft palate. These articulators modify the air-stream up into individual speech sounds.

Articulation is said to be normal as long as the speech sound production of the speaker is conveying the meaning intended by him. If the speaker fails to convey the meaning intended by him by the use of inappropriate phonemes it is deviant or abnormal articulation. An articulation disorder can be defined as incorrect production of speech sounds due to faulty placement, timing, direction, pressure, speed or integration of the movements of the lips, tongue, velum or pharynx.

The types of articulation errors observed are:

Addition: It is the addition of phoneme(s) not part of the word itself.

Distortion: Approximation of a phoneme in some manner which renders it acoustically unacceptable.

General oral innacuracv: Indistinct production of sounds, even though no specific omission, addition, substitution or distortion is heard.

Omission: It is the absence of a phoneme that is not replaced by another sound.

Substitution: Replacement of a standard speech sound by another standard speech sound.

Any deviation in normal speech persuade the parents or others concerned to seek help from a professional. Then it starts with identification and the nature and extent of the articulation error must be assessed. This is done with the use of articulation tests.

An articulation test is an evaluation that yeilds 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 structures of his language group.

Articulation tests are used in:

1) identifying abnormal articulation
2) locating possible causative factors
3) planning and evaluating therapy
4) in predicting the improvement of therapy and
5) in finding the effectiveness of the therapy.

follows:

1. Screening tests of articulation:These are designed to identify the articulation disorders.

2. Predictive screening test: It gives a gross measure of the individual's articulatory abilities to determine if further testing or intervention is warranted.

3.Diagnostic test: Test designed to determine which are defective sounds and to what degree, so that speech correction program can be tailored to a particular persons needs.

4. Deep test: It is a test designed to identify specific phonetic contexts in which misarticulations occur, as well as the specific phonetic contexts in which sounds are correctly produced and it assesses each phoneme in a variety of contexts. It is one of the diagnostic tests in which each sound is tested in all possible phonetic contexts. That is, 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.

The purposes of the deep test of articulation are:

1) to permit evaluation of speech sounds as audible, end products of a series of overlapping, ballistic movements, and,
2) 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 has several advantages.

The pictures and sentences can be used for administering any conventional tests to give information on consistencies and inconsistencies of errors, and to help search for key words and contexts. Emphasis is placed on the function of the consonant and the consistency of the consonant error in extended speech utterances of the child in many different phonetic contexts, thereby providing information which may be secured from more conventional tests which base their results on phoneme production in isolated words. It can be very useful in the exploration of phonemic environments in which consonant production may be correct. 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 deep tests that are available are in English (McDonald, 1964), Kannada (Rohini, 1989), Malayalam (Maya, 1990), Bengali (Animesh (1991). India is a multilingual country and it is apt that articulation tests are developed in various languages to cover the population speaking different languages. In this context, the present study aims to develop a deep test of articulation (Picture form) in Tamil. This would help in identifying specific phonetic environments which are easy for the client. It would also help to program therapy which would enhance the progress of the client.

CHAPTER II

REVIEW OF LITERATURE

Articulation testing is a procedure, using which the phonemic ability of an individual in a given language is determined. Some kinds of information can be obtained only by setting up structured tasks for the client to do and then systematically observe his performance. One such structured task to find the articulatory capability of an individual in various sound environments is the deep test of articulation. Only very experienced speech therapists can listen to the conversation of an articulation case and come up with a detailed presentation of each error, how it was made and under what condition. However, the same results can be obtained by using a systematic articulation testing program.

Articulation tests have several purposes as follows:

1) To 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 sounds that have to be treated first,

10) Predicting improvement, 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 that speech correction should take, a diagnostic test is needed. McDonald (1SS4) 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 occuring singly or in clusters, is either to release or arrest syllables. The movements of articulators into and out of a given consonant affects the character of the consonant. In order to analyse the correctness 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 superimposed on the syllable. Sounds are studied as parts 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
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 inconsistencies 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 utterances 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 test 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 its inclusion in the assessment of articulation disorders. At present, deep tests of articulation are available in English, Kannada, Malayalam and Bengali.

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 than 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 & 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 (Daniloff and Moll, 1968; Harris, Schrey and Lysawght, 1962; Okman, 1966;

Wang and Fillmore, 1961; Schwartz, 1967; 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. Shiner, Holloway and Daniloff (1969) recommended that co-articulation and context be considered in the selection of speech units for correcting articulation.

Both the picture form and the sentence form assess the production of 13 consonants and the picture test uses non-sense materials 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 occured. 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 form a primer first and second grade reading lists and third grade reading level 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 responses 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 yeilds 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, 1957), 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 2 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.

Zehal and Shelton (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 are 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 or 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, ie. e)	Word medial 1 morpheme (CVSVC)
sell	race	racing	porsum
sit	miss	missing	wrestle
soup	purs	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/ /ʃ/ /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 correct response was given a score of 1 and the total correct 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 /l/ 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 the more difficult than single sounds. T test showed no significant difference between males and females within the age groups and also 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 8 key phonemes (/j/ /s/ /s/ /ʃ/ /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 were 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 /ʃ/ were the 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 /ʃ/ 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 misarticulated 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 and 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.

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 disccriminate between paired auditory stimuli presented by another speaker, along with 3 new tests, used 'deep test' of articulation for /r/ - additional test for discrimination constructed by Dorsay (1959) according to principles suggested by McDonald (1959). Correlations 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 to be 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 samples 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 tets 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 Tamil language.

CHAPTER III

METHODOLOGY

Material: In this deep test of articulation those key-phonemes which are most frequently misarticulated by the children were selected. In Tamil the most frequently misarticulated sound are /k/ /g/ /c / /j / /ṭ//ḍ/ /t/ /d/ /s/ /ṣ/ /r/ /l/.

Phoneme	Phonetic description
k	Velar voiceless unaspirated plosive
g	Velar voiced unaspirated plosive
c	Palatal voiceless affricate
ɟ	Palatal voiced affricate
ṭ	Retroflex voiceless unaspirated plosive
ḍ	Retroflex voiced unaspirated plosive
t	Interdental voiceless stop
d	Interdental voiced stop
s	Dental voiceless fricative
ṣ	Retroflex voiceless fricative
r	Retroflex voiced trill/flap
l	Retroflex voiced lateral/alveolar

Table-I: Phonemes selected for the study.

These 12 phonemes were included in the present test. Simple meaningful and picturable words with these phonemes in initial and final position were selected as a means of eliciting a response from the children. Two such word lists were prepared with 33 picturale words in the first and the second lists.

In Tamil, words ending with the phonemes /k/ /g/ /j/ /d/ /t/ /ḍ/ /ʃ/ are all pronounced as a vowel ending. So these phonemes could not be tested in the word final position. In the second list also, the same sounds have been left untested, due to the same reason.

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 Table-II. Eight simple words were selected and the pictures depicting these served as demonstration items (Table-Ill). All the pictures of the tests are in Appendix-I.

Key phoneme / Context		k	g	t	d	t	d	t	d	s	s	r	l
k	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	-	-	-	-	-	-	-	-	-	-	-	-
g	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	-	-	-	-	-	-	-	-	-	-	-	-
c	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	+	+	+	+	+	+	+	+	+	+	+	+
j	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	-	-	-	-	-	-	-	-	-	-	-	-
t	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	+	+	-	-	+	-	-	-	+	-	+	+
d	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	-	-	-	-	-	-	-	-	-	-	-	-
t	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	-	-	-	-	-	-	-	-	-	-	-	-
d	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	-	-	-	-	-	-	-	-	-	-	-	-
s	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	+	+	+	+	+	+	+	+	+	+	+	+
ʂ	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	-	-	-	-	-	-	-	-	-	-	-	-
r	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	+	+	+	+	+	+	+	+	+	+	+	+
l	P	-	-	+	-	+	-	-	-	+	-	+	+
	F	+	+	+	+	+	+	+	+	+	+	+	+

Table-II: Phonetic contexts selected for the study.

+ : Indicate phonemes are tested in that context.
- : Indicate phonemes are not tested in that context.
P : Indicates preceding and F indicates following.

For example taking the key phoneme /c / in column and /t/ in the row P + c preceding t is tested and c following t

F - is not tested.

Picture arrangement: All the pictures representing words with the key phonemes in final position were placed on the left side (Set-1) and those representing words with key phonemes in the initial position were placed on the right side (Set-2) such that any pictue on the left could be combined with that on the left. The first list had five pictures on the left and 12 pictures on the right and the second list had 5 pictures on the left and 11 pictures on the right. The pictures represent the following words in order (Table-IV).

Demonstration items

kav	kannadi
kav	toppi
val	kondai

Table - III : Trial pictures / words.

list - I

Va:tʃ (watch)

kɔrɔṭ (carrot)

NɔS (Nurse)

ṉe:r (chariot)

ka:l (leg)

kaṇ (eye)

gaḍiGa:ram (clock)

ʤanḍiran (moon)

djennal (window)

ṭɔmblɔr (tumbler)

ṉe:ŋga (coconut)

ḍa:yam (dice)

Salangai (anklet)

Saṭṭai (shirt)

ro:ʤa (rose)

lola:kɔ (Ear ring)

ḍama:ram (drum)

list - II

ṭa:tʂ (torch)

Sigɔret (cigarette)

Po:lis (police)

Aɪvar (people)

Mayil (peacock)

ko:lam (Rangoli)

golɔssɔ (anklet)

co:lam (corn)

dja:ṭai (whip)

ṉaiyal maʂin (Sewing machine)

telefo:m (telephone)

Shu: (shoe)

ra:ja (king)

laḍḍu (sweet)

Suɾian (sun)

ṉandava:lam (Railway track)

Subjects: 30 Tamil speaking normal children (15 males and 15 females) each in the age range of 4-5, 5-6, 3-4 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 Tamil and all of them were from middle-socio-economic status.

Administration:

The children were seated confortably and the test materials were placed such that he/she could see the pictures without any difficulty. Each child was tested individually in a quiet environment of the sch«ol at Porur, Tamil Nadu.

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 ie 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

'car' 'toppi' were shown to them and was uttered as a single word 'cartoppi'. Following thiS, the second picture pair 'val' and 'kondai' was presented which was again uttered as a single word 'valkondai' by the tester. 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 tobe 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, 5 phonemes were tested in 12 phonetic contexts and in list 2, 5 phonemes were tested in 11 phonetic contexts. Hence, the tester elicited a total of 60 responses (5x12) for list 1 and a total of 55 (5x11) responses for list 2. In total each child had to give 115 responses and for 120 children the total number of responses were 13800.

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 marked it on a scoring sheet. Depending upon the childs response, appropriate symbols were used to initiate whether he had articulated the test sound correctly or incorrectly as follows.

a) Correct response: -C-4

b) Substitution: The sound that was used instead of the target was noted down: -S-3

c) Distortion : -X-2

d) Omission: -0-1

e) Incorrect: -I-0

Sample score sheet given in Appendix II.

The total number of correct responses for each child was computed and the percentage of correct responses was determined by the formula:

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

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

CHAPTER IV

RESULTS AND DISCUSSION

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: It was observed that the scores increased linearly from 3-7 years of age. Also, in the age group 3-4 years, males obtained higher scores and in the age range 4-5 years and 5-6 years females obtained higher scores than males. In the 6-7 years both males and females performed equally. Table- V shows the average and the percentage scores for the groups tested.

Age (in years)	Sex	Total score	Percent score
3 - 4	M	191.8	79.91
	F	179.3	74.97
4 - 5	M	193.13	80.47
	F	196.66	81.94
5 - 6	M	215.6	89.8
	F	218.53	91.05
6 - 7	M	240	100
	F	240	100

Table- V Average and percent scores.

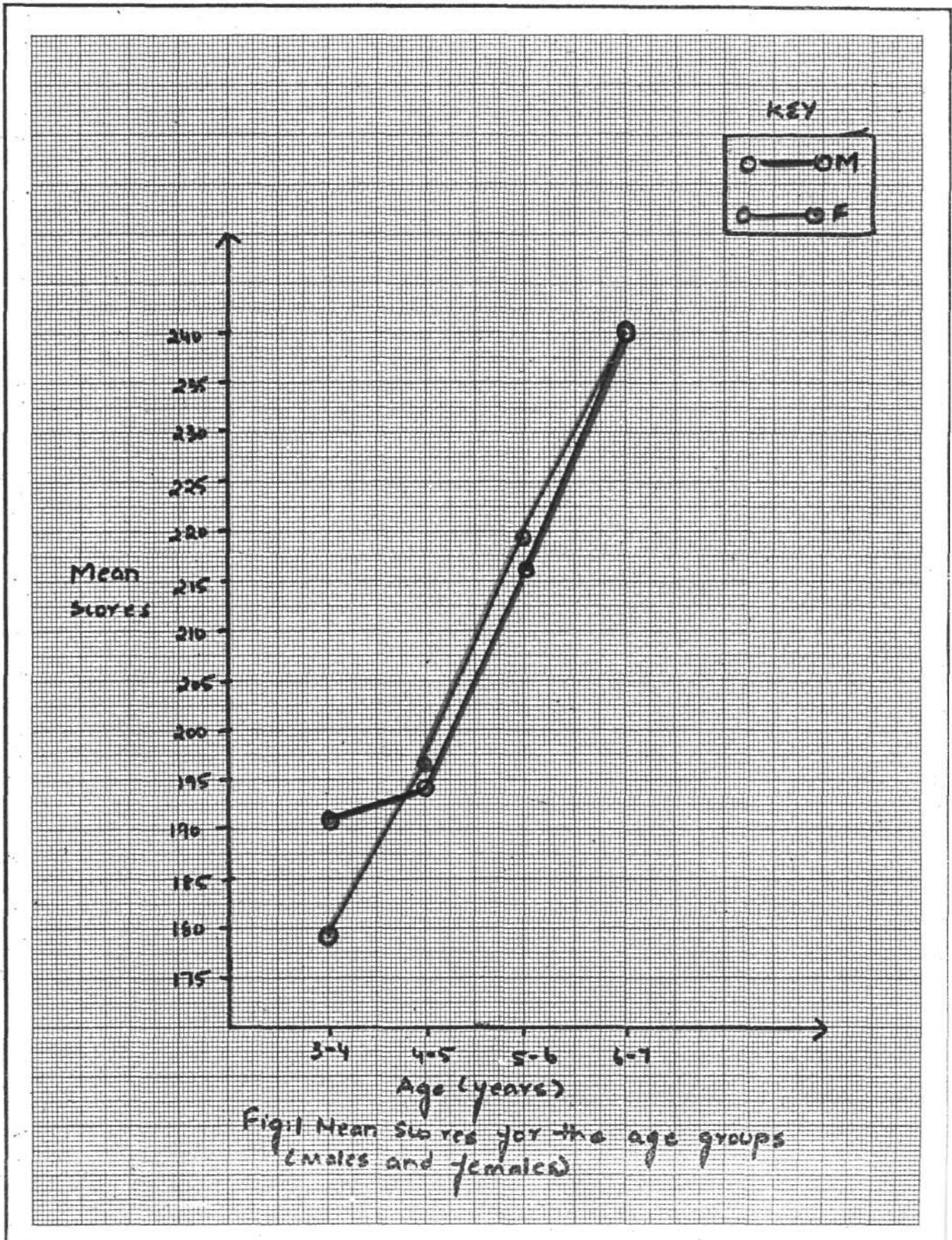

Fig:1 Mean scores for the age groups (males and females)

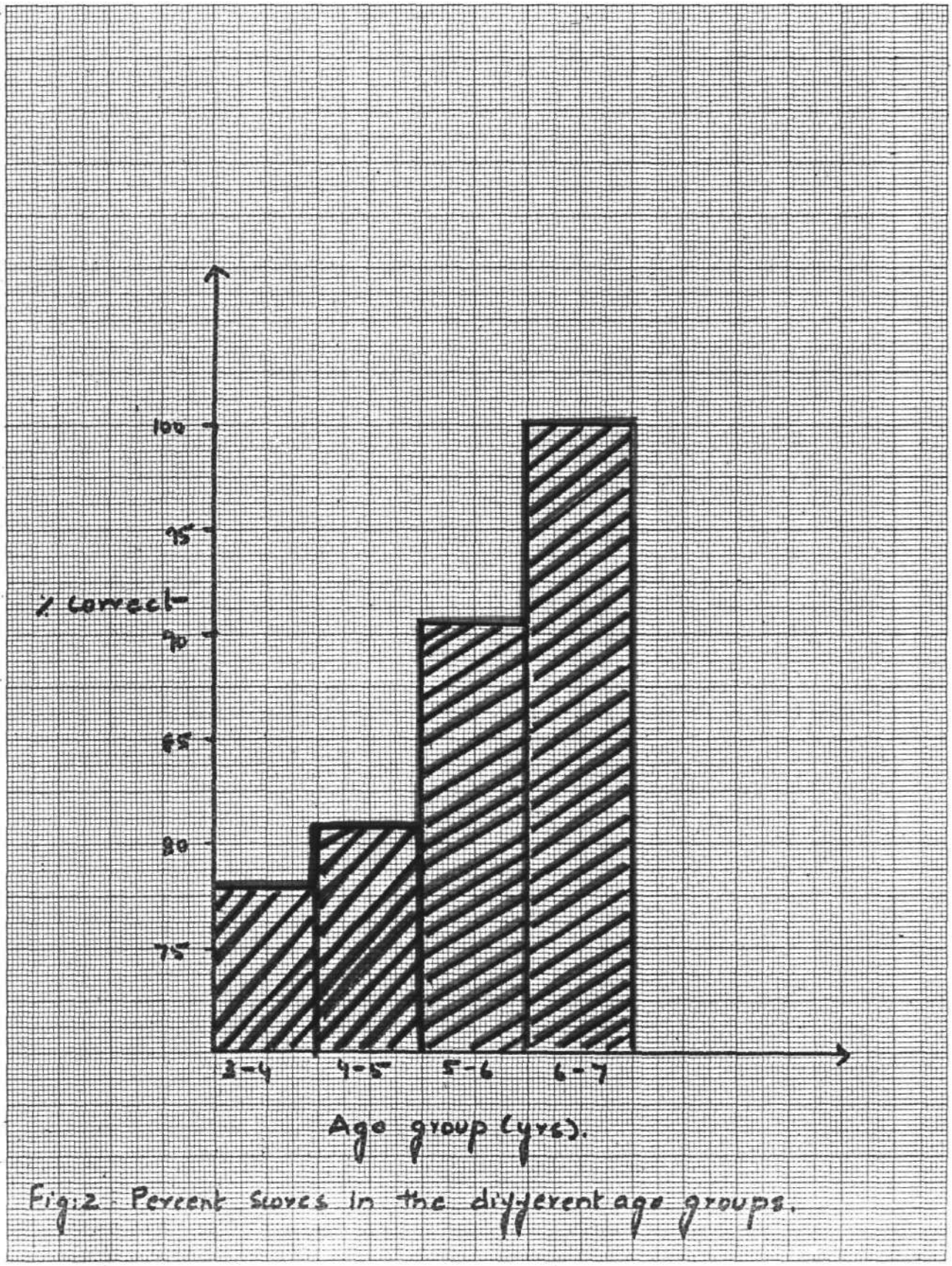

Fig:2 Percent scores in the different age groups.

Results of the T-test indicated that there was no significant difference between the performance of males and females. However, within the age groups there was a significant difference.

No significant difference was observed between the age groups 3-4 years vs. the 4-5 years. However, for the age groups 3-4 years vs 5-6 years, 4-5 years vs 5-6 years, 4-5 vs 6-7 years and 5-6 vs. 6-7 years, significant difference between the mean scores was observed. Table-VI. shows significant difference between the age groups for articulatory performance.

Age (in years)	3-4	4-5	5-6	6-7
3-4	-	-	S	S
4-5	-	-	S	S
5-6	S	S	-	S
6-7	S	S	S	-

Table-VI Significant difference between the articulation scores

S - The difference is significant.

Between the groups there was significant difference with low scores for the younger age group and high scores in

the older age group. Overall, females did better than males.

2. Distribution of scores among sub-groups

2.1: 3 to 4 years: The children in this age group obtained a mean score of 185.5, with a percentage score of 77.44%. Within this group, males obtained a higher score than females. It was noticed that there was a significant difference between the mean scores of males and females.

2.2: 4 to 5 years: The children in this age group obtained a score of 194.89 and a percent score of 81.2%. Within the group, males obtained a lower score than females.

2.3: 5 to 6 years: The children in this age group obtained a score of 217.06 and a percent score of 90.44%. Males had a lower mean score when compared to females.

2.4: 6-7 years: The children in this age group obtained a score of 240 and a percent score of 100. Both males and females were able to articulate all the phonemes correctly in all combinations. Figure 3 shows the

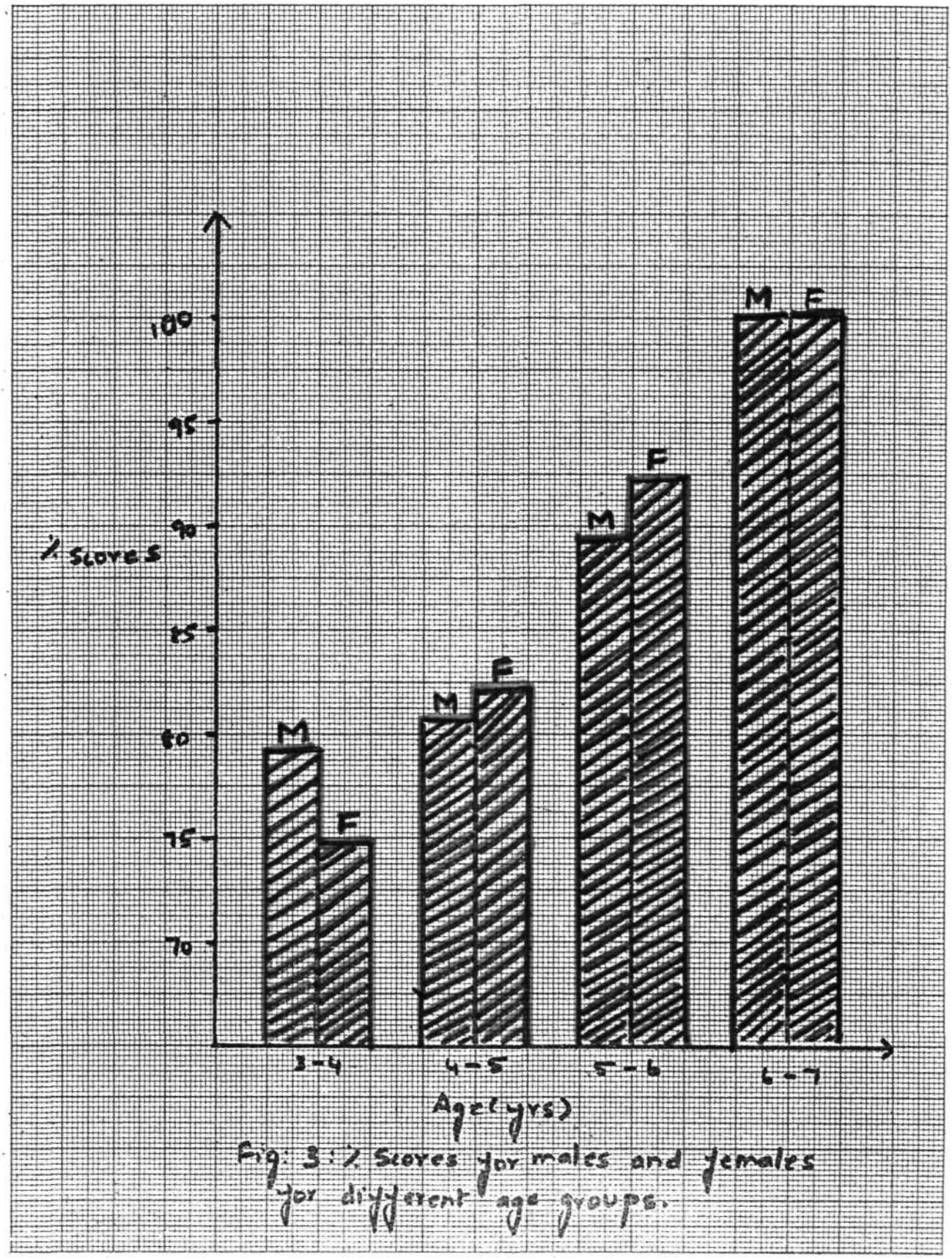

Fig: 3: % scores for males and females for different age groups.

percentage scores of males and females obtained across the age groups.

In general, the scores increased linearly from 3-7 years and females did better than males in all the age groups except in the age group of 3-4 years where the performance of males was better than females. Based on the means, the cut off for each age group can be established. The cut off for the age groups 3-4, 4-5, 5-6 and 6-7 will be 77.3%, 81.89%, 90.44% and 100% respectively.

3. Item analysis: An item analysis was carried out on the l380O responses that were obtained from 120 children. This was done to obtain the information on the item correct/wrong and to list them in the order of difficulty.

The results of the analysis indicate that in both males and females, the percent of correct response increased as the age progressed and reached a maximum at 6-7 years of age.

Based on the percent scores obtained for each phoneme from item analysis (general) the items were listed in the order of difficulty for each age group. For all the age

groups /r/ was the most difficult phoneme followed by /c/ /t/ /s/ and the easiest phoneme was /l/. Table-VII shows the order of difficulty of phonemes.

Age (in years)	Sex	1	c	t	s	r
3-4	M	72.28	71.12	52.78	41.12	10
	F	72.28	63.83	58.34	29.45	20.45
4-5	M	81.12	76.67	76.12	58.34	18.89
	F	82.78	71.12	71.61	66.12	39.45
5-6	M	90.56	87.78	88.34	70.56	68.34
	F	90	89.45	85.56	90.11	60
6-7	M	100	100	100	100	100
	F	100	100	100	100	100

Table-VlI Order of difficulty of phonemes in percent.

The order of difficulty as indicated by item analysis was as follows:

3-4 years: In this age group the order of difficulty for both sex was /l/ /c/ /t/ /s/ /r/.

4-5 years: For males the order of difficulty was /l/ /c/ /t/ /s/ /r/ and for females the order of difficulty of items was /l/ /t/ /c/ /s/ /r/.

5-6 years: For males the order of difficulty was /l/ /t/ /c/ /s/ /r/ and for females it was /s/ /l/ /c/ /t/ /r/.

6-7 years: The children were able to articulate all the phonemes correctly.

4. Order of difficulty of items: Table-Vffi depicts the item analysis results. It was observed that in 3-4 years easiest phonetic environments were /k/ /g/ /c/ / j / /t/ /d/ /l//t/ /d/ and the difficult phonetic environments were /s/ /ʃ/ and /r/.

4-5 years: In this age group it was found that the easiest phonetic environments were /r/ /s/ and /ʃ/ and the difficult phonetic environments were /k/ /g//c/ / j / t/ /d/ and /l/ /t/ /d/.

5-6 years: In this age group, the phonetic environments that were the easiest to articulate included /ʃ/ and /r/ and the environments that were most difficult to articulate included /k/ /g/ /c/ / j / /t/ /d/ /t/ /d/ /s/ and /l/.

Sound tested /c/

0-10	k g c j t d t d l
10-20	s
20-30	r

Sound tested /s/

0-10	g t d s s r
10-20	k c j t d l
20-30	

Sound tested /l/

0-10	r
10-20	s
20-30	k g c j t d

Sound tested /t/

0-10	s r
10-20	k g j
20-30	c t d t d l

Sound tested /r/

0-10	k g c j t d t d s r l
10-20	
20-30	

Age group 3-4 years

Sound tested /c/

0-10	r
10-20	s
20-30	k g c j t d t d

Sound tested /s/

0-10	r
10-20	s
20-30	k g c j t d t d l

Sound tested /l/

0-10	r
10-20	s
20-30	k g c j t d t d s

Sound tested /t/

0-10	r
10-20	s
20-30	k g c j d l

Sound tested /r/

0-10	k g c j t d t d s r l
10-20	
20-30	

Age group 4-5 years

Sound tested /c/

0-10	
10-20	
20-30	g t d s r

Sound tested /s/

0-10	
10-20	r
20-30	k g c j t d t d s l

Sound tested /l/

0-10	
10-20	
20-30	s r

Sound tested /t/

0-10	
10-20	r
20-30	k g c t d t d

Sound tested /r/

0-10	
10-20	s
20-30	k g c j t d t d r l

0-10 : least mistakes
10-20: Few mistakes
20-30: Maximum mistakes.

Age group 5-6 years

Table-VIII Item analysis results of various age groups

It is interesting to note that the difficulty of the phonetic environments completely reversed after the age group of 3-4 years. Table- shows the various phonemes and the phonetic environment in the order of difficulty.

Phoneme	Order of	3-4	4-5	5-6
c	1	k,g,c,j,t,d t,d,l	/r/	/s/
	2	s	s,	-
	3	ʃ,r	k,g,c,j,t,d t,d,l	g,t,d,s,g
s	1	g,t,d,s,s,r	r	r
	2	k,c,j,t,d,l	s,	k,g,c,j,t,d
	3	-	k,g,c,j,t,d t,d,l	t,d,s,l
t	1	r,s,	r	s
	2	k,g,j	s,	r
	3	c,t,d,t,d,l	k,g,c,j,t,d, t,d,l	k,g,c,j,t,d, t,d,s,l
r	1	k,g,c,j,t,d, t,d,s, ,r,l	k,g,c,j,t,d, s, ,r,l	s
	2	-	-	k,g,c,j,t,d,
	3	-	-	t,d,l
l	1	s,r	s,r	-
	2	s	-	s,r
	3	k,g,c,j,t,d	k,g,c,j,t,d, t,d,s,l	

Table- IX: Order of difficulty of phonetic environments.

1. Least difficult with a score of 80-120.
2. Difficult with a score of 40-80.
3. Very difficult with a score of 0-40.

To summarize the results indicated the following:

1. Articulation skill increased with age.
2. Females performed better than males though not significantly.

3. The phoneme /r/ was the most difficult articulate followed by /s/ and then /ʂ/.
4. The phonetic environments with trills and fricatives were more difficult to articulate.

DISCUSSION

The findings of Wellman (1931), Poole (1934) and Templin (1957) 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-existant in well controlled studies. Rohini (1989), Maya (1990) and Animesh (1991) 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 present study findings show that there are significant differnces between all the ages except 3-4 and 4-5 years. This agrees with the results of Rohini (1989)

and Animesh (1991) 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) and Animesh (1991) are compared in Table- X.

Age in years	Rohini (1989)	Maya (1990)	Animesh (1991)	Present study
3-4	-	-	-	77.3%
4-5	-	-	92.25%	81.89%
5-6	93.17%	85.8%	94.5%	90.44%
6-7	94.19%	95.86%	97.49%	100%

Table- X : 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 6-7 years obtained 100% scores, which was not the case in the previous studies. The difference might be because of the material used. 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 /ʃ/ were the most difficult. Animesh (1991) reported that /d/ and /r/ 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. However, in the present study no stop consonants were evaluated (as Tamil does not have words ending with stop consonants) and, /l/ and /c/ emerged to be the eaisest consonants (Table-XI).

Author		Order of difficulty
Rohini (1989)	5-6 years	/g/ /j/ /v/ /d/ /c/ /ʃ/ /l/ /r/ /n/ /d/ /f/ /s/
	6-7 years	/g/ /d/ /c/ /j/ /d/ /r/ /l/ /v/ /y/ /n/ /s/ /ʃ/ /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/
Present study	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

Table- XI 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-XII.

Age in years	Cut off scores
3 - 4	77.3%
4 - 5	81.89%
5 - 6	90.44%
6 - 7	100%

Table-XII The cut off score for picture Deep Test of Tamil

It could be concluded that the present test helps in deep testing articulation in Tamil 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 phonetic contexts. It is very useful as a diagnostic and a therapeutic tool. At present deep tests of articulation are available in English (McDonald, 1964) and Kannada (Rohini, 1989), Malayalam (Maya, 1990) and Bengali (Animesh, 1991) among the Indian languages. The present study was planned to develop a 'Deep test of Articulation' (Picture form) in Tamil 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.

Twelve phonemes that were most fequently misarticulated [/k/ /g/ /c/ /J/ /t/ /d/ /t/ /d/ /s/ /r/ /s/ and /l/] were considered for the study. The phonemes that were tested in the final position were /c/ /t/ /s/ /r/ and /l/, as they were the only phonemes occuring in the final position in Tamil. Thirtythree meaningful picturable easy Tamil words with the phonemes in initial and final position were

selected and pictures were written for these words. The pictures with the target phoneme in the final position were placed on the left side and those with the phoneme in the initial position was on the right side. These pictures were bound together to form a test booklet.

The study included 30 (15 males and 15 females). Tamil speaking normal children each in the age range of 3-4, 4-5, 5-6 and 6-7 years. None of the children had any history of ear discharge and hearing problem. All of them were from middle socio-economic status and a total of 120 children (60 males and 60 females) were chosen for various schools in Madras.

The children were instructed to produce a big funny word by combining the word depicted by the picture on the left side with that on the right side. They were instructed to produce the big funny word by seeing the picture or reading the words which were written below the pictures. When they were unable to produce the phonemes, properly, in the first instance, they were given a second trial and were instructed to repeat after the tester. Two trials were given before the actual testing started.

After repetition of two trials, if the child was unable to produce the target phoneme, then it was considered as an error. In this manner the responses were elicited, recorded and analyzed. Each correct articulation was given a score of 4, substitutions were given a score of 3, distortion 2 and omission 1 and incorrect articulation was scored '0'. The total score of each subject was calculated and statistically analysed. T test was performed and it was found that there was no significant difference between males and females in general, within the group, and also between the groups.

The result indicated that the articulatory skill increased with age. On the item analysis, it was observed that the phonemes /r/ and /ʃ/ were the most difficult to articulate. The fricatives and the trills were the most difficult environment. Based on the result, the cut off scores for articulation testing were provided (Table-XIII) which can be used further.

Age in years	3 - 4	4 - 5	5 - 6	6 - 7
Cut off scores	77.3	81.89	90.44	100

Table XIII: Showing the percentage scores that can be used as the cut off scores for different age groups.

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

CHAPTER VI

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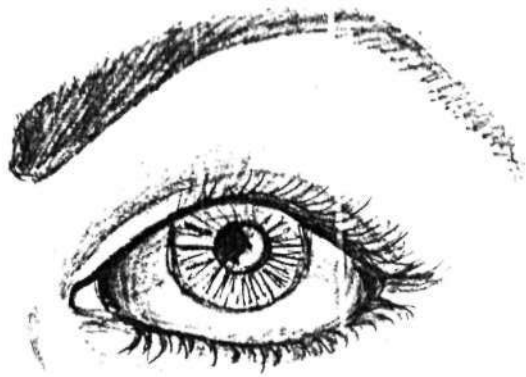

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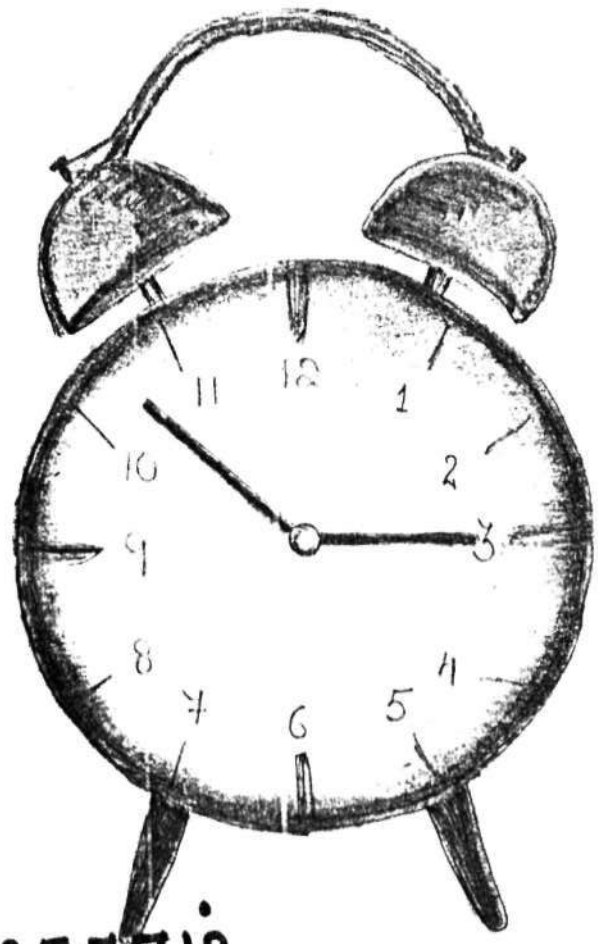

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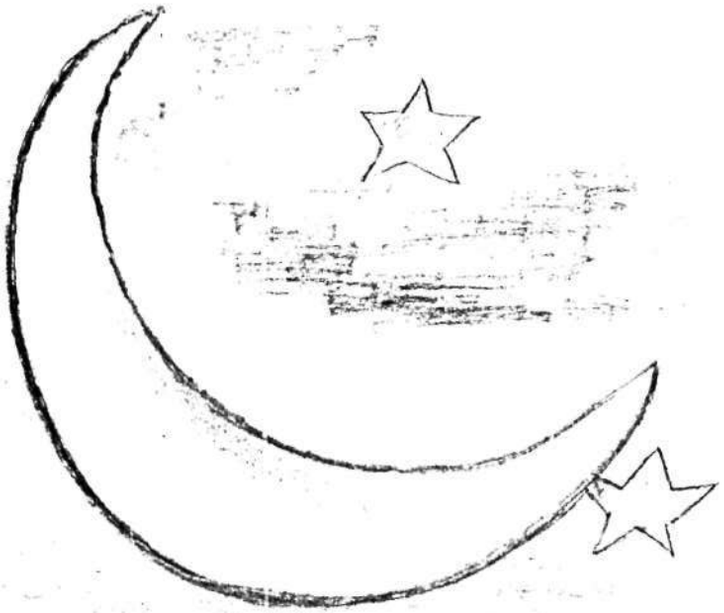

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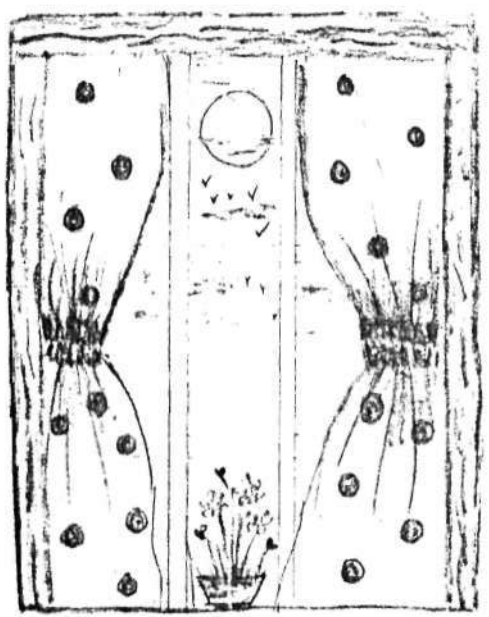

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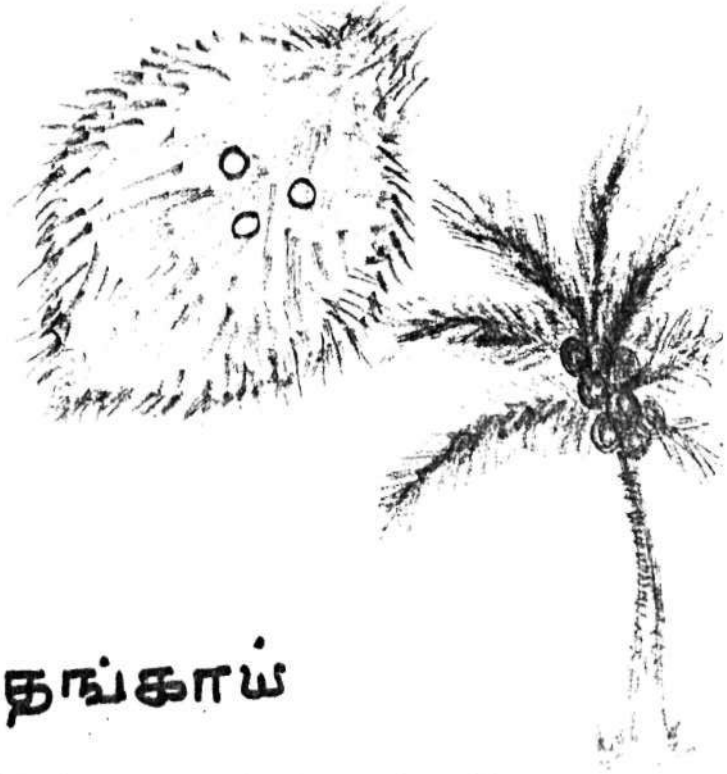

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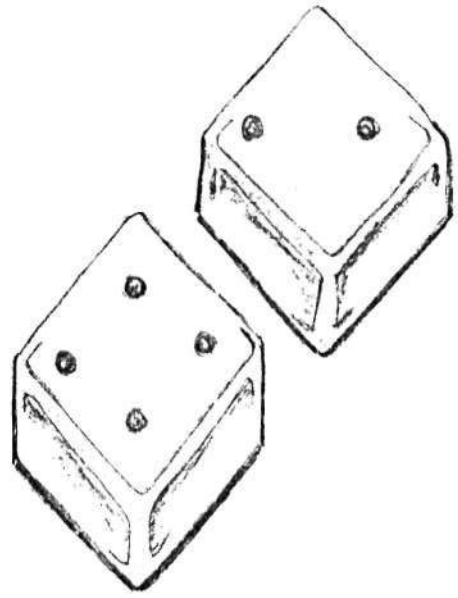

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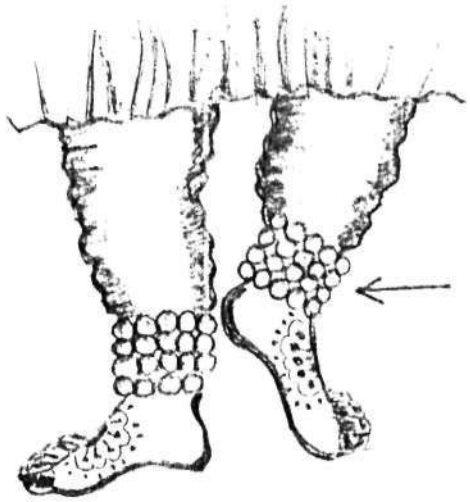

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ചിത്രം 7

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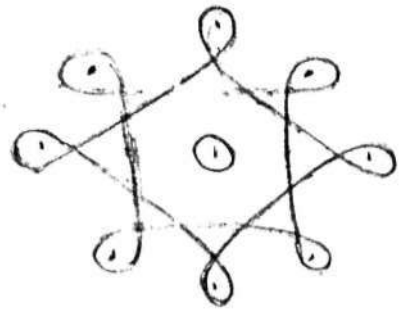

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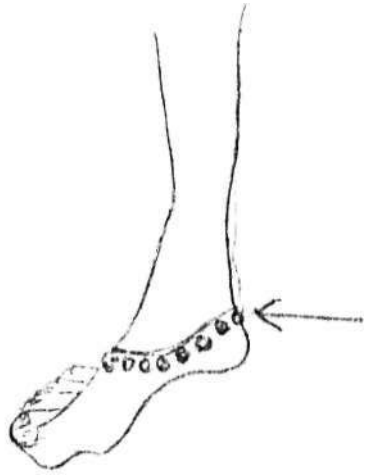

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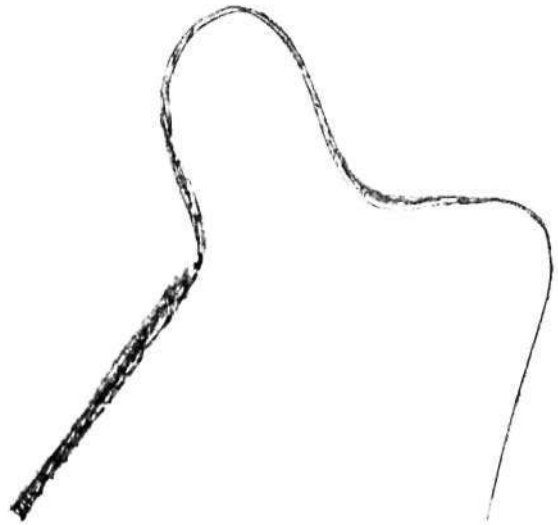

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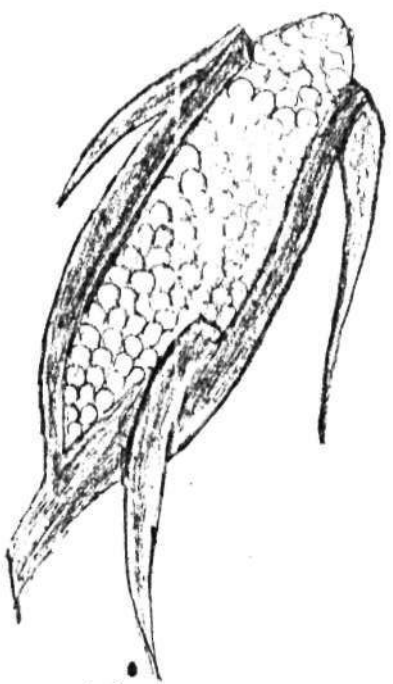

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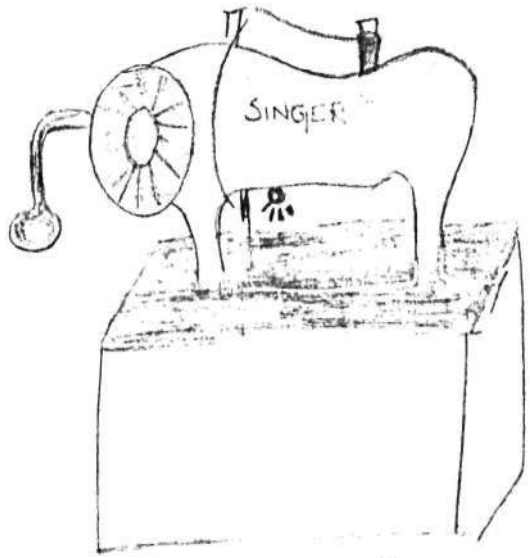

தையல் மெஷின்

فانوس

ภาพที่ 6

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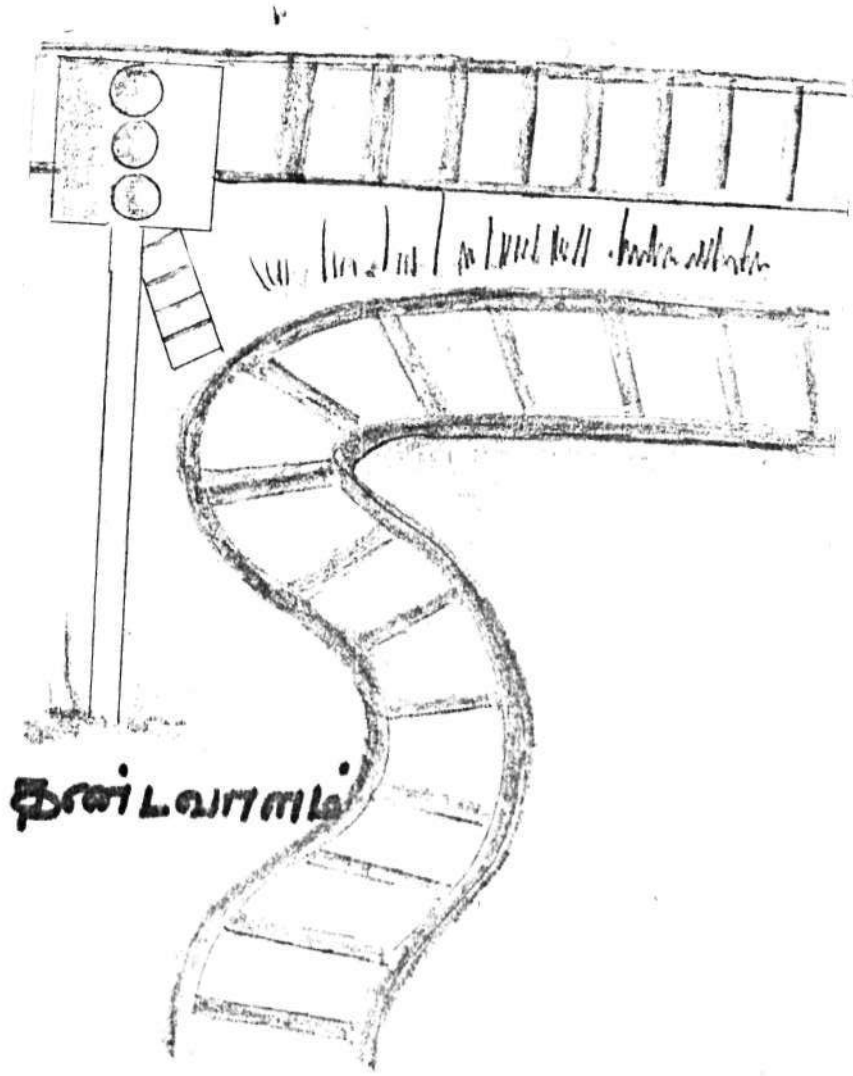

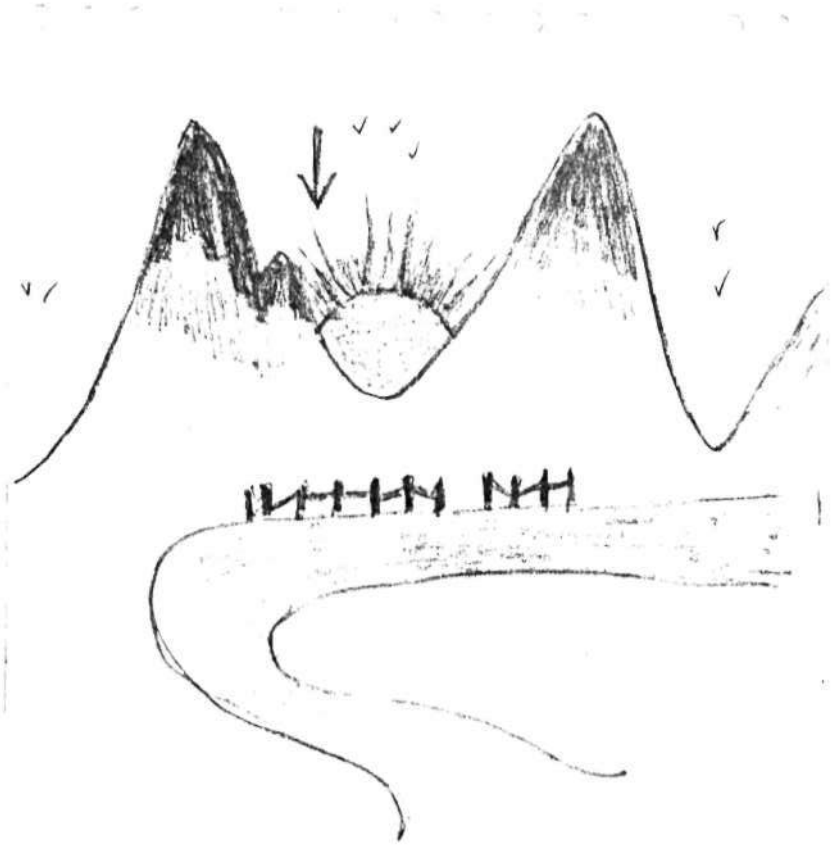

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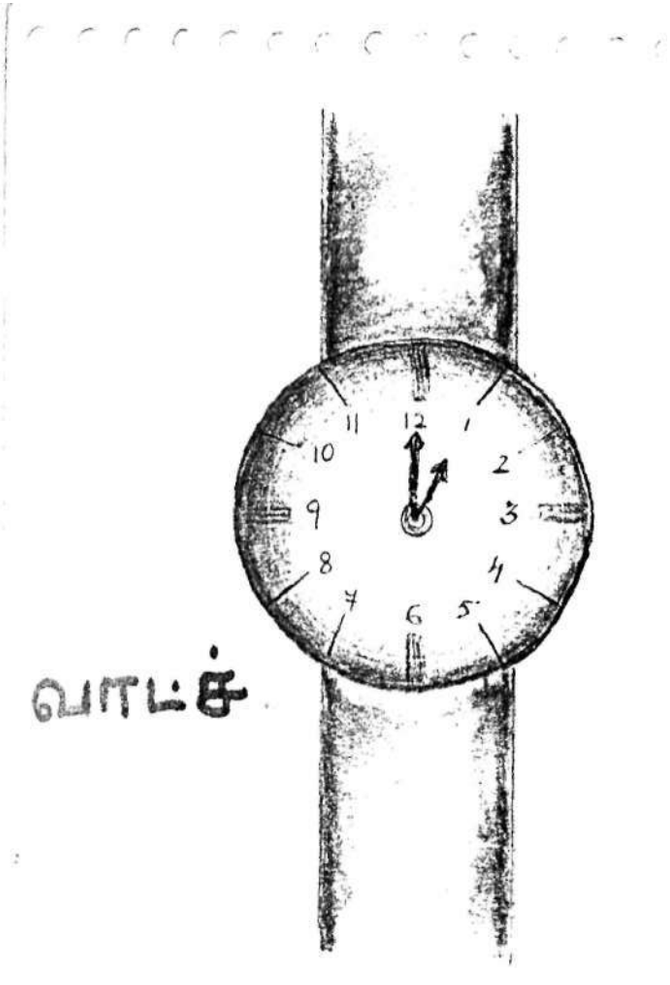

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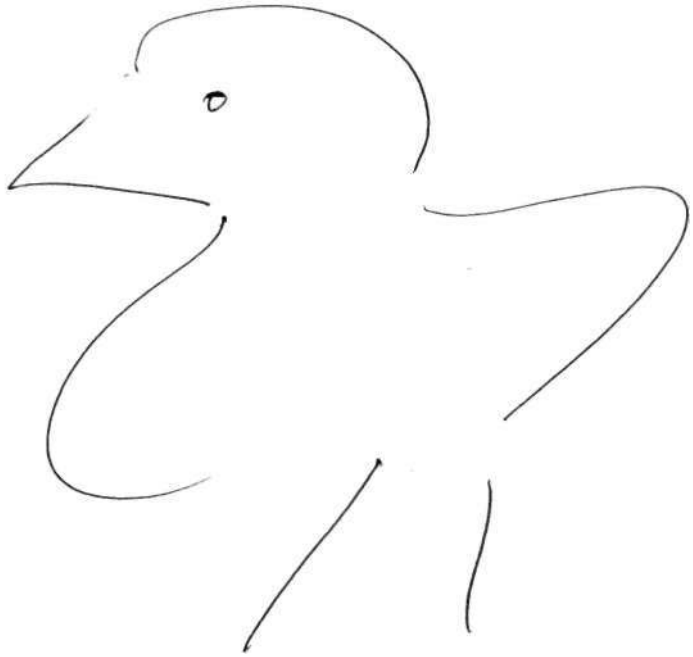

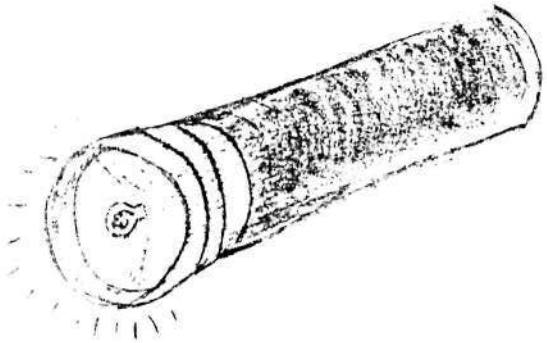

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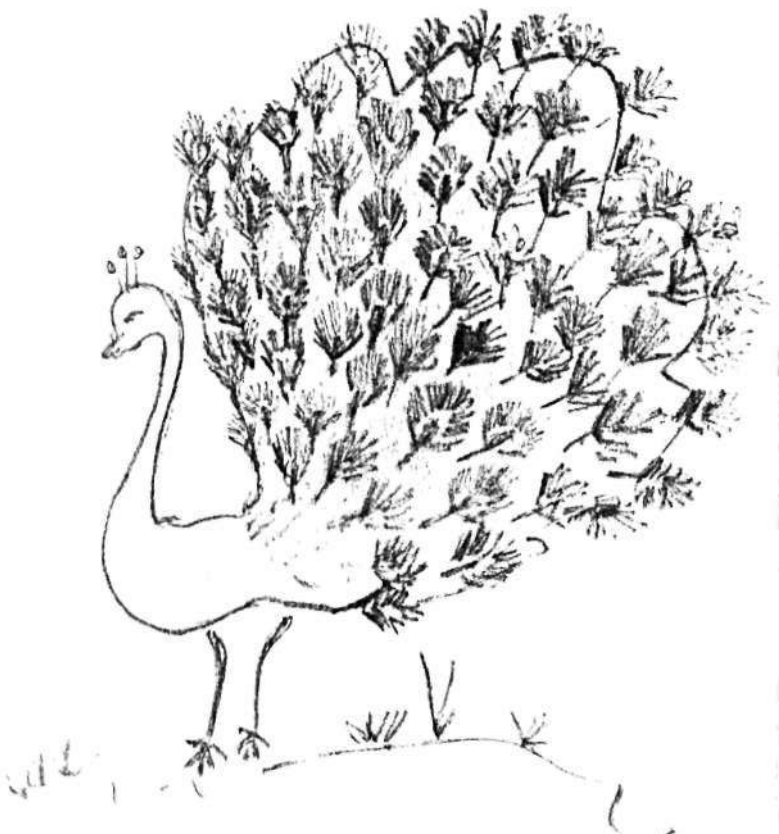

மயில்

Name:

Mother tongue:

Age/sex:

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Date:

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