Oral form Discrimination Skill as a Function of Age and Sex in Childern

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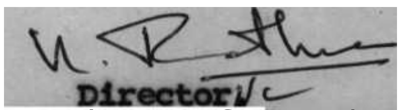
CERTIFICATE

This is to certify that the dissertation entitled "Oral form discrimination skill as a function of Age and Sex in Children" is the bona fide work in part fulfillment for M.Sc. in Speech and Hearing of the student with Register



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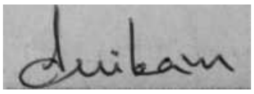
This is to certify that this dissertation has been prepared under my supervision and guidance.



Guide

D E C L A R A T I O N

This dissertation is the result of my own study undertaken under the guidance of Dr (Ms) Shailaja Nikam, Head of the Department of Audiology, All India Institute of speech and Hearing, and has not been submitted earlier at any university for any other Diploma or Degree.

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C O N T E N T S

CHAPTER I

INTRODUCTION

Mouth is a versatile apparatus. We use the mouth for all sorts of purposes, not just one. The organ of perception is often intermingled with organs of action and overlap with ether organs of perception. This is typical of perceptual systems (Gibson, 1967). Mouth is no exception to this having dual functions of oral motor activity and oral sensory and perceptual ability.

Oral sensory and perceptual integrity are important feed-back components for the regulation and refinement of oral motor patterns necessary for normal speech (Bosma[110] 1960, 1970). Disturbances in oral tactile perception related to normal speech has been found to be associated with disturbances in speech output. For this reason, it has of late received much attention in the line of research and therapy.

Contribution of oral sensory ability to normal speech has been investigated in two groups of subjects: (1) Pathologic Croup (Class[68], 1956; Levine[95] 1965; Rutherford and McCall, 1967; Chase, 1967; Bloomer, 1967, Rootes and McNeilage, 1967; Res Mason, 1967; Hochberg and Kabcenell, 1967; Gullford and Hawk,[95] 1968; Ringel and Scott, 1968; Rosenbek, 1970, 1973; Ringel et al,1970; Fucci and Robertson, 1971; Sommers at al, 1972; Creech and Wertz, 1973; Teixeira et al, 1974; Pressel and Hochberg, 1974; Jensen et al, 1975; Manohar et al, 1975; Hutchinson and Ringel, 1975; McNutt, 1977; Kelly, 1977; Lum and Russel, 1978; and Devraj, 1978).

(2) Normal Group in whom sensory disruption was artificially induced (McCrosky[80], 1950, 1958; Ringel and Steer, 1963; Ladefoged, 1967; Scott and Ringel, 1971a, 1971b; Gammon et al, 1971; Mason, 1971; Putnam and Ringel, 1972, 1976; Leanderson and Perason, 1972; Horii et al, 1973; Prosek and House, 1975; Burke, 1975; and Gerald et al, 1977).

Pathologic Group studied included both cases with organic and functional disorders. The aspect of speech production that was mainly disturbed was articulation (Bloomer, 1967; Creech and wertz, 1973; Ringel and Scott, 1968; Ringel et al, 1970; Fucci and Robertson, 1971; Sommors et al, 1972; Kelly, 1977; and McNutt, 1977); although fluency disruption was also noticed Class 68, 1956; Jensen, 1975; Manohar, 1975; Hutchinson and Ringel, 1975; and Devraj, 1978). Those in whom speech was deficient, oral sensory ability was also affected (Rutherford and McCall, 1967; Bloomer, 1967; Chase, 1967; Levine, 1965; Guilford and Hawk, 1968; Rosenbek, 1970, 1973; Creech and Wertz, 1973; Teixeiro, 1974; Lumand Russel, 1978; Andrew, 1973; Class, 1956; Ringel and Scott, 1968; Ringel et al, 1970;

Fucci and Robertson, 1971; Sommers et al, 1972; Kelly, 1977 and McNutt, 1977).

The battery of tests used to measure oral senaory ability included tests of tactile acuity, texture discrimination, localization, pattern recognition, two point discrimination, vibrotactile sensitivity and oral stereognostic tests (Rutherford and Mccall, 1967; Fucci, 1972; McDonald and Aungst, 1967; Ringel et al, 1970; Ringel and Ewanowski, 1965).

In the second group of normals the role of oral sensory perception in normal speech function was demonstrated by anaesthetization of both topical and nerve block nature. The intelligibility of speech was minimally affected, consonants undergoing maximum disruption compared to vowels (Ringel and Steer, 1963; Gammon et al, 1971; Scott and Ringel, 1971).

Among all these groups, the test which gave more consistent results was the test designed to evaluate the ability in oral stereognosis (Lass et al, 1972).

Oral Stereognosis

Oral stereognosis is the faculty of perceiving the nature of objects on the basis of tactile kinesthetic sensations from the oral cavity, particularly the tongue (Thompson, 1970). Such a faculty is said to be indicative of the integrity of nervous system.

For normal articulation of the individual needs to develop an ability to integrate spatial representations of his oral cavity. Similar ability is required in performing the oral stereognostic task successfully. Therefore, the performance on oral stereognostic test would assess individual's proficiency in articulation. This is supported by the studies of oral stereognostic capability which indicate that a significant relation exists between oral stereognosis and articulation proficiency (Class, 1966).

The most common method of assessing oral sensory ability if oral form recognition. In a typical test, a subject is asked to orally manipulate a previously unseen 3-dimensional form and to identify that form from a group of visually presented forms. Methodological differences in the studies may account for conflicting results and place certain limitation on comparison of results (Ringel, 1970).

The major complaint that was raised against the oral form recognition test was its inter-sensory nature. Weineir (1968) and Ringel et al (1968) noted that experiments using oral form recognition task measure not oral sensory capability by itself but rather some aspect of inter-sensory matching. Visual acuity played a role in the performance on oral form recognition. Therefore, Ringel et al (1968) constructed a test to eliminate the inter-sensory nature of the form matching tasks. The test was intended to serve as a measure of form discrimination.

The oral form discrimination test required the subject to judge and say whether the two forms presented successively in the mouth were same or different. This procedure when applied to functional misarticulation and normal speakers, was found useful in differentiating them. Subjects with different degrees of misarticulations showed significant difference in performance (Ringel et al, 1968, 1970).

Variables involved in oral form discrimination

Several variables affecting the performance in oral form discrimination test were studied. The attempt was to have a standardized test so as to make it possible to compare the different test results.

Studies were conducted with various stimulus parameters as independent variables (Lass et al, 1972; Lass and Clay, 1973; Torrans and Beasly, 1975; and Lapointe and Williamson, 1971). The variables studied in relation to oral form were size and shape of the forms and the presence or absence of handle. Thinner forms, triangular shape and handlers forms enhanced the possibility of poor performance. The other variables studied were retention time, inter-stimulus interval. The optimum performance was achieved with 5 seconds of retention time and inter-stimulus interval.

Variables in relation to subjects were also studied (Lass et al, 1972; Lass and Cleve, 1973; and Mani, 1978). It was found that (1) feedback and learning had no effect on performance, (2) memory had a role, (3) adults performed better than children, and (4) oral form discrimination skill increased as a function of age.

The variables which have not yet received much attention are: sex difference, socio-economic status, linguistic factors, motivation, intelligence and developmental trend.

Mani (1978) conducted a study designed to evaluate the developmental trend and sex difference in oral form discrimination ability in children ranging in age from 5 to 13 years. She found that the development was not uniformly linear and no sex difference was demonstrated in oral form discrimination skill. The study was conducted on 'odd-year' age group. Those children with ages 5, 7, 9, 11 and 13, were considered as the 'odd-year' age group children.

Information is not available about the oral form discrimination skills of even age group children.

Need for the study

Sex difference and age trend in other sensory-motor skills studied shows a gradual development of the skill in successive age groups. Presence of sex difference seems to vary with the skill.

Sex

With regard to visual form discrimination ability, Gainer (1956) found that the girls and boys did not differ in their performance. But, Thompson (1962) found that females were superior to males in color vision.

Hearing acuity of females in frequencies above 100 Hz was found to be significantly better than that of males(Corso, 1967). But, boys after puberty were found to have superior ability to hear low tones compared to girls (Reyman and Rolman[38], 1946).

Gliner (1953) in his study which was conducted to find tactual discrimination threshold, found that girls were better in texture discrimination and boys in shape discrimination.

In speech development, girls were ahead of boys in reaching 95% correct articulation (Templin, 1952; and 1957). In consonant production girls excelled boys, though no sex difference was found for vowel production (Wellman[99] et al, 1973). Ladefoged (1967) suggested that vowel production mainly depends upon auditory feedback while consonant production on tactile feedback.

No sex difference was reported in oral form recognition ability (William and Lapointe, 1971; Canetta, 1977). This failure in detecting sex difference may be mainly due to the fact that the study was conducted on adult population. since oral form discrimination ability has been found to be more related to speech proficiency than oral form recognition task, sex difference in consonant development was expected to be revealed in oral form discrimination ability. But, in a study conducted on odd age group from 5 to 13 years (Mani, 1978) no sex difference was reported on oral form discrimination task. Therefore it was intriguing to see if the even age group would present similar results.

Age:

Speech sound acquisition starts at a very young age and is completed by 8 years of age (Wellman[69] et al, 1931; Pool[112] 1934; Templin, 1957). Pickson, Roe and Milisen (1934) found that those who misarticulated could improve in their performance as a function of maturation from 1st to 5th grade. But Sayler (1941) found no reduction in mlsarticulatlon as the child grew elder. Thus, same children retain misarticulations beyond the age by which articulation acquisition is complete. Such children showed strong deviation in their gross motor ability (Pickson, 1962) and auditory discrimination ability below the age of 9 years (Van Riper, Irwin, 1958).

Since oral form discrimination ability is more closeby related to articulation ability than general motor ability, the former may be more sensitive in identifying children who are likely to retain their mlsartlculation.

It was hypothesized that, as the articulation skills become stabilized they run over the monitoring to oral sensory feedback. Such a transit was expected to take place by 8 to 9 years of age (Van Riper and Irwin, 1958). Therefore information regarding the development of oral form discrimination skills in children will be beneficial diagnostically and therapeutlcally.

A high correlation was found between tests of stimulability and oral form discrimination scores (Lass and Moreau, 1974). Prognostic value can therefore be attached to oral for discrimination.

A glimpse over the trend of development in other sensory skills would indicate the importance of the study on oral form discrimination ability.

In visual form discrimination, error rate was found to decrease in the higher grades. (Gainer, 1956). Gibson[27] et al (1962) conducted a study to find discrimination ability of letter-like forme in 4-9 years old children. They found that errors decreased linearly as the age increased.

Tactual discrimination ability was found across the age range of 5.8 to 8.8 years. It was found that older children performed better than the younger ones (Giner, 1953).

The ability to distinguish between speech sounds is clearly an age related variable. In a few normative studies available, errors were found to have inverse relationship with the age, and reached a celling at about 9 years of age (Templin, 1943, 1957; and Wepman, 1958).

Carpenter (1976) studied acoustic cue discrimination ability in 4.5 and 6 year old children. A gradual development for temporal cue was found with an increase in age. Similarly Allison (1975) found that the ability for self-monitoring auditory discrimination increased from kindergarten to 4th grade gradually. However the improvement was not statistically significant. Irwin (1974) reported decrease of errors in auditory discrimination linearly with increase in age from 5 to 8 years.

A gradual development in the ability to judge temporarally distributed pattern both visually and auditorily was found in 5-11 year old children (Kloppor and Birch, 1971). The performance decreased slightly in 10-11 year old children but was not statistically significant.

Kidd and Kidd[54] (1964) reported that there was a tendency toward better auditory acuity and pitch discrimination with age. Gilbert[36] (1893) found pitch sensitivity to increase from 6-10. Andrews and Madeire (1977) studied the ability in pitch discrimination of children from 6-8½ years and reported that this ability increased with age.

Age was found to be an important variable affecting performance in oral recognition task (Arndt et al, 1970; McDonald and August, 1967; Williamson and Lapointe, 1971; and Canetta, 1972). McDonald and August (1967) found that mean score in oral form recognition task increased linearly as a function of age till midteen. They had chosen children from successive ages.

The studies so far reviewed agree that the developmental trend is a linear one. But the study on oral form discrimination (Mani, 1978) do not support this. The study was conducted on 'odd-age' group.

Therefore the present study was conducted to answer the following questions:

1) Is there a significant increase in oral form discrimination ability with an increase in age in even age group;

2) Will the performance of boys and girls differ significantly in oral form discrimination task in these age groups;

3) Is there an interaction effect between age and sex in oral form discrimination task;

CHAPTER II

REVIEW OF LITERATURE

Recently, researchers have taken much interest in the area of human oral sensory function as one of the possible etiologic factor for defective speech. Investigators have sought to mainly two means to establish presence or absence of relationship between oral sensory ability and speech proficiency. The series of studies that have been conducted in oral sensory ability have used wide variety of methods to measure sensory abilities. The literature relevant to this will be reviewed here under two sub-headings:

I Studies with adults serving as subjects

II Studies with children serving as subjects

Studies in each of the above category will then be reviewed under the sub-categories:

i) Studies with pathologic group

ii) Studies with normal group in whom sensory disruption was artificially induced

iii) Studies relevant to the methods used in determining oral sensory abilities

I Studies with adults serving as subjects

i) Studies with pathologic group: The pathologic group studied constitute cases both diagnosed as having organic pathology and those diagnosed as not having any organic deviation - the functional cases. Each of these will be reviewed separately.

a) Studies with cases diagnosed as having organic pathology:

under this category are included patients with sensory-motor pathology and patients with oral structural changes.

Sensory-motor pathologic group included cases with dysarthria, aphasia and apraxia.

Levine[95] (1965) studied twentyseven normal and twentyseven aphasic subjects. He compared them for oral stereognostic perception. Each subject was asked to point to the tracing on the paper which corresponded to the form in the mouth. Aphasics made three times more errors than the normal subjects. The findings of Guilford and Hawk[95] (1968) fall in the similar lines.

Rosenbek et al (1973) administered three oral sensitivity tests to three groups of subjects, (1) thirty adults with cortical lesion, (2) ten aphasic adults without apraxia, and (3) thirty normals serving as control. The test battery consisted of the following:

i) Oral form discrimination test (Ringel et al, 1968): The patients was blindfolded and two geometric forms differing either in shape or in size were placed in his mouth successively. The subjects task was to judge whether the two forms were same or different.

2) Two point discrimination test: An esthesiometer was used to obtain two point discrimination threshold on the tongue tip and the blade.

3) Mandibular Kinesthesia Test (Ringel et al, 1967): The subject had to judge whether a series of seven mouth openings were greater than or lees than a standard mouth opening.

The finding of the study was that the first group had significantly greater difficulty on all the three tests. Further, severity of apraxia was found to be significantly related to the performance on all the three tasks. Rosenbek (1970) reported similar findings with apraxia having direct relation-Ship with oral sensory difficulties. Studies in agreement with above findings have been reported by Teixeira et al (1974) and Lunn and Russel (1978).

Twenty subjects diagnosed as cases of CVA formed experimental group and six normals formed the control group. Subjects in experimental group were categorized as dysarthric, aphasic and apraxic using Johnson-Darler test. Results revealed that normals had performed better on oral stereognoatic recognition tests than any of the clinical group and that apraxica scored significantly lover in comparison other groups (Teixeira, Defranand and Nichols, 1974).

Lum and Russel (1978) administered oral form discrimination teat to sixteen post CVA dyspraxlcs. This study was done in order to validate Luria's[55] (1977) hypothesis that oral discrimination would be associated with afferent form of than afforant form of dyspraxia. The results were in agreement with earlier findings where oral atereognostic scores have been found to correlate with severity of dyspraxia. However, unlike the findings of Rosenbek (1973), the study indicated that oral atereognostic scores are more closely correlated to the particular type of dyspraxia, which predominantly shows errors of substitution. This would add evidence to the model proposed by Luria[55] (1977) that abnormalities in kinesthetic feedback may be involved in patients suffering from afferent kineethetic dyspraxia, the locus of lesion probably being in the area of secondary zone of post central gyrus.

Other than apraxia and aphasic, dysarthrics have also been tested for oral stereognostic ability (Creech and Wertz, 1973). Twenty dysarthric patients were matched for age and sex with twenty control subjects. Oral sensation and perception tests consisted of the oral form discrimination test, two point discrimination test and mandibular kinesthetic test used by Rosenbek et al (1973). A tape having ten minute sample of imitative and spontaneous speech was rated for intelligibility on a seven point rating scale by experienced speech pathologists.

The results indicated that the scores of the dysarthric group were significantly lower than that of control group on all the three tests. However, Creech and Wertz (1973) could find no relationship between oral sensitivity and speech intelligibility.

The results of the above studies reveal that patients with neurological disorder have deficit in oral stereognosis. This deficit might be the cause for the speech problem.

Subjects with cleft lip or palate came into the group of those with oral structural changes. These subjects may also present congenital anomalies of sensory end organs and/or their central connections. Also repositioning of tissues by various surgical procedures may diminish the oral sensory inputs. Therefore, studies have been conducted on cleft palate subjects, for their ability in oral stereognosis.

Hochbergs and Kabeenell (1967) administered oral stereognosis test to twelve cleft palate adults and thirteen normals. The sample was heterogenous with respect to age, type and the extent of cleft, type of management, speech proficiency and ether associative disabilities. Subjects who wore prosthetic aids were tested with and without the aid.

Significantly poor scores were demonstrated by cleft palate subjects. It was noted that the subjects with prosthesis performed significantly better than those without it. The older cleft palate subjects performed significantly better than the younger cleft palate subjects. Similarly findings were reported by Andrews (1973) whose subjects' age ranged from 6 to 29 years.

Andrews (1973) compared the performances of cleft palate group with non cleft palate subjects on a test of oral form discrimination. He also tried to relate the results of the cleft palate group to the type of cleft and the adequacy of articulation.

Thirty-nine cleft palate patients were each matched by age, with non cleft palate subjects having no known defect of speech and oral structures were studied. All the clefts were surgically closed except for one subject and one subject with anterior palate closed but had an unrepaired posterior palate.

Oral form discrimination test was administered to both the groups. Man cleft subjects performed significantly better than the cleft subjects. The number of errors on the oroaensory test were similar for patients with bilateral, left unilateral and isolated palatal cleft*. The cleft palate subjects who had fewer articulation errors had almost the same scores on oral form discrimination test as did normals. The mean number of errors on oral form discrimination teat for poor articulation group was significantly greater than for either non cleft group or the cleft palate group with relatively good articulation.

The two studies reviewed here give limited information. More detailed analysis and homogenity of grouping is needed in terms of number of years of prosthesis use, number of years of speech therapy. Studies have to be done with groups who are surgically treated, maintaining the homogenity in number of years after surgery.

b) Studies with eases diagnosed as having functional disorders;

The recent research evidences in the area of tactile feedback has given us interesting facts regarding the etiology of so called 'functional speech disorders'. The speech problems which are considered to be functional may show an etiological oral sensory disturbance. Stuttering and cases with misarticulation mainly come under this type of functional disorder.

Studies in tactile feedback which have been extended to the area of stuttering are reviewed here.

Jensen et al (1975) while studying oral sensory perceptual integrity of stutterers tested intra oral form recognition, labial and lingual two point discrimination, interdental, intra oral weight discrimination and interdental thickness discrimination. They chose stutterers and normal speakers who were matched for sex, age, race and education as subjects for the study. They found no difference between stutterers and normal speakers in oral sensory perceptual integrity. The investigators pose that the result may be so because they were not successful in testing oral sensation and perception during the act of speaking.

Studies were conducted using the technique of oral anes-thetization to evaluate the oral sensory ability in stutterers (Hutchinson and Ringel, 1975; Manohar et al, 1975; and Devraj, 1978). Hutchinson and Ringel (1975) anesthetized the oral region of a group of stutterers using a aeries of nerve block injections. The subjects were asked to deliver a talk. The investigators found that there was increased dysfluency and they attributed this to unchecked emergence of dysfluency pattern which is preprogrammed.

However, the above findings were contradicted by Manohar et al (1975) and Devraj (1978). Manohar et al (1975) studied 3 stutterers under four conditions, viz., (1) base rate; (2)

105 dB SPL masking noise; (3) lingual anesthesia; and (4) masking noise and lingual anesthesia. All these conditions involved reading and spontaneous speech sessions. They analyzed repetition and eye blink responses. They reported improved fluency in their cases under tongue anesthesia.

Devraj (1978) studied the speech sample of a stutterer after lip and palate anesthetization separately. The findings of this study were: (1) There was substantial reduction in stuttering of stutterer under palatal and labial anesthesia; and (2) Labial anesthesia produced more reduction in stuttering than palatal anesthesia. On the basis of the study the investigator concluded that stuttering may be due to disturbance in tactile and kinesthetic feedback.

Studies reviewed here have been very inconclusive. Further research needs to be done taking an adequate number of subjects.

Literature on articulatory disorders suggest that normal development and maintenance of articulation presupposes, to some degree the adequacy of gross and specific motor and sensory functioning within the oral region. Some sources of disordered articulation may reflect a basic oral sensory disability.

Ringel and Scott (1968) administered oral form discrimination test to articulation defective subjects and normals.

The pathologic group included nine females and eighteen males. The articulatory defective subjects reported no past or present history of sensori and/or motor defects and gross abnormalities of the oral structures were not observed upon examination. Articulatory defective subjects were further subdivided into 2 groups: (l) mild mlsarticulation (a_1); and (2) moderate misarticulation (a_2) group. the group comprising of normal speaking subjects had sixteen females and four males. All subjects were judged free of speech defects, oral structure anomalies and reported no past or present history of sensory and/or motor disturbance.

The findings of this study indicated that on the average normal speakers produced significantly fewer errors than the total articulatory-defective group and its sub group. In Addition, the two articulatory defective sub groups differed significantly in their average performance. Subjects in sub-group a_2 made greater average number of mistakes compared to sub group a_1.

The findings of the study are as expected, demonstrating poor oral sensory ability in misarticulators. However, this being the only study in adults does not allow us to come to definite conclusion.

ii) Studies with normal group in whom sensory disruption was artificially induced:

Role of tactile feedback in speech production has been studied by artificially inducing sensory disruptions. A aeries of studies have attempted to delineate the role of sensory mechanisms in speech through anesthetization. Review of these studies reveal that the results are controversial. The two techniques of anesthetization used were:

(a) Topical anesthesia wherein Xylocaine Hcl 4% is applied to oral region. This appears to remove tactile feedback alone.

(b) Nerve block anesthesia - achieved by bilateral injection of Xylocaine 2% with epinepherine to infra orbital, posterior palatine and medial naso palatine nerve.

Articulatory proficiency under anesthetization have been evaluated by means of direct assessment of speech and muscular movements recorded through photography and Electromyography.

(a) Topical anesthesia: Studies using this technique appear to have minimal effect on speech accuracy.

Ringel and Steer (1963) conducted the study on thirteen females with normal speech and hearing subjects. The subjects were tested under six conditions: (1) a control situation without anesthesia or nolsey (2) binaural wideband noise;

(3) topical anesthetization of oral region; (4) local anesthesia of bilateral mandibular and infra-orbital nerve block technique; (5) combination of conditions (2) and (3); and (6) combination of conditions (2) and (4).

Analysis of speech after anesthesia revealed a significant increase in average peak level of speech. No change in fundamental frequency, speech duration or articulation was noted. When a combination of masking noise and anesthesia was used, significant articulation impairment was noted as compared to conditions when either only topical anesthesia or masking noise was used.

In another study (Ladefoged, 1967) five subjects were tested under a control and three experimental conditions: (1) binaural masking noise; (2) topical anesthesia of the surface of the lips, tongue and roof of the mouth; and (3) combination of (1) and (2). The subjects ware asked to read a test passage and to make spontaneous remarks under the 4 conditions noted.

In condition (3), though speech was intelligible, speech of most subjects were very disorganized. Subjects had difficulty in controlling their lip movements in condition (2), resulting in misarticulatlon of /p/,/b/, /m/, /f/ and /v/.
Difficulty in producing satisfactory /s,z/, /t,d/ and striking
of /l/ was noted. Pitch and nasality were affected
variations in articulation/along with vowel in condition (1).

Thus, it appears for vowel production auditory feedback is important while most consonant production depend on tactile feedback (Ladefoged, 1967).

The results of above two studies do not agree regarding the speech performance under anesthesia. The intelligible speech even with local anesthesia may be reasoned out, that a alight shift in the place of articulation may still result in correct acoustic results (Sussman, 1970).

A study was conducted (Burke, 1975) to demonstrate any substantial relationship between delayed auditory feedback (CM;) susceptibility and selected auditory perceptual and oral sensory ability.

Subjects with high and low susceptibility to DAF were chosen and tested for their dependence on auditory or oral sensory feedback. Auditory masking, whispering and local anesthesia were used separately and in combination to achieve a reduction in one or more feedback channels. subjects were tested for their ability in oral diadokokinesis rate and oral stereognpsis under oral anesthesia.

Results obtained revealed that reduction of either auditory or oro sensory feedback had no differential effect on speakers with high and low susceptibility to DAF.

More studies taking several variables may aid in better understanding of speech production tasks under local anesthesia, so that such a technique can be used to study the effect of feedback on speech production with more certainty.

(b) <u>Nerve block anesthesia</u>: Anesthetization of the oral cavity through nerve block injection has become a fairly common technique in assessing the significance of tactile-kinesthetic feedback during speech.

McCrosky[80] (1950, 1958) was the first to use this technique for studying the speech production. He reported that most articulatory changes were of the substitution type.

(1) Ringel and Steer (1963) studied the effect of nerve block anesthesia alone and in combination with wide band noise on thirteen normal subjects. A significant increase in average peak level of speech was noticed in both conditions in all the thirteen normal subjects. Phonation-time ratio increased significantly. Articulation was most severely affected by nerve block anesthesia or in combination with masking noise. Major type of misarticulation was distortion. The difference in mean syllable duration between nerve-block condition and control and topical anesthesia condition was found to be very large, but they were not statistically significant.

Spectrogram analysis and phonetic transcription of the words spoken with and without nerve-block injection was studied by Scott and Ringel (1971a). Two normal adult males were required to produce 2 bisyllable words from CID auditory teat W-1 with and without nerve-block injection.

The result revealed that articulation of stop consonants wader experimental condition was characterized by (1) retracted place of closure for /t, d, k, g/; (ii) upper lip inactivity for /p, b/; and (iii) the affricated release of voiceless syllable-initial stops.

Almost total loss of retroflexion was noticed in /v/ ; /w/ characterized by deiabiallzation was noticed in consonant production.

Fricatives ware noticed to retain their manner of production. The production was characterized by less close constriction and a retracted place of constriction. The spectrogram revealed that the high frequency energy sequence of /s/ was considerably diminished in experimental condition.

Vowels needing labial movements were altered during experimental condition. A alight tendency toward a more neutral vocal tract configuration during vowel production was noticed. Nasality was not found to be altered.

(3) putman and Ringel (1972) studied the role of sensory feedback in the lip by using a combination of anesthesia and photography. An adult female with normal speech and oral structure was the subject of the study. Anesthetization was

by bilateral infra orbital and mandibular injection to the trigeminal nerve branches. The effect of labial sensory deprivation on articulation of /p/, /b/ and /m/ in initial position of monosyllable words were studied.

The findings of the study were: (1) during experimental condition, lip movement was less accurate and less extensive; (2) bilabial consonants appeared unilabial and incomplete closure for /p/ was seen in /sp/ clusters. A qualitative analysis revealed that during anesthesia lack of accurate monitoring of the intra buccal air pressure in /p/ resulted in fricative sound. But this change was not seen in /b/ or /m/ with /m/ being least effected. Anticipatory lip rounding was noted in clusters like /pr/ and /br/. in the manner of production of a single initial /p/, /b/ or /m/ under anesthesia no major changes were noticed. This may be due to the passive motor system in which the lower lip is moved up and down from the upper lip by the movement of the mandible which is unaffected by anesthesia. The movement of mandible is believed to be monitored by temporo-mandibular joints.

Articulation and stress/juncture production has been studied under oral anesthesia and masking noise (Gammon et al, 1971). The study consisted of three experimental conditions - (1) auditory masking binaurally with wide band noise at 110 dB SPL; (2) tactile nerve-block anesthesia; and (3) combination of (1) and (2)along with a control condition. Eight college students of whom four were aware of the experimental design and purpose, and four who were naive served as subjects. The subjects were required to read 30 paired sentences and a prose paragraph.

The analysis of the results revealed that in none of the three conditions were the stress and juncture disrupted. consonants suffered more in condition (2) and (3) than in (1) as in earlier studies. Fricatives requiring precise opening for turbulance, were more often misarticulated than plosives. Feedback regarding articulatory shape, area of contact and pressure of contact (sad pressure of contact) appeared to be important in consonant production.

EMG activity of facial muscles during speech was found in 10 normal adults with and without trigeminal nerve block. Patients with trigeminal neuralgia were also included in the study. The EMG was recorded for them before and after the blockade of the gasserion ganglion. NO perceptible difference in speech was found in subjects before anesthetization and after anesthetization (anesthetization of both unilateral and bilateral nature). The most consistent finding was a general increase in the amount of pre speech and background activity as well as in particular the amount of articulatory activity. The EMC changes observed after blocking of the afferent activity in the trigeminal nerve may be accounted for by a disturbed positional sense. To compensate for this disturbance, the control of articulatory activity which is not normally conscious, may be referred to a higher level of central nervous system. Such a more conscious control might explain the overshooting of muscle activation (Leanderson and Persson, 1972).

Horii et al (1973) studied the acoustic characteristics of the speech produced without oral sensation. An young adult, the subject of the study, was asked to read a passage for 85 seconds before and after anesthetization. Sensation was eliminated by nerve block injections.

Analysis of speech produced without oral sensation revealed (1) reduction of natural frequency spectral components (2) some temporal disorganization (decreased rate of utterance and prolongation of voice syllabic nuclei) and (3) a higher and more variable fundamental frequency.

Changes in intra oral air pressure and consonant duration in subjects with sensory deprivation due to anesthesia was studied by Prosek and House (1975). Four young adults with normal speech and intact oral structures were asked to read 20 bisyllabic words, first in isolation and then in sentences. A list of 13 sentences were also read which provided a wide variety of allophonic variation of the stop consonants under study. The findings of the study were that, the characteristic carriage of the tongue shifted posteriorly, the rate of speech was slower and misarticulation of consonants were present in anesthesia condition. In addition, the consonants were produced with slightly greater intra oral air pressure.

Putnam and Ringel (1976) used cine radiography to study the behavior of the lips, tongue and mandible in 2 subjects talking normally and under the influence of trigeminal nerve block anesthesia. The speech sample consisted of isolated words and sentences. Frame by frame measurements of lip protrusion, tongue position and jaw placement were taken from the film data for selected stops, glides, fricatives and vowels in the speech sample.

Comparison of these measurements between the normal and nerve block conditions revealed the following changes. In nerve block data (1) reduction in context appropriate lip protrusion and loss of precision in lip closure activity which was more noticeable for the upper than the lower lip; (2) a reduction in the precision of tongue articulation particularly on contacts for lingua-alveolar and lingua-velar consonants, apical retroflexion on glides and steady state postures for lingua-palatal fricatives and vowels and (3) noticeable alterations in inferior and superior jaw position which symmetrically close to the maxilla for bilabial consonant closure and often reduced or extended in excursion for vowels and other consonants.

Studies so far reviewed on oral sensory deprivation reveals the importance of oral sensation in speech production. All the studies reveal that anesthetization his maximum disruptive influence on consonant production. Stops and fricative production were most effected. Loss of retroflexion in /r/ production was noticed with complete omission of sometimes. Most of the studied used very small number of subjects. One of the major criticisms has been that anesthetization may also have impaired motor nerves due to their proximity to the sensory nerve. Motor disturbance was not studied in any of the studies (Locke, 1960). However, Scott and Ringel (1971b) compared the speech samples obtained from individuals with motor disability and individuals with sensory disruption due to anesthesia. The subjects consisted of six dysarthric adults and two normal adults with nerve block anesthesia. Subjects read 11 spondee words. Phonetic transcription and wide band spectrogram analysis revealed several differences between the two groups. The authors concluded that motor and sensory dysfunctions result in a variety of defective articulatory patterns. If investigators had tested the oral sensory perception of the dysarthric group better conclusions could be reached.

Sieget et al (1977) studied the speech of a single adult talker whose oral cavity was anesthetized. Effect of task variables on speech after desenaltlzation was studied. Subject's performance in oral stereognostic test, diadokokinetic task, speech tasks in familiar and unfamiliar language were tested before and after the anesthetization.

In diadokokinetic tasks, the rate of response was lower after the anesthesia than before anesthesia. The subject's performance on oral stereognostic test was errorless before the anesthetization, but the subject could not detect the presence of form in her mouth after sensory deprivation. On intelligibility analysis deviation from intended words was noticed in speech after the nerve block. Smallest percentage of errors for two syllable words and greatest percentage of errors for complex passage was noticed on analysis of articulation of familiar words. Analysis of subject's performance on unfamiliar words after nerve block injection revealed that imitation had deteriorated.

The effect of sensory deprivation on oral stereognostic ability was studied on 30 normal subjects (Mason, 1971). Oral stereognostic score did not appear to be effected by right unilateral mandibular block anesthesia. Bilateral mandibular block anesthesia appeared to be critical factor in breakdown of oral perception.

Effects of anesthetization on gross oral functioning ware estimated using a test of oral stereognosis on tan normal subjects. Results indicated a significant increase in number of errors after anesthetization (Burke, 1975).

All the studies mentioned above agree that the anesthetization of oral structure brings minimal disruption in speech accuracy though gross motor function seems to be definitely affected. A controlled study would help one to find the reason for this unexpected result.

iii) Studies relevant to the methods used to determine oral sensory abilities:

a) Measures of oral sensitivity

A number of attempts have been made to device accurate methods for evaluating oral sensory functions. The tests have taken the form of either measurement of sensory acuity or sensory discrimination. Attempts have been made to relate these measures with speech proficiency.

Grossman (1967) used nylon filaments of varying diameters to teat oral tactile stimulation. The filaments were ranging in diameter from 0.071 to 0.142 mm. Tactile stimulation of various oral and non oral sites were found out. The subjects of the study were two men and four women ranging in age from 35 to 40 years. The oral sites of tactile stimulation were incesive papilla, the dorsal surface of the tongue tip, and upper and lower lips. All were tested in the midline. Two extra oral sites were also chosen. The filament was placed on the test site and a 'just noticeable bend' of the filament was achieved by contact with the test surface. Immediately the subject was questioned as to whether he felt it or not. The question was also asked without touching the site. The results demonstrated that the upper lip was significantly more sensitive than any of the other sites. The lower lip and tongue did not differ. However, they were significantly more sensitive than the other oral and extra oral sites.

Another test for oral sensory acuity is tactile acuity. It has been operationally defined as the ability to detect a groove engraved on a smooth plastic piece. Normal acuity was found to be 1.5 mil. The test for kinesthetic pattern recognition requires the subject to first trace a pattern cut into a plastic piece with the tongue. Subsequently, he is asked to point to the picture of the pattern he traced. It was found that normal and dysarthric could be successfully differentiated using these two tests (Rutherford and McCall, 1967; McCall, 1969).

Studies have been conducted to evaluate the ability of oral cavity to assess the object size and hole size. Dellow et al (1970) investigated the oral assessment of plastic cylinder size and found that subjects made errors of over-estimation which were significantly greater than those produced by manual comparison alone.

Subject's ability to assess the size of holes of various diameter was studied by asking the subject to match the intra-orally presented hole with visual display. The result was in agreement with previous study, that incorrect judgement was predominantly in the direction of overestimation (La Pointe et al, 1973).

Williams and La Pointe (1914) devised an instrument and procedure for measuring discrimination of small deviation from the vertical and horizontal orientation of a groove engraved in plastic disc. The instrument was designed so that the disc with groove engraved could be rotated to change the orientation of groove relative to a horizontal or vertical plane. The subjects were required to make judgements of the groove's angular relationship to the vertical and horizontal axes.

Ten males and ten females were blindfolded and instructed to explore the groove with the tongue and report the position of groove as (1) vertical, (2) horizontal, or (3) angled to right of vertical, or (4) angled to left of vertical. Results indicated no significant difference in number of errors made by males and females. When response to the left of the vertical plane was compared with those of right of plane no significant difference was found. Subjects performed better in horizontal plane than vertical plane condition.

Ringel and Flecher (1967) tested twentyfour normal adults for ability in texture discrimination. Six pieces of cloth varying in coarseness formed the stimulus material. The oral spatio-temporal discrimination ability was hypothesized to be related to textural discrimination. The subject was presented with a standard stimulus and its number was informed. Then he was presented in random order a series of 'variable' stimulus, above and below the value of the standard. the subject was then instructed to assign a numerical value which expressed its proportional relationship to the standard. The subject was blindfolded throughout the experimental session. The stimuli were presented to selected oral and extra oral structures. The results suggest characteristic patterns of response for the structures evaluated in relation to the texture of the stimuli.

Ringel et al (1967) tested thirty normal adults to determine normal mandibular kinesthetic DL. The change in mandibular positioning which was necessary for the perception of such changes is termed mandibular kinesthesia difference limen. The mandibular positioning were measured using the vernier calipers. The results revealed that as the size of the oral aperture increased proportionately smaller difference limen were noticed.

These tests used for oral sensitivity, so far, reveal that there is a need for more research regarding their relation to speech production before they can be used as clinical tools. Other than the tests described above, there are teats for measuring vlbrotactile sensation and two point discrimination which are more widely used when compared to other tests for oral sensitivity evaluation.

Oral vlbrotactile sensation is a more accurate measure of oral sensation and is used to differentiate normals and abnormal speakers. The measurement made is vibrotactile threshold. Grossman (1970) has noted that vibratory stimuli share same central nervous system pathway as touch and involve high level perceptual judgements akin to speech. Geldard (1940) was the first investigator to demonstrate that vibrotactile stimuli could be used successfully to assess central and peripheral tactile processes. Oral vibrotactile sensitivity of functional misarticulation subjects was found to be significantly less than normal (Pucci, 1972; and Telague, 1973).

Studies have been conducted by varying several variables in vibrotactile threshold measurement. Pucci and Hall (1971) obtained vlbrotactile thresholds for five male and five female adults. Thresholds were established by the psychophysiological method adjustment. Each subject was tested on two oral structures and two non oral structures. Threshold obtained on the tip of tongue were compared with those obtained on the palmar surface. Results indicate that there is a statistically significant difference in threshold for the tongue and palmar surface while the tip shows no significant difference for the frequencies tested.

The ether variable that was studied was the frequency. Telage, Fucci and Arnst (1972) attempted to provide normative data regarding the Vibrotactile sensitivity of the tongue far 110 normal adult speakers at 200 and 400 Hz. The range of frequencies to which the tongue was most sensitive was selected (Fucci, 1972). Threshold for all speakers were obtained at 200 Hz to 400 HZ using method of limits (Hall 96 et al, 1972). Comparison of threshold at the test frequencies showed a lower mean sensitivity at 400 Hz than 200 Hz. The lowest vibrotactile threshold for the tongue were obtained in the range between 300 and 400 Hz.

Fucci et al (1977) studied oral sensory changes in subjects speaking with disrupted auditory feedback. Thirty normal adults were the subjects of the study. Lingual vibrotactile threshold was used to assess quantitatively the Changes in oral sensory function. Threshold at frequencies 125, 250 and 500 Hz were obtained from lingual doraum. Auditory masking was given while measuring the lingual vibrotactile threshold. The analysis of the results showed no effect of auditory masking on lingual sensory ability.

The complexity of the instrument used to measure vibrotactile sensitivity makes it difficult for one to use it in determining oral sensory function. Another test, which is simpler than vibrotactile measurement, is the two point discrimination test.

Classically, the threshold of two point discrimination has bean the index of tactile spatial discrimination. The two point discrimination limen is measured as the smallest separation of two points that can be perceived as two points rather than one. This measure is considered to be an index of a basic discriminatory process (Ruch, 1951). This test has been used to differentiate normal and defective speakers (Rutherford and McCall, 1967). studies in two point discrimination have revealed that in normals it varies from one oral site to another. McCall and Morgan (1971) designed a study to investigate bilateral symmetry in 2 point limen on tongue Margin on both left and right sides. The subjects of the study were twenty-five adults. Modified vernier caliper was used to determine threshold of 2 point discrimination. Variation in force and tongue dryness were controlled. Subjects were asked to acknowledge perception of two points only when both stimuli were definitely separate and point like. A statistically significant difference in limen value between right and left margins of the tongue was evident. This study is in agreement with other studies in demonstrating the fact that, asymmetry on right and left sides of selected oral structures exists (Lass and Park, 1973; Lass et al, 1972; Ringel and Ewanowski, 1965; Hanlkln and Banks, 1967). These investigators concluded that the tip of the tongue was most sensitive.

Controversial findings were reported by McNutt (1975). He compared the two point discrimination ability in adults to that of children and found that unlike children, adults showed no significant difference between right and left margins of tongue. He also found that some of the adults showed significantly smaller limens on right side of the tongue and some showed significatly smaller line on left side of the tongue. The investigators attributed difference between adults and children to differential development of central nervous system.

With the studies reviewed above it is difficult to arrive at any conclusive statement regarding the relation of speech proficiency with the test scares. More systematic studies are needed with speech defectives before it can be employed in the battery at other testa.

(b) Measures of oral stereognosis: These measures deal with the ability of the oral cavity to recognize and discriminate the form of objects by means of a sense of touch. Measures of oral stereognosis have taken two forma, oral form recognition test and oral form discrimination test.

Oral form recognition test:

This is one of the most popularly used teat in measuring oral stereognosis. The test forms consist of three dimensional geometric plastic forms. In the test procedures, one form at a time is placed in the oral cavity of the subject. Gare is taken not to allow the subject to see the form. The subject is then asked to identify the form kept in his mouth from a set of visually presented forms or their pictures.

Several sets of forms, each set varying in number, shape and size, have been developed. Three of the most common ones are: (1) Twenty form developed at National Institute of Dental Research - NIDR (Shelton et al, 1967). (2) Five three-dimensional forms produced by the Speech and Hearing Clinic of Pensylvania State University and NIDR (McDonald and Aungst, 1967). (3) Sixteen forms in Nuttall test of oral stereognosia (Thompson, 1970).

A standard oral stereognostic test was developed by Shelton et al (1967). The stimuli were twenty plastic forms fixed on a handle. Some were geometric and others irregular presenting a range of difficulty. The forms are commonly called as NIDR-20.

The oral form recognition teat has been administered to pathologic group, misarticulators, stutterers and cerebral-palsied and was found effective in differentiating than on the basis of performance (Moser, 1967).

Class (1966) studied the effect of variation in size of stimuli. The six geometric forme varied in size from 1/8" to 1/2" in maximum hight and width dimensions. The findings indicated that sizes 1/4", 3/16" and 1/8" were increasingly difficult to identify and needed more time. Significant effect on performance was not noticed for size above 1/4". Time required did not vary much for different pathologic groups.

William and La Pointe (1971) studied the variables related to form such as form size and thickness, and other variables such as age, sex, education and time required for identification affecting oral form recognition. Twelve teat forms varying in shape and each shape varying in 8 different sizes were chosen for the study. The subject of the study were grouped into different age levels ranging from 20-29 yrs. 30-39 yrs, 40-49 yrs and 50-59 yrs. The results revealed that a hierarchy of difficulty for shape existed. There was no linear relationship between the size of the stimuli and the performance. But the too smallest in size were found to be the most difficult to identify. Age levels were suggested as an important variable in the performance on the oral fora recognition task. Sex and education were not found to be significant variables. An inverse relationship was found between the time taken for identification and scores obtained.

Another study was conducted (Lapointe and Williams, 1971) to find the effect of three attachment condition upon the oral sensory scores. They studied the performance with stainless steel orthodontic wire attachment, nylon monofilament line attachment and no attachment and found that stainless steel wire was most effective attachment. However the difference in performance with three different attachment were not significant, although, no attachment condition brought about poorest response.

Subject's performance on separate testa of oral stereognosis has been evaluated. Thompson (1970); Torrans and Beasley (1975) found that five forms developed by Pennsylvania State University was the most difficult, followed by NIDR-20 and then Nuttall teat. Relationships between oral form recognition test and lingual touch sensitivity has been studied. Twentyfive adults were administered the following tests: (1) Ten form test of oral stereognosis; (2) Test of light touch; and (3) Two point discrimination test. The results showed no significant relationship among the three measures (William and Lapointe, 1971).

Thompson (1970) compared the performance on the oral stereognostic and articulation tests under conditions of increasing oral sensory deprivation. The results revealed a positive relationship between articulation and oral stereognostic skills. Fewer errors on oral stereognostic test but mare articulation errors were observed on placement of palatal shield.

Fitch et al (1975) conducted a study to find the relationship between lingual motor performance and oral form identification. Oral form recognition task was administered to young adults. To evaluate lingual motor performance, handle that could be lingually manipulated was mounted so that excursion and strength of movement could be callberated. Lingual motor performance was noted for 15 seconds. The correlation obtained was not statistically significant. Therefore authors conclude that no conclusive statement can be made.

Canetta (1977) investigated the decrease in oral perception ability with Increasing age. Subjects ranging in age from 20 to 70 years were chosen. Oral form discrimination test was administered. The mean scores indicated a gradual decline in the performance but no significant difference between any two age groups between 20-60 years was found. Significant decrement between each of younger age group and subjects in their 70's was noticed. Subjects in their 60's did not deviate significantly from performance level of young adults. Therefore it was concluded that no appreciable decline of oral perception was found until the subject reaches 70 years of age.

The results of various studies employing these tests have been inconsistent. Such tests have sometimes failed to differentiate normals from articulation defectives. Ringel et al (1968) felt that the reason could be due to the inter-sensory nature of the oral form recognition task. Hence they eliminated the participation of the visual channel by develop-ing the oral form discrimination test.

Oral form discrimination test:

This was developed by Ringel et al (1968). The teat stimuli consisted of 10 forms, representing a wide range of item difficulty and confusability. This was selected from NIDR-20 forms. These forms were categorized into 4 geome-tric groups - triangular, rectangular, oval and binconcave. The pairing of the forms resulted in 'within class' and 'bet-ween class' stimulus pairs. In all, 55 form pairs were used along with 10 pairs selected randomly for reliability check. The subject was required to tell if a pair of stimuli is same or different when placed consecutively in mouth.

This test was administered to twenty normal speaking and twentyseven functional misarticulation adult subjects. The latter group was further divided into mild and moderate misarticulators. The results revealed that the misarticulation group as a whole made more errors to a significant degree than normals. Significant differences in performance between mild and moderate misarticulation group was noted with latter group faring poor.

Variables affecting oral form discrimination scores have been studied. Lass et al (1972) conducted four experiments with normal adults to determine the effect of several variables on oral form discrrimination test. They concluded that: (I) subject's oral form discrimination skills did not improve with simple repetition of the test. (2) Significant effect on performance was not noticed when feedback information concerning the correctness of the subject's responses were given. (3) The scores were not affected by the presence or absence of handles. (4) The location of the forms in the oral cavity i.e. in front or back of the mouth, affected the scores, when the forms were placed on the tongue tip fewer errors were made.

Williams and Lapointe (1972) conducted experiment to explore the relationship between the oral form recognition interdental thickness discrimination and inter dental weight discrimination. For interdental discrimination, the subject had to make 'same' or 'different' judgements for a series of blocks which were presented in pairs, one at a time, between the upper and lower central incisors. Tor thickness variation discrimination, a standard block and another block which varied in thickness was presented. Similarly the blocks, standard and another with varying weight were used for weight discrimination. Scores were obtained for oral recognition task. NO significant relationship were found between oral form recognition and interdental thickness discrimination or between interdental thickness discrimination and interdental weight discrimination.

Thirty normal adults were tested to find the effect of memory on performance of oral form discrimination task. Lass and clay (1971) administered oral form discrimination test to their subjects under two conditions - (1) No delay condition where the pair to be discriminated was placed simultaneously in the oral cavity; and (2) Delay condition where an interval of 5 seconds was allowed between successive presentation of the two forms. The investigators did not impose any time limit on the exploration of each form. Better performance la delay condition was noted. Exploration of the form in the midline did not seem possible when the forms were placed in the mouth simultaneously.

In another study (Yairi and Canness, 1975) sixty normal female adults were grouped into 30 each and adminis-
(Oral Form Discrimination)
tered the OFD /test. The presentation of form to one group

was one at a time with 5 seconds interval and for another group forms were presented simultaneously. The exploration time was limited to 7 seconds. The result of the study was in agreement with the previous study (Lass and Clay, 1971), In addition to this, they observed that simultaneous presentation resulted in more between class errors than within class errors while the converse was observed in the group who were given successive presentation. Thus, the normal speaking subjects to whom forms were presented simultaneously showed oral stereognostic response pattern similar to articulatory defective speakers.

The smaller number of studies in each aspect limit any generalization. Therefore there is a need for more evidences to be obtained to make generalization of the above findings. Further, more variables have to be evaluated for their effect on oral form discrimination score. Informations are yet to be obtained to find the effect of speech training on oral form discrimination score and vice versa. Studies on these would add to the information available on oral form discrimination.

II Studies with children serving as subjects:

i) Studies with pathologic group: As discussed earlier under the subheading of adult group, this category also constitutes the study with pathological group diagnosed as having organic etiology (sensory-motor pathology and oral-structural changes) and pathological group diagnosed as having functional disorder.

a) **Studies with cases diagnosed as having organic pathology:**

These pathologies are usually the congenital sensory motor type and studies have been reported as single case study reports. However, Rutherford and McCall (1967) conducted a study on a group of seventeen cerebral palsied subjects. Eleven youngesters were matched for mental age and acted as controls. They administered a series of five tests of oro-facial sensation and perception. Tactile acuity was tested through the subject's ability to detect a groove engraved on the smooth surface of a plastic plate. The depth of the groove ranged from 0.5 mil to mil in steps of 0.5 mil each. The plates were passed in random order over the tongue tip or the finger tip and the threshold for tactile acuity was defined as the groove depth which can be detected on 50% of trials.

Tactile localization was tested by touching the subject twice in rapid succession. Then he was asked whether he was touched at the same or different points.

Tactile pattern recognition was assessed by tracing a series of geometric designs on the dorsum of the tongue with a blunt plastic stylus. the subject was then shown a series of similar designs, one of which he was to pick out, the one made on his tongue.

Kinesthetic pattern recognition was tested using a pattern cut out of a plastic piece. The subject was asked to trace the pattern with hie tongue. Then the subject was shown a series of pictures out of which he had to pick out the pattern he had traced.

Two-point discrimination was studied by using a modified caliper. By employing the minimal change, threshold was Measured by averaging three ascending and three descending trials utilizing increments of 0.25 in. The results revealed that the cerebral palsied group performed significantly poorer than normal group in only three tasks, i.e., tactile acuity, kinesthetic pattern recognition and two-point discrimination. Athetoids and the controls showed significantly better performance than spastics on kinesthetic pattern recognition test. However, no significant differences were found between athetoid and normals.

Bloomer (1967) and Chase (1967) in their independent studies identified two girls with congenital sensory pathology who had similar natal and prenatal history. Sucking and swallowing difficulties along with drooling was presemt in infancy. Clumsiness in fine movements and problem in coordination were reported. However developmental milestones were reported normal.

In Bloomer's (1967) case study, neurological evaluation revealed speech problem, which was attributed to the muscular incoordination of oral structures especially the tongue. No other neurological disturbance was noticed. The case was diagnosed as having cranial nerve palsy with weakness of the muscles of the tongue, jaw and pharynx when she was eight years of age. Even after intensive speech therapy her speech remained almost completely unintelligible. Frequent substitutions and omissions of the sounds were noticed. Difficulty in coordinating phonatory and artlculatory movements were also reported.

An oral etereognostic test administered to the subject at ten years of age revealed that the subject was not able to distinguish even the most dissimilar plastic forms. Abnormal diadokokinetic rate was observed. The case was diagnosed as having oral astereognosis and dysdiodokokinesis.

Chase (1967) reported the findings of the case examined for neurological deficit at seventeen years of age. The examination revealed absence of corneal reflex and absence of pain in the oral cavity. Protrusion and lateral tongue movements and also coordinated movements of the oral structures were impaired. smell and taste sensations were normal but gag reflex was absent. sensory examination revealed marked impairment in localization of point stimulation and two-point discrimination en the face and lips, though normal on the extremities. Manual stereognosis was markedly impaired. Though general motor ability was within normal limits yet when visual feedback was eliminated a marked impairment was observed. Even after speech therapy the subject's speech was limited to the production of vowels. Speech intelligibility remained minimal.

Similar findings were reported by Rootes and McNielage (1967) who studied a sixteen year old girl with impairment in somesthetic perception and motor function. They administered a series of tests of speech perception and production. While her speech was almost unintelligible, she did not have any difficulty in apprehending speech produced by others. However, the amount of muscle activity on speech production task was comparable to the normal subject. Coordinating voicing and upper articulatory actions were found to be difficult for the subject.

From the studies reviewed here, we learn that impairment of complex sensory information processing at such an early age implies that motor gesture patterns will be learned in a manner reflecting the limitations in sensory representation of movement patterns.

Children with cleft lip or palate come under the group of those with oral structural changes. They present asymmetry in maxillary archform, abnormalities in tongue posture and abnormal communication with nasal cavity. Also the aspects discussed under the subheading of adults can be expected to function in children. Therefore to find out if any oral sensory deficit exists in children Mason (1967) and Pressel and Hochberg (1974) tested children with cleft lip and/or palate.

Mason (1967) tested fortytwo children and adults with cleft palate in isolation or in combination with cleft lip for their ability in oral stereognosis. The subject's age ranged from six to fortyfive years. seme wore prosthetic aids and some were post-surgical subjects. In case where prosthesis was used, they were tested with and without prosthetic aid. Twenty geometric shape plastic pieces mounted en a handle formed the test stimuli. subjects were administered the test of oral form recognition. No time limit was imposed for the subject to explore the form in his mouth.

The results revealed no perceptual deficit within the cleft lip and palate population. Tissue manipulation during surgery and also the prosthesis did not appear to affect oral stereognostic scores. Mason concluded that congenital anomaly was not accompanied by a congenital sensory impairment of oral area. Similar findings were reported by Pressel and

Hechberg (1974) when they used oral form discrimination test to evaluate oral stereognosis. Sixty surgically repaired cleft palate children were compared with sixty non-cleft palate children in their study. However, controvertial reports have been presented by Andrews (1973) in subjects ranging in age from six to twentynine years of age.

The heterogenous nature of these subjects makes it difficult to compare the studies. Further research with more controlled variables are to be conducted before coming to any conclusion.

b) Studies with cases diagnosed as functional disorders:

In the two disorders, stuttering and misarticulation, generally considered as functional disorders with oral sensory disturbance, children with stuttering have not been studied for reasons unknown. Most of the findings reported were on the performance of children with misarticulation on an oral stereognostic test.

Ringel et al (1970) described the application of oral form discrimination test to children with various degrees of misarticulation. Sixty children with so called functional misarticulation constituted experiental group of this study. All were receiving speech therapy. Degrees of misarticulation ranged from mild, moderate to severe. A control group of sixty normal children were selected to parallel the experimental group in age and sex.

The data obtained from the 120 children were compared to data contributed by adults in the earlier study (Ringel, Burk and Scott, 1968). (1) In general, it was shown that subjects with articulatory defect made more errors on the oral form discrimination task than did the subject with normal speech patterns. (2) Furthermore, there was a clear tendency for errors to increase as a function of severity of articulation defect. (3) It also revealed that children had more difficulties than adults with the discrimination task.

In order to find whether the normal speakers and individuals with functional speech disorder vary consistently in their general performance levels on the oral stereognostic, Fucci and Robertson (1971) tested ten normal speakers and ten misarticulators. Articulation-defect group had no gross abnormality of oral structures and no history of sensory motor deficit. The test of oral stereognosis using the forms developed by NIDR was administered.

Normal speakers and individuals with functional speech disorders in this study vary consistently in general performance levels on oral etereognostic task. What appeared to be most important is that the subjects considered to have functional misartlculation made fewer and proportionately different types of correct response in tasks of oral stereognosis than were made by ten normal speakers. These findings suggest the term 'functional' may not be appropriate for people having articulation disorder auch as those found in thia experiment.

Summors, Cox and West (1972) studied the performance of seventy children with three degrees of articulation proficiency in an oral form discrimination task. Each group of thirtyfive children included subjects with superior articulation, subjects with deviant articulation and subjects with articulation defect. Their findings are in agreement with that of Ringel et al (1970). The superior articulation group had significantly batter scores than the deviant or defective articulation group.

Lingual vibrotactile threshold of thirty normal articulation children was compared with a group of thirty misarticulation children (Kelly, 1977). All the children had normal hearing with no history of neuro-motor or neuro-sensory disturbance. Misarticulations were analyzed in terms of distinctive features. Templin Darley Diagnostic Test of Articulation was used to determine phonemic scores. Lingual sensitivity was determined on the anterior midline region of the dorsal surface of the tongue at 125, 250 and 500 Hz.

The conclusion that was arrived at was that lingual sensitivity is significantly reduced in children with misarticulation. However, this reduced sensitivity did not appear to be related to articulatory phonemic test scores or to the pattern of distinctive feature errors made by these children. The findings of the present study are in agreement with the findings of the study with adults (Fucci, 1972).

Studies reviewed so far give the information about performance of misarticalation group as an entity in oral stereognostic test. McNutt (1977), therefore, designed a study to evaluate the performance of different articulation defective group (in terms of sounds misarticulated) on the oral stereognostic test. He tested the hypothesis that specific perceptual and motor difficulties exist in children who produce different articulatory errors. The subjects included in the study were fifteen normal children, and fifteen children with /R/ sound misarticulation and fifteen children with /S/ sound misarticulation. The subjects were administered the tests of (1) two-point discrimination to measure peripheral and cortical abilities related to discrimination process (Ruch[66] 1965); (2) oral form discrimination test to measure pheripheral and central integrating process (Chusid and McDonald[66] 1967); and (3) oral motor abilities by finding performance on alternate motion of tongue.

It was found that children who misarticulated /s/ were found to have comparably normal performance on tasks that evaluated different oral sensory abilities bat deficient in oral alternate movement rate of tongue. Children who misarticulated /r/ sound were found to be deficient in both oral alternate motor response and sensory tasks. When compared on other variables, it was found that between class error did not differentiate misarticulators and normal speakers but differentiated /S/ and /R/ misartlculation group.

The studies reviewed so far indicate definite disturbance in oral sensory perception in those children with 'functional' misarticulation. It is also found that different misarticulation group present differential result. However, more controlled studies are to be designed considering the aspect of speech therapy, i.e., if the misarticulation group has undergone speech therapy, and if so, how long. Further oral sensory measures have to be evaluated in children with stuttering.

ii) Studies with normal group in whom sensory disruption was artificially induced:

The relative significance of tactile-kinesthetic feedback in children who are developing speech using anesthetization was studied by Daniloff et al (1977).

Daniloff, Bishop and Ringel (1977) studied the effect of acute oral anesthetization on speech of young children.

Speech was recorded before and during oral anesthetization. Spectrographic and perceptual analysis of the speech produced during sensory deprivation yielded following facts:

1) Children's speech was somewhat more affected by sensory deprivation than that of comparable adults;

2) Consonants and vowels were equally affected in terms of error rate. Apical dental and other abstract consonants were most strongly affected; and

3) The older children revealed a slowing of speech rate, an exaggeration of VOT, and other behaviors which might be indicants of attempts to compensate for loss of oral sensation.

The results indicate no strong differences between the children of varying age. The investigators concluded that it would appear likely that once a speech sound is mastered by Children they display adult like motor control patterns when challenged by oral sensory deprivation.

A procedure to alter or eliminate tactile kinesthetic feedback in children without the use of painful injection is yet to be developed (Frick, 1964); which may lead to more number of studies conducted on children.

iii) Studies relevant to the methods used in determining oral sensory abilities:

a) Oral sensitivity measures:

Used in children were eral vibrotactile sensation and two-point discrimination (Longer, 1974; Kelly, 1977; McNutt, 197S). Kelly (1977) compared lingual vibrotactile threshold of a group of normal articulation children with articulation defective children. Lingual sensitivity was determined on the anterior region of the dorsal surface of the tongue at 125, 250 and 500 Hz. Mean lingual vlbrotactile threshold for subjects with defective articulation are seen to be higher than for normal articulation children for all test frequencies. This study is in agreement with the findings of Longer (1974).

On the teat of two-point discrimination ability, children have demonstrated asymmetry on right and left side of the tongue (Manikin and Banks, 1967; McNutt, 1975).

b) Oral stereognostic Measures:

Studies in children using oral form recognition test have tested pathologic groups as misarticulators and deaf. Also the effect of speech therapy has been studied.

Fucci and Robertson (1971) studied the performance of normal and articulation defective subjects on oral form recognition task. Performance of the subjects were analyzed for the effect of several variables. The conclusions drawn from their studies were:

1) Normal speakers and individuals with 'functional' speech disorder vary consistently in the general performance levels on the oral stereognostic tasks;

2) There wers consistent differences in oral tactile performance both within and between the groups;

3) These differences in oral stereognostic performance were larger for structures not in oral region (eyes, finger tips) than structures in oral region (tongue tip, tongue blade): and

4) The within class and between class responses vary within and between group subjects.

Oral form recognition ability was found in orally trained deaf children. These children had their training in oral language from the age of two years. Children's ability in passive (with tongue stationary) and active (explore with tongue) lingual recognition of the form was evaluated. Deaf children were better able to identify geometric shapes passively than their hearing pears, but performed no better when exploring the shapes actively. The investigators reason that deaf children who are taught orally gave greater attention to oral speech and they depend on fewer cues (Weiss and Skalbeck, 1975).

Shelton et al (1973) conducted a study to find if better scores on oral form recognition resulted in improved articulation. But they did not observe reduction of articulation errors. Ruscello and Lass (1977) administered oral form recognition test before, during and at the end of speech therapy. No progressive improvement across the three testing period was noticed. But their scores on these tests did improve from first to third testing period.

Since the inter-sensory matching task is embedded in this test, the test might not give reliable results. Therefore it will be better to base the conclusion on the findings of oral form discrimination test.

Oral Form Discrimination Test:

Ringel et al (1970) have found that the oral form discrimination test is effective in differentiating children with functional misarticulation and normal children.

Most of the studies with oral form discrimination test including Ringel et al (1970) have revealed that a more positive relationship exists between 'between class' discrimlnation skills and articulation proficiency. Thus, 'within class' and 'between class' comparison task appears to be evaluating performance at different levels of discrimination. Performance on 'within class' discrimination appears to be independent of speech function. Ringel et al (1976) have suggested further research using the test stimuli classified as 'between class' pairs.

In the study conducted to test the hypothesis, specific perceptual and motor differences exist in children who produce different articulatory errors, between class errors did not differentiate the children with normal articulation from children with misarticulation. The 'between class' errors did, however, differentiate the children with misarticulation of /V/ from children with /s/ misarticulation (McNutt, 1977).

Studies have been done to find the relationship between stimulability and oral form discrimination task and they present controvertlal reports. Sommors, cox and west (1972) studied artlculatory effectiveness, stimulability and children's performance on perceptual and memory tasks. The performance of seventy children was studied on 4 auditory measures and oral form discrimination task. The children were divided into 5 groups - (1) Superior articulation group; (2) Group with deviant articulation and poor speech stimulability; (3) Group with deviant articulation and good stimulability;

(4) Group with defective articulation and poor stimulabillty; and (5) Group with defective articulation and good stimulability. Performances on speech sound stimulability task were not found to be related to performance on any auditory measures and only slightly to the oral sensory task.

In another study (Moreau and Lass, 1974), fortynine children with misarticulation Carter- Buck Prognostic test and Ringel et al (1968) oral form discrimination test. A positive correlation was found between the two tests. Thus, the oral form discrimination test was capable of distinguishing between children who will improve their articulation through maturation and those who may not.

To check the ability of oral stereognosis in predicting speech performance, Schlieser and Cary (1973) chose children with normal hearing and no physical or mental abnormality. Eleven children out of fifty children were chosen for experimental group after screening out from oral atereognoatic identification test. Those children with poor performance on this test were chosen and given oral form discrimination test. Children's speech performance was rated. Results showed no significant correlation between the scores on oral form discrimination and speech performance. Therefore, the author concluded that while it may be expected that children with functional misartlculation demonstrated differences in oral stereognostic tasks, the converse is not necessarily true.

Schlieser and Cary (1973) also found relation between the two tests of oral atereognoaia and found statistically aignificant correlation between the scores obtained by the two tasks. Therefore, both identification teat and discrimination test seem to measure similar oral stereognostic skills.

Bishop at al (1972) compared the oral form discrimination abilities of manually trained deaf subjects with normals and with orally trained subjects. In general, significant difference in performance was found when there were differences in Shapes. The two groups of deaf children did not differ when the forms were presented in hand. This suggested that poorer performance on oral form discrimination test by the manually trained deaf was not due to general cognitive deficiency. Larsen and Hudson (1973) found that oral and non-oral deaf significantly differed in their performance in oral form discrimination. Improvement in articulation ability has been found to be accompanied by improvement in oral form discrimination Skills (Ruscello and Lass, 1977). However, studies have not been conducted to see if the converse is true.

Van Riper and Irwin (1958) hypothesized that . . ."younger children monitor their articulation mainly by means of the auditory feedback. As their new articulation skill becomes stabilized, they run over the monitoring to the kinesthetic and tactual feedback systems". Research projects using older subjects have found no relation between speech sound discrimination and articulation, but studies involving younger children have Shown that there is relationship between articulation and auditory discrimination. in the area of oral stereognosis the situation regarding the age has generally been transverse.

On the basis of the hypothesis and the earlier findings, studies have been conducted to find relation between auditory discrimination and oral stereognostic ability. Madison and Fucci (1971) have found a significant negative correlation between speech sound discrimination and oral stereognoatic discrimination in children of first grade. The authors of the study concluded that ". . .the result of this study strongly indicates the need for examination of articulation-monitoring process across age levels. A longitudinal research paradigue could do much to help determine whether there is a Shift from the auditory to the tactile kinesthetic system with articulatory maturation".

Larsen and Hudson (1973) demonstrated that auditory measures correlated with oral form discrimination teat in children. Low but significant correlation between errors on auditory discrimination task and oral form discrimination task was achieved in a study conducted on fifteen adults (Kelly and Lewis, 1974).

One of the important variables in both oral form recognition and oral form discrimination task is the age. To study the variation in performance of oral form recognition as a function of age, McDonald and Aungst (1967) administered a 25 item test of oral form recognition. The subjects of the study ranged in age from 6 to 89 years. The results revealed that scores improved as a function of age upto midteens and decreased markedly in the geriatic group. They noted that the levelling of the growth curve in the midteens seem to parallel the completion of the growth of oral and facial structures.

In another study (Ringel et al, 1970) children were found to have more difficulty than adults with oral form discrimination task. It was noted that the proportion of 'between class' errors for children and adults increased monotonically as a function of severity of articulation defects.

To study developmental pattern and sex differences in oral form discrimination skill a study was conducted (Mani, 1978). Sixty normal children of both sexes were chosen for the study. The ages of these children were 5, 7, 9, 11 and 13 years. Oral form discrimination task was administered to the subjects. The conclusions of the study were: (1) oral form discrimination skills increased from age 5 years to 13 years. However, the increase was not a uniform gradual increase but a stepwise increase. (2) Sex differences were not present in the development of oral form discrimination across the age levels studied.

The review of the literature on oral sensation and perception reveals that the growth pattern of oral form discrimination is not linear but stepwise in the age ranges studied. Since the scores improved as a function of age on oral recognition task, it would be interesting to note if the similar trend of development is present in the development of oral form discrimination skill when 'even age' group children are considered.

CHAPTER III

METHODOLOGY

An oral form discrimination test (Ringel et al, 1968) was administered to forty eight normal school going children. The total errors made on the test were tabulated and analyzed to study the effect of age, sex and their interaction effect. The findings of the present study were compared to a similar study in different age ranges which was conducted earlier (Mani. 1978).

Subjects:

Forty-eight normal school going children ranging in age from 6-12 years served as subjects. All of them spoke Kannada as their mother tongue. Based on their age, they were divided into four groups, considering only even age groups and skipping every odd age groups. At each age level within -6 months difference was allowed. Each group consisted of twelve children with equal numbers of boys and girls.

All the subjects were tested for normal intelligence, speech and hearing. Only those who met the criteria of normalcy were included in the study. The subjects were required to have normal oral structures. They had to qualify on the test of superficial tactile sensation and motor coordination.

Test stimuli used in Screening Sessions

Intelligence Assessment

Raven's Coloured Progressive Matrices was used to assess the intelligence. This has three sets (A, A_B and B), each having twelve problems which tap the chief cognitive processes of children under 11 years of age.

Hearing Screening

Screening for normal hearing was done using pure tones by means of a portable audiometer (Beltone Model 12D).

Speech Assessment

To assess articulatory characteristics, material chosen was from a Kannada Articulation Test (Form A of the test developed by Babu et al, 1972). Older children were asked to read a passage which had all the segments in the Kannada language except for the aspirated ones. The aspirated phonemes were not tested as they are used relatively less by children. very young children who could not read the passage were asked to repeat the words from Part I, Part II and Part III of Form A of the same test given to older children (Appendix (2)).

Tests of superficial Tactile Sensation

Superficial tactile sensation was evaluated using cotton ball and common objects like spoon, pencil, watch, coin and key.

Test Stimuli used in Experimental Session

The stimuli used in the oral form discrimination test were eight geometric forms drawn from a standard twenty item set developed at the National Institute of Dental Research (McDonald and Aungst, 1967). These forms were made of white plastic material. The forme were selected to insure the multiple occurence of items having the same gross geometric descriptions. These forms included four geometric shapes; bi concave, oval, triangle and rectangle of two different sizes (Appendix 1). The forms could be manipulated in the mouth by means of a handle.

Test Environment

The screening and experimental sessions were held in the children's homes because during the time of data collection most of the schools were closed due to vacation. However the noise and distraction in the test room was kept at a minimum. The subjects were seated comfortably. The test environment was such as to elicit reliable and valid results.

Procedure

Two sessions were required for each subject: one screening and one experimental session. The screening session included procedures for the selection of subjects. The experimental session consisted of administering oral form discrimination test. Each session, screening and experimental, lasted for thirty minutes.

Screening Session

The following tasks were included in the screening session: (1) an intelligence screening testy (2) a hearing screening evaluation; (3) evaluation of the articulatory characteristics of the subject; (4) an oral peripheral examination; (5) three tests of superficial tactile sensation; and (6) a test of motor coordination. Each of the tests was administered individually.

Intelligence Assessment

The children were first given the booklet and than instructed as follows - "Look at this (point to the main figure). You see, it is a pattern with a piece cut out of it. Each of these pieces (point to the 6 alternatives) is the right shape to fit the space, but only one of them is the right pattern. Tell me the number of that pattern which fits the blank space. Any questions;"

The first item was for trial. At times additional cues were given in case the subject found it difficult to solve it.

There was no time limit for this test. The subject who scored below average on this test was eliminated from the study. The criteria for below average was taken from the manual.

Hearing Screening

The hearing was screened bilaterally from 250 Hz through 8000 Hz at 20 dB (re: ISO, 1964). The subjects were tested in a reasonably quiet room. The instructions were as follow - "You will hear a tone in one of your ears. Every time you hear the tone,raise your finger. As soon as the tone stops, drop your finger. If you hear the tone in the left ear, raise your left finger; if in the right ear, raise your right finger. Raise your finger even when you hear a very faint tone. Any questions;" Having given the instruction, the subject was seated comfortably with his back to the audiometer and earphones were placed in position.

Those subjects whose hearing acuity was within 20 dB HTL (I.S.O.) for the above mentioned frequencies, were included in the study. Biological caliberation was done prior to each testing session. Instrumental caliberation was done once before and once after the experiment and found that the characteristics of the audiometer had not changed.

Speech Assessment

The passage in Kannada was given to be read by older subjects

Younger children were asked to repeat the word after the experimenter. The subject's articulation was assessed. Any child with deviant articulation was not included in the study. Presence of substitution, omission or distortion even in a single sound formed the criterion for deviant articulation.

Oral Peripheral Examination

The oral cavity was examined and individual's with structural abnormalities of oro facial region were eliminated from the study. Later subjects were assessed for structural integrity of the oral cavity. The subjects were asked to phonate the vowel /a/. The children were asked to move the tongue up and down, side to side, and protrude it. The subject who were unable of the movement or who had noticeable deviation in the movement were not included in the study.

Tests of Superficial Tactile Sensation

a) Localisation of tactile sensation

The child was instructed to name the part of the body which would be brushed by a cotton ball. The task was carried out with the subject blind folded. Apriori instructions were given as to where exactly the cotton ball would be placed. The cotton ball was brushed randomly on forehead, right and left cheek, hands and forearms.

b) Manual stereognosis

The subject, who was blind folded, was instructed to feel the object placed in his palm and name it. The subject had the opportunities to see the objects prior to commencement of the testing. Thus it was ensured that they were familiar to the subject. The objects were placed in subject's preferred hand one at a time.

c) Postural Sensibility

The subject was asked to stand with his hands outstretched horizontally. His hands were moved up and down. The subject was directed to say whether he felt his hand moving up or down.

Subjects who carried out the above tasks without any error were included for the study.

Test of Coordination

With his eyes closed the subject was instructed to touch the tip of his nose with the tip of his index finger. He was asked to do the task as rapidly as possible, first with right and then with his left hand. Gross deviations in performing this task disqualified the subject from participating in the study.

Experimental Session

Experimental Session

The task required the subject to compare two forms presented successively in the mouth and indicate whether they were 'same' or 'different'.

The following procedure was used to form the lists. First each of the forms were numbered. Then the forms were grouped into four geometric categories: binconcave, oval, triangle and rectangle. The forms in each geometric category was paired with each form in the other geometric category. Thus, 24 pairs were obtained as each stimulent pair was used only once. (For example, pairs 7-6 precluded the use of pair 6-7). Each form was paired with itself, thus adding eight more pairs to form a total of 32 pairs. Five pairs selected at random from the total number of pairs were included to check reliability. In summary, each subject evaluated a total of 37 stimulus form pairs.

Six lists were formed having randomised the order of stimulus pairs. The list was so formed that half the subjects would get a particular form of a pair first and the other half would get the other form of the pair first, but which half would get which form first was established apriori by chance.

The child was seated facing the experimenter and was instructed as follows: "I have forms like these (show forms). I will place one of these forms in your mouth for 5 seconds. Then I will take it out and put another form in your mouth. You can feel it for 5 seconds. You may move the forms around in your mouth with the handle. After feeling it with your tongue and mouth, I want you to tell me if the two forms were 'same' or 'different'. Guess if you are not sure. Are there any questions;" To prevent visual cues from influencing evaluations, subjects were blind folded.

The forms in each stimulus pair were presented successively to the subject. Each form was placed in the subject's mouth. The subject was allowed to retain the first form of the pair for a period of 5 seconds. Then the form was removed and within 5 seconds the next form was placed in the mouth. Again the subject was allowed to explore the form for 5 seconds. Once the form was in the subject's mouth, he was allowed to manipulate it in any fashion he desired. Upon the removal of the second form of the stimulus pair the subject was asked to indicate whether the two forms were 'same' or 'different'. The procedure was followed for each of the 37 pairs of forms. Each of these forms were sterilized after presentation by using an antiseptic lotion (Savlon).

To check reliability, the 5 reliability items were presented using procedures identical to the one used in experimental session.

Subject's responses were manually entered in the data sheet. The sample of data sheet is given in Appendix(3).

Scoring

For each subject total number of errors were calculated. The correct responses were given the score of one and that which was an error was given the score of zero.

However, the total score did not include the 5 pairs of stimuli which were used for reliability check.

CHAPTER IV

RESULTS AND DISCUSSION

Results are presented in both graphical and tabular forms (Tables 1, 2, 3 and 4, and Figures l and 2). They were analyzed statistically. The total errors scored by each subject formed the raw data for the analysis. The two way ANOVA for unrelated sample (Guilford, 1965) was applied to determine the effects of age and sex, and their interaction effect on error scores. Mean, range and standard deviations were calculated for descriptive analysis.

Age

The mean error scores, range and standard deviations were calculated for subjects of each age group. The scores are presented in the tabular form (Table 1) and in the form of histogram (Figure 1). The mean error scores decreased as a function of age upto 10 years and then increased slightly from 10 years to 12 years. The t-test for independent sample (Garrett and Woodsworth, 1973) was applied and found that this increase from 10-12 years in error score was not statistically significant (0.05 level).

The application of two way ANOVA for unrelated sample revealed that age had an effect on the score, with F-ratio being

Table 1

Group	Mean Age (years)	Oral form disc. error scores		
		Mean	Range	Standard Deviation
I	6	9.91	10	4 32
II	8	8.00	13	5.06
III	10	4.08	14	3.30
IV	12	5.33	10	4.13

Table 1: Mean error, Range, and Standard deviation on an oral form discrimination test at different age levels

Figure 1 : Mean error scores on oral form discrimination for both boys and girls in the four age groups

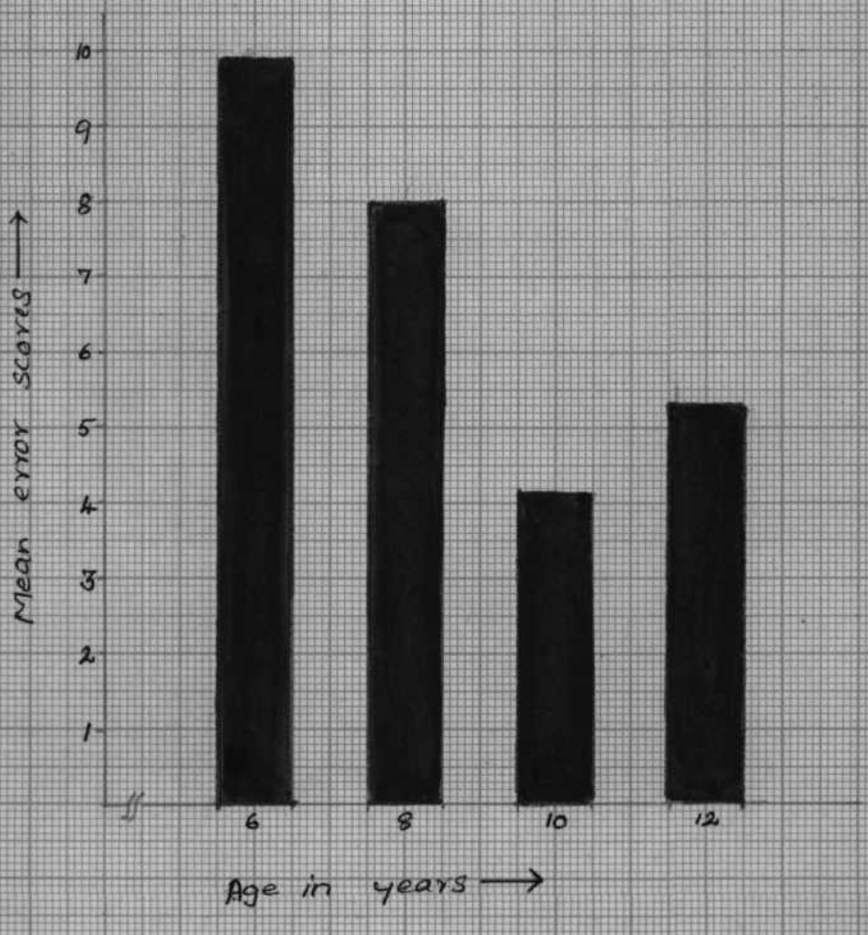


Table 2

Group	Mean Age (years)	Oral form disc. error scores		
		Mean	Range	Standard Deviation
I	6	11.5	5	2.30
II	8	8.0	8	3.10
III	10	4.83	5	1.86
IV	12	6.3	8	3.19

Table 2: Mean error scores, Range, and Standard deviation for boys at different age levels

Table 3

Group	Mean Age (years)	Oral form disc, error scores		
		Mean	Range	standard Deviation
I	6	8.33	8	3 24
II	8	8.0	12	3.78
III	10	3 33	7	2.74
IV	12	4.33	7	2.20

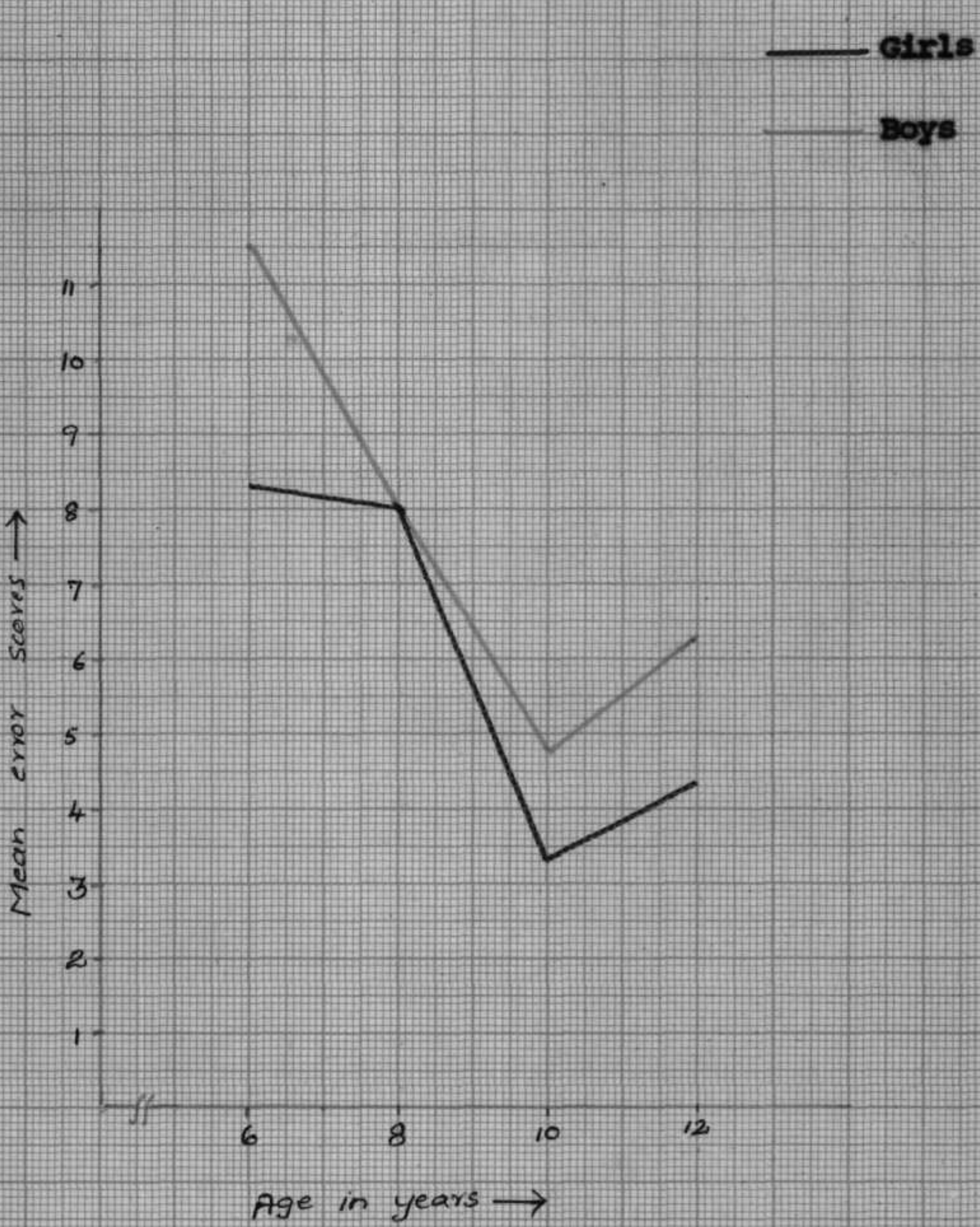
Table 3: Mean error scores, Range and Standard deviation for girls at different age levels

Table 4

Sources of variation	Ss	df	Ms	F
Age	239.37	3	79.79	8.35
Six	33.66	1	33.66	3.52
Age x Sex	23.44	3	7.81	0.82
Error	382.20	40	9.56	-

Table 4: Results of two-way ANOVA for the main effects of age, sex and their interaction

Figure 2 : Mean error scores on oral form discrimination for boys and girls separately in the four age groups



significant at 0.05 level (Table 4).

Sex

Tables 2 and 3 show the mean error scores, range and Standard deviation obtained by boys and girls respectively.

Mean error scores seem to decrease with age, the score for 12 years group increasing slightly. Calculation of standard deviation revealed increased variability in the performance of younger age group. Performancesof boys were similar to that of girls, with improvement in oral form discrimination from 6 to 12 years, and poor performance at the age of 12. Maximum variability is seen at 12 years of age.

Mean error scores for boys and girls at different age levels are shown in the graph (Figure 2). The graph shows that girls' performance is superior to that of boys' except at 8 years of age. Here the points collide indicating no difference in performance. However, the t-test for independent sample when applied indicated no significant difference in the performance of boys and girls at all the age groups (0.01 level). These findings are confirmed by the two-way ANOVA findings. F-ratio for sex was not significant (Table 4).

Discussion

The results of the present study is compared with the

Figure 3a : Mean error scores on oral form discrimination for both boys and girls in odd age group

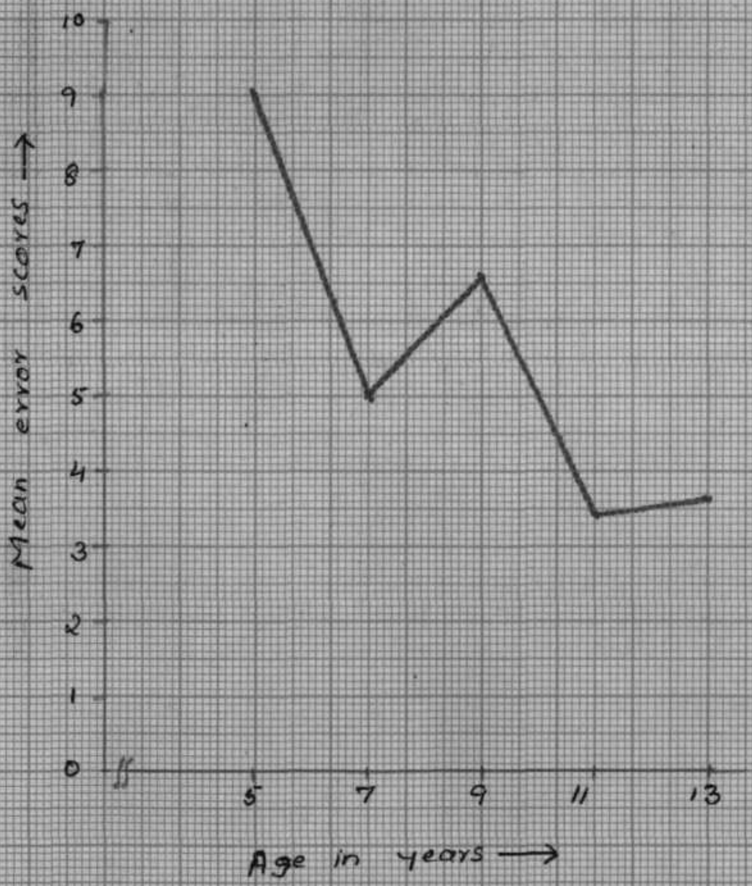
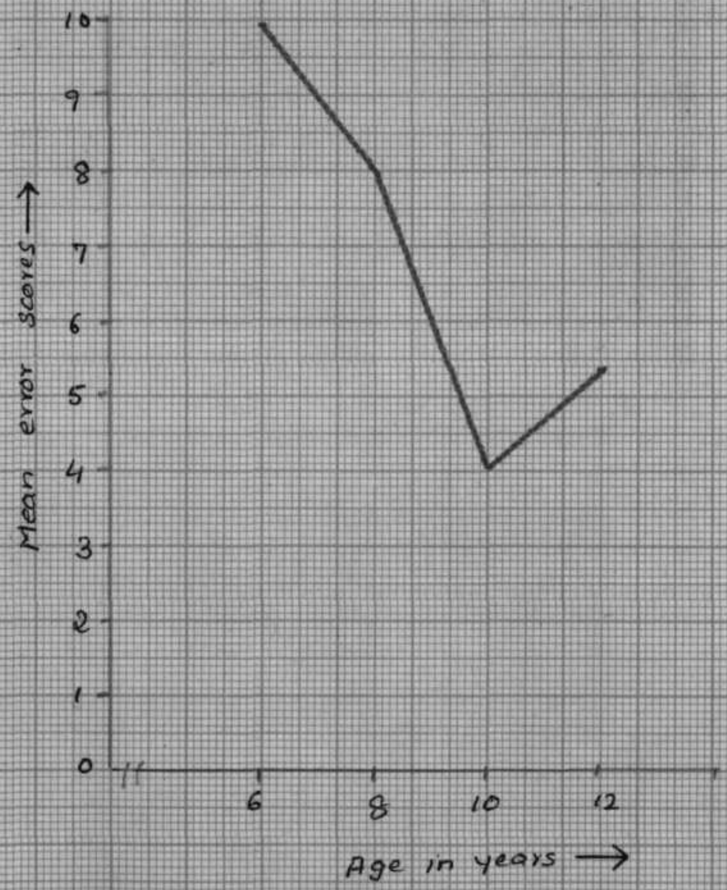


Figure 3b : Mean error scores on oral form discrimination for both boys and girls in even age group



responses collected from odd-age group (Mani, 1978). Figure 3 (a & b) shows the graphs drawn for two age groups - the 'odd-age' group and 'even-age' group. It can be interpreted from these graphs that the growth curve for the 'even-age' group does not simulate the growth curve for 'odd-age' group, with the former group having comparably linear pattern and the latter group demonstrating a stepwise trend. The 'even-age' group children's Skill in oral form discrimination seems to improve with age until ten years of age with a slight deterioration in performance at 12 years of age which is not Statistically significant. This deterioration of the skill in oral form discrimination at 12 years of age may be due to the 'over-carefulness' to make better judgements. These children may be rejecting obvious differentiating features and may be looking for non-existent complexities. However, the significant F-ratio score obtained for age reveals that oral fora discrimination ability increases with age, in the age group studied.

To facilitate comparison of Mail's findings with those of this experiment the results of both investigations are shown in Table 5.

A glance at the Table 5 shows that general performance of 'even-age' group is poor when compared to that of 'odd-age' group. The possible reason could be that the latter group was

Table 5

Odd-Age Group Mean Age	Mean oral form disc. error scores		Even-Age group Mean Age
5	9.00		
		9.91	6
7	5.00		
		8.00	8
9	6.58		
		4.08	10
11	3.42		
		5.33	12
13	3.56		

Table 5: Oral form discrimination error rates (Mean) from Table 1 along with results for 'odd-age' group from Mani (1978)

tested in a more formal environment (in school) and the former group was tested in a less formal environment (in houses during vacation). These situations could have influenced the criterion maintained by different groups of children and thus effecting their scores.

Tables 6 and 7 give the scores of 'even-age' and 'odd-age' groups separately for boys and girls respectively.

It can be said that findings for the group as a whole also holds good for the boys and girls groups. A better performance by 'odd-age' group is seen for both boys and girls.

when a comparison is made between the oral form discrimination scores of boys and girls within each group (odd and even groups), the findings of each age group differ. The performance of boys sometimes exceeded that of girls and sometimes was poorer than girls depending on age in case of 'odd-age' group, whereas in case of 'even-age' group, girls excelled boys in their ability at all ages except at the age of 8 where there is no difference. However, these two groups present similar findings that no sex difference exists when statistically analyzed.

McDonald and Aungst (1967) studied the development of oral form recognition ability in children ranging from 6 to 13 years of age and reported improvement as a function of age until the

Table 6

Odd-Age Group Mean Age	Mean oral form disc. error scores		Even-Age Group Mean Age
5	8.00		
		11.5	6
7	6.83		
		8.00	8
9	6.83		
		4.83	10
11	2.17		
		6.3	12
13	4.12		

Table 6: Mean error scores on oral form discrimination test for boys at different age levels for both even and odd age groups

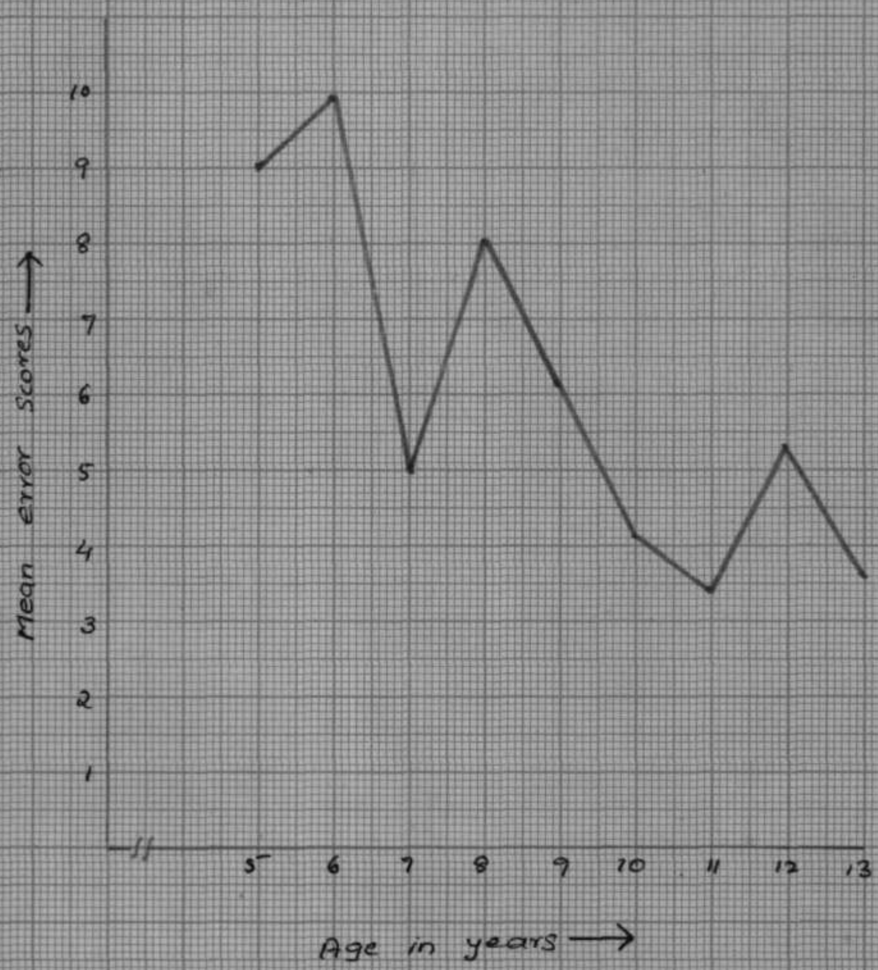
Table 7

Odd-Age Group Mean Age	Mean oral form disc, error scores		Even-Age Group Mean Age
5	10.00		
		8.33	6
7	3.17		
		8.00	8
9	6.33		
		3.33	10
11	4.67		
		4.33	12
13	3.00		

Table 7: Mean error scores on oral form discrimination teat for girls at different age levels for both even and odd age groups

Figure 4 : Mean error scores on oral form discrimination for both boys and girls ranging in age from 5-13 yrs.

(Note: Data for odd-age group was taken from Mani's (1978) study)



midteen. The score of 8 year old children was slightly lower than that of 7 year olds. However, no statistical analysis was done to determine if the trend was significant.

Figure 4 gives the growth trend in oral form discrimination skill when the scores of even-age group were embedded in the scores of odd-age group. From this it is obvious that, even with additional score the growth seems to be stepwise. If comparisons are made between the trend of oral form discrimination and oral form recognition, one can deduce that development of oral form discrimination is not similar to that of oral form recognition. However, definitive conclusion can be made only when the data are treated statistically. Further, the graph in Figure 4 also indicates that, before coming to any conclusive statement about the age where plateau is reached, the children beyond 13 years need to be tested.

The possible reason for the development curve pattern achieved for oral form discrimination skill can be discussed with reference to the visual color and form discrimination ability tested by Brian and Goodenough (1929).

Brian and Goodenough tested children ranging in age from 2 to 14 years. The children were tested for both color and form discrimination ability. The results showed that, the form discrimination was best at 2 years and decreased gradually upto 4 and than further increased at the age of 4½ years with a decrement at 5. On the other hand, the color discrimination developed gradually, with a steep Increase from 2½ years to 3½ years, reaching maximum at 4 years and declining slightly, with these results the investigators explained that, upto the age of three years the children showed a marked tendency to choose form as a basis for matching; from 3 to 6 years of age, color became the most potent factor. From the age of 6 years to adult life, form again became the predominating factor in the subject's choice.

similarly, it can be said that children depend on different sensory feedback channel at different age ranges, and that there is a shift in their dependence on channels at different ages. Thus, when the child depends on his auditory feedback for effective speech production, his oral sensory feedback may be functioning at a comparatively low level and vice versa.

In a study conducted to determine developmental progression in auditory sound discrimination for distinctive features, Kumudavalli (1973) found that for certain items of distinctive features children ranging in age 5 to 9 showed differential development. The discrimination ability was said to have reached the peak at 8 years of age, but general trend of development was not reported.

However, correlation between oral-sensory perception and auditory discrimination as a function of age are yet to be evaluated.

Clinical implications

The normative data on even-age group may be used with evaluation of speech defective population. Further, as noted by Mani (1976) there is no need far the differential treatment for boys and girls in terms of oral form discrimi nation.

CHAPTER V

SUMMARY AND CONCLUSIONS

Oral form discrimination skill in 'even-age' group children ranging in age from 6 to 12 years was tested to determine the developmental trend and sex difference in them. Forty-eight school going children with Kannada as mother-tongue were chosen after administering the screening tests. Children were grouped under four age groups, 6, 8, 10 and 12, with each group consisting equal number of boys and girls.

Oral form discrimination test developed by Ringel et al (1968) was administered to these children. Eight plastic forms from the 4 geometric categories (oval, rectangle, triangle and binooncave) were selected and paired to form thirty-two 'between-class' pairs. The children were instructed to say 'same' or 'different' when the pairs of forms were presented successively in the mouth. Children's responses were noted on data sheet and their total number of errors were calculated. The total number of errors formed the raw scores.

These error scores were statistically analyzed and the following conclusions were arrived at:

1) Oral form discrimination skills increase in 'event-age' group children as a function of age. The improvement is found to be uniformly gradual improvement except with a slight reduction in ability at 12 years of age which is not statistically significant;

2) Sex differences in the oral form discrimination skill is not present in the age groups studied; and

3) There is no significant interaction effect of age and sex in the development of oral form discrimination ability in 'even-age' group children.

Suggestions for further research

Further information regarding oral form discrimination can be obtained by conducting studies in the areas mentioned below;

1) Oral form discrimination skill can be tested beyond the age ranges studied till now, i.e., below 5 years and above 13 years;

2) Correlational studies can be conducted to teat correlation between oral form discrimination and auditory discrimination as a function of age;

3) Subject variables, such as, linguistic factors - bilingualism or multilingualism, intelligence, socio-economic status, motivation and Learning aspects can be studied;

4) Oral form discrimination may be evaluated in various clinical population by giving the test used in the present study and comparing with the normative data;

5) The test may be made more complex by varying the shapes, so as to make it more sensitive test for older age group; and

$) Oral form discrimination test may be administered to children of 'even-age' group in school set up and see if the children's performance varies.

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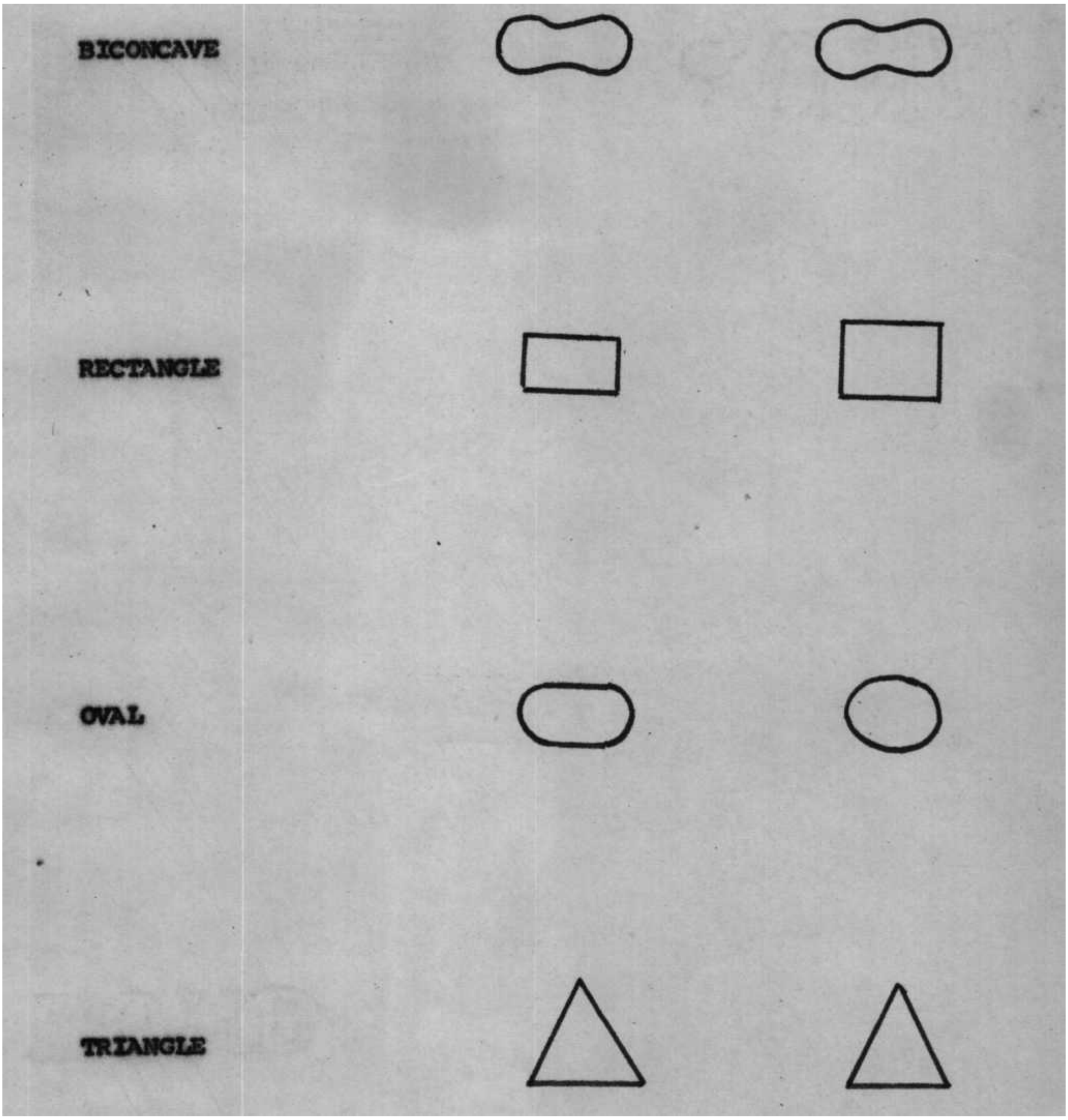
A P P E N D I X

(1)



The 8 geometric form drawn fro the pool of 20 plastic NIDR- 20 forms

THE WORDS SELECTED FROM KANNADA
ARTICULATION TEST

ಡಬ್ಬಿ	ಡಾಕ್ಟರ್	ರೈಲು
ದ್ಯಾಂಬಿ	ದೋಣಿ	ಸ್ಟಾಂಪು
ಗಡಿಯಾರ	ಗುಲಾಬಿ	ಸ್ಕೂಟರ್
ಛತ್ರಿ	ಹಾವು	
ವಿಮಾನ	ವೀಣೆ	
ಸೂರ್ಯ	ಸೈಕಲ್ಲು	
ಶರ್ಟು	ಶಂಖ	

THE PASSAGE SELECTED FROM KANNADA
ARTICULATION TEST

ಒಬ್ಬ ಬಕ್ಕತಲೆಯ ಮನುಷ್ಯನಿದ್ದ. ಬೇಸಿಗೆಯಲ್ಲಿ ಒಂದು ದಿನ ಅವನು ಕೆಲಸಮಾಡಿ ಸಾಕಾಗಿ ಕುಳಿತುಕೊಂಡ. ಆ ಸಮಯಕ್ಕೆ ಸರಿಯಾಗಿ ಒಂದು ನೊಣ ಬಂದು ಅವನ ನುಣ್ಣನೆಯ ತಲೆಯ ಸುತ್ತ ಹಾರಾಡುತ್ತಾ ಬಕ್ಕತಲೆಯನ್ನು ಕಚ್ಚಲಾರಂಭಿಸಿತು.

ನೊಣವನ್ನು ಹೊಡೆಯಬೇಕೆಂದು ಅವನು ಕೈ ಎತ್ತಿ ಹೊಡೆದ. ನೊಣ ತಪ್ಪಿಸಿಕೊಂಡಿತು. ಪೆಟ್ಟು ಅವನ ತಲೆಗೆ ಬಿತ್ತು. ನೊಣ ತಿರುಗಿ ಬಂತು. ಅವನು ತಿರುಗಿ ಹೊಡೆದ. ಏಟು ಪುನಃ ಅವನ ತಲೆಗೇ ಬಿತ್ತು. ಆಗ ಅವನಿಗೆ ಬುದ್ಧಿ ಬಂತು. ಕ್ಷುದ್ರ ಪ್ರಾಣಿಗಳನ್ನು ಗಮನಿಸುವುದರಿಂದ ನಮಗೆ ಹಾನಿ ಎಂದುಕೊಂಡ.

THE DATA SHEET USED IN THE PRESENT STUDY:

Screening Test

Name:________Age:_____

Std____S.No.____sex___Gp___

1. Articulation -
2. Hearing Acuity -
3. Tactile Sense -
4. Motor Coordination -
5. Oral Structures -
6. Intelligence -

	A		A_B		B
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	
6		6		6	
7		7		7	
8		8		8	
9		9		9	
10		10		10	
11		11		11	
12		12		13	

TOtal:

EXPERIMENTAL SESSION

Total Score:-----

TS	Resp.	TS	Reap.	TS	Resp.
1		17		33	
2		18		34	
3		19		35	
4		20		36	
5		21		37	
6		22			
7		23			
8		24			
9		25			
10		26			
11		27			
12		28			
13		29			
14		30			
15		31			
16		32			