A PICTURE SPEECH IDENTIFICATION TEST FOR HINDI SPEAKING CHILDREN

Reg. No. 02SH0006

An Independent Project submitted in part fulfillment for the
First year M.Sc, (Speech and Hearing)
University of Mysore, Mysore

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MANASAGANGOTHRI, MYSORE-570006

JUNE-2003

Dedicated

to

my Dad, Mom,

Elder Brother & Sister in-law

CERTIFICATE

This is to certify that this independent project entitled **"A PICTURE SPEECH IDENTIFICATION TEST FOR HINDI SPEAKING CHILDREN "** is a bonafide work in part of fulfillment for the degree of Master of Science (Speech and Hearing) of the student (Register No.02SH0006)

DIRECTOR
DR. M. JAYARAM
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Mysore
June, 2003

CERTIFICATE

This is to certify that this independent project entitled **"A PICTURE SPEECH IDENTIFICATION TEST FOR HINDI SPEAKING CHILDREN"** has beer prepared under my supervision and guidance. It is also certified that this has not beer submitted earlier in any other University for the award of any diploma or degree.

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DECLARATION

This independent project entitled "A PICTURE SPEECH IDENTIFICATION TEST FOR HINDI SPEAKING CHILDREN" is the result of my own study under the guidance of Dr. ASHA YATHIRAJ, READER AND HOD, Department of Audiology, All India Institute of Speech and Hearing, Mysore and not been submitted in any other University for the award of any degree or diploma.

Mysore,

June, 2003 **Reg. No. 02SH0006**

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INRODUCTION

Hearing is an extremely important sense. In children, it is most significant because the ability to develop and use oral language is closely related to their ability to process speech through the ears. Hearing is the avenue for communication and majority of what we learn through out lives occur through hearing and speech (Erber, 1982). The crucial role of hearing in spoken language development is indicated by the language delay observed among children with bilateral hearing loss (Lach & Ling, 1970; Ling, 1976). Therefore, it is the essential duty of an audiologist to identify, evaluate and rehabilitate aurally handicapped individuals.

There are several clinical tests, which help the audiologist to make an accurate and effective diagnosis. Speech audiometric tests help evaluate and rehabilitate the hearing impairment. Assessment of hearing using pure tones provide information regarding the sensitivity but not on the receptive auditory ability (Elliott, 1963; Harris, 1965; Marshall & Bacon, 1981). Geers and Moog (1987) opined that perception and comprehension of speech is an important ingredient in the development of spoken language and language abilities.

The importance of speech audiometry has been highlighted by several experts. It has been utilized for various purposes, which are listed below.

- It measures how well listeners understand Speech (Giolas & Epstein, 1963).
- It reflects degree of communication handicapped created by a hearing loss (Schwartz & Surr, 1979).

- It gives information for planning and management of aurally handicapped (Griffith, 1967).
- Monitor listener's performance throughout the therapeutic process (Griffith, 1967).
- To assess the success of different types of material and surgical treatment (Jerger, Speaks & Trammell, 1968).
- To classify the degree and type of hearing loss (Schultz & Schubert, 1969).
- To be used as a baseline measure for other test procedures (Mendel & Danhauer, 1997).
- Speech materials are used to check in hearing aid selection and rehabilitation (Markides, 1977, cited in Katz, 1978).
- Speech audiometry helps detect higher auditory functions using filtered speech test (Bocca & Calero, 1963; Hodhson, 1972.), Time compressed speech test (Beasly, Schwimmer & Rr ntelmann, 1972).

Aim of the Study

The present study has been undertaken to

- Develop a picture speech identification test for Hindi speaking children between the age range of 4-7 years
- Study the effect of presentation level on speech identification scores
- Study the effect of age on speech identification scores
- Compare the performance of the children with the half and full list
- Check the equivalence of the two half lists.

Need for Development of Speech test for Children

Studies show that it is difficult to assess the pediatric clinical populations through routine pure tone testing. Hardy and Bordley (1951) pointed out that children pay closer attention to verbal stimuli than to nonverbal stimuli. Bunch (1934, cited in Martin, 1987) reported that speech test items have a higher validity than non-speech test items.

Olsen and Matkin (1979, cited in Rintelmann, 1979) found that children find speech tests easier and less abstract than pure tone tests and are willing to participate for speech tests than pure tone tests.

Speech stimuli represent the class of sounds most important to the effective daily function of humans, therefore, tests utilizing speech stimuli are essential for the evaluation of clinical paediatric population.

Speech test material helps to measure how well listeners understand speech in a controlled environment, as a reflection of how they may perform in everyday listening situations (Giolas & Epstein, 1963). The assessment can be made, of the extent to which a hearing loss affects the ability to perceive, recognize, and discriminate speech. Thus, speech items are essential in diagnosis of the type and severity of hearing disorders, in assessing the prognosis and monitoring of aural rehabilitation efforts.

Need for speech identification material in Hindi

When speech is used as stimuli for evaluation, the language used for testing becomes an important variable (Alusi, Hinchcliffe, Ingham, Knight, & North, 1974). It is always better to use material in an individual's native language when a speech identification/ recognition test is to be earned out. Best, McRoberts, and Sithole (1998, cited Hume & Johnson, 2001) have found that listeners are more adept at perceiving sounds of their native language than those of a second language acquired later in life. Berman, Blumenfeld, Cascardo, Dash, Levitt and Margulies (1976, cited in Mendel & Danhauer, 1997) were the first to note an effect of native language on speech perception tests in older adults. They found that their older adults subjects who did not learn English as their first language (even though they had been speaking the language for an average of more than 50 years) had more difficulty on degraded speech tasks than did their subjects who were native speakers of English. Thus, it is ideal to test an individual's speech identification ability using their native language.

India is a Multilingual country with 18 official languages and 1650 dialects spoken across different cultures and geographical regions (Atlas of the language and Ethnic communities of South Asia, 1999). There are a few speech identification tests developed in Indian languages. Some of them are developed for children while others for adults. Some of the speech tests developed in India for children include "Picture speech reception threshold test for children" in Kannada (Hemalatha, 1981); "Perception of monosyllabic words in Indian Children in English" (Rout, 1996); "Picture test of speech perception in Malayalam" (Mathew, 1996); "Speech identification test for children in Kannada" (Vandana, 1998) and "A picture speech identification test in Tamil" (Prakash, 1999). For adults, the tests have been developed in Hindi (Abrol, 1971); Tamil (Kapur, 1971; Samuel, 1976); and Bengali (Ghosh, 1988). No test material for evaluating speech identification in children is available in the Hindi language. Thus, there is need to develop a standardized picture speech identification test in Hindi.

Implication of the present study

The test would be useful for hearing evaluation and fitting appropriate amplification device for children with hearing disorders whose language age is between 4- 7 years. The test material can be used for central auditory tests for Hindi speaking children such as dichotic monosyllabic tests, time compressed speech tests, filtered speech tests or binaural fusion tests. The test material can also be used in the evaluation and rehabilitation of children with cochlear implants.

REVIEW OF LITERATURE

Historical Background

The first systematic use of speech materials for diagnostic purpose was initiated as early as 1874 by Wolf (cited in O'Neill & Oyer, 1966). According to him, human voice is the most prefect conceivable measure of hearing. He constructed a table of intensity values for the various sounds of German language. The intensity was expressed in paces, or distance from the speaking source. The major testing materials used were consonants, syllables and words. Later, in 1890 Wolf (cited in O'Neill & Oyer, 1966) recorded the words in an Edison Wax Cylinder. He presented the words to the ear of the patients through adjustable tubing, which permitted to control of the intensity of the recorded materials.

Further systematic attempts to measure speech intelligibility began in 1910 when Campbell established the practical method of evaluating telephone channels (cited in Mendel & Danhauer, 1997). A sender read a list of nonsense syllables at one end of a telephone channel to a listener at the other end. The receiver's percent-correct scores were used as a measure of the relative intelligibility of the stimuli, which was used to determine the quality of the telephone. Fletcher and Steinberg (1929, cited in ASHA, 1978) used words and sentences to assess telephone channel for the above purpose.

Later, speech tests were developed to assess hearing abilities. The recorded auditory test, Western Electric 4C was developed at Bell Telephone Laboratories and presented via the Western Electric audiometer to determine an individual's hearing threshold for speech (Hudgins, Hawkins, Karlin & Stevens, 1947, cited in ASHA, 1978).

Egan, (1948) and Hudgins, Hawkins, Karlin, and Stevens (1947) developed a battery of speech test materials at the Harvad Psychoacoustic Laboratory (PAL) during World War II to evaluate military communication systems. Hirsh, Davis, Silverman, Reynolds, Eldert and Benson (1952) developed the auditory tests CID W-1, W-2 and W-22 at Central Institute for the Deaf. Silverman and Hirsh (1955, constructed the CID everyday sentences test to develop test materials in sentence form. Lehiste and Peterson (1959) developed monosyllabic word lists in a consonant-nucleus-consonant (CNC) context. In 1962 Peterson and Lehiste revised the CNC words lists.

The following section deals with various variables that should be kept in mind when constructing any speech intelligibility test.

Target population

A basic dichotomy separates the materials developed so far for adults and children. Developing test material for adults are relatively easy because of the availability of a wide variety of stimuli. However, for children one has to consider the limited vocabulary and linguistic competence (Jerger, 1983). Jerger, Jerger and Lewis (1983) suggested some important considerations necessary in paediatric speech test development and administration i.e. the need to control the influence of receptive language ability on test performance and the need to consider the effect of extra auditory (cognition) factors on children's performance. Olsen and Matkin (1979) pointed out that the selection of receptive vocabulary competence depends on appropriate response task and the utilization of reinforcement that may affect the reliability and validity of paediatric measurements.

Familiarity of test materials

Most authors have suggested that word lists characterized by greater familiarity are significantly more intelligible than those that are less familiar (Hirsh, Davis, Silverman, Reynolds, Eldert & Benson, 1952; Owens, 1961; Peterson and Lehiste, 1962; & Schultz, 1964). Devaraj, (1983) conducted a study in India to measure the effect of word familiarity on speech discrimination scores of non-native speakers of English. It was noted that subjects who were familiar with the words of the NU- 6 test, scored better than those who were not familiar with the words.

Word Frequency effects

It has been reported by many authors that stimuli with a high frequency of occurrence are more readily perceived than low-frequency stimuli in both vision and audition (Solomon & Howes, 1951; Solomon & Postman, 1952; Savin, 1963). Elliot and Katz (1980) found that monosyllabic words that had been determined to be familiar to 3 years old inner city children were much more easily perceived by adults than by young children and hypothesized that this was attributable to the words frequency effects.

Cross language effects

The language of testing is also an important variable for speech perception assessments. Bergman, et al., (1976, cited in Hume & Johnson, 2001) were the first to report an effect of native language on speech perception tests in older adults. They found that their older adults subjects who did not learn English as their first language, even though they had been speaking the language for an average of more than 50 years, performed poorly in the test. Nelson, Henion and Martin (2000, cited in Martin, 2003) found that non-native speakers of Spanish were less accurate at scoring in Spanish word recognition tests than native speakers. Best, McRoberts and Sithole (1988, cited in Hume & Johnson, 2003) found that listeners are more adept at perceiving sounds of their native language than those of a second language acquired later.

Singh (1966) studied perceptual confusion of plosives in two conditions of distortion with native speakers of English and Hindi language. He found that the direction and magnitude of errors that occur in perception were systematically related to the spoken language of the individual. The incorrect responses for aspiration contrast for instance, were very few for native Hindi speakers when compared to native English speakers. Hence, specific articulation of a given language may have influence on speech perception.

Sapon and Carroll (1957, cited in Sinha, 1981) attempted to assess the effects of perceptual habits, conditioned by native language on the discrimination of actual or potentially meaningful sound contrasts by presenting the same stimulus materials to speakers of Japanese, English and Spanish languages. They concluded that there was a significant difference between speakers of different languages in the perception and discrimination of CVC sounds. The probability of a perception of given sound in a given environment is related to the language of the listener. Thus, it seems that a difference in the ability to discriminate phonemes or speech-like sounds could be attributed to the linguistic experience with certain phonemes or syllables in various languages.

Gat and Keith (1978) in a study of the effect of linguistic experience on the auditory discrimination, presented CID W-22 words in quiet and in the presence of white noise at three different S/N ratios (+ 12, + 6 and 0 dB). Their subjects included native and nonnative speakers of English. In quiet the results were essentially equivalent for both groups. However, as noise level increased, word discrimination deteriorated for all subjects, with non-native speakers of English obtaining results significantly poorer than native speakers of English. Thus, limited linguistic experience resulted in persistent deterioration of auditory word discrimination under impoverished conditions of audition. Hence, it is important to evaluate individuals in the language that they are most familiar with.

Redundancy and Context

Speech is highly redundant, due to the superfluity of rules in the system: phonological rules which constrain the occurrence of phonemes to form words, syntactic rules which govern the structure of sentences, and semantic rules which restrict the co-occurrence of words in a sentence. These rules facilitate speech reception by enabling an individual to make intelligent guesses, when parts of the acoustic signal are missing or not heard.

Speech material range from those with negligible contextual information (least redundant) as is the case of nonsense syllables such as CV, V, VC, CVC or VCV'S to sentence materials which are abundant in contextual cues (highly redundant) like in real speech. The use of speech tests comprising material that is rich in contextual cues taps the subjects' knowledge of language and the ability to use contextual information to perceive speech, in addition to the auditory ability to hear and process acoustic cues. Materials with low redundancy and low context on the other hand, tests only the listener's ability to perceive acoustic cues. Therefore, the kind of material that is used in assessment is a very important consideration.

Acoustic Context:

Acoustic features also have a role in the designing of speech tests. All phonetic contrasts are cued by a multiplicity of interacting acoustic cues. Vowels for example are known to vary in terms of formant frequencies, amplitudes and durations. The richness of the acoustic context of a test item or the number of cues present in an item, is related, first to the phonetic context in which it is presented and secondly to the way in which it is recorded. For instance an intonation test may based only on voice pitch changes in nonsense syllables as in the THRIFT test (Boothroyd, 1986) or by semantic information and variations in relative intensity and duration in addition to differences in voice pitch in connected discourse as in SPAC test (Boothroyd, 1984).

The enunciation of the speaker while recording can also affect the amount of acoustic information and hence the relative difficulty of the test, especially when monosyllables are used. In addition, when a test items occurs in an accented syllable, it has greater clarity than in an unaccented syllable due to inherent changes in frequency, amplitude and duration associated with the accent (Cole & Jakimik, 1980).

The acoustic context of the stimuli can also be varied for assessing the perception of particular acoustic features. Natural speech could be modified with computer manipulation to neutralize some cues and retain others (Revoile, Pickett, Holden & Talkin, 1982) or synthetic speech closely modeled on natural speech could be used to test perception of major acoustic cues (Hazan & Fourcin, 1985).

Types of test materials

The test material can be constructed using nonsense syllables, monosyllabic words, bisyllabic words and sentences. Depending on the materials used, the identification scores could vary.

Nonsense syllables

Many researchers felt that the use of nonsense stimuli may be more accurate in measuring the listener's speech perception (especially phoneme recognition abilities) than meaningful test items because they minimize the contextual cues one receives from meaningful stimuli. Carhart (1965) recommended nonsense syllables, since they are non redundant and it is easier to construct the test materials than meaningful test materials. Nonsense syllables are independent of the listener's vocabulary (Berger, 1971) or language (Mayadevi, 1974). However, the drawback is that, they are abstract and very confusing to the listener. Also the tester needs special training to read out the words in the intended way.

Monosyllabic words

Several speech intelligibility tests have been constructed making use of monosyllabic words. Egan (1948) developed phonetically balanced test lists, which contained 50 monosyllabic words. Hirsh et al- (1952) developed the CID-22 test material which is a combination of CV/CVC monosyllabic words. Abrol (1971) was the first person in India to develop speech test materials for adults. Abrol (1971), Chandrashekar (1972), Samuel (1976), Malini (1981) and Rout (1996) have used monosyllabic words to construct test materials. Monosyllabic words are preferred because these are non redundant and are meaningful (Carhart, 1965). An advantage of monosyllabic word lists is that they can be easily manipulated to represent colloquial speech (Giolas, 1975).

Monosyllabic words in isolation are more difficult to discriminate than the same words in a sentence (Miller, Heise & Litchen, 1951).

House, Williams, Hecker and Kryter (1965) developed the Modified Rhyme Test (MRT) for use with speech communication systems and for clinical tests of hearing. This test employs a closed set response, in which subject must choose one of the six alternative words for each stimulus item. The words are of CVC construction. The variable or differential phoneme is either the initial or final consonant. The stimulus words differ from the error responses by only a single phoneme. Knafle

(1973) developed a Rhyme Test for children. He has mentioned that children had difficulty to select Rhyming words that required differentiation at the end of the words.

Mc Pherson and Pang-Ching (1979) designed a distinctive feature discrimination test (DFDT) for adults. The test items were constructed primarily from the corpus of words found in the Modified Rhyme Test (House, Williams, Hecker & Kryter, 1965). Each of the four lists was constructed by choosing fifty monosyllabic CVC stimulus words and three rhyming error responses for each stimulus word. Of the fifty stimulus words in each list, twenty-five have the initial consonant as the variable phoneme. The vowel nuclei for the words in each list reflect the frequency of occurrence of vowels in the English language. The error ' responses in each of the fifty sets of four words, in each of the lists, include words in which the variable phoneme is one, two, and three distinctive features removed from the corresponding phoneme in the stimulus word. The distinctive features are essentially those proposed by Miller and Nicely (1955): Voicing, nasality, affrication, duration and place of articulation. This test was developed in order to obtain a more sensitive estimate of the individuals' auditory discrimination problem. This was done by giving weightage to the error response scoring depending on whether the response deviated from stimulus items by one, two, or three distinctive features. Merlein (1981) developed a short speech perception test for severe to profound deaf children which incorporated distinctive feature elements in a minimal contrast forced choice and picture format.

From the above research using monosyllabic words, it is evident that they are very popular material used in speech audiometry. However, Edgerton and Danhauer, (1979) have commented that the use of monosyllabic words is a trend rather than diagnostically benefited.

Bisyllabic words

Kapur (1971), Mathew (1996), Vandana (1998) and Prakash (1999) have developed and standardized bisyllabic word lists for speech identification testing. Bisyllabic words were selected mainly due to the lack of availability of monosyllable words in the languages in which they were developed. Comstock and Martin (1984) developed a Spanish bisyllabic word discrimination test for children, which could be efficiently administered by English speaking clinicians to Spanish speaking children. However, bisyllabic words can be identified not only based on phonetic elements but also on the basis of stress patterns (Hirsh, 1952). Bisyllabic words are less analytic than monosyllabic words.

Sentence test material:

Silverman and Hirsh (1955) developed an everyday sentence test to evaluate speech identification. There were natural sentences, commonly encountered in everyday communication. However, sentence stimuli contain a considerable amount of external redundancy and contextual cues. It is difficult to determine whether the subject's responses are a result of perceiving the entire stimulus or the use of closure to fill in the gaps where they do not perceive the components of sentences. Berger (1969) found that, it is less sensitive to predict hearing impairment using sentences stimuli. However, the advantage is that one can predict how efficiently one can use hearing for communication purpose. Jerger, Speaks and Trammell (1968) developed a synthetic sentence identification test to evaluate central auditory dysfunction. This test contains sentences that are, systematically altered from the standard rules of grammar and is meaningless. This was done in order to eliminate the contextual effects in sentence identification. Nagraj (1977) has developed a Synthetic Speech Identification test for adults in Kannada language.

Number of lists and test items

In clinical applications one rarely needs a large number of lists because clinical time constraints preclude using a large number of test material. However, in certain experimental settings, it may be required to compare a large number of experimental conditions and the scores tend to improve due to repeated application of items. Tillman and Carhart (1963) noted that the scores might be contaminated with memory and practice effect if an individual is presented the list of words more than once. Lickliden and Miller (1965) reported that as the number of stimuli decreases the amount of familiarity or practice effects increases. Thus, it is important that a sufficient number of stimulus items be used for each test. An alternative is equivalent lists so that any item is presented only once. Carhart (1965) noted that as long as the test items are meaningful monosyllabic words for the patient and their phonetic distribution is appropriately diversified, one 50-word compilation is relatively equivalent to another.

Half list Versus Full list

To save time and to avoid patient fatigue, it has become a common practice for many audiological clinics to use only half list (Penrod, 1979). Elpern (1961) pointed out that a 25-word list was as efficient as a 50-item list, based on his analysis of CID W-22. Companelli (1962) obtained similar results on the PB-50 lists. Katz and Elliott^ 1980) reported that half list of NU-chip test is equally reliable as compared to full list across all four test forms.

Phonetic Versus Phonemic balance

The test material having a reasonable proportional representation of the sounds that occur in everyday speech is said to be phonetically balanced (Egan, 1948, cited in Plant & Spens, 1995). Grubb (1963) also defined phonetic balancing as proportional representation of fundamental speech sounds.

Phonemic balancing refers to the appearance of a phoneme in a list with respect to its frequency of occurrence in a particular language. Phonemically balance is normally measured separately for initial and final consonants, and is based only on the distribution of phoneme in monosyllables in spoken language. As such it is constrained by the phonological rules operating in the sound system, and is more aptly described as phonemic balance. The rational for using phonemically balanced test material is that if the listeners are unable to perceive a particular phoneme which occurs infrequently in normal everyday speech, the handicap experienced is not as severe as it would have been had the phoneme a more common one (Denes, 1963).

The PAL PB-50 (Egan, 1948) and the subsequent CID W-22 were lists (Hirsh et al., 1952) are phonetically balanced. Later monosyllabic word tests such as CNC (Lehiste & Peterson, 1959) and the Northwestern University Number, 6 (NU-6, Tillman & Carhart, 1963) tests were developed using phonemic balancing. Individual speech sounds have different phonetic manifestations depending on sounds that follow and precede them. These co-articulatory effects prevent every production of a single phoneme from being identical (Lehiste & Peterson, 1959). Therefore, they suggested that it is not possible to have lists of words that are phonetically balanced, but rather it is possible to balance word lists phonemically by having each initial consonant, each vowel and each final consonant appear with the same frequency of • occurrence within each list. This controls co-articulatory effects.

There is inconsistent agreement among researchers regarding the use of phonetic Vs phonemic balancing of monosyllables and whether any kind of list balancing is necessary at all. According to Martin and Pennington (1971), Martin and Forbis (1978) and Martin, Amstrong and Champlin, 1994 (cited in Martin & Clark, 2003) phonetically and/ or phonemically balanced monosyllabic word lists are the most frequently used tests in clinical audiology: However, researchers like Tobias (1964) suggested that phonetic or phonemic balance is not an important factor in the diagnostic utility of the test.

Recorded Versus Live voice presentation of the test materials

ASHA (1978) recommended using either a recorded or a monitored live voice presentation technique for speech audiometry. The recorded presentation of the test materials is the preferred procedure. Both recorded and monitored live voice presentation have advantages and disadvantages. Monitored live voice is flexible, rapid and can be administered easily especially with children and the aged. The disadvantage of monitored live voice is that the scores depend on the talker. Brandy (1966) found significant variability in scores within a single talker upon repeated presentation. Differences are also found in speech identification scores across different talkers (Campbell, 1965; Penrod, 1979; Hood & Poole, 1980). Resnick (1962) found low correlation between discrimination scores obtained with monitored lived voice testing on different days from different testers, and a some what higher score when the tester remains the same and the list is changed.

O'Neill and Oyer (1966) have suggested that recorded test materials provide greater standardization of the test materials. Olsen and Matkin (1979) reported that almost 65 out of 281 his of subjects responded poor for monitored live voice testing in word recognition ability. Recorded materials have fixed acoustic information of the talker, which do not vary across clinics and hence it ensures uniformity of presentation. However, the signals recorded will deteriorate over the time. Also the inter-stimulus time interval cannot be manipulated. These problems can be over come with the use of computers to present the material.

Presentation level

Speech recognition is clinically measured at one intensity level. The effect of presentation level on speech identification can be determined by employing performance intensity function (PI function). At low sensation levels the scores are poor. With an increase in intensity above reception threshold, the word recognition scores increases. After a particular point an increase in intensity does not show any more change in subject responses.

Giolas (1975) obtained maximum speech intelligibility scores at 60 dBSPL for CID W-22 word list. Tillman and Carhart (1963) got almost perfect discrimination at 24 dBSL (ref. SRT) for NU-4 auditory test. However, Nerbonne, McMullin and Hipskind (1974) noted scores are an asymptote at 40 dBSL (ref. SRT) using Goldman-Fristoe-Woodcock test of auditory discrimination.

Some of Indian studies have obtained maximum scores at 35-40 dBSL (ref. F.A.). Abrol (1971) obtained maximum speech discrimination scores at 30 dBSL using Hindi PB lists. Ghose (1988) and Mathew (1996) obtained same scores using in Bengali and Malayalam PB word list respectively. Kapur (1971) obtained high scores at 35 dBSL using Tamil PB word lists. Vandana (1998) and Prakash (1999) obtained higher scores at 40 dB SL (ref. Fletcher's avg.).

Response format: Open set Versus Closed set

If the test format is an open set, the stimulus is given without any specified alternatives. This format allows the listener to choose among an unlimited number of possible responses. However, in a closed set format, the stimulus is provided among a limited number of response alternatives, and the listener is required to select one item from the given sets of response.

Open set tests are not appropriate for all children. Some children may lack the ability to give oral responses, some others may be unwilling or too shy to respond, still others may have such poor speech production that their oral responses cannot be discriminated by the examiner. The major advantage of closed set test is that they can be administered without requiring the listener to make either a spoken or written response (Black, 1957; Jerger, Speaks & Trammell, 1968). Picture identification can be used for this purpose. Because the number of potential responses is limited, closed set tests are easier and yield higher scores than an open set procedure. Therefore it is the preferred method with children. However, the disadvantage of closed set tests is that they may not adequately represent a listener's performance in natural situations. The sensitivity and difficulty of a closed set test can be altered by changing the response set. When the items on a closed set test are embedded among foils that are acoustically/phonetically similar, and when the response set changes for each stimulus presentation (as in WIPI), children cannot use a "process of elimination" to select a response. Such closed set tasks therefore, tap sensory capabilities. However, if a closed set is provided to a listener and the target item stands alone (either because it is phonetically dissimilar from the foil, or because all the foils serve as target and the item can be selected by process of elimination) the listener may be able to guess the correct response, even when limited acoustic information is available. Therefore, very careful consideration is due in constructing closed set test items.

Bode and Oyer (1970) commented that both open set and closed set materials may yield clinically useful information. Although, most everyday listening situations require close set monitoring skills, many words in connected speech such as, proper nouns, unfamiliar vocabulary and technical language are not bounded by contextual influences.

Response method

The subjects can indicate their response in several ways. In an open response set, the subject is required to either repeat verbally or write down what he or she heard. Either method can create errors. Verbal answers can be misheard by the tester. Written answers, unless the subject can write phonetically, can contain spelling errors, which can be misinterpreted by the tester as errors of perception. Research investigating the accuracy of examiners' perception of subjects' responses has shown that an average of 16% to 20% of the responses were scored in error (Merrell & Atkinson, 1965 and Nelson & Chaiklin, 1970). For subjects with no speech production disorders the best solution is to have the subject response verbally and by writing and for the tester to watch the subjects lips as well as listen. In critical applications, additional examiners could record responses independently, either online or offline (Videotaped).

If the response format is closed set the subject can indicate the number of the chosen response, or can point to it. There are several tests where in the subject has to respond by pointing to appropriate picture. The use of picture or objects is generally reserved for small children who otherwise cannot or will not participate in a test. An alternative response method is to ask the subject to make a response appropriate to the stimulus rather than simply repeat the stimulus.

Several tests have been developed which employ either picture pointing or repetition or an object selection task. These include tests developed by Ross and Lerman, (1970), Katz and Elliott (1978), Olsen and Matkin (1979) and Moog and Geers (1990). In India Rout (1996), Mathew (1996), Vandana (1998) and Prakash (1999) have developed speech identification tests, which use picture pointing as the response task to obtain responses from the subjects.

Carrier Phrase

Fletcher and Steinberg (1930) reported higher scores for the identification of CVC syllables when an introductory sentence was used. The most frequently used carrier phrases are: say the word———, you will say————, write the word. . . . . -—————and show me——————.

There have been equivocal results reported in the literature regarding the scores on monosyllabic words tests with or without the use of a carrier phrase.

Martin, Hawkins and Bailey (1962) reported no significant differences in discrimination of words recorded in isolation and word recorded with a carrier phrase for PB word lists. Gladstone and Siegenthaler (1971) found that words from CID-22 tests presented in isolation were more difficult to identify than were words spoken with a carrier phrase. Lynn and Brotman (1981) suggested that when a test material is presented in the same carrier phrase in which it was recorded, the co-articulatory effects in phonemes adjacent to the test item could help identify the target (Lynn & Brotman, 1981).

Use of Background noise or Speech competition

In many clinical and research situations some type of background noise is used in competition with speech perception test materials. Generally, background noise/ competition is used because speech communication in everyday listening situation most commonly takes place against a background competition. Secondly, noise tends to make the test more difficult. Some investigators contend that the presentation of speech test materials against a back ground of noise enhances the sensitivity of the test in detecting and demonstrating communication difficulties experienced by individuals who are hearing impaired (Cooper & Cutts, 1971; Cohen & Keith, 1976). These researchers have reported a markedly greater decrease in scores in noise, for listeners who have high frequency hearing loss, than those with normal hearing. Goldman and Mills (1975) found that children perform significantly poorer than adults in recognition of monosyllabic words in presence of noise.

However, Danhauer, Doyle and Lucks (1985) stated that noise can add considerable confusion to the results without serving to solve the problem of test sensitivity, because there are several factors that must be considered when using noise with speech perception tests including presentation levels, S/N ratios, ipsilateral Vs contralateral presentation, selection of noise type. Unless the test procedures are standardized for use in noise, its addition will place several uncontrollable variables on the test situation.

Instructions

Instruction regarding the test procedure and response task is a very important factor determining speech identification scores. Inappropriate instruction to the subjects may lead to misinterpretation of the results. Markides (1970) and Eisenberg, Berline, Dill and Frank (1966) reported that reinforcement and instruction given to the listener could make a difference on speech discrimination scores, especially so in case of children.

Scoring procedure

For speech identification tests, one can measure and express the scores in a variety of ways. For a monosyllabic word test for example, the item can be scored as proportion of words correct (word scoring) or proportion of phonemes correct (phoneme scoring). Phoneme scoring normally leads to higher scores than word scoring, and since the numbers of score items are more, it increases test reliability. The only disadvantage of phoneme scoring is that it places additional demands on the concentration of the tester. Such a percentage score has some relative value in that it permits comparison between individuals, and between the performances of the same individual on different trials. This method of scoring however, gives equal weight to all errors and does not reveal the types of discrimination problems the individual may have. Hence, McPherson and Pan-Ching (1979) constructed a discrimination test, where error responses could be evaluated in terms of their distinctive feature differences from a stimulus item. This is the Distinctive Feature Discrimination Test (DFDT). In error scoring, scores are assigned according to distinctive feature differences between the error response and stimulus item, that is, one point is assigned to a one-feature error, two points to a two-feature error and three points to a three-feature error. The advantage of such a system is that it could provide a more sensitive estimate of the severity of individual's discrimination problem. Moreover, the subjects' confusions could be determined which would prove helpful in planning rehabilitation. Another scoring method is to count complete sentence as items. This could be done when the response task requires the subject to follow an instruction or answer a question, and when subjects' actions are then judged as write or wrong.

From the above review, it can be observed that are a host of factors that could influence the out come of any speech identification test. Due consideration should be given to each of those factors, ensuring that the variables that are most appropriate are selected, while constructing a speech identification test.

Table 1 and 2 give the summary of the material used, response mode and research carried out using the specific tests. While Table 1 summaries information regarding children, Table 2 give information about adults.

Table 1: Summary of Tests of speech Perception for Children

1 = Phonetic Balance; 2 = Phonemic Balance, VC =Vowel consonant; CV = Consonant Vowel; CVC= Consonant Vowel Consonant; CNC =Consonant Nucleus Consonant

Test Name	Content		Response		No. of items	No of lists	Additional Information
	PB	Test material	Set	Method			
Kendall Toy Test, Kendall (1953)		Monosyllabic words in carrier phases	Closed set 10 choice	Object pointing	Words-10	3	
PBK, Haskins (1964)	1	Monosyllabic words in isolation	Open set	Repeat	Phonemes-150 Words-50	4	
WIPI (word intelligibility by Picture Identification, Ross & Lerman, (1970)		Monosyllabic Words in carrier phrase	Closed set 6 choice	Picture pointing	Words-25	4	Sanderson-Leepa and Ritlemann (1976) conclude that the WIPI is not suited for comparing and fitting devices, Hodgson (1973) compared WIPI and PB-K 50 on normal children. He found higher score on WIPI
Monosyllabic Trochee-spondee Test (MTS), Erber and Alenwicz (1976)		Monosyllabic and bisyllabic words in carrier phrase	Closed set 12 choice	Picture pointing	Words-12	1	-
McCormick Toy test, McCormick (1977)		Monosyllabic words	Closed set	Picture pointing	Words-12	1	Ousey, Palmer- Shappard (1989) and Marshal (1991) developed a revised version whicffnTghly advanced and accurate.

Test Name	Content		Response		No. of items	No of lists	Additional Information
	PB	Test material	Set	Method			
Matrix: test 1year and Hoisted (1978)		Words in sentence	Closed set 2 choice	Pointing to words	60 items	2	To evaluate of effectiveness of hearing aid, tactile aids and cochlear implant.
Bamford - Kowal Bench sentence (BKB) test, Bench, Kowal and Bamford (1979)		Sentences	Open set	Repeat	Sentences-16 Words- 77 Key words- 50	21	It is also used to identify cognition skills
Nonsense Syllable Test (NST), Edgerton and Danhauer (1979)		Monosyllabic words (CV& VC,V=a,e,I)	Closed set	Mark on Response sheet	9 syllables 7 models		Danhauer, Doyle and Lucks (1985) used NST in assessing childrens' perception Butts et al(1987) compared the errors on NST to pure tone threshold. found excellent predictive relation
North-western University-children's perception or speech (NU-CHIPS) Elliot & Katz (1980)	-	Monosyllabic words	Closed set 4 choice	Picture pointing	Words - 50	4	This test is meant for children upto 10years and can also be used for children as young as 2-5 years

Test Name	Content		Response		No. of items	No of lists	Additional Information
	PB	Test material	Set	Method			
Auditory Number test, Erber (1980)		Single Number or Number in sequence	Closed set 5 choice	Picture pointing	Numbers 1-5	1	Erber (1980) reported that this test showed high test-retest reliability and can be used for rapid evaluation of speech perception of young hearing impaired children.
Paediatric speech intelligibility test, Jerger, Lewis, Hawkins & Jerger (1980)		Monosyllabic words	Closed set 5 choice	Picture pointing	Words-10	1	
Picture Speech Keception Threshold for Children in Kannada, Hemalatha (1981)		Poly syllabic words	Closed set	Picture pointing	Words-20	2	It is a speech recognition threshold (SRT) test standardized for children in the age range of 4-8 years.
Glendonald auditory screening procedure (GASP\ Erber (1982)'		Phonemes, Syllables, Words, Phrases, Sentence Continuous discourse	Closed set	Picture pointing	Words-24	1	Has three subtests: Phoneme detection, Word identification. Sentence Comprehension. Usina this material detection .discrimination, identification and comprehension are evaluated.

Test Name	Content		Res)onse		No. of items	No of lists	Additional information
	PB	Test material	Set	Method			
GAEL-P Moditied single word task. Moog, Kozak and Geers, (1983)	-	Monosyllabic words, Multisyllabic words	Closed set	Picture pointing	Words-30 Monosyllabic-19 Multisyllabic-11	1	Used for children as younq as 2 yrs of aqe.
PLOTT test, Plant (1984)	-	Phonemes Monosyllabic, Spondees, I rochees, Polysyiiabic, words	Closed set 2 choice	Yes/no pointing choice	*Phoneme detection-22 *Number pattern- 5 *Monosyllable, Spondee, Trochee, Polysyllable-12 *Picture vocabulary-12 "Vowel length-10 * Vowel identification-10 *Consonant voicing-10 *Consonant manner of articulation-10 *Consonant place of articulation-10	1	It has got nine subtest: *Phoneme detection *Number pattern *Monosyllable,Spondee, Trochee.Polysyllable *Picture vocabulary *Vowel lenqth *Vowel identification *Consonant voicing *Consonant manner of articulation *Consonant place of articulation

Test Name	Content		Response		No. of items	No of lists	Additional Information
	PB	Test material	Set	Method			
Minimal pairs test, Robbins Renshoaw, Miyamato, Osberger.Pop (1988)	1	Monosyllabic words	Closed set 4 choice	Picture pointing	Words = 40	2	Used to assess speech Perception abilities for segmental features in children who use cochlear Implants
Early speech perception (ESP), Moog and Geers (1990)		Monosyllable spondee trochee Three syllable words	Closed set 12 choice	Picture pointing	For pattern perception-12 Spondees-12 Monosyllables-12	1	This test has two parts. Standard and Low Verbal version. Low version is used for verv vouna children (2 vears and Up) children and standard version is used for 6 years and up hearing impaired children. It scored for pattern perception and word nernpntinn
Toy test for young children with English as second language, Bellman and Marcuson (1991)	-	Monosyllabic words carrier phrase	Closed set	Picture Pointing	Words - 6	2	Standardized for 3-5 years old Indian children who speak English as second language.
Mr.Potato Head Task, Robins (1994)		Sentences	Open set	Object manipul-ation	Sentences-10		Designed for hearing impaired children, can be used even for 2 years old children.

Test Name	Content		Res aonse		No. of items	No of lists	Additional Information
	PB	Test material	Set	Method			
Speech Identification test for for Kannada speaking children, Vandana (1998)	2	Bisyllabic words	Closed set	Picture pointing	Words- 50	4	Has two equal half lists
A picture speech identification test for children in Tamil, Prakash (1999)	2	Bisyllabic words	Closed set	Picture pointing	Words- 50	4	Has two equal half lists
A speech perception test for English speaking Hearing Impaired Indian Preschoolers, Begum (2000)		Monosyllable, Bysyllable, Tri-syllable Words	Closed set	Picture pointing	Version I *Syllable categorization-9 * Word identification a) Bisyllabic- 6 b) Monosyllabic-6 Version II *Syllable categorization-12 *words identification a) Bysyllabic-10 b) Monosyllable-10 c) Vowel identification-6		Has two version, one for 2-3 year old children, and the other for 3-5 year old children.
A speech perception test for Tamil speaking hearing impaired children, Tamilamani (2002)		Monosyllable, Bysyllable, Tri-syllable Words	Closed set	Picture pointing	Pattern perception - 9 Word identification: Trisyllable - 8 Bisyllable - 8 Monosyllable - 8		This test has only one version for children in the age range of 3-5 years

Table2: Summary of tests Speech Perception for Adults

Test Name	Content		Response		No of items	No. of lists	Additional Information
	PB	material	Set	Method			
Psychoacoustic Laboratory List PB-50, Egan (1948)	1	Monosyllable words in carrier Phrase	Open set	Repeat	Word - 50	20	
CID W 22, Hirsh, Davis (1952)		CVC words in isolation	Open set Closed set	Repeat Multiple Choice	Phoneme - 150 Words - 50	4	Maximum scores was reached at 60 dBSL ref. SRT
Rhyme test, Fairbanks (1958)	-	Rhyming monosyllabic words in isolation	Open set	Insert missing sound in word frame	Words - 50	1	

Test Name	(Content		Respc)nse		No of items	No. of lists	Additional Information
	PB	Test material	Set	Method			
CNC words Peterson and Lehiste, (1962)	2	Monosyllabic - CNC words in isolation	Open set	Repeat	Words - 50	10	It is a revised form the original CNC list developed in order to control for word frequency effects
Synthetic sentence identification (SSI), Jergerand Speaks (1965)	1	Synthetic sentences Sentences 1 , 2 ,3 synthetic sentences	Closed set 10 choice	Mark on response sheet	Sentences-10	2	
Modified Rhyme test, House, Williams, Hecker and Kryter (1965)	-	Monosyllabic words (CVC, CV)in isolation	Closed set	Mark on response sheet	Phoneme - 50	6	
NU-6, Tillman & Carhart(1966)	1	Monosyllabic words CV/CVC **carrier phrase**	Open set	Repeat	Words - 200	4	

Test Name	Content		Response		No of items	No. of lists	Additional Information
	PB	Test material	Set	Method			
Short Isophonemic word test, Boothroyd(1968)		Monosyllabic words CVCin isolation	Open set	Repeat	Phoneme - 30 Words-10	15	Recommended use of phoneme scoring. Takes less than 6 minutes to plot a PI function of at least 3 levels on the slope and 3 on the plateau
PB words list in Hindi, Abrol (1971)	1	Monosyllabic words	Open set	Repeat	Words - 50	1	
Speech Perception test in Tamil and Telugu, Kapur(1971)	1	Bisyllabic words	Open set	Repeat	Words - 50	1	Standardized in both languages
Disyllabic Speech test in Malayalam, Kapur(1971)	1	Bisyallabic words	Open set	Repeat	Words - 34	1	Maximum scores of Speech identification obtained at 45 dBSL (ref. Fletcher's avg.)

Test Name	Content		Response		No of items	No. of lists	Additional Information
	PB	Test material	Set	Method			
CUNNY non sense syllable test, Levitt and Resnick (1978)	-	Nonsense syllables CV, VC in carrier phrase	Closed 7-9 choice	Mark on response sheet	Phoneme-55	1	In this the vowels used are /a/, /I/ & /u/ with consonants of varied place and manner..
Picture Identification Task, Wilson and Antabolin, (1980)	2	CVCin carrier phrase	Closed set	Picture pointing	Phonemes-50	4	Words recognition for non verbal patients who are unable to respond orally.
Iowa vowels recognition test. Tyler, Preece, Lowder (1983)	-	Monosyllabic words (b v d)	Closed set	Repeat	Phoneme -45	6	Inter consonantal vowels are /a/, /e/,/i/,/o/,/u/and/a/
Speech pattern contrast test ,Boothroyd(1984)	-	Phrases with different word stress	Closed set 3-choice	Mark on response sheet	Phonemes-12	4	Developed for post lingual deaf of age 9 years.

Test Name	Content		Respc>nse		No of items	No. of lists	Additional Information
	PB	Test material	Set	Method			
Three interval forced choice test of speech pattern contrast perception | (THRIFT), Boothryod (1980		Synthetic tones for long short distinctions	Closed set 3-choice	Mark on response sheet	Duration Scores - 24	4	This test is applied to generate a profile of an individual's access to several phonologically significant speech pattern contrasts. It measures the amount of sensory evidence that the subject obtain from speech regardless of such things as current age, age at onset of deafness, listening experience, motor speech skills and language development.
Four Alternative Auditory Feature (FAAF), Foster and Haggard (1987)		Monosyllabic words CVC in carrier phrase	Closed set 4 choice	Mark on response sheet	Words= 80	5	

METHOD

The aim of the present study was to develop and standardize a monosyllabic picture speech identification test for Hindi speaking children.

The present study was carried out in two stages, namely

Stage 1: Construction of test materials

Stage 2: Obtaining normative data.

Stage 1: *Construction of test material*

A list of monosyllabic Hindi words was constructed which had words within the vocabulary of 4-7 years old children. The list of about 127 words was selected from books meant for children in the age arrange of 4-5 years and from the parents of the children. Only words which could be picturized were chosen. These monosyllabic words were subjected to a familiarity test.

Twenty subjects were involved in checking the familiarity of the test items. The criteria for selection of subjects was as follows:

1. All the subjects were native speakers of Hindi and they were well exposed to the language.
2. They were within the age range of 4-7 years.
3. They had normal hearing.
4. They had normal speech and language development

5. They did not have any history of otological, neurological, psychological and ophthalmologic problems.

Each subject was tested individually during the word familiarity test. It was done in two ways. Either they were asked to name the pictures (depicting the items of the word list) or point to the picture named by the examiner (in a set of four pictures). For the speech identification test, the word was retained only if 90 percent of the children could name the picture and identify the picture correctly.

Development of test material:

Seventy-two words were found to be familiar to the children. Among the seventy-two words, fifty words were used as test items and three words were used as practice items. The remaining words were used as distracters.

The test items contained phonemes that had a frequency of occurrence similar to the data published by Ramakrishna, Nair, Chiplunkar, Atal, Ramachandran and Subramanian (1962). However, the phonemes /au/, /jh/, /d/, /dh/, /n/, /dh/, /v/ and /sh/ which were mentioned in the study by Ramakrishna et al., (1962) were not included in the present study since it was found that children were not familiar with words containing those phonemes. The majority of these phonemes had a very low frequency of occurrence as per the findings of Ramakrishna et al., (1962). The only phonemes which had a higher frequency of occurrence, as per this study, was *l\l* (1.45 %). The remaining phonemes had a frequency of occurrence between 0.17 to 0.03. Since these phonemes had such a low frequency of occurrence in adults, they were not familiar to children.

The list was divided into two parts, with each part having 25 words. The phonemic balance was equally maintained for the **full** list and the two half lists. The practice items and the word list are given in appendix A.

To obtain responses from the children, a picture book was developed (appendix B). Each page of the book had four pictures, one the test item and the rest distracters. Thus each item had three distracters. Either the initial or final sounds of the test item were similar to those of the distracter words. The first three pages have the practice items and rest of the picture book depicts the test items.

Stage *2. Obtaining normative data:*

Thirty children were involved in this part of the study. They met the same criteria as the subjects involved in obtaining the familiarity of the test items. The children were grouped into three-age groups, 4-5 years, 5-6 years and 6-7 years. These children were taken from various cultures, socio-economic backgrounds, all residing in an urban area and speak Hindi at their homes.

Instrum entation:

A two channel, clinical diagnostic audiometer (Madsen OB 822) TDH 39 circumaural earphones housed in cushions MX-41/AR and bone conduction vibrator "Radioear" B71 was used for testing. The frequency and intensity calibration for air conduction, bone conduction and speech was done with reference to ANSI (S 3.6 - 1996) (cited in Wilber, 2002) specifications.

Test Environment:

The test was carried out in a sound treated double room setting. The ambient noise levels were within the permissible limits as recommended by ANSI (S 3.1-1991) (cited in Wilber, 2002) standards.

Instruction:

The subjects were given instructions in the following way in Hindi "You will hear some words through the head phones. Listen carefully to each word, look at all the pictures in the page and point to the picture of the word that you hear".

Procedure:

It was ensured that the children had normal hearing by obtaining air conduction and bone conduction thresholds for the frequencies 250-8000 Hz and 250-4000 Hz respectively. The subjects were randomly tested in the left or right ear for the speech test. Half the subjects were evaluated in right ear, while the other half in the left ear.

Administration of the speech identification test:

Two examiners conducted the speech test. One examiner presented the speech stimuli using monitored live voice, ensuring that the deflection of the VU meter was to zero. A distance of 6-9 inches was maintained between the microphone and the mouth of the tester, as recommended by Penrod (1994). The other examiner was seated beside the child to help him/her turn to the appropriate page of the picture response book.

Initially, three practice items was presented at a comfortable level i.e., 40 dBSL re: Fletcher's average (the average level of two better thresholds among the speech frequencies - 500, 1000, 2000 Hz (cited in ASHA, 1977). The test was administered at 20 and 40 dB SL re: Fletcher's average. At each of these intensity levels all the 50 test items were presented. The items were randomized to avoid the effect of familiarity when testing at the two intensity levels. The subjects responded by pointing to one of the four- choice pictures of the picture book.

Scoring:

The response was recorded on a score sheet (appendix C). A correct response was given a score one and an incorrect responses was given a score of 'zero'.

Statistical Analysis:

The mean and standard deviation for both the half and full lists across the age group was calculated. The t- test was done in order to find out the significance of difference between the mean of the different groups.

RESULTS AND DISCUSSION

The objective of the present study was to develop a monosyllabic picture speech identification test for Hindi speaking children. Thirty children with normal speech-language and hearing were administered the test to obtain normative data. The children were in the age range of 4-7 years and were divided into three age groups (4-5 years, 5-6 years and 6-7 years).

The data collected from the subjects were subjected to statistical analysis, and the results are discussed under the following headings:

1. The effect of presentation level on speech identification scores.
2. The effect of age on speech identification scores.
3. Comparison of speech identification scores with the half versus full list administration.
4. Equivalence of the two half lists.

1. The effect of presentation level on speech identification scores

The test materials were administered at two intensity levels, 20 dBSL and 40 dBSL with reference to Fletcher's average.

Table 3: Mean, standard deviation and 't'-values, of speech identification scores across the two presentation levels, for the three age groups.

Age group	Presentation level	Mean	SD	t -value
4-5 years	20dBSL	44.4	1.26	4.83**
	40 dBSL	47.2	1.32	
5-6 years	20dBSL	46.7	0.82	6.32**
	40 dBSL	49.1	0.88	
6-7 years	20 dBSL	48.4	1.02	3.11**
	40 dBSL	49,8	0.63	

Maximum score = 50 ** P< 0.01

Table3 shows that the mean speech identification scores were higher at 40 dBSL as compared to the scores at 20 dBSL for all age groups i.e., children in the age range of 4-5 years obtained a mean score of 44.4 at 20 dBSL and 47.2 at 40 dBSL where as children in the age range of 5-6 years obtained a mean score of 46.7 at 20 dBSL and 49.1 at 40 dBSL and children in the age range of 6-7 years obtained mean score of 48.4 at 20 dBSL and 49.8 at 40 dBSL. This difference in speech identification scores across the two intensity levels was also statistically significant at the 0.01 level. Thus, with increase in the intensity level, there was improvement in the childrens' performance. This could be attributed to the greater acoustic energy available at higher intensity level. This finding is consistent with earlier studies which have reported high speech identifications scores in children at 30-40 dBSL (ref. Fletcher's avg.) compared to lower intensity levels (Hemalatha, 1981; Vandana, 1998; Rout, 1996; Mathew, 1996; Prakash, 1999; Elliott & Katz, 1978). However, Hirsh (1952) and Giolas (1975) obtained high scores of speech intelligibility only at 60 dBSL (ref. PTA) for CID W-22 word list, which could be related to the selection of difficult test material. Hence, based on the results of this study, it is recommended that the test be administered at 40 dBSL (ref. Fletcher's avg.) to ensure good scores.

*2. The effect **of** age **on** speech identification scores*

Table 4: Mean, standard deviation and 't'-values of speech identification scores across the three age groups at 20 dBSL and 40 dBSL

Presentation level	Age	Measure		t -value
		Mean	SD	
20dBSL	4-5 years	44.4	1.26	4.51**
	5-6 years	46.7	0.82	
	5-6years	46.7	0.82	3.33**
	6-7 years	48.4	1.26	
	4-5 years	44.4	1.26	5.56**
	6-7years	48.4	1.26	
40dBSL	4-5 years	47.2	1.32	3.33**
	5-6 years	49.1	0.88	
	5-6years	49.1	0.88	2.69*
	6-7 years	49.9	0.63	
	4-5 years	47.2	1.32	5.42**
	6-7years	49.9	0.63	

Maximum Score = 50

**<P0.01
*<P0.05

Table 4 reveals an increase in the speech identification scores with increase in age of the children at both presentation levels, t- tests were carried out to determine the significance of difference between the mean scores of each age group to yield 3 comparisons at each presentation level. The results demonstrated significant differences at 0.01 level for all age group comparisons at 20 dBSL as well as 40 dBSL. However, difference was significant at the 0.05 level between the elder two groups when the signal was presented at 40 dBSL. The following words were found to be consistently reported wrong by the youngest (4-5 years) group at 40 dBSL: /dzeb/, /Per/,/zib / and /Ped/. The second age group (5-6 years) misperceived the following words most often at 40 dBSL: /dzeb,/zib / and /Ped/. Hence, while using the test on a deviant population, this information should be kept in mind.

These findings are an agreement with previous studies done by Vandana (1998) and Prakash (1999) in different languages. They too found that with increase in age there was a significant improvement in speech identification scores.

3. Comparison of speech identification scores with half Vsfull list administration

In order to compare the data from the half list with that of the full list, the raw data were converted to percent scores. This facilitated easy comparison of the mean scores of half list and full list.

Table 5A. Mean, standard deviation and 't'- values of speech identification scores for half vs. full list at 20 dBSL for the three age groups.

First Half List vs. Full List					Second Half List vs. Full List			
Age	Measure	25words	50words	t - value	Measure	25words	50words	t- value
4-5 yrs	Mean	88.8	88.8	0^{NS}	Mean	88.8	88.8	0^{NS}
	SD	1.58	2.52		SD	1.84	2.52	
5-6 yrs	Mean	93.2	93.4	0.33^{NS}	Mean	93.6	93.4	0.32^{NS}
	SD	0.96	1.64		SD	1.04	1.64	
6-7 yrs	Mean	96.8	96.8	0^{NS}	Mean	97.2	96.8	0^{NS}
	SD	1.20	1.52		SD	1.90	1.52	

Maximum Score = 100 NS: not significant difference

Table 5B. Mean, standard deviation and 't'- values of speech identification scores for half vs. full list at 40 dBSL for the three age groups.

First Half List vs. Full List					Second Half List vs. Full List			
Age	Measure	25words	50words	T	Measure	25 words	50words	T
4-5 yrs	Mean	98.8	94.4	$0\ 38^{NS}$	Mean	94	94.4	0.42 NS
	SD	1.90	2.64		SD	1.42	2.64	
5-6 yrs	Mean	98.4	98.2	0.31^{NS}	Mean	98	98.2	0.31^{NS}
	SD	1.04	1.76		SD	1.06	1.76	
6-7 yrs	Mean	99.6	99.6	0^{NS}	Mean	99	99.6	1.25^{NS}
	SD	0.64	1.26		SD	0.84	1.26	

Maximum Score =100 NS : not significant difference

From Tables 5A and 5B, it is evident that there is no significant difference between the mean scores for half list and full list at 20 dBSL and 40 dBSL. Thus it can be inferred, that using a half list will give results reliable as that of the full list and it will be economical in terms of time. Researchers like Carhart (1965) and Elliott and Katz (1980) have also recommended the use of half list in evaluating speech identification in order to save time and avoid patient fatigue.

4. Equivalence of the two half lists.

To determine whether the two half lists are equivalent, the mean scores of the first half list was compared with that of the second half list, for both the presentation levels and the three age groups of children.

Table 6. Mean, standard deviation and 't'-values of speech identification scores across the half lists for the three age groups at 20 dBSL and 40 dBSL

Presentation level	Age	Measure	1st Half list	2nd Half list	t -value
20dBSL	4-5 years	Mean	22.2	22.2	0 NS
		SD	0.79	0.92	
	5-6 years	Mean	23.3	23.4	0.43^{NS}
		SD	0.48	0.52	
	6-7 yrs	Mean	24.2	24.3	0.97^{NS}
		SD	0.60	0.95	
40 dBSL	4-5 years	Mean	23.7	23.5	0.53^{NS}
		SD	0.95	0.71	
	5-6 years	Mean	24.6	24.5	0.42^{NS}
		SD	0.52	0.53	
	6-7 years	Mean	24.9	24.9	0 NS
		SD	0.32	0.42	

Maximum Score = 25 NS: not significant

As evidence from Table 6, there is no significant difference in the speech identification scores obtained from three groups of children, for the two half lists at both presentation levels. Hence, either of the two half lists could be use to obtain reliable estimates of speech identification.

The findings of present study can be summarized as follows:

1. There is an improvement in the speech identification scores of children of all age groups with increase in the presentation level. Higher score was obtained at 40-dBSL compared to 20 dBSL (ref. Fletcher's avg.)

2. There is an improvement in speech identification scores with increase in the age of the children.
3. The two half lists were found to be equivalent to the full list.
4. The two half lists were found to be equivalent.

SUMMARY AND CONCLUSION

The aim of this study was to develop and standardize the picture speech identification test for Hindi speaking children in age range of 4- 7 years. As of now, no test material is available for assessing speech identification in children in Hindi. It has been suggested by Best, McRoberts and Sithole (1998, cited in Hume & Johnson, 2001) that it is best that the native language of a speaker be used when assessing their speech identification abilities. In the present study, a picture pointing task has been used for eliciting the responses, in a closed set format.

The test material included fifty monosyllabic words in Hindi. The list was phonemically balanced. The phonemes /au/, /jh/, /d/, /dh/, /n/, /dh/, *hi* and /sh/ found to have low frequency of occurrence in Hindi (Ramakrishna, et al., 1962), were not included in the present study since it was found that children were not familiar with words containing these phonemes. Using the fifty monosyllables, two half lists were constructed, with each half list being phonemically balanced.

The test items were administrated to thirty normal children at two intensity levels (20 dBSL and 40 dBSL ref. Fletcher's avg.). These children were divided in to three subgroups based on their age (4-5 years, 5-6 years, and 6-7 years). The children responded by pointing the appropriate picture from a four choice alternative. The responses were scored and the data was subjected to statistical analysis.

The summary of the results are as follows:

1. There was significant improvement in the speech identification scores of children with increase in intensity of presentation.
2. There was an improvement in speech identification scores with increase in the age of the children. The youngest age group had difficulty in the following words: /dzeb/, /per/,dzib^{h}/, and /ped/. The second age groups had problems in perceiving the words /d^eb/, /per/, and/SgibV.
3. The two half lists were found to be equivalent to the full list.

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4. The two half lists were found to be equivalent to each other.

Recommendations of the test

1. The developed test materials can be used for assessment of speech identification of Hindi speaking children above the age of 4 years.
2. The test materials can be used for auditory training or prescribing amplification device.
3. The test should be administered at 40 dBSL (ref. F.A.) to obtain better speech identifications score.

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APPENDIX

APPENDIX-A

WORD LIST AND FAMILIARIZATION

Appendix A

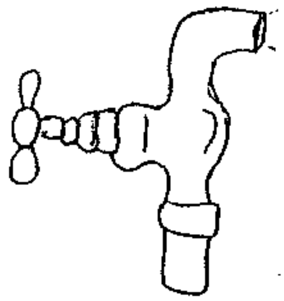
Test items

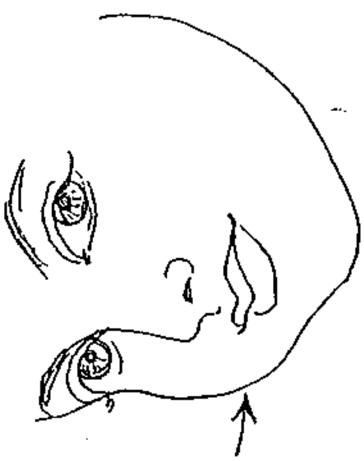
Familiarization items

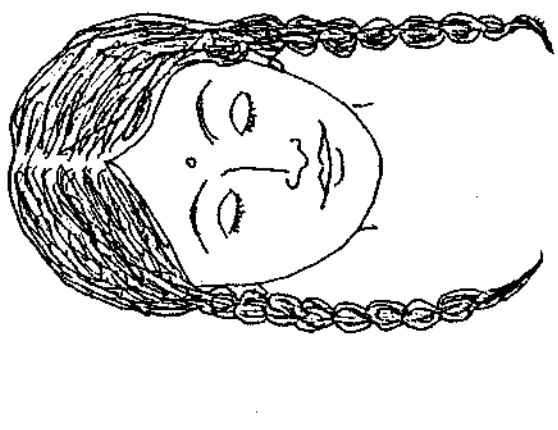
गाल /gal/ मेज /mez/ चोर /tʃoɾ/

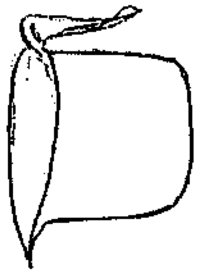
1. बस /bas/
2. सूई /sui/
3. फोन /fon/
4. पेट /pet/
5. गाय /g aj/
6. फल /phal/
7. खून /kʰuːn/
8. चाँद /tʃand/
9. घर /gɦaɾ/
10. भूत /bʱut̪/
11. माँ /mã/
12. सेब /seb/
13. जेब /dʒeb/
14. कान /ka:n/
15. पेड़ /peɽ/
16. आग /a'g/
17. कार /kaɾ/
18. दीप /d̪i:p/
19. शेर /se:ɾ/
20. पीठ /pitʰ/
21. बाल /bal/
22. हाथ /ha:t̪ʰ/
23. मोर /moɾ/
24. छत /tʃʰat̪h/
25. मुँह /mũh/
26. दाँत /d̪ ã: t̪/
27. बम /bam/
28. रेल /ɾel/
29. रंग /raŋg/
30. नाक /nak/
31. साँप /sãnp/
32. फूल /phul/
33. मूछ /mũch/
34. ऊँट /ũ:t/
35. तीर /t̪iɾ/
36. नोट /not/
37. आँख /ã:kʰ/
38. जीप /dʒi:p/
39. मग /mag/
40. पैर /peɾ/
41. एक /ek/
42. बाघ /bagɦ/
43. ब्रश /bɾaʃ/
44. गेंद /g ẽ nd̪/
45. होट /hotʰ/
46. चाय /tʃ ai/
47. घास /gɦas/
48. आम /a:m/
49. नल /nal/
50. जीभ /dʒibɦ/

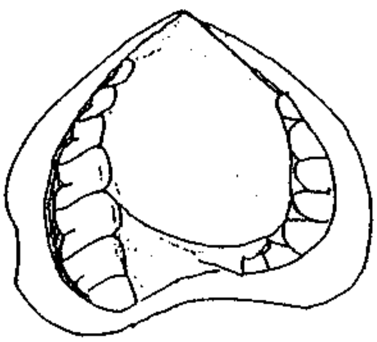
FAMILIARIZATION ITEM

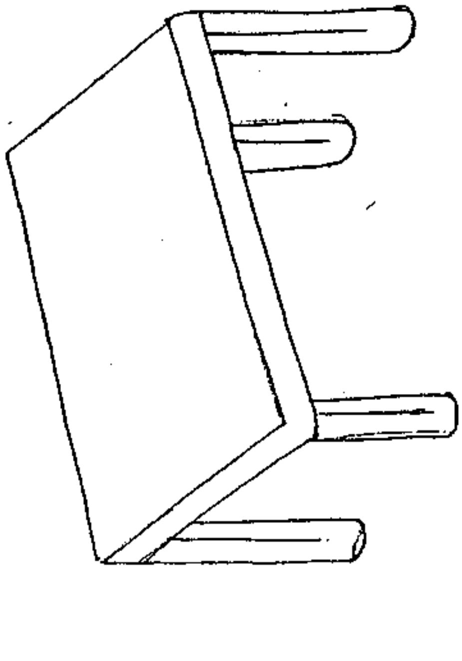


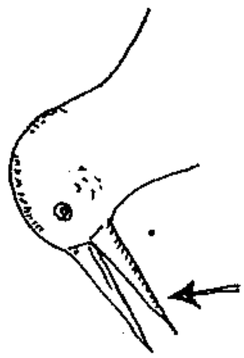
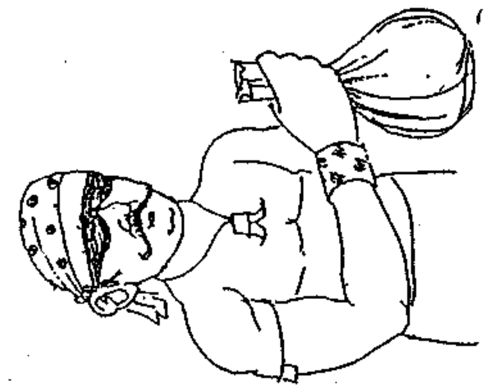


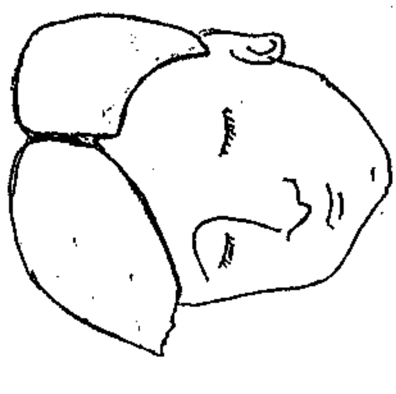






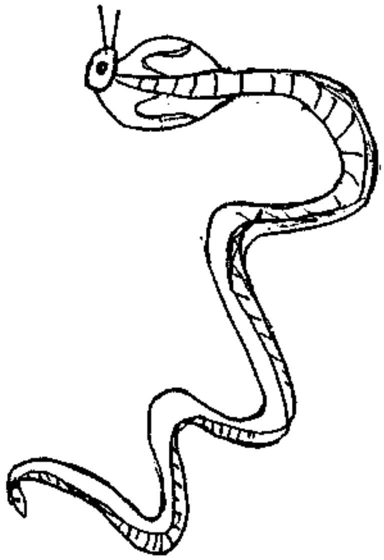


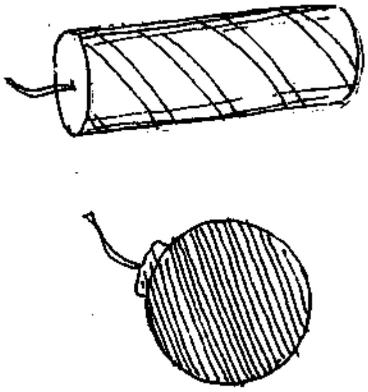



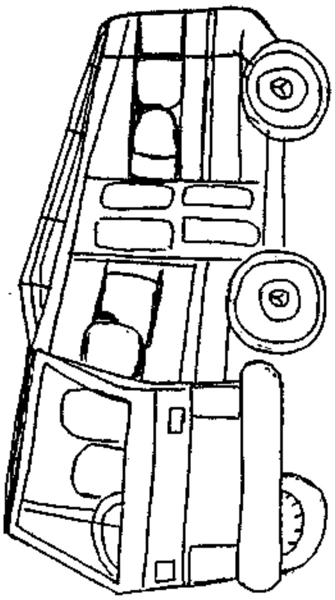


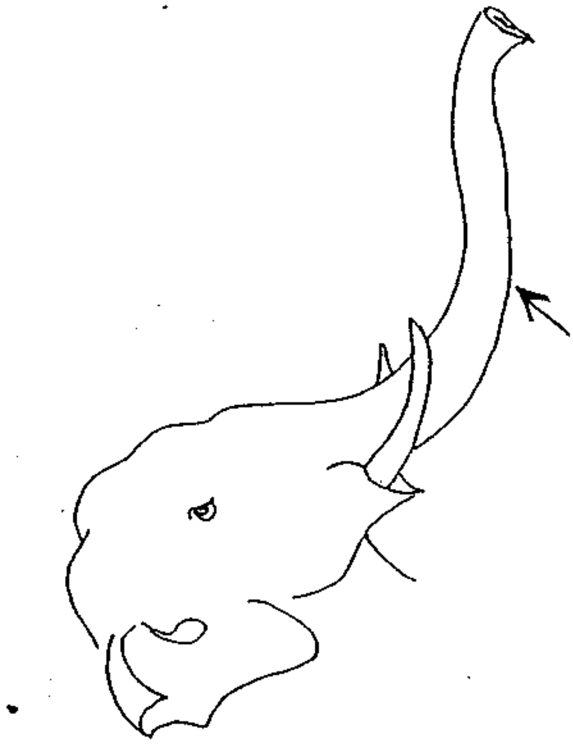
APPENDIX - B

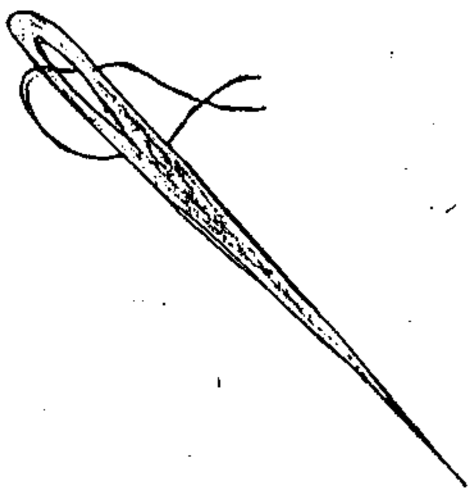
PICTURE BOOK

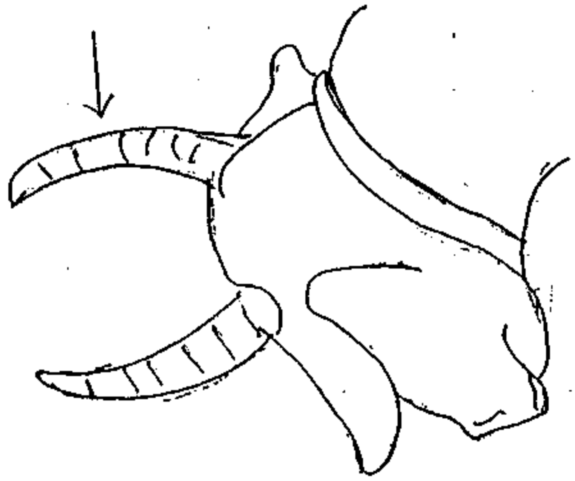


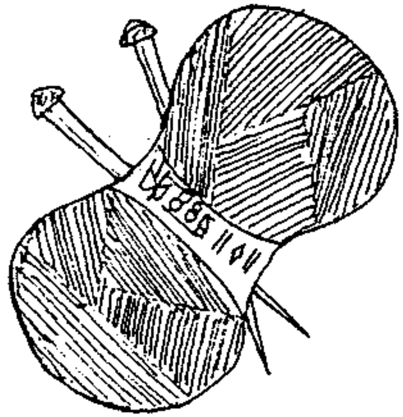










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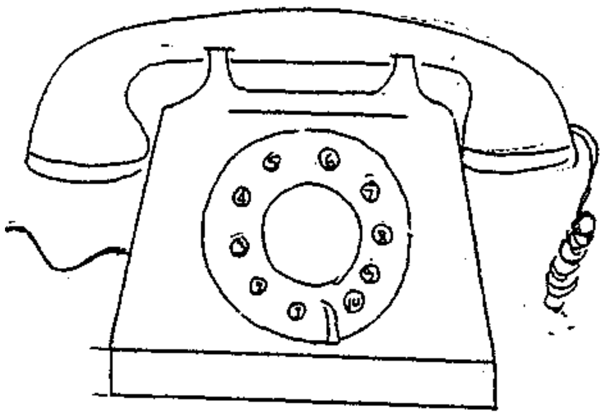

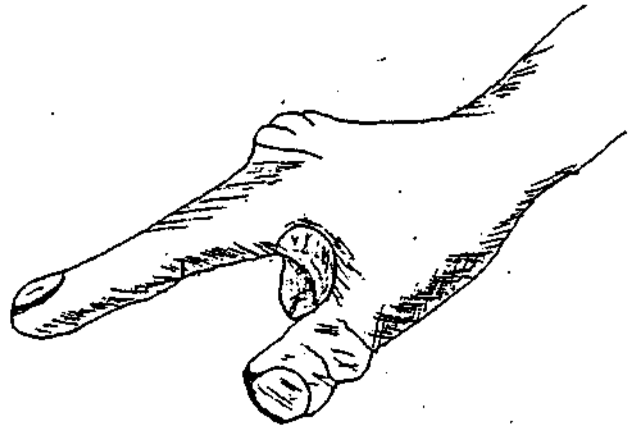

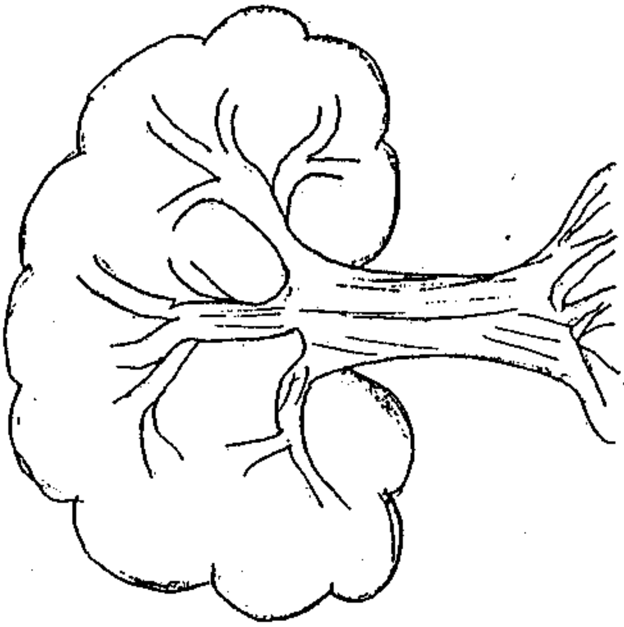

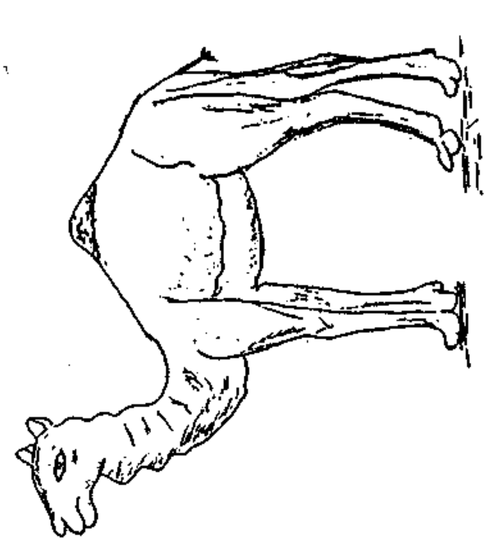

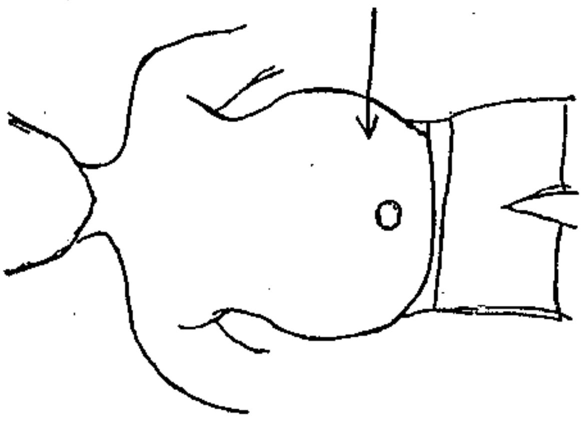

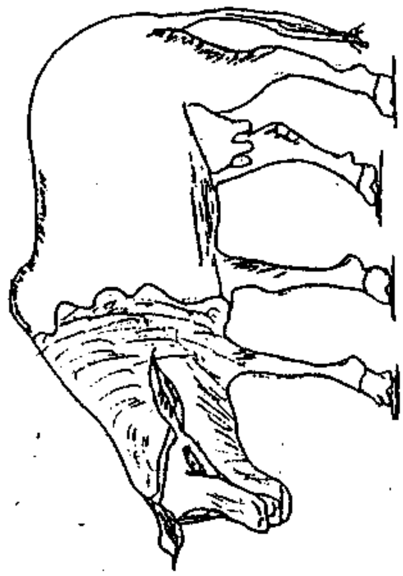
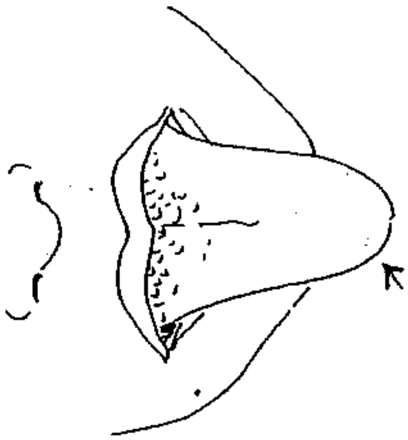
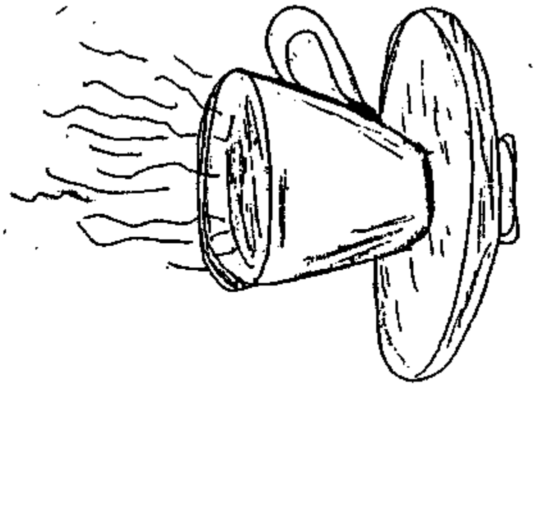


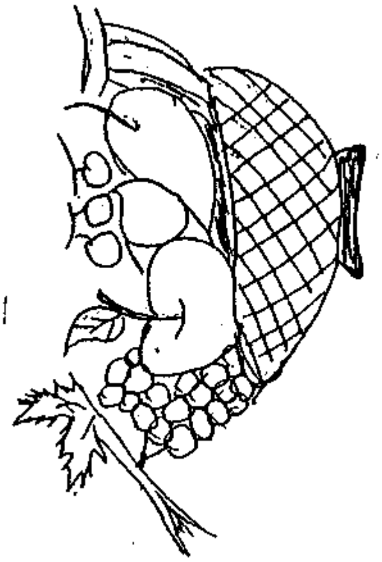

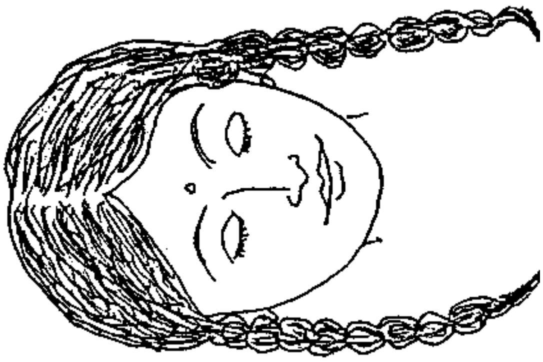

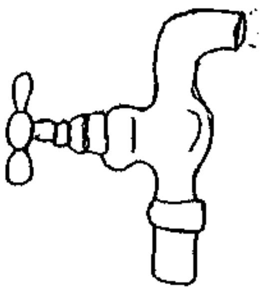

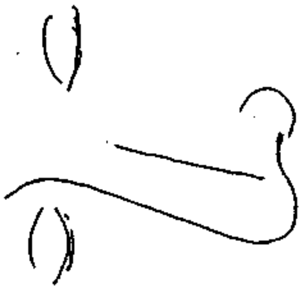

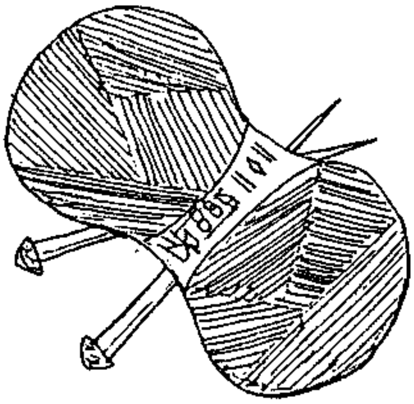

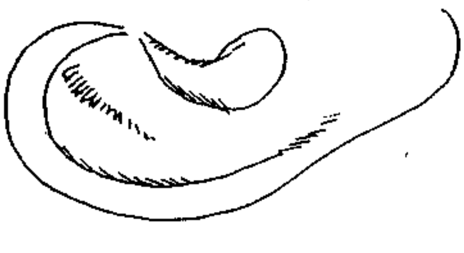

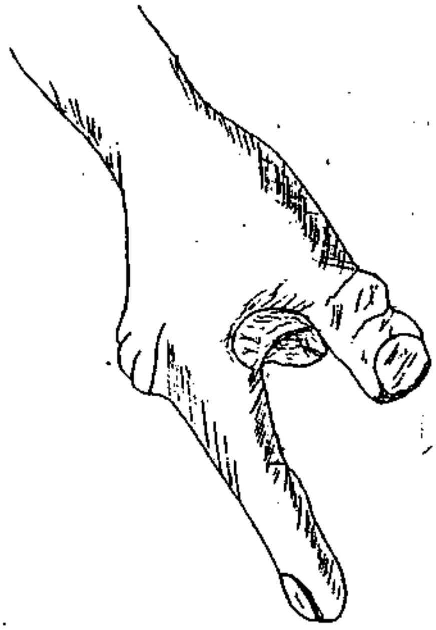

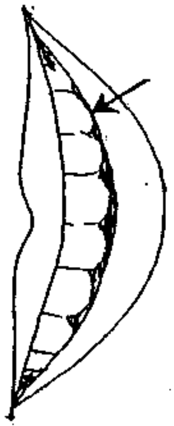
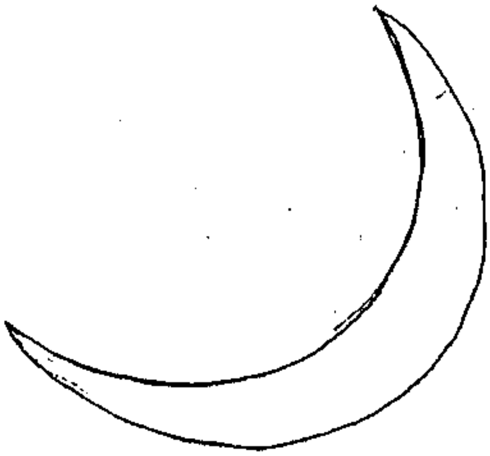
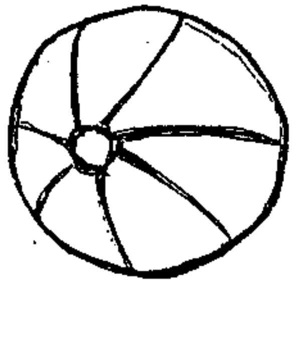
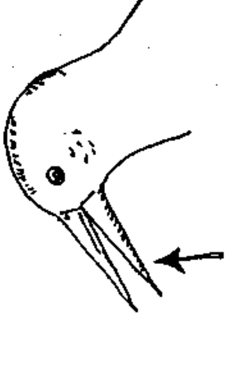

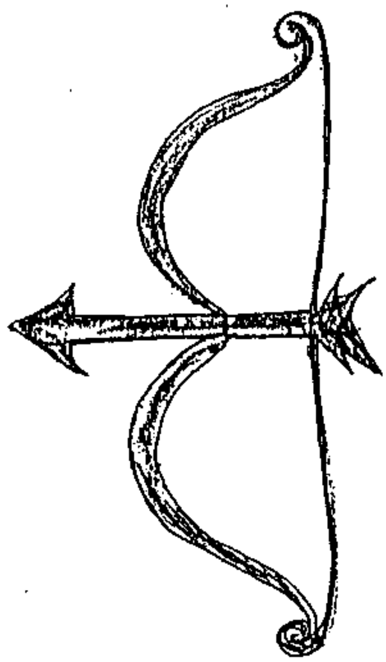

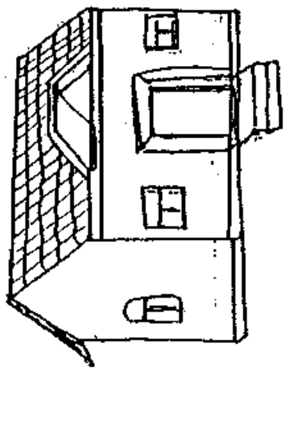

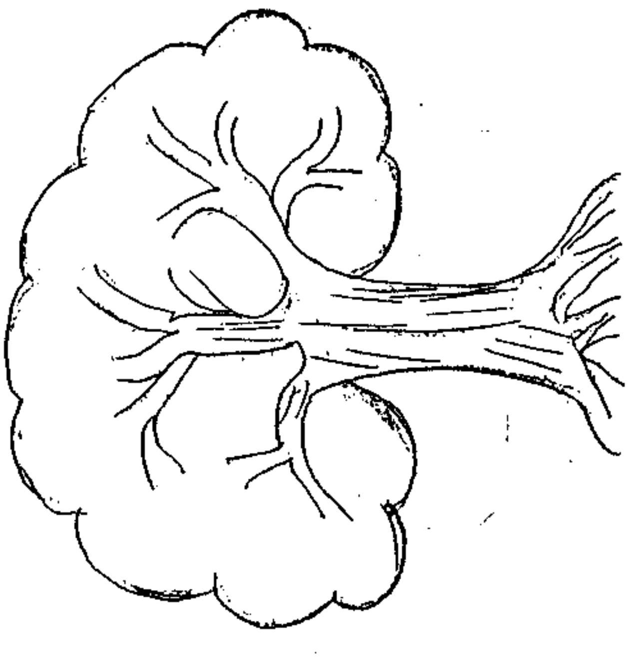

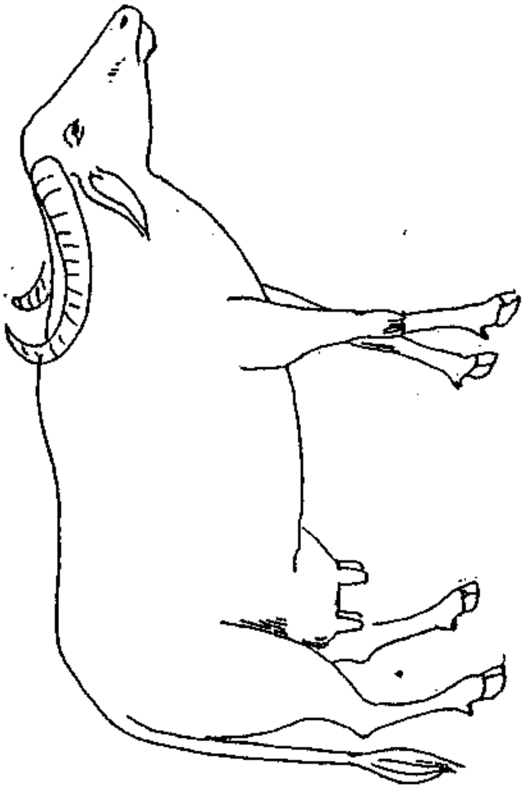
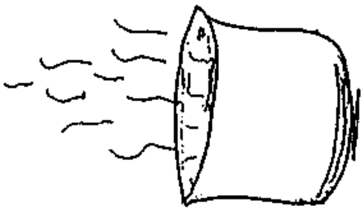

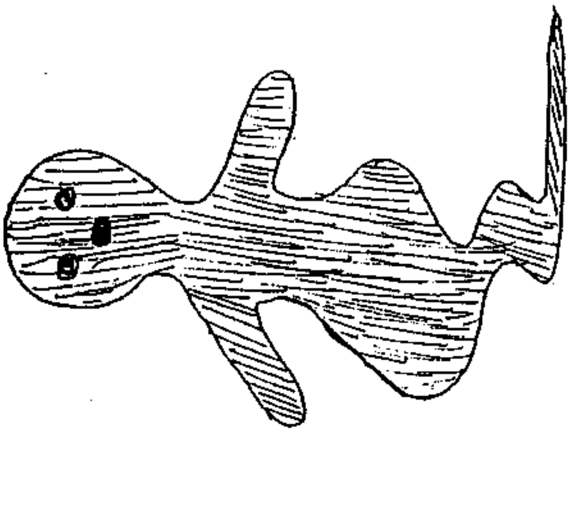
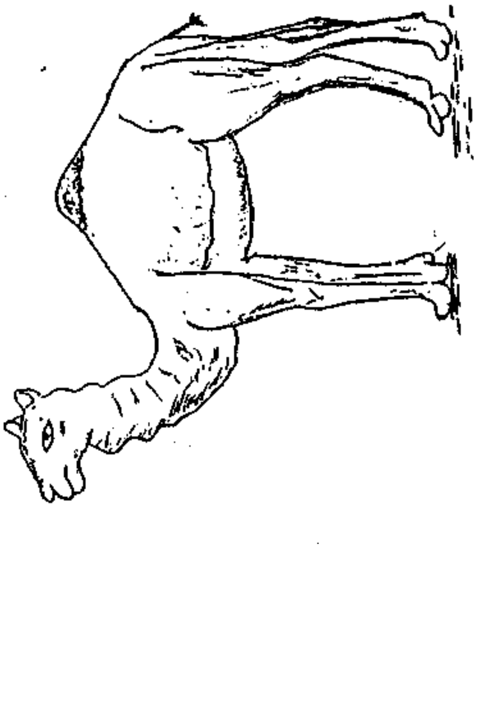

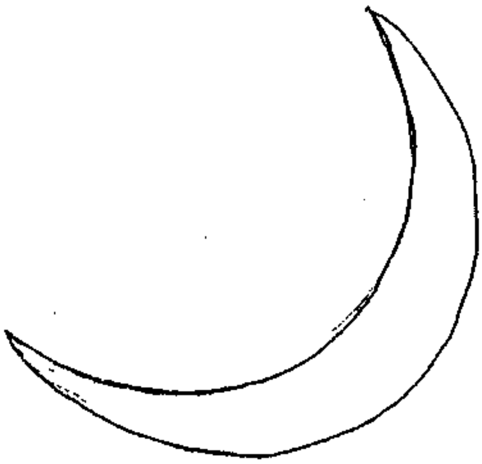

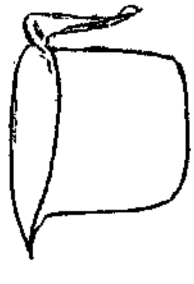

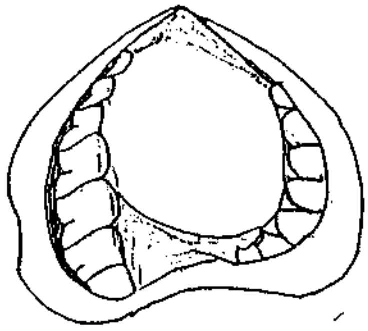

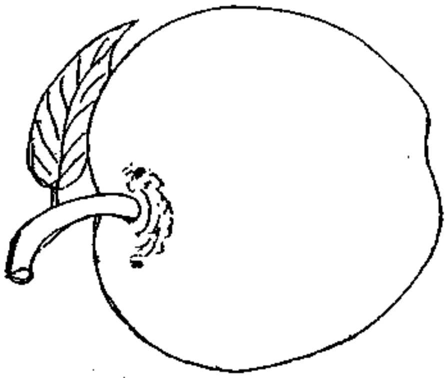

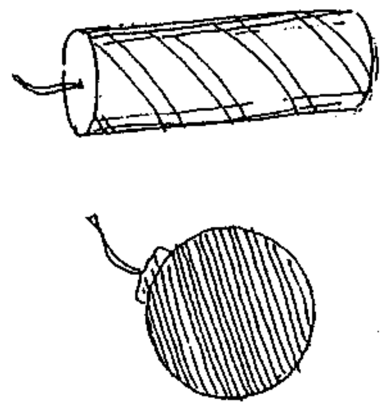

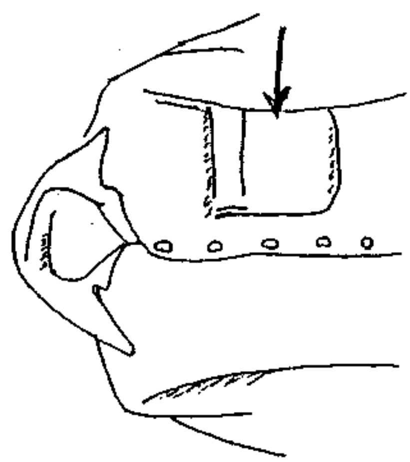

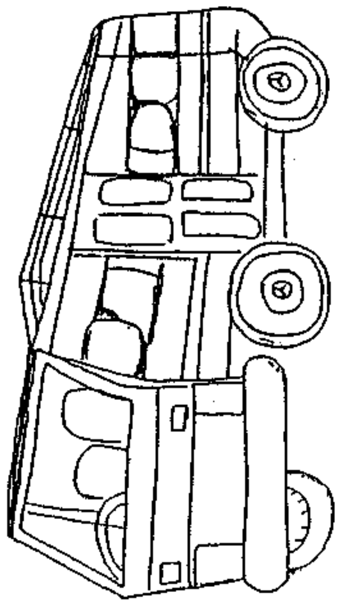
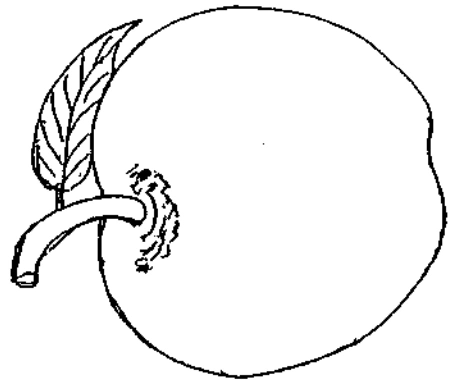

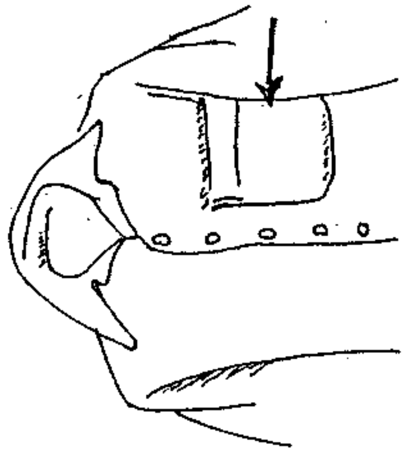

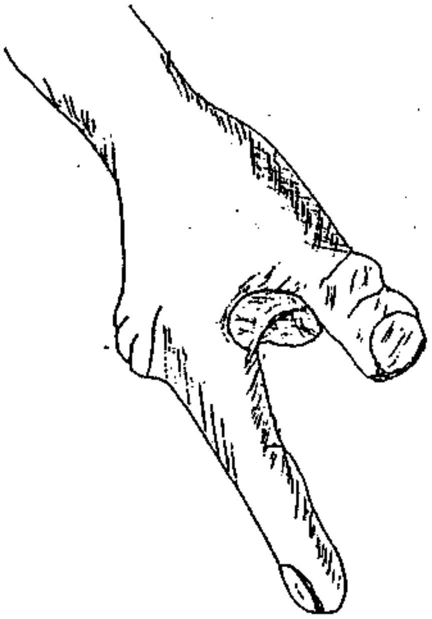

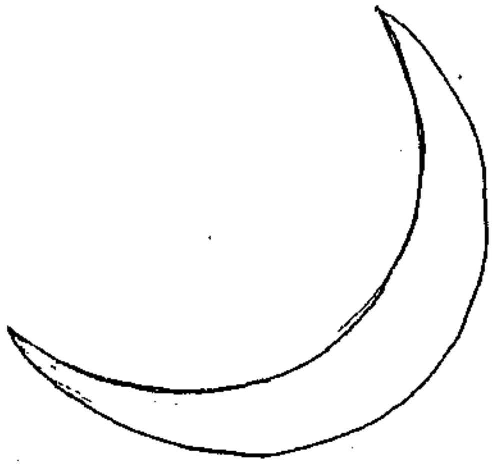

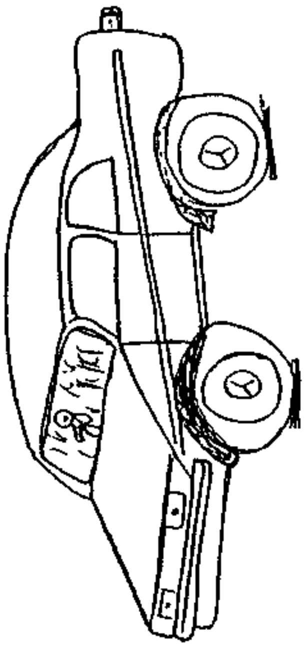

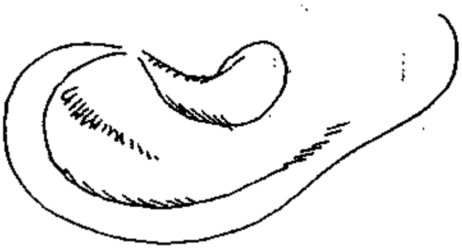

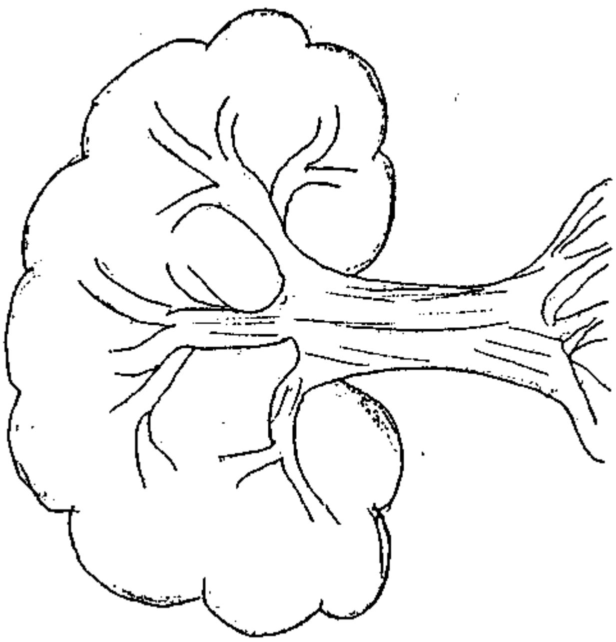

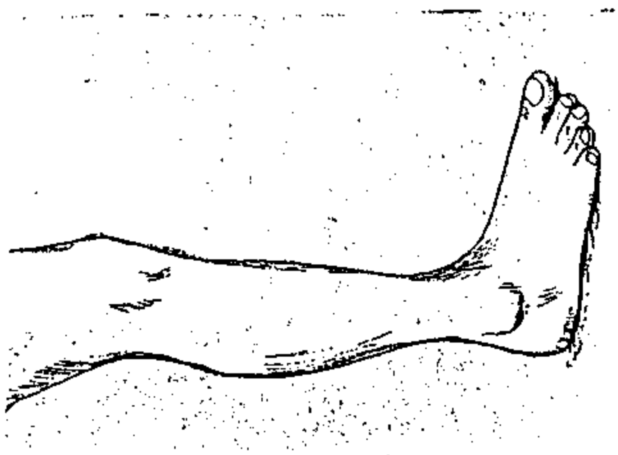

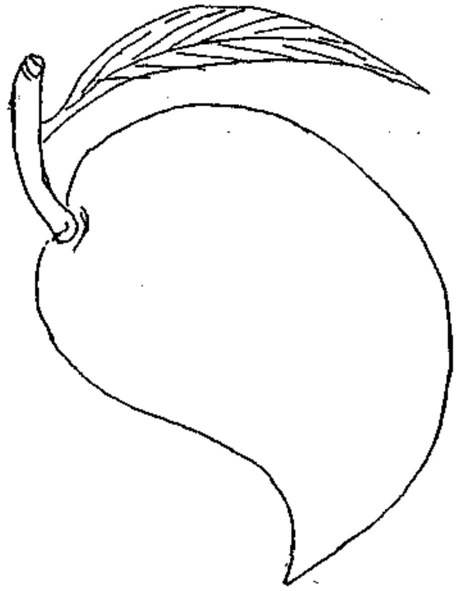

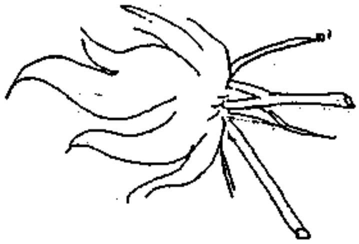

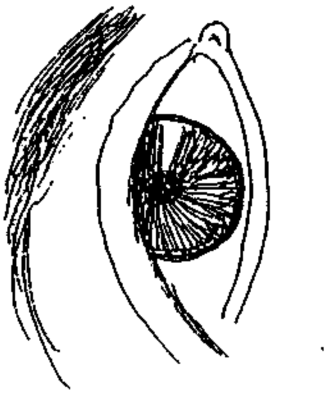

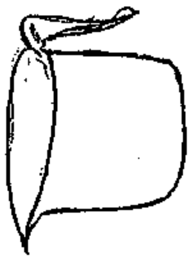

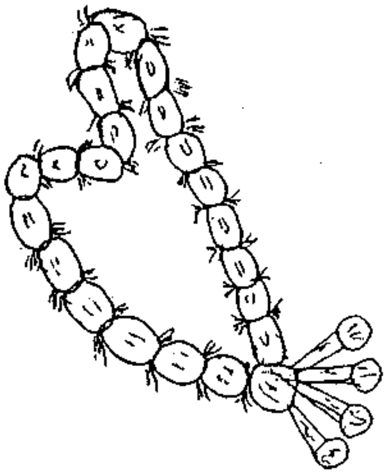
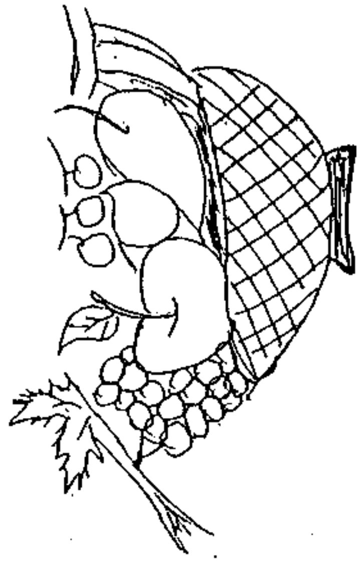
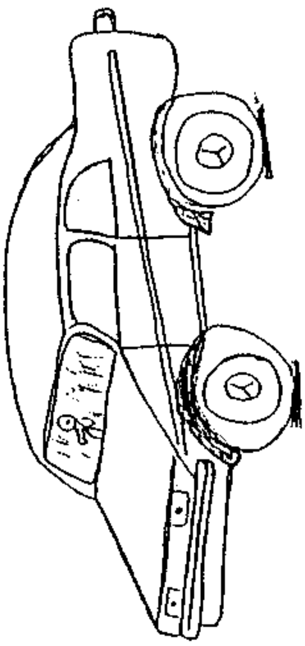


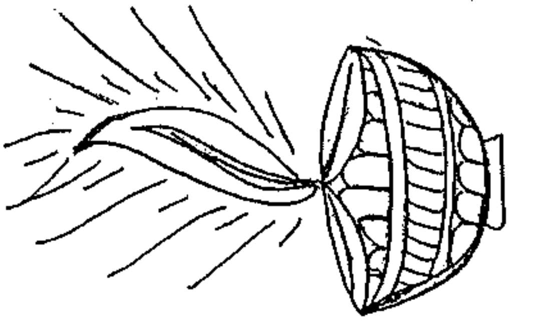

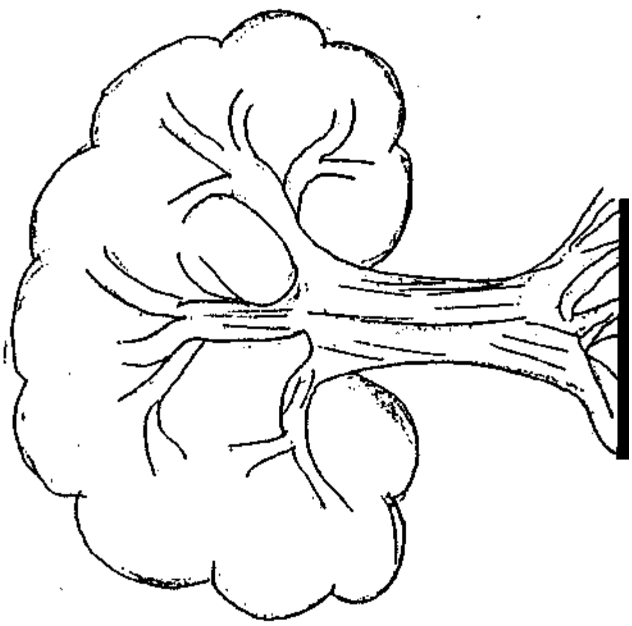

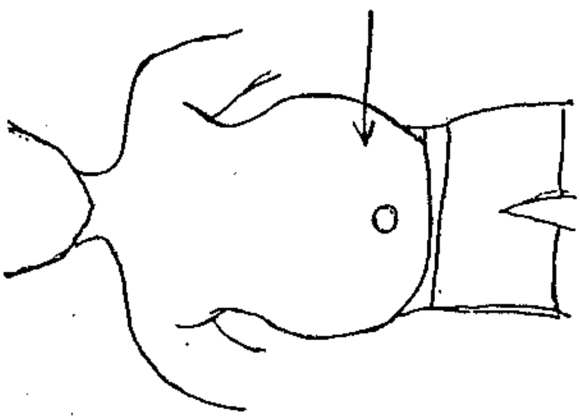

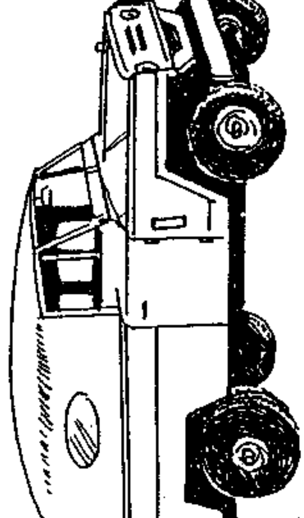

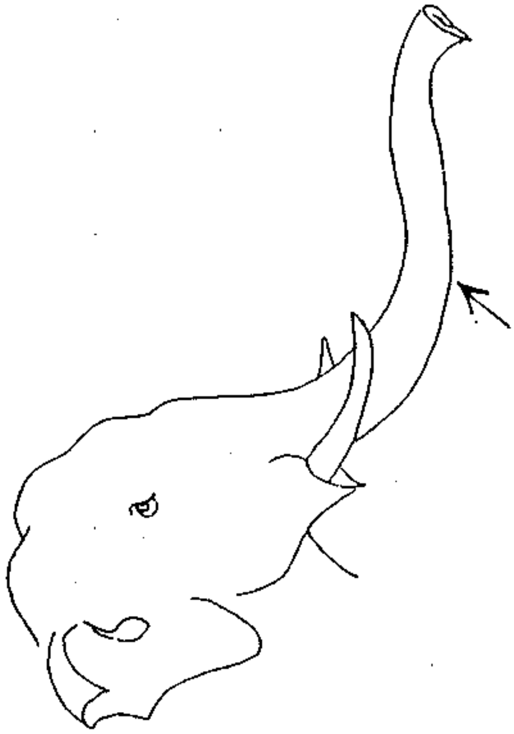

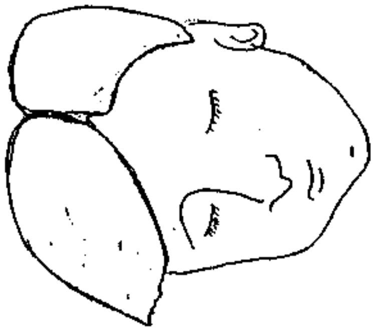

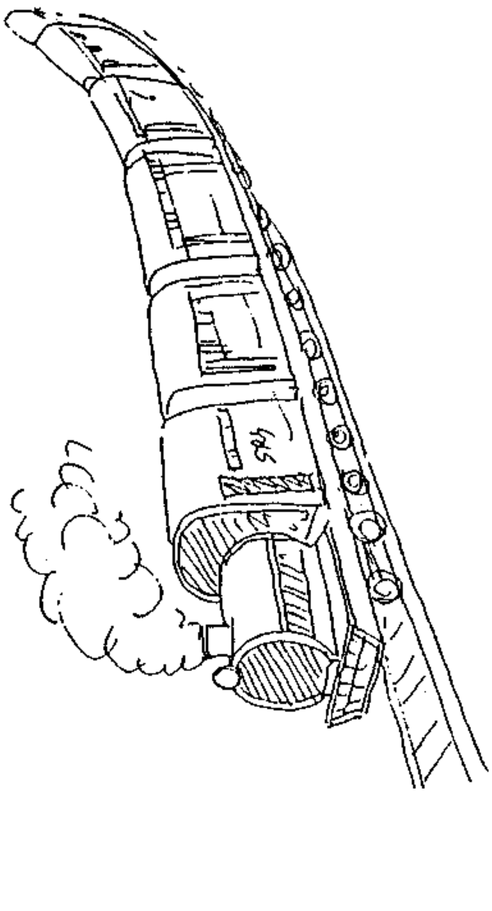

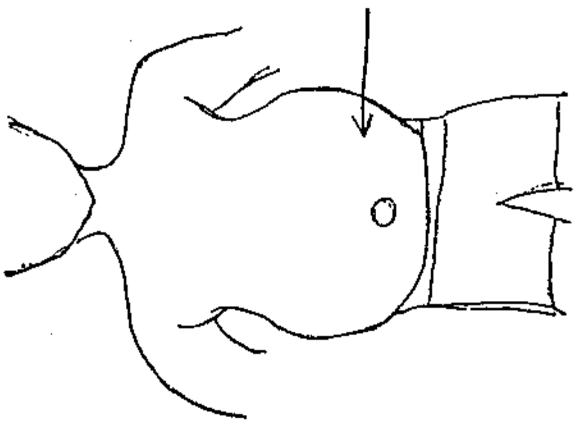
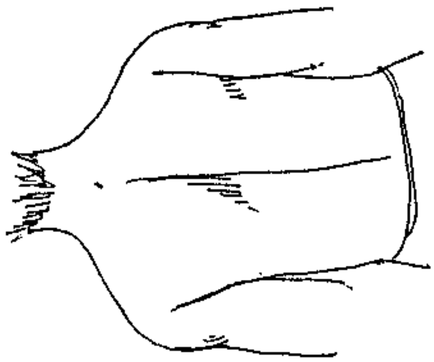
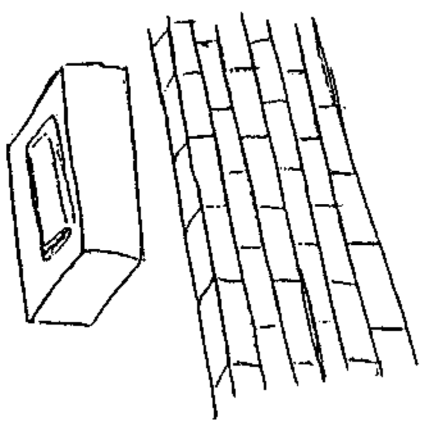
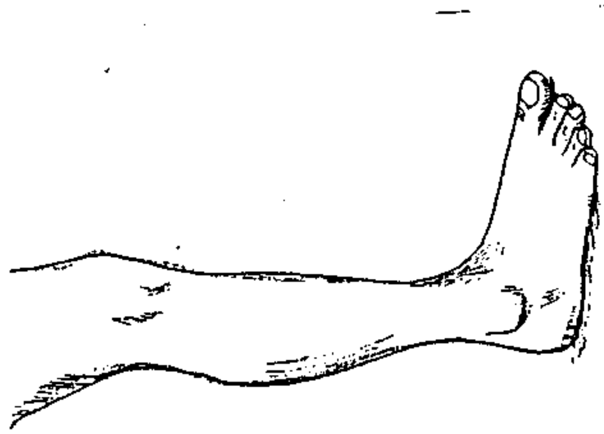

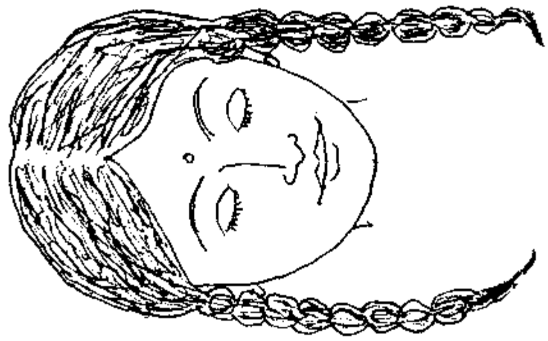

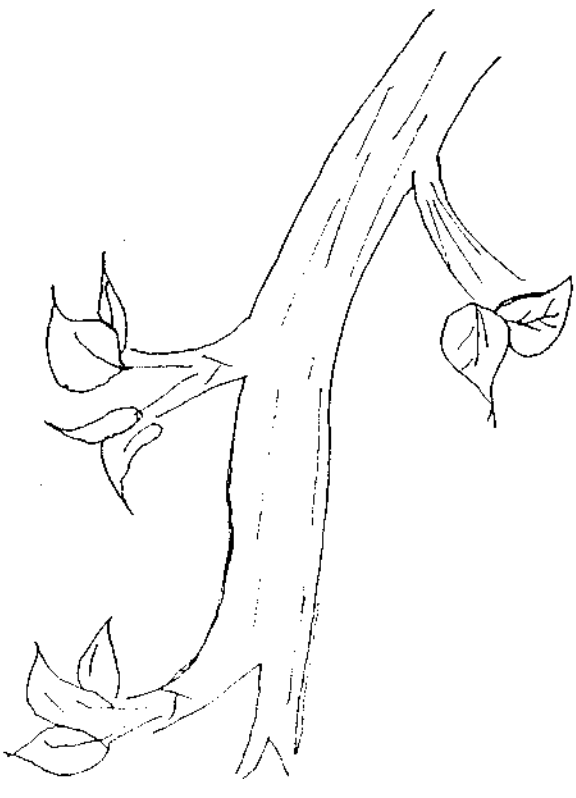

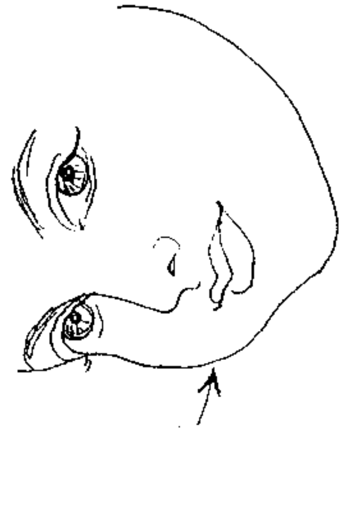

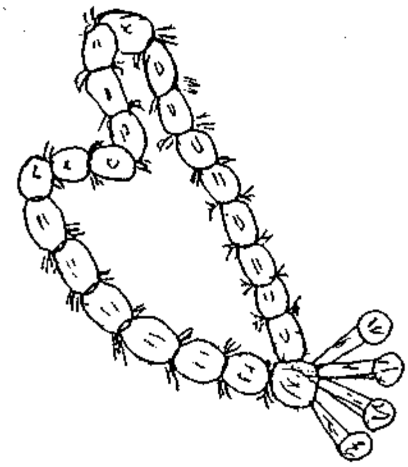

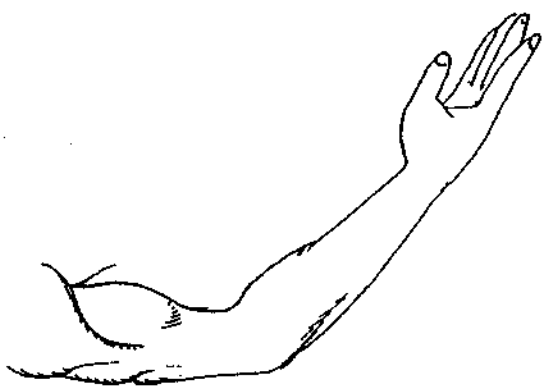

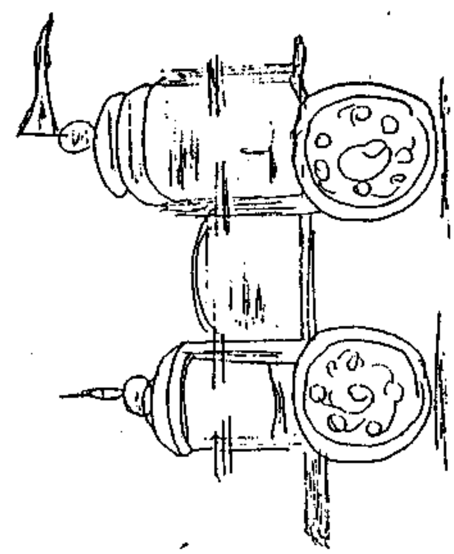

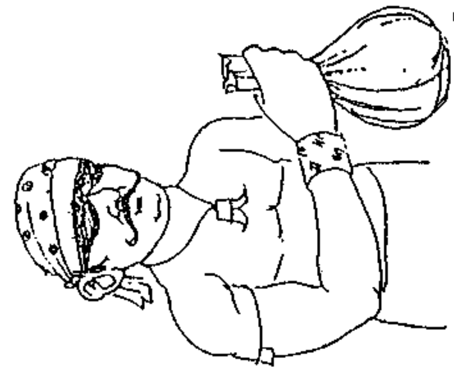

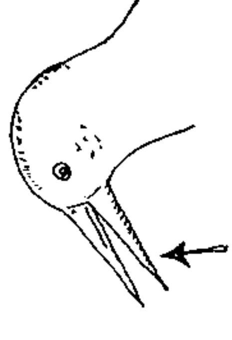

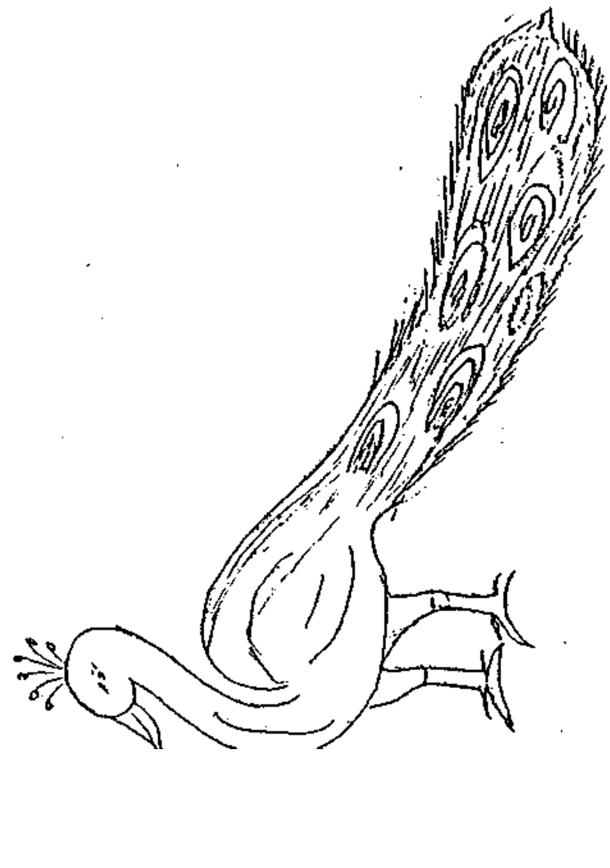

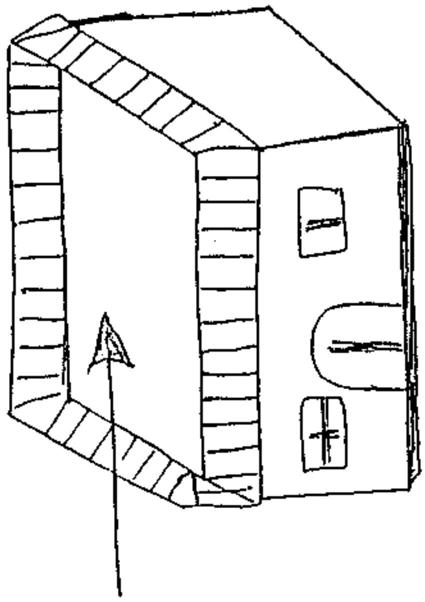

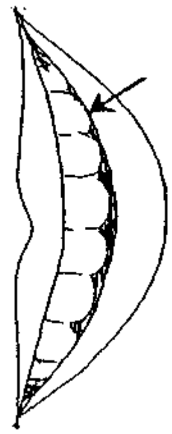

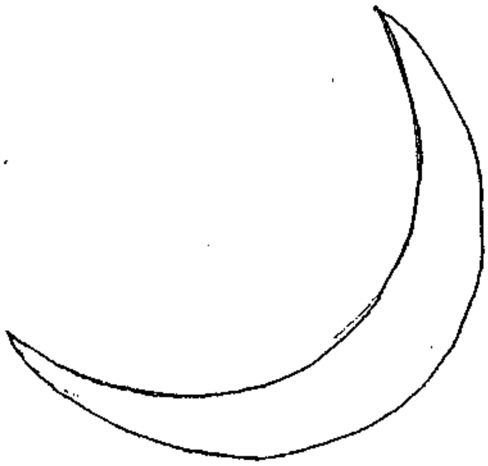

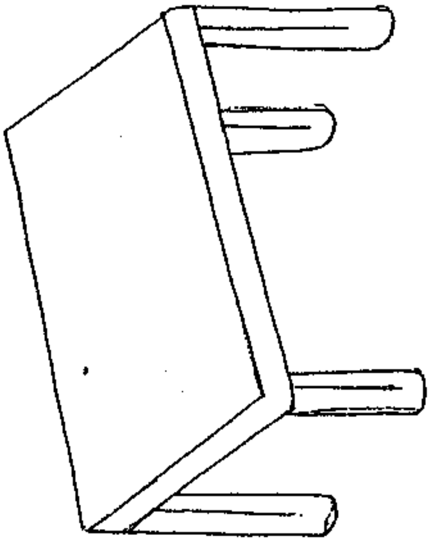

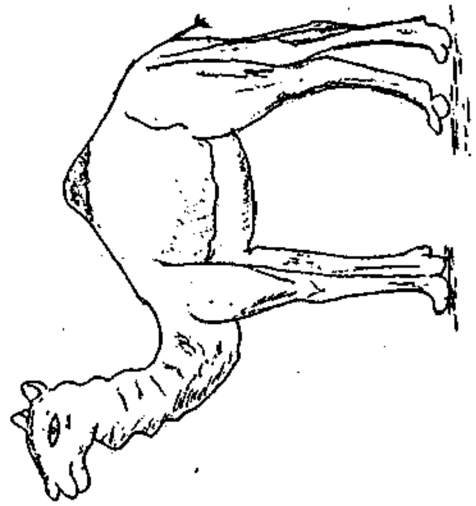

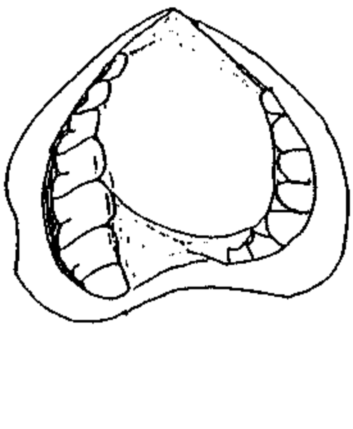

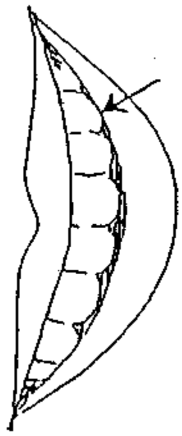

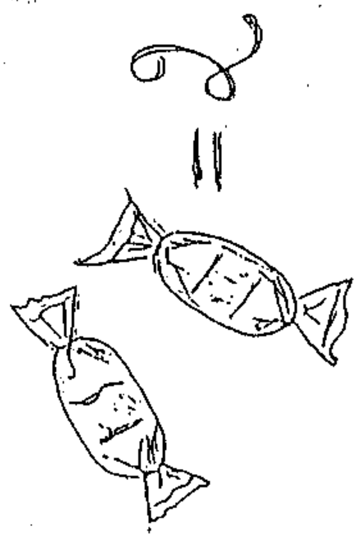

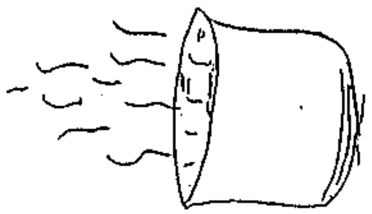

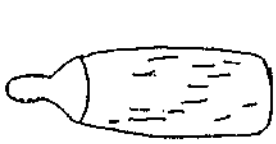

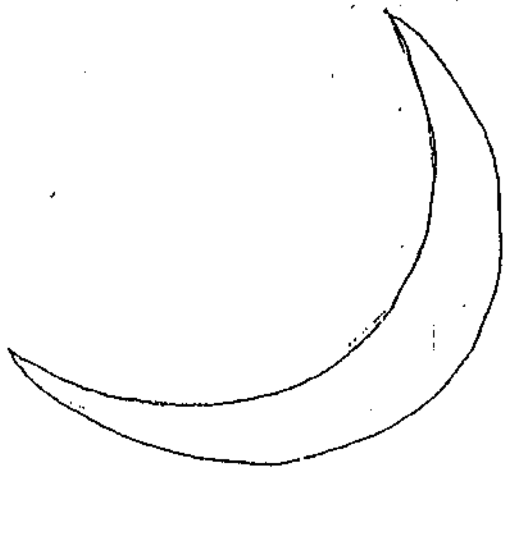

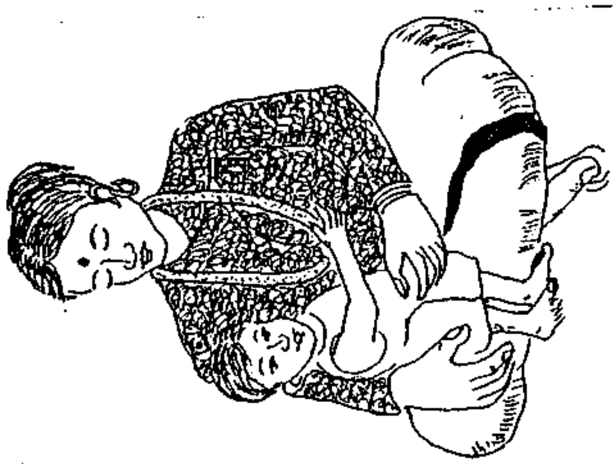

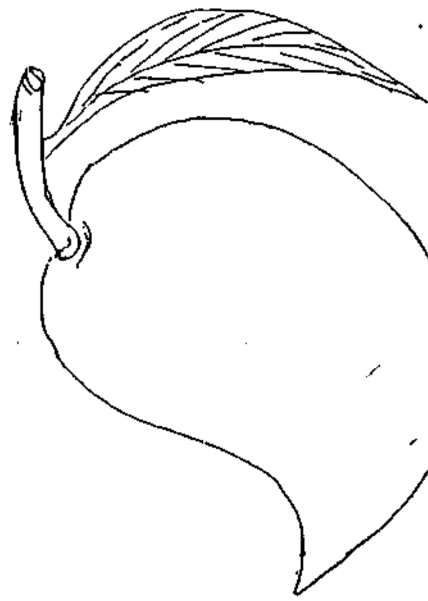

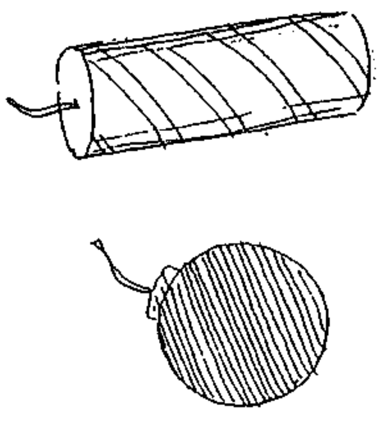

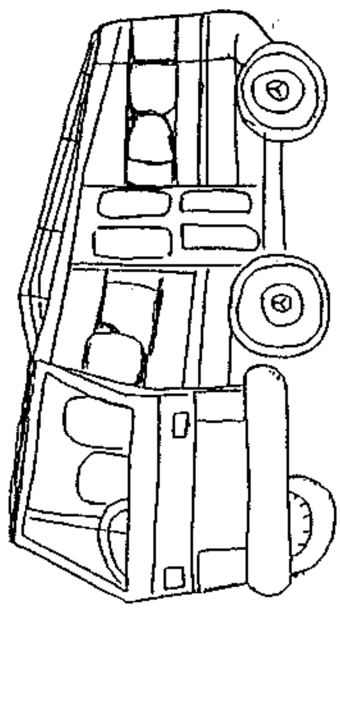

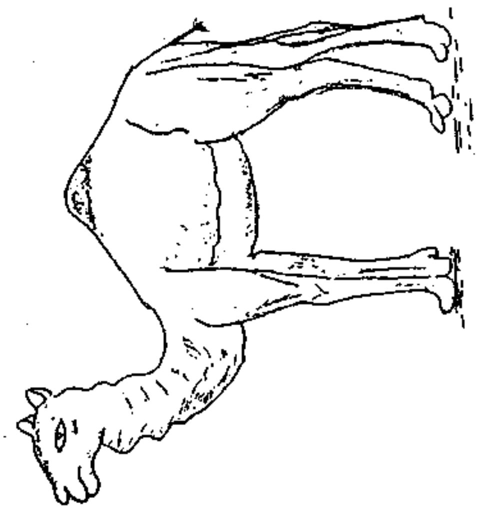

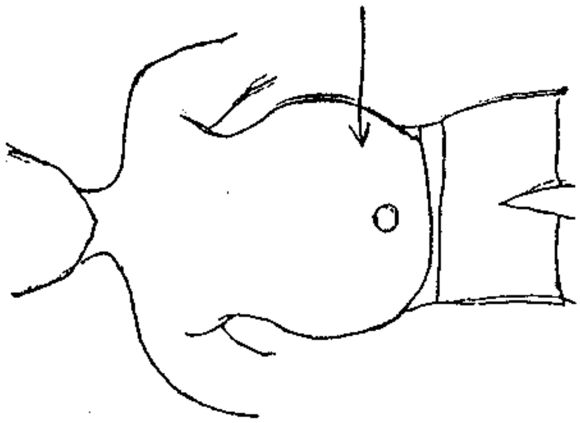

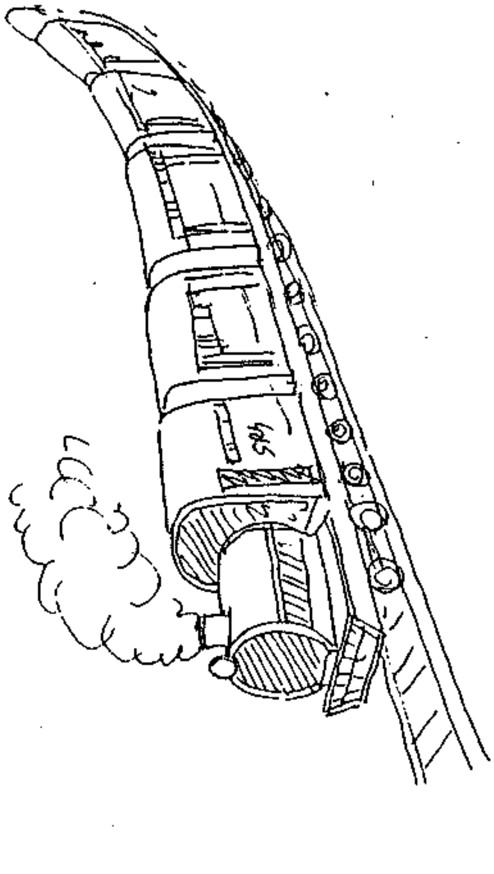

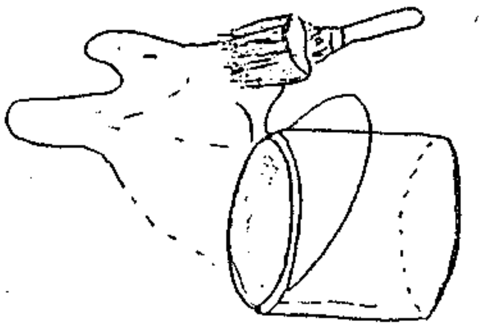

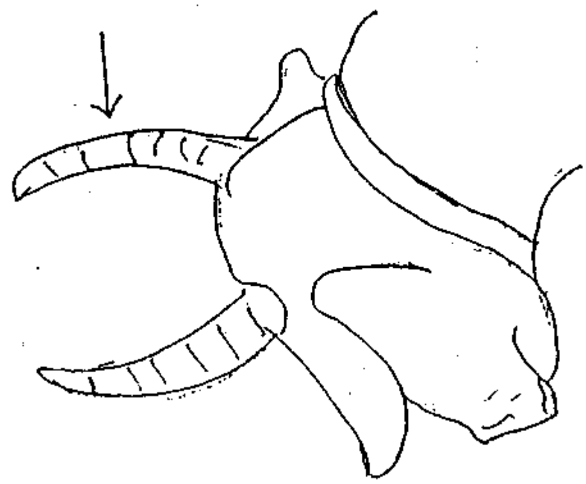

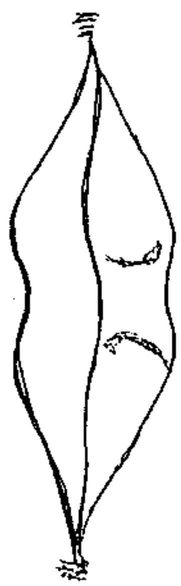

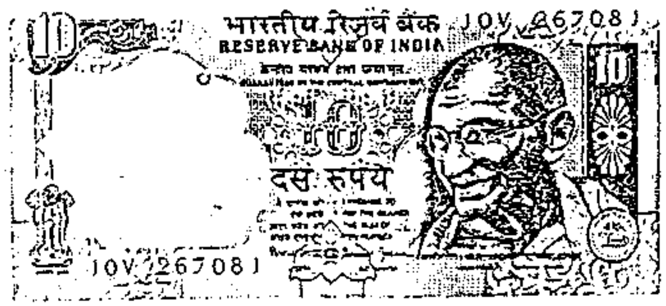
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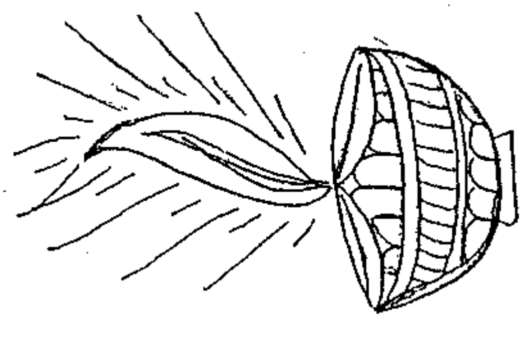

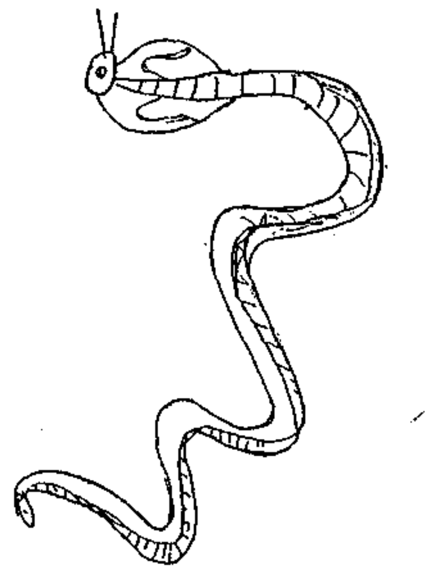

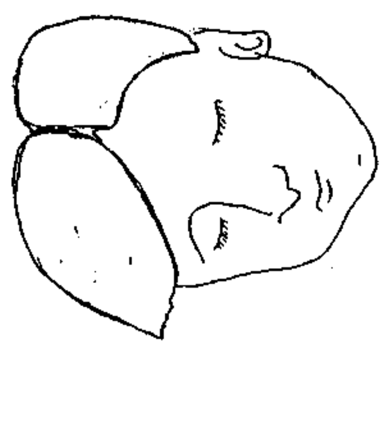

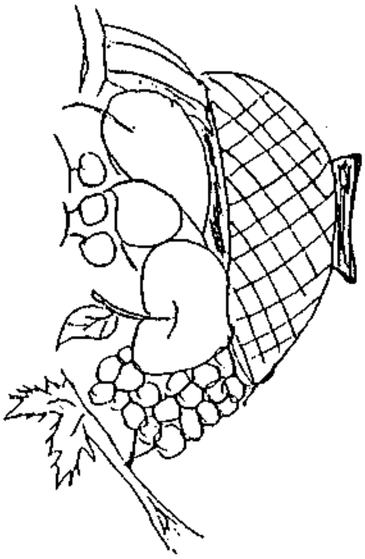

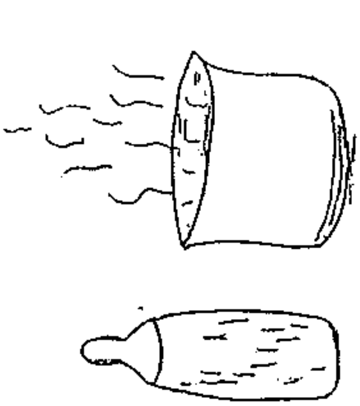

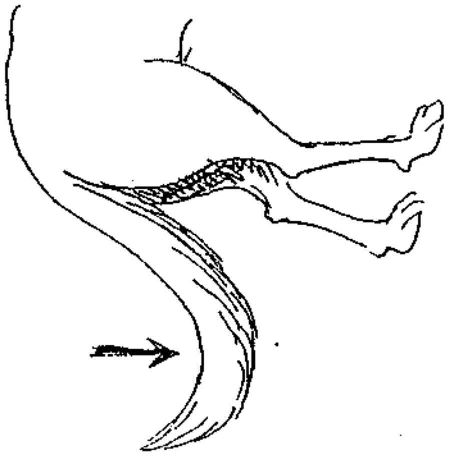

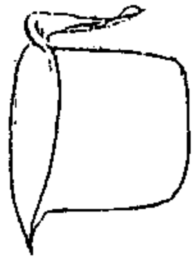

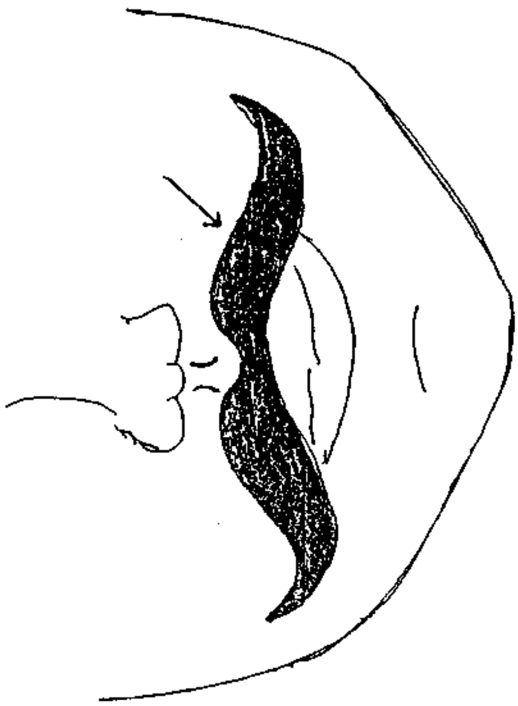

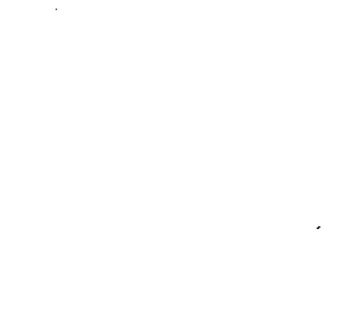

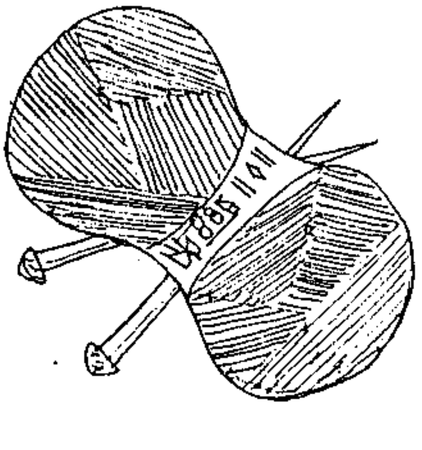

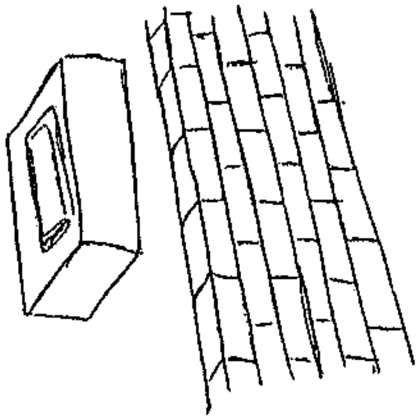

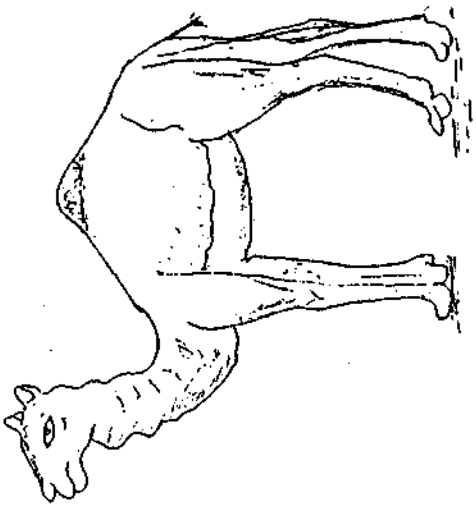

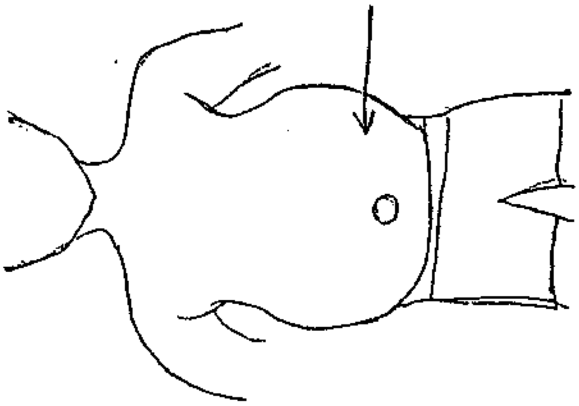

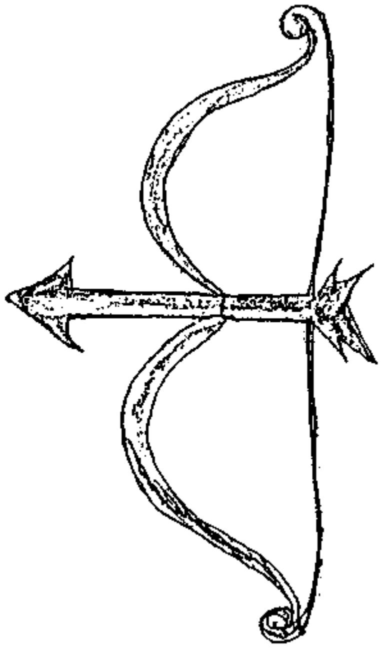

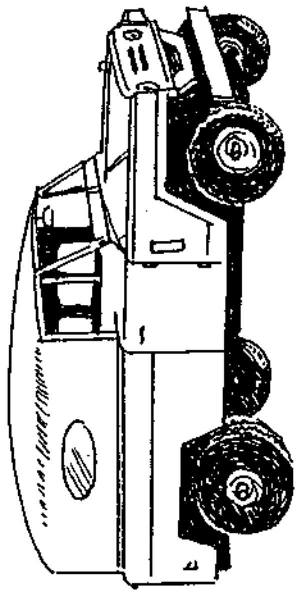

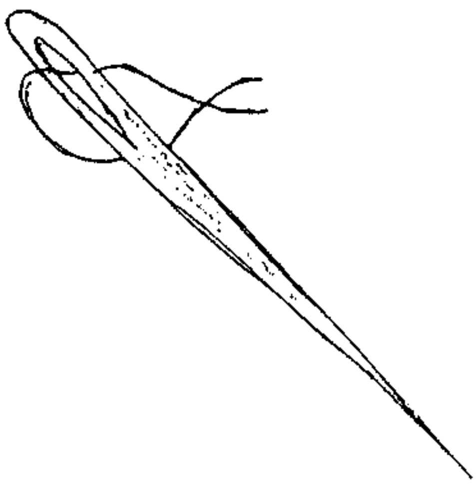

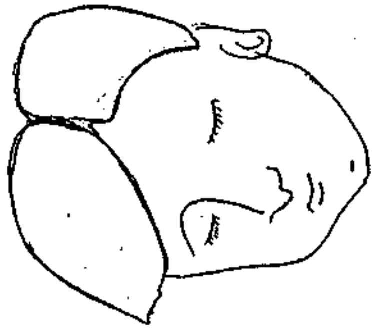

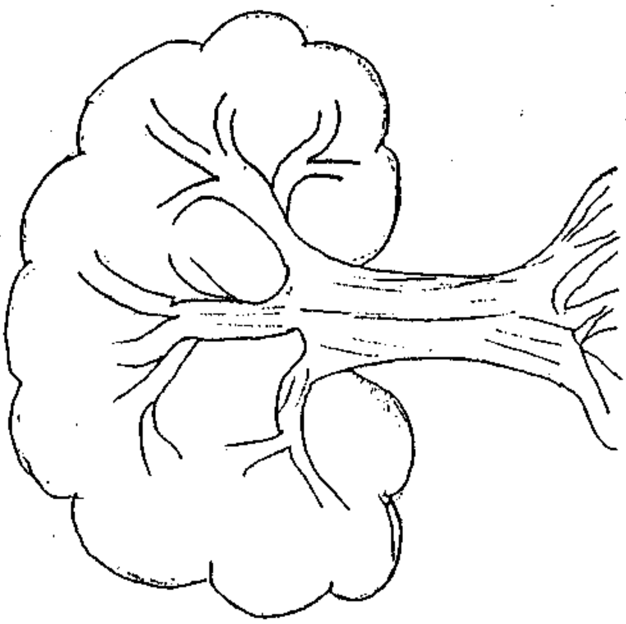

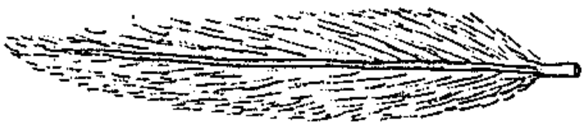

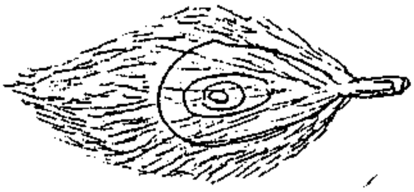

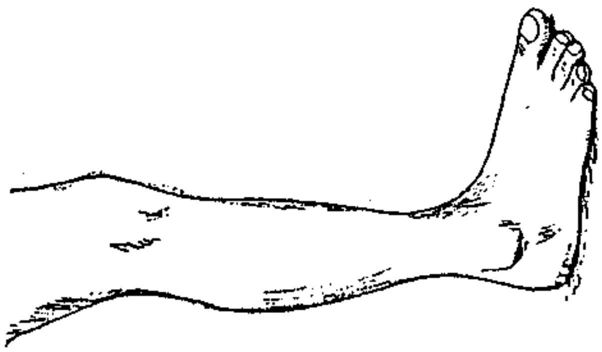

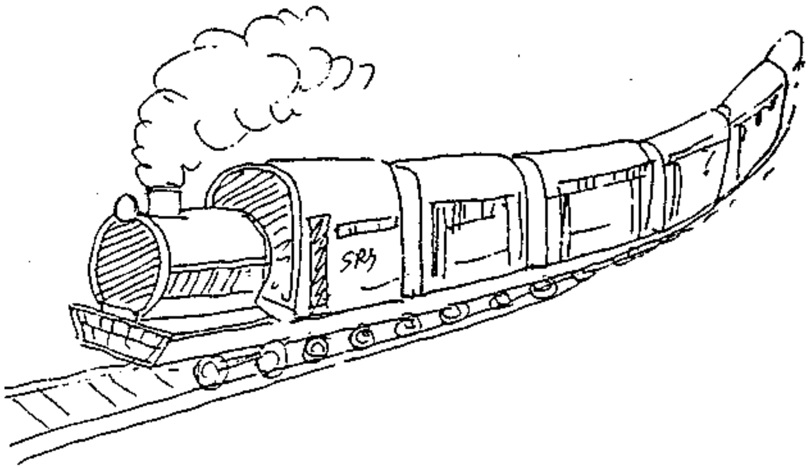

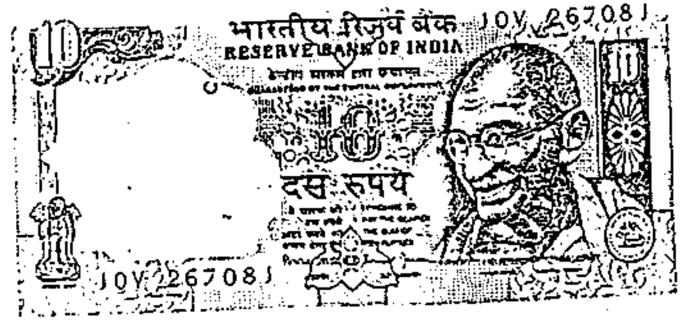

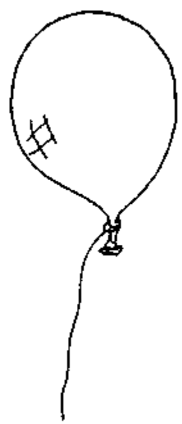

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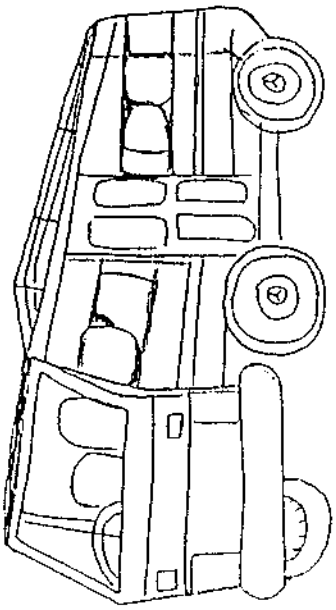
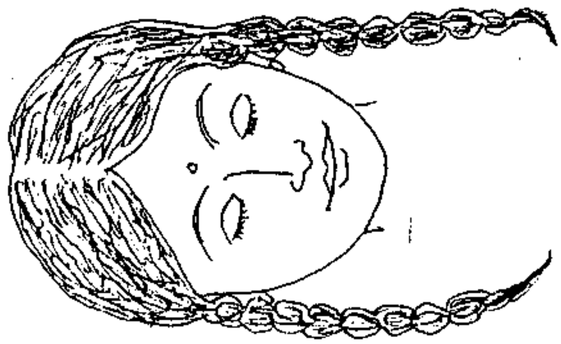

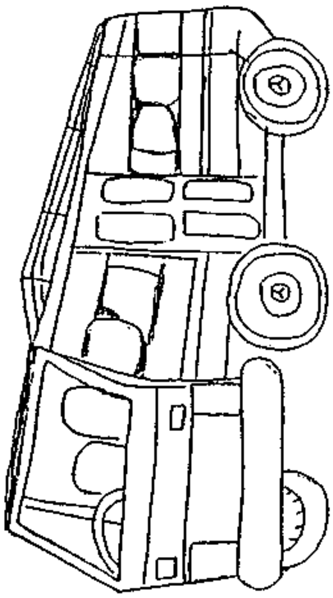

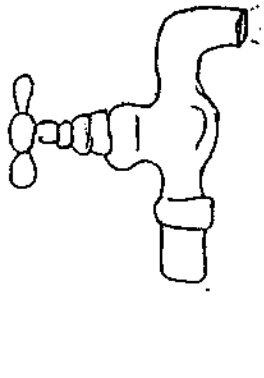

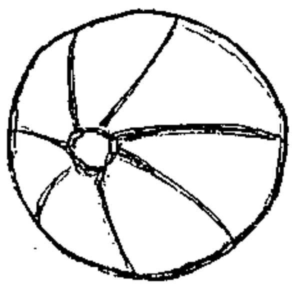

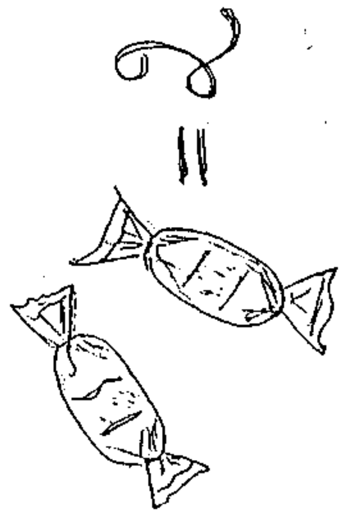

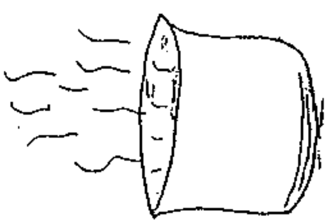

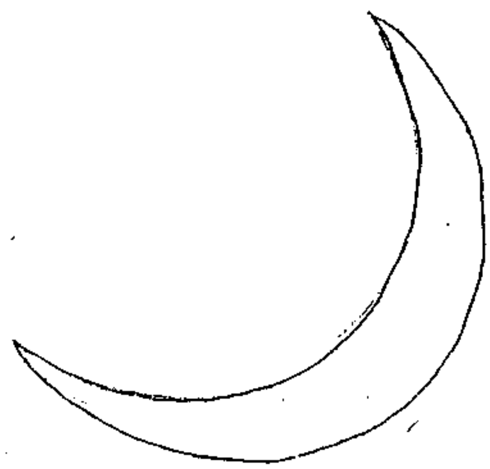


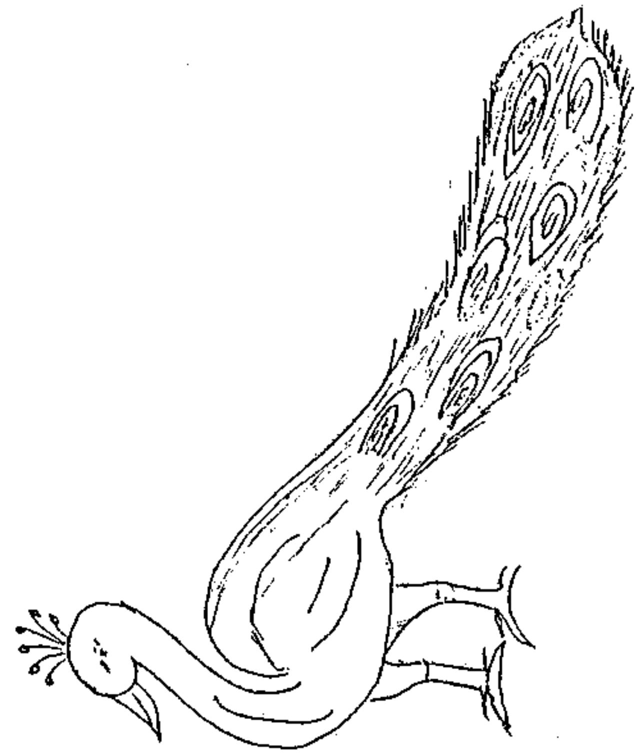
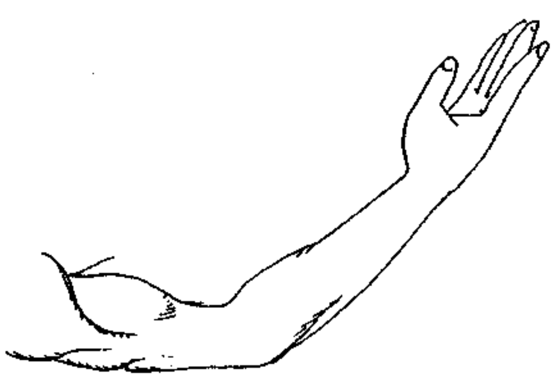
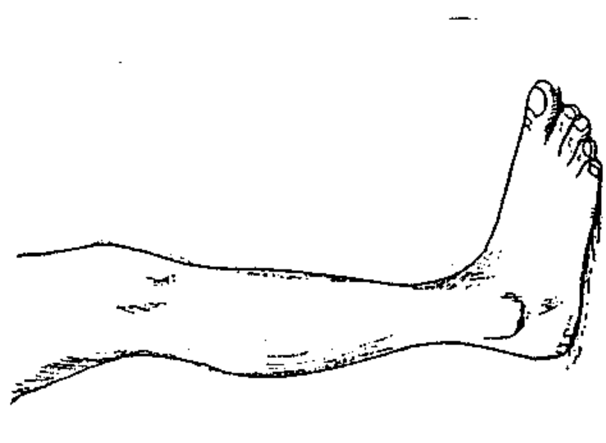

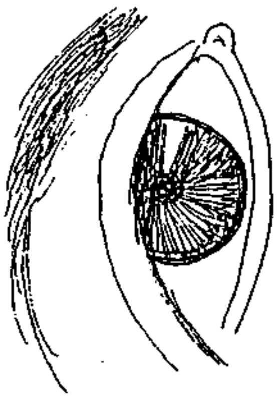

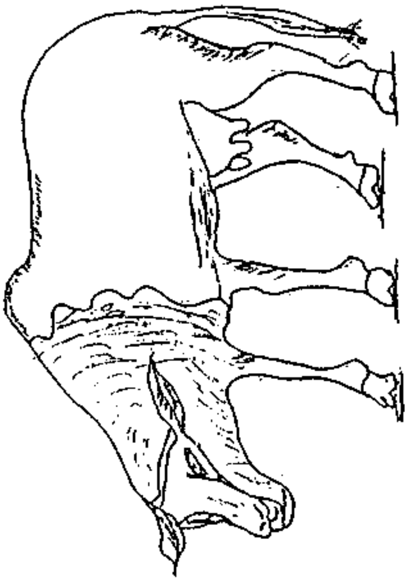

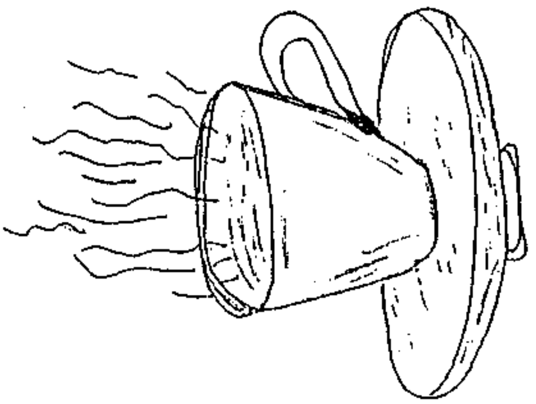

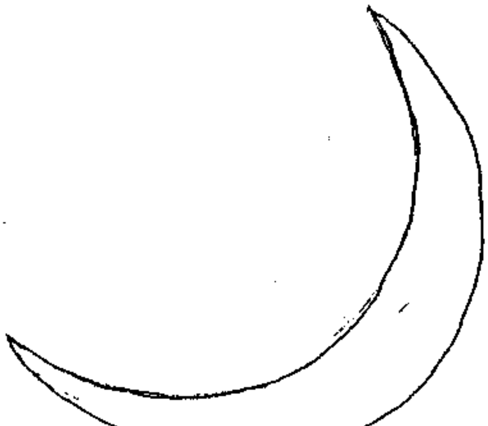

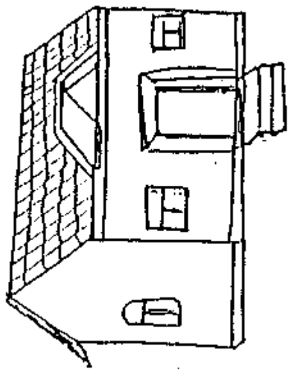

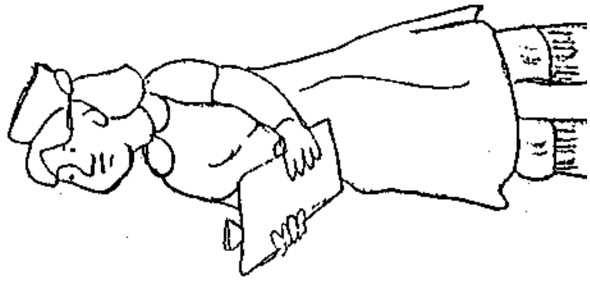

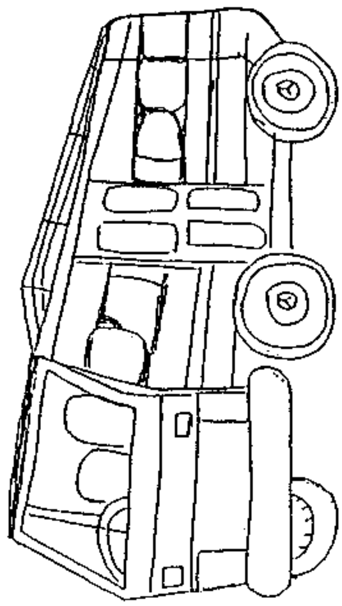

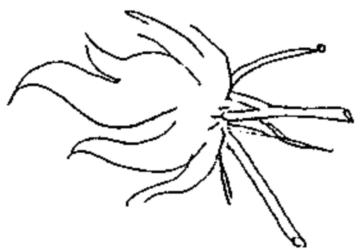

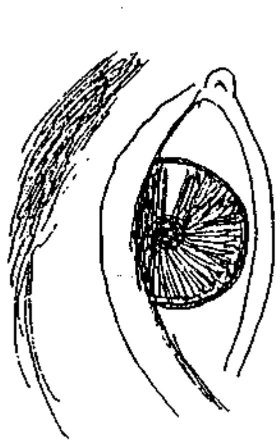

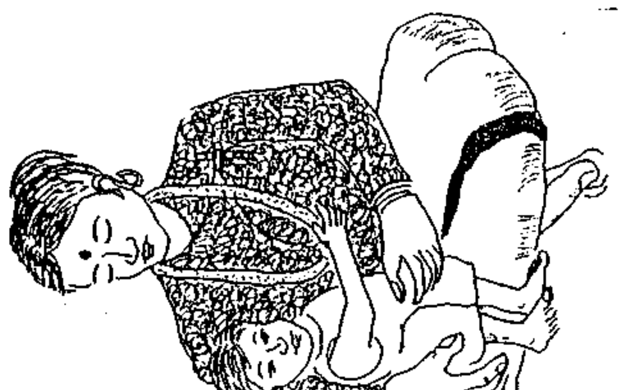

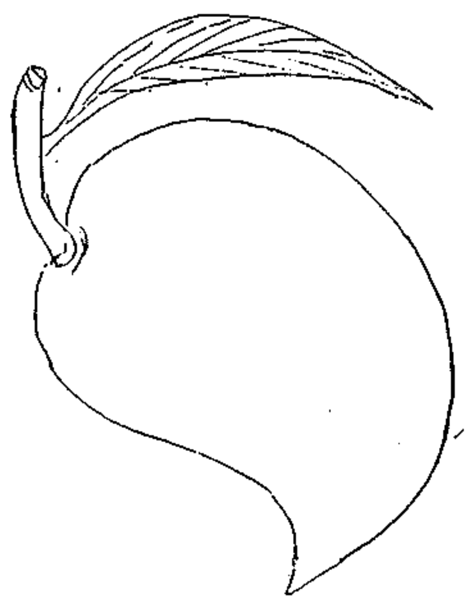

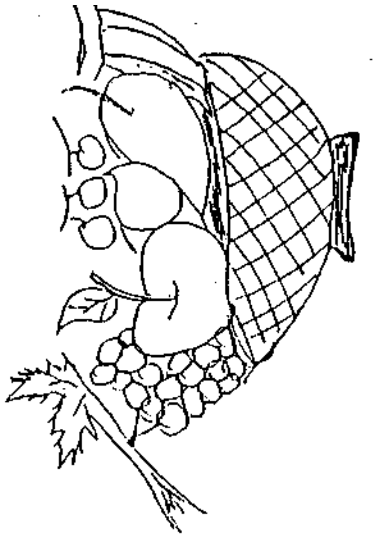

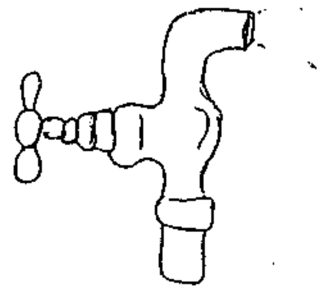

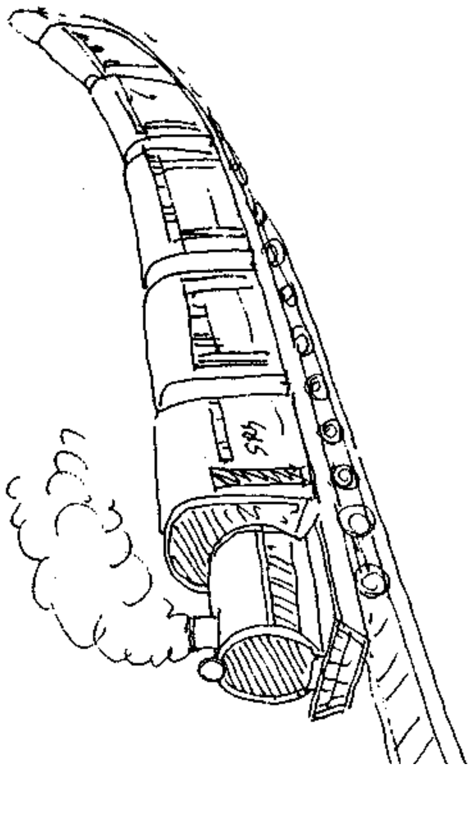

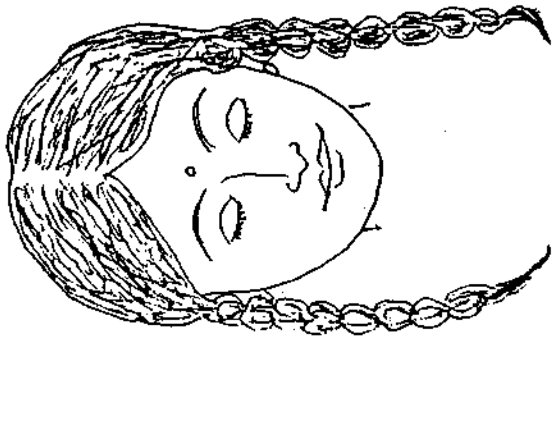

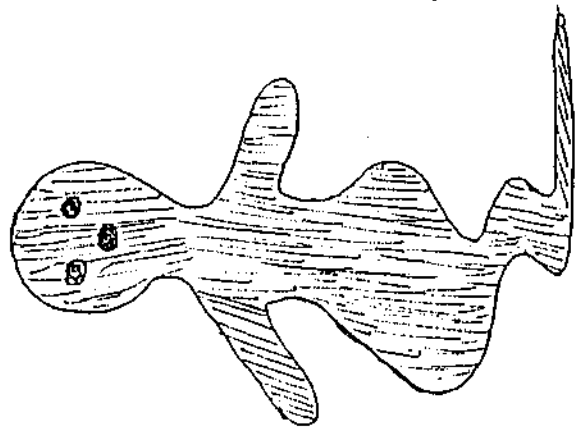

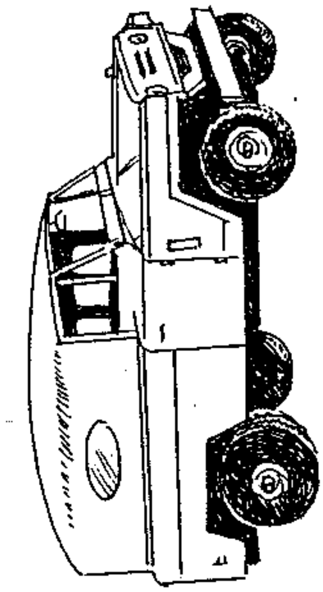

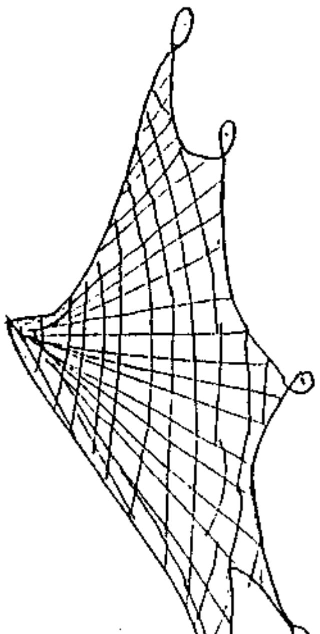

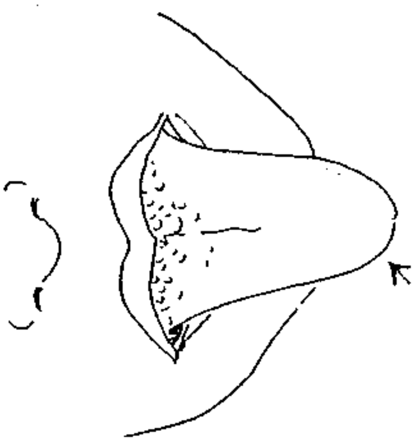

APPENDIX-C

SCORE SHEET

Appendix C

Score sheet

Name: **Age:/Sex:**

Subject No.:

Audiological Assessment

Pure tone	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
RtAC						
LtAC						
BC						

Correct Response	V	1
In Correct Response	X	0

Presentation level at 20 dBSL and 40 dBSL (ref. Fletcher's avg.)

Familiarization items:

गाल / gal/ मेज/mez/ चोर/tʃoɾ/

1. बस / bas /
2. सूई / sui /
3. फोन / fon /
4. पेट / pet /
5. गाय / g a j /
6. फल / phal /
7. खून / k^h ᵘn/
8. चाँद / ʧand /
9. घर / gɦaɾ/
10. भूत / b^hut/

1. दाँत / d ã:lt /
2. बम / bam /
3. रेल /ɾel /
4. रंग / raŋg /
5. नाक / nak /
6. साँप / sãnp /
7. फूल / phul/
8. मूँछ / mũch/
9. ऊँट / ũ:t /
10. तीर / ʈiɾ /

1. माँ /mã/
2. सेब /seb/
3. जेब /dʒeb/
4. कान /ka:n/
5. पेड /pe^R/
6. आग /a'g /
7. कार /kaɾ/
8. दीप /dị:p/
9. शेर /se:ɾ/
10. पीठ /pit^h/
21. बाल /bal/
22. हाथ /hat̪^{h}/
23. मोर /moɾ /
24. छत /c ^{ha}th/
25. मुँह /mũh /
26. दाँत /d̪ã: t̪/
27. बम /bam /
28. रेल /ɾel /
29. रंग /rang /
30. नाक /nãk /
31. साँप /sãnp /
32. फूल /phul/
33. मूछ /much/
34. ऊँट /ũ:t /
35. तीर /t̪ir /
36. नोट /not /
37. आँख /ã:k^h /
38. जीप /dʒip/
39. मग /mag /
40. पैर /per /

11. नोट /not /
12. आँख /ã:k^h /
13. जीप / dʒip/
14. मग /mag /
15. पैर /per /
16. एक /ek/
17. बाघ /bag^h /
18. ब्रश /braʃ /
19. गेंद /g ẽ nd /
20. होट /hot^h/
21. चाय /t̪ʃai /
22. घास /g^{h}as /
23. आंम /a:m /
24. नल /nal /
25. जीभ /dʒib^h /
26. बस /bas /
27. सूई /sui /
28. फोन /fon /
29. पेट /pet /
30. गाय /g ay/
31. फल /phal /
32. खून /k$^{h\,u}$n/
33. चाँद /ʧand /
34. घर /ghaɾ/
35. भूत /b^{h}ut/
36. माँ /mã/
37. सेब /seb/
38. जेब /dʒeb/
39. कान /ka:n/
40. पेड /peɽ/

41. एक /ek/

42. बाघ /bag^h/

43. ब्रश /braʃ/

44. गोंद /g ê nd /

45. होट /hot^h/

46. चाय /tʃ.ai /

47. घास /g^{h}as/

48. आंम /a:m/

49. नल /nal /

50. जीभ /dʒib^h /

41. आग /a'g /

42. कार /kaɾ/

43. दीप /d̪i:p/

44. शेर /ʃe:ɾ /

45. पीठ /pit^h/

46. बाल /bal/

47. हाथ /hat^h/

48. मोर /moɾ/

49. छत /c ^{ha}th/

50. मुँह /müh /

Maximum Score = **Obtai**

Result: