"AUDI0L0GICAL REHABILITATION OF CENTRAL AUDITORY PROCESSING DISORDERS - A REVIEW"

Reg: No. M9802

Independent Project submitted as a part fulfillment for the First Year M.Sc, (Speech and Hearing) to the University of Mysore.

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MYSORE - 570 006

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CERTIFICATE

This is to certify that this Independent Project entitled **"AUDIOLOGICAL REHABILITATION OF CENTRAL AUDITORY PROCESSING DISORDERS - A REVIEW"** is a bonafide work in part fulfillment for the degree of Master of Science (Speech and Hearing) of the student with *Register No. M 9802.*

Place : Mysore
Date : May 1999

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CERTIFICATE

This is to certify that this Independent Project entitled: **"AUDIOLOGICAL REHABILITATION OF CENTRAL AUDITORY PROCESSING DISORDERS - A REVIEW** has been prepared under my supervision and guidance.

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DECLARATION

This Independent Project entitled: **"AUDIOLOGICAL REHABILITATION OF CENTRAL AUDITORY PROCESSING DISORDERS - A REVIEW,** is the result of my own study under the guidance of Mrs. P. Manjula, Lecturer in Audiology, AIISH, Mysore and has not been submitted earlier at any University for any other *Diploma or Degree.*

Place : Mysore

Date : May 1999 **Reg.** No. M **9802**

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INTRODUCTION

AUDIOLOGICAL REHABILITATION OF CENTRAL AUDITORY PROCESSING DISORDERS - A REVIEW

Central auditory processing disorder (CAPD) is a term that has become well known not only in the field of audiology, but also in the fields of speech-language pathology, education, psychology and in some medical specialities. CAPDs are recognized as one of the many types of communication disorders for which specialists in a variety of professions should have an understanding.

The term central auditory function is used interchangeably with other terms like central auditory ability, central auditory perception and central auditory processing (CAP). A deficiency in this area might be termed as central auditory dysfunction (CAD), as an auditory perceptual disorder, as a non-sensory auditory deficit, or as an auditory processing problem.

WHAT IS CAP AND CAPD ?

The concept of CAP and CAPD is seen differently by different professionals, making the term difficult to define. Many definitions exist, here are but a few which give a clear picture.

"Central auditory processes are the auditory system mechanisms and processes responsible for the following behavioural phenomena; sound localization and lateralization; auditory discrimination; auditory pattern recognition; temporal aspects of audition including, temporal resolution, temporal masking, temporal integration and temporal ordering; auditory performance with competing acoustic signals; and auditory performance with degraded acoustic signals (ASHA, 1996)"

Sanders and Haggard (1989) coined the term 'obscure auditory function' to describe the problems of a group of healthy people with auditory problems but normal audiograms.

American Council of Learning Disabilities (ACLD) defined central auditory dysfunction as a generic one referring "to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning or mathematical abilities". The ACLD further stated that these disorders are presumed due to central nervous system dysfunction.

Thus central auditory processing is "what we do with what we hear" - that is, the use we make of what has been heard. On the other hand, limitations in dealing with auditory signals above and beyond that of the hearing level may be labelled as CAPD"

WHAT COULD BE THE PREVALENCE DATA FOR CAPD ?

Chermak and Musiek (1997) estimated prevalence of CAPD in children as 2-3% with a 2:1 male-female ratio. Estimates of prevalence of CAPD in older adults range from 10-20% based on a stratified random sample of the U.S. population (Cooper and Gates, 1991) to 70% of clinical patients over age 60 years (Stach, Spretnjak and Jerger, 1990). No data are available estimating the prevalence of CAPD for particular racial or ethnic groups; however, one might anticipate variations across groups given racial and ethnic differences in the incidence of conditions associated with CAPD (e.g. Chronic otitis media, sickle cell anemia, noise-induced hearing loss, fetal alcohol syndrome) (chermak and Musiek, 1997).

WHAT CAN BE THE CAUSE OF CAPD?

Neurologic insult to the central auditory nervous system is clearly one of the bases for CAPD (Reeves, 1985). Degenerative disorders such as multiple sclerosis, vascular problems such as strokes, mass lesions such as tumors, seizure disorders, and normal aging all can cause CAPD in adults if the auditory tracts are affected.

Vascular problems, mass lesion, seizure disorders and various neurologic syndromes can occur in children as well and can be the reason for CAPD. Fortunately, these types of disorders are relatively rare in children; however, they do occur and should not be overlooked as possible causes of CAPD.

IS CAPD A MULTIPLE DISABILITY?

The CAPD can occur as isolated disability or some other problems can also be associated with it. The most common problem associated with CAPD is "learning disabilities" (dyslexia). CAPD may be more common in those with certain voice disorders, language disorders, especially receptive skills have been associated with auditory perceptual deficits. Expressive problems, pragmatic disorders and more general language disabilities also may be related to CAPD.

IS THERE DIFFERENT TYPES OF CENTRAL AUDITORY PROCESSING DISORDER ?

Musiek and Gollegly (1988) posited three types of CAPD seen in children, particularly in association with learning disabilities.

1. CAPD Resulting from neuromorphological disorder may comprise the largest group or some 65-70% of diagnosed CAPD. Underlying CAPD in this group would be areas of polymicrogyri (i.e., underdeveloped and misshapen cells) and heterotopias (i.e., misplaced cells), most likely in the left hemisphere and the auditory region (splenium) of the corpus callosum (Galaburda and Kemper, 1979; Musiek, Gollegly and Ross, 1985).
2. Some 25-30% of paediatric CAPD might be the result of maturational delay of the central auditory nervous system (Musiek, Kibbe and Baran, 1984; Musiek et al., 1985).
3. Neurologic disorders, diseases and insults, including neurodegenerative disorders, might account for under 5% of CAPD diagnosed in association with learning disabilities (Musiek, Baran and Pinheiro, 1992; Musiek et al., 1985). The latter category would also characterize acquired CAPD in adults.

WHAT ARE THE AUDITORY PROBLEMS IN CAPD ?

The primary problem in children with CAPD is perceptual problem. The perceptual problem in this group includes,

* Difficulty in perceiving the accurate acoustic cues for the identification of speech sounds, especially when these are embedded in the contexts of syllables, words or phrases.
* Difficulty in retaining a sequence of auditory signals.
* Difficulty in organizing phonemes into accurate sequential patterns both in perception and in production.
* Difficulty in perceiving the temporal patterns of speech and utilizing these to facilitate recognition and retention.
* Difficulty in categorizing or structuring then child's auditory word.
* CAPD children also have been noted to have difficulty in understanding an increased rate of speech and recalling previous events in the correct order (Sanger, Fried and Decker, 1985).
* Musiek and Guerkink (1980) suggested that information provided by parents could help identify children who should be seen for central auditory testing. Problems that might be observed include difficulty hearing in noise, confusion of verbal directions, asking for repetition of verbal messages.

Cherry (1980), Jerger et al., (1988) also have found that characteristically, individuals with CAPD experience difficulties in comprehending spoken language in competing speech or noise backgrounds.

The child with an auditory processing disorder will 'misperceive' sounds, words and phrases. It is possible that some brief sound segments are not detected at all. Longer auditory messages are not retained in their entirety, or they may be missed altogether. This limitation in retention span also interferes with the accurate reception and comprehension of language.

They cannot reconstruct the phonetic structure of an utterance from such a rapid influx of acoustic information.

Willeford (1977) noted that various teachers independently reported similar listening difficulties among children later found to have central auditory processing problems.

The results of the study done by smoski, Brunt and Tannahill (1992) provided evidence that children with CAPD may show difficulty with more than one listening condition but not necessarily with all listening conditions.

At the 1979 ASHA convention, Rupp report-ed on the central tendency findings for 50 such children, the three major processing deficit areas that were observed with these children included:

* Marked inability to identify phonetically balanced (PB-K) words in noisy environments.
* Marked lag in sequential auditory memory where the child attempted longer and longer trains of units and
* Marked inability to perform phonemic synthesis when attempted in abstract and analytic approaches.

WHAT ARE THE NON-AUDITORY PROBLEMS IN CAPD ?

Merrified, Hall and Merrell (1976) suggested that CAPD children appear to respond to all sounds with equal importance and therefore become easily distracted and unable to maintain attention.

Other commonly observed characteristics that can be found in, and that identify children with, central auditory disorders are:

* Distractability by both auditory and visual stimulation
* Difficulty in following long commands
* Constant requests for information to be repeated
* Poor memory
* Being frightened or upset by loud noises.
* Classroom behaviour problems such as hyperactivity.
* Hypoactive behaviour, especially toward the end of the day.
* Lack of significant progress after undergoing longterm speech therapy for auditory difficulties.
* Chronic ear infections
* Visual perceptual problems
* Poor articulation-substitutions, omissions and distortions of sounds; indistinct connected speech; reversals; syntactical problems; even voice problems that may be due to poor discrimination may be indicative of processing problems.
* Exhibit difficulty in thinking of the word he wants to use.
* Omit words in sentences
* Musiek and Guerkink (1980) found reversals in reading and writing in children with CAPD
* Evidence of general academic difficulty with spelling, mathematics and phonics
* Withdrawn and disruptive
* Academic underachievement.

Related performance deficits in understanding verbal directions and auditory memory, as well as academic underachievement and reading difficulties, demonstrate the complex linkages between central auditory processing and more global cognitive and linguistic functions (Chermak and musiek, 1992; Sloan, 1980, 1986, 1992; Willeford and Burleigh, 1985).

HOW TO DIAGNOSE CAPD ?

A variety of specialists have been concerned with this problem. They include classroom teachers, audiologists, speech-language pathologists (SLPs), and psychologists.

There are different approaches to diagnose CAPD. They are

1. Diagnosis by observation
2. Diagnosis by exclusion
3. Diagnosis by behavioral tests
4. Diagnosis by electrophysiological tests.

Diagnosis by observation can be extremely useful. Noting the exact situations in which the individual experiences maximum listening difficulty can provide valuable clues as to the nature of the disorder. The exclusion approach can also be helpful. Myklebust (1954) used a combination of observation and exclusion in evaluation of children.

Speech-language pathologists and audiologists emphasized behavioural tests (Cherry, 1992). Speech-language pathologists usually test with standardized instruments the evaluation of auditory, visual and linguistic skills. Audiologists have favoured scaled-down versions of the kinds of behavioural tests found useful in the evaluation of adults with brain lesions.

Electro-physiological tests of auditory function, especially auditory evoked potentials are available for the diagnosis of CAPD. There is no universal electro physiological index of CAPD.

Thus, the diagnosis of CAPD will ultimately be made by a judicious combination of clinical observation coupled with more sophisticated behavioral test protocols and with carefully chosen elector physiological measures.

WHAT CAN BE DONE ABOUT IT ?

Sloan (1985) indicated that there are three important questions to be answered first:

1. What is the nature of the disorder ? Is it fixed or can performance be modified ?
2. If performance can be modified, what conditions improve it and can that improvement be maintained when those conditions are removed ?
3. If the deficits are fixed, what compensatory skills can improve function ?

There is still lack of database to definitely identify infants and young children who may be at risk for subsequent language and learning delay or disability. Young, pre- linguistic, high risk children should be followed longitudinally to determine if they do develop problems.

Each child should be planned individually since same intervention approaches doesnot apply equally to all subgroups because each child's problems vary in nature as well as in severity.

Thus far, intervention has been considered from the point of view of aiding the severely involved child, one with an obvious disorder. However, there is milder, less obvious involvements. Hyperactivity, emotional lability and perhaps even some memory dysfunction can be related to less traumatic lesions.

Older children - who use compensatory strategies but who are having problems in school and problems in their families- begin to be called by other disorders. Adults have similar difficulties at work and at home. Somehow, the diagnostic and intervention programs haven't extracted the subtler or milder forms of central auditory disorders. For some patients, even a mild disorder may be a serious problem; if not in speech perception, then in reading or learning or behaviour. It then be comes difficult to discriminate between central auditory dysfunction and learning disability and this too may have therapeutic implications.

Keith (1985) indicated how confusion it is. He pointed out that the name for the problem changes from central auditory disorder to auditory perceptual problem to auditory deficit, depending on the patient's age, the work setting, the examiner's training etc. He also noted that many of the diagnostic tests are not well normed; some with questionable assumptions and inaccurate generalizations. There is an important reason for including this observation. If we don't take a specific look at this problem, there likely to miss a central auditory processing difficulty.

Furthermore, what are the appropriate interventions ? Auditory comprehension problems are multifaceted, and whether a patient comprehends depends on many variables in addition to the linguistic message itself. Difficulties in processing phonologic, semantic and syntactic aspects of message obviously influence auditory comprehension. In addition, the psychological dimensions may be as important as how the material is presented. For example, whether the message is delivered in a familiar situational context or how the patient must indicate whether he/she understands are all contributory. In otherwords, cognitive utilization of contextual information contributes to success in auditory comprehension.

Review of

There is no much work available on ^"Rehabilitation of central auditory processing disorders" till recent past. Hence, we need to put effort to gather all the information that is available about the rehabilitation of CAPD, to help the individuals who work with such dysfunction.

AIM OF THE PRESENT STUDY

Aim of the present study is to,

1. List out the techniques in detail employed to mitigated functional deficits commonly observed in CAPD.
2. Improve the knowledge about what actually has to be done for the cases suffering from such dysfunction.
3. Help in selecting the techniques or strategies according to the type and severity of the problem for the better way of rehabilitation.
4. Outline the activities that may be undertaken with very young children suspected with CAPD
5. Enlighten the role of child's internal motivation in success/failure of CAPD management program.
6. Stress the importance of multidisciplinary team approach for the betterment of the individual as a whole.

AUDITORY TRAINING TECHNIQUES

INTRODUCTION:

For the past 50 years, investigators have studied the prospect of using Auditory Training (AT) to improve the auditory performance of people with peripheral hearing impairment (Schow and Nerbonne 1996). However, only recently has intensive AT gained popularity for use with children with learning disabilities and associated central auditory processing disorders (CAPD) (Musiek and Berge 1998).

For people with CAPD, AT is directed toward central mediated functions of hearing and language. Tallal et al., (1996) reported that specific types of AT may have a positive influence on the temporal processing of children who have language learning difficulties.

Tallal et al.,(1996) and Merzenich et al.,(1996) reported that children with language-learning impairment showed improvement in the temporal ordering of acoustic elements (speech segments and complex tones) after adaptive training an temporal ordering tasks.

Some approaches to AT target a specific aspect of auditory ability (Alexander and Frost, 1982; Katz and Harmon, 1982; Katz et al, 1984; Tallal et al, 1996), while other approaches are more eclectic (Chermak and Musiek, 1992; Sloan, 1986).

I. SPECIFIC APPROACHES:

Heasley (1972,1980) listed out the auditory training techniques for CAPD in a hierarchy that follows the normal developmental sequence of skill acquisition in the child. They are as follows;

AWARENESS OF SOUND:

Awareness is the ability to recognize and respond to the presence or absence of sound. Awareness of gross sound training require only brief practice for majority of the individuals. A few, however, who may have psychologically 'tuned sound out', may require concerted work to respond to a gross sound signal.

Awareness of gross sound can be developed by seating the individual very close to a record player, tape recorder, television or radio. Turn the volume up loudly enough that he can recognize when it is turned on or off. Place his/her hand on the instrument so that he/she can get additional help from the channel of vibration. Turn it off and on several times until the listener consistently indicates awareness of the presence or absence of sound by a designated method of response.

This is an important preconditioning task for helping the listener respond for the more difficult tasks. (Heasley, 1980).

AUDITORY ATTENTION:

Auditory attention is necessary to sound processing. It is an aspect of auditory perception that would seem to improve as a result of programmed listening exercises combined with behaviour modification (operant conditioning) techniques. (Heasley, 1980).

An excellent way to obtain a child's listening attention for specific details may be the use of short stories or narrative that has been modified to include absurdities or false statements. When the child hears something wrong in the story, he or she should immediately say, stop !'. He or she should then explain what was wrong and what should have been read. (Heasley, 1980).

AUDITORY LOCALIZATION ACTIVITIES:

The ability to identify the direction from which a sound source originate is localization. A deficit in this skill can result in the listener losing much information message while he searches his environment for the direction and source from which the stimulus or stimuli came.

For this, group activity, such as blind folding the listener who is standing in the centre of the circle and then the sound of an instrument or some noise should be made by an individual or may say a word. Then the listener should point out or walk to the person who created the sound.

The clinician may walk softly to various parts of the room and can provide a sound stimulus. Then, the blind-folded listener has to point to the correct direction. To make it more interesting, the listener can be provided with a bag and whenever the sound or word or a sentence is heard, the listener has to throw the bag towards the direction of the sound. (Heasley 1980).

Localization training may be conducted in a sound booth or in a quiet room, and stimuli should be varied and challenging. Localization activities should also progress from least difficult (greatest separation of sources of auditory stimuli) to most difficult (minimal separation of stimuli sources).

AUDITORY DISCRIMINATION:

It is described as the ability to recognize and respond appropriately to similarities and differences in sound. Discrimination task should include four dimensions of sound i.e., frequency (Pitch), intensity (loudness), duration (rate), and phase (quality), whether the stimuli be gross sound or speech sound. It is necessary to develop discrimination, beginning with gross sound stimuli and progressing gradually to the more difficult sounds-speech probably the first form of sound discrimination would be in the area of pitch. (Heasley, 1980).

Activities such as selecting a target sound and whenever the client utters the target sound, reinforcements such as marking a checkmark on paper, dropping a chip into a box, saying yes, clapping hands etc., can be given. The clinician may read a passage after setting a target sound. Whenever the child hears the target sound in the passage, he/she has to say 'stop!'. Activities such as giving the child ten words and asking the child to list out the words which starts with the target sound or giving the child some scrambled words. Then the child has to unscramble them.

Eg: Jookie Car (cookie jar)

Lead night (head light).

AUDITORY MEMORY:

The auditory perceptual training should be directed towards both long and short-term memory. These kinds of exercises will implement improvement of auditory attention and attention span.

Auditory memory can be tested and extended by gradually increasing time lapse between the signal and the response (identification) by the child. This assists the child to remember for longer period of time what the signal sounds like (Barr, 1976).

Also exercises like repeating words, giving the child some related tasks to perform, giving some unrelated tasks in perform, to categorize words that go together, teaching body laterality, narrating a simple poem or a story to the child and then the clinician will ask for the words which appeared or not appeared in the story or poem. The child has to say whether that word appeared in the story/poem or not etc., can be given (Heasley, 1980).

AUDITORY SEQUENCING:

The ability to identify a series of sounds in correct, respective order is called sound sequencing (Heasley, 1980). This is an oversimplification of a complex task that involves several auditory perceptual dimensions and that is critical in the ultimate development of verbal language.

Auditory sequencing, is a critical factor in the processing of auditory perceptual input. A disability in sequencing will delay or prevent language acquisition and expression. (Heasley, 1980).

Disorders may be related to nonverbal sound reception of the individual. The implication are that, prior to requiring ordering of speech sounds, the auditorially perceptually impaired individual should be provided the necessary practice in ordering non speech sounds. (Heasley, 1980).

AUDITORY PROJECTION:

Projection will be defined as the ability of the individual to attend to and process sound signals that originate from increasingly greater distances from the listener (Heasley, 1980 and Barr, 1976). Projection is of vital importance to the individual's survival and ultimately to his social well-being, since it normally leads to the ability to 'scan' the auditory environment. Scanning for danger signals as well as scanning for socially reinforcing signals is a common auditory activity.

For the listeners who seem unable to attend unless the speaker is in physical proximity to him, any of the auditory perceptual activities that are age and interest-appropriate may be presented at distances that are gradually farther from him. The clinician should choose activities that may cover additional auditory processing deficits in the listener.

Activities should be planned so that the sound source finally originates around a corner, or in a different room from the listener. Additionally, background may be gradually added to encourage the listener to attend and discriminate at gradually greater distances.

AUDITORY SEPARATION:

Auditory separation is related to foreground-background sound discrimination. It is the ability to attend to a primary sound signal in the presence of extraneous (competing) sound stimuli. The important role of auditory separation, permits the individual to respond selectively to a multitude of choices among auditory stimuli. (Heasley, 1980 and Barr, 1976).

The development of auditory attention and attention span will help the listener to attend to the desired message while ignoring other sounds. A system of timed reinforcements has been helpful in conditioning the listener who has an auditory separation problem. Initially, tapping the table every few seconds that he is able to ignore non important extraneous sounds during a lesson, and providing a token reward after each tap, can soon be extended into longer listening periods. Activities such as asking the child to repeat short sentences in the presence of gradually louder extraneous noise and rewarding with verbal approval, asking questions in the presence of gradually louder extraneous sound, or the clinician may tell a story against background sound. Then the clinician has to ask questions about the story after finishing it.

AUDITORY BLENDING:

Auditory blending entails the facility to combine isolated syllables into words.

AUDITORY CLOSURE:

The purpose of auditory closure activities is to assist the child in learning to fill in the missing parts in order to perceive a meaningful whole (Bellis, 1996). Earlier it was pointed out that auditory closure involves the ability to recognize and synthesize discrete parts of sound production into a whole production. This may occur at the sound level, word level, sentence, paragraph, or thesis level. (Heasley, 1980).

Auditory closure cuts across lines of the components of auditory processing in that it requires awareness, attention, memory, discrimination, sequencing, reauditorization synthesis of these factors to make use of association, and a 'filling in the missing parts' to obtain meaning and comprehension where information may be inferred but not specifically stated. Auditory closure apparently requires considerable abstract reasoning of the listener to adequately process the information. (Heasley, 1980). Therapeutic activities that focus on auditory closure are most appropriate for those children who have demonstrated reduced performance. On tests of central auditory function that challenge the process of auditory closure, such as monoaural low redundancy speech tasks.

The activities such as missing word exercises, missing syllable exercises, missing phoneme exercises are presented in sequential fashion, from least to most difficult. The child in question should demonstrate mastery of one level before moving on to the next. (Bellis, 1996).

MISSING WORD EXERCISES:

These exercises are designed to teach the child to use context to fill in the missing word in a message. Beginning with very familiar subject matter and then moving to the new information is best.

For example, when working with a very young child, the clinician may start with familiar songs or nursery rhymes in order to familiarize the child with the task of listening to the whole in order to predict the missing part.

For Eg: *Twinkle, Twinkle, little . . . . (star).*

Some children will exhibit difficulty with even this simple task. In that case, at all stages of auditory closure activities, the child should be talked through the process and prompted with questions.

A slightly higher level activity is prediction of rhyming words. For eg: the clinician may ask the child, can you name an animal that rhymes with house ?'. If the child is unable to perform the task, prompts should be given that guide the child in solving the puzzle. For eg; the child may be instructed to begin at the beginning of the alphabet and substitute the initial consonant of the word with different letters until the correct consonant is reached (aouse, bouse, couse etc.,).

A third method of prompting, useful when the child correctly chooses an initial consonant and combines it with the remainder of the word to derive a meaningful, but incorrect, word (eg, douse), may be to draw the child's attention to the key word or words in the clue. In this situation, the clinician has to remind the child that what is wanted here is an animal sounding as 'douse' some examples are,

- Colour that rhymes as drown (brown)
- Family member that rhymes with other (Brother and Mother)

Once mastery of these steps has been demonstrated, the clinician may move to new, unfamiliar messages in which the child must utilize the context of the phrase, sentence, or paragraph in order to predict the missing component.

When, using this approach, the clinician should begin with simple sentences (eg. when I am sleepy, I....) then move to more complex sentences, such as paragraphs in textbooks or popular novels. Also, in addition, the clinician should progress from omitted the subject or object of the sentence or phrase (eg. Jack cut an .... with a knife), to omissions of verbs, adjectives and other positions of the message (eg. Jack. . . . .an apple with a knife). The child should be prompted continually to use context in order to predict missing components, as well as to derive meaning from the whole message. (Bellis, 1996).

MISSING SYLLABLE EXERCISES:

Once the child has demonstrated that he or she can predict a missing word based on context, the clinician may move to omission of syllables. As with missing words, missing syllable exercises should be presented in a progression from least to most difficult. Initially, the context should be familiar so that the child is best able to fill in the missing components of the target word. The clinician may find that, even if the child is able to predict an entire missing word from a sentence easily, he or she may have great difficulty when only a portion of the target word is omitted. In addition, achieving closure for words in which the initial syllable is omitted is a more difficult task than for words in which the final syllable is omitted. Therefore, the clinician should begin by omitting the final syllable of the target word, once mastery is achieved, move to omission of medial and initial syllables.

Through repeated drills such as these, the child learns to become less dependent on hearing and decoding every component of the target word and more aware of the need for contextual derivation. When the complete acoustic signal is inaccessible (Bellis, 1996).

MISSING PHONEME EXERCISES:

Exercises in which specific phonemes are omitted may be carried out in a similar fashion to the missing syllable exercises. It is best to use a progression of least to most difficult, moving to the next stage only when the child has demonstrated mastery of the previous stage. Initially, the child should be able to supply the missing phonemes in words with contextual cues (eg; I like to (w)atch (t)ele(v)sion), before moving on to isolated words. With these exercises, taperecording the target sentences or words may be useful, as it may be difficult to perform the necessary phonemic omissions using a live voice approach. Again, when focussing on isolated words, it is helpful to provide general categories as a contextual cue (eg. Animals: Ele(p)ha(n)t, L(i)on), and to require mastery with final phonemes prior to moving on to medial and initial phonemes.

OTHER AUDITORY CLOSURE ACTIVITIES:

Virtually any method where by the external redundancy of the acoustic signal is reduced may be utilized to train auditory closure skills (Bellis, 1996). Therefore, auditory closure activities such as missing words exercises, missing syllable exercises and missing phoneme, exercises may be undertaken in distracting or noisy situations to increase the difficulty of the task further. In addition, variation in speakers, such as the introduction of regional dialects, misarticulations, and other speaker-related characteristics may be utilized to help train the child to use context to achieve auditory closure.

AUDITORY LOCALIZATION OR LOCALIZATION TRAINING:

Difficulty understanding speech-in-noise may be due to an auditory decoding or closure deficit, or it may be due to dysfunction at the brainstem level affecting the listener's ability to lateralize and localize auditory information, thus interfering with the detection of signals in noise. For this reason, it may be beneficial in some cases to include localization training in a comprehensive management program (Bellis, 1996).

VOCABULARY BUILDING:

Vocabulary building is the final activity which falls within the category of auditory closure activities. Just as a word may be indecipherable due to missing syllables or phonemes, requiring the listener to use context to predict the word, a word may be indecipherable due to the child's lack of familiarity with the word or subject itself. The ability to derive or predict word meaning for an unfamiliar term depends on the ability to utilize context effectively. (Bellis, 1996).

Miller and Gildea (1987) while describing how children learn new vocabulary, emphasized that the most effective vehicle for learning the meaning of new vocabulary is through contextual derivation, or utilizing the surrounding context to predict meaning to the unfamiliar term.

Therefore, it is important that the child learn to use the context in which the word appears to deduce its meaning. First, the child should learn to say the word aloud a few times, (Reauditorization), so that the sight and sound of the word becomes familiar. Then, the child should be encouraged to attempt a definition of the new word based on the context in which it appears.

Next, the actual definition of the word should be provided to the child. Dictionary skills are encouraged only when the motivation of the child to learn the meaning of the word remains high. Therefore, immediate problem solving in the form of providing the definition, rather than telling the child to look it up in the dictionary, is necessary. Finally, the child should be encouraged to define the new word in his or her own way, thus assuring that comprehension of the provided definition has been achieved.

By following this process, the child has learned to recognize the new word visually and auditorily, utilize contextual cues to achieve closure, and has added a new word to his or her internal vocabulary store.

Materials for vocabulary building should be interesting and encourage maintenance of a high level of motivation. Therefore, popular novel and stories are often good choices for this activity. In addition, since vocabulary is frequently a weak area for children with CAPD, it may be useful to utilize new vocabulary from the student's specific academic classes so that the child is able to become familiar with the new terminology prior to its introduction in the classroom setting.

Vocabulary building thus serves as vehicle for emphasizing the skills learned in all auditory closure activities namely, the use of context to predict missing or unfamiliar components of the whole. Therefore, the use of contextual cues to deduce word meaning is an appropriate addition to a comprehensive CAPD management plan (Chermak and Musiek, 1992). Particularly when the child exhibits a deficit in the area of auditory closure.

Barr (1976) suggested the auditory training techniques given by Heasley (1972) for CAPD, as well as he suggests the following techniques.

SUB-VOCALIZATION AND REAUDITORIZATION:

Sub-vocalization and reauditorization appear to be components on the continuum of auditory association that stores and processes heard information, compares it with prior information, makes generalizations and draws conclusions from inferred information as well as specific information.

For this, activities such as listing many reversible words and discussing the various meanings can be given. It helps the listener to use each word in a grammatically correct, meaningful sentence.

(eg)	House boat	Boat house
	Race horse	Horse race
	Book work	Work book

Then, giving the client a stimulus sentences and then he/she has to supply as many appropriate words as possible.

(eg) *Stimulus sentence:* It can run,

Possible words *:* various animals, cars, motor cycles, water, people, clocks, etc.

Activities such as arranging jumbled sentences, sequentially. The clinician can read a story to the client substituting unfamiliar, meaningless words for common words. The client must obtain the meaning of the unfamiliar words from the context of the story.

Developing a story is another activity. In this the clinician will suggest a topic, then take turns in adding a sentence or two to the plot. This is a good group activity. The clinician may end' the story. Then ask the client to tell the entire story. This is a good reauditorization activity (Heasley, 1980).

AUDITORY SENSITIVITY AND MOTOR TRAINING:

In auditory sensitivity (imagery) training, a story (word pictures) is spoken to the child with his eyes shut. The child interprets the action of the story with the various body movements he feels appropriate. The ability to visualize and interpret an image from an auditory description is stressed. (Barr and Carlin, 1976).

In auditory motor training, simple directional commands are given at first, 'Give me the chalk', 'Go to the board and write your name', and so on. Progressively, the child will learn correct responses to multidirectional commands, (eg) Place your hands above your head, move them back and forth and then place them back at your sides'.

Following square dance directions by a caller which are superimposed on the dance music and interpreting the action depicted in songs while being sung are other commonly used activities in auditory motor training.

Body movement and auditory perception are stressed in the 'Ithaca schools perceptual Evaluation and Training program'. In this program the children he on the floor and perform the following movements to the beat of a drum:

1. Turning the head completely to the right, then to the left;
2. Raising the arms straight in front of the face and returning them to the floor;
3. Raising the right leg up straight and returning it to the floor, then raising the left leg likewise; and
4. Lifting the head to look at the toes and returning the head to the floor. A counting rhythm is established with the drum beat, so children can establish a cadence of movement.

AUDITORY TRACKING:

Auditory tracking techniques involve the following:

1. Pure tones are presented through an audiometer and the frequency of tone is varied. Three equidistant lines are drawn on a sheet of paper and the child traces over the lower line when low frequency tones are presented,

the middle line for mid-frequency tones, and the top line for high frequency tones.

2. Have the child trace over three or more lines as the duration of the lines are varied from one-half to four seconds. The length of the lines should vary corresponding vwith the duration of the tones.

3. Have the child trace over a broad line, for low intensity tones, a less broad line for tones of medium intensity, and a narrow line for high intensity tones. A piano may be substituted for the audiometer if needed. The perception of variations in frequency, duration and intensity is stressed by Kirk (1969).

Willeford and Burleigh (1985) developed therapy activities which include procedures to strengthen environmental localization; sequencing of sounds; memory tasks, such as remembering digits and directions; sound blending and discrimination of speech in noisy backgrounds. They have developed some training programs which are as follows.

SEMEL AUDITORY PROCESSING PROGRAM:

The Semel Auditory Processing Program (SAPP) was developed in 1976 to help teachers remediate auditory processing disorders mat relate to skills involved in reading, cognition, and communication' (Semel, 1976). Semel (1976) stated that 'Auditory training to awaken the child's potential is directed toward releasing the accumulated store of auditory information and ability that was never properly developed. This type of training is ordinarily accomplished through feeding the brain sequentially-ordered micro-units of auditory configuration patterns'. Semel also advocated teaching the child to listen to what he/she hears. Auditory attention is directed to the localization of sounds. The child is shown how to recognize, focus on, discriminate, memorize, categorize, integrate and synthesize the various patterns of all parts that are essential to the total auditory process.

The primary emphasis of the SAPP seems to involve the identification of target sounds in various words. For example, beginning, intermediate, and advanced levels of this program have differences in difficulty, but all concentrate on listening to initial and final consonants, vowels and blends. Therefore, it appears to be semel's philosophy that a central auditory processing problem can be treated by working primarily on speech-sound identification.

AUDITORY PERCEPTUAL TRAINING (APT):

Willette, Jackson and Peckins (1970) suggested the Auditory perceptual training (APT) program, which is a remediation plan used to train 'essential' auditory processing skills based on progressive levels of attainment. In this program, five basic units of study are presented at three levels of difficulty. The units are -

1. Auditory memory,
2. Auditory motor,
3. Auditory figure-ground,
4. Auditory discrimination, and
5. Auditory imagery.

This program is designed for children in primary and intermediate grade levels.

The APT II therapy plan is an extension of the APT program. The APT II plan was developed to help children improve their ability to listen and follow directions. The units of study are similar to those in the APT program, except for the exclusion of auditory discrimination. This program is suggested as appropriate for the young adolescent student who is not performing at age level.

AUDITORY PERCEPTUAL TRAINING PROGRAM:

Butler, Hedrick and Manning developed the Auditory Perceptual Training Program in 1973. It is applicable primarily to students in grades one to three, or LD students through grade six -

* Who don't know how to pay attention
* Who are easily distracted by classroom noise
* Who have trouble recognizing voices, hearing differences between sounds and understanding or remembering what they hear.

This remediation plan is also intended for -

* Children who have learning or reading problems related to inadequate or faulty processing of auditory information.

If a child fails the composite Auditory Perceptual Test, this twice-a-week program is recommended. This remediation program includes

39 tape recorded lessons that are divided into four basic units that include exercises such as-

1. **Listen for sounds-** Selective listening, temporal sequencing, speech-sound discrimination and analysis.

2. **Listen for words and speakers-** Intonation patterns, voice identification, temporal sequencing, auditory closure and auditory synthesis.

3. **Listen to Remember-** Recognition of the number of sounds and syllables in words and phrases and figure-ground discrimination through competing messages, and

4. **Listen to Learn-** More difficult competing messages and recognition of subject-verb agreement, active and passive voice and complex syntactical structures. The authors state that, after training with this program, the child will be able to process auditory information more efficiently.

AUDITORY DISCRIMINATION IN DEPTH PROGRAM:

The Auditory Discrimination in Depth (ADD) Program, developed by Lindamood and Lindamood (1969), was deviced 'for developing the function of the ear in monitoring the correspondence between the contrasts, sequences, and shifts of our spoken language and the sets of graphic symbols which represent them'.

The program includes four levels of activities.

1. **Gross level:** Which includes activities geared to problem- solving techniques and the gross discrimination of sounds.

2. Oral-Aural level: Pertaining to the teaching of auditory discrimination of sounds, consonant/vowel changes in syllable patterns, and changes in syllable combinations.

3. Sound symbol level: Teaching students to recognize graphic representations for different phonemes, and

4. Coding Level: Coding of nonsense syllables into graphic and oral patterns and generalization into works.

Primary goal of this program is to help the child encode and decode multi-syllable nonsense patterns until the student has achieved competency with real words (Lindamood and Lindamood, 1969).

The ADD program is recommended as a precursor for any speech, spelling, or reading program and is appropriate for anyone from pre-schooler to adults. The length of time that the individual is enrolled in this program varies according to the student's progress. The average amount of therapy consists of 40-minute sessions daily for 2-3 months.

The techniques recommended for a particular child will be determined by the CAP test battery and the category or categories of CAPD identified by the basic test battery. The two major categories are - a) 'decoding' poor auditory processing at the phonemic level, and b) 'tolerance - fading memory': associated with difficulty in listening in the presence of noise and poor short-term memory.

Phonemic training is recommended for subjects in the 'decoding' category; noise desensitization training and FM amplification are recommended for those in the 'tolerance- fading memory' classification.

The auditory training approach assumes that weaknesses can be improved with systematic and sustained training.

PHONEMIC TRAINING:

There are two approaches to phonemic training : Phonemic synthesis and Phonemic analysis. Both Lindamood and Lindamood (1971) and Katz (1983) report that phonemic ability is not dependent on intelligence. Lindamood and Lindamood (1971) reported that instead of a normal distribution of this ability, there tends to be a bimodal distribution of 'haves' and 'have-nots'. They describe phonemic analysis as an auditory ability that is predictive of reading and spelling success in Kindergarten through seventh grade. Ka-tz (1983) concurs that skill in phonemic synthesis is more related to verbal measures than performance measures of intelligence. He suggested ability that is frequently underdeveloped in CAPD children. Also, improvements in phonemic synthesis can result in improvement in reading and spelling, as well as articulation.

PHONEMIC SYNTHESIS:

Phonemic synthesis is simply the blending of discrete phonemes into a co-articulated syllable . Use of the phonemic synthesis program is an excellent training program for decoding problems because it is effective, yet simple to administer. The program uses a tape-recorded format, which requires a quiet room and a high quality tape recorder. High fidelity headphones are also necessary. The entire program consists of 15 lessons; however since mastery is required the program will call for repetition of lessons that are not mastered. This requires a sequence of 20 to 30 lessons for most students to complete the program.

ESSENTIAL ELEMENTS OF PHONEMIC SYNTHESIS PROGRAM:

* **Auditory only/unisensory approach** - The child is allowed to listen without visual or orthographic interference.

* **Phonemes presented in isolation** - Phonemes are presented in their most neutral/medial form, minimizing unnecessary co-articulation.

* **Slow rate of presentation** - Phonemes are presented slowly at a rate of one per second, giving the child adequate time to listen.

* **Sequential/hierarchial program organization-** The program introduces short, easier blends first and builds on learned behaviours. This usually allows students to move through the program smoothly with success at each level.

* **Discovery learning** - Children are never told whether a blended response is correct or incorrect. They must discover the correct answer through auditory learning. They are praised for appropriate attending behaviour, not for correct answers.

* **Mastery learning** - The mastery level, for each phonemic synthesis lesson is defined as, is the requirement for completing that lesson. Mastery of this skill is required for accurate auditory phonemic decoding as well as success in phonics.

* **Training stops at syllable length** - Four and five phoneme, one-syllable blends are the longest required in the later training stages.

* **Control of stimulus** - The tape-recorded format allows for complete stimulus control as well as ensuring an auditory- only presentation.

Phonemic synthesis (PS) as described by Katz (1982), is a therapeutic strategy that covers several areas of the central auditory test battery.

PS correlates with the central auditory test battery in several ways.

1. By singling out the specific cues phoneme by phoneme, one uses selective listening;
2. Binaural integration is used, since the phoneme cues are given bilaterally; and
3. Temporal sequencing and interhemispheric interaction are used, as the child must sequence and process the phonemes into meaningful units (words) and yield a response (the word).

A PS therapy program developed by Katz and Harmon in 1982 is available commercially.

PHONEMIC ANALYSIS:

If the CAP evaluation identifies a decoding problem, it is actually a phonemic analysis problem, not a phonemic synthesis problem. The Lindamood Auditory Conceptualization (LAC) test by Lindamood and Lindamood (1971) is a test of phonemic analysis ability that begins at a level appropriate for Kindergarten students. The most difficult items can be completed by most sixth and seventh-grade students. The LAC tests is a part of Auditory Discrimination in Depth Training Program also developed by Lindamood and Lindamood (1975). This program contains training exercises based on the LAC test as well as many aspects that go beyond auditory phonemic analysis training. Phonemic analysis training uses the same techniques as the test.

The pre-check on the LAC requires the child to understand four basic concepts: Same-different, number concepts to 4, Left-to-right progression, and first-last. Category I test items are isolated phonemes presented in groups of two or three. On the easier items the child must use coloured blocks to demonstrate whether the phonemes were all the same or all different. The blocks are arranged left to right with spaces separating them to represent the discrete, separate presentation of the phonemes. On more difficult items in this category, the child must be able to detect the sequence of three discrete phonemes. Category II items use co-articulated non-sense syllables consisting of two to four phonemes. The child must detect subtle phonemic changes between two non-sense syllables and represent those changes with the colored blocks. In this category, the blocks are ordered left to right without spaces. This visually represents the co-articulation of the non-sense syllable. This task is easy enough that even Kindergarteners learn the response format quickly and enjoy arranging the colored blocks.

The program offers a training tape to prospective examiners to demonstrate the live-voice technique. Since an auditory-only approach is preferred, children can be asked to close their eyes when listening. For therapy using discrete phonemes, the rate of presentation can be slowed to one phoneme per second from the recommended rate of two per second to give the child adequate listening time.

Occasionally a child will have difficulty on a phonemic synthesis lesson. It may be helpful to break away and utilize a different technique (eg. Phonemic analysis) to work on the same phonemes that were a problem in the phonemic synthesis program.

NOISE DESENSITIZATION TRAINING (OR) SPEECH-IN-NOISE TRAINING:

Katz and Burge (1971) analyzed the improvement of speech-in-white-noise performance after 8, 30 minute therapy sessions with a group of children from 5 to 14 years of age. They noted post therapy improvement by 2 1/2-3 times in selecting pictorial representations of monosyllabic words presented in the presence of noise. The children could obtain a possible 120-122 correct responses depending upon the test list presented. They averaged 30.9 correct responses on the pre-test for monaural presentation of stimuli and 15.1 correct responses of stereo presentation as compared to post-therapy test scores of 34.4 for monaural and 17.6 for stereo listening, respectively.

When drilling speech production in the hearing-impaired child, Ling (1976) recommended frequent, short training intervals (5-7 minutes in length) since such intense concentration is required. Similar high levels of concentration are required in training speech-in-noise skill. Short training intervals are appropriate.

Katz et al., (1988) recommended that monosyllables be used in a background of increasingly noxious and increasingly intense noise. Monosyllables are selected because of their low predictability. This allows the therapist to maintain success and avoid frustration. Higher-interest sentences or stories can also be used for therapy for progress. Checks should utilize monosyllables.

Katz et al., (1988) recommended presenting the speech and the noise via tape-recorders. The speech is kept at a constant comfortable listening level throughout therapy. Therapy begins in a quiet back-ground followed by a minimally distracting noise such as fan noise or audiometric speech spectrum noise at a very quiet level. Relaxation exercises are helpful at this stage in the training. As training progresses noise levels are increased (the volume control on the tape play-back equipment should be carefully marked with about 15 levels so that the volume of the noise can be increased in measurable steps). As the child progresses, the noxiousness of the noise is also increased (eg., fan noise to cafeteria noise to single-talker discourse). When the noise produces an adverse effect (eg. poor discrimination of the words), the background noise is eliminated for about ten items. Following this drill in quiet, the noise should again be raised in small steps with approximately ten items presented at each noise level (Katz et al., 1988).

Katz et al., (1988) reported that speech-in-noise skills tend to deteriorate following the termination of therapy unless they are periodically reinforced. Once-a-week, reinforcement by the parent at home is suggested.

FM amplification systems are often recommended, when the CAP evaluation indicates a speech in noise problem (Katz et al, 1988; Katz et al, 1991; and Stach et al, 1987).

Trehub (1976), Swoboda, Morse, and Leavitt (1976) and Cole (1977) have all suggested that the ability to discriminate speech sounds is an innate talent and Rees (1973) hypothesized that if the ability to discriminate speech is innate, perhaps it cannot be improved with therapy. If this is true, it would seem to be equally applicable to speech discrimination in noise.

According to Chermak and Musiek (1997) Auditory skills training is directed toward improving auditory vigilance, temporal and spectral detection and discrimination, and inter hemispheric transfer. A variety of stimuli may be used, although success with non-linguistic stimuli should precede use of linguistic material as stimuli. Similarly, more demanding psychoacoustic tasks requiring identification, recognition, and production may be constructed once the client achieves criterion performance on the detection and discrimination exercises. The data available indicate that auditory processing abilities continue to improve in children with normal audition as a function of age, achieving adult like function between ages 6 to 12 years, depend on the nature of the task (Elliot, 1986; Elliott and Hammer, 1988; Grose, Hall and Gibbs, 1993; Jensen and Neff, 1993). This developmental effect must be considered in designing auditory skills training tasks and establishing criterion performance. According to Chermak and Musiek (1997) clients should perform at a minimum of 70% accuracy before proceeding to these more demanding psychoacoustic tasks. All exercises should be presented at a client's comfortable listening level.

DETECTION:

Trained adult listeners with normal hearing can detect temporal gap as brief as 1 msec or less (Abel, 1972). Based on this data, clients are asked to detect brief gaps inserted within brief bursts of white noise which are progressively shortened approaching the criterion of 1-5 msec gap detection.

VIGILANCE:

Vigilance (i.e. sustained attention) is a global neurocognitive process which serves acoustic signal processing. Vigilance is trained using procedures much like those employed in auditory or visual continuous performance tasks (Keith, 1994; Lindgren and Lyons, 1984). The client is required to sustain attention to a continuous stream of auditory stimuli, such as environmental sounds, syllables, or words, and to respond (eg; raising a hand, tapping the table) when a particular stimulus is heard. Failure to detect the target stimulus reflects inattention. False positive errors (i.e., responding to a stimulus other than the target stimulus) may reflect impulsivity.

INTERHEMISPHERIC TRANSFER:

Interhemispheric transfer via the corpus callosum is employed in tasks requiring interaction between information processed in each hemisphere. As such, it underlies binaural integration (eg; divided attention) and binaural separation (eg; selective attention). Tasks useful in promoting interhemispheric transfer include requiring verbal identification through tactile cues of objects held in the left hand; describing a picture while drawing it;

singing to music and various music activities; and responding motorically with the left side of the body to a targeted verbal command.

DISCRIMINATION:

Discrimination exercises require the client to decide whether two stimuli are the same or different. Frequency discrimination is trained by requiring clients to discern frequency differences of approximately 5-10 HZ [A frequency difference of 3HZ is normally obtained for trained adult listeners (Moore, 1973)].

Trained normal listeners can identify frequency sweep direction for tone bursts with duration of only 1 to 2 msec (Divenyi and Robinson, 1989) Tone glide discrimination task of Chermak and Musiek require clients to determine upward and downward direction of a frequency sweep for tone bursts of a few milliseconds.

Normal trained adult listeners can discriminate temporal gap of approximately 10 msecs (Penner, 1976). In Chermak and Musiek's temporal gap discrimination task, subjects compare the duration of a gap in two consecutive noise bursts. The basic gap is approximately 20 msec, a value typical of a phonetically meaningful distinction and the comparison gap is approximately 30-40 msec.

Ina related task, the client is asked to discriminate between steady-state and interrupted noise. Flutter Fusion, or the failure to perceive temporal gaps, is seen in normal listeners when interruption rates exceed 10 per second (Yost and Moore, 1987). Accordingly, flutter fusion training task of Chermak and Musiek involves interruption rates of 5-15 per second.

Temporal order discrimination involves comparing tone sequences in a same-different paradigm. Based on Hirsh's (1959) data showing correct order discrimination for tone durations of about 20 msecs, Chermak and Musiek (1997) targeted order discrimination for tones with durations of approximately 25 msec. Since the tone frequencies are sufficiently separated to ensure their distinctiveness, the client's task is restricted to discriminating tone order.

Bellis (1996) suggested auditory training techniques such as auditory closure, phoneme training, prosody training temporal patterning training and interhemispheric exercises for CAPD.

PROSODY TRAINING:

Children with Temporal Patterning deficits who exhibit difficulty on the Frequency patterns Test may also exhibit difficulty recognizing acoustic contours. Therefore, specific training in recognition and use of prosodic aspects of speech, such as rhythm, stress, and intonation, may be indicated (Musiek and Chermak, 1995). Prosody training may begin with words in which a change in the syllabic stress pattern changes the meaning of the word (eg., con*vict* versus *con*vict, re*cord* versus *re*cord, su*bject* versus *subj*ect) (Musiek and Chermak, 1995). Each version of the word should be introduced to the child and, if the word is unfamiliar, the steps delineated in vocabulary building should be utilized to familiarize the child with the sight, sound, and meaning of the new word. The change in meaning brought about by relative syllabic stress should be pointed out clearly. Once the child is able to define both versions of the word in isolation, the word may be imbedded in a sentence, so that the child must listen for relative stress within the word as well as use contextual cues to determine which meaning of the word is appropriate.

After working with words, training may focus on sentences in which subtle differences in stress, temporal cueing, or other prosodic features alter the meaning of the entire sentence (eg. 'Don't touch that *book* versus Don't touch *that* book'). At first, the stress and rhythm characteristics of each sentence will need to be exaggerated; however, once the child becomes familiar with the task, the activities may be undertaken in a more normal tone of voice. The child should be led, step by step, through analyzing the sentences for meaning depending on relative stress and rhythm characteristics.

Many children with deficits in Temporal patterning often misunderstand or misconstrue what they hear, resulting in hurt feelings as they jump to an often erroneous conclusion about the intent of the message. This may be attributed to the difficulty these children experience in extracting and using prosodic features of speech correctly, which contribute not only to meaning, but to emotion and intent, which contribute not only to meaning, but to help in determining intent of a message, as well as understanding the overall meaning of the message.

Many of these children, in addition, exhibit difficulty in sequencing and following directions, understanding complex messages, and so on. If, in fact, the child's perception of prosodic features is dysfunctional, the child may well hear a message simply as a string of equally stressed words, so that remembering the message for dictation or follow through purposes becomes a task of memory, rather than comprehension. Many of these children, when taking dictation, tend to write down sentences that make little or no sense, and articles and other filler words may be transcribed accurately, while key words in the message are left out (Chermak and Musiek, 1996).

For these children, training in the 'detection of key words' within a message is very helpful. The child may need to be taught to listen specifically for subject, verb, and object, while placing less emphasis on articles, conjunctions and other, less important words. After being given a complex direction, the clinician may prompt the child with questions such a 'What was the action word' etc. Training in key word extraction, a component of Prosody Training, may greatly help the child to remember and understand complex directions or messages.

Finally, many children with CAPD are described as flat or monotonic readers. This may be due to their lack of awareness of prosodic features of speech. Reading aloud daily, with special emphasis on animation, is a good task for these children that may be done at home/school. Reading aloud serves not only to increase reading aptitude but also to reauditorize and reinforce the use of rhythm, stress and intonation in expressive language.

According to Tedeschi (1983), the therapeutic strategies are directed at five target areas.

1) Temporal sequencing,
2) Selective listening,
3) Binaural separation,
4) Binaural integration, and
5) Inter-hemispheric interaction.

It should be noted that as a general rule, prior to central auditory testing or therapy, the child involved should have a comprehensive speech and language evaluation. This could include an in-depth investigation of the child's secondary language system and transduction abilities.

SPEECH WITH A COMPETING SIGNAL:

AREAS: Selective listening,
Binaural separation, and
Binaural integration.

These three areas of processing represent a hierarchy of difficulty, with selective listening being the most basic and binaural integration requiring the greatest processing ability. Therapy is directed accordingly.

Those children who have difficulty with selective listening would be introduced to a primary speech signal in one ear and a competing signal (white noise) in the contralateral ear. The noise is introduced at an intensity level sufficiently below the speech signal to ensure success. The aim of therapy is to increase the competing signal gradually until it is 20 dB SL above the primary signal. After the child has completed this stage, the next step is to work on binaural separation. Here, the noise stimulus is replaced by a more meaningful stimulus such as cafeteria noise, by a more difficult task such as a set of instructions (eg.)' Draw a triangle around the red ball' or by a continuous discourse used as the competing signal.

Again, the therapeutic objective is to have the child retain the primary message when the competing signal is 20 dB SL above the primary message. Binaural integration uses two signals, with each signal providing acoustic information to form a message. Eg; Willeford's Rapidly Alternating Speech Perception test (RASP), which alternates acoustic cues between ears to form one primary message. Therapy should begin with basics, using small word groups, and then should progress in complexity to an age - appropriate level.

RATE-ALTERED SPEECH.

Areas: - Binaural integration,

- Interhemispheric interaction and
- Temporal sequencing.

The underlying premise of rate-altered speech is that the temporal redundancy of acoustic information is not perceived because the individual cannot process the information at a rate essential for comprehension.

This therapeutic strategy uses equipment capable of altering the signal's rate without distorting the signal itself. The signal is presented at a rate below normal, which will allow the child to perceive the redundancy of the acoustic cues that in turn will facilitate comprehension. The therapist then gradually increases the rate until it is at the rate accepted as normal.

Clinically, if one cannot process the acoustic information at the appropriate rate, then the temporal sequencing will be off set. If the temporal sequencing is poor, there will be an inability to integrate acoustic material effectively. Interhemispheric interaction would also be extremely poor. Again, as in speech, with a competing signal, there is hierarch of complexity, with temporal sequencing representing the basic level and interhemispheric interaction the most complex.

The following Auditory Training techniques are given by Musiek and Schochat, (1998).

INTENSITY TRAINING:

Intensity discrimination is a key factor in speech perception and is an excellent exercise for improving auditory vigilance (Schlanger, 1962). Intensity discrimination training includes discerning an intensity increment that are superimposed on a continuous tone of the same frequency. The duration of intensity increment is 300ms with a 50 ms rise/fell time and varied from 1 to 5 dB to reach the proper success-failure rate. The continuous tone is set at a most comfortable loudness level. The frequency of the tones of 500 HZ and 2000 HZ, presented in a sound field. The length of time the patient spent on each task will be guided by his motivation.

FREQUENCY TRAINING:

Training on frequency discrimination and transition is indicated by the patient's poor performance on the Frequency Pattern Perception Test. Successful identification of frequency patterns requires frequency discrimination and temporal ordering of frequency changes, as well as other processes (Pinheiro and Musiek, 1985).

-All frequency training tasks are administered at a comfortable loudness level in a sound field. Continuous tones (approximately 5 sec in duration) are modulated. The patient is required to detect the modulation as a variation in pitch. The amount of the frequency modulation and the rate of modulation will be varied to achieve the appropriate success-failure rate. The frequency of modulation tone will be varied from session to session, and low, mid and high frequencies are used equally.

In another frequency task, the patient is asked to compare the modulation rate of two successive tones, approximately 1 sec in duration with a 1 sec interval between them. The patient is asked to detect a difference in the modulation rate and identify which of the two tones modulated faster. The degree of frequency modulation is kept constant at a frequency difference easily recognized by the patient. The frequencies of the tones used for this task is also varied similar to the frequency discrimination task.

Another frequency training involves sweeps moving from a low frequency to high frequency, or a high to low frequency. The sweep rate varies and is controlled manually. The sweep rate is usually less than 10% of the frequency of the tone used. The patient is asked to determine if a change occurred and if so in which direction (i.e., low to high, high to low). This training procedure is a modification of Tallal et al., (1996) temporal training technique.

TEMPORAL TRAINING:

The temporal training tasks are considered important due primarily to the poor performance of the patient on the Frequency Pattern Perception Tests. A key part of pattern tests is temporal processing, hence the use of temporal training procedure therapeutically (Pinheiro and Musiek, 1985). All temporal tasks are performed in a sound field at a comfortable loudness level.

The first temporal training task is the discrimination of consonant-vowel pairs as different (eg. ba,da) or the same (eg; ba, ba) with the interstimulus interval varied (Tallal et al, 1996). For some sessions, the patient can be asked to determine the consonant vowel pairs (recognition), and later in other sessions the same or different determination can be given.

GAP DETECTION:

This is another temporal training task. Stimuli are 10sec periods of broad band noise with two or three interruptions (gaps). The gaps, or silent intervals are systematically varied to permit the appropriate range of performance by the patient.

DICHOTIC SPEECH PERCEPTION TRAINING:

Another type of auditory training therapy is speech recognition tasks in various competing conditions in a sound field. This tasks is given when the patient has subpar performance on the Dichotic Listening (digit) Test and the Compressed Speech in Reverberation Test. Difficulty on the dichotic digits task could indicate problems in binaural integration of acoustic information (Musiek and Pinheiro 1985). To offset this potential problem the intensity of dichotic stimuli is varied and presented to each speaker positioned at each side of the patient. This sound field condition provides more cross over between signals and greater demands on the patient than if the task is conducted under earphones. The task has two parts. In the first part, the patient is asked to concentrate on only one. speaker and ignore the other. The patient is instructed to attend to the speaker delivering the less intense stimuli (X dB below the stimuli coming from the other speaker). In the second part, the patient is asked to attend to both speakers. The intensity of the stimuli in both conditions are varied in 10dB steps, with 5-10 trials at each intensity. Again, the task difficulty is regulated to achieve the desired success- failure rate. The stimuli are words, sentences and consonant-vowel-consonant (CVC) words. The CVC words are segmented so that the first consonant is directed to one speaker, the vowel directed to the opposite speaker, and the final consonant to first speaker. For the CVC words, the patient is asked to always repeat the whole word and not the segments; the intensities of the word segments are varied as with the other dichotic tasks.

SPEECH PERCEPTION IN COMPETITION TRAINING:

Another technique of auditory training is listening to target words (from w-22 lists) with competing four-speaker babble. The target words are presented through one speaker, while the babble is presented through the other speaker at two speech-to-competition ratios (the exact ratios are determined by performance). The patient is asked to listen in the following four positions:

1) speakers at each ear,
2) Speakers in front and back of the head
3) Speakers at each ear in the opposite position of condition one, and
4) Speakers in front and back of the head in the opposite position of condition two.

The target signal is set at 50dBL. Ten words are presented at each position at each signal-to-noise ratio (80 words).

SPECIALLY DESIGNED AUDIO-BASED COMPUTER GAME:

Merzenich and Tallal (1996) have shown that a training program made up of specialized computer games and other language exercises can drastically improve the oral language ability of children who lag several years behind their age in their ability to understand and respond to spoken language. The exercises are aimed at remedying a basic auditory problem that Tallal's research suggests is at the root of the language impairment: an inability to recognize the very short duration sounds of spoken speech. "The results are quite provocative and intriguing ... and certainly suggest that this (therapy) is very potent", reported of Tomblin (1996) (University of Iowa speech-language pathologist).

Merzenich and Tallal (1996) reported that their results could have implications for more than the roughly 5% to 8% of children who have the kind of oral-language impairment they studied.

Many speech researchers have doubts about those broader claims, however, Stark (1996) opined that 'it is not clear yet how it will apply to the broad spectrum of all language- impaired children, because there is so much variability among them'.

Tallal (1996) studied on children who have normal IQ who score below the 16th percentile on oral-language tests. Using exercises that required children to discriminate between different sounds. Tallal (1996) found that these children have trouble distinguishing syllables such as 'ba' and 'da' that begin with consonant sounds that last only tens of miliseconds. The problem was not limited to speech sounds, the children also had trouble discriminating non-speech sounds that arrived in rapid succession and had similar 'fast-element' recognition problems in other sensory modalities, including vision and touch. For example, if they were touched in rapid succession on two different fingers, they could not identify the fingers, something a normal child can do easily.

These findings led Tallal (1996) to hypothesize that the children's brains are unable to process information that flashes by, on time scales of tens of milli seconds, a deficit that she suggest would have its most disruptive impact on speech. Because many of the critical changes that differentiate one speech sound from another occur within this time window.

Tallal (1996) had shown that they could distinguish 'ba' and 'da' when the consonant sounds were stretched from 40-80 milliseconds. This suggested that they might better understand altered speech in which the fast consonant sounds were slowed.

Merzenich explained that similar exercises might reshape the brains and improve the discrimination skills of the children Tallal was studying.

To do this, they used two complementary sets of exercises. For one set, Bedi (1996) and Miller (1996) in Tallal's group (1996) designed a series of games such as 'simon says' in which the children were required to follow spoken commands. A group of scientists and engineers in Merzenich's lab modified the commands using a computer algorithm that streched the speech by 50% and emphasized rapidly changing speech components, such as short consonant sounds by making them louder-a formula that, according to Tallal's and Merzenich's (1996) research, should make the speech easier for language-impaired children to understand. The subjects, 22 language-impaired children with normal IQs, were divided into two matched groups. One group heard the commands in modified speech, while the other children, who served as controls, played the same games, but received their commands in normal speech.

During the same four week period, the children in the experimental group also played computer games designed by Jenkins in Merzenich's lab, in which they won points by being able to distinguish various sound cues. The games began at a very easy level, with long duration and well spaced sounds-either non-speech sounds or speech components that had been modified so even the language-impaired children could easily distinguish them. The children improved at the games, and as they did, the games got harder, the sounds becoming shorter in duration and spaced more closely in time. The control group played computer games that exercised the children's memory and eye-hand co-ordination but did not specifically hone their listening skills.

At the end of four weeks of training, a battery of language tests showed improvement in both groups. But the experimental group did significantly better, gaining 1 to 2 years worth of language ability during the four week training period. Much of the improvement was maintained when the children were tested again six weeks ago the end of the training.

After training on the stretched speech, the children generalized to normal speech. Kuhl (1996) suggested that the training didn't just supply the children with specialized tricks for performing on particular exercises, but actually improved their understanding of language.

The results so far suggest that the training can help the 5% to 8% of children with deficits in general oral language skills. But they haven't addressed whether the training has an impact on the children's reading problems as well, nor whether it might help the greater number of children who are dyslexic, but may not have oral-language deficits as serious as the first set of subjects.

FAST FORWARD COMPUTERIZED THERAPY PROGRAM:

No one scientist has studied the auditory processing abilities of children with specific language impairment (SLI) as thoroughly and systematically (Sloan, 1986). Tallal et al.,(1996) suggested that children with specific language impairment have difficulties processing brief acoustic events that occur in rapid succession such as the acoustic cues for speech sounds that occur in rapid succession in running speech. More recent research with an intervention program called Fast Forward (Scientific Learning Corporation, 1997), which evolved out of this understanding, supports this idea.

Fast forward is an intensive computerized therapy program that present sounds, syllables, words, and sentences that have been acoustically modified such that the brief acoustic cues embedded in the stimuli are lengthened and amplified. Under these conditions and with intensive exposure to these stimuli, children with SLI show significant improvements in both auditory processing abilities and language development (Merzenich et al, 1996 and Tallaletal, 1996).

Many researchers working in this field support the work done by Merzenich et al, (1996) and Tallal et al, (1996). Cacace and McFarland (1998) suggest that perceptual training by Merzenich et al (1996) and Tallal et al.,(1996) may improve language skills and possibly reading ability in some school- aged children.

II. ECLECTIC APPROACHES:

Chermak (1981) delineated four basic eclectic versions of approaches to the remediation of central auditory processing deficits. They are i) Traditional direct approach, ii) Supportive services and counselling; iii) Experiential-Linguistic approach; and iv) Psychoacoustic or Molecular approach.

TRADITIONAL DIRECT APPROACH: (TDA)

The Traditional Direct Approach is the most popular central auditory processing remediation program. This approach emphasizes the assessment and remediation of individual auditory processing skills, eg; memory, attention, discrimination, localization . If, for example, the diagnostic battery (including case history information) suggests deficiencies in the areas of selective attention and auditory memory, then the remediation program is designed to focus on these particular skills. In this, the client would be provided with tasks or drills that emphasize selective attention and memory. eg., word discrimination amidst competing noise and message backgrounds and sequencing series of unrelated and related words. Tasks similar to those employed to ascertain the processing problems are utilized to ameliorate the deficits (Heasley, 1974; Johnson and Mykleburst, 1976).

Although the TDA appears logical ie., to direct therapy toward specific areas of deficiency, its validity is questionable. This approach does not seem to improve academic and /or linguistic skills despite gains in isolated skills (Willeford and Billger, 1978). The client may manifest progress in the specific skill areas being remediated and tested; however the carry over to broader kinds of learning is uncertain (Lerner, 1976).

SUPPORTIVE SERVICES AND COUNSELLING:

An alternative to the Traditional approach was offered by Willeford and Billger (1978). They suggested a remedial program that involves counselling the child, family and educational personnel concerning the nature of auditory processing problems and controls for coping with auditory world. Willeford and Billger (1978) suggest this approach as a result of the lack of evidence supporting the usefulness of the Traditional Direct approach.

The focus of the supportive services and counselling approach is shifted away from the amelioration of isolated auditory skills to the provision of support to the child presenting auditory problems and the counselling of that child's parents, family and teachers (Willeford and Billger, 1978).

Improved communication skills, better grades, and heightened self-esteem may result from this approach (Willeford and Billger, 1978).

EXPERIENTIAL LINGUISTIC APPROACH:

This approach is advocated by Ling, (1978) and Simmons- Martin, (1977). The emphasis in the Experiential Linguistic approach is on active communication within realistic and meaningful contexts.

This approach may be seen as an extension of both the Traditional Direct approach and supportive services and counselling approach. Isolated auditory skills are not specifically targeted; however, several auditory skills may be emphasized through listening experiences that lead to communication and/or academic development.

The Experiential-Linguistic approach is based on the overlapping, interrelated, and somewhat simultaneous nature of the component processes of audition eg. attention, discrimination and memory and the elaborate relationships formed among audition, cognition and language processing. One must attend, focus, discriminate, sort, scan, and sequence available auditory input in a very brief time period, and the failure of any one skill will influence message resolution.

Detection is the very simplest case of discrimination (Bench, 1972). To be able to detect any sound, it is a logical requirement that the sound must be distinguished from all other sounds that form the background. Detection necessarily implies discrimination (Bench, 1972). Likewise, identification necessitates adequate discrimination, which in turn hinges upon selective attention.

The Experiential-Linguistic approach stresses the need to watch as well as to listen is communicative exchanges. A bimodal or multimodal approach to communication is supported by experimental and clinical evidence. Multimodal processing results in more successful and less fatiguing interactions. Remediation for auditory processing problems must be directed toward the auditory modality; however, the utilization of visual cues during the early stages of remediation serves increase the likelihood of success during those initial experiences. A bimodal approach to perception is natural and logical based upon sensory redundancy and the less than optimal nature of the environments in which we communicate. An auditory-visual approach fosters the development of the referential function of sound for an infant. The suprasegmental, as well as segmental, features of speech contribute to message resolution, and clients should be encouraged to use both types of clues (Martin, 1972). Situations should be experienced by the client in which both types of features provide significant information for message resolution.

Initial therapy sessions should be conducted in well lighted and acoustically controlled therapy rooms. Auditory and visual distractions are minimized in such rooms. As the clients succeeds in these controlled situations the clinician should increase the difficulty of the task by removing the above restriction. The effect of lifting these controls is to decrease redundancy and approach natural, typical, everyday listening situations.

Redundancy can be decreased by adding noise (visual and auditory distractions) eliminating the use of visual feed back, increasing the linguistic complexity of the message, using unfamiliar topics, reducing lighting, reducing time allowed for response, etc. The elimination of visual clues serves to decrease redundancy (and therefore increase the difficulty of the task). In addition, the elimination of the visual clues allows for concentrated practice in the auditory sensory mode.

The final phase of therapy should proceed in realistic contexts not manipulated or structured by the clinician cafeterias, bus station, libraries , waiting rooms, grocery stores, etc., may be used as realistic settings for auditory processing remediation.

The experiential linguistic auditory remediation program allows for experiential activities, using conversational stimuli, within a supportive context established by the clinician, client, and his/her family. The client must be provided with an outlet through which he/she can express frustrations, fears and concerns.

The auditory processing training program must be individualized to meet the client's deficits and integrities. Emotional factors, medical status, and home environment should be considered. The program should be interesting and motivating for the client. The clinician should strive for self-reinforcement such that the client views successful behaviour as reinforcement. Tangible, visual and social reinforcement should be used only when necessary.

The combination of realistic experiences with reinforced targeted learning may be superior to either mode alone.

PSYCHO ACOUSTIC (OR) MOLECULAR APPROACH:

Auditory processing remediation conducted within the framework of the psychoacoustic (molecular) approach focuses on the skills delineated by Mazeas (1972) . Remediation activities attempts to improve the client's detection of frequency, intensity and time differences. Mazeas (1972) viewed these parameters as the basis of all auditory processing and suggested that remediation efforts be directed toward the basics.

Difference limens for intensity and frequency are ascertained in the beginning of the remediation program and serve as baseline measures of an individual's ability to detect the number and sequence of tone. Therapy focuses on drills in which the client is required to listen to pure tones and detect minimal frequency, intensity and duration differences.

Study conducted by Strit Zver (1958) suggested that difference limens may not reliably predict speech recognition scores.

COMPENSATORY STRATEGIES

INTRODUCTION:

Compensatory Strategy is the final component of management for auditory processing difficulties related to helping the student function well and learn, despite the auditory difficulties, that is, finding ways to compensate for what skills they lack. These compensatory strategies help the child to become an active rather than a passive listener. The child must learn to accept responsibility for his or her listening comprehension and to invoke strategies for determining and retaining the content and meaning of each message.

The effective use of these strategies will vary with the age and experience of the child, his or her strengths and weaknesses, the availability of resources, and the organization of the classroom.

Compensatory strategies include comprehension monitoring (Sloan, 1998), metalinguistic and metacognitive approaches (Chermak and Musiek, 1997) and linguistic chart technique - which are dealt in detail.

COMPREHENSION MONITORING:

One strategy that is applicable to all students and should be taught as soon as the child is identified as having auditory difficulties is comprehension monitoring. This strategy can be taught to pre-schoolers up to teenagers (Sloan, 1998). It is first and foremost a way to help the student help herself/himself take responsibility for his/her own understanding and learning. Second, once this is understood by parents and teachers, it is a way for them to let go of having to monitor the student themselves, which breaks the dependency that develops when teachers habitually provide individual instruction to certain students.

Comprehension monitoring can be taught using any kind of task. It works particularly well in the context of teaching auditory short-term memory strategies, such as verbal rehearsal and imagery. In this context, the student is instructed to ask for repetition if he or she cannot recall the stimulus and verbally rewarded for doing so. The emphasis is on being sure of what the child have to remember, and asking to hear the stimulus again is a way to do this. Comprehension monitoring must also be taught within the activities of daily life both at home and in the classroom.

Strategies to help children with auditory short-term memory deficits can be very helpful to students with CAPD. Many children pick up on these strategies incidentally but students with auditory processing and language difficulties are not always good incidental listeners. They need to be taught these strategies directly and given opportunities to practice them until they become automatic. The use of verbal rehearsal and imagery can be taught easily to children in Kindergarten.

Other strategies, such as chunking or grouping (breaking long messages into smaller component parts and grouping like concepts together) for unrelated sequences like phone numbers, clustering by meaning or association, can be used in appropriate contexts, and paraphrasing (having the child reiterate the message in his or her own words). These strategies are likely to be most effective with children who exhibit an Associative or output-organization deficit; however, all children with CAPD may benefit from training in these approaches.

Parents need to understand and teach these strategies at home to help students remember shopping lists, dates and times, spelling lists, phone numbers, and addresses.

Other compensatory strategies include using a 'buddy' for assistance in the classroom and for note-taking, using a tape recorder to replace or enhance note taking, learning to paraphrase teacher talk into one's own language, and learning to associate new ideas with known information.

Teaching the child to use note books, calendars, computerized diaries, other aids may be effective in training overall organizational learning skills.

Regardless of the underlying deficit, the child with CAPD most often will benefit from activities designed to increase motivation and self-confidence. The first step in increasing motivation and returning control of the situation to the child is to educate the child regarding the nature of his/her disorder. Then, the situations in which spoken language are most difficult should be precisely identified and discussed openly.

The child, along with the clinician, may develop a list of suggestions that he/she can use when in a difficult listening situation, as well as tips for predicting when a listening situation is likely to be problematic.

Students in the upper grades sometimes need to be taught how to use crib-sheets or notation devices and how to outline and summarize information to facilitate retention and recall.

Chermak (1992), Musiek and Chermak (1995) provided many suggestions for using metalinguistic and metacognitive strategies to aid the child in actively monitoring and self- regulating his/her own message comprehension abilities, developing general problem-solving skills and to facilitate retention and recall of information with the older student.

METALIN - GUISTIC AND METACOGNITIVE APPROACHES:

Effective listening requires orchestration of the multiple knowledge bases and skills, including decoding, segmentation, language knowledge, and metacognitive knowledge and control (Chermak and Musiek, 1997). Listening deficits observed in individuals with CAPD often result from the complex interaction between primary deficits in auditory processing and secondary metacognitive and motivational deficits (Chermak and Musiek, 1997). Because metacognition develops in the context of experience, individuals with CAPD may present metacognitive strategy deficits secondary to deficient listening experience.

Although CAPD is a sensory disorder, linguistic, metalinguistic, and metacognitive systems can be harnessed into remediation strategies to enhance listening and spoken language comprehension (Chermak and Musiek, 1997).

DISCOURSE COHESION DEVICES:

Discourse cohesion devices link propositions into more complex messages (Halliday and Hasan, 1976; Van Dijik, 1985), allowing speakers and listeners to more efficiently formulate and resolve messages, respectively (Chermak and Musiek, 1997) Cohesive ties are used to establish relationships between ideas (example, causal relationships signified by because or so). Discourse cohesion devices include referents (example, pronouns); substitution; ellipsis (i.e., deleting rather than reiterating part of a message that can be inferred); definiteness; and conjunctions.

Discourse cohesion devices reduce verbiage and can increase efficiency of message transfer. Hence, the clinician must be aware of the significant demands these devices place on cognitive and linguistic processing (Chermak and Musiek, 1997).

SCHEMA INDUCTION:

A schema is a set of expectations, an abstract and generic knowledge structure stored in memory that preserves relations among constituent concepts and provides a framework to guide listening (Miller, 1988; Rumelhart, 1980, 1984) schemata operate at two levels, content and form. Content schemata provide a generalized interpretation of the content of experience (Dillon, 1981) helping listeners interpret messages and invoke inferential elaborations (Chermak and Musiek, 1997).

Formal schemata are linguistic markers that promote cohesive and coherent messages (Chermak and Musiek, 1997). They organize, integrate, and predict relationships across propositions (Dillon, 1981). Formal schemata include conjunctions (eg; and furthermore), adversatives (eg., although however), causal (eg; because, therefore), disjunctive (eg; but, instead), and temporal conjunctions (eg; before, after), as well as patterns of parallelism and correlative pairs (eg; not only/but also) (Chermak and Musiek, 1997). Formal schemata do not specify meaning. Rather, they evoke certain expectations, narrow the range of possibilities, and provide listeners with direction in constructing meaning (Chermak and Musiek, 1997). Schema utilization depends on cognition (eg; memory), metacognition (eg; self-regulation and self-monitoring), and cognitive flexibility (Rumelhart, 1984).

There are a number of techniques to enhance the activation and the use of schema. One particularly useful technique involves 'asking questions' to promote critical responses (Chermak and Musiek, 1997). Schema induction, whereby the client is led to recognize patterns in discourse and to explain those patterns, builds on this technique. In the event, somewhat indirect discovery approach is unsuccessful, the clinician may attempt to provide greater structure to the input to induce the rule governing the patterns in salient and available to the listener (connell, 1988).

Focusing attention on minimally contrastive pairs highlights and draws the client's attention to the formal schemata (Chermak and Musiek, 1997). The induction approach may be adapted for group work through reciprocal teaching.

CONTEXT-DERIVED VOCABULARY BUILDING:

Deducing word meaning from context is one of the most practical and useful approaches to build vocabulary, improve auditory and grammatic closure, and enhance message comprehension (Chermak and Musiek, 1997). Although context sometimes can be ambiguous, misleading, or simply uninformative, in many cases context clarifies word meaning (Miller and Gildea, 1987)

A sentence that illustrates the potential of context- derived vocabulary building is : 'The robber pilfered the jewels'. The context surrounding the unknown word 'pilfered' is sufficiently informative to enable a listen with basic vocabulary knowledge to derive its meaning (Chermak and Musiek, 1997).

SEGMENTATION AND AUDITORY DISCRIMINATION:

Auditory discrimination is essential to phonemic analysis and synthesis (i.e., sound blending or closure). These skills are so important to spoken language comprehension that CAPD treatment programs have been designed around them (Katz and Harmon, 1982; Sloan, 1986).

Syllabic segmentation is a particularly viable alternative to the more traditional phonemic analysis and synthesis programs (Elkonin, 1973; Slingerland, 1971) Syllabic segmentation recognizes the co-articulated nature of spoken language and avoids the creation of artificial sound categories that actually create problems by infusing phonemes.

PROSODY:

In contrast to segmental analysis, prosody involves the suprasegmental aspects of spoken language. Prosody refers to the melody, timing and rhythm of spoken language. Intervention for CAPD should include some attention to prosody since prosody links phonetic segments (Goldinger, Pisoni, and Luce, 1996), guides attention to the more informative parts of a message (Cutler and Fodor, 1979; Cutler and Foss, 1977), and provides information about the lexical, semantic, and syntactic content of the spoken message (Goldinger et al., 1996; Studdert-Kennedy, 1980). Since resolving prosodic distinctions requires fine temporal processing, therapy directed toward prosodic detail also targets auditory training of temporal features of spoken language.

A number of approaches may be used to increase a client's use of prosody for spoken language comprehension. For example, heteronymns (i.e., words that change meaning and grammatical function relative to the stress pattern) require focus on prosody to resolve semantic distinctions (eg., sub 'ject Vs subject').

Similarly, intonation changes meaning. For example, depending on the speaker's intonation and timing, the sentence, 'Look out the window', can be interpreted to mean 'Look out!, the window', 'Look!, out the window', or simply the imperative statement, 'Look out the window' (Musiek and Chermak, 1995).

Temporally cued sentences (eg., 'They saw the car go on the ferry' versus 'They saw the cargo on the ferry') (Cole and Jakimik, 1980) may also develop attention to prosody and segmentation (Chermak and Musiek, 1997).

Reading poetry and noting the location of the emphasis and stress in sentences and words may improve perception of prosody. (Musiek and Chermak, 1995).

METAMEMORY:

Because memory serves an essential role for spoken language comprehension, directing attention to metamemory, or the knowledge and awareness of one's own memory system and strategies, may benefit individuals with CAPD.

Memory enhancement strategies may be grouped into internal and external devices Internal strategies consists of naturally learned strategies (eg; asking for repetition) and mnemonic devices (i.e., artificial or contrived memory aid for organizing information (Harris, 1992).

External strategies are compensatory aids (eg; prosthetic devices and cognitive orthotic devices).

MNEMONIC DEVICES:

Most mnemonic devices are language based, including elaboration, transformation and chunking.

Elaboration involves assigning meaning to items to be remembered by recasting them in a meaningful sentence, analogy, or acronym (Chermak and Musiek, 1997).

Transforming Einstein's relativity theory into a simple equation ($E=MC^2$) provides the individual with a concise means for storing complicated material.

Chunking involves organizing items into categories. For example, one might parse a 10-digit phone number into three chunks of digits representing the area code, the telephone exchange or the prefix and the extension.

METACOGNITIVE STRATEGIES:

The skills and processes underlying the effective use of metacognitive strategies for listening comprehension include: 1) Understanding task demands, 2) appropriately allocating attention, 3) Identifying important parts of the message, 4) Self-monitoring 5) Self questioning, and 6) deployment of debugging strategies. Although a number of these processes take place automatically and tacitly in skilled listeners, they may require direct instruction and opportunities for application and reinforcement in clients with CAPD.

A number of metacognitive approaches may be incorporated in CAPD management programs. These approaches include attribution training, cognitive behaviour modification, cognitive processing style, reciprocal teaching, and assertiveness training.

Attribution training targets motivation and internal control. Cognitive behaviour modification approaches promote active, self regulatory listening and learning styles. Reciprocal teaching is a highly motivating technique that fosters self-esteem and self-regulation. Encouraging flexibility in selecting a cognitive processing style enables the listener to meet diverse processing demands and listening tasks. Assertiveness training empowers clients and advances therapy goals.

ATTRIBUTION TRAINING:

Attribution training focuses on instilling causal attributions for failure to factors that are under an individual's control (eg; inadequate effort) rather than to sensory or intellectual incapacity (Torgesen, 1980). Attribution training should foster higher self-esteem and increased persistence on task, particularly under challenging listening tasks and conditions (Chermak and Musiek, 1997). The clinician provides opportunities for the client to confront listening failures in a supportive environment and to learn to attribute failure to insufficient effort.

The ultimate success of this training depends largely on the careful wording of clinician feed-back and the validity of the new attributions. Feed-back must acknowledge hard work, while eliciting even greater effort (Miller et al., 1975; Schunk, 1982). Feed-back should reinforce and instruct, encouraging careful listening and strategy use (Chermak and Musiek, 1997).

Attribution is credible only to the extent to which the client sees that increased effort leads to improved performance (Dweck, 1977). If increased effort leads to improved performance, one may expect persistent and generalized effects (Licht and Kistner, 1986).

GENERALIZATION STRATEGIES:

There are a number of within-training as well as environmental strategies to facilitate generalization of skills beyond the clinical environment. Within-training strategies are incorporated within the therapy sessions and include increasing length of clinical training, using real life scenarios and training vignettes, using multiple exemplars and diverse training experiences, incorporating self-monitoring homework exercises, focusing on relevant and pivotal skills, and adding booster sessions as follow-up to therapy (Guevremont, 1990).

Environmental support training requires collaboration with families and other professionals to extend therapy into the natural environment (Chermak and Musiek, 1997). These strategies seek to make more salient and relevant the skills and strategies learned in the treatment environment (Chermak and Musiek, 1997). Implementing contingencies supporting the use of skills and strategies in the home, school, and/or work place is a primary example of an environmental support strategy.

COGNITIVE BEHAVIOUR MODIFICATION:

Cognitive behaviour modification (CBM) induces self- control through playful and reflective processing and response style (Lloyd, 1980). CBM includes self-regulation, and cognitive strategy training (Whitman et al, 1984). While there are differences among these approaches, all CBM training shares a set of common foci:

1) Clients are involved as active collaborators in the clinical process,
2) Target strategies are modeled during training.
3) Reflective processing and a reflective response style are emphasized, and
4) The relationship between the client's actions and task outcomes are underscored (Lloyd, 1980, Meichenbaum,1986).

SELF-INSTRUCTION:

Through self-instruction, clients are trained to formulate self-directing verbal statements to guide their task performance. Meichenbaum and Goodman (1971) described the five step process:

1) Task performance by the clinician while self-verbalizing aloud,
2) Performance by the client while the clinician verbalizes,
3) Performance by the client while self-instructing aloud,
4) Performance by the client while whispering, and
5) Performance by the client while self-instructing covertly.

This approach should promote inculcation and generalization of the self-instructional routine.

COGNITIVE PROBLEM-SOLVING:

Cognitive problem-solving training helps clients resolve problems. Clients are instructed to analyze situations, generate potentially viable solutions and identify and implement and most effective solution (Chermak and Musiek, 1997) Fig.2.1 Illustrates cognitive problem solving in the context of spoken language comprehension. During implementation, the client must self-monitor his/her performance to determine whether the solution has been effective. If one has been ineffective, one must re-analyze the situation to determine alternative strategies. Cognitive problem solving is easily adapted for group work.

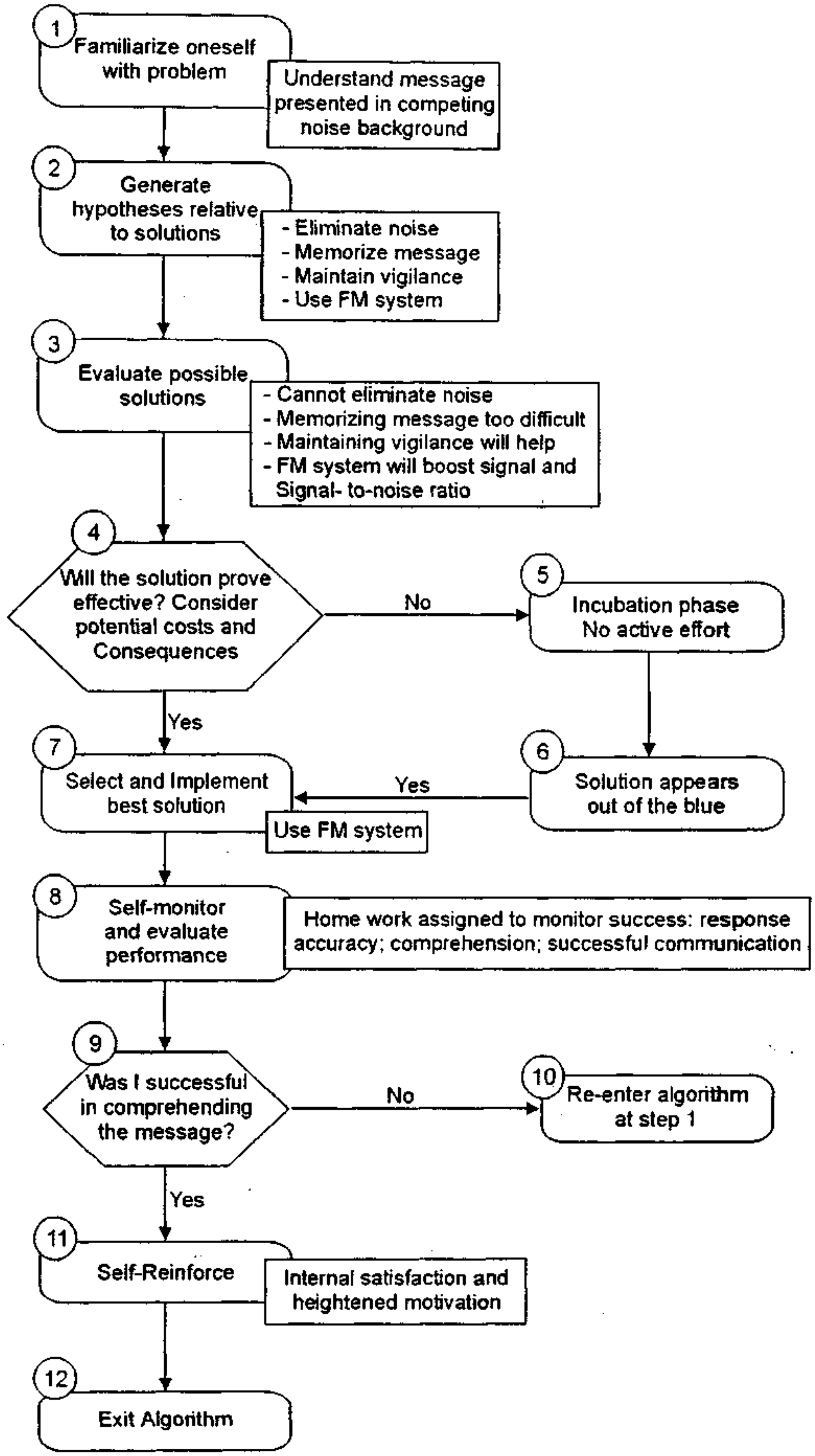


Figure *2.1:* Cognitive problem solving in comprehending spoken language

SELF-REGULATION PROCEDURES:

Self regulation procedures target self control through a three-step process involving self-monitoring, self- evaluation, and self-reinforcement (Brown, Campione and Day, 1981; Kanfer and Gaelick, 1991). It promotes effective listening by encouraging a listener to monitor comprehension processes to determine whether these processes are meeting comprehension needs (Chermak and Musiek, 1997). The listener learns to modify strategies to ensure that processes are effective (Danks and End, 1987).

RECIPROCAL TEACHING:

Reciprocal teaching is a process where by clinician and client switch roles (casanova, 1989; Palincsar and Brown, 1984). It leads to a transfer of responsibility for performance from the clinician to the client, boosting self-esteem and self-efficacy (Chermak and Musiek, 1997). It allows the clinician an excellent opportunity to ascertain whether the client understands and can execute targeted strategies.

Reciprocal teaching is based on the following principles and procedures:

1) The clinician-teacher actively models the desired behaviour, making the processing strategies overt, explicit, and concrete;
2) Strategies are modeled in context;
3) Discussions focus on the content of the message as well as the client's understanding of the strategies being used for message comprehension;
4) The clinician provides feed-back appropriate to the client's level of mastery; and

5) Responsibility for comprehension is transferred from the clinician to the client as soon as the client demonstrates an adequate success level (Harris and Sipay,1990). Reciprocal teaching can be expanded to include peer tutoring.

COGNITIVE STYLE AND REASONING:

Flexibility in reasoning and cognitive style is essential to meet the variety of processing demands and listening tasks we face (Chermak and Musiek, 1997). Sole reliance or over reliance on one cognitive style may bias interpretation and impede comprehension. This is especially true for individuals with CAPD whose deficient auditory processes leave them less able to cope with degraded acoustic signals and imprecise and ambiguous messages. While the clients with CAPD are encouraged to take advantage of information revealed through bottom-up processing (eg., phonemic distinctions revealed through auditory discrimination, changes in prosody revealed through temporal differences), they must also be encouraged to employ top-down processing to read between the lines, recognize conceptual nuances, achieve auditory and grammatic closure, and infer or abstract meaning (Chermak and Musiek, 1997). Similarly, individuals with CAPD need to identify listening tasks that demand a more reflective, rather than impulsive, cognitive style.

ASSERTIVENESS TRAINING:

Clinical experience confirms a positive relationship between a client's assertiveness and successful treatment outcomes. Assertive client tend to be more actively involved in their own therapy, and they tend to generalize new strategies and skills to their life contexts (Chermak and Musiek, 1997). Assertiveness depends on motivation, verbal and non verbal skills, and a positive cognitive mindset (Kelley, 1979). Assertive messages are communicated through verbal expressions and are reinforced by nonverbal aspects of message delivery (eg; posture, gestures) and paralinguistic elements (eg; vocal intensity, intonation). A positive attitude reinforces one's confidence and motivates persistence (Kelley, 1979). Assertiveness training includes modeling, guided practice, coaching, homework and self-management, readings, and small group discussion (Kelley, 1979), Homework assignments assist in reducing anxiety and establishing assertiveness skills in real world contexts.

LINGUISTIC CHART TECHNIQUE:

Patients with severe auditory processing disturbances, however, tend to react poorly to these techniques. They appear puzzled by the bombardment of auditory stimulation. Even the most elementary speech units seem confusing unless they are presented in a highly structured manner. For these patients, materials must be presented in such a way that auditory input is drastically reduced, rigidly controlled, and accompanied by a variety of non auditory cues. Such limitation of auditory input allows the patient the opportunity to focus on a specific target within a range of possibilities. Limiting and structuring input reduces the number of percepts to which the patient must listen (Caplan, 1978) and reduces the possibility of overloading the auditory system.

Patients with auditory receptive difficulties also appear to have a deficit in categorizing auditory stimuli (Caplan, 1978; and Jakobson, 1973). Therapy for these patients should provide methods to assist the categorization process, visual and tactile cues to accompany the verbal presentation, and limited auditory input. The linguistic chart technique (LCT) was developed to meet these criteria. It has been useful with aphasic patients of any type whose symptomatology is severe, but it is particularly useful with patients who have auditory processing disorders.

The linguistic chart is not one, but many charts, each devised according to the patient's linguistic needs. It begins on the level of single sounds with application of distinctive feature analysis as the linguistic principle, and proceeds to syllables and words of increasing complexity. Charts of more complex functioning, such as those based on the morphologic or syntactic structure of the language, can also be constructed. The framework provided by linguistic principles allows the therapist to select and diagram specified items for presentation and to build upon the items in a highly structured manner. The use of colored symbols, figures, and diacritical marks may be added for visual cueing of the auditory input. Initially, this technique can be used in conjunction with the more traditional therapy approach. But as the patient finds the LCT less frustrating and more rewarding, more therapy time should be devoted to it.

The LCT came into existence primarily through trial and error, and has been modified as more knowledge of linguistics and its application to language disorders has accumulated. Its evolution is not complete; there has been little experimentation with controlling the lexicon with regard to parts of speech presented (Ulatowska and Richardson, 1974; Hatfield, 1972; and Naeser, 1975) and the underlying theory regarding distinctive features needs refinement (Parker, 1976). But despite these limitations, the LCT has been successful because of the combined effects of reducing and controlling inputs, of providing a variety of non-auditory cues, of organizing a well-ordered linguistic progression, and of proceeding at a pace suited to individual needs.

DEVICES FOR CAPD

INTRODUCTION:

The primary objective of auditory processing remediation is to improve communication by maximizing the contribution of the auditory system. Better communication skills pave the road to academic achievement and improved self-image. The appropriate use of hearing aids is a significant factor contributing to the attainment of these objectives with peripherally hearing impaired clients.

Hearing impaired persons inevitably experience great difficulty detecting and analyzing certain speech components (particularly in noise). The appropriate fitting of, and guided experience with amplification forms the basis of auditory processing remediation with peripherally hearing impaired individuals. Auditory processing dysfunction is often observed in the absence of peripheral hearing loss. Remediation programs as well as specialized devices (eg; FM systems) have been developed to meet the needs of clients presenting peripheral as well as central auditory processing deficits.

AMPLIFICATION AND CAPD IN CHILDREN:

Attempts have been made to use amplification system in children with educational handicaps who have normal hearing or mild hearing loss and who are not considered by traditional criteria to be candidates for hearing aids. The underlying assumption of these studies is that educational deficits are often related to auditory deficits. Alteration of auditory information with amplification, therefore, should enhance auditory processing and have a positive effect on educational intervention.

Sarff, Ray and Bagwell (1981) described a program entitled Mainstream Amplification Resource Room Study (MARRS) in which 110 children from grades 4,5 and 6 were selected for the study. Each child in the group had an academic deficit and auditory thresholds of no better than 15dBHL and no poorer than 35dBHL. Although central processing ability was not measured directly, the educational difficulties of these children were presumed to relate directly to auditory deficits resulting from minimal hearing loss.

Students from the MARRS study were assigned to one of two groups. The intervention procedure for one group was the form of special help in a learning disabilities resource room as an adjunct to the traditional classroom setting. The other group has no special resource room. Instead, the students were confined to a standard classroom in which amplification equipment was installed. The teacher were a microphone and wireless transmitter coupled to two loudspeakers. The teacher's lecturers and instructions were, thus amplified before being presented to the students.

Preceding and following these intervention strategies, student competency in various academic areas was measured. Results showed increased academic achievement for both groups and a tendency for greater achievement by students in the amplified classroom. Apparently, the enhancement of S/N by amplification intervention altered the classroom listening environment enough to reduce the negative educational effect of auditory deficits.

These positive results may have resulted simply from overcoming the mild peripheral hearing loss present in these children. (Stach, 1995). An alternative explanation is that many of these children with minimal hearing loss and educational deficits had CAPD, although auditory processing ability was not measured directly. If so, then it would follow, based on the MARRS study, that amplification intervention on a group or an individual basis might prove to be a beneficial strategy for children with such an auditory disorder. (Stach, 1995).

Shapiro and Mistal (1985) also provided evidence supporting a pro-active amplification approach to educationally - impaired children. On the assumption that one characteristics of reading-disabled children is their relative inability to process rapid speech formant transitions, the authors suggested that such children would have difficulty with perception of high-frequency consonant information. They hypothesized that fitting these otherwise normal hearing children with mild-gain, high-frequency, in- the-ear (ITE) hearing aids would provide the additional information necessary for good speech perception. Four illustrative cases demonstrated improvement in areas such as auditory memory, complex word repetition, and intelligibility of PB words.

These findings are intriguing in terms of the potential for benefit from amplification in children with auditory processing deficits. However, large deficiencies remain in understanding of candidacy, measurement techniques and appropriateness of amplification arrangements.

Children with central processing disorders may or may -not have concomitant peripheral hearing loss. Similarly, children with peripheral hearing loss may or may not have central processing disorder. As a result, few children with central disorder are fitted with amplification. Consequently, the effect of amplification on central disorder in this population is not well known.

SPECIAL HEARING AID CONSIDERATIONS IN ELDERLY PATIENTS WITH AUDITORY PROCESSING DISORDERS:

Elderly individuals often have more deficits in speech understanding then would be expected in younger individuals with the same degree of hearing loss. Such deficits may be attributed to the complex nature of age-related changed that occur throughout the central auditory nervous system. and are generally referred to as auditory processing disorders.

Elderly patients will have problems in the attenuation of acoustic information, distortion of that information and/or disordered processing of neural information. These deficits have been related to poor performance with hearing aids, reduced satisfaction with hearing aids and reduced prognosis for successful benefit from hearing aid use. Intervention strategies that enhance signal-to-noise ratio are often successful in overcoming the debilitating effects of auditory processing disorder in the elderly.

THE NATURE OF AUDITORY PROCESSING IN THE ELDERLY:

Auditory processing ability is usually defined operationally on the basis of behavioral measures of speech understanding. Degradation in auditory processing has been demonstrated by the use of 'sensitized' speech audiometric measures. (Antonelli, 1970; Bergman, 1971; Bergman, Blumfield, Cascardo, Dash, Levitt and Marguiles, 1976; Bosatra and Russolo, 1982).

Age related changes have been found on degraded speech tests that use both frequency (Bocca, 1958) and temporal alteration (McCroskey and Kasten, 1982; Price and Simon, 1984).

Tests of dichotic performance have also been found to be adversely affected by aging (Arnst, 1982; Jerger, Stach, Johnson, Loiselle and Jerger, 1990).

In addition, aging listener do not perform as well as younger listeners on tasks that involve the understanding of speech in the presence of background noise. (Goetzinger et al., 1961; Heifer and Wilber, 1990; Shirinian and Arnst, 1982).

PERFORMANCE WITH HEARING AIDS:

Older patients, particularly those with auditory processing disorder, do not perform as well on aided speech understanding measures as younger patients or patients with normal auditory processing ability. Hayes and Jerger (1979) evaluated aided performance in a sound field by a group of patients with a speech audiometric pattern consistent with peripheral sensitivity deficit and a group with a pattern consistent with auditory processing disorder. They found that those with auditory processing disorder did not perform as well with hearing aids as those without auditory processing disorder. They also found that performance declined with increasing degree of the auditory processing component. Even with age and degree of hearing loss controlled, the auditory processing disorder group performed worse.

AMPLIFICATION AND CAPD IN AGING:

The phenomenon of central presbycusis appears to be well substantiated, but the question of its effect on hearing aid use remains unclear. Some studies have suggested that elderly patients are generally less satisfied with amplification than younger patients (Jerger and Hayes, 1976; Berger and Hagberg, 1982), but it is not clear whether this dissatisfaction is related to non-auditory aging problems or central auditory aging. Two areas of research have addressed this question. The first is the relationship between central auditory disorder and clinical performance with amplification, and the second is the relationship between central auditory disorder and satisfaction with or benefit from hearing aid use.

CENTRAL PRESBYCUSIS AND HEARING AID PERFORMANCE:

The elderly patients with central presbyacusis perform more poorly during hearing aid evaluations, if the central auditory processing disorder affects the hearing aid use. Hayes and Jerger (1979) studied performance with hearing aids of 154 patients (of age 60 years or older). They divided the patients into three groups based on comparison of speech intelligibility scores for PB words presented in quiet and SSI sentences presented in competition. The peripheral group has SSI scores that were equal to or better than PB scores, the intermediate group had SSI scores that were poorer than PB scores by no more than 20% and the central group had SSI scores at least 20 percent poorer than PB scores.

Comparison of aided performances was based on a hearing aid evaluation procedure in which the SSI was presented at various message-to-competition ratios (MCR) for aided and unaided conditions (Jerger and Hayes, 1976).

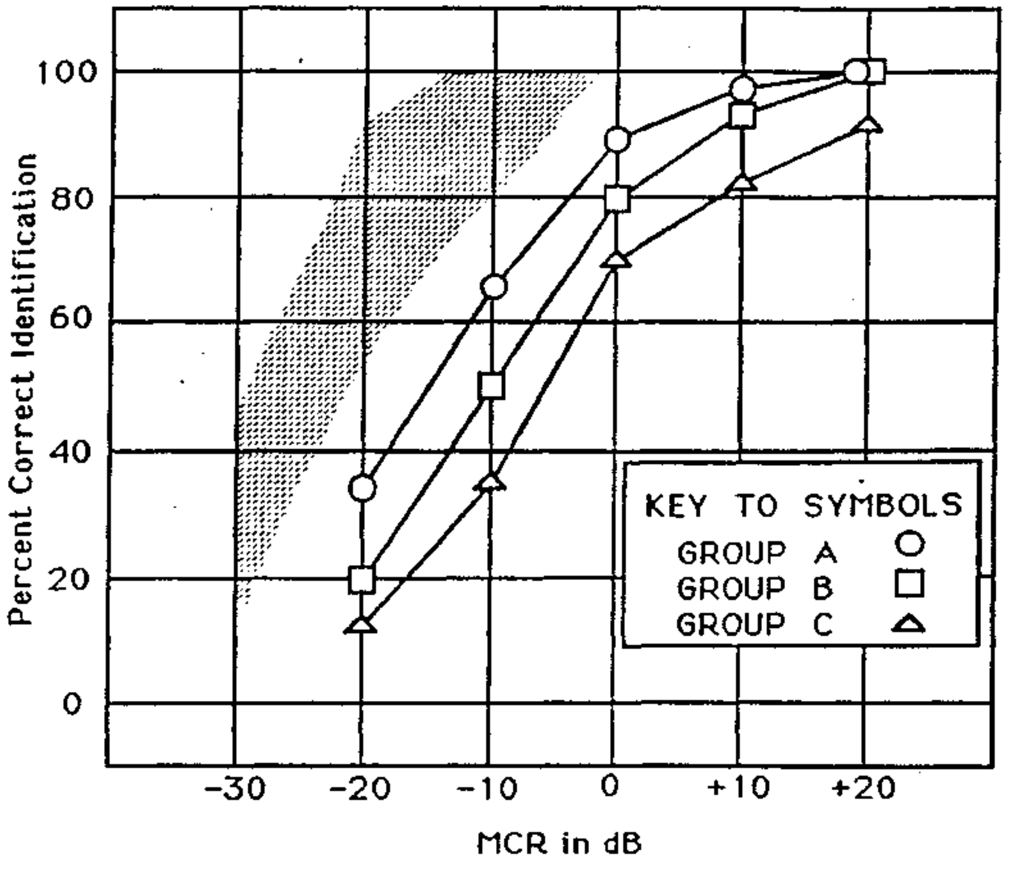


FIG 3:1: Aided performance in the sound field for three groups of elderly subjects: Group-A = Peripheral, Group-B = Intermediate, Group-C = Central, MCR = Message -To -Competition ratio (Hayes and Jerger, 1979).

The figure [3.1] shows results of aided performance for the there groups. The group with central disorder performed more poorly than the other groups of all MCRs. A systematic decline in performance also occured as the central component increased. The authors further divided the groups to match for age and degree of sensitivity loss in an attempt to rule out any possible contribution of these factors to the performance differences. Even with age and degree of hearing loss accounted for, the group with central auditory disorder performed move poorly. The authors concluded that central auditory processing disorder has a detrimental effect on performance with hearing aids in the clinical setting. Since the evaluation procedure used has been suggested to be a valid measure of hearing aid user satisfaction. (Jerger and Hayes, 1976; Gerber and Fisher, 1979; Hayes, Jerger, Taff and Barber, 1983), it is reasonable to assume that the deleterious effect of central disorder shown in the clinic would manifest itself as reduced benefit to the user in everyday life situations.

CENTRAL PRESBYCUSIS AND HEARING AID SATISFACTION AND BENEFIT:

Several studies have reported on the relationship between central presbycusis and hearing aid user satisfaction . Jerger and Hayes (1976) sent questionnaires to patients seen for hearing aid evaluations. The authors asked the patients to rate their hearing aid use as satisfactory, sometimes helpful, or unsatisfactory. Of 47 respondents who had purchased hearing aids, 72.3% rated the hearing aid as satisfactory, 14.9% as sometimes helpful, and 12.8% as unsatisfactory To determine whether the groups exhibited differences in central auditory ability, the authors studied aided sound-field performance on the SSI at three MCRs. Results showed little difference in performance between groups at an easy MCR. (+ 10dB) but a progressive separation of groups as the listening condition became more difficult. At a difficult listening condition (- 10dB), aided performance for the unsatisfactory group was substantially poorer than aided performance for the satisfactory group.

McCandless and Parkin (1979) classified 140 hearing aid users into site-of-lesion categories based on twelve audiologic measures. Criterion for successful hearing aid used was total daily wearing time. The authors considered a successful user to be anyone who wore the hearing aid for 8 hours a day or longer. A moderately successful user were the aid for 4 to 8 hours, whereas anyone who wore the aid fewer than 4 hours was placed in the category of poor fit. Individuals who did not wear the hearing aid at all were placed in the rejection category. Of all hearing aid users with central site of lesion, only 11% were classified as successful users, and 89% rejected hearing aid use. In contrast, 84% of users with middle ear site and 71% of users with cochlear site were considered successful. The authors cautioned that the groups with the higher rejection rates were comprised mostly of aging patients and that general decline with aging could not be ruled out as a causative factor.

In another study relating hearing and performance to hearing aid user satisfaction, Hayes et al., (1983) surveyed 78 hearing aid users who had been fitted based on hearing aid evaluation with the SSI procedure. Users were asked to judge their satisfaction based on a 4-point scale. Aided results in a difficult listening condition (-10 MCR) were 30% poorer for those in the unsatisfactory and sometime helpful categories than for those in the very helpful category. It appears that hearing aid users who have central processing difficulty are generally less satisfied with hearing aid use than those with more peripheral losses.

An attempt was made to study directly the influence of central disorder on hearing aid benefit (Krisco, Lesner, Sandridge and Yanke, 1985). The authors described results from four patients whose central auditory function was classified on the basis of PB-SSI discrepancy. They used the Hearing Aid performance Inventory (HAPI) (Walden, Demorest and Hepler, 1984) to define successful uses of amplification. One 66 year old man with a peripheral pattern was judged as a successful hearing aid user, and one 77 year old patient with a peripheral pattern was judge as unsuccessful. Similarly, one 67 year old patient with central pattern was considered as successful user, and one 72 year old patient with a central pattern was considered unsuccessful. On the basis of these four subjects, the authors concluded that there was no relationship between perceived hearing aid benefit and central auditory function.

In an expanded study of 24 adult male subjects (Krisco, Lesner, Sandridge and Yanke 1987), the authors reported that the HAPI score of the group with a central pattern was not significantly different than that of the group with a peripheral pattern. Interestingly, HAPI scores also could not be used to differentiate between groups that were formed on the basis of degree of peripheral hearing loss or an the basis of subject age. This apparent lack of sensitivity of the HAPI to these important factors may be reflected in the central versus peripheral comparison as well.,

One of the most challenging aspects of hearing aid research has been the validity of fitting techniques. The difficulty has always been the means of quantifying user satisfaction. The audiologist likes to define hearing aid benefit as the amplification arrangement that will best maximize use of residual hearing. Thus, the best aided performance in the clinical setting should provide the patient with the audiologist's definition of benefit, and consequently, the patient should be satisfied with hearing aid use. Yet patient's definition of benefit can be quite different, and their reasons for satisfaction or dissatisfaction can be unrelated to the actual quality of sound (Kapteyn, 1977; SUIT, Schuchman and Montogomery, 1978; Brooks, 1985; Franks and Beckmann, 1985). Indeed, Berger and Hagberg (1982) suggested that there is no well defined connection between help from the hearing aid and patient satisfaction.

The difficulty of defining patient satisfaction and relating it to hearing aid performance can be especially difficult in studies of central presbycusis. Aging patients appear to be less satisfied with hearing aid use in general (Berkowitz, 1975). How much of this dissatisfaction is related to sound quality is also not altogether clear. Patients who perform more poorly on auditory tasks because of reduced central processing ability or, conversely, patients who perform better, may or may not relate satisfaction to this performance. Thus, some patients who benefit' from amplification may not be 'satisfied' with amplification.

To evaluate, further the question of hearing aid benefit in patient with CAPD, Stach, Jerger and Smith (1986) carried out study using an interviewing technique in an attempt to circumvent some of the problems associated with patients definition of satisfaction. They tried to focus, not on whether the patient was satisfied with hearing aid use, but on the extent to which the patient benefitted from the use of amplification.

Two groups of patients with hearing loss were selected based on results of SSI obtained during routine, unaided speech audiometry and placed into either central or a peripheral group. Criterion for inclusion in the central group was a maximum SSI score of 60 percent or less that could not be explained on the basis of peripheral sensitivity loss. Inclusion in the peripheral group required a maximum SSI score of 70 percent or better with roll over of no more than 20 percent. Only those patients with obvious, bilateral central or peripheral patterns were included. Two groups of 15 patients each were then matched on the basis of age and degree of peripheral sensitivity loss. Benefit from hearing aid use was then determined by telephone interview by an audiologist who was blind to both the study design. Then the audiologist rated the patients use of hearing aid on a 5-point scale from very helpful (rating of 5) to no benefit (rating of 1).

Results revealed that although the patients in peripheral group were slightly older and had slightly more hearing loss, there were no statistically significant differences between groups when compared to the age and degree of hearing loss of the two groups. Mean SSI score for the central group was 32.5 percent and for the peripheral group, it was 83.3 percent. Also, aided performance of the two groups on the SSI procedure at an MCR of -10dB. The central group performed more poorly with hearing aid, as indicated a mean score of 67.5 percent as opposed to the peripheral group mean score of 81.7 percent. Length of hearing aid use was similar in the two groups.

Benefit ratings assigned to the central group were poorer than those assigned to the peripheral group. The mean rating for the central group was 3.0, and the mean rating for the peripheral group was 4.0. While the mean difference was small, the distribution of ratings for the two groups was strikingly different (Fig: 3.2).

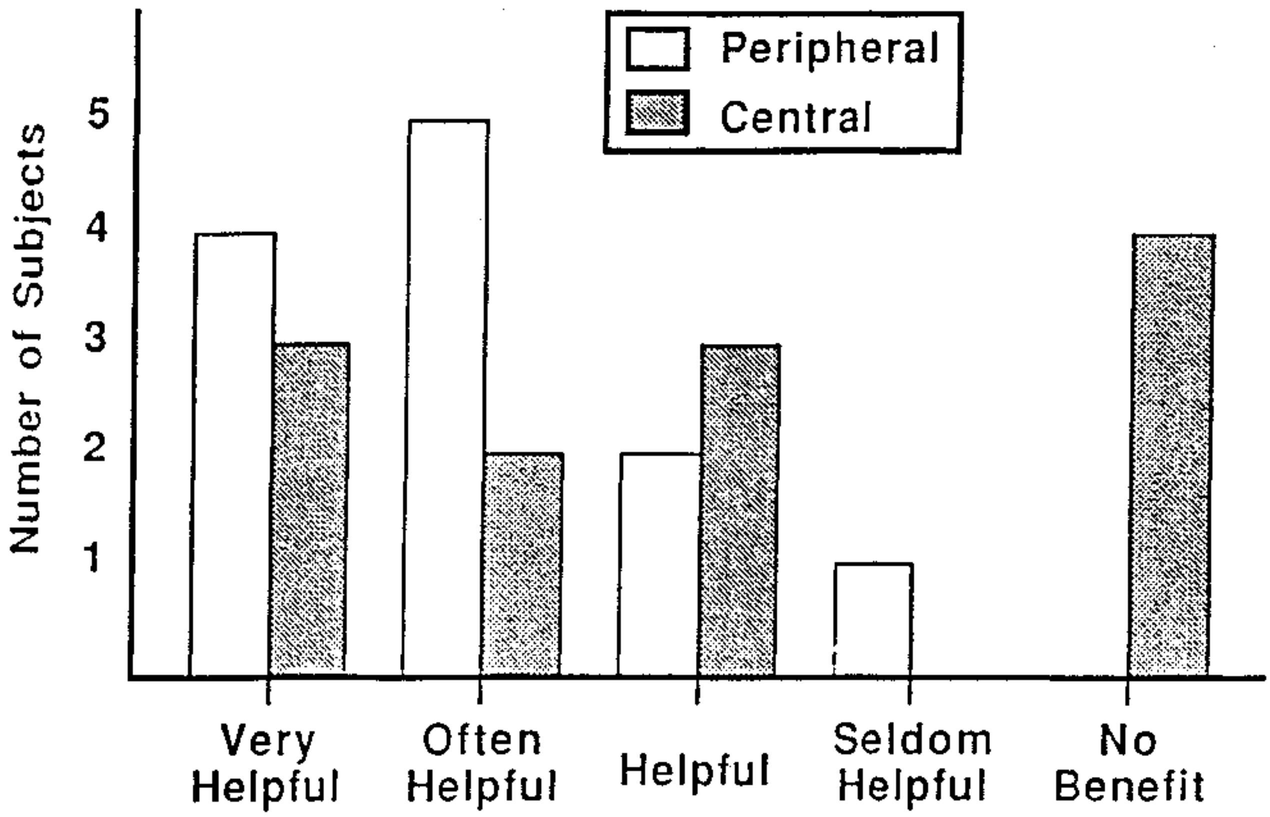


FIG 3:2: Distribution of reported benefit ratings of hearing aid use for peripheral and central groups.

In an attempt to identify factors contributing to the lack of benefit for certain patients in the central group, the patients with rating 5 were compared with patients with rating 1. The group that reported hearing aids to be very helpful had a flatter audiometric configuration, and the group that did not benefit from hearing aids had a more steeply sloping configuration. Also, the audiometric slope was not related to benefit rating in the peripheral group. Correlation between rating and slope of hearing loss (difference between pure tone thresholds at 500 and 4000Hz) was 0.61 for the central group but only 0.04 for the peripheral group.

Thus, in general, patients with central auditory disorder were not judged to be receiving as much benefit from hearing aid use as patients with peripheral hearing loss. This study may help to explain the findings of Kricos etal.,(1985).

Study done by Givens and Arnold (1998) investigated the relationship between central auditory processing skills and satisfaction with hearing aids in a hearing impaired geriatric sample of fifth eight adult wearers of hearing aid who were between the ages of 65 and 91 years. Analysis suggested the importance of adding central auditory tasks such as compressed speech or dichotic listening tasks to the evaluation of candidacy for hearing aids. This could lead to the better understanding of satisfaction with amplification by the geriatric population.

SUCCESSFUL AMPLIFICATION STRATEGIES IN CAPD:

Evidence of decreased hearing aid performance resulting from central auditory disorder is interesting and could certainly help guide the professional in terms of patient counselling about reasonable expectations and optimal listening conditions and strategies. Yet it would be disappointing at best if a more active approach to amplification could not be taken to help ameliorate the communication difficulty resulting from central processing disorder.

ELECTRO ACOUSTIC ALTERATION OF CONVENTIONAL HEARING AIDS:

If patients with CAPD are to have even a chance of successful hearing aid use, alterations that reduce background noise and enhance S/N are critical. The presence of background noise is probably more detrimental to patient with CAPD than to any other group of hearing aid users. It is even quite likely that hearing aid amplification of background noise makes hearing aid use counter productive for some of these patients. The same electro-acoustic modification strategies that are used to reduce noise for patients with peripheral hearing loss are even more critical for patients with central disorder. As adaptive signal processing technology advances, the likelihood of increased amplification benefit for people with CAPD will undoubtedly improve (Stach, 1995).

SOUND ATTENUATION DEVICES (EARMUFFS AND EARPLUGS):

Personal sound-attenuating devices such as earplugs and earmuffs have been employed as treatment for children with CAPD (Hasbrouck, 1980; willeford, 1980; Willeford and Billger, 1978). Such an approach can be rationalised by the common knowledge that shows that individuals with an impaired CANS tend to have significant difficulty processing auditory information in unfavorable acoustic environments. Thus, by occluding the weak ear and, therefore, improving the conditions under which auditory signals arrive, a reduction in stress is placed on the impaired system, which allows for better comprehension of the message. The figure-gound, or signal-to-noise ratio, is also enhanced, of course, by strategic seating in the classroom or any auditory environment that will place the child in closer proximity to the desired auditory signal-the speakers, and/or away from sources of auditory competition.

Children who were diagnosed as having CAPD are counselled in the selective-use of plugs and/or muffs, that is, to use them in situations where ambient noise interfered with important academic tasks, combine their use with favourable seating arrangements, and use them only when the situation necessitated an advantage. Bilateral occlusion was recommended during desk activities when concentration was important. Obviously, the use of bilateral occlusion devices is not indicated during periods of oral instruction by the teacher.

Hasbrouck (1981) recommended the following treatment procedures.

1. If unilateral ear occlusion improves performance in background noise (on the Goldman-Fristoe-Wood Cock (GFW) Noise subtest), have the patient wear a plug in the ear which produces the best results whenever they must attend to relevant auditory stimuli in noise environment.
2. When performance on the GFW noise subtest is superior while wearing bilateral occlusion, have the patient wear plugs in both ears when the backgound noise is distractable, but when fore-ground sound is not relevant to the listener.

On comparison whether they were more effective when worn in the weak ear or strong ear as determined by central auditory test performance, greater satisfaction has been reported when weak ear is occluded. (Willeford and Billger, 1978).

A possible explanation for improved figure-ground listening by blocking sound to the weak ear might be the reduction of neurological interference from the weak ear to the strong ear, even though Speaks(1975) has shown that such occurs with CVs but not with SSI sentences. One could argue that there is no apparent logic to plugging the strong ear since that would place greater dependence on the weak ear. In real life situations, the listener would logically utilize environmental positioning with combinations of body and head movements to achieve figure-ground advantages. It seems reasonable to believe that listeners with a unilateral weakness would eliminate or reduce the possibility of such contamination.

CAP tests used to establish the relative strengths of the two ears are helpful in making decisions regarding the implementation of unilateral occlusion.

Johnson et al., (1981) suggested that there are specific classroom strategies for learning disabled (LD) youngsters who perform poorly on the SSW test.

They also suggest that these children may benefit from ear plugs and earmuff intervention strategy to mask out background noise in noisy situations. Selective use of amplification, for example, CROS type, classroom auditory trainer etc., may be a strategy to allow a child to better use hearing for understanding in noisy settings by allowing the better understanding ear to receive additional phonemic information.

Keith (1982) commented on Johnson et al's., (1981) statement that 'these data suggest specific classroom intervention strategies for learning disabled youngsters who perform poorly on SSW test'. Keith says that

Johnson et al., (1981) go on to state that a child with a learning disability and poor SSW score will have difficulty hearing in noisy environment. In fact, Johnson et al (1981) suggested that their results indicate that the use of earplugs for 'masking out' background noise in a classroom or selective use of amplification may be strategies for classroom intervention. Since no testing of speech comprehension in noise was done, it is not possible to conclude anything about these abilities from the SSW or CES (competing environmental sounds) test results.

EXTERNAL AIDS:

External compensatory aids (Eg:prosthetic devices and cognitive orthotic devices) may be preferred over internal strategies by children younger than 11 years old (Kreutzer et al., 1975) because they offer a relatively powerful and immediate means to augment memory. External devices should not be used to the exclusion of internal aids and repetitive practice. Indeed, internal strategies and repetitive practice are preferable because they require an individual's active central and self-regulation and therefore more likely to be applied across setting and maintained over time (Borkowski et al., 1989: Guevremont 1990a).

Attention is basic to any memory enhancement strategy. Alerting a child in a classroom to follow along or listen carefully is an important first step in implementing an external aid to memory.

PROSTHETIC DEVICES:

Prosthetic devices are non-electronic or non- computerized electronic devices or systems (Fowler, Hart, Sheehan, 1972). These devices are usually inexpensive and relatively simple to learn to use. Examples of prosthetic devices include alarm clocks, watches and electronic diaries; pocket tape recorders; signs, icons, or cuing cards; checklists; notebooks and appointment calendars.

COGNITIVE ORTHOTIC DEVICES:

Cognitive orthotic devices employ computers and software to perform memory functions for the client. Examples of these devices include telephone answering machines, spelling and grammar checkers, and inventory of software and expert systems (Harrell et al., 1992).

ASSISTIVE LISTENING DEVICES (FM SYSTEM):

One of the most important manifestations of auditory processing disorders is a reduction in the ability to understand speech in the presence of background noise. Although the adverse effects of noise on speech understanding is greater in listeners with peripheral sensitivity loss than in normal hearing listeners, it is likely that these effects will be confounded by the additional deficit resulting from auditory processing disorder. Although modern conventional hearing aids offer minor frequency response alterations aimed at reducing background noise, here is no evidence to suggest that such acoustic alterations can overcome a problem as substantial as auditory processing disorder. Instead, to provide the listening conditions in the patient with auditory processing disorder can function successfully, the use of remote microphone technology may be the only viable solution.

For those patients who are less than successful users of conventional hearing aids, frequency modulation (FM) system use has been recommended (Stack, Loiselle, Jerger, Mintz and Taylor, 1987). Over a 2 year period, 170 patients were identified as potential FM system users. Of these, 73 (42.9%) used FM systems successfully. Of all the patients identified, 108 were adults, 35 of who were eventually successful FM system users. Of the 35 adult users, 18(51%) were over the age of 65 at the time of dispensing. Five of these patients had a primarily peripheral auditory disorder pattern and 13 had a mixed pattern of both sensitivity loss and auditory processing disorder.

Stach and Hudson (1991) showed that 221 elderly patients had tried a personal assistive listening device. Of these, 52 elected to purchase a device without any trial period. The remaining 169 patients used a device from loaner stock for atleast a 2 week period. After the trail period, devices were dispensed to 48(28%) of the patients. Of the 100 patients to whom a device was dispensed, 19 had a primarily peripheral auditory disorder pattern and 81 had a mixed pattern. Thus the use of an FM system had a positive impact on the patient's quality of life.

FM amplification fits into the management program for children with CAPD who are intolerant of poor signal to noise ratio at the user's ears. The face validity and construct validity of this approach are obvious and strong.

USE OF FM SYSTEMS IN CLASSROOM:

To use an FM system, the teacher attaches a mini- microphone, which receives the teacher's voice, to a clip worn on the collar. This is wired to a small transmitter that can be clipped to a belt or the top of a pair of pants. The student wears headphones, a loop, or other devices, which is wired to a receiver that is clipped to a belt, a harness, or the top of a pair of pants also. This technology allows the child to hear the teacher's voice with far less distraction, although other children's voices can still be heard. It helps the child stay better focused on what the teacher is saying, and the child doesn't tire as quickly from listening.

FITTING CONSIDERATIONS: (FOR CHILDREN):

There is no established fitting protocol for FM systems with CAPD children. The FM systems currently being manufactured for this group of children are mild-gain systems with safe maximum power outputs. The FM receivers are typically used with walkman-style headsets or earbuds that can provides flat wideband responses from 250 to 8,000Hz and beyond. Since CAPD children perform poorly with destorted (filtered) or low-redundancy speech signals, the fitting goal is to provide students with high-fidelity, broad-frequency response, low-distortion amplification.

Flat wideband frequency responses are easily obtained with modern FM equipment. The real ear insertion response (REIR) of an FM system can be measured quickly and easily to reveal the frequency response delivered to the child's ear. Accurate real ear insertion response measurements require that the FM transmitter microphone be positioned close to the reference microphone at the student's ear. Flat FM frequency responses should not amplify low frequency background noise to any significant extent owing to the very favourable signal-to-noise ratio at the FM transmitter microphone.

This is not to minimize the importance of the high- frequency response. In striving for a flat wideband response, there is a desire to preserve the frequency- intensity relationships in the speaker's voice. The wideband frequency responses of 'stereo-quality' headphones suit this purpose well. Walkman-style headphones or earbuds perform extremely well. They are light weight and comfortable for extended use periods.

The noise rejection properties of walkman-style headphones and earbuds, as measured by negative real ear insertion gain, are very slight. If greater noise rejection is required a larger headset or a circumaural muff may be required. Earbuds can be inserted into commercially available noise-protection muffs (circumaural muffs) for excellent noise rejection. These muffs will not be as comfortable or as cosmetically acceptable as the light weight headsets, but they remain a viable option for children with more severe speech-in-noise problems.

The stetoclip 'stethoscope type' headset (phonic ear, Inc., Mill Valley, Calif) has impressive noise rejection properties but it is designed to be used with a button style transducer typical of some FM systems and body-style hearing aids. The frequency responses of these output transducers (earphones) do not meet the wideband frequency response criterion.

The transducer coupled at ear level avoids the acoustic transmission of sound through the stetoclip tubing but doesnot improve the response enough to meet the wideband criterion.

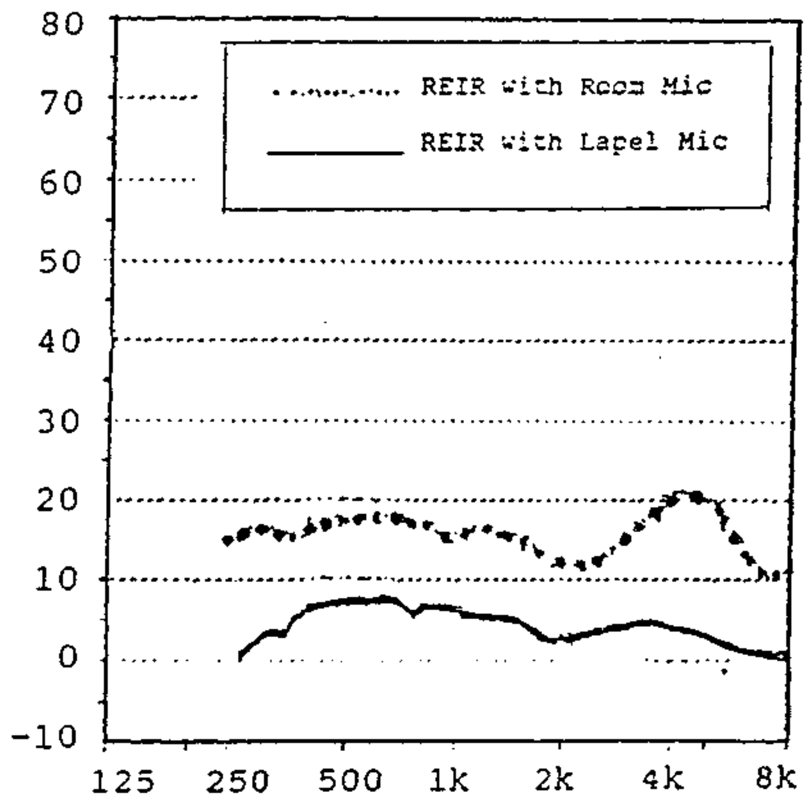


FIG:3:3: Real ear insertion response of phonic ear FM system utilizing directional lapel microphone placed in boom position (3 inches infront of speaker at side of speaker cone) and in lapel position (6 inches below and 1 inch back from front edge of speaker). Note: Reference microphone is at standard position with subject approximately lm from speaker.

The choice of microphone (eg; lapel, headworn boom) for the FM transmitter also affects the frequency response of the system. There are differences in the frequency response between a boom-style microphone and a lapel microphone.[FIG : 3.3]

The boom microphone's placement (approximately 2 inches infront of the side of the mouth) captures more of the speaker's high frequency vocal spectrum. The lapel microphone (placed approximately 6 to 8 inches below the speaker's mouth) loses some of the highs as well as receiving a weaker input signal overall (a less favourable signal-to- noise ratio is captured at the FM microphone). The lapel microphone is also somewhat susceptive to intensity variations because of changes in the teacher's head position. The disadvantages of the boom microphone are

1. Teachers may not like to wear them.
2. A loud-spoken teacher can drive a mild gain system into saturation, and
3. The boom microphone can visually obscure the teacher's mouth from some angles and impede speech reading.

RECOMMENDED FITTING PROTOCOL:

It is recommended that flat wideband FM systems with safe saturation sound pressure levels (not exceeding 105dB SPL) be fitted on a trial basis when the CAPD evaluation indicates the potential for FM benefit. If possible the response of the FM system should be clinically checked using real ear measurements to verify the appropriateness of the response.

The student, parents and teachers should be counselled as to the rationale for using the FM system, appropriate use of the equipments and the emotional impact of wearing an adaptive device. The trial fitting should be judged successful if the student shows willingness to continue wearing the equipment. It is helpful, but not necessary, that the teacher notices an improvement in listening ability and attendant behaviours.

BENEFITS OF FM AMPLIFICATION FOR CAPD CHILD:

*** IMPROVED SIGNAL TO NOISE RATIO:**

This is the most often cited and most important benefit of FM systems. The signal-to-noise ratio will be affected by the signal enhancement of the FM system and the nosie reduction at the child's ear due to the headset or earmold.

*** MORE UNIFORM INTENSITY LEVEL OF TEACHER'S VOICE:**

The proximity of the transmitting microphone to the teacher's mouth assures a more uniform intensity of the teacher's voice that is relatively immune to the teacher's physical orientation in the classroom (eg; where he/she is relative to the student) and the direction that the teacher is facing.

*** WIDEBAND FREQUENCY RESPONSE:**

The proximity of the transmitting microphone to the teacher's mouth also allows the high-frequency spectral information in the teacher's voice to be preserved in the transmitted signal. The bandwidth of FM receiver headset system allows frequency responses to extend to 8KHz and beyond.

PERSONAL FREQUENCY MODULATED (FM) ASSISTIVE LISTENING SYSTEMS:

Even when coupled with instructional modifications, rarely will acoustic modifications ensure an optimal classroom listening environment for the student with CAPD. Fortunately, the audibility of the teacher's voice can be increased with assistive listening systems. These technological advances, coupled with legislation mandating access to technology for reducing communicative and learning barriers in the classroom, have led to an increase in the availability and use of assistive listening systems in the classroom (ASHA, 1994).

The most commonly used amplification device for individuals with normal hearing is the frequency-modulated (FM) assistive listening system. These systems, once used exclusively by individuals with significant hearing impairment, are now recommended as a component of a remediation program for individuals with CAPD, fluctuating or minimal hearing loss, learning disabilities, phonological and language disorders and head injury (ASHA, 1996; Blake, Field, Foster, Platt and Wertz, 1991; Flexer, Millin and Brown, 1990).

By placing a remote microphone near the speaker's mouth and transmitting the signal via FM radio waves to receiver on or near the listener, the effects of noise, reverberation and distance are largely overcome (Lewis, 1995). Personal FM systems enhance the speech signal by approximately 15dB to 20dB at the listener's ear relative to the background noise (Hawkins, 1984). In essence, FM systems preserve the fidelity of the signal and reduce the effects of background noise and reverberation by enhancing the SNR. By improving the SNR, in noisy and reverberant environments, it is anticipated that attention to the speech signal will be increased and distractibility decreased (ASHA, 1991; Blake et al., 1991; Flexer, 1989; Ross, 1992). Indeed, improved spoken language understanding, academic achievement, and on-task behaviour have been reported consistently for a wide variety of clinical populations, including CAPD, when using FM systems (Flexer, 1989; Ray et al., 1984; Neuss et al., 1991).

FITTING PERSONAL FM SYSTEMS:

Candidates for FM technology must be evaluated by an audiologist to ensure optimal fitting (ASHA, 1994; ASHA, 1995). Individuals with CAPD are fitted with mild gain, low output units in either a traditional body-worn on, more recently, a behind-the-ear configuration. The body-worn FM system is coupled to the listener's ears using headsets, earbuds, or button receivers/earphone assemblies coupled to custom snap-ring, vented earmolds, the ear level FM system usually is coupled to the listener's ear using an open earmold. The open mold coupling is comfortable and allows the listner's to monitor environmental sound. In an effort to reduce interference caused by environmental noise, low gain, behind-the-ear FM systems do not employ an external microphone, which is commonly found in the traditional body worn systems. Although some body-worn FM systems allow independent adjustment of the gain of the external microphone relative to the FM transmitter microphone (Yuzon, 1994), concurrent activation of internal and external microphones (i.e., FM plus environmental microphone) may still cause a distorted signal due to temporal delay of the acoustical signal received at the external microphone relative to the electrical signal transmitted instantaneously through the internal microphone. Unfortunately, the absence of an external microphone may limit the user's ability to monitor the environment or interact with anyone (eg; other students) not speaking into the FM transmitter. Use of a conference microphone, which enables the listener to hear several different speakers, may minimize this limitation and be a particularly effective option for small group work (Lewis, 1995).

The behind-the-ear FM system's more restricted range of function relative to the traditional body-worn system (i.e., approximately 100 feet outdoors versus 300 feet) may limit its use in contexts where distances is a factor (eg; play grounds, outdoor recreation, large auditoria); however this restricted range also reduces the risk of interference among systems when more than one unit is transmitting on the same channel (Lewis, 1995). Because the behing-the-ear FM system may be more cosmetically appealing and less stigmatizing than the traditional body-worn system, it may be the preferred firing for children and teenagers struggling with peer pressure.

In fitting either system, the audiologist must carefully considered the type of microphone worn by the speaker (eg; Lavalier, Lapel, head worn boom). Although a boom microphone positioned infront of the lips may be optimal in noisy environments, this placement may obscure visual cues and impede speech reading. A lavalier microphone, worn around the neck or attached to clothing, may be more comfortable and less abstructive.

FM systems require careful handling, daily monitoring and regular maintainance. Audiologists must educate users, parents and teachers about the function and operation of the system.

SOUND FIELD FM SYSTEMS:

Sound field FM systems may provide an alternative in cases where a personal FM unit cannot be obtained. The sound field FM system provides a cost-effective means to improve the listening environment for all participants and has been well received in school settings. (Anderson, 1991; Berg, 1993; Crandell and Smaldino, 1995; Flexer, 1994). Basically a public address system, the sound field FM system requires placement of an FM wireless microphone by the speaker's (eg; teacher's) mouth. The signal is transmitted to an amplifier and then delivered to all listeners via several loudspeakers strategically placed throughout the room.

Benefits of this systems are particularly improved speech recognition and academic achievement, for students with normal hearing as well as students with hearing impairment (eg; unidentified or fluctuating hearing loss, unilateral hearing loss, minimal hearing loss, high frequency hearing loss) or other developmental disabilities (Berg, 1987; Flexer et al., 1990; Neuss et al., 1991). No active cooperation is required of students, who nonetheless benefit from the enhanced sound provided by the sound field FM system. Because, students need not wear a special receiver, the sound field system is seen as less stigmatizing than the traditional FM system (Lewis, 1994). Teachers also may feel more comfortable with the sound field system because there are no student receivers to monitor and troubleshoot (Lewis, 1994).

LIMITATIONS OF SOUND FIELD FM SYSTEMS IN COMPARISON TO PERSONAL FM SYSTEMS:

Sound field FM systems present some limitations, particularly in comparison to personal FM systems, as noted by Lewis (1995). Unlike the 15 to 20dB signal enhancement relative to the background noise experienced by the listener wearing a personal FM system (Hawkins, 1984), the sound field alternative provides only a 10 to 15dB boost (Crandell and Smaldino, 1995; Flexer, 1994). Morever, if a sufficient number of loudspeakers is not placed in appropriate locations in the room, signal enhancement may not be obtained uniformly throughout the classroom (Flexer, 1992; Leavitt, 1991). Infact, improper installation can result in increased reverberation and a poorer signal than that obtained in the absence of amplification (Flexer, 1992; Leavitt, 1991; Lewis, 1994). Careful attention to installation is crucial, given the physical differences in room size and shape, as well as variations in seating arrangements and teaching style (Lewis, 1994). Even if properly installed, the 10 to 15 dB amplification may not be sufficient in particularly noisy or reverberant classrooms (Crandell and Smaldino, 1995) or for students, with more than mild degrees of hearing loss (Blair et al., 1989). In addition, sound field systems are not portable and, therefore, do not support field trips or outdoor activities. Further, unless a sufficient number of systems are installed, older students who typically change classrooms during the day may find themselves in an unamplified classroom. A personal FM system may be a more appropriate fitting for these students.

INFRA-RED SYSTEMS:

Infra-red systems are an alternative to the sound field FM system for personal and area listening for individuals with CAPD.

Infra-red systems transmit acoustic signals via infra-red light. A modulator processes the acoustic signal for transmission. This processing includes amplitude limiting and expansion, pre-emphasis of high frequencies and modulating the acoustic signal onto a radio frequency subcarrier (Lieske, 1994). An infra-red emitter transmits the radio frequency signal via infra-red light. An infra-red receiver demodulates the radio frequency signal back to an acoustic signal. The receiver is coupled to the listener's ear using headphones or earbuds. (The receiver output can be coupled to a hearing aid through electro-magnetic induction using neckloops or silhouettes, or through direct audio input).

COMPARISON OF INFRARED AND FM SYSTEMS:

Both infrared and FM systems provide excellent sound quality. The major advantages of infrared systems are that they are impervious to radio interference or other electromagnietic distrubances, the same receiver can be used with any infrared transmitter, and any number of infrared systems can be used in contiguous rooms without interference from one another (Ross, 1994). Large-area infra-red systems, however, generally are more expensive per square foot of coverage, and they are more difficult to install than FM systems. They are not as portable as FM systems and cannot be used outdoors (Lieske, 1994). Because line of slight between transmitter and receiver is crucial, persons or other obstructions can impede infrared transmission; however, line-of-sight transmission can be used to secure privacy of communication.

GUIDELINES FOR RECOMMENDING AN FM ASSISTIVE LISTENING DEVICE (ALD):

*AGE:

Most children who comply with ALD-use are younger than 13 years or older than 18 years. Children in the middle school and high school grades are generally less likely to readily use an ALD, probably because they are conscious of the reaction of their peers.

* TEST FINDINGS:

An ALD is most appropriate for management of persons meeting clear and well defined criteria for CAPD. These criteria include depressed performance in comparison to age- corrected normative data (eg; outside of the normal region as defined by the 10th percentile or 2.5 standard deviations below average performance) for one or both ears on atleast two different CAPD test procedures. The strongest recommendation is made when performance is abnormaly depressed for a procedure involving a signal-to-noise, figure-ground or speech-in-competition task. (eg; the SSI-ICM).

*** EDUCATION SETTING:**

The need for an ALD is greater for children who are typically in classrooms with many other students (20 or more) rather than children who are taught with only a few other students (eg; home schooled children or those in self-contained special classes). The noisier the typical classroom setting, the more an ALD is likely to help the child.

*** OTHER EDUCATIONAL, COMMUNICATIVE AND MEDICAL NEEDS:**

As a rule, a recommendation for classroom use of an ALD is one component of a comprehensive and multi-disciplinary management strategy. In some cases, it is advisable to delay initiation of ALD use until other evaluations (eg; speech- language, psycho-educational, neurologic, otologic) are completed and the results known or other management recommendations are implemented. There is a tendency by some educational personnel to rely on the ALD to solve all of the child's academic and communicative problems. The ALD is, however, really a tool which should enhance the effectiveness of other management strategies.

*** FEATURES OF THE ALD:**

Usually, a no-gain personal ALD is indicated. Many children prefer to use an earbud type earphone rather than the head-set style because it is less conspicuous. If more than one child requires an ALD in a classroom, a classroom FM system should be considered. A variety of personal and classroom FM ALD systems are commercially available. A directional microphone typically is coupled to the transmitter.

TRAIL PERIOD VERSUS EXTENDED USE:

Sometimes school personnel may recommend a relatively brief (eg; 4 to 6 weeks) trail period of ALD use. The assumption is that clear signs of benefit will be evident within this period if the ALD is educationally indicated. If these signs are not observed, ALD use is discontinued. This strategy is used quiet freely, even with children who appear to have some characteristics of children with CAPD, but who have not undergone diagnostic assessment.

According to Hall and Mueller in 1997, the trial period approach to ALD use is, with many chidren, counter-productive. Because ALD's are used by children without an adequate diagnostic assessment, those who do not have CAPD undergo the trial period. Naturally, this population does not benefit from ALD use. The child, and most everyone involved with the child, may become frusrated and confused. School personnel may form the opinion that ALD's are of little value. The cost-to-benefit ratio of ALD use is very high. Limited school system resources (time and money) are not well spent. The child, parents and classroom teacher are apt to approach ALD use half-heartedly. Without full commitment. Even the child with definite CAPD may not obtain maximum benefit from ALD use in such a short trial period. As with hearing aids, there is an adjustment period with ALD use which may extend well beyond the trial period. Relatively long-term academic and communicative benefits, and personal benefits (eg; improved self-esteem) by definition do not occur within a span of just a few weeks.

A more effective approach is to limit recommendations for ALD-use to children with clear and consistent audiologic evidence of ALD. The child, parents, teachers, approach ALD use with total commitment and a positive attitude. ALD-use is introduced with care and the understanding that benefits will occur over time. The likelihood of benefit from ALD-use is much higher with careful selection of the appropriate users. ALDs are viewed as a necessary and potentially very beneficial treatment strategy for CAPD, rather than a hit-or- miss effort that is tried without much hope that it will produce any benefit.

CLASSROOM ACOUSTICS AND IMPROVING CLASSROOM ACOUSTICS

INTRODUCTION:

Spoken language comprehension is essential to successful communication and learning. The acoustic and linguistic redundancy of spoken language (Denes and Pinson, 1993 and Liberman et al., 1967) is of tremendous benefit to listeners with deficient central auditory function, however benefiting maximally from this highly redundant signal requires a high-fidelity listening environment.

I. CLASSROOM ACOUSTICS:

The intelligibility of speech is affected by a number of acoustic characteristics, including the intensity of background sound competitive relative to the signal and reverberation. (i.e., the persistence of sound within an enclosed space due to multiple reflections off hard walls and surfaces), as well as the distance between speaker and listener. Not unlike other physical spaces, the acoustic chracteristics of the classroom can substantially affect a student's ability to understand spoken language and learn (ASHA, 1995; Flexer, 1994).

Noisy, often crowded classrooms present a less than optimal acoustic environment for listening and learning (ASHA, 1995; Flexer, 1994; Berg and Tillman, 1978). The multiplicative distortions involving background noise and reverberation create a degraded and demanding listening situation: reflected noise increases overall noise level and creates a more uniform noise, both spectrally and temporally (ASHA, 1995; Harris, 1960). In addition, the student's distance from the speaker and poor acoustic design of many classrooms also reduce the quality of acoustic signal. Moreover, loss of high speech frequencies because the teacher is speaking while facing the blackboard (Bornstein and Musiek, 1992), as well as at a fast speaking rate (Mc Crosky and Thompson, 1973), further contribute to listening difficulties.

For the student with either peripheral or central auditory deficits, however the degradations to the message caused by poor room acoustics result in an arduous challenge (Finitzo -Hieber and Tillman, 1978; Bornstein and Musiek, 1992).

NOISE:

Background noise impedes spoken language recognition by masking acoustic features of the signal and thereby reducing the redundant cues available to the listener (Miller and Nicely, 1955; Cooper and Cutts, 1971). Ambient room noise of approximately 60dBA has been reported in traditional classrooms (when occupied) of average size, location and acoustics, and levels as high as 75dBA have been reported in open classrooms (Watson, 1964; Ross and Giolas, 1971; Finitzo -Hieber, 1988). More important than the absolute noise level is the signal-to-noise (SNR). Classroom SNRs range from + 5 db to -7dB; the speech signal is only 5dB greater than the background noise (Berg, 1993;Markides, 1986; Sanders, 1965).

Numerous investigators have demonstrated greater decrements in speech recognition in noise performance among listeners with peripheral hearing impairment, non-English and limited-English proficient listeners, children, older adults, and individuals with CAPD and learning disabilities relative to normal hearing adults (Bergman, 1980; Chermak, vonhof and Bendel, 1989; Crandell, 1991; Finitzo-Hieber and Tillman, 1978). Skinner

(1978) argued that even children with normal hearing require about a + 30dB SNR to maximally use spoken language information. Evermore conservating estimates requiring an SNR of + 6 to 12dB for normal hearing children (Crandell, 1991; Finitzo-Hieber and Tillman, 1978) demonstrate the potential for noise levels commonly reported in classrooms to adversely impact spoken language understanding in children with CAPD.

Elliott (1982) compared speech perception of learning- disabled (LD) young adults and normal young adults. The performance of LD listeners was close to normal when an easy speech test was delivered in quiet or at high S/Ns. However, their performance deteriorated relative to normal listeners when the S/N was lowered to 0 dB. On a more difficult test, some LD persons performed normally at an S/N of +10dB but performed very poorly at lower S/Ns. Other LD listeners experienced difficulty even at S/N of + 10dB.

REVERBERATION:

When the sound source cease to produce sound, the energy in the room does not disappear instantaneously. The energy gradually decreases whenever sound strikes surfaces and, in addition, is absorbed by the air. Eventually the sound can no longer be detected. This process of sound energy decay in a room is called reverberation. (Nabelek and Nabelek, 1994).

In a closed space, reverberation is always present. It can be long or short depending on the rate of sound energy decay. The measure of the rate of decay, or of the reverberation, is called 'reverberation time' (T); this is the time that is required for the SPL to decrease 60dB after the sound from the source stops. (ANSI - S 1.1 1960, R 1976). The reverberation time for a sequence of the reflections are shown in the figure (4.1).

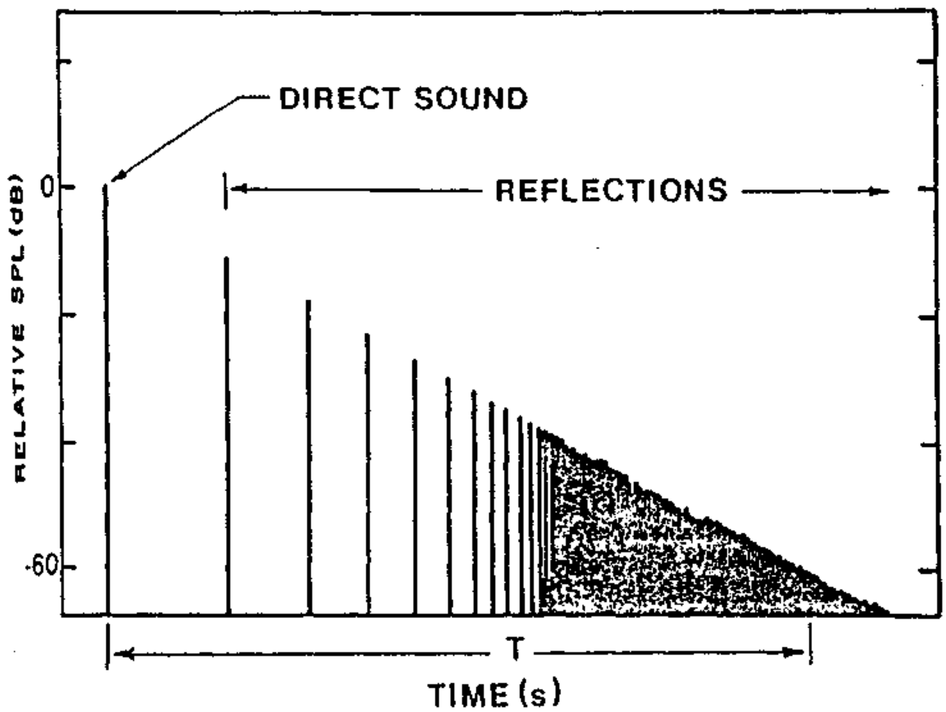


FIG 4:1: An example of a time sequence of reflections following a brief direct sound. Reverberation time (T) is shown for the 60dB SPL decrease.

Generally, spoken language recognition ability decreases as reverberation time (i.e., the time required for an acoustic signal to decay 60dB from its initial level) increases (Finitzo-Hieber and Tillman, 1978 and Nabelek and Nabelek, 1994). Reverberation time in typical classrooms, reported to range between 0.4 second to 1.2 seconds (Crandell and Smaldino, 1994). Although a 0.4 second reverberation time may not substantially degrade the speech recognition performance of children with normal hearing in relative quiet environments, longer reverberation times cause significant degradation for many listeners (Finitzo-Hieber and Tillman, 1978). These reverberation times pose greater challenges for individuals with peripheral or central auditory impairment, learning disabilities and older adults who experience greater difficulties understanding spoken language in reverberant environments than individuals with normal auditory function (Bergman, 1980; Crandell, 1991: Finitzo-Hieber and Tillman, 1978; Nabelek and Nabelek, 1994).

DISTANCE:

Distance between the listener and sound source in addition to noise and reverberation influences spoken language recognition. Because the intensity of the signal at the listener's ear decreases as a function of distance from the source, spoken language recognition generally decreases as distance between listener and source increases (Crandell and Smaldino, 1995). For eg: Crandell (1993) reported a 24% reduction in children's mean speech recognition in a typical classroom as the speaker-listener distance doubled from 6 to 12 feet. Crandell and Bess (1986) suggested that even children with normal hearing sensitivity experience greater difficulty understanding spoken language when seated in the middle to the rear of a typical classroom. In contrast to the spoken language signal level, which decreases with increased distance, noise is often distributed homogeneously throughout a room (Nabelek and Nabelek, 1994); therefore, the SNR as well as the absolute level of the signal, decreases as distance from the source increases. Hence, preferential seating for students with CAPD, which allows them more direct access to a louder and less reverberant signal, as well as to visual cues is appropriate and necessary.

MULTIPLE DISTORTIONS:

The interaction on noise and reverberation causes greater decrements in speech recognition than the sum of both distortions operating independently (Finitzo-Hieber and Tillman, 1978). As with noise and reverberation in isolation, individuals with CAPD, hearing impairment, or other special listeners, experience greater difficulty understanding spoken language in noisy and reverberant conditions than adult subjects with normal hearing (Finitzo- Hieber and Tillman, 1978; Nabelek and Nabelek, 1994). Even a favourable SNR of+12dB paired with a short reverberation time of 0.4 seconds leads to reduced speech recognition performance for normal hearing children (Crandell and Smaldino, 1995).

II. IMPROVING CLASSROOM ACOUSTICS:

Noise and reverberation degrade the acoustic signal and adversely affect spoken language comprehension. The effects are exacerbated for listeners with CAPD in whom auditory system deficits compound the difficulties presented by a degraded signal with decreased redundancy. Modification of the physical characteristics of the classroom can improve the listening environment for all students, especially those with CAPD.

CLASSROOM DESIGN:

Designing a classroom conducive to listening requires attention to background noise levels, reverberation, distance between listener and source, and access to visual cues. Classroom SNRs should exceed +15dB, reverberation levels should not exceed 0.4 secs (ASHA, 1995; Finitzo-Hieber and Tillman, 1978; Newman and Hochberg, 1983). Students with CAPD (as well as those with peripheral hearing loss) may require even more favourable SNRs and shorter reverberation times to maximize their access to acoustic information (Crandell and Smaldino, 1995). Control of both airborne (eg: produced by source directly radiating to the air, such as traffic, music, classroom activity) and structure borne noise (eg: noise transmitted through floors and walls of buildings) is necessary to meet their design criteria. Noise originating in the classroom, external to the classroom but within the school building and external to the school must be controlled.

The most effective means of reducing noise levels and limiting reverberation is through proper planning and architectural design

1. Schools should be built in quieter sections of communities.
2. Classrooms within these schools should be located away from noise source, such as the cafeteria, gymnasium, auditorium, and playground.
3. Double-walled construction, double-doors, double-paned windows, properly sealed doors and windows attenuate npise transmitted into the school building and into the classroom.

4. Installation of quiet heating and cooling systems, ventilation systems and other equipment can lessen unwanted structural and airborne noise.
5. Rooms and buildings can be acoustically modified by installing carpeting, curtains and acoustical panelling on the walls and ceilings to reduce noise levels.
6. Inexpensive modifications that reduce noise levels include placing rubber tips on chair legs and desks, placing sound absorbing rubber or felt insulation around windows and doors, using bookshelves as room dividers to produce quieter spaces for one-on-one communication and instruction and using corkboard as bulletin boards.
7. Acoustic modifications that cover hard, reflective surfaces with absorptive material (eg: celing tiles, carpeted floors, cushioned chairs, curtains, cork bulletin boards or bookshelves on walls, positioning mobile bulletin boards at an angle (i.e., not parallel) relative to the wall). also reduce reverberation.8. Some of these modifications, eg: curtains, carpets etc., also reduce glare which can impede access to visual cues, which provide supplementary information to maximize spoken language comprehension and learning for the youngsters with CAPD.
9. Creative landscaping, including strategic placement of shrubs, tree and earthern berms or banks may reduce noise transmission into the classroom by absorbing and diffracting sound (Crandell and Smaldino, 1994).

According to Barr (1976), classrooms should be designed to reduce the ambient noise level to allow for effective communication. The characteristics of a room that affect speech intelligibility are;

a. The loudness level of the speech signal.
b. The reverberation time of the room

c. The noise present and

d. The shape of the room. (Barr 1976).

Loudness can be controlled by the shape and size of the room and by how the room has been acoustically treated. When a classroom has acoustically hard-walls, floor, and ceiling, the room is reverberant or live. The noise is reflected back and forth, and the students are immersed in the noise with the feeling that it comes from everywhere. If, however, the classroom is treated with absorbing materials, the noise reflected is reduced and the sound is coming directly from its source, for eg: from the students themselves or from the air conditioners. When noise can be localized and reduced, it is less annoying.

The noise-absorbing materials used are acoustical tiles, carpets, padded seats and drapes.

The rectangular-shaped rooms with flat or convex surfaces generally provide the best acoustical qualities. Too much acoustical absorption, however, can actually be a detriment to effective communication, with the room sounding dead (Van Riper and Irwin, 1958; and Kingsbury and Taylor, 1968).

Van Riper and Irwin (1958) explained percentage articulation. This term refers to the percentage of syllables that will be heard correctly by the average listener. Percentage articulation can be measured by placing an individual or group with normal hearing in a room and presenting them a large number of nonsense syllables, such as ba,ka,fa, etc., Each syllable is produced separately and the listeners write down or otherwise indicate the syllables they think they hear. Even if a normal speaker is situated only three or four feet from a normal listener, and if mat speaker speaks at an ideal loudness level (usually 60 to 70 dB above threshold) and if all extraneous effects of noise and room size and shape are eliminated, the average listener will hear only some 96 percent of the isolated sounds produced. Thus, a score of 96 becomes an ideal score to be pursued in the percentage articulation (PA) test for a large room.

Actually, a PA of 96 will be obtained in very few group listening situations. As per as auditoriums are concerned, a PA of 85 percent is for excellent listening, 75 percent for satisfactory and 65 percent for minimal and anything below 65 percent useless.

These must be remembered for isolated nonsense syllables. Contextual speech would be heard with much greater accuracy. For eg: if 70 percent of isolated syllables can be understood, perhaps, upto 100 percent of contextual speech could be clear.

TECHNIQUE OF COMPUTING PA IN AN ACTUAL ROOM:

The technique of computing PA in an actual room is as follows:

PA = 96KlKrKnKs

Kl - Factor of reduction of loudness.

Kr - The factor or reduction for reverberation

Kn - The factor of reduction for noise and

Ks - The factor or reduction for the shape of the room.

Thus, for each of these factors, a 'K' unity of 'l' represents a perfect score.

It is evident at a bad room feature for any of the above factors can destroy the listening usefulness of the room.

REVERBERATION TIME:

The relation to preferences in reverberation time, Van Riper and Irwin (1958) report that the shorter the reverberation time, the greater the speech intelligibility. They point out that listeners do not always prefer the shortest reverberation time. In general, as the room gets larger in volume, listeners tend to prefer a longer reverberation time. Other things being equal, however, the shorter the period, the better the articulation. The preference for longer reverberation times is stronger for music than for speech among listeners.

FACTOR DETERMINING REVERBERATION TIME:

An important factor that determines reverberation time is the amount of energy that is reflected back. If, for instance, one is standing in the middle of an open field and speaks, almost none of the sound will be bounced back. The reverberation time will approach zero. If one talks in a room with the window open, two things will happen to the speech. a) Part of it will bounce back from the walls and b) Part will travel out of the open windows.

Thus, an open window can be regarded as a perfect absorbent - it gives back no sound. Obviously, other materials are not as absorbent as an open window.

The coefficient of a absorption of certain materials is the ratio of the absorption produced by it to the absorption of an equal area of open window.

Thus, acoustic engineers have computed, usually for a frequency of 512 Hz, the coefficient of absorption of various materials.

VISUAL CUES:

Maximizing access to visual information necessitates attention to listening, as well as distance and angle between speaker and listener.

1. The classroom environment should be well lighted and free of glare from reflective surfaces such as glass-tabletops and waxed floors (Harley and Lawrence, 1977).
2. Materials written using large print, double-spaced and on contrasting backgrounds are more visible.
3. A number of methods employed to reduce noise and reverberation also benefit lighting. For eg: carpeting, and curtains reduce glare, as well as noise levels and reflection.
4. Seating in the classroom offers another means to reduce noise levels, improve SNR and the ratio of direct-to- reverberant sound energy and maximize the listening environment for a student with CAPD.

Offering preferential seating to students with special listening needs within the direct sound field of the teacher and away from noise sources, such as ventilation fans, heating ducts and air conditioners improves the SNR and minimize interference from reflected energy, thereby positioning these students to access important visual information. a) Should be seated near the teacher or other sound source with full, face-to-face view. b) Reducing the distance between speaker and listener provides a louder, less reverberation signal, as well as the opportunity to take advantage of visual instructional aids and visible cues accompanying spoken language (eg: speech reading).

As many students do not maintain regular eye constant, teachers may need to modify this behaviour to enable them to fully utilize visual cues.

CONSIDERATIONS FOR CHILDREN WITH CAPD

INTRODUCTION:

For a very young child, we cannot wait until the disorder can be confirmed before beginning intervention even when the young children are clearly exhibiting many of the behavioural signs and symptoms of CAPD.

Communication, academic achievement, and social function are affected in a child with CAPD who have not been identified and diagnosed earlier. Hence, early identification and diagnosis of CAPD is especially important for this age group, i.e., pre-schoolers (Musiek and Chermak, 1995; Keith, 1981; Willeford, 1985).

Comprehensive central auditory assessment cannot be undertaken in preschool-age children, the fact remains that early and aggressive intervention is imperative as soon as the presence of CAPD is suspected.

Also a firm diagnosis of CAPD may be impossible to obtain with this age group because the paediatric speech intelligibility (PSI) test (Jerger and Jerger, 1984) criterion measures of CAPD with sufficiently documented reliability and validity are not yet available for this age group (Musiek and Chermak, 1994). Efficiency data, even for screening measures of CAPD, are sparse for this population (Stach, 1992). Hence, it is probably prudent to involve preschool children suspected of, or at-risk for CAPD (eg., children with histories of recurrent and persistent otitis media with effusion) in programs designed to promote development of auditory perceptual skills (Chermak and Musiek, 1997). Although valid and reliable test procedures to diagnose CAPD in the preschool age child are not available at the current time, early intervention can and should be undertaken with children suspected of CAPD. As with other auditory disorders, early intervention may help to dilute or avoid entirely later difficulties that will inevitably appear when a child exhibits CAPD.

Programs for these children should build on the philosophy of whole language, which emphasizes the principles of natural language learning (Norris and Damico, 1990). The development of auditory perceptual and auditory - language skills may be facilitated through a highly responsive language environment involving planned activities that are interesting to the child and provide natural opportunities for listening and communication.

Repetition of daily routines creates a sense of familiarity, allowing the child to focus attention on new auditory information. Collaboration between speech and hearing professionals, preschool teachers and families maximizes the transfer to skills to daily routines and other settings (Chermak, 1993).

Children should benefit from experiences early in life that encourage careful listening since listening is fundamental to learning at all levels. To be successful in early intervention/prevention, creating an optimal listening environment is crucial. Strategies used to enhance the acoustic signal and the listening environment for individuals with hearing impairment are also appropriate for children suspected of, or at risk for, CAPD. Presenting visual information (example, pictures, facial expression, gestures and other nonverbal cues) to support and reinforce auditory information also will enhance the saliency of the acoustic signal.

To enhance the acoustic signal strategies such as reducing the distance between child and speaker (example, preferential seating, one-on-one or small group activities), gaining the child's attention before speaking to her/him; speaking slowly, clearly, at a comfortably loud level, and with natural intonation, using appropriate vocabulary; repeating key words and rephrasing important information; allowing adequate time for processing and responding;

and using frequent comprehension checks to ascertain that information was understood (Roberts and Medley, 1995). In addition, personal or sound field FM amplification may provide useful in group situations in providing a clearer, louder signal over unwanted background noise (Flexer, 1994).

To enhance the listening environment strategies such as reduction of noise background through decreasing or eliminating noise (example, turning off televisions, radios, dishwashers), architectural modifications like carpet, drapes, upholstered furniture and acoustic ceiling tiles etc.

Musiek and Chermak (1995) suggested that children suspected of CAPD be involved in a program that focuses on auditory skills development which are as follows.

PHONEME TRAINING:

The Phoneme Training activities can be adapted for use with the very young child in much the same manner in which auditory training activities are carried out with the preschooler with hearing impairment. Instead of associating the sound with the printed letter symbol, pictures may be used to illustrate the minimal contrast pairs (eg; a picture of a tiger for/t/ and a dog for /d/). The remainder of the activity may be carried out as with older children, although the speech-to-print activities probably would not be necessary with preschoolers.

FOLLOWING DIRECTIONS:

Authentic contexts can be provided to the child in which the child must follow sequenced directives to successfully complete the task. Games can also be organized which require the child to follow directions presented auditorily (Musiek and Chermak, 1995). The directive should require some motor activity. The child can be asked to repeat the directive before acting to enhance reauditorization and transference to a motor activity.

Games requiring children to repeat. What they have heard to other people (eg; telephone) and barrier games in which the child must follow directions presented auditorily to create something (eg; building and drawing) also are effective activities to promote listening.

Directives may range from simple to complex, involving one or multiple sequenced actions. Oral directives may be made more complex by inserting adjective sequences, prepositions, a number of facts or using more sophisticated linguistic concepts such as 'After I point to my nose, you point to yours'.

The barrier game offers a particularly challenging opportunity to focus on listening as the child attempts to replicate a configuration of objects on the other side of the barrier without the benefit to visual cues by asking questions and listening to the responses.

Group actions requiring cooperation among the children may be used. Reciprocal teaching can be used i.e., children can be given the chance to act as clinicians by generating directives for others to follow, thereby building confidence and self-esteem.

SELECTIVE LISTENING:

Reading aloud to children serves several purposes, including concept learning, vocabulary building and practice in selective listening (Musiek and Chermak, 1995) . To encourage selective listening, target words, for which the child should listen, should be designated before beginning the story. For example, children might be instructed to raise their hands each time a word is read that represents an animal. Focusing on target words may also encourage the child to listen for subtle prosodic cues (example, Intonation, stress). To ensure that the child listens to the story and not only the individual words, comprehension questions should be posed at the end of the story to promote listening for meaning. A story grammar might be used to formulate questions (example, action, setting, consequences) posing questions that require tracking of both the story context and the designated target words promote auditory closure and comprehension.

Multisensory integration can be fostered by allowing the child to examine the accompanying pictures and words as the story is read aloud. Joint book reading, wherein the caregiver and child elaborate on the pictures in a book or sections of the text that are of particular interest to the child seems to foster vocabulary development and reading skills (Ninio. 1980; Teale, 1984 and Wells, 1985).

DISCRIMINATING SOUNDS:

Discriminating sounds is a challenging task for most preschool children. Environmental sounds differing in intensity, frequency, duration, and quality can be used to develop auditory discrimination. For example, a child might be asked to state which of three bells of different pitches has the highest, middle and lowest pitch. Identifying different but familiar voices is also an excellent exercise .

To increase the difficulty of the task, the speakers can alter their voices, speak quickly, say short words or consonant vowel combinations, or use a combination of these three modifications (Musiek and Chermak, 1995).

PLANNING:

Children have begun to develop metacognitive knowledge and executive strategies by the age of 5 years (Krietler and Kreitler, 1987). Given the importance of the strategies to listening comprehension, activities to reinforce and nurture these strategies are advisable. Short scenarios and follow up questions that require planning knowledge can provide material for such activities (Krietler and Kreitler, 1987).

Additional remediation activities may be conducted in the preschool classroom as a fun, group activity. Interhemsipheric exercises such as 'grab bag' activities offer an interesting diversion for any preschool child. Activities that require the child to guess the emotion based on intonational characteristics may foster awareness of prosodic features of speech, and elementary verbal scavenger hunts and variations of 'Simon says' assist in the development of skills necessary for following verbal directions. Even temporal patterning activities can be developed that build on the young child's inherent love of imitation and body movement.

The child who is suspected of CAPD should be watched carefully in the classroom inorder to identify areas of functional difficulty. As many preschool classrooms are experiential in nature, involving multimodality stimulation every step of the way, the child should be monitored carefully for signs of confusion when more than one modality is introduced, a possible sign of integration deficit. The teacher or clinician may discover that the child in question does much better when information is presented via one mode at a time, thus providing useful insight into the possible underlying, deficit as well as into the child's primary learning mode.

CONSIDERATIONS FOR ADULTS AND OLDER ADULTS WITH CAPD

The adult and older adult with CAPD present a different clinical profile than that of a younger person with CAPD. A neuromorphological disorder is suspected in the majority of youngsters with CAPD, particularly when associated with learning disabilities; in contrast, the CAPDs of adults are likely the result of fairly circumscribed and identifiable lesions of the central auditory nervous system (Musiek and Gollegly, 1988; Musiek et al, 1990). . The CAPDs of older adults, have a neurologic basis, resulting form accumulated damage or deterioration to the central auditory nervous system due to aging, neural insult, and/or neurodegenerative disease (Baran and Musiek, 1991). Adults and older adults are experiencing loss or disruption of processing function that are previously intact, which children with CAPD may never have developed efficient processing skills.

Interventions for adults and older adults will usually focus on compensation rather than recovery of function due to the reduced plasticity inherent to their mature central nervous system (ASHA, 1996). Remedial approaches may still be appropriate with adults and older adults who have suffered acute brain insults where opportunity for spontaneous recovery and/or stimulation-induced recovery of function presents itself (ASHA, 1996).

An older adult suffering from aphasia is less likely to benefit as much from CAPD treatment as would an otherwise normal older adult with presbycusis who is experiencing CAPD as a result of the aging central auditory nervous system (ASHA, 1996). The group and individual differences resulting from variation in intellectual, cognitive, linguistic, and psychosocial state will influence treatment outcome.

Older adults experience difficulty understanding speech in competing noise backgrounds (CHABA Working Group on Speech Understanding and Aging, 1988). Although peripheral reductions in sensitivity, particularly at high frequencies, account for some of these difficulties, other factors including central auditory nervous system changes and/or senescent changes in cognition may also contribute to reduced speech understanding in noise among older adults (CHABA Working Group on Speech Understanding and Aging, 1988).

There is little doubt that peripheral deficits and cognitive decline or differences could exacerbate the effects of a CAPD. For example, older adults with peripheral and central auditory deficits receive less benefit from hearing aid use (stach, Loiselle and Jerger, 1991). Even age related cognitive style differences affect processing outcomes. For example, Craig et al (1993) found that older adults required longer duration segments to correctly identify monosyllabic word targets. They interpreted these results to suggest that older adults may impose greater lexical restrain than younger adults, displaying less flexible lexical searching behaviour. Older adults may present differences in decision - making strategies and reduction in overall speed of processing, which exacerbate difficulties resolving spoken language (Craig et al., 1993).

The primary complaint of the older adult with CAPD is difficulty in understanding spoken language in the presence of background noise, as well as the frequent co-occurrence of peripheral and central auditory deficits among older adults (Stach et al, 1991). Management of CAPD in older adults must begin by considering amplification preferably a personal frequency - modulated (FM) system. The remote microphone technology employed in FM system is more effective than hearing aids in reducing the background competition, which interferes with the older adult's ability to understand spoken language (Stach et al., 1991). The management program should also include development of strategies to enhance utilization of central resources (example, auditory discrimination in context, flexible cognitive style, etc.).

MANAGEMENT GUIDELINES

INTRODUCTION:

For the management program of CAPD to be successful and more effective, many authors have suggested (Rampp, 1980; Barr, 1972) both therapy as well as parent-teacher management guidelines. The guidelines can effect significant improvement in the listening skills and habits of specific children. The following guidelines are helpful for teachers and parents in the management of CAPD Children.

TEACHER MANAGEMENT GUIDELINES:

Classroom management techniques should begin by stressing to the classroom teacher the significance of CAPD as a handicapping condition. Not only do educators need to realize that the behaviors exhibited by a child with auditory processing problems are symptoms rather than indices of a disorder, but educators need to be aware that the implementation of appropriate classroom techniques will reap towards not only for the targeted student, but for the teacher and each of the other students in the class.

Many authors (Clark, 1980; Rampp, 1980; Sloan, 1998) have suggested schemas that impact classroom management. The review of their treatment protocols or any treatment protocol have similarity between the classroom management of students with auditory perceptual deficits and of students who are hard of hearing. This fact should prove reinforcing on two levels: first, it reemphasizes the concept that these strategies generalize to other students; and second, it adds credence to the general management of students who have difficulty processing auditory signals.

There are a series of strategies that can be provided to teachers as they deal with students in their classroom. These strategies facilitate the student's ability to process language in the classroom environment and provide modelling of ideal language behaviours. The goal is to help the student become more comfortable, and learn better in his or her educational environment. Parents, administrators, and educational staff can work together as a team in determining what appears to be in the best interest of a particular student.

1) REDUCE DISTRACTIONS:

Avoid extraneous noises and visual distractions (Sloan, 1998, and Bacon 1992), especially when giving instructions and teaching new concepts (Hall, 1997 and Chermak, 1981). Before giving instructions stand close to the student and call the student's name or touch his/her shoulder to make sure you have his or her attention. Traditional classrooms are generally less distracting than open-style classrooms. Reduce motor activities during verbal presentations (i.e., avoid giving complicated directions during Calisthenics; avoid explanations while student is drawing or colouring). (Hall, 1997). For independent work, a study Carrel, earmuffs, or both are helpful. Sometimes it is necessary to find a quiet space outside the classroom (Deconde, 1984).

2) PREFERENTIAL SEATING:

Provide seating away from known auditory and visual distractions such as open windows, pencil sharpeners, doorways, air conditioners, computers, and learning centres (Sloan, 1998). The teacher may have to experiment to find the best location for each student (Hall, 1997; and Deconde, 1984). These children should be provided optimal seating in regard to both auditory and visual stimuli. Ideally, the student should be placed so that the visual field contains the instructional material. The concept of preferential seating should be flexible and the student should be involved in the seating decision (Bacon, 1992).

Chermak (1981) suggested that these children should be placed in the front of the classroom which provides maximum reception.

3) DELIVERY STYLE:

Avoid multiple commands. Presenting instructions in the simplest form possible. Gestures that enhance the message may be helpful, but extraneous gestures and excessive movement while delivering the message may be distracting. Speaking at a slower rate than normal rate will improve auditory comprehension skills (Bacon, 1992; Chermak, 1981). Speaking clearly and at a comfortably loud level, using words within the student's vocabulary. Research has shown that background noise is often equal to or louder than the teacher's voice (Hall, 1997).

Sloan (1998) suggested to insert pauses to help student 'catch-up'. Bacon (1992) suggested that the gestures that enhance the message are effective tools.

4) INSTRUCTIONAL TRANSITIONS:

By reviewing past material before beginning new lessons, the teacher will give the student a feeling of success. In addition, the student will be better prepared to assimilate new information. Preassigned readings and home assignments will also help when introducing new concepts and topics. Try to use "pretuning" techniques to focus the student's attention on the subject coming up. Words such as "Listen", "Ready" and "Remember this one" seem to be effective for signaling an important message (Hall, 1997).

5) ATTENUATE DISTRACTIONS:

Sound-attenuating ear muffs and earplugs may help the student tune out distractions during seatwork. If several pairs of ear muffs are made available to the class, the student with auditory processing difficulties will not feel singled out (Hall, 1997; Chermak, 1981).

6) VISUAL AIDS:

Visual aids, including overheads, opaque projectors, and computers may be utilized to supplement the teacher's oral presentations as well as to provide an alternative mode to the auditory channel. Combining the visual and auditory modes of learning may benefit all students in the classroom. Written instructions may be provided in conjunction with verbal instructions to aid the student in following directions. (Hall, 1997; Deconde, 1984). Sloan (1998) suggested to use visual aids such as objects, pictures, diagrams and maps.

According to Bacon (1992), teachers should be encouraged to use visual aids., especially when new concepts are introduced. Strategies such as cognitive mapping (student- created pictorial representations and interactions of auditory information), graphic organizers (teacher-provided illustrations/statements which help students 'track' the lecture), and pictures in the mind (imagination strategies) are all effective reinforcements for auditory information.

7) UNAMBIGUOUS DIRECTIONS/INSTRUCTIONS:

Students benefit from clear, concise, and succinct instructions. They equally benefit by clearly understanding the purpose of the activity. A clearly stated purpose provides a preparatory attitude that allows the student to focus on the appropriate information (Bacon, 1992).

8) FACILITATE CUEING STRATEGIES:

Many students with auditory process deficits exhibit difficulty with word retrieval strategies. It is the teacher's responsibility to determine the most effective retrieval strategy, provide the student success in retrieval exercises, encourage self-awareness of effective strategies, and gradually withdraw the external cue so that the student can achieve independent success (Bacon, 1992).

9) AUDITORY EXHAUSTION:

Students with auditory processing problems tend to fatigue or exhaust more easily due to the external distractions of the classroom. Teachers may want to consider special adaptations to allow for this fatigue. These might include avoiding demanding auditory tasks when the student is already fatigued. This might be accomplished by presenting auditory tasks early in the day or by alternating lessons requiring a higher amount of auditory processing with less demanding study periods. Physical activity can be used fro reduction of the stress.

According to Deconde (1984), breaks during the day may be necessary for the children with CAPD to relax. Because, tension can build and fatigue occur when children are constantly straining to attend and comprehend what is going on around them.

Bacon, (1992) suggested that educators need to be aware that even when the most successful strategies are implemented there will be days, and especially afternoons, students with the best of intentions struggle to process information. One effective way of dealing with this phenomenon is to instruct in segments no longer than twenty minutes and vary instructional strategies.

10) CHECK COMPREHENSION:

The teacher should watch for signs of inattention, decreased concentration or understanding. Instructions may need to be repeated and/or simplified for the student. (Hall, 1997; Willeford and Burleigh, 1985). To check for understanding, the student should be asked to repeat the instructions in his or her own words. Besides being a good check, this will also improve his/her listening habits since the student knows he or she will be expected to do this occasionally. To help with reading comprehension, the student may be allowed to sub-vocalize while reading until such time as this is unnecessary (Hall, 1997).

11) BE SUPPORTIVE:

Many students with auditory processing problems experience a lack of self-confidence or diminished self- worth due to comparisons made by self or others concerning their performance versus classmates. Demanding performance that is comparable to other students is not recommended. Professionals working with the student should reinforce all work performed successfully to help alleviate this problem.

12) BUDDY SYSTEM:

A buddy system can be helpful, especially for older students to check notes and assignments (Deconde, 1984).

A buddy system can be started by having one student, who appears to be strong in auditory processing, help the student who is having difficulty. Various methods may be tried to find what seems to be the most beneficial . Assistance may include note-taking, assistance with instructions, small group projects, and tutoring.

13) BE REPETITIVE:

Repeat key words and phrases verbatim and use paraphrase to get comprehension.

14) ENCOURAGE REAUDITORIZATION:

Encourage the student to repeat directions or instructions to her/himself upon hearing them for better retention and recall (Sloan, 1998). This not only helps the student remember what he heard but also gives the teacher a chance to see how the message was perceived. If it was incorrect, the message can be restated, and if correct, the student can be reinforced for good listening (Deconde, 1984).

15) PROMOTE GOOD SELF-CONCEPT:

It is most important to allow the student to experience as much success as possible to promote a good self-concept. When children are frustrated with themselves as well as having academic difficulties, it is hard to stimulate interest to build skills that will help restore confidence.

16) USE AMPLIFICATION SYSTEMS:

Amplification systems that allow for direct input of the teacher's voice to the student without any additional sound (FM-auditory training units) are helpful with students who have particular difficulty blocking out back-ground noise (Deconde, 1984).

17) KEEP THE STUDENT INFORMED:

Tell students what you are going to talk about before you begin; make the purpose for listening known.

18) REINFORCE THE CHILD:

Give the child praise, and reinforcement for even minimal improvement. 'Encourage' and 'support' are key factors for success (Chermak, 1981).

19) CLASSROOM ADAPTATIONS:

Class lessons or instructions can be recorded so the child can hear the material again at a later time. Mild amplification might be used to assist the student in attending to the teacher. This should be done with caution, and only with the assistance and supervision of an audiologist. The classroom may be sound treated to reduce background noise by adding drapes, carpets, and sound absorbing materials. The teacher may wish to structure the classroom in a more traditional format to reduce background distractions. Written directions and assignments should be given, along with verbal instructions. The student should be encouraged to ask for repetition of instructions, if needed. When repeating instructions, rephrase and reward the instructions. Verbal information should be presented in a brief, concise and clear fashion. Another compensatory practice would be teaching the student good note-taking skills, small group and individual instruction is very helpful whenever possible (Hall, 1997).

20) MAINTAIN RECORDS:

Regardless of which classroom management strategy is implemented, it is important to maintain records. These records should include which strategies are most successful and under what circumstances other techniques failed. The success stories need to be shared with all of the resource personnel working with the student so that a consistent reinforcing plan can be implemented. The student deserves to achieve success in as many arenas as possible (Bacon, 1992).

21) COMPASSION:

This is connected with the child by letting him or her know the teacher understand his or her struggles and are willing to listen and to brainstorm about strategies that will help the student perform in the classroom (Bacon, 1992).

In addition to the above, it is often necessary for these children to receive small group or one-to-one instruction from a learning disabilities resource specialist. The severity of the disorder and the specific academic needs will determine the amount of time spent with the specialist. This time is best spent working in individualized reading, language, or math programs that replace regular classroom instruction or to provide additional skill building to maintain the child's performance in his classroom.

Levinson and Sloan, (1980), and Sloan, (1998) suggested the following treatment principles for teachers to deal with auditory processing difficulties.

1. Give the child direct instructions.
2. Don't allow guessing; emphasize being sure of what the child hear.
3. Maximize signal detection; use cues if needed and a slow or prolonged speaking rate.
4. Gradually withdraw cues.
5. Present speech units in contrast pairs.
6. Work until recognition or discrimination is automatic; work for accuracy first, then efficiency.
7. Make the child responsible for signal detection from the start; encourage and shape self-monitoring and perceptual decision making.
8. Work on several levels of linguistic structure: sound, syllable, word, phrase, sentence.

9. Use articulation as soon as it is accurate; listen, repeat, respond.
10. Program in very small steps; vary one element at a time.
11. Maintain a high success rate.
12. Use nondistracting tangible reinforcements for good listening and correct responding.
13. Begin with a warm-up (review of previous successful steps)
14. Use blocks of trials; keep the child informed of how much work has been done and how much is left to do.
15. Develop a simple system to keep track of quantitative data; code responses for accuracy and promptness.

Willeford and Burleigh (1985) suggested fourteen teaching techniques that will be of use to teachers. The teaching techniques are as follows:

1. Group the children in a way that will make it possible to work with them effectively.
2. Teach children in a way that provides maximum feedback on what they are learning and where they are having difficulty.
3. Make use of the feedback.
4. Gear the presentation to the lowest member of the group.
5. Don't be afraid of looking back.
6. Make maximum use of study periods; reduce homework to a minimum. The less control you have, the less you know that the child is learning what he is supposed to learn.
7. Learn to isolate the concepts. This means that the concept must admit to one and only one interpretation the desired one.
8. Don't use complicated demonstrations; always seek the simplest form in which to present a concept.

9. Don't correct the child by appealing to his intuition or his thinking habits-program rules for thinking. 10. Preserve the child's self-image, but tell him when his answers are wrong.
11. Give the child ample evidence that he is capable of learning.
12. Structure the teaching sessions so that the children work for no more than five to eight minutes on a particular series of tasks.
13. Use fun examples and tasks with a pay off.
14. Concentrate on those aspects of the curriculum that can be accelerated.

PARENT MANAGEMENT GUIDELINES:

The same recommendations that are given for school should be carried out at home. A written list should be given to the parents at the time the test results and recommendations are discussed. It is often difficult for parents to understand the central auditory processing concept. Whenever possible, therefore, they should be allowed to sit through the central auditory processing evaluation. This provides an opportunity to explain the tests to the parents as well as for the parents to see how their child performed during the assessment.

With subtle central auditory processing disorders, parents may not feel that problems exist in the home environment. This may be true, or it could be the response of a defensive parent. Always explain to the parents that their child's performance will vary depending upon the environment. At home the child may be secure in the established routine, whereas in a new situation, such as school, the child may respond quite differently. From year to year the child's performance will also vary. More problems are usually evident at the beginning of the school year as the child adjusts to a new teacher, new classroom, and new routine. As the child progresses gradewise, difficulties may also increase because the teaching styles generally move from concrete in thought and multisensory in presentation, to abstract and primarily verbal. Compensation skills are crucial for the child as the information to be learned reaches the lecture-style format (Deconde, 1984).

The following are the few suggestions for the parents given by several authors. (Hall, 1997; Barr and Carlin, 1976)

1. A child with auditory processing problems seems to hear inconsistently. If the child seems to hear somethings, but not others, do not assume he or she is purposely ignoring you.
2. Encourage your child to talk to you and take time to talk to your child.
3. Try to give him your undivided attention for atleast a short period of time every day.
4. You will have greater success in communicating with your child if there are no other activities (other children or adults talking or laughing, tele\ision or radio playing, dishwasher or vacuum cleaner running, etc.) competing with you.
5. During communication, learn to control your child's environment by providing a quiet setting. Take the child to a quiet room, shut off the TV, ask others to be quiet for a moment, etc.
6. Delay important conversation until a quiet time can be found.
7. Let him tell you what he did, what he said and how he did it.
8. Ask him questions and encourage him to speak.
9. Listen to his ideas.
10. Answer his questions.
11. Reward him with verbal praise (that's good-you did well).

12. Make a point of finding "quiet conversation periods" on a regular basis during the course of each day.
13. Simplify your language level if your child does not seem to understand.
14. Try slowing down your rate of speech if your child continues to have trouble understanding. One way to accomplish this is to pause between utterances, especially after your child has finished talking and before you respond.
15. If you have to repeat something for your child, try saying it in a different way (different words, different type of sentence).
16. Do not try to have discussions when you and your child are in separate rooms (HamaGuchi, 1995).
17. Make your child alert to sounds around him.
18. Identify sounds for your child.
19. Ask him what he thinks about matters which he can understand.
20. Name things for your child - help him to call things by their right names.
21. Help him to look at pictures and describe what he sees.
22. Help him to make up stories about pictures.
23. Tell him stories, fairy tales and nursery rhymes.
24. Stimulate your child to speak you may want to put magazine picture on the wall or give him objects to talk about.
25. Help your child to listen to sounds around him and identify them (the ring of the phone, the television, the pots and pans, the water, the door slamming, the window closing, the clapping of hands, etc.)
26. Take your child for a walk and talk about the things you see and hear.
27. While you are cooking, talk to your child about the foods you are making and the things you are doing.

28. Whenever you go to any place with your child, try to talk to him about where you are and what you see, hear and do. (eg.) on a trip to the grocery store, tell your child what you are buying - name the foods for your child. Do the same thing in any other store.
29. Help your child to notice the things in his environment. Point out things to him, and perhaps even play a game of counting how many different things he sees or how many of one thing he sees.
30. Take every opportunity to talk to your child.
31. When conversing, allow your child adequate time to respond.
32. Your child may need time to rest and recuperate after school. Allow time for relaxation before asking him or her to do chores, homework, and so on.
33. Read aloud to your child and discuss what you have read.
34. Praise any accomplishment (academic or otherwise) that represents even small improvements over previous levels. It is not helpful to compare his or her performance to other children.
35. Make sure your child is looking at you and ready to listen before beginning a conversation.
36. If your home is noisy due to tile or hardwood floors, consider carpeting your living areas. This flooring will improve the acoustics and make it easier for your child to hear.
37. If your find yourself in a noisy situation, speak just a little more loudly. This will help your child focus on your voice and tune out the background noise, which is difficult to filter out.
38. Repeat and rephrase important messages. If your child can read, write them down in a conspicuous place.

Willeford and Burleigh (1985) listed out the following suggestions for the parents of children with CAPD.

1. STRUCTURE THE ENVIRONMENT:

a) Attempt to foster Co-operative and understanding relationships in the home. The child needs a stable base.

b) Provide day-to-day, pleasant learning experiences of a formal or informal nature.

c) Provide a calm, simple; austere decor.

d) Use few mirrors and stimulating objects.

e) Have the work place facing a blank wall.

f) Give every child a quiet corner of his own.

2. PUNISHMENT:

a) Set consistent limits and standards.

b) Don't punish a child for behaviour that he cannot control, like clumsiness or easy frustration. Spankings are not recommended, for they are often too exciting and violent.

c) Punishment should be prompt.

d) Choose appropriate punishment. Don't impose major punishment for a minor transgression.

e) Avoid long sermons and logical reasonings. Handle the problem directly and simply.

f) Don't spend excessive time punishing bad behaviour at the expense of encouraging good behaviour.

g) Use of child's bed as a place of rest, not as a punishment site.

h) If you wish to teach a child to hold his temper, then be able to exhibit that behaviour yourself.

3. TROUBLE PREVENTION:

a) Remove and prevent intolerable.

b) Give simple, clear instructions in short series.

c) When the child exhibits impatience about impending activities, help him by building a step-by-step inner picture. Describe in detail any and all facets of the activity, such as its purpose, any stops, and interesting sights to be expected.

d) Anxious children can be made more comfortable about expected events if they are predictable as to time, place, etc. Meals should be at regular times, and activities can be scheduled somewhat consistently.

e) Parents should appear unified on issues to the child, and should avoid disagreement and harsh criticism of each other infront of the child.

f) Rules of behaviour should be definite, simple, and unchanging from parent to parent.

g) Gradual increase in independence can be achieved by:

1. Simple, useful, needed household chores.
2. Encouragement of special talents and interests.

TEAM MEMBERS FOR CAPD REHABILITATION

INTRODUCTION:

Central auditory processing disorders do not exist in a vacuum, and neither does the clinician involved in the assessment and management of such disorders. Instead, the clinician involved in the field of CAPD must interact with other professionals in the special education arena, medical personnel, administrators, parents, and additional key individuals inorder to ensure the success of any CAP program.

The key members involved in the CAPD team are

1. Audiologist,
2. Speech-language pathologist,
3. Neuropsychologist,
4. Special educator,
5. Educational psychologist,
6. Paediatric neurologist,
7. Otolaryngologist,
8. Child development centre,
9. Classroom teacher,
10. Parents, and
11. Child advocate.

1. AUDIOLOGIST :

Audiologist guides the CAPD team, review data collected, engage in comprehensive assessment procedures, make recommendations for management, meet with teachers, parents and other individuals to explain the recommendations made and ensure follow - through, and provide inservice training to all applicable persons.

2 . SPEECH - LANGUAGE PATHOLOGIST:

A properly credentialed person with expertise in the evaluation and management of the child language disorders is an essential member of the team.

The speech - language pathologists are mostly involved in the implementation of management suggestions, particularly if recommendations involve direct therapeutic techniques that can best be handled in an individual therapy situation, or if the child in question exhibits a language - based CAPD that requires more traditional language intervention.

In addition, information from the speech - language pathologist concerning the individual child's speech and language capacities is necessary for the CAPD team.

3. NEUROPSYCHOLOGIST:

A properly credentialed clinical neuropsychologist will provide valuable services, such as independent assessment of intelligence.

4. SPECIAL EDUCATOR:

Special educator must have expertise in learning disabilities, including assessment and remediation of reading disorders. Special training in reading techniques designed for children with weak auditory processing skills (eg; Lindamood Bell Learning Process) is particularly important.

5. EDUCATIONAL PSYCHOLOGIST:

Many children with CAPD may be under the care of the psychologist for associated symptoms of frustration and depression that may occur with continual academic and communicative strategies. Therefore, the psychologist is an important member of the CAP team in that he/she may be in the unique position to provide valuable information regarding the social-emotional impact of the disorder, as well as cognitive functioning and scatter of skills.

6. PAEDIATRIC NEUROLOGIST:

The population of children suspected of having CAPD will include some who are suspected of having neurologic disorders, including seizure disorders and developmental delay. The paediatric neurologist can evaluate these children and order appropriate diagnostic medical studies (eg, MRI, Lab tests, EEG) and treatment.

7. OTOLARYNGOLOGIST:

Optimally, an otologist and/or a paediatric otolaryngologist is included in the team. A substantial proportion of children undergoing CAPD assessment will have peripheral hearing loss. Middle ear disorders are especially common during the winter months. Whenever possible, peripheral auditory dysfunction should be treated medically or surgically before CAPD assessment/treatment is carried out.

8... CHILD DEVELOPMENT CENTRE:

Children with multiple psychoeducational, communicative, and/or medical problems are often best referred to a centre staffed by multiple disciplined professionals.

9. CLASSROOM TEACHER:

Implementation of recommendations for educational modifications begin and end with this important team member.

The classroom teacher has the responsibility of addressing the educational needs of all the students of his/her classroom, and he/she may be responsible for 25 to 35 students in addition to the one child who exhibits CAPD. Although these educators may be extremely motivated to do whatever is necessary to help the child in need, it cannot be denied that little additional time is available for implementation of direct management suggestions in the classroom. Conversely, the educator may be unaware of the nature of CAPD and the unique needs such a child demonstrates and instead, feel that the child in question is just 'not trying hard enough' or 'not paying attention'.

10. PARENTS:

Implementation of recommendations for home management and assurance that all recommendations for management are implemented, is usually the responsibility of the parents and other family members. They must understand what CAPD is and what can be done about it.

11. CHILD ADVOCATE:

Unfortunately, parents often need the assistance of someone who can serve as an advocate for their child to ensure that an appropriate education plan is developed and carried out fully. This person, who accompanies the parents of multidisciplinary team meetings, may be a professional, or another parent, or well-versed in state and federal educational laws, or even a lawyer.

SUMMARY

SUMMARY

There was a time, when it was common to hear, professionals in speech-language pathology and audiology say that there was no point in evaluating central auditory processing disorders because there was nothing that they could do about them. Let us put this misconception to rest. Many researchers interested in the field of CAPD have suggested several therapy techniques which have been found to be successful for these individuals with CAPD.

Rehabilitation program should be designed to meet individual symptoms, deficits, integrities and needs. The program should also vary depending on the age of the client. The program should be as deficit-specific as possible.

Rehabilitation program can be mainly divided into four aspects:

a) Instituting an auditory training regimen.

b) Teaching compensatory strategies.

c) Fitting an assistive listening device and

d) Manipulating the acoustic environment in the child's favour.

Auditory training approaches can be divided into two, a) Specific, which targets at specific aspects of auditory ability, and b) Eclectic, which are indirectly targeted to the auditory abilities.

Compensatory strategies relate to helping the individual function well and learn, despite the auditory difficulties, that is, finding ways to compensate for what skills they lack. Many researchers have suggested different compensatory strategies. In that, Chermak (1995 and 1998) provided many suggestions for using metalinguistic and metacognitive strategies to facilitate comprehension, retention, and recall of information with the older student.

There are two general approaches in improving the listening environment, a) Reducing background noise and reverberation in the environment, and b) Enhancing the speech signal.

The newest approach to improving listening environments that is gaining ground in classrooms is the use of classroom FM systems to enhance the speech signal. This approach has replaced the use of personal FM systems for chilren with CAPD.

In addition, the management programs also should address behavioural, educational, and communicative sequelae so that maximum functional benefit may be achieved. Therefore, management of CAPD should be multi-disciplinary in nature. Speech-language pathologists, psychologists, audiologists, neuropsychologists, LD specialists, Social workers, Teachers, Parents and others may all be involved in the child's over all care. The extent of each team member's contribution will depend on the nature of the disorder, the functional manifestations of the disorder, and the degree to which the problem may be medically treated.

Some clinicians feel that therapy programs alone will help a child with CAPD. Othes (Barr, 1972; Rampp, 1980; Hall, 1997) recommend both therapy techniques and management guidelines (for parents and teachers) to aid the child with CAPD.

In the case of adults, especially elderly persons, counselling the individuals and/or significant others as to the nature of the problem is equally important. The use of compensatory strategies and assistive listening devices as well as sound attenuation devices such as earplugs and earmuffs are also recommended for elderly population with CAPD.

Recently developed computerized programs such as Specially designed audio-based computer game and 'Fast forward computerized therapy program' (Tallal et al., 1996) are found successful in remedying a basic auditory problem (an inability to recognize the very short duration sounds of spoken speech) with this population.

Thus, there are a number of efficacious intervention strategies that can be helpful to individuals with auditory processing problems across the entire age range.

APPENDIX

I. AWARENESS OF SOUNDS

OBJECTIVE: To make the child more aware of the sounds

MATERIALS: An alarm clock with a fairly loud alarm box and several coloured buttons.

ACTIVITY:

1) Demonstrate what is expected of the child by performing the following tasks:

a) Turn the clock to the 'on' position. The alarm should be comfortably loud. Immediately upon hearing the sound, drop a button into the box that is placed on a table between the clinician and the listener.

b) After several demonstrations, help the listener to drop a bottom into the box as soon as the sound is heard.

c) Reverse roles. Allow 'listener' to manipulate the clock.

VARIATIONS:

a) To Maintain Interest:

1) Instead of buttons, blocks can be given to the child and whenever the child hears the sound, he/she should keep the block near the ears and drop it down, when he/she doesn't hear the alarm.

2) Child can raise the finger, whenever he/she hears the sound and drop the finger when there is no sound.

3) The child can pretend to be asleep and then pop up as his response.

4) If there is a doll, the child can pretend that the doll is asleep and let it make the same response.

5) Place two pictures, one showing a sleeping child and the other in which the child is awake and whenever the child hears the sound, he/she has to point out to the picture indicating the awaken child.

6) Using music from a record player, at a sufficiently loud level, help the child to perform rhythmic body movements, clapping, etc.

To Increase the difficulty:

Obscure the listener's vision and repeat the exercise.

Exercises: "QUICK-FIX"

Match the words to appropriate sounds:

Bee	o
Bag	i
Hen	a
Bow	u
Due	e

II. AUDITORY ATTENTION

OBJECTIVE: To make the child say 'stop' when he/she hears something incorrect in the passage and the child has to tell which word or phrase was in error.

MATERIALS: A picture of any object (example, car).

ACTIVITY:

1) Showing the picture to the child, the clinician describes it correctly, until the child gets familiarized with the description.
2) Explain to the child that whenever he hears something incorrect about the description of the picture, he has to say 'stop' and has to tell which word or phrase was in error.
3) Reverse roles.

VARIATIONS:

1) A poem can be used for this purpose.
2) To make it interesting, a passage can be given and according to the description, the child can be asked draw using a crayon.
3) A story can be read and ask the child to underline the false statement or words.

Example 1: (Obtain a picture car as an orientation clue for the child).

When *modern* cars are built, they always have *wooden wheels.* The *dog sits* in the back seat. The *Motor sits on top of the hood.* The car has *seven* *wheels.* You can see a crank between the front wheels (if the picture does not show this, underline it as a false statement). There are *no head lights.*

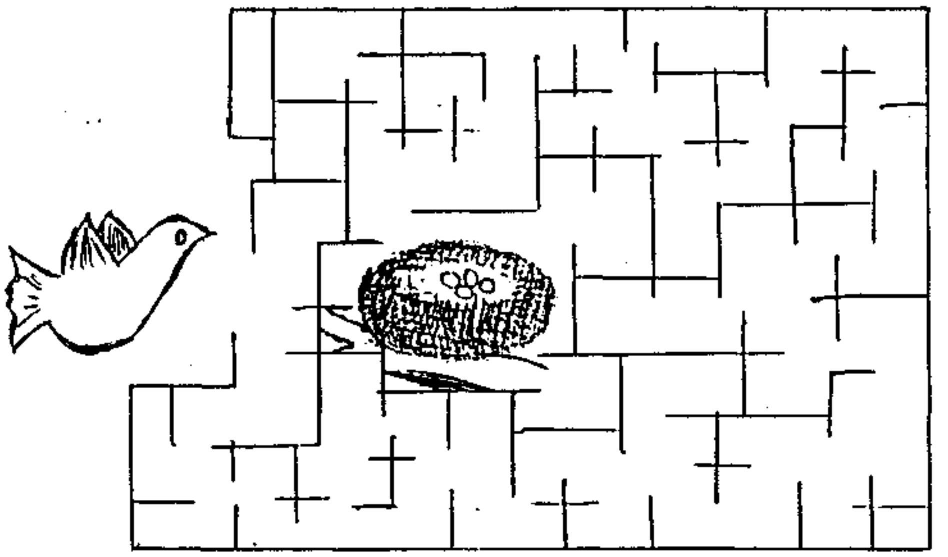
Example 2: "HEAR N' MAZE"

ACTIVITY:

The child should be instructed that if he tracks the correct path, he will hear a particular sound, (eg; Bell) and if he tracks the wrong path, he will hear a different sound (eg; Drum). Now, ask the child to start tracking. Depending on the child's tracking (correct/wrong), the clinician has to present the sound stimulus. Continue presenting the sound stimulus until the child reaches the target. Reinforcement should be given once the target is reached by the child.

- Time limit can be given
- Gross and fine sound discrimination can also be taught using this method.

HEAR N' MAZE



III. AUDITORY LOCALIZATION

OBJECTIVE: The child has to localize the direction of the sound.

MATERIALS: Any instrument.

ACTIVITY:

a) Station two or three persons in various locations in the room having identical sound instruments.

b) The child is blind-folded and made to stand in the centre of the room.

c) Any one person should sound the instrument.

d) Then the child has to localize the direction in which the sound came by turning towards the direction or pointing the direction in which the sound came.

VARIATIONS:

1) The child can be given a ball or a bag. Whenever he hears the sound, the child has to throw the bag towards the direction of the sound.

2) Gradually decrease the volume and repeat the above exercise.

3) Repeat exercises, introducing a short time lapse.

4) Gradually increase the time lapse to develop memory for localization of sound.

5) Gradually increase the distance to make the exercise difficult.

IV. DISCRIMINATION OF SOUNDS

GROSS DISCRIMINATION:

OBJECTIVE: Correct listener identification of unlike sound instruments under conditions of reduced volume.

MATERIALS: Drum, bell, whistle, glass and spoon.

ACTIVITY:

1) The clinician will sound each of the five instruments and name them.
2) The clinician will hand each of the five instruments to the listener, request that he 'sound' them, name them, and remember the sound.
3) The clinician will request to listener to turn his back to the instruments. The clinician will bound one (The clinician will have preconditioned the listener not to turn toward the instruments until tapped by the teacher).
4) The teacher will say 'ready', indicating that the listener may turn and identify the instrument.
5) Express approval of correct response.
6) Sound each of the instruments in the same way. Be careful not to look at the instrument that was sounded.
7) Repeat above exercises with gradually reduced levels of loudness.
8) Reverse roles.

VARIATIONS:

1) Clinician can play the sounds of various animals and ask the child to point out to the picture of that animal.

2) Clinician can give loud and soft sounds and ask the child to point out to a big circle for loud sound and to a small circle for a soft sound.

3) Clinician can give high and a low pitched sounds and ask the child to point the finger upwards indicating high pitch and downwards indicating low pitch.

4) Verbal discrimination in gross level can be done.To make it interesting the activities can be modified according to the interest of the child.

To increase the difficulty:

Discrimination of fine sounds following the same steps can be done.

V. AUDITORY MEMORY

OBJECTIVE:

1. Reinforcement of the listener's auditory memory.
2. Development of the listener's skill in memory for sound sequencing using two unlike sound instruments.

Exercise: 1 : **Sound sequence**

MATERIALS: Drum and toy squeaker.

ACTIVITY:

1. With the listener seated comfortably across the table from the clinician, demonstrate the procedure he is to follow:

a) Sound the toy squeaker. Name it. Allow the listener to do the same.

b) Sound the drum. Name it. Encourage the listener to do the same.

c) Call attention to the sound differences.

d) Sound one instrument. Identify it. Repeat but ask the listener to identify it.

e) Explain that this time clinician will sound both instruments and clinician will have to remember which came first and which came second. The clinician has to do himself/herself first. Encourage the listener to perform the task.

2. Request the listener to turn his head so that vision is obscured. Sound one instrument, then the other. Ask the listener to identify which was heard first and which second. Repeat procedure, mixing the presentation to avoid 'patterning'.

3. Reverse roles to give the listener further insight into the process of sound sequencing.

To make it difficult:

Many instruments i.e., more than two can be used in the similar way.

Exercise 2: Repeating words.

a) Give a set of words eg., apple, mango, orange and pineapple.

b) Ask the child to repeat in the correct sequential order.

c) Gradually increase number of words to be repeated as the child gains skill.

d) Reverse roles frequently.

TO MAKE IT DIFFICULT:

Give unrelated words such as chair, flower, dog, rain and book.

VARIATIONS:

1. Play activity using the same exercise can be given like, give a basket to the child and ask him/her to pick up ball, flower, bat, book in the correct sequencial order in the basket.
2. Keep three containers and ask the child to drop a ball into the first container, a marble into the second and a stone into the third.
3. Make five children sit in the form of circle, the first child has to say 'when I went to Mysore, I took a *(bag)'.* The second child must say, 'When I went to Mysore, I , took a bag and a *(Sweater)'*. The third child must say, When I went to Mysore, I took a bag, a sweater and a *(hat)'* etc.
4. Read out a poem to the child. Then ask the child whether he/she heard the following words, in the poem which are asked by the clinician

(eg)

Ghosties sliding,
gliding by.
Witches. Slithering
through the sky.
what was that-?
Have you seen
spooky things on
Halloween?

Ask the child whether he heard there words in the poem ?
Toasties ? Sliding ? Riding ? Flying ?
Gliding ? Over ? Witches ? Across ?

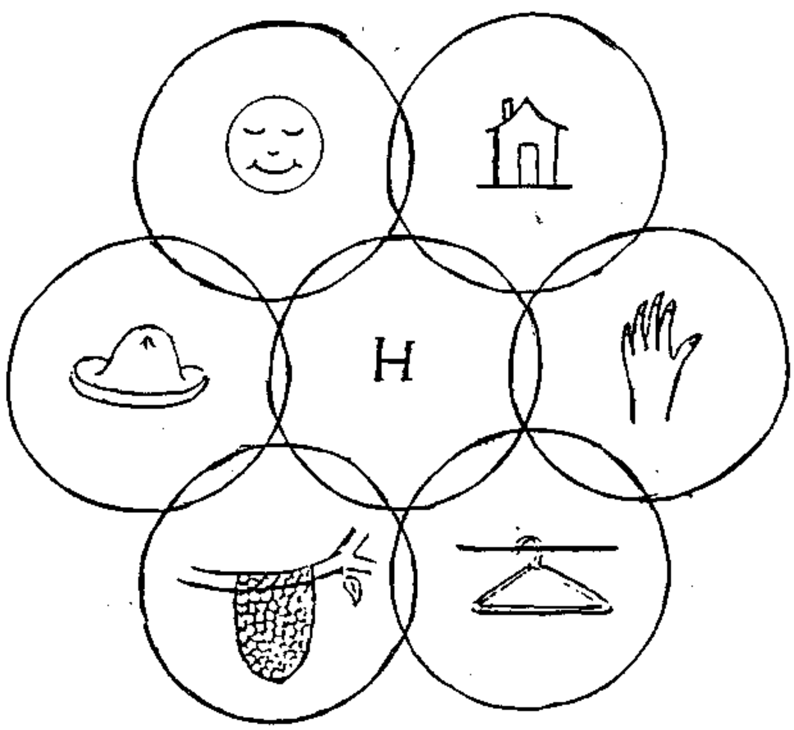
Sky ? Slinky ?

Example 3: "JUST 'A' MINUTE"

ACTIVITY:

Show the picture to the child. The clinician has to point out to the pictures and has to name it. Then take the picture off and ask the child to recall the pictures shown to him or her.

JUST 'A' MINUTE



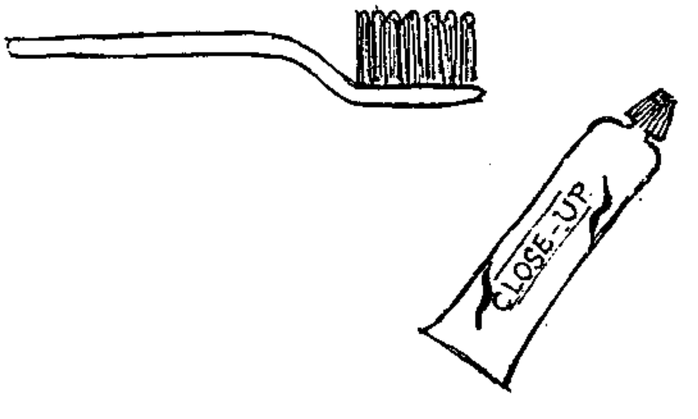
Example 4: "FAST FORWARD... "

ACTIVITY:

Tell the child an activity, for eg; brushing, also show few pictures showing the objects or material related to the activity. Then, ask the child to draw the materials/objects which are all left out.

- Time limit can also be given
- It can be used as an auditory closure activity also.

FAST FORWARD ....



Exercise 5: "PERFECT MATCH"

Combined and bring a meaningful word.

1. Com	ket
2. Mo	cel
3. Tele	rol
4. Blan	pact
5. Moun	cuse
6. Par	phant
7. Corri	phone
8. Ex	ment
9. Ele	dor
10. Pet	tain

Exercise 6: "PERFECT MATCH"

Combine and bring a meaningful word

1. Ins	fa	dile
2. Re	hi	ing
3. Pro	co	der
4. Un	tru	bit
5. Cro	ren	stand
6. Buf	sur	ber
7. Mea	der	ment
8. Beau	tec	ful
9. Ex	mem	lo
10. Sur	ti	tion

VI. AUDITORY SEQUENCING AND PROJECTED LISTENING

OBJECTIVES:

1. Reinforcement of the listener's skill in retaining the order for sound sequence.
2. The listener will accomplish objective number one with distance as an added difficulty factor.
3. Development of skill in recognizing and reproducing rhythm.

MATERIALS: Drum

ACTIVITY:

Demonstrate the procedure and manner in which the listener is expected to respond. Allow the child to observe visually the first time, then he should respond with vision obscured.

1. Present one or two taps on the drum. Listener should reproduce. Gradually increase the number of taps to three or more.
2. Introduce pauses to obtain a rhythm which, along with the correct number of taps, should be reproduced.

Example: One — two,

One two,

One — **two** — three,

One — two three etc.

VII. AUDITORY CLOSURE

OBJECTIVE:

To make the child recognize and correctly identify the sounds omitted.

MATERIALS: Any three instruments (Drum, bell and squeeker)

ACTIVITY:

Demonstrate what is expected of the child by performing the following tasks:

1. Present three instruments to the child.
2. Sound any two of the instruments.
3. Ask the child which instrument was omitted.
4. Repeat the exercise with the listener's vision obscured.
5. Increase the number of instruments and repeat above steps with two omissions.

VARIATIONS:

1. Instead of sounds, a sequence of words can be used.
2. Clinician can use a sentence. Ask the child to repeat the sentence. Then the clinician repeats the sentence but omits one word. The child has to identify the omitted word.
3. Clinician can use clues.

For example,
I live in water
I swim with the help of fins
Once I am out of water
I am dead.

People makes tasty dishes
out of me.

Who am I ?

The child should 'guess' in a complete sentence: 'Are you a fish?'

4. Exercises like 'What goes together?' can be given.

For example,
Paste and *(brush)*
Table and *(chair)*
Lock and *(key)*
Bread and *(butter)* etc.

5. Give the child a picture and the child has to select the opposite picture for that picture.

For example,
Thin (fat)
Big (small)
Tall (short) etc.

6. Completing a sentence can be given to the child.

For example,
Grass is *(green)*
September comes next to *(August)*
Morning I used to________
I saw_______
Yesterday I went with_______

7. Tell the child that every sixth word in a short, written story will be omitted The clinician will read the story aloud to the listener, pausing where the omissions occur. The listener will be given a list of words on a card. Then a copy of the story will also be given to the child. Then the child has to fill in the blanks with appropriate words from his card.

For example,

Word card: Go, For, To, Spring, Their, Sleep, Nuts, Like.

Story: When the weather begins *(to)* get cold, squirrels look *(for)* nuts to store in *(their)* nests for winter. When winter comes, squirrels *(sleep)* most of the time. *(They)* do not have to (go) outside their nests until *(spring)*.

8. Give the child some situational words and the child has to guess the activity.

   Example: Hook, lake, line, worm, boat, pole, catch, bait (fishing).

9. Ask the child to complete the sentence with a rhyming word.

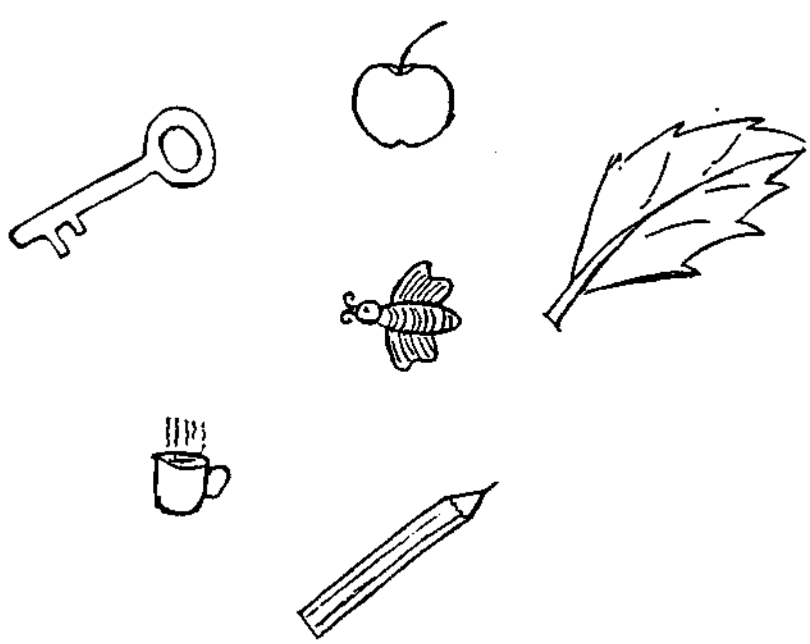
   For example,

   He threw the ball against the *(wall)*
   The children sang until the bell *(rang)*

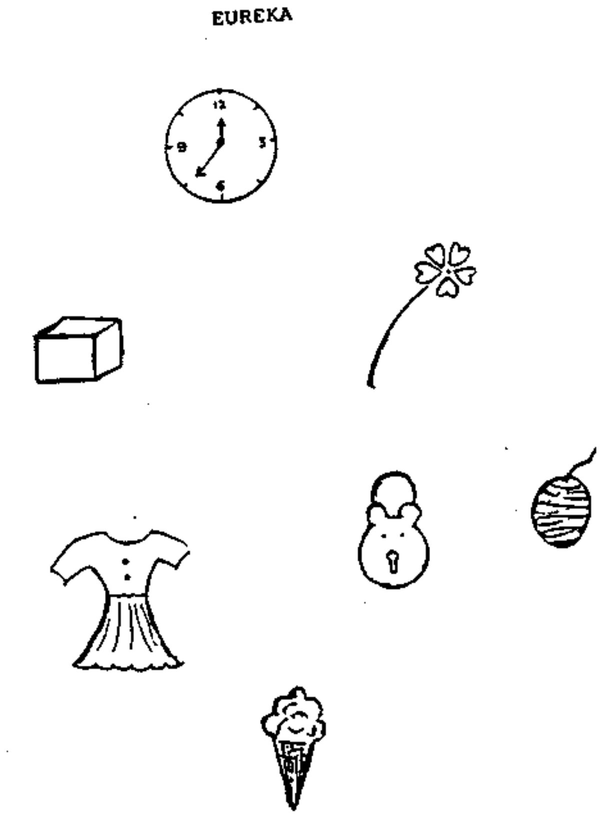
   The cat chased a *(rat)*.

10. "EUREKA" - Write the words which rhymes Like 'me' in the picture.

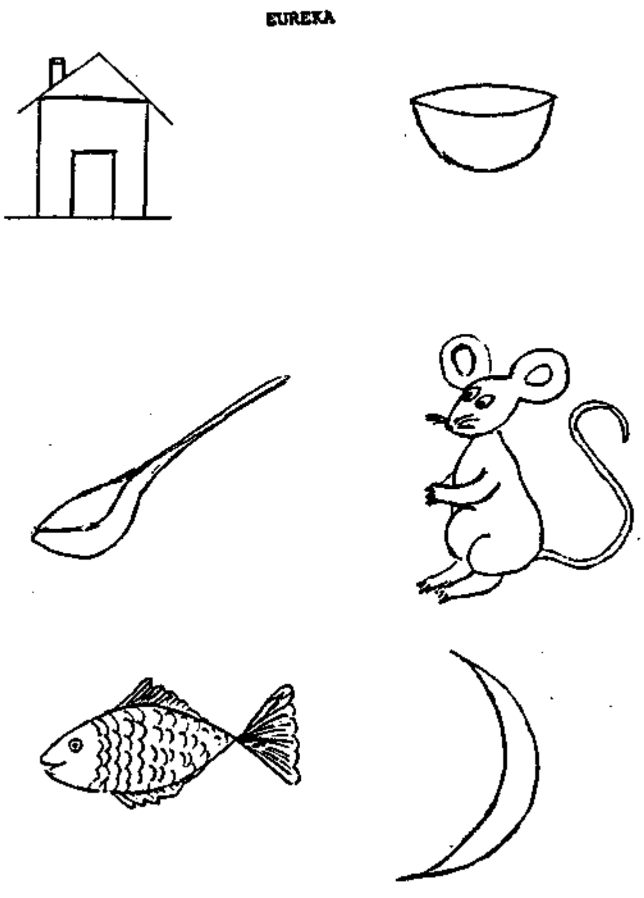
EUREKA



11."EUREKA" -Point out to the pictures which rhymes like 'soc

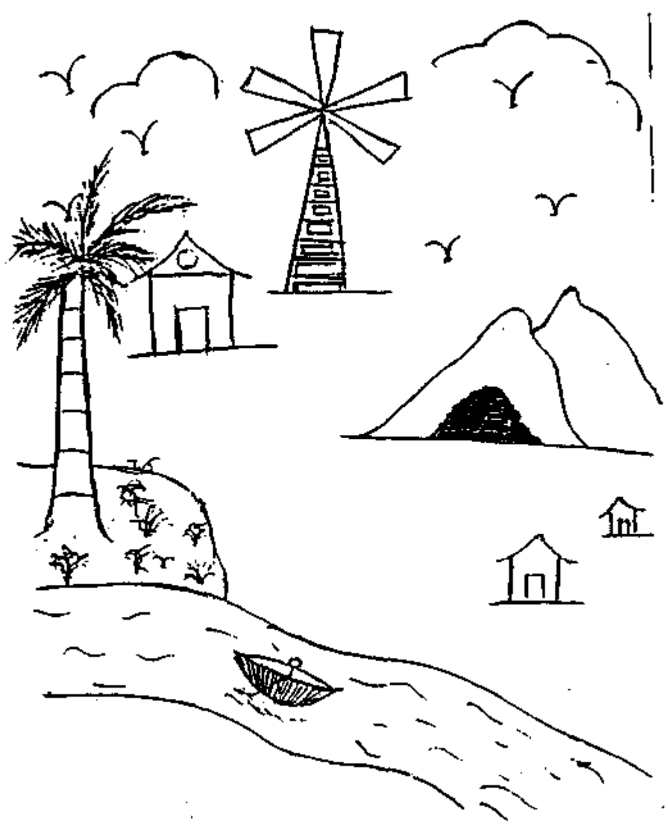


12. "EUREKA" - Match the pictures which rhymes the same.



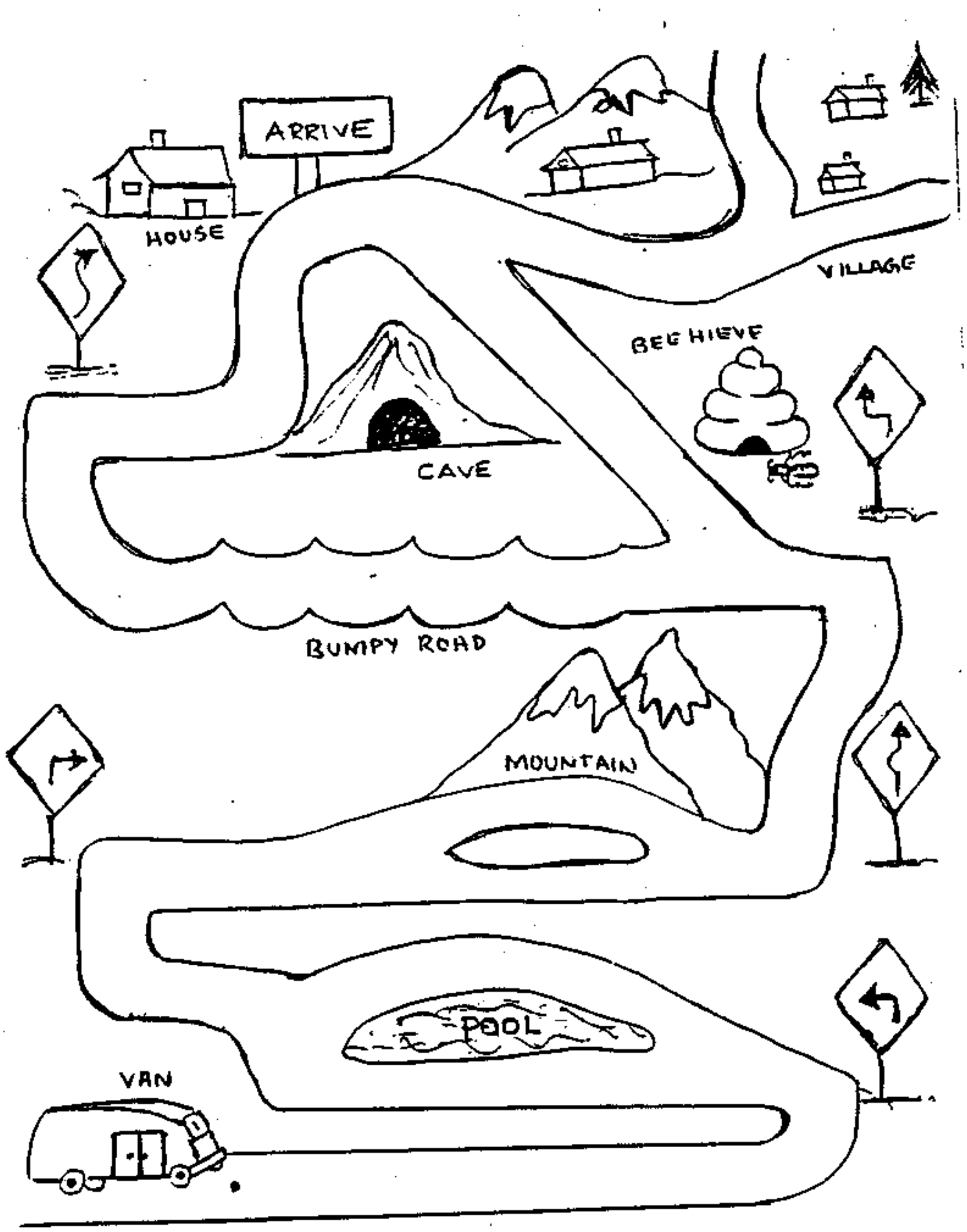
13. "LONG LONG AGO ..." - Tell a story about the picture. (vocabulary building).

14. "LONG LONG AGO...." - See this picture and tell a story (vocabulary building)



15. "FLASH BACK" - Take a trip to your village in the van and tell a story about the trip.(vocabulary building).

FLASH BACK



VIII. LISTENEERS

This program consists of twenty short, appealing rhymes that, if used as suggested, involved a number of auditory processing components: awareness, attention and attention span, discrimination, both short-term and long-term memory, sequencing ability, and auditory closure.

It can be scored and easily converted to a percentage of adequate. The worksheets are graduated in difficulty. All the suggested steps should be administered. They may, however, be presented in a single session or used in two or three sessions.

MATERIALS: A box of crayons

PROCEDURE:

Say to the listener, "I am going to read a short poem to you. Listen carefully because when I am finished, you will be asked to do something about what you heard, with crayons. This will show how well you listened and remembered".

Step 1:

1) Read the poem to the listener
2) The clinician will then fold down the top of the worksheet so that only the picture or blank portion of the sheet is available. The listener will then draw or finish a picture based upon what was heard.
3) If there are errors, re-read the poem, helping the listener to recognize his errors.

Step 2: Help the child to memorize the poem (short-term memory).

Step 3: The clinician will read the poem line by line, inserting incorrect words. The listener will say, "stop !" as quickly as he hears something incorrect. He will tell which word or phrase was in error. (attention and attention span).

Step 4: The clinician will read the poem line by line, omitting one word. The listener will identify the omitted word. When sufficient skill has developed, two or three words may be omitted.

Step 5: Engage in role reversal.

Step 6: One week later, request the listener to repeat the poem (long-term memory).

Step 7: Assist the listener to construct like this by his own.

MISS JICKIE JOE

Miss Jickie Joe
Wears a red bow.
On her yellow hair
and she looks fair.

SCORE:

Red bow..........................
Yellow hair......................
% correct........................

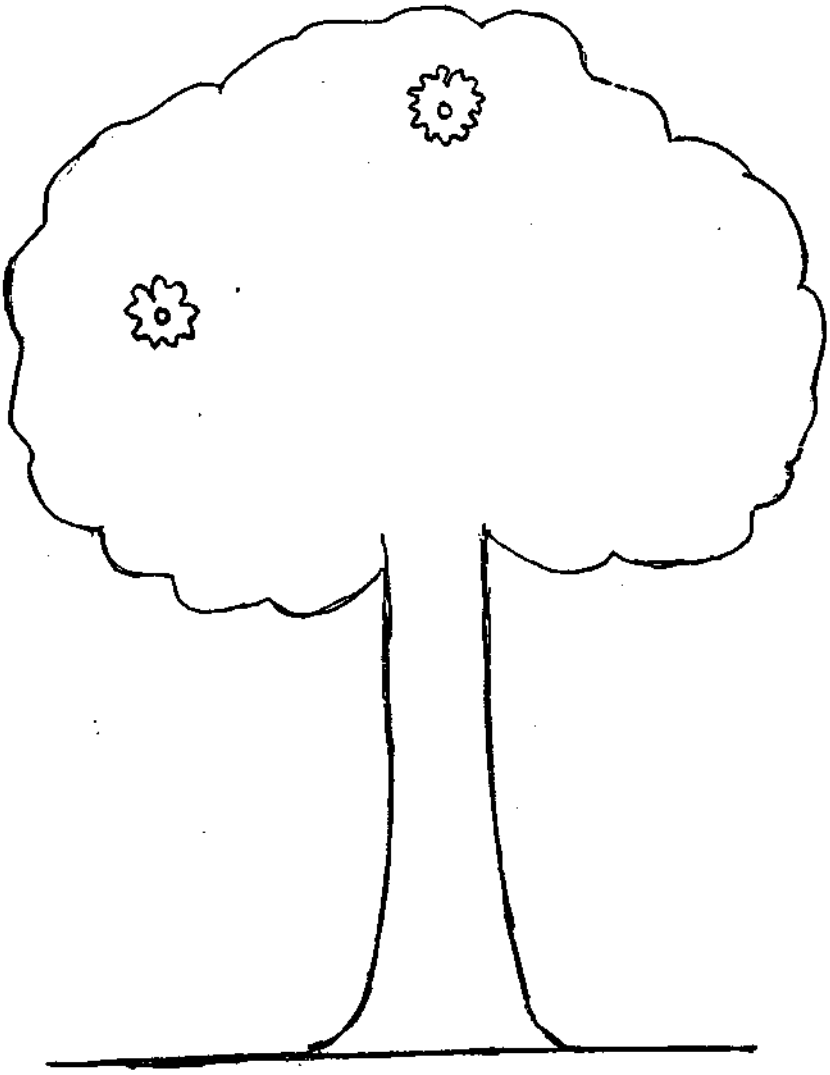
Finish the picture of **'MISS JICKIE JOE'**

AUROCCA

I am a tall tree
and I look green
I have little flowers
they are blue in colour.

SCORE:

Green tree........................
Little flowers...................
Blue flowers...................:...
% correct........................



Finish the picture of **'AUROCCA'** tree

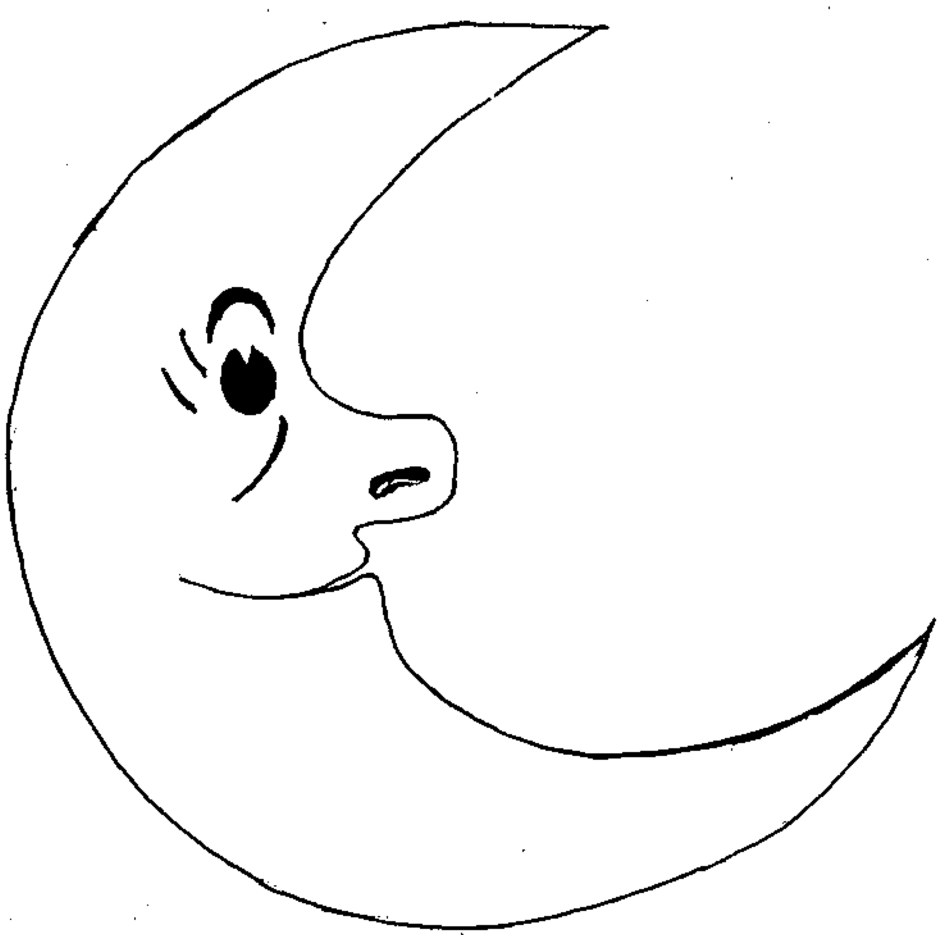
FUNNY MOON

Funny green moon
Comes in the noon
Smiles at everyone
Until here comes the red sun.

SCORE:

Green moon ....
Smiles ....
Red sun ....
% correct ....

Finish the '**FUNNY MOON**'



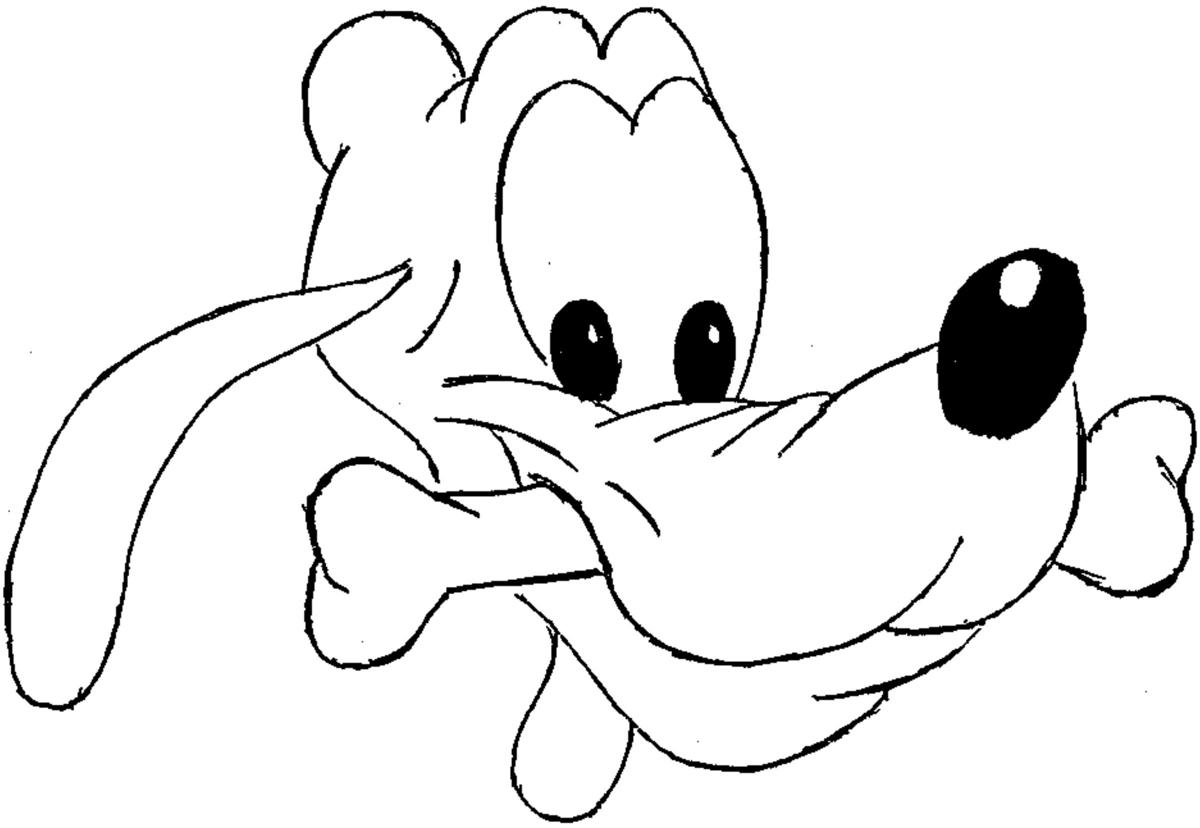
DINKU

Dinku is a pink dog
Who sat on a brown log
He carried a big bone
Which was as hard as a stone.

SCORE:

Pink dog..........................
Brown log.........................
Big bone..........................
% correct.........................

Complete the picture of '**DINKU**'



MATTY CAT

Matty cat wears a black hat
It looks furry
and it eats mat
when it feels hungry

SCORE:

Black hat........................

Furry............................

Mat..............................

% correct........................

Draw the ' **MATTY CAT'**

Draw a **'SILLY PURPLE PEN'**

SILLY PURPLE PEN

Donald has a silly purple pen
which he uses very often
He pours blue ink
and it writes in pink

SCORE:

Purple pen........................
Blue ink..........................
Pink writing......................
% correct.........................

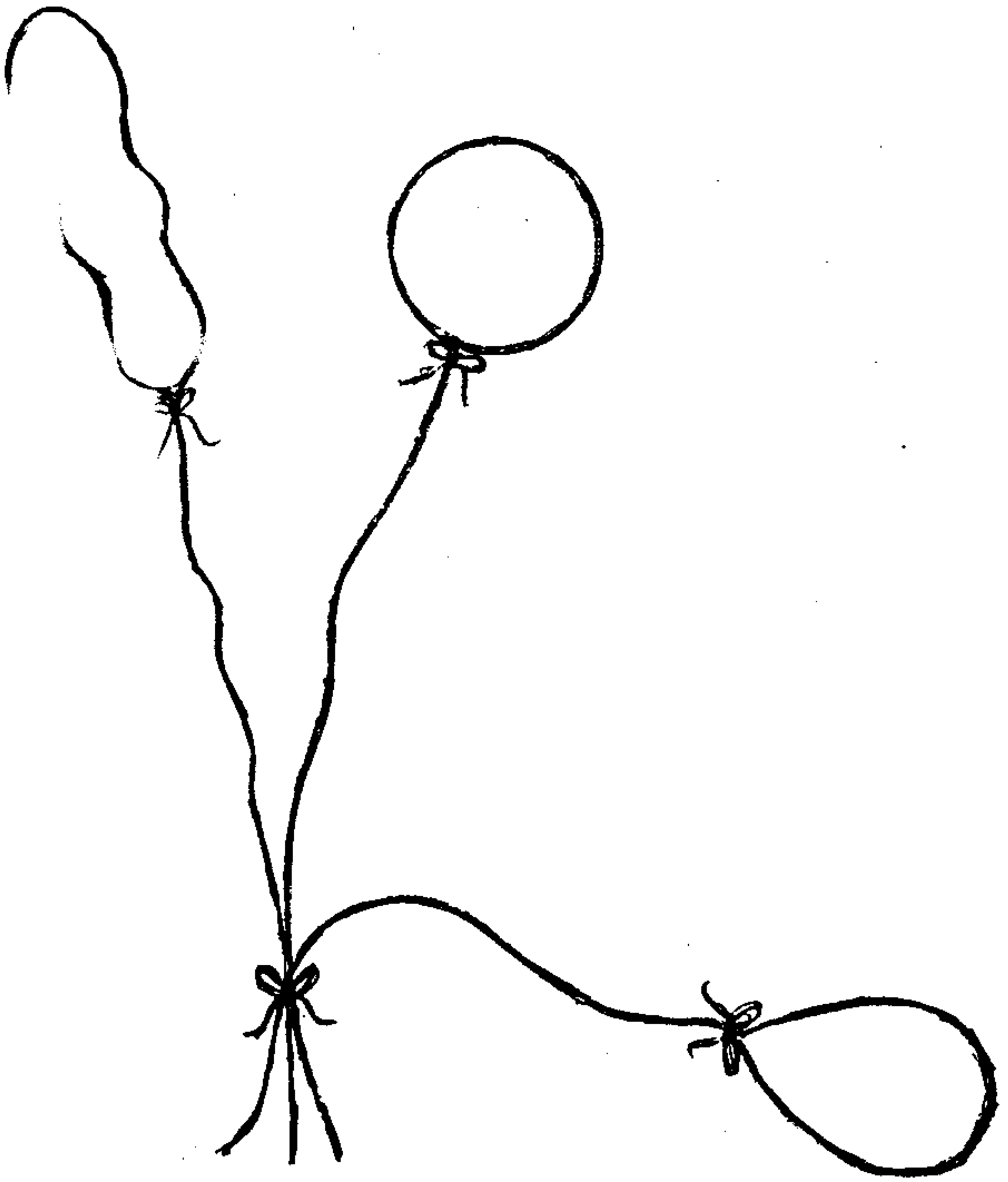
MONA, RONA AND SONA

Mona, Rona and Sona are balloons
Violet Mona is long
Red Rona is round
Green Sona is oval and lie on ground.

SCORE:

Violet Mona......................
Red Rona........................
Green Sona......................
Ground (Sona)....................
% correct.......................

Colour - **'MONA, RONA AND SONA'**



LEPSI BA....

Lepsi Ba is a green bottle
with water, which is so little
It has an orange lid
and played by a blue kid.

SCORE:

Green bottle......................
Little water......................
Orange lid ....
blue kid.......................
% correct........................

Finish the picture of **'LEPSI BA. . . '**

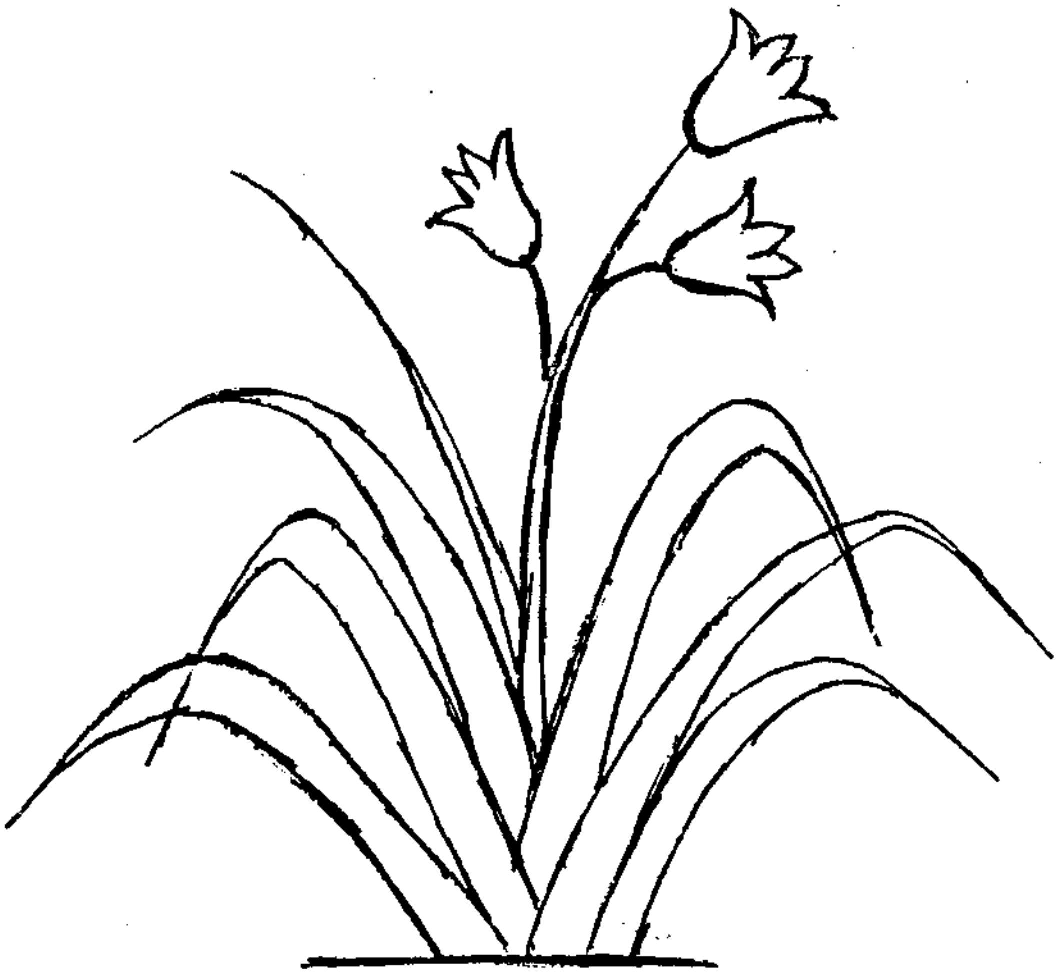
SALFLORA

Salflora is an orange plant
On that runs a blue ant
On it blooms red and green flowers
Which are very rare.

SCORE:

Orange plant.....................
Blue ant.........................
Red flowers......................
Green flowers....................
% correct........................

Finish the picture of **'SALFLORA'**



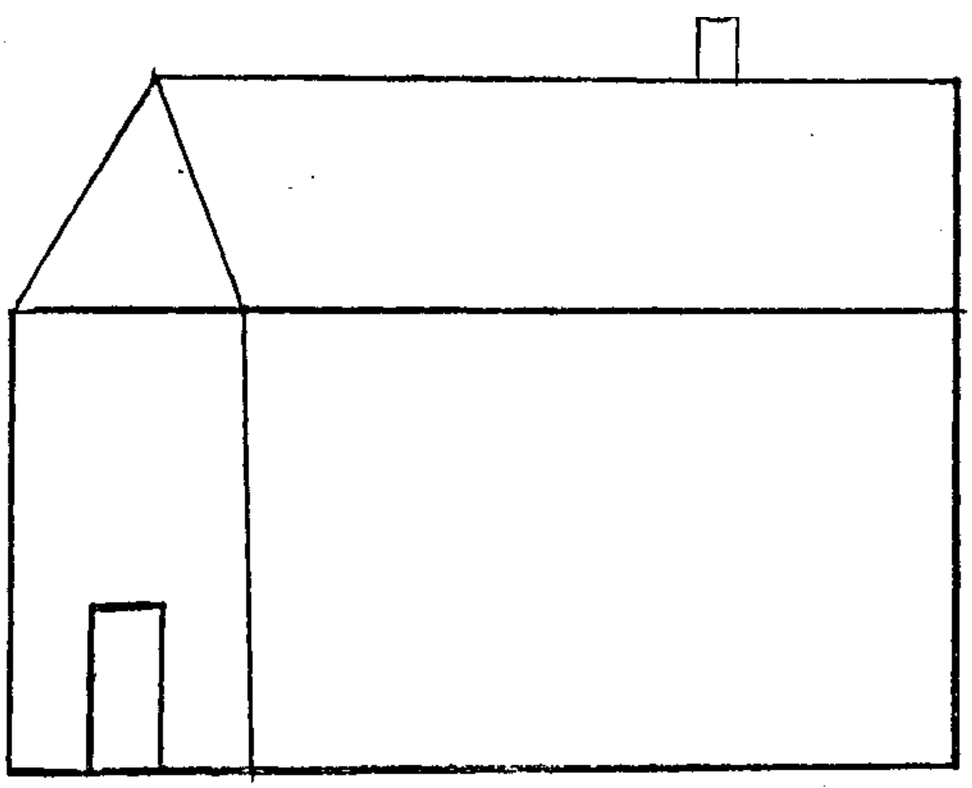
METTLE HOUSE

Mr. Cuttle lives in Pink Mettle House
Which is full of red little mouse
It has a brown roof
Which is water proof.

SCORE:

Pink house........................
Red mouse.........................
Little mouse......................
Brown roof........................
% Score...........................

Complete the picture of **'METTLE HOUSE'**



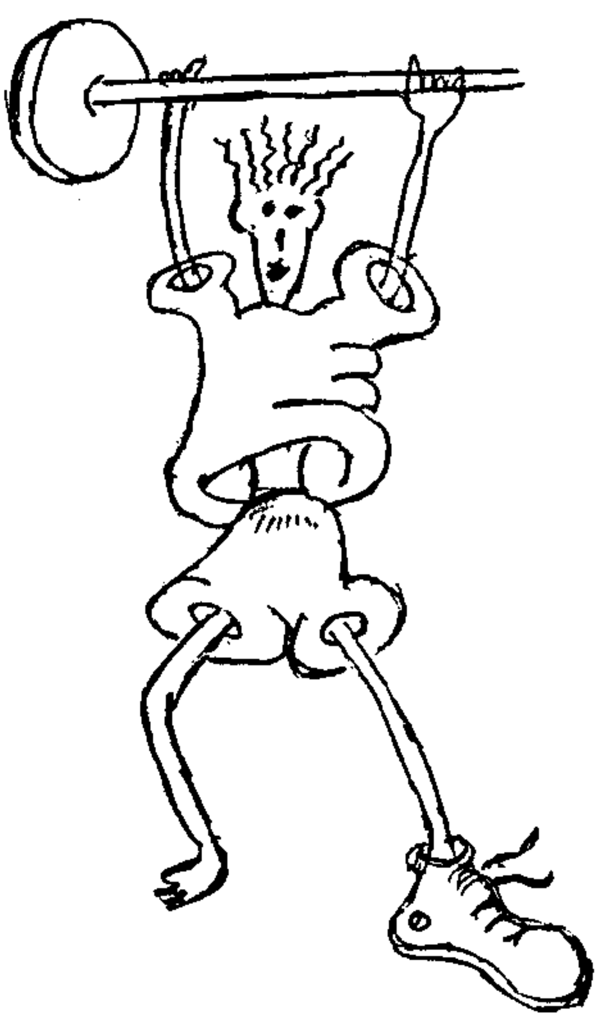
MECKEROLA

I am a weight lifter
also a football kicker
who lost a shoe
which was blue.

SCORE:

Weight lifter.....................
Football..........................
Shoe.............................
Blue shoe.........................
% correct.........................

Complete the picture of **'MECKEROLA'**



DUCKLEY JOLL

Duckley Joll has a small face
with sharp beak
It stands with one leg
and lays three eggs.

SCORE:

Small face........................
Sharp beak........................
One leg...........................
Three eggs........................
% correct........................

Draw a **'DUCKLEY JOLL'**

GRANDPA BELL

Grandpa Bell is old
and wears a ring of Gold
He walks with a stick
which is thick.

SCORE:

Old...............................
Gold ring.........................
Stick.............................
Thick stick.......................
% correct.........................

Draw the picture of **'GRANPA BELL'**

DOSSEN ZAFFOON

Miss Dossen Zaffoon
Born with a golden spoon
She wears yellow dress and looks very fat
And she always blinks like a cat.

SCORE:

Golden spoon......................
Yellow dress......................
Very fat..........................
Blinkslike cat....................
% correct.........................

Draw a **'DOSSEN ZAFFOON'**

TERORRA

Terorra looks like a purple tiger
has two small blue ears
He opened his big mouth
to eat an orange moth

SCORE:

Purple tiger.......................
Small ears........................
Blue ears.........................
Big mouth.........................
Orange moth.......................
% correct.........................

Complete the picture of **'TERRORA'**

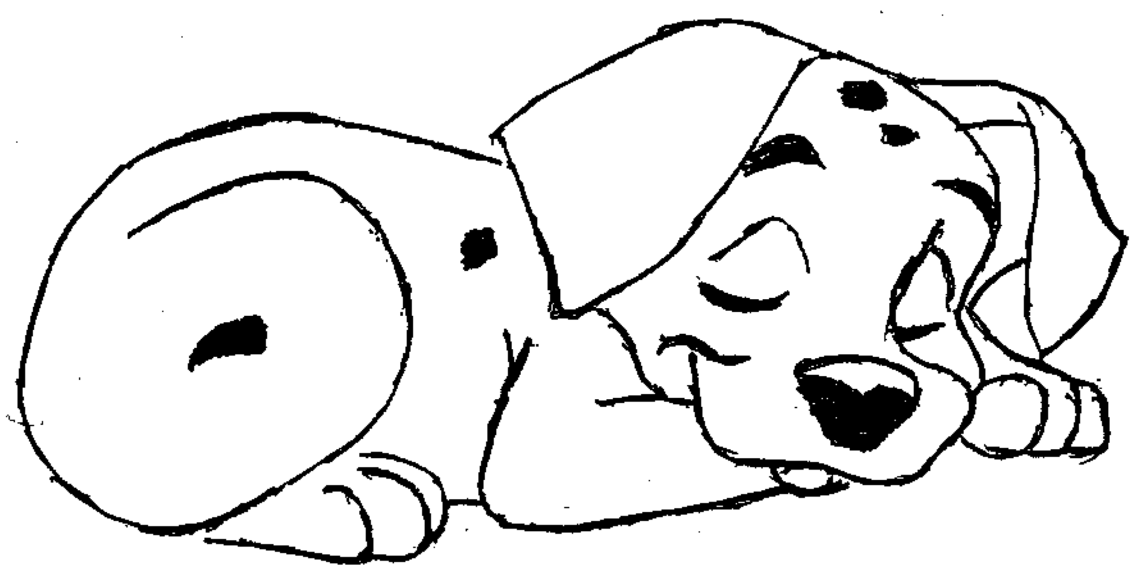
AISNEY

Aisney looks like a puppy
Has black spotted body
with two straight tails
Her fingers has sharp nails.

SCORE:

Spotted body......................
Black spots......................
Two tails........................
Straight tails....................
Sharp nails......................
% correct........................

Finish the picture of **'AISNEY'**



STRIPED RED FISH

Near a huge purple dish
I saw a striped red fish
in a orange pot
and the water was hot.

SCORE:

Purple dish......................

Striped fish.....................

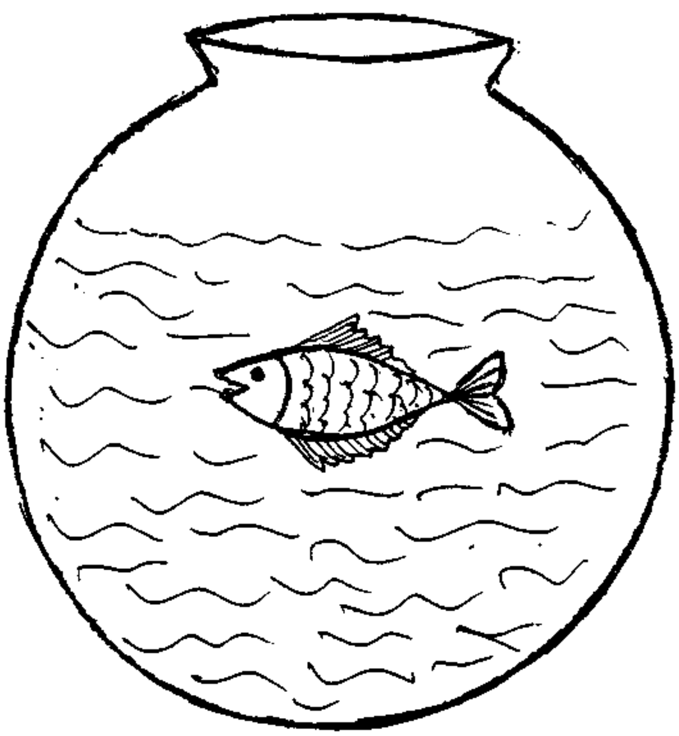
Red fish........................

Orange pot.......................

Hot water........................

% correct........................

Finish the picture of **'STRIPPED RED FISH'**



RHINOPUS

Rhinopus lives in water
and look fatter
It has a big nose
and 6 legs of 3 rows.

SCORE:

Water............................
Fatter...........................
Big nose.........................
6 legs...........................
3 rows...........................
% correct........................

Draw a picture of **'RHINOPUS'**

GRAPBERRY

Grapberry is a grey creeper
On it always stands a green grasshopper
It has grapes and strawberry
They are plucked by Tom Jerry.

SCORE:

Grey creeper......................
Grass hopper......................
Green grasshopper.................
Grapes............................
Strawberry........................
Tom Jerry.........................
% correct.........................

Finish the picture' of **'GRAPBERRY CREEPER'**

CUNNING MOUSE

Cunning mouse has a blue cap
Walks around with a long tape
He wears a checked shirt
and it is full of dirt
He has a long tail
and wears a big red shoe without fail

SCORE:

Blue cap........................
Long tape........................
Checked shirt....................
Dirt.............................
Long tail........................
Big shoe.........................
Red shoe.........................
% correct........................

Finish the picture of '**CUNNING MOUSE**'

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