Auditory Processing Disorders

Purpose

This technical assistance paper (TAP) was written to assist audiologists in the educational setting in responding to frequently asked questions concerning audiological auditory processing (AP) evaluations. A task force of public school audiologists prepared this TAP to assist public school personnel in establishing district procedures for a comprehensive diagnostic audiological AP evaluation, re-evaluation, and identification of behaviors that may affect classroom performance. It also includes suggestions for management of an auditory processing disorder (APD).

Auditory processing disorder is a controversial issue in the educational setting. As a result of widespread concern, a national conference was held in April 2000 with the intent of reaching a consensus on problems related to the diagnosis of auditory processing disorders in children. One outcome was a change in terminology from central auditory processing disorder (CAPD) to auditory processing disorder (APD). The following issues described by Jerger & Musiek (2000) provide an overview of the issues related to APD discussed at this landmark conference.

> The reality of auditory processing disorders (APD) in children can no longer be doubted. There is mounting evidence that, in spite of normal hearing sensitivity, a fundamental deficit in the processing of auditory information may underlie problems in understanding speech in the presence of background noise, in understanding degraded speech, in following spoken instructions, or in discriminating and identifying speech sounds. The challenge to the audiologist is the accurate diagnosis of the disorder. But rising interest in APD has been accompanied by mounting concern in two areas; first, the realization that children may fail auditory tests for a variety of non-auditory reasons; second, the tendency to diagnose the disorder when the child fails only a screening test, rather than a systematic battery of diagnostic measures. (Jerger & Musiek, 2000.)

Audiologists are trained to evaluate the entire auditory system, both peripheral and central, and to consider possible disorders involving both areas. The evaluation of auditory processing is included in the scope of practice for audiologists and documented in numerous guidelines and regulations including the licensure of audiologists in the State of Florida (ASHA, 1996, 1997; Educational Audiology Association, 1997).

Although students with central auditory processing disorders (CAPD) are a heterogeneous group, students with CAPD have a significant scatter in ability, intelligence, or performance on achievement tests. Chermak and Musiek (1997) estimate that the prevalence of CAPD is two percent to three percent of children, with a 2:1 ratio between boys and girls. When identifying behaviors related to auditory processing, it is important to distinguish between statistical and educational significance. By interpreting performance from the audiological battery of evaluations and classroom observations, school personnel can determine if the multidisciplinary team needs additional information. If it is determined that a student needs special assistance in the classroom, information from audiological evaluations and classroom observations may assist in developing a 504 plan or revising an individual educational plan (IEP) to include instructional accommodations.

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Division of Public Schools
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Bureau of Instructional Support
and Community Services

Refer Questions To:
Lezlie Cline
(850) 488-1106 or SC 278-1106

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This TAP includes questions and answers to address CAP audiological evaluation procedures and the appendices provide additional information on CAPD. The specific Resources in the appendices are the following:

Appendix A: Summary of Audiological Tests of Auditory Processing (CAP)

Appendix B: Sample Forms for Use in the Evaluation and Management of CAP/D

- Descriptions of student and classroom observation forms.
  - *Fisher's Auditory Problems Checklist*
  - *Children's Auditory Performance Scale (CHAPS)*
  - *Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.)*
  - *Pre-kindergarten Screening Instrument for Targeting Educational Risk (Pre-K S.I.F.T.E.R.)*
  - *Evaluation of Classroom Listening Behaviors (ECLB)*
  - *Listening Environment Profile*
- Forms adapted or developed by the Audiology Task Force on Central Auditory Processing Disorders (CAP/D)
  - CAP Referral Form
  - CAP Case History
  - Central Auditory Processing Disorders (CAPD) Accommodations and Modifications Checklist
  - Information for Parents about CAP Observations and Tests
  - CAP Profile Chart
  - Classroom Environment Checklist
  - Medical Clearance Form for Use of FM System
  - Permission to Use Auditory Amplification
  - FM System Pre-Trial Appraisal
  - FM System Appraisal: Post-trial or Annual Review
  - Student Appraisal of FM System

Appendix C: Information on CAPD for Professionals and Parents

- Characteristics of Children with Possible Central Auditory Processing Disorders
- Ways CAP Problems Can Influence Reading
- Characteristics of Subprofiles of CAPD
- Suggestions for Successful Management of Children with CAPD: Tips for the Classroom Teacher
- Central Auditory Processing Management: Tips for Parents
- Modifications to Improve Classroom Acoustics
- An Inservice for Staff and Students on Personal FM Systems

Definitions

1. What is auditory processing?

Very simply, auditory processing is what the brain does with what the ear hears (Katz, 1994). The following definitions of auditory processes (and auditory processing disorder) are from the 1996 ASHA Consensus Statement on APD. *Auditory Processes* are the auditory system mechanisms and processes responsible for the following behavioral 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 decrements with competing acoustic signals
- auditory performance decrements with degraded acoustic signals

These mechanisms and processes are presumed to apply to nonverbal as well as verbal signals and to affect many areas of function, including speech and language. They have neurophysiological as well as behavioral correlates. Many neurocognitive mechanisms and processes are engaged in recognition and discrimination tasks. Some are specifically dedicated to acoustic signals, whereas others (e.g., attentional processes, long-term language representations) are not. With respect to these non-dedicated mechanisms and processes, the term auditory processes refers particularly to their deployment in the service of acoustic signal processing.

2. What are auditory processing skills?

There is a hierarchy of auditory skills that is basic to the listening and communication process. Although sequential in development, each of these skills overlap and are essentially inseparable (Bellis, 1996; Educational Audiology Association, 1996; DeConde, 1984; Gillet, 1993; Keith, 1995).

- *Sensation* is the ability to identify the presence of sound.
- *Discrimination* is the process used to discriminate among sounds of different frequency, duration, or intensity (e.g., high/low, long/short, loud/soft). A problem with auditory discrimination can affect following directions, reading, spelling, and writing skills.
- *Localization* is the ability to determine the location of the acoustic signal relative to the listener's position in space. Being able to determine where the sound originates contributes to one's general listening effectiveness.
- *Auditory attention* is the ability to direct attention to relevant acoustic signals, particularly speech or linguistic stimuli, and sustain that attention for an age-appropriate amount of time.
- *Auditory figure-ground* is the ability to identify the primary linguistic or non-linguistic sound source from a background noise. During classroom instruction, for example, the teacher's voice is the primary signal and student's conversations and other noises in the room comprise the competing noise. When the primary signal and the noise levels are nearly equal, listening distress easily can occur.
- *Auditory discrimination* is the skill necessary to discriminate among words and sounds that are acoustically similar. When noise is present it becomes increasingly difficult to discriminate between acoustically similar words such as *fin/thin* or *sun/fun* without possibly relying on additional visual clues or contextual clues.
- *Auditory closure* is the term used to describe the ability to understand the whole word or message when a part is missing. In noisy listening environments this skill is often used to comprehend messages. For adults with a rich language and experience base, this task is much easier than it is for students who are building language skills.
- *Auditory synthesis* is the ability to synthesize (i.e., merge or blend) isolated phonemes into words. Auditory synthesis is critical to the reading process.
- *Auditory analysis* is the ability to identify phonemes or morphemes embedded in words. This skill is important for distinguishing verb tenses (e.g., *worked* vs. *works*) and other morphological markers that may be acoustically distorted or masked by background noise.
- *Auditory association* is the attachment of meaning. It requires the listener to identify an acoustic signal and associate it with its source or to label a linguistic or non-linguistic sound or experience. Auditory association is a fundamental skill for developing auditory memory.
- *Auditory memory* refers to the recall of the acoustic signal after it has been labeled, stored, and then recalled. This skill also requires remembering and recalling various acoustic stimuli of different length or number. Some information must be recalled in exact order to be useful. Auditory memory skills involve both short- and long-term storage and recall. *Auditory short-term memory* is the ability to retain auditory information as immediately presented. *Auditory sequential memory* is the ability to recall the order of a series of details.

3. What is auditory processing disorder (APD)?

Auditory processing disorder is a sensory processing deficit that commonly impacts listening, spoken language comprehension, and learning (ASHA, 1996). More than one definition is included to accommodate individuals with different levels of APD awareness.

Auditory processing disorder is the inability or decreased ability to attend to, discriminate among or between, recognize, or understand auditory information. Most language is learned by listening. In order to learn, a student must be able to attend to, listen to, and separate important speech from all the other noises at school and home. When auditory skills are weak, the student may experience auditory overload. This makes learning more challenging and sometimes too difficult without special assistance. Most people with auditory processing problems have normal intelligence and normal hearing sensitivity.

The ASHA Consensus Committee (1996) defined **auditory processing disorder (APD)** as an observed deficiency in one or more of the following behaviors: 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 decrements with competing acoustic signals; auditory performance decrements with degraded acoustic signals. For some persons, APD is presumed to result from the dysfunction of processes and mechanisms dedicated to audition; for others, APD may stem from some more general dysfunction, such as an attention deficit or neural timing deficit, that affects performance across modalities. It is also possible for APD to reflect coexisting dysfunction of both sorts (ASHA, 1996).

4. What are the causes of auditory overload?

Students with APD are often overwhelmed by auditory overload. Factors contributing to auditory overload are the following (Freil-Patti, 1995; Katz, 1997; Sloan, 1986, 1998):

- brevity of signal or signal components
- fast rate of speaking
- rapid presentation rate of new information
- increased phonetic complexity (e.g., consonant clusters, unstressed syllables, multiple syllables)
- increased acoustic/phonetic similarity among signals (e.g., rhyming words, phonetically similar syllables)
- reduced context (e.g., linguistic, visual, situational)
- decreased word familiarity
- increased length of decontextualized material
- poor listening conditions (e.g., noise backgrounds, distance from speaker, reverberation)
- temporal distortions (e.g., time, rate)
- increased specificity of expected response
- increasing task uncertainty (e.g., open response sets)
- demand for verbatim retention or recall

Evaluation Consideration

5. Why conduct audiological AP evaluations?

Students referred for an audiological evaluation due to concerns about learning or listening may require an AP evaluation to help determine if special services or assistance are needed to meet their educational needs. Reasons for conducting an audiological CAP evaluation include the following: determining if there are medical aspects of the disorder that may require treatment; increasing awareness of the presence of a disorder that can truly affect a student's ability to learn; and minimizing psychological factors affecting the student and family. Identifying the presence of a disorder will promote appropriate educational planning. An audiological AP evaluation also may help in determining and implementing effective educational interventions (Musiek et al., 1990). These interventions may include: 1) environmental modifications, 2) management strategies, 3) auditory training, or 4) Frequency Modulation (FM) assistive listening devices.

6. What are factors to be considered when a student has been referred for an audiological AP evaluation?

- **Age of student.** Due to the neuromaturation of the central auditory pathways, caution must be taken in the assessment of young students. Screening for APD generally is not appropriate until a student is three or four years old. Caution in the assessment of students under the age of seven is recommended due to a high

degree of variability in their performance on CAP tests (Bellis, 1996). This variability is most likely due to neuromaturational differences in the auditory nervous systems (ANS) of young students. If the ANS are immature, the system may be unable to handle higher level auditory processing tasks. There are, however, some AP tests for the five to seven year old student. Refer to appendix A for a description of AP tests.

- **Peripheral hearing.** Hearing sensitivity must be in the normal range or the student must be cleared by an audiologist for AP evaluation if there is any degree of hearing loss or asymmetry between the ears. Many AP tests cannot be administered to students with peripheral hearing loss; however, some AP instruments are somewhat resistant to the effects of peripheral hearing loss and thus may be administered. Electrophysiologic tests may also be useful for students with peripheral hearing loss. Although information on AP abilities may be incomplete due to peripheral hearing loss, the information that is obtained may be useful in identifying auditory problems and sensory loss and assist in the comprehensive management of the student's auditory problems.

- **Cognitive ability.** Performance on auditory tasks is greatly affected by cognitive ability. It is recommended any student assessed have learning potential within the normal range. It is important to interpret AP test results with reference to the student's mental age (MA) in instances where the student's cognitive level is less than 100.

- **Language competence.** Students with weak language skills typically have more difficulty with AP tasks, particularly those requiring more sophisticated language processing (i.e., linguistically loaded tasks). Results must be interpreted with caution when evaluating students with language delays or disorders. Likewise, caution must be exercised in the evaluation of students for whom English is a second language, since there are no AP tests standardized in languages other than English. For these students, it is advisable to use tests with nonverbal stimuli.

- **Phonology.** The majority of audiological AP tests require a verbal response. Therefore, the student's speech must be highly intelligible.

- **Other Presenting Conditions.** Consideration should be given to neurological conditions, social/emotional maturity, attention span, motivational level, and other special needs or conditions (e.g., attention deficit hyperactivity disorder [ADHD]). AP evaluation of the student with ADHD can be clinically challenging. If the student is taking central nervous system (CNS) medication on a daily basis, the student should have medication when the AP evaluation is done (Tillery, 1998).

- **AP Screening.** If the student has passed an audiological AP screening, careful consideration should be given as to whether a comprehensive diagnostic evaluation is indicated.

- **Multidisciplinary assessment.** Audiological AP assessments should not occur in isolation from other psycho-educational and psycho-linguistic screenings or evaluations. Consideration should be given to all factors affecting a student's performance in order to view the student's strengths and weaknesses holistically. The audiologist should consider all information from the multidisciplinary assessment in conjunction with the audiological AP evaluation results to determine the factors that may contribute to the disturbance of auditory behaviors (e.g., cognitive, linguistic, social/emotional).

Differentiating APD from Other Conditions

7. Is there a difference between APD and attention deficit hyperactivity disorder (ADHD)?

Recent research studies have shown that APD and ADHD have distinctly different diagnostic profiles (Chermak, Somers & Seikel, 1998; Chermak, Hall & Musiek, 1999). Behavioral characteristics of the two disorders have been clearly differentiated. However, two behavioral manifestations are common to both conditions — inattention and distractibility. There are major differences between ADHD and APD. ADHD is an output disorder that involves the inability to control behavior, whereas APD is considered to be an input disorder that impedes selective and divided

auditory attention (Chermak, Hall & Musiek, 1999). Most students with APD do not have ADHD, but many students with ADHD have symptoms of APD (Tillery, 1999). Nonetheless, for some students, both conditions exist. In these comorbidity cases, management strategies depend on the diagnostic category of the primary disorder (Chermak, Hall & Musiek, 1999).

AP Screening and Evaluation

8. Is there a difference between APD and specific learning disability (SLD)?

By definition, auditory processing disorder and learning disability are heterogeneous conditions (Chermak & Musiek, 1997). The important issue here is whether the student exhibits a specific learning disability in auditory processing and/or whether the AP evaluation results suggest the presence of a deficit in auditory processing, that is, specifically an input problem. It is important to remember that for some students diagnosed with a learning disability that the problems may be of a more global nature, that is, a generalized difficulty in learning that affects other areas of processing (e.g., visual, motor, auditory). It is possible for a student to present with deficits that would support the presence of both conditions. In order to determine which of the conditions may be present and to determine the clinical and educationally relevant distinctiveness of the conditions, a multidisciplinary evaluation is indicated. Sometimes a student may be eligible for an SLD program based on a deficit in auditory processing, but not show a deficit on audiological tests of auditory processing. While a student with a learning disability may process linguistic auditory information differently than his/her peers, this behavior would not necessarily suggest that the student has an APD.

9. Are there audiological AP screening tests?

There are audiological AP screening tests; however, auditory processing disorder *cannot* be identified by an AP screening alone. An audiological AP screening determines if the student demonstrates age-appropriate skills by passing the screening or whether results indicate referral for a diagnostic audiological AP evaluation. Descriptions of frequently used audiological AP screening tests listed below may be found in Appendix A.

- *Screening Test for Central Auditory Processing Disorders in Children (SCAN-C)*
- *Screening Test for Central Auditory Processing Disorders in Adolescents and Adults (SCAN-A)*
- *Dichotic Digits Test (DDT)*
- *Selective Auditory Attention Test (SAAT)*
- *Pediatric Speech Intelligibility Test (PSI)*
- *Test of Auditory Perceptual Skills (TAPS)*

10. What is the protocol for a comprehensive diagnostic audiological AP evaluation?

The protocol includes the referral process, case history, a peripheral audiological evaluation, and an audiological AP test battery.

- **Referral**

  Anyone may initiate a referral for an audiological AP evaluation; however, ideally the referral should come from the school's Student Study Team (SST) or an Exceptional Student Education (ESE) team member. Information accompanying the referral may include: evaluation data (e.g., psycho-educational evaluation, speech-language evaluation, specific learning disability (SLD) process testing, other evaluative data or medical information); anecdotal records; classroom and auditory behavior observation checklists; and AP screening test results. Observation checklists may include: Fishers *Auditory Problems Checklist, Children's Auditory Performance Scale (CHAPS), Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R..) or Preschool S.I.F.T.E.R.* Refer to Appendix B for a description of these and other observation instruments and a sample AP referral form.

- **Case History**

  It is important to obtain a thorough case history prior to an AP evaluation. Parents can become actively involved in the evaluation process by providing information about their student and by identifying areas of concern, thereby providing guidance in test selection. Case history information also may be useful in

interpreting the AP evaluation and will most likely offer some guidance for managing students with a APD (Hall & Mueller, 1997; Johnson, Benson & Seaton, 1996; Willeford & Burleigh, 1985). A sample AP Case History is in appendix B.

- **Complete Audiological Evaluation**
  An audiological evaluation should include the following: air and bone conduction thresholds, Spondee Threshold, immittance audiometry, ipsilateral and contralateral reflexes, and speech recognition testing in quiet and in noise. Speech in noise tests compromises the speech signal by adding background noise to the signal. A frequently used signal-to-noise (S/N) is +5 dB HL with speech being delivered at 50 dB HL. Adult listeners require a S/N of at least +6 dB for maximum communication to occur. Subsequently, many researchers have estimated that children require at least a +10 dB S/N to achieve speech recognition at a level comparable to adult listeners (Berg, 1993; Crandell & Flexer, 1994; Lewis, 1994). Factors in speech in noise tests are: choice of word list, intensity level of the primary signal, signal-to-noise ratio, type of competing noise (e.g., speech noise, multitalker noise), type competition (e.g., ipsilateral, contralateral), and method of presentation (e.g., monitored live voice, recorded). Caution must be used in the interpretation of speech recognition test results obtained in noise due to the high degree of variability in these tests. In addition, these tests have been shown to be marginally sensitive to APD and are often the most misused test of auditory function (Colorado Department of Education, 1997; Mueller & Bright, 1994). Bodkin, Madell and Rosenfeld (1999) designed a speech-in-noise test paradigm. Their results suggest that most children should perform no worse than 86 percent in the sound field at a 0 dB S/N. However, it is important that each audiology facility uses consistent procedures for testing word recognition ability in noise.

- **AP Test Battery**
  In selecting tests for the audiological AP battery, criteria established by the ASHA Consensus Statement on Auditory Processing (ASHA, 1996) should be considered.
- Tests should be selected based on referring complaints or other relevant information.
- Individual tests should examine different central processes.
- Selected tests should include both verbal and nonverbal stimuli to examine different levels of auditory processing and the central auditory nervous system (CANS).
- Individual tests should be reliable, valid, and age-appropriate.
- The duration of the test session should be appropriate for the student's attention span and motivation.

  The battery shall include both linguistically loaded and non-linguistically loaded tests. At least one test from each of the four behavioral categories below should be included in the AP battery, if age-appropriate. Results of speech-in-noise tests should be considered along with tests in the AP battery in assessing the student's AP profile. Electrophysiologic tests may provide additional information about the integrity of the central auditory nervous system (CANS). Refer to appendix A for a detailed description of the test categories and individual test instruments.

- **Dichotic.** Dichotic tests present a different stimulus to each ear simultaneously. Dichotic speech tests may assess either binaural integration or binaural separation.

- **Low-redundancy monaural speech.** Monotic, low-redundancy speech tests involve modification (distortion) of the acoustic (extrinsic) signal to reduce the amount of redundancy.

- **Temporal processing.** Monotic tone tests are also used to measure the student's ability to use each ear independently, with the stimuli for these tests being tones rather than speech. Most of these tests focus on the student's pattern perception and temporal functioning abilities.

- **Binaural interaction.** These tests are diotic in that the stimuli are presented to each ear at the same time; however, the information is presented in either a non-simultaneous, sequential manner or so that a portion of the message is presented to each ear. Tests of binaural integration or interaction are effective in evaluating the integration between the two ears.

- **Electrophysiologic tests.** Electrophysiologic tests measure the neuromaturation and neuroplasticity of the central auditory pathways. This information will be important in the differential diagnosis process for some students.

11. What criteria are used to identify an educationally significant APD?

The student must meet the following two criteria in order to be identified as having an educationally significant APD:

- scores that are below the age-corrected normal region (-1.5 standard deviation [SD]) for one or both ears on at least two different procedures
- evidence of difficulty in the academic setting based on observation, multidisciplinary assessment, and academic performance

12. What is the recommended reevaluation for a student identified with APD?

For all students in an Exceptional Student Education (ESE) program, re-evaluation is required every three years, and if the IEP team recommends it, an AP reevaluation may be a part of that formal process The audiological reevaluation procedure should include a peripheral audiological assessment, an AP reevaluation, and observation checklists. If the student is using a FM system, the reevaluation should include monitoring the use of this equipment.

13. What should occur when a district receives a report that diagnoses a student with a APD?

The report should be reviewed by an audiologist who will share impressions and recommendations with the SST. The audiologist determines if the audiological AP assessment is of sufficient scope and intensity. At that point the SST should determine if additional evaluations (e.g., psycho-educational, speech-language) are needed to determine if the student is eligible for a special program or if a 504 plan is needed. A student may need accommodations or modifications in the educational setting. Refer to appendix B for recommended accommodations and modifications for students with an APD.

Management Considerations

14. What are some factors to be considered in developing a management plan for a student diagnosed with an APD?

APD management, like assessment, should be multidisciplinary in nature. Comprehensive management of an APD must occur because of the range of listening and learning difficulties associated with this complex group of disorders (Chermak, 1996). The extent to which each person (e.g., audiologist, speech-language pathologist, psychologist, learning disabilities specialist, social worker, regular classroom teacher, parent) is involved depends on the nature of the disorder and the functional manifestations of the disorder (Bellis, 1996; Keith, 1996; Zarella, 1995). An integrated collaborative management approach should produce the best results for the student.

Generally, the primary goal is to improve the ability of a student with an APD to process or use auditory information. Thus, the management of APD should focus on improving the student's learning and listening skills, providing accommodation strategies in the environment, and remediating the disorder. Bellis (1996) states that every APD management program should include components from each of these categories; however, the overall management plan should be individualized and based on the individual student's AP profile and observed behaviors.

- **Student's Internal Motivation**
  Many students diagnosed with APD are described by parents, teachers, and peers as being passive or inactive listeners because they cannot attend selectively and utilize comprehension strategies (Bellis, 1996; Chermak & Musiek, 1992). By the time a student is diagnosed with an APD, he or she may not feel successful in school or at home as a participant in discussions. It is important to help the student understand the nature of his or her APD deficits. The student will need assistance analyzing difficult listening

situations, learning how to become an active participant, and learning self-advocacy skills. The above also will help to improve the student's motivation and control.

- **Not a "One-Size-Fits-All" Management Plan**
  It is not recommended that a preprinted "one-size-fits-all" list of suggestions be given to parents and teachers of students with an APD. A lengthy list of recommendations tends to be overwhelming or confusing and often results in inappropriate accommodations being made by teachers and parents. See appendix C for a comprehensive listing of strategies and modifications.

- **Partnership with the Classroom Teacher**
  It is critical to obtain the support and cooperation of the classroom teacher to ensure that effective classroom management recommendations are implemented. If the teacher is unconvinced of the need for classroom modifications, or feels that modifications or accommodations are unfair to the other students (or the teacher), it is unlikely that this teacher will fully implement management suggestions on a daily basis. Thus, classroom teachers must be included as part of the management team in all aspects of assessment and management of APD. In addition, teachers and other professionals should be provided with insightful information about the nature of the student's AP disorder and the underlying theoretical basis for suggested management approaches. The management team will provide the teacher with additional specific management strategies based on the student's profile of strengths and weaknesses.

- **Parents as Partners in APD Management**
  Providing parents with information about the nature of the their child's AP disorder as, well as the underlying theoretical basis for suggested management approaches, gives parents the opportunity to play an important role in the management of their child with a central auditory processing disorder. *Auditory Processing Management: Tips for Parents* may be found in appendix C.

15. What is the role of the audiologist in managing students with APD?

The *Recommended Professional Practices for Educational Audiologists* (EAA, 1997) include the following statements regarding the role of the educational audiologist in the assessment and management of auditory processing disorders: 1) provide identification and assessment information, ideally as a member of an interdisciplinary team, for students suspected of having APD; and 2) provide information to the student, parents, teachers, and other school personnel concerning auditory strengths and limitations of the student with APD, as well as possible learning and teaching strategies for the classroom and other learning environments that assist the student with an APD to learn and manage the auditory environment to his or her best advantage. Counseling parents about what an APD actually means to the student can be one of the audiologist's most important contributions to the overall process (Jerger, 1998). Counseling helps the student and parents to understand *how* these difficulties impact learning and academic performance and *why* it is important to focus on developing compensatory strategies.

A. Evaluation and/or interpretation of AP test results and educational relevance

The school district may want to develop a written policy regarding audiological AP evaluation. The evaluations may be on-site or contracted with an outside entity. However, the district's audiologist should be present at the SST meeting to interpret the audiological AP results. Results may be displayed on a worksheet to show a "visual" AP profile (see appendix B for sample AP profile forms).

When interpreting AP evaluations, it is important to determine educational relevance of the evaluation results and any special assistance the student may need. The issue of clinical significance versus statistical significance is one that must be addressed in relation to the educational setting (Whitelaw, 1999).

1. Is there evidence of an AP disorder based on the multidisciplinary assessment?
2. Does the severity of the disorder support the need for special education and/or related services?
3. What are the characteristics of this student's AP profile?
4. What services might be considered for the student (e.g., assistive listening device, speech-language therapy, audiological monitoring, counseling, special educational service)? The IEP team or the 504 committee determines specific educational services for the student.

B. Communicate with members of the multidisciplinary team

At SST and other educational meetings the audiologist reviews data, discusses remediation strategies, provides recommendations for further evaluation or reevaluation, and suggests informational strategies. The educational audiologist also assists in evaluating the appropriateness of management recommendations from audiologists in settings external to the school district. It is helpful to refer to the following sources of information when recommending appropriate strategies: 1) the student's APD test profile (i.e., audiological, speech-language, psycho-educational, observational) and 2) the characteristics of the subprofiles of APD. See appendix C.

When a student arrives from outside the district and has a recommendation for use of an FM system, this recommendation should be reviewed in conjunction with the student's complete AP profile. A FM system is not suitable for every student with an APD, and, in fact, is inappropriate for some students. Bellis (1996) states that only those students for whom access to and decoding of auditory input is an issue will benefit significantly from auditory equipment designed to improve access to auditory information. Conversely, students with integration deficit, associative deficit, or output-organization deficit will be likely to demonstrate the same difficulty with auditory information whether access to the initial message is improved or not. Another frequent recommendation is for the teacher or parent to rephrase or repeat auditory information. Whether this strategy is effective depends on the specific deficit(s) the student demonstrates as well as how information is repeated or rephrased.

The audiologist can provide ongoing assistance to teachers concerning the student's learning needs. Best practice suggests the periodic use of checklists such as the *S.I.F.T.E.R.* in the academic setting in order to monitor auditory and other school-related behaviors, as well as changes that might be observed as a result of FM use. Districts that contract for audiological services may wish to consider including responsibilities such as interpretation of auditory processing evaluation and participation in SST and IEP meetings.

C. Monitoring the Classroom Environment(s)

The audiologist should survey the classroom environment and make suggestions for acoustical modifications as appropriate. To make acoustical modifications, contact the district's facilities department or look in a local telephone directory for "acoustical engineering." Refer to appendix B. Although there are national guidelines available, there are currently no appropriate acoustical standards for educational facilities. Special interest groups and the Americans with Disabilities Access Board are collaborating to develop reasonable acoustical standards for educational environments.

D. Management of FM Equipment

Use of a FM system in the classroom is one component of a comprehensive and multidisciplinary management strategy (Hall and Mueller, 1997). The FM system should enhance the effectiveness of other management strategies. FM systems are often recommended for a student when the AP evaluation indicates that the student has a problem with understanding speech in the presence of competing noise. FM systems can minimize the effects of competing noise. Best practices indicate that *only* an audiologist should select and fit an individually worn FM system on a student diagnosed with APD. Medical clearance should be obtained for a student before an FM is fitted. Assistive listening devices (i.e., a FM system) are not appropriate for all students who have an APD (Ferre, 1999). For instance, if a student has a processing problem with auditory association, the student heard what was said but did not understand it. Likewise, the student with an auditory integration deficit heard what was said but can not pull all the information together. Making speech louder improves neither linguistic comprehension nor the ability to "get the big picture." Typically, unless a student demonstrates significant difficulty understanding speech-in-noise in both the clinical and educational environments, a FM system is *not* an appropriate recommendation as a APD management strategy.

If the recommendation is for a sound field FM system rather than an individually worn FM system, the audiologist may facilitate the placement of the equipment. Medical clearance is not required for use of a sound field system. Following is a summary of the recommended protocol for selecting and fitting of a FM system for use by students diagnosed with an APD.

1) *Medical clearance.* Obtain medical clearance from the student's physician prior to fitting. Refer to the medical clearance form in appendix B.

2) *Permission to use FM.* Ensure parent participation in the decision to use a FM system by obtaining a signed permission form. Refer to form in appendix B.

3) *Selection and fitting options.* Determine if the student could most benefit from an individually worn or a sound field FM system. This may require trials with several system options (e.g., individually worn, personal sound field, classroom sound field). If using an individually worn system, fitting options such as those listed below must be evaluated based on individual student needs.
   a) coupling options: headset (attenuated or regular), earbud or transducer; various headset design options (e.g., over-the-ear, stetoclip, pediatric or regular headsets)
   b) monaural or binaural fitting
   c) microphone options (e.g., directional or omnidirectional, lapel, collar, or behind-the-neck)
   d) special options
      Contact manufacturers in cases where special adaptations are necessary to achieve an appropriate and comfortable fit.

4) *FM evaluation period.* An audiologist should coordinate the FM evaluation period. Following is a summary of suggested best practice procedures to be observed during the trial period:
   a) FM evaluation time period: 30-45 school days
   b) Environmental checklist
      Complete a classroom environment checklist to assist in selecting the most appropriate type of FM system and to identify how to maximize listening abilities. Without attention to other modifications and accommodations in the learning environment, use of a FM system alone may not be sufficient to meet the student's educational needs. The classroom environment checklist may be a district-devised form or a commercially available tool such as the *Listening Environment Profile* (Phonic Ear, 1995). (See appendix B for suggested forms.)
   c) Pre-Evaluation Observation Form and a *S.I.F.T.E.R.*
      It is recommended that the classroom teacher complete an auditory behavior observation form and the *Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.)*. The auditory behavior observation form may be district-devised or a commercially available instrument such as *Fisher's Auditory Problems Checklist,* the *Children's Auditory Performance Scale (CHAPS)*, or the *Evaluation of Classroom Listening Behaviors*. (See appendix B.)
   d) Inservice Training.
      The audiologist should train classroom teachers on the use and benefits of the FM system. This is an excellent opportunity to suggest specific modifications, accommodations for the classroom environment, and listening and management strategies. Engaging students in the inservice can be an effective means of providing the training. Parents and ESE staff working with the student should be invited to the inservice training. Inservice training should be conducted annually for students who continue to use an FM system. The audiologist should provide the teacher with an information packet which also includes contact information. The audiologist may wish to have staff participants sign a form at the end of the session to indicate their understanding of the purpose and benefits of a FM system. Selected management strategies and additional information in appendix C may be included in the packet.

      The following components should be included in the inservice: Introduction, FM System Overview, Benefits, Demonstration, and Summary. Refer to *An Inservice for Staff and Classroom Students on Personal FM Systems* in appendix C for further information on the inservice training.

   e) Post-Evaluation Observation.
      The classroom teacher should complete the auditory behavior observation form and a *S.I.F.T.E.R.* as post-trial measures. Also, it is recommended that parents assist their child in completing the

form. (See appendix B for sample post-trial forms.) Finally, it is suggested that the classroom teacher complete an appraisal form in order to obtain information related to the perceived benefits of the FM system. This recommendation should be based on data collected during the trial period. It is important to place emphasis on the student's, teacher's, and parent's level of acceptance and perception of benefit from the FM system. At the conclusion of the trial period, the IEP committee must make a recommendation regarding the benefit of FM use. This can be facilitated through an IEP revision or development of a 504 plan.

f) Equipment monitoring.
The audiologist coordinates the monitoring of the FM system. An in-school contact (e.g., classroom teacher, ESE teacher, speech-language pathologist), or student, if appropriate, should conduct a daily check of the system. The audiologist should be involved in the monitoring process on an as-needed basis. School personnel should contact the audiologist for assistance when the FM system malfunctions. To ensure maximum performance of the FM system, annual maintenance is recommended.

g) Hearing sensitivity monitoring.
The audiologist should ensure that the student's hearing sensitivity is monitored on a periodic basis during the school year.

16. What are possible sources of funding for assistive listening devices?

Possible funding sources for assistive devices such as FM systems include the district's assistive technology budget, the district's ESE budget, the district's or school's discretionary budget, capital outlay funds available during new construction or remodeling, Medicaid or Children's Medical Services (CMS), grants, service organizations (e.g., Sertoma, PTO), business partners, and private donations.

17. What are some management approaches or strategies that may be used with students with an APD?

Management strategies for students with an APD fall into two main categories: 1) managing the learning environment and 2) compensatory strategies or remediation therapy. Management goals for students with APD are to improve listening ability and spoken language comprehension (Chermak & Musiek, 1997). Four interrelated management approaches follow (Bellis, 1996, 1999; Chermak & Musiek, 1997; EAA, 1996; Jerger, 1998; Johnson, Benson & Seaton, 1996; Musiek & Schochat, 1998; Sloan, 1998).

- **Environment**
The audiologist should evaluate the classroom environment and identify elements and conditions that may be problematic for the student with an APD. This information may be used to improve the acoustical environment for all students in the class. To improve the classroom listening environment, it is necessary to reduce background noise and reverberation and to enhance the speech signal. Both students and teachers have a responsibility for managing acoustical factors in the learning environment. The initial or annual FM inservice training session is an opportunity for the audiologist to address critical environmental issues for students with an APD. Refer to appendix C for further information on acoustical modifications. For some students, use of an assistive listening device, such as an FM system, may be an appropriate accommodation for noisy and reverberant listening environments, particularly if the student's AP deficits are related to the need for acoustic signal clarity.

- **Individual Intervention**
A student with an APD may need individualized instruction and management strategies. Special assistance or instructional strategies should be addressed in the student's IEP or 504 plan, as appropriate. A student with an APD may receive special educational services such as those available through a speech-language pathologist or an SLD program if the student meets the specific program's eligibility criteria. Other

students may be able to receive intervention services if they are eligible for their districts' specially designed program for academic enhancement or remediation. For young students with an APD, the availability of a phonological awareness program in the regular classroom may be very beneficial.

- **Modifications and Accommodations for Students with APD**
  The *APD Accommodations and Modifications Checklist* found in appendix B should be of assistance to parents and professionals in devising a management plan for students diagnosed with APD. The accommodations and modifications are organized according to Florida's Matrix of Services. This checklist provides a menu of accommodations and modifications that include adaptations to be made by the teacher to improve the student's opportunities to learn. *Accommodations* are provisions made in *how* a student accesses and demonstrates learning. That is, accommodations provide adjustments to presentation to or response from a student that do not change the content or the intended outcome. Examples of accommodations include use of a notetaker, visual supplements, study guides and pre-teaching, peer partners, adjusted pace of instruction, repetition of ideas, and reduced language level. *Modifications* are changes in *what* a student is expected to learn and demonstrate and include changes in content, requirements, or expectations. Some examples of modifications include reducing the difficulty of the material, shortening assignments, giving alternative assignments, and using alternative grading systems.

- **Compensatory Strategies**
  In order to demystify the term APD, it is important for the audiologist and other professionals working with the student and parents to help them understand the nature of the student's auditory processing difficulty. This helps the student and parents comprehend how these difficulties impact learning and academic performance, and compensatory strategies must be developed. Strategies training focuses on metacognitive and metalinguistic skills that enable the student to recognize conditions that interfere with learning and use executive control strategies and linguistic resources to act on them as a self-advocating problem-solver to improve listening outcomes (Chermak & Musiek, 1997). Strategies are designed to develop back-up or compensatory systems and increase redundancies. Carefully selected strategies and techniques are essential to successful management of functional deficits associated with an APD. Some examples include peer partner systems, tape recorders, preteaching, reauditorize, subvocalize, "chunking," lists, calendars, color-coded organization systems, self-imposed timeout, predictable rules and outcomes; earplugs, reducing noise sources in the room, and asking for clarification or additional help. This comprehensive approach focuses on self-regulation of strategy use and the student's development of self-efficacy (Chermak, 1998). Refer to the *APD Checklist: Recommended Accommodations and Modifications* in appendix B and *Characteristics of Subprofiles of APD* in appendix C.

In summary, each student's educational needs must be addressed individually. The classroom accommodations and modifications must be specific to the student's auditory processing strengths and weaknesses. The most effective process to address the student's needs is a multidisciplinary approach. The referral, evaluation, and management procedures and forms are provided to assist district staff in developing district procedures and policies.

Glossary

assistive listening device: a device such as a FM system that emits enhanced speech signals to the user; an assistive listening device improves the signal-to-noise ratio and helps to overcome barriers in the listening environment, such as distance from the speaker, background noise, and reverberation

auditory analysis: the ability to identify phonemes or morphemes embedded in words

auditory association: identifying an acoustic signal and association with its source or labeling a linguistic or nonlinguistic sound or experience

auditory attention: ability to focus on relevant acoustic signals, particularly speech or linguistic stimuli, and sustain that attention for an age-appropriate amount of time

auditory closure: ability to understand the whole word or message when a part is missing (in noisy listening environments this is an often-used skill in order to comprehend messages)

auditory discrimination: the skill necessary to distinguish words and sounds that are acoustically similar

auditory figure-ground: ability to identify the primary linguistic or nonlinguistic sound source from a background noise

auditory memory: the recall of the acoustic signal after it has been labeled, stored, and then recalled

auditory overload: occurs when the listener's auditory system is unable to efficiently process incoming auditory information

auditory sequential memory: the ability to recall the order of a series of details

auditory short-term memory: ability to retain auditory information as immediately presented

auditory synthesis: ability to synthesize (i.e., merge or blend) isolated phonemes into words

binaural integration: listener is required to process different information presented to both ears simultaneously and repeat everything that is heard in both ears

binaural interaction: listener must attend to complementary but different pieces of information presented to each ear and then integrate the information to perceive the whole message

binaural separation: listener is required to process an auditory message delivered to one ear while ignoring a dissimilar message presented to the opposite ear at the same time

central auditory nervous system (CANS): the pathway of auditory signals to the brain beyond the peripheral hearing mechanism

dichotic: a different stimulus presented to each ear simultaneously

diotic: presentation of the same sound to both ears

directional microphone: a microphone used with an FM system that eliminates lower frequencies that can mask consonant sounds; able to operate at high output levels without feedback

discrimination: the process used to discriminate among sounds of different frequency, duration, or intensity (e.g., high/low, long/short, loud/soft)

electrophysiologic tests: evaluation of the neuromaturation and neuroplasticity of the central auditory pathways

FM: an acronym for frequency modulation; modification of the frequency signal on a carrier wave

FM system: an assistive listening device consisting of a microphone, transmitter, and receiver; signal is transmitted by FM radio waves

HL: hearing level measured in decibels

localization: ability to determine the location of the acoustic signal relative to the listener's position in space

metacognition: appropriate use of knowledge to plan, monitor, and regulate performance, including attention, memory, listening, learning, and language processing

metalinguistic: strategies to improve listening and spoken language comprehension (e.g., discourse cohesion devices, schema induction, linguistic closure and context-derived vocabulary building, prosody, segmentation)

monotic: presentation of a sound stimulus to only one ear

omnidirectional microphone: a microphone used with an FM system when the signal-to-noise ratio is 15 dB or greater

peripheral hearing: the auditory mechanism including the outer, middle, and inner ear

sensation: the ability to identify the presence of sound

SL: sensation level expressed in decibels; the number of decibels above a reference point such as the Spondee Threshold

signal-to-noise (S/N) ratio: the ratio of the signal to the corresponding noise (for example, a +5 dB S/N means that the primary signal is 5 dB louder than the noise competition)

speech recognition testing: measurement of speech identification ability

Spondee Threshold: the lowest hearing level in dB at which 50 percent of spondee words (bi-syllabic words with equal stress on each syllable) are identified correctly

temporal processing: discrimination of sound based on a sequence of auditory stimuli or temporal order

References

Books

Bell, S. (1993). *What is auditory processing?* Vero Beach, FL: The Speech Bin.

Bellis, T. (1996). *Assessment and management of central auditory processing disorders in the educational setting.* San Diego: Singular Publishing Group.

Berg, F. (1987). *Facilitating classroom listening: A handbook for teachers of normal hearing and hard of hearing students.* Austin, TX: Pro-Ed.

Chermak, G. & Musiek, F. (1997). *Central auditory processing disorders: New perspectives.* San Diego: Singular Publishing Group.

Crandell, C., Smaldino, J. & Flexer, C. (Eds.) *Sound-field FM amplification: Theory and practical applications.* San Diego: Singular Publishing Group.

Ferre, J. (1997). *Processing Power: A Guide to CAPD Assessment and Management.* San Antonio, TX: The Psychological Corp.

Florida Department of Education (1995). *Improving classroom acoustics (ICA): Inservice training manual.* Tallahassee, FL: Author.

Gillet, P. (1993). *Auditory processes.* Novato, CA: Academic Therapy Publications.

Graser, N. (1992). *125 ways to be a better listener.* East Moline, IL: Linguisystems, Inc.

Hall, J. & Mueller, G. (1998). *Audiologists' desk reference, Vol. I & II*. San Diego: Singular Publishing Group.

Handel, S. (1989). *Listening: An introduction to the perception of auditory events.* Cambridge: MIT Press.

Jasper, J. & Morgan, E. (1981). *Developing listening skills.* Hamilton, IL: Hamilton Press, Inc.

Katz, J., Stecker, N. & Henderson, D. (Eds.) (1992). *Central auditory processing: A transdisciplinary view.* St. Louis, MO: Mosby-Year Book.

Johnson, C., Benson, P. & Seaton, J. (1997). *Educational audiology handbook.* San Diego: Singular Publishing Group, Inc.

Kelly, D. (1995). *Central auditory processing disorder: Strategies for use with children and adolescents.* Communication Skill Builders.

Lasky, E. & Katz, J. (Eds.) (1983). *Central auditory processing disorders: Problems of speech, language, and learning.* Baltimore: University Park Press.

Margolis, R., Anderson, J., & Fournier, E. (1997). *Audiology clinical protocols*. Boston: Allyn & Bacon.

Masters, M., Master, G., Stecker, N. & Katz, J. (1998). Central auditory processing disorders: Mostly management. Boston: Allyn & Bacon.

Ross, M. (Ed.) (1992). *FM auditory training systems: Characteristics, selection, and use.* Timonium, MD: York Press.

Sloan, C. (1991). *Treating auditory processing difficulties in children.* San Diego: Singular Publishing Group.

Willeford, J. & Burleigh, J. (1985). *Handbook of central auditory processing disorders in children.* Orlando: Grune & Stratton.

Chapters

Cherry, R. (1992). Screening and evaluation of central auditory processing disorders in young children. In J. Katz, N. Stecker & D. Henderson (Eds.), *Central Auditory Processing: A Transdisciplinary Review* (pp. 129-140). St. Louis: Mosby Year Book.

Conway, L. (1990). Issues relating to classroom management. In M. Ross (Ed.) *Hearing-impaired children in the mainstream* (pp. 131-157). Parkton, MD: York Press.

Crandell, C. & Smaldino, J. (1995). Acoustical modifications in classrooms. In Crandell, C., Smaldino, J. & Flexer, C. (Eds.), *Sound-field FM amplification: Theory and practical applications* (pp. 83-92). San Diego: Singular Publishing Group.

Crandell, C. & Smaldino, J. (1995). Classroom acoustics. In R. Roeser & M. Downs (Eds.) *Auditory disorders in school children* (3rd. ed.), pp. 219-234). New York: Thieme Stratton.

DeConde, C. (1984). Children with auditory processing disorders. In R. Hull & K. Dilka (Eds.), *The hearing-impaired child in school* (pp. 141-162). Orlando, FL: Grune & Stratton.

Edwards, C. (1995a). Identifying and managing the learning environment. In Crandell, C., Smaldino, J. & Flexer,

C. (Eds.), *Sound-field FM amplification: Theory and practical applications* (pp. 93-106). San Diego: Singular Publishing Group.
Edwards, C. (1995b). Listening strategies for teachers and students. In Crandell, C., Smaldino, J. & Flexer, C. (Eds.), *Sound-field FM amplification: Theory and practical applications* (pp. 191-200). San Diego: Singular Publishing Group.
Hart, P. (1983). Classroom acoustical environments for children with central auditory processing disorders. In Lasky, E. & Katz, J. (Eds.), *Central auditory processing disorders: Problems of speech, language and learning* (pp. 343-352). Baltimore: University Park Press.
Hasenstab, M. & Laughton, J. (1995). Remediation of children with auditory language disorders. In R. Roeser & M. Downs (Eds.), *Auditory disorders in school children (3rd ed.)* (pp. 309-328). NY: Thieme Medical Publications.
Katz, J. & Wilde, L. (1994). Auditory processing disorders. In J. Katz (Ed.), *Handbook of clinical audiology* (4th ed., pp. 490). Baltimore: Williams & Wilkins.
Keith, R. (1995). Tests of central auditory processing. In R. Roeser & M. Downs (Eds.), *Auditory disorders in school children (3rd ed.)* (pp. 101-116). NY: Thieme Medical Publications.
Kent, R. (1992). Auditory processing of speech. In J. Katz, N. Stecker & D. Henderson (Eds.), *Central auditory processing:* A *transdisciplinary review* (pp. 93-105). St. Louis: Mosby Year Book.
Lasky, E. & Cox, L. (1983). Auditory processing and language interaction: Evaluation and intervention strategies. In E. Lasky & J. Katz (Eds.), *Central auditory processing disorders: Problems of speech, language, and learning* (pp. 243-268). Baltimore: University Park Press.
Nabelek, A. & Nabelek, I. (1994). Room acoustics and speech perception. In J. Katz (Ed.), *Handbook of Clinical Audiology (4th Edition),* (pp. 624-637). Baltimore: Williams & Wilkins.
Rosenberg, G. & Blake-Rahter, P. (1995). Inservice training for the classroom teacher. In Crandell, C., Smaldino, J. & Flexer, C. (Eds.) *Sound-field FM amplification: Theory and practical applications* (pp. 149-190). San Diego: Singular Publishing Group.
Schneider, D. (1992). Audiologic management of CAPD. In J. Katz, N. Stecker & D. Henderson (Eds.), *Central auditory processing: A transdisciplinary review* (pp. 161-168). St. Louis: Mosby Year Book.

Articles

American Speech-Language-Hearing Association (1990). Audiological assessment of central auditory processing: An annotated bibliography. *Asha, 32* (Suppl. 1), 13-30.
American Speech-Language-Hearing Association (1991). Amplification as a remediation technique for children with normal peripheral hearing. *Asha, 33 (*Suppl. 3), 21-24.
American Speech-Language-Hearing Association (1993). Guidelines for audiology services in the schools. *Asha, 33 (*Suppl. 10), 24-32.
American Speech-Language-Hearing Association (1994). Guidelines for fitting and monitoring FM systems. *Asha, 36* (Suppl. 12), 1-9.
American Speech-Language-Hearing Association (1995). Position statement and guidelines for acoustics in educational settings. Asha, *35* (Suppl. 14), 15-19.
American Speech-Language-Hearing Association (1996). Central auditory processing: Current status of research and implications for clinical practice. *American Journal of Audiology, 5* (2), 41-54.
American Speech-Language-Hearing Association (1996). Scope of practice in audiology. *Asha, 38 (*Suppl. 16), 12-15.
American Speech-Language-Hearing Association (1997). *Preferred practice patterns in audiology.* Rockville, MD: Author.
Bellis, T. (1999). Subprofiles of central auditory processing disorders. *Educational Audiology Review, 16* (2), 4-9.
Bellis, T. & Ferre, J. (1996). Assessment and management of central auditory processing disorders in children. *Educational Audiology Monograph, 4,* 23-27.
Bellis, T. & Ferre, J. (1999). Multidimensional approach to the differential diagnosis of central auditory processing disorders in children. *American Journal of Audiology, 10,* 319-328.
Berg, F., Blair, J. & Benson, P. (1996). Classroom acoustics: The problem, impact, and solution. *Language, Speech & Hearing Services in Schools (27)* 16-20.

Bilger, R., Neutzel, J., Rabinowitz, W. & Rzeczkowski, C. (1984). Standardization of a test of speech perception in noise. *Journal of Speech and Hearing Research, 27,* 32-48.

Blake, R., Field, B., Foster, C., Platt, F., & Wertz, P. (1991). Effect of FM auditory trainers on attending behaviors of learning-disabled children. *Language, Speech, and Hearing Services in Schools, 22,* 111-114.

Bloomfield, R. (1987). Classroom noise control strategies. *Hearsay*, 41-44.

Blumsack, J. (1999). Behavioral management strategies in central auditory processing assessment. *Educational Audiology Review, 16* (2), 22-23.

Breedin, S., Martin, R., & Jerger, S. (1989). Distinguishing auditory and speech-specific perceptual deficits. *Ear and Hearing, 10,* 311-317.

Bregman, A. (1990). *Auditory scene analysis: The perceptual organization of sound.* Cambridge: MIT Press.

Brunner, B. (1999). Roles of the educational audiologist in CAPD evaluation and management. *Educational Audiology Review, 16* (2), 20.

Cacace, A. & McFarland, D. (1998). Central auditory processing disorder in school-aged children: A critical review. *Journal of Speech, Language, and Hearing Research, 41,* 355-373.

Campbell, T. & McNeil, M. (1985). Effects of presentation rate and divided attention on auditory comprehension in children with acquired language disorder. *Journal of Speech and Hearing Research, 28,* 513-520.

Chermak, G. (1998). Managing central auditory processing disorders: Metalinguistic and metacognitive approaches. *Seminars in Hearing, 19*, 379-392.

Chermak, G., Hall, J. & Musiek, F. (1999). Differential diagnosis and management of central auditory processing disorder and attention deficit hyperactivity disorder. *American Journal of Audiology, 10,* 289-303.

Chermak, G. & Musiek, F. (1992). Managing central auditory processing disorders in children and youth. *American Journal of Audiology, 1* (3), 61-65.

Chermak, G., Somers, E., & Seikel, J. (1998). Behavioral signs of central auditory processing disorder and attention deficit hyperactivity disorder. *Journal of the American Academy of Audiology, 9*, 78-84.

Chermak, G., Styler, S. & Seikel, J. (1995). Study compares screening tests of central auditory processing. *Hearing Journal, 48* (5), 29-34.

Chermak, G., Traynham, W., Seikel, J. & Musiek, F. (1998). Professional education and assessment practices in central auditory processing. *Journal of the American Academy of Audiology, 9*, 452-465.

Colorado Department of Education (1996). *Central auditory processing disorders: A team approach to screening, assessment, and intervention practices.* Denver: Author.

Crandell, C. (1991). Classroom acoustics for normal-hearing children: Implications for rehabilitation. *Educational Audiology Monograph, 2* (1), 18-38.

Educational Audiology Association (1997). Recommended Professional Practices for Educational Audiology. *Educational Audiology Review, 13* (2), 20-21.

Edwards, C. (1991). Assessment and management of listening skills in school-aged children. In C. Flexer (Ed.), *Seminars in hearing: Current audiologic issues in the educational management of children with hearing loss, 12* (4) (pp. 389-401). New York: Thieme Medical Publications.

Edwards, C. (1993). The changing classroom environment: Implications for auditory management. *Educational Audiology Newsletter, 10* (3), 8-9.

Elliott, L. & Hammer, M. (1988). Longitudinal changes in auditory discrimination in normal children and children with language-learning problems. *Journal of Speech and Hearing Disorders, 53,* 467-474.

Ferre, J. (1987). Pediatric central auditory processing disorder: Considerations for diagnosis, interpretation and remediation. *Journal of the Academy of Rehabilitative Audiology, 20,* 73-81.

Ferre, J. (1999). CAP tips. *Educational Audiology Review, 16* (2), 28.

Fifer, R., Jerger, J., Berlin, C., Tobey, E. & Campbell, J. (1983). Development of a dichotic sentence identification test for hearing impaired adults. *Ear and Hearing, 4,* 300-305.

Friel-Patti, S. (1994). Auditory linguistic processing and language learning. In G. Wallach & K. Butler (Eds.), *Language learning disabilities in school-age children and adolescents* (pp. 373-392). New York: Charles E. Merrill.

Hall, J. & Grose, J. (1990). The masking-level difference in children. *Journal of the American Academy of Audiology, 2,* 81-88.

Hall, J., Baer, J., Byrn, A., Wurm, F., Henry, M., Wilson, D. & Prentice, C. (1993). Audiologic assessment and management of central auditory processing disorder (CAPD). In *Seminars in Hearing* (pp. 254-264). New York: Thieme Medical Publications.

Iskowitz, M. (1999). Assessing and managing CAPD. *ADVANCE, 9* (30), 6-8.
Jerger, J. (1998). Controversial issues in central auditory processing disorders. *Seminars in Hearing, 19*, 393-398.
Jerger, J., Johnson, K., Jerger, S., Coker, N., Pirozzolo, R. & Gray, L. (1991). Central auditory processing disorder: A case study. *Journal of the American Academy of Audiology, 2,* 36-54.
Jerger, J. & Musiek, F. (2000). Report of the Consensus Conference on the Diagnosis of Auditory Processing Disorders in School-Aged Children. *Journal of the American Academy of Audiology,* 11(9) 467-474.
Katz, J. (1962). The use of staggered spondaic words for assessing the integrity of the central auditory system. *Journal of Auditory Research, 2,* 327-337.
Katz, J. & Kusnierczyk, K. (1993). Central auditory processing: The audiologic contribution. In D. Beck (Ed.), *Seminars in hearing: Audiology: Beyond the sound booth, 14* (2) (pp. 191-199). New York: Thieme Medical Publications.
Keith, R. (1996). Understanding central auditory processing disorders. *The Hearing Journal, 49* (11), 20-28.
Keith, R., Young, M., & McCroskey, R. (1999). A brief introduction to the Auditory Fusion Test-Revised. *Educational Audiology Review, 16* (2), 16-19.
Lecomte, B. (1996). Strategies to improve listening skills in students. *Advance for Speech-Language Pathologists and Audiologists, 6* (46), 13, 21.
Lewis, D. (1994). Assistive devices for classroom listening: FM systems. *American Journal of Audiology, 3,* 70-83.
Miller, F. & Gildea, P. (1987). How children learn words. *Scientific American, 257,* 94-99.
Musiek, F. (1983). Assessment of central auditory dysfunction: The dichotic digit test revisited. *Ear and Hearing, 4,* 79-83.
Musiek, F. (1984). Selected topics in central auditory dysfunction. *Seminars in Hearing, 5* (3), 219-352.
Musiek, F. (1999). Habilitation and management of auditory processing disorders: Overview of selected procedures. *American Journal of Audiology, 10,* 329-342.
Musiek, F. & Chermak, G. (1994). Three commonly asked questions about central auditory processing disorders: Assessment. *American Journal of Audiology, 3,* 23-27.
Musiek, F. & Chermak, G. (1995). Three commonly asked questions about central auditory processing disorders: Management. *American Journal of Audiology, 4,* 15-18.
Musiek, F., Gollegly, K., Lamb, L. & Lamb, P. (1990). Selected issues in screening for central auditory processing dysfunction. *Seminars in Hearing, 11,* 372-384.
Musiek, F. & Lamb, L. (1994). Central auditory assessment: An overview. In J. Katz (Ed.), *Handbook of Clinical Audiology (4th Edition),* (pp. 197-211). Baltimore: Williams & Wilkins.
Musiek, F. & Schochat, E. (1998). Auditory training and central auditory processing disorders: A case study. *Seminars in Hearing, 19*, 357-366.
Olswang, L. & Bain, B. (1994). Data collection: Monitoring children's treatment progress. *American Journal of Speech-Language Pathology, 3* (3), 55-66.
Phillips, D. (1998). Sensory representations, the auditory cortex, and speech perception. *Seminars in Hearing, 19*, 319-332.
Phillips, D. (1999). Gap detection, perceptual channels, and temporal resolution in speech perception. *American Journal of Audiology, 10,* 343-354.
Ray, H., Sarff, L. & Glassford, J. (1984, Summer/Fall). Sound field amplification: An innovative educational intervention for mainstreamed learning disabled students. *The Directive Teacher,* 18-20.
Rosenberg, G. (1998). Development of Local Child Norms for the Dichotic Digits Test. *Florida Journal of Communication Disorders, 18, 4-10.*
Schmitz, J. (1988, Spring). Working with CAP. *Central Auditory Processing: A practical newsletter of diagnostic and intervention strategies, 1* (1), 5.
Schow, R., Seikel, J., Chermak, G. & Berent, M. (2000). Central auditory processes and test measures: ASHA 1996 revisited. *American Journal of Audiology,* 9, 63-68.
Singer, B. & Bashir, A. (1999). What are executive functions and self-regulation and what do they have to do with language-learning disorders? *Language, Speech and Hearing Services in Schools, 30,* 265-273.
Singer, J., Hurley, R. & Preece, J. (1998). Effectiveness of central auditory processing tests with children. *American Journal of Audiology, 7* (2), 73-84.
Sloan, C. (1998). Management of auditory processing difficulties: A perspective from speech-language pathology. *Seminars in Hearing, 19*, 367-278.

Stuart, A. & Phillips, D. (1998). Deficits in auditory temporal resolution revealed by a comparison of word recognition under interrupted and continuous noise masking. *Seminars in Hearing, 19*, 333-344.

Truesdale, S. (1990). Whole-body listening: Developing active auditory skills. *Language, Speech, and Hearing Services in Schools, 21,* 183-184.

West, K. & Strand, K. (1995, April). *Interdisciplinary evaluation of auditory processing disorders in children.* Paper presented at the American Academy of Audiology annual convention, Dallas, TX.

Whitelaw, G. (1999). Blending clinic-based and education-based audiology: How to best address the needs of school-aged children with central auditory processing disorders. *Educational Audiology Review, 16* (2), 24-26.

Yencer, K. (1998). The effects of auditory integration training for children with central auditory processing disorders. *American Journal of Audiology, 7* (2), 32-44.

Young, M. & Protti-Patterson, E. (1984). Management perspectives of central auditory problems in children: Top-down and bottom-up considerations. *Seminars in Hearing, 5* (3), 251-261.

Zarrella, S. (1995). Category system, test battery enhances diagnosis and management of CAPD. *Advance for Speech-Language Pathologists and Audiologists, 5* (27), 6-7.

Zoochi, L. (1999). Generating CAPD recommendations using the auditory domain approach. *Educational Audiology Review, 16* (2), 13-14.

Zoochi, L. (1999). The auditory domain approach for interpretation of CAP results. *Educational Audiology Review, 16* (2), 10-12,

Appendices

Appendix A

Summary of Audiological Tests of Central Auditory Processing (CAP)

Following is a summary of CAP tests by stimulus presentation. The ASHA (1996) report suggests including tests from each of the four following categories: dichotic, low redundancy monaural speech, temporal processing, and binaural interaction. Electrophysiologic tests may provide important information about the integrity of the central auditory system for certain students.

DichoticæThe dichotic tests present a different stimulus to each ear simultaneously. Dichotic speech tests may assess either binaural integration or binaural separation:

- **binaural integration:** requires the listener to repeat everything that is heard; measures directed listening ability
- **binaural separation:** requires the listener to direct attention to one ear and repeat or indicate what is heard only in that ear; tests recognition of two inputs

With younger children there is typically a right ear advantage on these tests. However, the left ear score improves as the child's auditory system matures. Within a CAP test battery, it is advisable to use one linguistically loaded and one non-linguistically loaded dichotic test.

Following are examples of dichotic CAP tests.

- Dichotic Digits Test: binaural integration, auditory recognition, memory
- Competing Sentences: binaural separation, auditory recognition, memory
- Dichotic Rhyme: binaural integration, memory
- Dichotic CV: binaural integration, memory
- Dichotic Sentence Identification (DSI): binaural integration, auditory recognition, memory
- Synthetic Sentence Identification (SSI) w/CCM: binaural separation, auditory recognition, memory

Low Redundancy Monaural SpeechæThese tests involve modification (distortion) of the acoustic (extrinsic) signal to reduce the amount of redundancy. If there is a central auditory system pathology that reduces the (intrinsic) redundancy of the system, the signal cannot be processed. Extrinsic redundancy is provided by the characteristics of the auditory signal, whereas intrinsic redundancy refers to the repeated representation of that signal throughout the CANS (Bellis, 1996). These tests assess auditory closure, the ability to fill in missing components (e.g., phonemes, syllables, words). Monotic, low redundancy speech tests include low-pass filtered speech, time-altered speech, and speech-in-noise tests. Following are examples of low redundancy monaural speech tests.

- Filtered Speech: generally low-pass filtered with 1K Hz cut-off; tests auditory closure and recognition
- Time Compressed Speech: auditory processing time; generally 45% compression; measures auditory closure and auditory recognition
- Compressed Speech with Reverberation: as above plus reverberation
- SSI w/ICM: primary skill is auditory selective attention; also tests auditory recognition, memory, and auditory figure-ground
- Speech-in-Noise: with ipsilateral or contralateral competition; measures auditory figure-ground, recognition, closure

Temporal ProcessingæMonotic tone tests are also used to measure the child's ability to use each ear independently, but the stimuli for these tests are tones rather than speech. The majority of these tests focus on the child's pattern perception and temporal functioning abilities, that is, the ability to process nonverbal auditory signals and to recognize order or patterns. Tests of temporal processing require the listener to discriminate sound based on a sequence of auditory stimuli or temporal order. Usually non-speech stimuli such as tones or clicks are used. Temporal processing tests that measure ordering, discrimination, resolution, and integration include:

- Pitch Pattern Sequence (through age 9 typically): taps interhemispheric transfer with humming and linguistic response modes; measures auditory sequencing, pitch discrimination, memory, temporal ordering
- Duration Pattern Test (above age 9): measures as above except that it uses duration rather than pitch
- Auditory Fusion Test-Revised: measures temporal gap detection
- Click Fusion
- 2-tone Ordering

Binaural InteractionæThese are diotic tests in that the stimuli are presented to each ear at the same time. These tests have complementary but separate information presented to each ear. Unlike dichotic tests per se, the information is presented in either a nonsimultaneous, sequential manner, or a portion of the message is presented to each ear. The listener is required to integrate the information to perceive the whole message. The binaural interaction test requires the listener to direct attention to one ear and repeat or indicate what is heard only in that ear. Binaural interaction tests are sensitive to brainstem pathology and assess binaural fusion. Examples include:

- Rapidly Alternating Speech Perception: tests ability to fuse phonemes alternating between the ears into meaningful sentences
- Binaural Fusion: resynthesis process; spondee binaural fusion requires auditory recognition, closure, and binaural interaction
- Masking Level Difference (MLD): can test with tones or speech; strongest of the binaural interaction tests

Electrophysiologic Testsæ Electrophysiologic measures may offer additional information about the integrity of their central auditory system through examination of the neuromaturation and neuroplasticity of the central auditory pathways. This information will be important in the differential diagnosis process for some students. The electrophysiologic tests most frequently used in CAP evaluation are: auditory brainstem response (ABR), middle latency response (MLR), late evoked potential (LEP), P300, Mismatch Negativity (MMN), and otoacoustic emissions (OAE). The functional MRI also is used as a follow-up measurement in CAP evaluation. The full array of electrophysiologic testing generally is not available within the public school setting, but this testing is available through university clinics and other sites specializing in electrophysiologic assessment.

Table 1. Summary of Central Auditory Processing Tests by stimulus presentation.

Test Instrument/Procedure	Age Range	Linguistic Loading	Type of Test: *Dichotic (D), Monaural low redundancy speech (M), Temporal processing (T), Binaural interaction (B), Other (O)*
Auditory Fusion Test-Revised	3-80	no	(T) temporal resolution, (B) binaural fusion
Competing Environmental Sounds Test	3-12	no	(D) binaural integration
Competing Sentences Test (Auditec)	7-adult	yes	(D) binaural integration
Dichotic Consonant-Vowel (CV) Test	7-adult	yes (L)	(D) binaural integration
Dichotic Digits Test	5-adult	no	(D) binaural integration
Dichotic Rhyme Test	8-adult	yes (L)	(D) binaural integration
Dichotic Sentence Identification Test	7-adult	yes	(D) binaural integration
Duration Pattern Test	8-adult	yes (L)	(T) duration discrimination, temporal ordering, linguistic labeling
Masking Level Difference	5-adult	no	(B) binaural fusion
NU-6 (low pass filtered speech)	7-adult	yes	(M) low pass filtered speech
NU-6 (time compressed speech)	7-adult	yes	(M) time compressed speech
NU-6 (compressed speech with reverberation)	7-adult	yes	(M) time compressed speech with reverberation
Pediatric Speech Intelligibility Test (S)	3-7	yes	(L) speech-in-noise
Phonemic Synthesis Test	6-adult	yes	(O) phonemic decoding
Pitch Pattern Sequence Test	6-adult	no	(T) frequency discrimination, temporal ordering, linguistic labeling
SCAN-C (S)	5-10.11	yes	(D), (M) (see subtests below)
SCAN-C Filtered Words Subtest	5-10.11	yes	(M) low pass filtered speech; auditory closure
SCAN-C Auditory Figure-Ground Subtest	5-10.11	yes	(M) speech-in-noise
SCAN-C Competing Words Subtest	5-10.11	yes	(D) binaural integration
SCAN-C Competing Sentences Subtest	5-10.11	yes	(D) binaural separation
SCAN-A (S)	12-adult	yes	(D), (M) (see subtests below)
SCAN-A Filtered Words Subtest	12-adult	yes	(L) low pass filtered speech; auditory closure
SCAN-A Auditory Figure-Ground Subtest	12-adult	yes	(L) speech-in-noise
SCAN-A Competing Words Subtest	12-adult	yes	(D) binaural integration
SCAN-A Competing Sentences Subtest	12-adult	yes	(D) binaural separation
Selective Auditory Attention Test (S)	5-adult	yes	(M) speech-in-noise
Spondee Binaural Fusion	7-adult	yes	(B) binaural fusion
SSW	5-adult	yes	(D) binaural integration
SSI-CCM	8-adult	yes (L)	(D) binaural separation
SSI-ICM	8-adult	yes (L)	(M) auditory closure; speech-in-noise
Test of Auditory Perceptual Skills-Rev. (S)	5-adult	yes	Multiple screening subtests (live voice)
Willeford: Binaural Fusion	6-adult	yes	(B) binaural fusion
Willeford: Competing Sentences	5-adult	yes	(D) binaural separation
Willeford: Low-Pass Filtered Speech	5-adult	yes	(M) low pass filtered speech

(L) = lightly linguistically loaded; (S) = screener

Auditory Fusion Test-Revised (AFT-R)

McCroskey, R. & Keith, R. (1996). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119 (314/962-5890).

- *diotic or monotic tone test*
- *a test of temporal resolution*
- *test yields auditory fusion thresholds*

The *AFT-R,* a revision of the *Wichita Auditory Fusion Test,* is a monotic test of auditory fusion. The listener must understand the concept of *one v*s *two* and also be able to indicate the response to the examiner. The *AFT-R* uses 18 pairs of tonal stimuli that ascend from a 0 msec interpulse interval (ipi) through a 300 msec ipi. The listener is required to report if one or two tones are heard. There is a screening version, and based on the results of the screener, the examiner then elects to administer the full test (tape A-2) or the expanded version (tape A-3). The presentation level selected should be between 40 and 60 dB Sensation Level (SL) in order to be consistent with the norming sample. The test is administered in a diotic mode, although it may be given to the right and left ears independently. Norms are available for ages three through 80 years of age. An *auditory fusion threshold* (AFT) is calculated for each ear at each frequency. There is an age effect but no frequency or ear effect. However, severely depressed scores on monotic tonal tests can be considered abnormal and ear asymmetries can provide useful information as part of the CAP test battery (Stecker, 1992). In addition, there is no gender effect; however, there are effects for age, frequency, and intensity. The younger the subject, the longer it takes to hear two tones. There appears to be a strong maturational effect on auditory fusion threshold from three years of age to nine years of age. AFTs are generally consistent across frequencies; however, the 250 Hz stimulus occasionally reveals elevated thresholds. The test is administered for test frequencies 250-4000 Hz. *Intensity Effect: As* signal level increases in intensity, the AFT becomes smaller (better). The authors provide numerous suggestions regarding interpretation and remediation in cases of articulation disorders, language or learning disabilities, reading disorders, dialect, mental handicap, and below level academic achievement.

Competing Environmental Sounds (CES) Test

Katz, Kushner & Pack (1975). Precision Acoustics, 411 NE 87th St., Suite B, Vancouver, WA 98664, 206-892-9367.

- *dichotic test*
- *non-linguistically loaded*

The *CES* is based on the Staggered Spondaic Word (SSW) Test procedure in that stimuli are presented dichotically but they are not staggered. The *CES* test uses 14 familiar everyday sounds for the 20 test items. For example, one might hear a door slamming in the right ear and a man coughing in the left ear. The listener is then to choose from four choices represented pictorially. The pairs of sounds are grossly overlapping in time dichotically. Katz (1975) states that by avoiding precise overlapping, individual sounds are quite easily identified by the "normal" listener, particularly within the multiple choice response paradigm. However, persons with CAPD do tend to make errors on the *CES* test despite the simple response mode. Test items are presented at 50 dB SL. The *CES* is sometimes used with young children due to the simple nature of the task. Another application of the CES is to use it in conjunction with the SSW, comparing the right and left ear scores of the two tests to determine if a consistent pattern of strengths and weaknesses is observed. Because there are no norms for the CES, it is best used in conjunction with the SSW and a battery of other tests to support basic strengths and weaknesses of the student's CANS.

Competing Sentences Test

Auditec (1985). Auditec of St. Louis, 330 Selma Avenue, St. Louis, MO 63119, 314/962-5890 or Oaktree Products, Inc., 2134 Heather Glen Drive, Chesterfield, MO 63017-5022, 800-347-1960.

- *dichotic sentence test*
- *linguistically loaded*
- *test of binaural separation*

The test stimuli are 30 pairs of simple sentences (six to seven words in length), with the two paired sentences being of similar theme. Twenty sentences are used for formal testing (10 for each ear), with the remaining 10 available for practice (five to each ear). The primary sentence is delivered at 35 dB SL (re: SRT) and the competing sentence is

presented at 50 dB SL (re: SRT). Scoring is liberal, particularly with children. The intent of the primary sentence, or the key words, must be repeated for a correct response. Hall & Mueller (1997) note that incorrect repetitions are assigned a value of 0, 2.5, 5, or 7.5 percent, depending on how much meaning is lost. Normative data show variability in the scores of the poorer (usually non-dominant) ear of children below age 10 years. When children reach age 10, their scores are anticipated to be consistent with adult performance (i.e., 90-100 percent). The CST also may be administered where the student is required to repeat both sentences. In this case the presentation should be at 50 dB SL bilaterally. Scoring is the same as for the single response. The test's author encourages the development of local norms for children. The CST recording appears to be clearer than the competing sentences test of the Willeford Battery.

Dichotic Consonant-Vowel (CV) Test

Berlin (1972). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119, 314/962-5890 or Oaktree Products, Inc., 2134 Heather Glen Drive, Chesterfield, MO 63017-5022, 800-347-1960.

- *dichotic test*
- *binaural integration*
- *lightly linguistically loaded test*

The Dichotic CV test uses six CV nonsense syllables (pa, ta, ka, ba, da, ga). Single CV segments are presented to each ear using a dichotic paradigm with presentation at 55 dB HL. Using a printed list, the listener is asked to choose both segments heard. Although the test is very lightly linguistically loaded, its difficulty lies in the high degree of similarity among the CV segments as well as the close acoustical alignment of the stimuli. Dichotic CV segments are the most difficult dichotic task due to the limited amount of linguistic information and the close temporal alignment of stimuli presentation. The test also may be presented in a mode whereby the presentation of a CV segment in one ear may lag the presentation to the other ear by 15, 30, 60, or 90 msec. The purpose of this presentation option is to investigate the lag effect on listener performance. The CV test is sensitive to cortical lesions. Auditory capacity (correct double ear scores) is seen to improve with age; however, single ear scores do not appear to maturate, with the right ear advantage (REA) remaining fairly stable over age.

Dichotic Digits Test

Musiek (1983). Oaktree Products, Inc., 2134 Heather Glen Drive, Chesterfield, MO 63017-5022, 800-347-1960 or by contacting Frank Musiek, Ph.D., Otolaryngology and Audiology Section, Dartmouth-Hitchcock Medical Center, Hanover, NH 03756.

- *dichotic test*
- *binaural integration*
- *non-linguistically loaded test*

The *Dichotic Digits Test (DDT)* stimuli include numbers 1 through 10, except 7. The listener is instructed that he or she will hear different numbers in each ear at the same time, such as 6, 1 in the left ear and 8, 2 in the right ear. The listener is to repeat all of the numbers heard, regardless of order. The test is administered at 50 dB SL (re: spondee threshold) or at the most comfortable loudness level (MCL) for listeners with peripheral hearing loss. The test is scored by percent correct. Normative data indicates a typically lower left ear score, particularly for younger listeners. Local norms available from the Sarasota County School District were developed in 1996 for students 5.0-12.0 years of age. Adult norms are available with the test protocol. The DDT is not highly influenced by cognition, attention, and intelligence because the digit response is a somewhat closed response set, nonlinguistically loaded.

Dichotic Rhyme Test (DRT)

Musiek, Kurdziel-Schwan, Kibbe, Gollegly, Baran & Rintelmann (1989). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119, 314/962-5890 or Oaktree Products, Inc., 2134 Heather Glen Drive, Chesterfield, MO 63017-5022, 800-347-1960.

- *dichotic test*
- *binaural integration*
- *lightly linguistically loaded*

The DRT is a lightly linguistically loaded, dichotic test that assesses binaural integration ability. Stimuli are 30 pairs of rhyming, consonant-vowel-consonant (CVC) words, each beginning with one of the stop consonants [p, t, k, b, d, g]. Each pair of words differs only in the initial consonant (e.g., *ten/pen, kid/bid*). Test stimuli are almost perfectly aligned so that fusion takes place and the listener most often hears and repeats just one of the two words presented. The test is presented at 50 dB SL (re: SRT). Norms are available. The DRT has been shown to be particularly sensitive to detection of dysfunction in the interhemispheric transfer of information via the corpus callosum (Musiek, Kurdziel-Schwan, Kibbe, Gollegly, Baran & Rintelmann, 1989).

Dichotic Sentence Identification (DSI) Test

Fifer, Jerger, Berlin, Tobey & Campbell (1983). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119, 314/962-5890 or Oaktree Products, Inc., 2134 Heather Glen Drive, Chesterfield, MO 63017-5022, 800-347-1960.

- *dichotic test*
- *linguistically loaded test*
- *tests binaural integration*

The *DSI*, as a dichotic test, can be administered to persons with hearing loss up to a Pure Tone Average (PTA) of 50 dB HL. The *DSI* consists of 30 pairs of sentences from the Synthetic Sentence Identification (SSI) test. Sentences are presented dichotically, with onsets and offsets of the two sentences aligned with an accuracy of 100 microseconds. The test is administered at 50 dB SL (re: PTA for the respective ears). The listener is requested to identify the numbers of the two sentences heard from a numbered, printed list. If loudness tolerance is a problem, the *DSI* may be presented at the listener's most comfortable listening level (MCL). The listener is given a printed list of the six *SSI* sentences and is instructed to indicate (by number) which sentences were heard. Results are scored in percent correct per ear. Due to the nature of this test, it would not be appropriate for very young children. *DSI* results may be interpreted in terms of individual ear performance as well as the interaural difference. Normative values for the *DSI* are based on the degree of hearing loss, with individual ear scores of 75 percent-100 percent considered to be within normal limits regardless of the PTA. As a function of increasing PTA, the normative values decrease accordingly (e.g., PTA<39 dB, asymmetry no greater than 16 percent; PTA=40-59 dB, asymmetry no greater than 39 percent).

Duration Pattern Test (DPT)

Pinheiro & Musiek (1985). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119, 314/962-5890 or Oaktree Products, Inc., 2134 Heather Glen Drive, Chesterfield, MO 63017-5022, 800-347-1960.

- *monotic tone test*
- *tests temporal patterning, duration discrimination ,and linguistic labeling*

The Duration *Pattern Test (DPT)* is similar to the *Pitch Pattern Sequence Test (PPST)* with the exception that the frequency of the tones is held constant at 1000 Hz and duration is the variable to be discriminated by the listener. Stimuli are short (250 msec) and long (500 msec) tone bursts presented monotically in triad sequences consisting of two tones of one duration and one of the other duration (e.g., SSL, LSL, LSS), with six possible duration patterns available. The interstimulus interval is 200 msec. The DPT requires the listener to use temporal processing ability to order tonal stimuli, discriminate duration, and attach a linguistic label. The test is presented at 50 dB SL (re: 1000 Hz threshold). For children experiencing difficulty labeling the acoustic stimuli, credit is given for acoustic reversals (e.g., short-short-long vs long-long-short). Alternate response mechanisms may be used by listeners who have difficulty verbally stating the linguistic labels for the tone. For instance, responses may be hummed or sung, or the child may point to symbols for *long* and *short.* Bellis (1996) states that information about the child's interhemispheric integration of auditory information is provided when a child persists in singing or humming a response rather than giving the linguistic label. The *DPT* may be given to persons with hearing loss since research has shown that the duration cue is more resistant to cochlear hearing loss than a frequency or intensity cue.

Masking Level Difference (MLD) Test

Sweetow & Redell, 1978; Wilson, Zizz & Sperry (1994). Tonal and speech materials for auditory perceptual assessment are available in CD version from Richard Wilson, VAMC, Audiology 126, Mountain Home, TN 37684 (423/926-1171, Ext. 7533).

- *diotic test*
- *tests binaural interaction*
- *tonal or speech stimuli*

Masking level difference (MLD) is the difference in binaural threshold for tones or speech in noise that are in or out of phase with the noise, or in or out of phase at the two ears. Specifically, when the signal is out of phase (antiphasic) for the two ears or with the noise there is a release from masking and the thresholds improve, as compared to the in-phase condition (Chermak & Musiek, 1997). A listener's performance on MLD testing is dependent on the type of stimuli and masker and the specific administration protocols used (Bellis, 1996). For normal listeners the mean MLD for a 500 Hz pure tone and an 80 dB SPL masker is 11.0 dB for SπNø and 8.5 dB for SøNøπ. Corresponding MLDs for speech (spondees) are 8.3 dB for SπNø and 6.9 dB for SøNøπ. A release from masking is also seen when one compares monaurally masked thresholds with those obtained employing a binaural masker. The MLD for pure tones may be as high as 10 to 15 dB, depending on the frequency of the signal and the characteristics of the masking stimulus. The MLD for speech typically is smaller than that for pure tones. The preferred method for use with children is the premixed, spondaic MLD test.

Northwestern University Auditory Test No. 6 (NU-6)

Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119, 314/962-5890 or Tonal and speech materials for auditory perceptual assessment are available in CD version from Richard Wilson, VAMC, Audiology 126, Mountain Home, TN 37684 (423/926-1171, Ext. 7533).

- *NU-6 Low Pass Filtered Speech Test*
- *NU-6 Time Compressed Speech Test*
- *NU-6 Time Compressed Speech with Reverberation Test*

These three versions of the NU-6 monosyllabic word lists are monaural low redundancy speech tests. Each version represents an alteration of the monosyllabic word stimuli by reducing redundancy (i.e., filtering), by manipulating the timing feature, or by adding reverberation. The *NU-6 Low Pass Filtered Speech Test* is available with cut-off frequencies of 500, 750, 1000, and 1500 Hz; however, the 1000 Hz cut-off frequency is most commonly used with children at a presentation level of 50 dB HL. The *NU-6 Time Compressed Speech Test* is available with 45% and 65% compression, although the 45% compression rate is most commonly used with children. The *NU-6 Time Compressed Speech with Reverberation Test* is identical to the compressed speech version previously described, with the addition of a 0.3 second reverberation. This reverberation level would be typical of a good acoustical classroom setting. Scores are reported in percent correct for each ear.

Pediatric Speech Intelligibility Test (PSI)

Jerger & Jerger (1984). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119, 314/962-5890 or Oaktree Products, Inc., 2134 Heather Glen Drive, Chesterfield, MO 63017-5022, 800-347-1960.

- *linguistically loaded*
- *can be used as a screening test*
- *appropriate for children ages 3-6 years*

The PSI consists of 20 monosyllabic words grouped into four lists and two levels of sentence materials based on receptive language ability. The listener is asked to point to the appropriate pictures while the stimuli are presented either in quiet or with competing messages. Comparison of performance for words versus sentences frequently yields diagnostic information about central auditory function, even in listeners with peripheral hearing loss. Message-to-Competition (MCR) functions are obtained in either an ipsilateral or contralateral masker condition. MCR functions, unlike the PI functions, cannot be obtained if the listener has a peripheral hearing loss. Performance-intensity (PI) functions are obtained at different intensity levels in both quiet and noise. The goal of the PI function testing is to define performance from that intensity level yielding 0-20 percent correct to a maximum speech intensity of 90 dB HL. This test is appropriate for children ages three to six years.

Phonemic Synthesis Test

Katz & Fletcher (1998). Precision Acoustics, 411 NE 87th St., Suite B, Vancouver, WA 98664 (206-892-9367).

- *diotic test*
- *tests phonemic decoding ability*

The *Phonemic Synthesis (PS) Test* directly assesses phonemic decoding ability, an important skill that underlies speech and language development and is closely associated with reading and spelling. Student who have poorly developed phonemic decoding ability have difficulty in class with understanding what is said, making verbal associations, and in verbal recall. There are 25 items (words) on the PS test and the words vary from two to four sounds each, ordered according to level of difficulty. Presentation is at 50 dB SL (re PTA) and the test may be given binaurally under phones or in the sound field. This test may be administered to students with a unilateral hearing loss. The test yields both quantitative and qualitative scores. The quantitative score is the number of words correct and the qualitative score takes into consideration various qualifiers that characterize the student's response (e.g., delayed responses, quick responses, quiet rehearsals, extreme delays, reversals, non-fused responses, perseveration). If the quantitative score is abnormal, the qualitative score need not be computed. The qualitative indicators are correlated to Katz's categories of APD and the SSW (i.e., Decoding, Tolerance-Fading Memory, Integration, and Organization). There are norms from age six through adult, although the authors indicate that the test is most sensitive for students under age 10.

Pitch Pattern Sequence Test (PPST)

Pinheiro (1978). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119 (314/781-8890).

- *monotic tone test*
- *tests temporal patterning, frequency discrimination ,and linguistic labeling*

The *Pitch Pattern Sequence Test (PPST)* is a test of frequency discrimination used to test temporal patterning ability, and subsequently, frequency discrimination and linguistic labeling. Stimuli are three tone bursts (two of one frequency and one of the other). The frequencies used in the *PPST* are 1122 Hz (high) and 880 Hz (low) and are 150 msec in duration and the interstimulus interval is 300 msec. The test is administered at 50 dB SL (re: 1000 Hz threshold). Six possible patterns are available on the *PPST* (e.g., HHL, LLH, HLH, LHL, HLL, LHH). Although the *PPST* was designed to be administered monotically, a modified protocol (Hall, 1997) uses a presentation of 20 triads binaurally (under phones or in the sound field). The listener is requested to verbally report which pattern has been heard, thus attaching the linguistic label. However, alternate response mechanisms may be made available to children who have difficulty verbally stating the linguistic labels for the tone. For instance, responses may be hummed or sung, or the child may point to symbols for *high* and *low.* A percent correct score is derived as well as alternative scoring to accommodate listeners who acoustically reverse linguistic labels. Norms are available for ages six to nine years. Bellis (1996) provides additional norms for children ages 8.0-12.0 years. She states that information about the child's interhemispheric integration of auditory information is provided when a child persists in singing or humming a response rather than giving the linguistic label. Children with learning disabilities are generally able to hum patterns but demonstrate difficulty when they are required to respond manually or verbally (Cherry, 1992). Due to the high degree of variability found in children ages seven and younger, the PPST is probably most appropriate for children eight years of age and older (Bellis, 1996). The *PPST* is relatively resistant to cochlear loss. Because it does not use speech as a stimulus, the test can be used to assess individuals with limited or impaired language skills.

Screening Test for Auditory Processing Disorders in Children (SCAN-C)

Keith, R. (1999). The Psychological Corp., Harcourt Brace & Co., 555 Academic Ct., San Antonio, TX 78204-2498 (800-228-0752).

- screening test for children ages 5.0-10.11 years
- tests auditory closure (monotic), speech-in-noise test (monotic), binaural integration (dichotic), binaural separation

The SCAN-C includes four subtests. The Filtered Words (FW) subtest is a monotic test of low-pass filtered speech that includes two 20-word lists of 1000 Hz low-pass filtered monosyllabic words (with a roll-off filter of 32 dB/ octave). It is a low redundancy speech test that is a measure of auditory closure ability. The Auditory Figure

Ground (AFG) subtest also consists of two 20-word lists presented with contralateral competing multitalker babble recorded at +8 dB signal-to-noise ratio. The listener is requested to repeat the monosyllabic words on this monotic speech-in-noise test. The Competing Words (CW) subtest is a dichotic, linguistically loaded task that consists of two lists of 25 paired monosyllabic words. The CW subtest is sensitive to neuromaturation and assesses binaural integration. The listener is requested to repeat the word heard in the right ear first for the first list and for the left ear first for the second list. Total ear score and ear advantage scores are derived for this subtest. The Competing Sentences (CS) subtest assesses development of the auditory system, auditory maturation, and hemisphere specialization. It is a binaural separation task that requires listening to a sentence presented to each ear and repeating the sentence heard in the right ear for the first list and the left ear for the second list. Unlike other competing sentences tests, the stimuli in this subtest are both presented at the same intensity level. Ear advantage scores also may be calculated for the CS subtest. Because the SCAN is a screening test, results should be viewed in light of other data for determining if further diagnostic evaluation is indicated, and it cannot stand alone as a diagnostic test of CAP function.

Screening Test for Auditory Processing Disorders in Adolescents and Adults (SCAN-A)

Keith (1993). The Psychological Corp., Harcourt Brace & Co., 555 Academic Ct., San Antonio, TX 78204-2498 (800-228-0752).

- *screening test for ages 11-50 years*
- *tests auditory closure (monotic), speech-in-noise (monotic), binaural integration (dichotic)*

The SCAN-A is a modified version of the SCAN and can be used with listeners ages 11-50 years. The SCAN-A consists of four subtests: Filtered Words, Auditory Figure-Ground, Competing Words and Competing Sentences. (Refer to subtest description below for further information.) The Filtered Word (FW) subtest is a monotic test of low-pass filtered speech, composed of two 20-word lists of low-pass filtered monosyllabic words. Unlike the SCAN, which was filtered at 1000 Hz (with a roll-off filter of 32 dB/octave), the FW subtest of the SCAN-A employs a filter at 500 Hz, thus making the task more difficult. It is a low redundancy speech test that measures auditory closure ability. The Auditory Figure Ground (AFG) subtest is a monotic speech-in-noise test. It also consists of two 20-word lists presented with contralateral competing multitalker babble recorded at a 0 dB signal-to-noise (S/N) ratio, meaning that the monosyllabic words and the competition are at the same intensity levels. The listener is requested to repeat the monosyllabic words. The Competing Words (CW) subtest is a dichotic, linguistically loaded test of binaural separation. It consists of two lists of 15 paired monosyllabic words. The CW subtest is sensitive to neuromaturation and assesses binaural integration. The listener is requested to repeat the word heard in the right ear first for the first list and for the left ear first for the second list. Total ear score and ear advantage scores are derived for this subtest. The Competing Sentences (CS) subtest is a linguistically loaded dichotic task, consisting of two lists of 10 paired sentence lists. The listener is requested to repeat the sentence heard in the right ear first for the first list and for the left ear first for the second list.

Selective Auditory Attention Test (SAAT)

Cherry, R. (1980). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119 (314-962-5890).

- *diotic speech-in-noise test*
- *tests auditory closure*

The *SAAT*, a diotic speech-in-noise test, is a closed response set test that uses the Word Intelligibility Picture Identification (WIPI) test picture stimuli. This test is useful with young children because the receptive vocabulary level is appropriate for young children; it does not require a verbal response, but rather a picture-pointing response; and it does not require the ability to read. The *SAAT* may be used for CAP screening. The *SAAT* has two parts: Quiet Listening (a list of 25 monosyllabic words prerecorded in quiet, providing a speech recognition score in percentage correct) and Selective Listening (an equivalent list prerecorded with a semantic distracter providing a selective listening score in percentage correct). The Selective Listening portion of the test examines auditory closure ability and should not be administered unless the student has achieved a score of at least 88 percent in the quiet condition to establish the child's baseline ability to perform the task. The selective task has been prerecorded at a 0 dB S/N. The *SAAT* was normed on 325 children, pre-kindergarten through second grade (ages four to nine years old). The children were divided into three groups: normal achieving, learning disabled, and those making insufficient school progress. On the quiet listening subtest there was no difference between groups; however, in the

presence of the semantic distracter, at each age level the learning disabled children scored significantly lower than the "teacher concerned" children, who scored significantly lower than the normal achieving children. The SAAT appears to be efficient in identifying those children who may be "at risk" for learning problems as measured by teacher concern. Percent correct scores are available for the three groups as well as the total test group for ages four through eight years.

Spondee Binaural Fusion

Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119, 314/962-5890

- *tests binaural interaction, specifically binaural fusion*
- *linguistically loaded*

Band-passed spondaic words are used as stimuli, with the low-pass segment of each word presented to one ear and the high-pass segment presented to the opposite ear. Twenty words are presented to each ear. Presentation levels are 30 dB SL for the low-pass ear and 10 dB SL for the high-pass ear, with the test ear being designated as the ear receiving the low-pass band. Filter cut-offs at 24 dB or 48 dB per octave are available.

Staggered Spondaic Word (SSW) Test

Katz, J. (1962, 1994). Precision Acoustics, 411 NE 87th St., Suite B, Vancouver, WA 98664 (206-892-9367).

- *dichotic test*
- *tests binaural integration*
- *linguistically loaded*

The SSW, a dichotic test of binaural integration, is perhaps one of the most discriminating CAP tests. The bi-syllabic stimuli in the SSW are arranged in a manner such that spondaic words are presented in four conditions: 1) right noncompeting (RNC), 2) right competing (RC), 3) left competing (LC), and 4) left noncompeting (LNC). Stimulus presentation is alternated between the left leading and the right leading. The listener is required to simply repeat the words heard. Following is a sample item from the SSW.

right ear:	*up stairs*
left ear:	*down town*

Scoring of the SSW was revised in 1994, using the Number of Errors (NOE) analysis format in an effort to simplify the scoring, make it a complete statistical analysis, and not sacrifice either sensitivity or specificity. This scoring procedure is more efficient when evaluating AP in children. Traditional scoring methods are still appropriate for site-of-lesion testing and for persons with hearing loss who are seen for AP evaluations. Norms are available for ages five-69 years, at one-year intervals through age 11, followed by two adult group norms. The NOE is given, as well as the mean and standard deviation for each of the four listening conditions and the total score. Norms for word discrimination scores (WDS) are presented separately, unlike the original version where an adjustment was made for the WDS. Procedures are also available for calculating response biases (i.e., reversals, order effect, ear effect) and Type-A using the NOE process. The SSW may be given to persons with peripheral hearing loss.

Synthetic Sentence Identification with Contralateral Competing Message (SSI-CCM)

Jerger, J. & Jerger, S. (1974). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119 (314/962-5890).
develop description

- *dichotic test*
- *tests binaural separation*

Stimuli for the SSI are closed set nonsense sentences delivered in a story about Davy Crockett. For the SSI-CCM, a synthetic sentence (e.g., Small boat with a picture has become) is presented to one ear at a comfortable listening level (e.g., 50 dB SL re: SRT) while the meaningful competing message is delivered to the contralateral ear. The intensity level of the competition is typically set at -40 MCR. The listener must be able to read the response sentences in order to select the number of the stimulus sentence heard. The percent correct performance is plotted on a chart as a function of the difference between the sentences and the competing message (message to competition ratio) in dB. The SSI was designed to minimize the listener's reliance on linguistic skills by using third order approximations of English sentences. The SSI is independent of degree of hearing loss and cognitive function. Normative data suggests that normal 10 year olds perform like adults.

Synthetic Sentence Identification with Ipsilateral Competing Message (SSI-ICM)

Jerger, J. & Jerger, S. (1974). Auditec of St. Louis, 330 Selma Ave., St. Louis, MO 63119 (314/962-5890).

- *monotic test*
- *tests auditory closure and speech-in-noise*

Stimuli for the SSI are closed set nonsense sentences delivered in a story about Davy Crockett. For the SSI-ICM, a synthetic sentence (e.g., Small boat with a picture has become) is presented to one ear at a comfortable listening level (e.g., 50 dB SL re: SRT) while the meaningful competing message is delivered to the same ear. The intensity level of the competition is varied from +10 to -20 for each presentation of 10 sentences. The listener must be able to read the response sentences in order to select the number of the stimulus sentence heard. The percent correct performance is plotted on a chart as a function of the difference between the sentences and the competing message (message to competition ratio) in dB. The SSI was designed to minimize the listener's reliance on linguistic skills by using third order approximations of English sentences. The SSI is independent of degree of hearing loss and cognitive function. Normative data suggests that normal 10 year olds perform like adults.

Test of Auditory Perceptual Skills - Revised (TAPS-R)

Gardner, M. (1996). Psychological and Educational Publications, Inc., P.O. Box 520, Hydesville, CA 95547 (800/523-5775)

- *auditory perceptual skills screening test*

The TAPS-R measures seven areas of auditory-perceptual skills: number memory–forward, number memory–reversed, sentence memory, word memory, interpretation of directions, word discrimination, and processing (thinking and reasoning). Normative data is available for ages 4.0 through 12.11. The TAPS-R is also available in Spanish. The test may be administered in 15 to 25 minutes.

Willeford Battery: Binaural Fusion (BF)

Willeford, J. (1977). Jack A. Willeford, Ph.D., Colorado State University, Dept. of Communication Disorders, Ft. Collins, CO 80523. (907/491-8671)

- *diotic test*
- *tests binaural interaction*
- *segmented spondee words*

This test is also known as the *Ivey Binaural Fusion Test* (1969), which was an adaptation of the *Matzker Binaural Fusion Test* (1959). The BF test uses two 20-word spondee lists with a low-pass band (500-700 Hz) to one ear and a high-pass band (1900-2000 Hz) presented to the other ear. Recommended presentation level is 30 dB SL (re: pure tone thresholds at 500 and 2000 Hz). The listener must fuse or resynthesize information from one ear with information from the opposite ear in order to identify the stimulus word. The listener repeats the words heard and the score is based on the number of correct answers (percent correct). Norms are available for age six through adult. Due to identified list differences, Willeford and Burleigh (1985) suggest that 10% be added to the score obtained from the use of List 2 for compensation purposes. Norms for 10 year old children are very near that of adults. Tests of binaural fusion are sensitive to brainstem lesions (Bellis, 1996). In addition, abnormal binaural fusion or resynthesis performance has been seen in children with dyslexia and/or learning disabilities (Willeford, 1977).

Willeford Battery: Competing Sentence (CS)

Willeford, J. (1977). Jack A. Willeford, Ph.D., Colorado State University, Dept. of Communication Disorders, Fort Collins, CO 80523. (907/491-8671)

- *dichotic test*
- *tests binaural separation*
- *linguistically loaded test*

The Competing Sentence (CS) from the Willeford battery is a linguistically loaded dichotic test. Simple sentences are presented dichotically with the target sentence at a level 15 dB softer than the competition sentence. From the list of 25 sentences, 10 are presented to each ear with the five remaining being available as practice items. The presentation level is 35 dB SL (re: PTA) for the target sentence and 50 dB SL (re: PTA) for the competing sentence.

Listening conditions are with the ipsilateral competing message or a contralateral competing message (most popular). It may also be administered at 50 dB SL for each ear, but this is a very difficult task for children. The listener is instructed to repeat the target sentence and ignore the competing sentence, which assesses the binaural separation of auditory information. For children, liberal scoring is encouraged. Paraphrasing of the target sentence is allowed. Responses are scored as incorrect when the child's response either includes significant intrusions of words from the competing message or the child fails to respond at all. Musiek (1994) has developed a more stringent scoring method for the CS test. Each of the 10 target sentences is assigned a value of 10 points and is divided into quadrants, with each worth 2.5 points (25 percent of the sentence score). Norms are available for children ages five-12; older children use the age 12 to adult norms. Bellis (1996) derived local norms (Colorado) for the eight-12 year old population and noted that based on her norming sample (N=150) that for the right ear, adult-like performance is achieved by age nine, whereas this is not reached until age 11 for the left ear. The CS test is valuable in investigating neuromaturation and language processing abilities (Willeford & Burleigh, 1994). Ear advantage decreases as a function of increase in the age of the child.

Willeford Battery: Low-Pass Filtered Speech

Willeford, J. (1977). Jack A. Willeford, Ph.D., Colorado State University, Dept. of Communication Disorders, Fort Collins, CO 80523. (907/491-8670)

- *monotic, low redundancy speech test*
- *tests auditory closure*

The Low-Pass Filtered Speech test from the Willeford battery is also known as the *Ivey Filtered Speech Test* (1969). It is a monotic, low-redundancy speech test that assesses auditory closure ability. It consists of two 50-item lists of Michigan CVC words that are filtered at 500 Hz with an 18 dB per octave rejection rate. Removing part of the frequency spectrum of speech stimuli limits their intelligibility. Norms are available for ages 5-10 years and adults. Norms show that task performance improves with age and obviously maturation of the CANS. Normative data shows that performance is comparable in both ears and that fairly wide range of scores is shown among subjects at all age levels. Problems may be noted if there is abnormal performance for both ears or if there is an asymmetry of greater than 0-12 percent between the ears.

Appendix B

Sample Forms for Use in the Evaluation and Management of CAP/D

The following student and classroom observation forms are described in this appendix.

- *Fisher's Auditory Problems Checklist*
- *Children's Auditory Performance Scale (CHAPS)*
- *Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.)*
- *Pre-kindergarten Screening Instrument for Targeting Educational Risk (Pre-K S.I.F.T.E.R.)*
- *Evaluation of Classroom Listening Behaviors (ECLB)*
- *Listening Environment Profile*

Sample forms listed below are included in this appendix. Forms have been adapted or developed by the Audiology Task Force on Central Auditory Processing Disorders (CAP/D).

- CAP Referral Form
- CAP Case History
- Central Auditory Processing Disorders (CAPD) Accommodations and Modifications Checklist
- Information for Parents about CAP Observations and Tests
- CAP Profile Chart
- Classroom Environment Checklist
- Medical Clearance Form for Use of FM System
- Permission to Use Auditory Amplification
- FM System Pre-Trial Appraisal
- FM System Appraisal: Post-trial or Annual Review
- Student Appraisal of FM System

Classroom and Auditory Behavior Observation Forms

Student and classroom observation checklists are helpful to teachers, parents, speech-language pathologists, audiologists, and other professionals concerned about students who are suspected of listening or auditory processing problem.

Children's Auditory Performance Scale (CHAPS)

Smoski, Brunt & Tannahill(1998). Educational Audiology Association, 4319 Ehrlich Rd., Tampa, FL 33624 (800/460-7EAA).

The *Children's Auditory Performance Scale (CHAPS)* was developed as a scaled questionnaire to systematically collect and quantify listening behaviors observed in children age seven and older. The checklist is to be used by parents and teachers as part of the screening process to help identify children who are experiencing listening difficulties due to hearing loss or to identify children who are at risk for a central auditory processing disorder. While this checklist is similar to the range of behaviors included in the other rating scales (e.g., Fisher's, Willeford and Burleigh), the *CHAPS* narrows the targeted behavioral characteristics to include only those involving listening behavior. The *CHAPS* is a 36-item checklist divided into six listening conditions and functions (i.e., noise, quiet, ideal, multiple inputs, auditory memory and sequencing, auditory attention span).

The parent and teacher are requested to make an assessment of a child's listening abilities by comparing the child to a reference population of other children of similar age and background (i.e., peers in the child's class). Precise instructions regarding the reference population comparison appear on the checklist itself. Each listening condition is described on the checklist and items that follow the condition are designed to examine practical listening demands.

Response choices (i.e., degrees of listening difficulty) are as follows: +1 (less difficulty), 0 (same amount of difficulty), -1 (slightly more difficulty), -2 (more difficulty), -3 (considerably more difficulty), -4 (significantly more difficulty), 5 (cannot function at all).

The CHAPS also can be used to help determine individual management strategies for children for listening difficulties caused by hearing loss or CAP disorders as a pre- and post-therapy evaluation device. The profile also includes a *CHAPS* subsection analysis that allows for a visual comparison of normal and below normal range observations in each subsection area. The summary profile is useful for plotting a comparison of parent and teacher observations; and, it is likewise useful for sharing information at Student Study Team meetings. The authors suggest that the *CHAPS* has helped to objectify the effects of auditory processing therapy on the listening ability of children by having both the classroom teacher and parents complete the rating scale as a pre- and post measure. The authors further suggest that the *CHAPS* may be useful for early and simple identification of children who should be referred for a CAP evaluation.

Evaluation of Classroom Listening Behaviors (ECLB)

Florida Department of Education (1995). *Improving Classroom Acoustics: Inservice Training Manual.* Tallahassee, FL. Additional Reference: VanDyke, J. (1985). Evaluation of classroom listening behaviors. *Rocky Mountain Journal of Communication Disorders (1).*

The *Evaluation of Classroom Listening Behavior (ECLB)* was adapted from VanDyke (1985) for use in the *IMPROVING CLASSROOM ACOUSTICS (ICA)* special project. The form was selected because it met the following criteria: 1) user-friendly, 2) can be completed quickly, 3) provides information about a child's listening abilities, 4) provides information about the benefits of using personal or classroom amplification. Most of the items are paired (e.g., close and distant listening, single and multiple directions, comprehension in one-to-one and group, close and distant comprehension). The *ECLB* has been used successfully by audiologists in educational settings as a pre- and post-observation instrument for students using personal and classroom assistive listening devices. In this instance the goal is to determine if there has been improvement in listening skills. The checklist is also useful as a pre-/post-observation of listening skills when other types of classroom intervention have been tried. The 10 items are rated on a five-point scale where "5" indicates frequently, "3" indicates sometimes, and "1" indicates seldom. The maximum score is 50.

Fisher's Auditory Problems Checklist

Fisher, L. (1976). Educational Audiology Association, 4319 Ehrlich Rd., Tampa, FL 33624 (800/460-7EAA). Additional Reference: Benson, P. (1995). Fisher's Auditory Problems Checklist. *Educational Audiology Newsletter*, 12 (2), 16.

This 25-item broad-based checklist was developed to help identify children with potential central auditory processing disorders (CAPD). It can be used easily by classroom teachers, other school support personnel, and parents to aid in classifying academic performance and related behaviors that characterize children as at-risk for CAPD. The checklist can be completed in less than five minutes. A score is derived by multiplying by four the number of items not checked. Normative data is available as mean percentage scores for individual grade levels, kindergarten through sixth. A Group Mean Score, which is the cut-off score suggesting need for further evaluation, is given along with Standard Deviations (SD). Some audiologists have found that this instrument has a high sensitivity rate for early identification of children with potential AP problems. Benson (1995) classified each item on Fisher's checklist according to the various components of auditory processing. Examining test items using these categories provides additional data that is helpful in describing a child's auditory (and auditory-related) perceived strengths and weaknesses.

Listening Environment Profile

Cockburn, J. (1995). *Listening Environment Profile.* Phonic Ear, Inc., Petaluma, CA. (800/227-0735).

This classroom observation form was developed to assess specific conditions in the listening and teaching environment. Each of these conditions is capable of influencing listening and learning in either a positive, negative, or

cumulative manner. Information from the worksheet may be used to modify the listening environment, customize amplification, and/or provide support to the teacher and students. Three or more conditions are described for each of 10 classroom environment components: classroom noise level, classroom acoustic treatments, noise sources, classroom structure, class size, grade level, number of students with special needs, teaching style, loudness of teacher's voice, and teacher's attitude towards technology. Each condition is weighted and the total score is compared to appraisals of the quality of the listening environment. The outcome of the *Listening Environment Profile* will assist school personnel in addressing specific student, teacher, and functional listening needs in the classroom environment.

Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.)

Anderson, K. (1989). Educational Audiology Association, 4319 Ehrlich Rd., Tampa, FL 33624 (800/460-7EAA).

The *S.I.F.T.E.R.* was developed as a screening instrument to provide a valid method by which children with known or suspected hearing problems could be educationally screened. This observation form consists of 15 questions, three in each of five categorical areas: academics, attention, communication, class participation, and school behavior. The classroom teacher is requested to compare the student's functional ability performance to that of his peers. It also may be used to track the performance of an individual child over time. This instrument is most appropriate for students in grades one through five.

The classroom teacher completes the *S.I.F.T.E.R.* by selecting a ranked response to questions that best describe the student's function in the classroom. Responses are on a scale of one to five. Descriptors for each number on the rating scale vary for each item and appear in each section of the form. Written comments from the teacher also are encouraged. Teacher responses are plotted on a scoring grid that indicates if the student passes, fails, or demonstrates marginal performance in each of the five areas, thus offering a profile of the student's functional abilities within the classroom setting.

The *S.I.F.T.E.R.* has been used to educationally screen children with unilateral hearing loss, minimal sensorineural hearing loss, recurrent otitis media, and listening problems. Another practical application is to use this tool as a pre-/post-observation relative to the use of personal and/or classroom amplification systems. Information from the *S.I.F.T.E.R.* is also valuable for consideration by participants in a Student Study Team meeting with regard to recommendations for interventions or further observation or evaluation.

Screening Instrument for Targeting Educational Risk in Preschool Children (Preschool S.I.F.T.E.R.)

Anderson, K. & Matkin, N. (1993). Educational Audiology Association, 4319 Ehrlich Rd., Tampa, FL 33624 (800/460-7EAA).

The *Preschool S.I.F.T.E.R.*, an adaptation of the *S.I.F.T.E.R.* (1988), is appropriate for children ages three through kindergarten. The primary goal of the *Preschool S.I.F.T.E.R.* is to identify those children who are at risk for developmental or educational problems due to hearing problems and who merit further observation and investigation. Analysis has revealed that two factors — expressive communication and socially appropriate behavior — distinguish those children who are normal from those who are at risk.

The format is the same as the original version. Categories include pre-academics, attention, communication, class participation, and social behavior. The 15 items are scored according to a five-point scale specific to each category. After the skills profile has been completed, scores are obtained for expressive communication and socially appropriate behavior. Ten targeted items from the observation instrument that are specific to these two domains are entered on the form and a profile is developed to describe the student's strengths and weaknesses. The *Preschool S.I.F.T.E.R.* is also useful as a pre- and post measurement for the use of personal or sound field amplification and for observing students who are suspected as being at risk for CAP disorder.

Referral for Audiological Central Auditory Processing (CAP) Evaluation

Student _____ D.O.B. _____
School _____ Gr. ___ Teacher _____
Parent/Guardian _____ Telephone _____
Address _____ Zip _____
Referral Source: speech-language pathologist
___ SST (Attach copy of Outcomes and Recommendations form.)
___ Other _____ (Attach documentation as appropriate.)
Referral Date: _____

Please note the following factors that may influence the referral for a CAP evaluation at this time.

- **Peripheral hearing.** Hearing sensitivity must be normal or near normal or the child should be cleared by an audiologist for AP evaluation if there is any degree of hearing loss.
- **Age of child.** Screening is generally not appropriate until a child is 3 or 4 years of age, and even at this age other factors must be taken into consideration. A diagnostic CAP evaluation is more sensitive for children age 7 and above. CAP evaluation of students below age 7 will be determined on an individual basis.
- **Cognitive ability.** Performance on central auditory tasks is greatly affected by cognitive ability. Thus, any child assessed must have ability within the normal range. Exceptions may be made for children with cognitive ability slightly below the normal range (i.e., IQ below 85).
- **Language competence.** Children with poor language skills will generally have more difficulty with CAP tasks, particularly those that require more sophisticated language processing (e.g., linguistically loaded tasks); results must be interpreted with caution. This caution also applies to ESOL students.
- **Phonology.** Most CAP tests require a verbal response; therefore, the student's speech must be intelligible.
- **Multidisciplinary assessment.** AP assessment should not occur in isolation from other psycho-educational and psycho-linguistic screening/evaluation. Consideration should be given to all factors that may affect the student's performance in order to view strengths and weaknesses in a holistic manner.

Brief Statement of Reason for Referral:

Collateral Test Data: Summarize below or attach available test data (e.g., speech/language, psychological, academic, processing).

Upon receipt of this referral, appropriate observational and case history forms will be sent to the student's teacher and parents prior to the CAP evaluation appointment.

Send this completed form to _____
.

Central Auditory Processing Disorders: Case History

Name_____ D.O.B. _____ Date _____

School _____ Gr. _____ Teacher _____

Classroom Type: open pod _____ traditional _____ portable_____

Student's preferred hand: right____left _____ Physician _____

Completed by:_____Telephone _____

Otologic History

(Ear problem includes: ear infection, earaches, draining ears, medicine taken for an ear problem, doctor noticed fluid behind the eardrum, hole in eardrum, etc.)

1. How many ear problems has your child had?
   None ____ 1-2 _____ 3-5 _____ 6-10 _____ 10 or more _____

2. Has your child had an ear problem in the last 6 months? yes no
   If *yes*, when? _____ What type of ear problem? _____
   Was medication given? yes no
3. Does your child have any of the following?

• frequent runny nose	yes	no	• ringing or buzzing in the ear(s)	yes	no
• frequent colds or sinus infections	yes	no	• dizziness	yes	no
• allergies	yes	no			

4. Has anyone related to the child had any ear problems? yes no
   Who? (parent, brother, sister, cousin, etc.) _____
   What type of ear problem? _____

5. Has your child ever been seen by an Ear, Nose & Throat (ENT) doctor? yes no
   If *yes*, which doctor? _____ When? _____

6. Has your child ever had any ear surgery?
   If *yes*, describe.
   yes no
7. Has your child previously had his/her hearing tested by an audiologist? yes no
   If *yes*, by whom? _____ When? _____

   What were the results?

8. Does your child have any permanent hearing loss? If *yes*, describe. yes no

   Has your child ever used amplification? yes no

Family History

1. Is there a family history of learning problems? yes no
   If *yes*, explain.

Developmental History

1. Were there complications before, during or after your child's birth? If *yes*, explain.	yes	no
2. Were there any delays in your child's development? If *yes*, explain.	yes	no
3. Has your child had any serious illnesses or accidents? If *yes*, describe.	yes	no
4. Does your child take any medications? If *yes*, please list.	yes	no

Listening and Understanding

1. Do you think your child has a problem listening or understanding? If *yes*, give examples. How long have you been aware of this problem?	yes	no
2. Does your child have difficulty with any subjects at school? If *yes,* please list.	yes	no
3. What are your child's best subjects in school?		
4. Does your child participate in any special class(es) or therapies? If *yes*, describe.	yes	no
5. Has your child been tutored? If *yes*, describe.	yes	no

Behaviors and Characteristics

Indicate (✓) if your child exhibits any of the following behaviors or characteristics.

- ☐ sensitive to loud sounds
- ☐ appears to be confused in noisy places
- ☐ easily upset by new situations
- ☐ difficulty following and/or understanding TV programs
- ☐ difficulty following directions
- ☐ does opposite of what is requested
- ☐ restless; problems sitting still
- ☐ overly active
- ☐ short attention span
- ☐ impulsive
- ☐ easily distracted
- ☐ daydreams
- ☐ forgetful
- ☐ asks for repetition
- ☐ reverses words, numbers, or letters
- ☐ prefers to play with older children
- ☐ prefers to play with younger children
- ☐ prefers solitary activities
- ☐ seeks attention
- ☐ disruptive or rowdy
- ☐ temper tantrums
- ☐ shy
- ☐ anxiety
- ☐ lacks self-confidence
- ☐ lacks motivation
- ☐ uncooperative
- ☐ disobedient
- ☐ destructive
- ☐ inappropriate social behavior
- ☐ does not complete assignments
- ☐ easily frustrated
- ☐ tires easily
- ☐ irritable
- ☐ dislikes school
- ☐ fakes illnesses
- ☐ awkward, clumsy

Please provide additional information to help us understand your child's strengths and weaknesses.

CENTRAL AUDITORY PROCESSING DISORDERS (CAPD)
ACCOMMODATIONS AND MODIFICATIONS CHECKLIST

Student_____ Date_____Completed by_____

The learning environment must be highly redundant for a student with a central auditory processing disorder (CAPD). The student should have to expend as little energy as possible to obtain critical information delivered in the classroom, at home, and in other social and learning environments. The following accommodations and modifications are recommended for this student to improve access to auditory information and are specific to the student's CAP deficit(s). The accommodations and modifications are presented according to Florida's Matrix of Services. For further information, refer to the current edition of the *Matrix of Services Handbook* and the *Accommodations* book, both available through the Clearinghouse.

Accommodation:

- Provisions made in how a student accesses and demonstrates learning.
- Adjustments to presentation to or response from student that does not change the content or the intended outcome.

Modification:

- Changes in what a student is expected to learn and demonstrate.
- Changes in content, requirements or expectations.

Domain A: Curriculum and Learning Environment

Environment:

_____Acoustically modified classroom
_____Reduce/minimize distractions:
___ auditory ___ visual ___ tactile
_____Flexible preferential seating
_____Provide isolated area for independent work (e.g., study carrel)

Curriculum:

_____Gain student's attention prior to delivery of information
_____Use outlines, organizers, study guides
_____Use technology to provide visual clues (e.g., overhead, computer)
_____Emphasize critical information
_____Monitor student's attending skills; provide breaks if necessary
_____Provide teacher notes
_____Pre-teach vocabulary
_____Use peer partners
_____Use cooperative learning groups
_____Provide visual augmentation
_____Modeling (clear demonstration of student performance expectations)
_____Use manipulatives
_____Reduce language level or reading level of assignments
_____Adjust difficulty level and length of assignments
_____Speak clearly without overexaggerating; adjust rate as needed
_____Extend time for task completion
_____Give extra cues or prompts
_____Provide alternative grading system
_____Avoid penalizing for spelling errors

Evaluation:

_____Teach test taking strategies
_____Provide alternative testing options
_____Read test to student
_____Allow oral response
_____Provide tape recorded tests
_____Allow tape recorded responses
_____Allow someone to record student responses
_____Preview language of test directions
_____Allow real world application/assessment
_____Tests administered by ESE teacher
_____Extend testing time
_____Provide alternate testing formats:
___ multiple choice ___ short answer ___ essay
___ fill-in the blank ___ true/false ___ open book

Domain C: Independent Functioning

_____Provide self-advocacy training and reinforce student's use
_____Teach organizational strategies
_____Teach study skills
_____Use visual daily schedule and calendars
_____Train students to "look and listen"
_____Review and check often for understanding
_____Have student paraphrase directions
_____Use study sheet to organize material
_____Review and practice in real life situations
_____Organize long-term assignments into manageable, sequenced steps
_____Vary type of response (e.g., copying, recognition, recall with cues)
_____Allow time for transitioning activities
_____Keep parents, teachers, and other professionals informed of student's independent functioning

Domain E: Communication

_____Use FM system
_____Use ear plugs to reduce distractions
_____Use tape recorder
_____Provide notetaker assistance
_____Provide assistive technology as needed
_____Use listening cues
_____Keep parents, teachers, and other professionals informed of student's communication strategies
_____Encourage and praise student for participation in expressive language activities

Other:

_____

Information for Parents About Central Auditory Processing (CAP) Observations and Tests

Central Auditory Processing (CAP). Very concisely stated, central auditory processing may be explained as "what the brain does with what the ears hear" (Katz, 1994).

Central Auditory Processing Disorder (CAPD). A central auditory processing disorder (CAPD) is an information input problem. A student with a central auditory processing (CAP) problem generally has normal hearing sensitivity, but has difficulty with the reception and interpretation of auditory information. Although some symptoms of a CAPD are similar to a hearing loss and/or an attention deficit disorder (ADD), which is an output disorder, a CAPD is a distinctly different problem. The student with a CAP problem has trouble making sense out of what he/she hears. Although the sounds are loud enough, the student has difficulty understanding the message, therefore often acting like someone with a hearing or attentional problem. Refer to Some Characteristics of Children with Central Auditory Processing (CAP) Problems for more information about symptoms that teachers and parents often have observed in students with a CAP problem.

Comprehensive CAP Evaluation Battery. The test battery administered to assess various levels of central auditory processing (CAP) ability may include the observational profiles and test instruments listed below. The CAP evaluation is a dynamic assessment, in that tests are selected based upon the student's age, observational data, case history information, and the student's profile of CAP strengths and weaknesses in order to achieve a comprehensive evaluation. It is important to note the specific listening/testing condition when reviewing information for each test. *Monotic* refers to testing each ear independently. In a monotic listening condition there may be competing stimuli (e.g., noise, multi-talker conversation) in the opposing ear. A *dichotic* listening condition means a different stimulus (e.g., word, sentence, digit) is presented to each ear simultaneously and the listener is requested to repeat both stimulus items. Some tests involve slight distortion of the auditory stimulus. The majority of the CAP tests are presented using recorded stimuli.

Observation Instruments

- ❑ ***Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.).*** The student's classroom teacher completes the S.I.F.T.E.R, a rating scale designed to "sift out" students who are educationally at risk, possibly as a result of hearing or other auditory problems. The S.I.F.T.E.R. compares the student to his or her classmates.
- ❑ ***Fisher's Auditory Problems Checklist.*** The parent and the classroom teacher complete this 25-item checklist, indicating if the auditory-related behaviors are characteristic of the student.
- ❑ ***Children's Auditory Performance Scale (CHAPS).*** The CHAPS is a scaled questionnaire used to quantify observed listening behaviors. The six listening conditions (noise, quiet, ideal, multiple inputs, auditory memory sequencing, auditory attention span) are rated on a 7-point scale. Each listening condition and the total score are scored as "pass" or "at risk".

Screening Test

- ❑ ***Screening Test for Auditory Processing Disorders (SCAN).*** The SCAN tests both monotic and dichotic listening abilities. The Filtered Word (FW) subtest is a low redundancy speech test that measures auditory closure ability. A 20-word list of low-pass filtered (slightly distorted) monosyllabic words is presented to each ear independently. The Auditory Figure Ground (AFG) subtest is a monotic speech-in-noise test that consists of two 20-word lists presented with contralateral (opposite ear) competing multi-talker noise. The Competing Words (CW) subtest is a dichotic task, consisting of two lists of 25 paired monosyllabic words. The CW subtest is sensitive to neuromaturation and assesses binaural integration. One word is presented to each ear at approximately the same time and the listener is requested to repeat both words. The Competing Sentences (CS) is another dichotic test that measures binaural separation, the ability to listen to a different sentence presented to each ear and repeat the sentence delivered to the target ear.

Monaural Low Redundancy Speech Tests: Each ear is tested independently. The words or sentences are slightly distorted in order to assess auditory closure ability.

- ❑ ***Filtered Speech Test.*** This is a monotic test where the student listens to monosyllabic words that have been

slightly distorted by filtering high frequency information. This test of auditory closure ability requires the student to repeat the words heard. Each ear is tested separately.

- ❑ ***Time Compressed Speech.*** This test of auditory closure ability requires the student to listen to words that have been compressed (i.e., speeded up) and then repeat the words. Each ear is tested separately.
- ❑ ***Time Compressed Speech with Reverberation.*** This test of auditory closure ability requires the student to listen to words that have been compressed (i.e., speeded up) and also distorted slightly by adding reverberation that is similar to a typical classroom listening environment. Each ear is tested separately and the student is requested to repeat the words.

Tests of Temporal Processing: These tests assess the student's pattern perception and temporal functioning abilities, that is, the ability to process nonverbal auditory signals and to recognize order or patterns. Tests of temporal processing require the listener to discriminate sound based on a sequence of auditory stimuli or temporal order.

- ❑ ***Pitch Pattern Sequence Test (PPST).*** This is a tone test of frequency discrimination (high/low) used to test temporal patterning ability. The PPST also evaluates the listener's frequency discrimination, temporal ordering, and linguistic labeling abilities. The test is administered binaurally (same stimulus to each ear simultaneously). The score is given in percent correct and an adjusted score gives credit for acoustic reversals (e.g., *high-high-low* for *low-low-high*).
- ❑ ***Duration Pattern Test (DPT).*** The DPT is a test of duration discrimination (short/long) used to test temporal patterning ability. The DPT requires the listener to use temporal processing ability to order tonal stimuli, discriminate duration, and attach a linguistic label. For children experiencing difficulty labeling the acoustic stimuli, credit is given for acoustic reversals (e.g., short-short-long Vs long-long-short).
- ❑ ***Auditory Fusion Test-Revised (AFT-R).*** The *AFT-R* is a monotic test of auditory fusion. The student reports if one or two tones are heard. The test is administered in a diotic mode (same stimulus to both ears), although it may be given to the right and left ears independently.

Dichotic Speech Tests: In the dichotic test, a different stimulus is presented to each ear simultaneously. Binaural integration tests require the student to repeat everything that is heard in both ears. Binaural separation requires the student to ignore what is heard in one ear and repeat what is heard in the target ear.

- ❑ ***Dichotic Digits Test (DDT).*** The *Dichotic Digits* test measures the listener's ability to process information in a dichotic listening condition (binaural integration). This test requires the student to repeat four digits, two of which are presented to each ear simultaneously. Stimuli are digits 1-10, except 7.
- ❑ ***Staggered Spondaic Word (SSW) Test.*** The *SSW* is a test of binaural integration that assesses dichotic listening skills. The student is asked to attend to two spondee (bi-syllabic) words such as *upstairs* and *downtown,* which are presented simultaneously in various overlapping conditions to the two ears. Scores are given for each of four listening conditions: 1) right non-competing (RNC), 2) right competing (RC), 3) left competing (LC), and 4) left non-competing (LNC). Stimulus presentation is alternated between the left ear leading and the right ear leading. The listener is required to simply repeat the words heard.

  Example: right ear: *up stairs*
  left ear: *down town*

- ❑ ***Competing Sentences Test.*** The *Competing Sentences Test* is another dichotic test. The stimulus sentence is presented at a lower intensity level to one ear and the competing sentence at a higher level (+15 dB) to the opposite (contralateral) ear. It is a test of binaural separation that requires the student to repeat the stimulus (softer) sentence and ignore the competition (louder sentence).
- ❑ ***Dichotic Rhyme Test.*** This is a dichotic test of binaural integration. The student listens to two rhyming words, one to each ear, and repeats the words.
- ❑ ***Dichotic Sentence Identification (DSI).*** The student listens to two sentences, one presented to each ear simultaneously, and then indicates which of six stimulus sentences he/she heard.

Binaural Interaction Tests: Complimentary information is presented to each ear and the student must integrate the information and repeat the word or indicate when a tone is present.

- ❑ ***Spondee Binaural Fusion.*** This test of binaural interaction requires the student to listen to spondee (bi-syllable) words (e.g., *sidewalk, doorbell*), where the words have been slightly distorted through filtering and one syllable is presented to each ear. The student is to repeat the spondee words.

- ❑ ***Masking Level Difference (MLD).*** This binaural interaction test requires the student to identify when the stimulus (a tone or a word) "comes out of" the background noise. Most often spondee words are used when testing children.

Other:

- ❑ ***Phonemic Synthesis Test.*** This test assesses phonemic decoding (sound blending) ability. There are 25 test items that vary from two to four sounds per word. The test is given binaurally (same stimulus to each ear). A Quantitative Score (number of items correct) and a Qualitative Score (accounts for response behaviors) are computed.
- ❑ ***Speech in Noise.*** These auditory figure-ground tests evaluate the student's ability to separate the target word from the competing stimulus (e.g., multitalker babble) in the opposite ear. This may also be tested when the target words and the competing stimulus are both presented through the speakers.

Following the evaluation, you will be provided with descriptions of any additional tests that are administered. The results of this test battery will be plotted on a CAP Student Profile to show your child's CAP strengths and weaknesses. A written report, along with appropriate recommendations, will be provided at a later date.

For further information, contact _____ at _____ .

Central Auditory Processing (CAP) Profile

Student: _____C.A.: _____Date: _____

	Below Average							*Average*						*Above Average*					
Standard Score	55			70			85			100			115			130		
Standard Deviation	-3			-2			-1						+1			+2		
Standard Score	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SCAN-C/A																		
Filtered Words																		
Auditory Figure-Ground																		
Competing Words																		
Competing Sentences																		
SCAN Composite Score																		
Dichotic Digits																		
Right Ear																		
Left Ear																		
SSW																		
Right non-competing																		
Right competing																		
Left competing																		
Left non-competing																		
SSW Total Score																		
Response Bias: *Significant: yes / no* *Order Effect:* *Significant: yes / no* *Ear Effect:* *Significant: yes / no*																		
Reversals:																		
Phonemic Synthesis																		
Quantitative Score																		
Qualitative Score																		

❒ **Pitch Pattern Sequence Test** ❒ **Duration Pattern Sequence Test**

Age Mean:		Adjusted Mean:	Adjusted Score:

TEST INSTRUMENT/PROCEDURE	**Right**	**Left**	**Binaural**	**Impressions**
Speech in Noise @ 55 dB HL (+5 dB S/N)				
Masking Level Difference (MLD) (tones/speech)				
Auditory Fusion Test (revised)				
Spondee Binaural Fusion				
Competing Sentences Test				
Dichotic CV Test				
Dichotic Rhyme Test				
Dichotic Sentence Identification				
Filtered Speech Test				

(over)

Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.)

Category	Pass	Marginal	Fail	Areas of Concern Compared to Peers
Academics				
Attention				
Communication				
Class Participation				
School Behavior				

Fisher's Auditory Problems Checklist (parent = P & teacher = T)

Acuity		1	2
Attention	3	4	5
Attention Span	6	7	8
Auditory Figure-Ground			9
Auditory Discrimination		10	11

Short-Term Memory		12	13
Long-Term Memory			14
Sequential Memory		15	16
Comprehension	17	18	19
Speech/Language Problems		20	21

Auditory-Verbal Integration		22
Motivation		23
Performance	24	25

Children's Auditory Performance Scale (CHAPS) (parent = p & teacher = t)

Listening Condition →	Noise	Quiet	Ideal	Multiple Inputs	Auditory Memory Sequencing	Auditory Attention Span	Total
Pass (P)/At Risk (R)							

Other Diagnostic Tests: *Below Average* ***Average*** *Above Average*

Standard Score	55			70			85			100			115			130		
Standard Deviation	-3			-2			-1						+1			+2		
Standard Score	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Classroom Environment Checklist

Student Name_____ School_____

Teacher_____ Grade_____ Date_____

Please provide us with the following information:

Yes No

____ ____ 1. The student receives preferential seating (near the teacher).

____ ____ 2. The student is taught in an enclosed classroom (4 walls).

____ ____ 3. The student's classroom is carpeted.

____ ____ 4. The student's classroom has minimal ambient noise (e.g., free from room air conditioners, street noise, frequent use of overhead projector).

____ ____ 5. The student has one teacher for academic areas.

____ ____ 6. The teacher typically provides instruction from one location in the classroom.

7. The student receives small group instruction (10 students or less) approximately _____% of the time.

8. The total number of students in the classroom is: (circle one)
   1-10 11-20 21-30 31 or more

Medical Clearance for Use of Auditory Amplification

This form is to be completed by the student's physician.

Student _____ **D.O.B.** _____ **School** _____

It has been recommended that this student be fit with a mild gain amplification system to aid in learning at school. Prior to use of any amplification device, the student must have a recent hearing evaluation. The use of a mild gain auditory amplification system is recommended for this student as an accommodation related to a central auditory processing deficit. Because this student's hearing is within the normal range, medical clearance is requested prior to fitting of mild gain amplification.

Thank you for your consideration in this matter. Please complete the following information and return this form to the address at the bottom of the form.

Is there any medical reason to contraindicate the use of a mild gain assistive listening device in this student's classroom? Yes ____ No ____
If *yes*, please comment.

Medical clearance is given for this student to use a low gain amplification device to aid in learning at school.
Yes ____ No ____

Recommendations or comments:

Physician's Signature: _____ Date: _____

Address: _____

_____

_____

Return to: _____

_____

_____

Permission to Use Auditory Amplification

Date _____

Dear Parent/Guardian:

Prior to the use of any individually worn amplification device, the student must have a recent audiogram on file. Parents should also be aware that periodic audiological evaluations are necessary during the period of time that the child uses the amplification system. Auditory amplification consists of a teacher transmitter (microphone) and student receiver coupled to a headset or earbud transducer. Inservice training is provided to school personnel in the proper use of this equipment.

If you have any questions regarding this procedure or the intent/use of this equipment, please contact_____at _____.

……

I give permission for my child, _____, to use auditory amplification system provided by the _____ School District and was informed of fitting procedures.

_____ _____

Parent/Guardian Signature Date

FM System Pre-Evaluation Appraisal

Student's Name_____ Date_____
School_____ Teacher_____ Grade_____
Subject(s)_____

Rating Scale:
NA = not appropriate/observed 1 = poor 2 = fair 3 = average 4 = good 5 = excellent

1.	Attentive behavior in a large group	NA	1	2	3	4	5
2.	Attentive behavior in a small group	NA	1	2	3	4	5
3.	One-on-one communication	NA	1	2	3	4	5
4.	Volunteering in class	NA	1	2	3	4	5
5.	Appropriate response when called upon	NA	1	2	3	4	5
6.	Completes work	NA	1	2	3	4	5
7.	Ability to follow verbal directions	NA	1	2	3	4	5
8.	Social interaction with classmates	NA	1	2	3	4	5

9. Estimate amount of time the student spends in whole-class instruction:
   _____ % of day

10. Other comments:

Thank you for your comments. Please return this form to _____.

FM System Appraisal

Post-trial period ____ Annual review ___

Student's Name _____ Date _____
School _____ Teacher _____ Grade _____
Subject(s) _____

Rating Scale:
NA = not appropriate/observed 1 = poor 2 = fair 3 = average 4 = good 5 = excellent

1.	Attentive behavior in a large group	NA	1	2	3	4	5
2.	Attentive behavior in a small group	NA	1	2	3	4	5
3.	One-on-one communication	NA	1	2	3	4	5
4.	Volunteering in class	NA	1	2	3	4	5
5.	Appropriate response when called upon	NA	1	2	3	4	5
6.	Completes work	NA	1	2	3	4	5
7.	Ability to follow verbal directions	NA	1	2	3	4	5
8.	Social interaction with classmates	NA	1	2	3	4	5
9.	Student's acceptance of FM system	NA	1	2	3	4	5
10.	Classmates acceptance of FM system	NA	1	2	3	4	5
11.	FM system helped student's ability to learn	NA	1	2	3	4	5

In which situations was the FM system most helpful?

12. When did the student use the FM system?
_____ all day, every day
_____ every day, part of the day When? _____
_____ some days When? _____

13. Have you encountered any problems with the use of the equipment?
_____ no
_____ yes If yes, explain.

14. Please check **all** that describe the student's use of the FM system in the classroom.

——— Before class began, the student remembered to give the transmitter/mic to the teacher and to get it back at the end of class
——— The student seemed irritable while using the FM system.
——— The student seemed to enjoy using the FM system.
——— The student continuously adjusted or played with the FM system.
——— Feedback or a whistling noise was heard occasionally.
——— The student took good care and made good use of the FM system.
——— The student turned the FM system on and off appropriately.
——— A daily listening check was performed on the FM system.

15. Would you recommend that this student use an FM system next year? yes ——— no ———
Why or why not?

16. Do you have any suggestions or recommendations for teachers who may use an FM system in the future?

Thank you for your comments. Please return this form to _____.

Student Appraisal of FM System

Student Name: _____ Date: _____

School: _____ Grade: _____

Type of FM System: _____

Please answer the following questions about the use of your FM System:

1. How long have you used the FM System? _____

2. List all classes taken this school year and how much the FM System was used in each class.

Class	Used FM system?		How often used?	
	Yes	No	Sometimes	Always
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

3. What problems have you had with the equipment this year?

4. Do you feel it will be helpful in next year's classes? Yes ____ No ____

5. Any other comments:

Please return this form to _____ .

Appendix C

Information on CAPD for Professionals and Parents

- Characteristics of Children with Possible Central Auditory Processing Disorders
- Ways CAP Problems Can Influence Reading
- Characteristics of Subprofiles of CAPD
- Suggestions for Successful Management of Children with CAPD: Tips for the Classroom Teacher
- Central Auditory Processing Management: Tips for Parents
- Modifications to Improve Classroom Acoustics
- An Inservice for Staff and Students on Personal FM Systems

Some Characteristics of Children with Central Auditory Processing (CAP) Problems

Definition. A child with a central auditory processing (CAP) problem has normal hearing but has difficulty in the reception and interpretation of auditory information. **Symptoms.** The symptoms of a CAP problem are very similar to the symptoms of a peripheral hearing loss (a hearing loss caused by a problem in the ear itself.) The child with a CAP problem has trouble making sense out of what he or she is hearing. Although the sounds are loud enough, the child has difficulty understanding the message, therefore acting like someone with a hearing problem. Following is a list of symptoms teachers and parents have often observed in children with a CAP problem.

Does the child…

- have difficulty with reading and spelling?
- pay attention only when he or she wants to, or have difficulty responding to part of the message?
- have difficulty staying on task and completing an assignment or project?
- look around for visual cues from other children before beginning an assignment?
- appear to tune out what is in the environment and become lost in his or her own little world?
- have upper respiratory problems such as allergies, sinus, colds, adenoid problems, or mouth breathing?
- have a history of fluctuating hearing loss, ear infections, earaches, feelings of pressure in the ears, discharge from the ears, or a complaint of noises in the ears?
- ever seem confused about where sounds are coming from and have trouble locating them quickly?
- have difficulty telling the difference between words that sound similar, such as cone/comb?
- demonstrate unusual expressions or body postures while listening (e.g., facial expressions, turning or tilting of the head, turning the body)?
- respond fairly well in quiet situations but have great difficulty listening in noisy environments such as with the TV or in a noisy crowd or classroom?
- have difficulty remembering what is heard (e.g., names, stories, numbers, multiple directions)?
- have trouble saying certain sounds correctly or have delayed language abilities or knowing the meaning of words as well as other children of his or her age group?
- pay attention to sounds within the environment? Is there curiosity about sound and attempts to imitate sounds?
- seem to be able to associate certain sounds correctly with the source (e.g., siren with picture of fire engine)?
- often confuse directions or words and think something else was said?
- seem to be able to learn children's songs and TV jingles easily?
- have difficulty remembering information in the order it was said?
- respond to very simple instructions but not to more complex instructions?
- tend to use the same words or phrases over and over instead of responding appropriately to changing verbal information?
- have difficulty associating letters of the alphabet with their sounds?
- seem to be visually alert (e.g., watching the speaker's face very closely, watching what others are doing)?
- show behaviors that are inappropriate (e.g., aggression, withdrawal, impulsiveness)?
- perform more poorly on tests requiring verbal language understanding rather than a "hands on" test situation?
- seem to be slow to respond to auditory information, as if it takes longer to think through the information?
- have difficulty working independently?
- seem to be easily distracted and appear to have a short attention span?
- perform very inconsistently – sometimes very well and other times very poorly on the same task?

Source: Educational Audiology Association: *Great Educational Handouts*, Vol. 1, 1998. Developed by Gail G. Rosenberg, M.S., CCC-A, School Board of Sarasota County, FL. Reprinted with permission from the Educational Audiology Association.

Ways CAP Problems Can Influence Reading (Gillet, 1993)

Reading is a visual symbol superimposed on previously acquired auditory language. Before a child learns to read, language learning depends almost exclusively on the auditory channel. The three aspects of the auditory processes that are most significant for reading are 1) discrimination of particular phonemes within words, 2) auditory discrimination of words, and 3) auditory closure.

A central auditory processing disorder (CAPD) can influence a child's ability to read. Following are some examples of difficulties the child with a CAPD may exhibit.

- ✓ inability to hear the similarities in the initial and final sounds of words
- ✓ cannot perceive the similarities in words (e.g., *fat/pat)*
- ✓ unable to hear the double consonant sounds in consonant blends
- ✓ lack of discrimination of short vowels (e.g., *ten, tin, ton)*
- ✓ cannot break words into syllables
- ✓ cannot break words into individual sounds
- ✓ inability to combine parts of words to form a whole
- ✓ cannot remember the sounds for the printed symbols or the names for the printed word
- ✓ difficulty in distinguishing similarities and differences in sounds
- ✓ lack of retention of sounds or syllables long enough to make matches or blends
- ✓ inability to relate the visual components of words to their auditory counterparts
- ✓ does not relate a part of a word to the whole word
- ✓ inability to synthesize or analyze unfamiliar words

Gillet, P. (1993). *Auditory Processes*. Novato, CA: Academic Therapy Publications (pp. 95-96).

Organization of and Rationale for Central Auditory Processing Disorder (CAPD) Profiles

Profiles of central auditory processing disorders (CAPD) relate to the underlying neurophysiologic region of dysfunction in the brain as well as to its higher level language and learning implications and sequelae. The purpose for the categorization model is to aid in the interpretation of CAP and related assessments to facilitate development of an individualized, comprehensive CAP management plan that addresses the student's functional deficits. By identifying the CAP profile, it is possible to develop an interactive intervention and management plan. Some students exhibit characteristics of more than one profile. By using a profile approach, the CAP evaluation results can be used to provide a better understanding of the student's strengths and weaknesses with respect to academic achievement, communicative success, and life skills.

The organizational model of CAPD profiles presented here is primarily based on the work of Bellis and Ferre (1999). Collaborative management strategies from Chermak and Musiek also are included. While this organizational model of CAPD profiles does not dictate a protocol including specific test instruments, it does infer that the behavioral CAP battery should include at least the following: dichotic speech tasks, monaural low-redundancy speech tasks, tests of temporal processing, and binaural interaction tasks (Bellis, 1996; Bellis & Ferre, 1999; Chermak & Musiek, 1997). When selecting a therapy program, it is very important that the professional consider the neuroscientific foundations and the reported outcome measures for the specific population, including the population for with the therapeutic program was intended. There are two basic types of therapy programs – bottom-up and top-down (Ferre, 2000).

Bottom-Up Therapy Programs	***Top-Down Therapy Programs***
stimulus-driven and intended to improve encoding of the signal through adaptive stimulation	*focus on improving ability to use metalinguistic/metacognitive strategies and enhancing the student's experiences and expectations to allow the strategies to be used*
▪ *Basic auditory skills training* ▪ *Phoneme training (Sloan)* ▪ *Fast ForWord Program* ▪ *Auditory vigilance training* ▪ *Interhemispheric transfer training* ▪ *Phoneme synthesis training* ▪ *LiPS* ▪ *Rhyming training* ▪ *Noise tolerance/desensitization training*	▪ *Auditory closure* ▪ *Discourse cohesion devices* ▪ *Schema induction* ▪ *Context-driven vocabulary building* ▪ *Prosody training* ▪ *Use of memory strategies (e.g., reauditorization, verbal rehearsal, visual imagery, chunking, transformation, mnemonic elaboration)* ▪ *Active listening* ▪ *Self-monitoring* ▪ *Assertiveness training and self-advocacy*

References

Bellis, T. (1996). *Assessment and Management of Central Auditory Processing Disorders in the Educational Setting.* San Diego: Singular Publishing Group.

--- (1999). Subprofiles of central auditory processing disorders. *Educational Audiology Review, 16* (2), 4-9.

--- (2000, Feb.) Assessment and management of central auditory processing disorders. Seminar presented at the South Carolina Speech, Language & Hearing Association annual convention. Hilton Head, SC.

Bellis, T. & Ferre, J. (1999). Multidimensional approach to the differential diagnosis of central auditory processing disorders in children. *Journal of the American Academy of Audiology, 10,* 319-328.

Chermak, G. & Musiek, F. (1992). Managing central auditory processing disorders in children and youth. *American Journal of Audiology, 1* (3), 61-65.

Chermak, G. & Musiek, F. (1997). *Central auditory processing disorders: New perspectives.* San Diego: Singular Publishing Group.

Ferre, J. (1999). CAP Tips. *Educational Audiology Review, 16* (2), 28.

--- (2000, Mar.) Issues in treatment efficacy: Using a deficit-specific model. Seminar presentation at the American Academy of Audiology annual convention. Chicago, IL.

Musiek, F. (1999). Habilitation and management of auditory processing disorders: Overview of selected procedures. *American Journal of Audiology, 10* (6), 329-342.

Primary CAPD Profile: Auditory Decoding Deficit

Region of Dysfunction: Primary (left) Auditory Cortex *(the most "purely auditory" CAPD subtype; frequently considered to be the "classic" manifestation of CAPD)*

CAP Test Findings	Associated Sequelae	Management Strategies
bilateral deficit on dichotic speech tests right ear performance often poorer (e.g., lower RC deficit on SSW test) deficit on Phonemic Synthesis Test tendency for errors to be phonemically similar to target (e.g., *bite/bike*) bilateral deficit on monaural low-redundancy speech tasks *(suggests left hemisphere dysfunction)* poor auditory discrimination poor temporal resolution cognitive testing often reveals poorer verbal than visuospatial skills testing often reveals weak receptive and expressive vocabulary skills CAP Tip: Check spelling skills. If the child can spell words the way they *sound*, the child does *not* have an auditory decoding deficit. CAP Tip: Poor decoders often have difficulty on psychoeducational tests, such as memory for names and memory for words subtests, with markedly better scores on memory for sentences due to the redundant nature of the target.	"I didn't hear you." or "Huh?" mimics high frequency hearing loss • appear to "mishear" and substitute similar-sounding words for the actual auditory target; slow and inaccurate; requires repetition • poor discrimination of fine acoustic differences in speech excessive auditory fatigue (as compared to peers); listening behaviors deteriorate as auditory overload increases adverse effect on sound recognition, sound blending, reading decoding, and writing skills difficulty in situations with reduced redundancy: • unfamiliar vocabulary • insufficient contextual clues • insufficient visual clues • excessive noise and/or reverberation • auditory chaos • groups communication problems: • weak semantic and syntactic skills • weak vocabulary skills • difficulty learning foreign languages; ASL alternative academic problems: • difficulty with spelling and reading decoding *(Generally manifested only as word attack or ability to phonetically sound out or spell regular and nonsense words, secondary to poor neural representation of acoustic/ phonetic features of speech in the primary auditory cortex.)* • notetaking • following directions • poor analytic skills (i.e., difficulty analyzing visual, auditory, and written information into its constituent parts) • tendency to perform better in subjects such as math computation where phonemic decoding is not required	include components of traditional aural rehabilitation strategies used with hearing impaired; bottom-up processing environmental modifications to improve: • acoustic signal clarity and redundancy • acoustic access to information • preferential seating to maximize *both* auditory and visual information • visual augmentation • notetaking assistance • noise reduction use of assistive listening technology minimize auditory overloading drill-type speech sound training often indicated; focus on stop consonants and other "hard-to-hear" contrasts activities to enhance auditory closure abilities; use of contextual clues to facilitate closure and contextual derivation of word meaning speech-to-print skills training; remedial reading activities focused on sound-symbol association preteach new information to achieve closure more easily counsel toward self-advocacy for listening, including recognition of adverse listening conditions and methods of dealing with them strategies training on methods to clarify auditory instructions visualization and verbalization approach to spelling and reading decoding skills that reinforce sound-symbol association speech-language therapy focus on top-down skills Commercial programs: Earobics, Fast ForWord, Sloan program, LiPS CAP Tip: *Repetition* (a more salient, acoustically clearer target) or *rephrasing* (gives target greater linguistic clarity) is appropriate modifications. When rephrasing, the message must be sufficiently clear so as not to confuse the child. CAP Tip: Teach the student to look *and* listen.

Primary CAPD Profile: Prosodic Deficit

Region of Dysfunction: Non-*primary (right) Auditory Cortex and associated areas*
(opposite of Auditory Decoding Deficit; profile suggests inefficient right hemisphere, because intact right hemisphere is required both for processing of left ear dichotic stimuli and for frequency/duration discrimination and tonal pattern perception; deficiency in ability to use prosodic features)

CAP Test Findings	Associated Sequelae	Management Strategies
left ear deficit on dichotic speech tasks deficit on temporal patterning tasks in both labeling and humming conditions cognitive testing often shows characteristics typical of right hemisphere dysfunction (e.g., performance abilities lower than verbal, difficulty with visual-spatial abilities, difficulty with mathematics calculation and gestalt [part-to-whole] patterning) poor temporal integration CAP Tip: Have the child sing and/or say the "alphabet song". Weak prosody skills show up when they sing. (Poor integrators can *sing* the alphabet, but struggle to pull out the letters.)	"hear but do not understand" wide variety of auditory symptoms pragmatic language problems (i.e., comprehend general content of message, but difficulty judging communicative intent) • trouble with nonverbal clues (e.g., facial expressions, body language, gestures) • difficulty perceiving prosodic cues that underlie communication (e.g., sarcasm, humor, irony, question forms) • frequently demonstrate weak social communication skills and pragmatics and often may respond inappropriately difficulty comprehending oral messages, particularly linguistically complex messages due to inability to isolate key words from those surrounding them may have flat or monotonic speech and oral reading; may exhibit little or nonexpressive affect difficulty with perception and use of prosodic cues (e.g., rhythm, stress, intonation) typically poor musical abilities variable academic impact, which may include: • good word attack skills but difficulty with sight words (i.e., ability to spell and recognize irregularly spelled words in the language) due to inefficient gestalt patterning abilities • visuospatial and mathematics calculation difficulties • difficulty comprehending the main idea of a spoken or written narrative • difficulty taking notes during lecture-based classes may exhibit typical complaints of right hemisphere based communication disorders and auditory manifestations of nonverbal learning disability, including common symptoms of ADD • bright but unmotivated • highly verbal but express relatively little meaningful content • interact well with adults but poor social interaction with children • late identification of learning disability • early history of tactile defensiveness social-emotional concerns due to deficient social judgment and social interaction skills prone to depressive disorders, and in extreme cases, at risk for suicide	placement with an animated teacher who uses a melodic voice with changes in rate and pacing of speech visual augmentations in the classroom use of demonstrations and examples multisensory input prosody training—specific therapy focusing on perception and production of suprasegmental aspects of speech (i.e., rhythm, stress, intonation), gestalt (part-to-whole) patterning skills, and oral reading with exaggerated prosodic features key word extraction—searching for and extracting key words from oral or written narratives of increasing linguistic complexity read aloud daily with exaggerated prosodic features untimed tests psychological intervention—psychological counseling for social/emotional concerns as part of the management plan speech-language therapy for pragmatics and nonverbal language may be indicated may require ESE/other remedial services to improve math calculation and sight word reading abilities use of assistive listening device is seldom indicated as the primary difficulty is not related to the clarity of the acoustic signal may benefit from dance or music lessons or participation in dramatic arts word games, rebus puzzles commercial programs: Orton reading program, Lindamood Bell programs

Primary CAPD Profile: Integration Deficit

Region of Dysfunction: deficit in interhemispheric integration via the corpus callosum *(many similarities to Prosodic Deficit because a left ear deficit on dichotic speech tasks may result from either right hemisphere or corpus callosum involvement; delayed or abnormal interhemispheric communication)*

CAP Test Findings	Associated Sequelae	Management Strategies
excessive left ear deficit on dichotic speech tasks deficit on temporal patterning tasks in linguistic labeling condition only (normal on humming) *(Temporal patterning tests differentiate between the two sites of dysfunction – right hemisphere [linguistic labeling and humming] or interhemispheric [linguistic labeling only]. This indicates delayed neuromaturation.)* may show age-appropriate performance on monaural low- redundancy speech tests deficiency in ability to coordinate multimodal inputs CAP Tip: Many children with this deficit perform poorly on the various psycho-educational tests that tap intersensory integration skills. CAP Tip: Have the child sing and/or say the "alphabet song". Weak prosody skills show up when they sing. (Poor integrators can *sing* the alphabet, but struggle to pull out the letters.)	"They do not synthesize!" Typical complaints from teachers and parents: • difficulty knowing "how to" do some tasks; tend to "watch and wait" • poor self-starter ability • difficulty with transitions • need more time to process information and complete work frequently say "I don't know.", "I don't get it." or "I have no idea." variable speech-in-noise skills *(This is not due to decreased intrinsic redundancy in the auditory system as with the AD deficit, but because a critical component of speech-in-noise skills — auditory localization and the concept of auditory space — is affected in cases of corpus callosum involvement.)* may have a variety of auditory, multimodality integration, and learning-related difficulties variable impact on communication, such as: • phonological deficits *(Phonological processing and decoding difficulties are associated with inefficient interhemispheric integration due to the difficulty combining component phonetic features into a gestalt pattern to achieve a cohesive whole.)* • difficulty linking prosodic elements with linguistic content of a spoken message • compromised linguistic content • difficulty processing ongoing discourse • difficulty following verbally presented directions • deficit in auditory verbal (language) learning • memory deficits • may have syntactic, pragmatic, and semantic receptive language deficits academic effects in various skills, such as: • sight word and word attack skills may be poor • difficulty with reading comprehension • motor skills requiring bimanual or bipedal coordination may be impacted, such as writing skills or other integrative tasks difficulty combining visual and auditory input often perform more poorly when visual or tactile augmentation is added due to impaired interhemispheric communication may need more trials to achieve normal temporal perception CAP Tip: Student may experience problems with visual or tactile "noise".	experiential, structured, "hands-on" environment where lots of examples are provided reduce or discontinue use of multimodality cues *(Provide multimodal inputs one at a time)* activities that enhance: • transfer of function • extraction of key information • "parts-to-whole" skills interhemispheric exercises to improve interhemispheric transfer of information (See Bellis, 1996; Musiek & Chermak, 1995, 1997): • verbal-to-motor transfer • motor-to-verbal transfer give task demands clearly and up front notetaker/notetaking assistance *(This is needed so that simultaneous listening and writing, a task that requires efficient interhemispheric dynamics, are not required.)* preferential seating to minimize exposure to extraneous sensory information avoid division of attention untimed tests in a quiet room may be eligible for sensory integration therapy specific academic intervention repetition **not** rephrasing *(Rephrasing exacerbates the manifestations of the integration deficit rather than minimizing them. Instead, repeat with associated visual or tactile cues.)* ALD may not be beneficial; however, use of tape recorders, notetakers, or books on tape may be very beneficial may benefit from music and/or dance lessons, juggling, karate, or gymnastics games: Bop It, Poker, Black Jack commercial programs: Orton reading program, Lindamood-Bell programs, Wilson Reading Program CAP Tip: An ALD is of little benefit to the poor integrator who cannot pull all of the information together; making the information louder does not improve the ability to "get the big picture". CAP Tip: Teach the child to look *or* listen or look *then* listens. (Adding visual clues is contraindicated with the integration deficit.)

Secondary CAPD Profile: Auditory Associative Deficit

Region of Dysfunction: deficit in left (associative) cortex (the area where acoustics and meaning come together and syntactic analysis occurs) *(perhaps more properly considered an "auditory language" deficit rather than a CAPD; inability to apply the rules of language to incoming auditory input)*

CAP Test Findings	Associated Sequelae	Management Strategies
bilateral deficit on dichotic speech tasks intact auditory closure (indicating intact functioning of the primary auditory cortex) intact phonemic synthesis (indicating intact functioning of the primary auditory cortex) good speech sound discrimination laboring on temporal patterning is intact	"I heard you, but I don't understand." Or "I don't know what you mean." (inability to translate information) communication problems may include: • receptive language deficits in vocabulary, semantics and syntax • syntactic difficulties, especially with linguistically complex messages such as passive voice and irregular verbs • difficulty understanding sentences in passive voice or compound sentences • semantic difficulties, such as poor use and understanding of antonyms, categorizations, synonyms, or homonyms • difficulty comprehending information of increasing linguistic complexity • difficulty understanding multiple meaning words • difficulty understanding negative "wh" questions • difficulty with pragmatics and social language • frequent difficulty acquiring a foreign language academic impact may include: • good reading decoding skills with poor reading comprehension • poor understanding of math application problems (word problems) despite good calculation ability • may impact written language, with errors of punctuation, grammar, verb tense, and capitalization; may use run-on sentences request *clarification* rather than *repetition* of information; rephrase using smaller or different linguistic units early academic performance may be grade appropriate with the deficit manifesting itself about third grade and becoming more obvious as linguistic demands increase in the academic program	focus on "use of the rules" systematic learning approach that includes use of systematic, multisensory, rule-based approach to language and learning rephrase information using smaller linguistic units *(The focus is linguistic clarity, not acoustic clarity for the poor associator.)* avoid whole language environments and situations requiring self-monitoring of learning behavior *(These environments are rarely appropriate as these they assume the child will perceive the rules of language via experience and exposure without explicit training in such.)* avoid ambiguity multisensory augmentation increase linguistic familiarity • contextual derivation of word meaning • preteach new information • state rules first metalinguistic/metacognitive strategies training to enhance auditory comprehension and memory, such as: • chunking meaningful units • verbal chaining • mnemonics • rehearsal/reauditorization • paraphrasing • summarizing comprehension check by asking for demonstration or paraphrase rather than repetition of information impose external organization aids use multiple choice or closed set tests waive the foreign language requirement speech-language therapy focusing on receptive language and to build linguistic/metalinguistic skills may benefit from dramatic arts, word games, rebus puzzles commercial programs: Orton Reading program, Lindamood-Bell programs CAP Tip: An ALD is of little benefit to the poor associator who heard what was said but did not understand it. Making the target louder does not serve to improve linguistic comprehension.

Secondary CAPD Profile: Output/Organization Deficit

Region of Dysfunction: deficit in temporal-to-frontal and/or efferent system *(also may be considered an expressive language/ executive function disorder; difficulty acting on incoming auditory information; deficit in the ability to sequence, plan, and organize responses; similar to the Katz Output-Organization Deficit)*

CAP Test Findings	Associated Sequelae	Management Strategies
deficit on any task requiring report of more than two critical elements (e.g., DDT, SSW, PPST, DPT, competing sentences) may have elevated or absent contralateral acoustic reflexes normal phonemic decoding normal monaural low redundancy speech test performance (one element report) may have poor speech-in-noise skills may have reversals and ordering problems may omit target or substitute previously heard word may have depressed contralateral OAEs	in quiet environments will indicate "I heard it, understood it, but cannot remember it or cannot do." (They can't get it back out.) typical key descriptors: • disorganized (e.g., poor notetaking and assignment completion skills) • impulsive • poor planner poor hearing in noise backgrounds poor performance on any task requiring report of more than two critical elements *(Some children are able to manage more than two critical elements if they are written.)* communication problems such as: • difficulty with expressive language and word retrieval, including poor syntactic skills • motor planning difficulties (e.g., articulation deficits, fine and gross motor skills) educational problems such as: • difficulty following oral directions; often better ability to act on written commands than auditory commands • poor sequencing and follow-through (e.g., remembering assignments) • difficulty acting on incoming information (e.g., notetaking) • may demonstrate good reading comprehension, but spelling and writing may be poor due to the multi-element nature of the tasks may seem to be distractible or inattentive *(This subprofile often overlaps with ADD.)* i impulsive or perseverative behavior both at home and at school or in the workplace exhibits reversals executive dysfunction	highly structured, systematic, rules-based environment • training and practice in the rules for organization • training in use of external organizational aids (e.g., lists, outlines, checklists, planning books, calendars) • avoid situations requiring self-monitoring of learning behavior management strategies similar to those under Associative Deficit (e.g., organization, metacognitive strategies) designed to strengthen the memory trace due to focus on specific order: • verbal rehearsal/reauditorization • tag words • chunking • mnemonics • visual imagery • visualization break information into smaller units; provide directions and information one step at a time preteach new information computer use academic intervention focusing on strategies training: • study skills • notetaking skills/assistance • test-taking strategies speech-language therapy focusing on expressive language and word retrieval deficits may do better with written instructions because of difficulties with the auditory/verbal mode of information presentation may require occupational or physical therapy to address motor planning and execution skills may require environmental modifications designed to enhance the S/N, including use of an ALD due to inefficient efferent function repetition **and/or** rephrasing may be beneficial, if no more than two critical elements; break down information into smaller linguistic units alphabet games, drama, follow-the-leader, Bop It

Suggestions for Successful Management of Students with Central Auditory Processing Disorder (CAPD): Tips for the Teacher

The student with a central auditory processing disorder (CAPD) will respond in a variety of ways to changes within their environment and instructional program. Management suggestions identified for a student with a CAPD should be based on the student's individual profile of auditory processing strengths and weaknesses. Suggestions in this listing are in the areas of attention, preferential seating, instructions, preview and review, time, classroom adaptations, self-advocacy, and organizational strategies. The audiologist will select those strategies most appropriate for the student's CAP profile.

Attention

- **Gain bi-sensory attention.** Auditory processing is maximized when the same information is received simultaneously through different modalities. Therefore, it is important to gain the student's visual as well as auditory attention before speaking with him or her.
- **Speak at eye level.** Whenever possible, speak at the student's eye level, get close to the student, and face the student to provide clear visual and auditory information.
- **Use cueing.** It may be beneficial to work out a cueing system to help students become aware of times when they are not paying attention. These "pretuning" techniques help to focus the student's attention on the subject coming up. Use words such as "listen," "ready," and "remember this one."
- **Assign peer partners.** Assign a peer partner to the student with a CAPD. The peer partner can assist the student with a CAPD in activities such as paying attention, getting assignments listed, participating in small group projects, and tuning in for key information. Peer tutoring may also be a part of the buddy system if appropriate.
- **Mark transitions between activities.** Students with auditory processing difficulties often need more time to make transitions. Therefore, it is helpful and important to mark transitions between activities by clearly identifying the new activity by naming and explaining the sequence of steps needed to accomplish the task.
- **Review and transition.** Clearly closing an activity may be accomplished by briefly summarizing what the student should have learned and/or completed before transitioning to the next activity.
- **Provide notetaking assistance.** Because it is difficult to watch the teacher and take notes simultaneously, it may be helpful for the student to be able to get a copy of another student's notes, to get a copy of the teacher's notes, to have a study guide, and/or be able to tape record the lesson for future reference and study.

Flexible Preferential Seating

- **Provide preferential seating distance.** Seat the student near the primary sound source (e.g., teacher, television, computer, center activity area). A distance of three-four feet is the best, but a distance up to six-eight feet should be adequate. This allows the student to derive maximum benefit from both auditory and visual information cues.
- **Avoid seating near noise sources.** Seat the student away from competing or distracting noise sources (e.g., external noise sources, bathroom area, telecommunications equipment, aquarium). Seating away from windows and doorways also will reduce possible sources of distraction.
- **Provide better ear option.** Seat the student so that the better ear, if indicated, is directed toward the primary sound source. (The audiologist will provide this recommendation if appropriate.)
- **Allow flexible preferential seating option.** Allow flexibility in seating to continuously achieve the preferential seating advantage. This enables the student to attend and actively participate as the classroom activities and the teacher or other primary sound source change location.
- **Provide quiet study/work area.** Provide the student with a "private" or isolated area, such as a study carrel, for individual seatwork, testing, or tutoring. This helps to minimize the student's problems in foreground/background discrimination.
- **Use daily routines.** Use daily routines or schedules to help keep the student focused and organized.
- **Use earplugs.** If their use is recommended, allow the student to use earplugs or earmuffs during individual seatwork time to help tune out distractions.
- **Use FM amplification.** Use a personal or sound field FM system to improve access to auditory information, if this is indicated by the student's CAP profile. Students with difficulty hearing in noise, integrating information, or organizing information may benefit from FM amplification. An audiologist should make the recommendation for an FM system. The teacher(s) will receive an inservice on the use of the FM system.

Instructions

- **Speak in a clear, well modulated voice.** Speak distinctly, at comfortably loud level, and at a rate the student can follow easily. Vary loudness to increase the student's attention. Remember not to overexaggerate your speech. Emphasize important information using intonation and stress. Repeat important words when necessary.
- **Use natural gestures.** Use natural gestures that enhance the message. Avoid extraneous gestures and excessive movement while delivering the message if this appears to distract the student.
- **Reduce distractions.** Avoid extraneous noises and visual distractions, especially when giving instructions and teaching new concepts.
- **Alert student.** Before giving instructions, stand close to the student, call the student's name, and gently tap the student's shoulder, or use another cue to make sure you have the student's attention. Using the student's name during teaching time also will help to maintain attention.
- **Reduce motor activities during instruction time.** Reducing motor activities during verbal presentations is helpful for some students with a CAPD, especially if the student has an integration deficit.
- **Define purpose.** State the purpose of each activity clearly and directly before introducing the specific instructions for task completion.
- **Give age and ability-appropriate directions.** Give direct and uncomplicated directions. Use age-appropriate vocabulary that clarifies the logical, time-ordered sequence (e.g., first, second, last).
- **Repeat direction and allow ample response time.** It may be necessary to repeat each step of the instruction and allow time between each step for the student to process the information.
- **Provide examples.** Work on an example together and leave the example on display.
- **Use modeling.** Use modeling to provide the a clear demonstration of student performance expectations.
- **Identify key words.** Emphasize key words when speaking or writing, especially when presenting new information.
- **Give written and verbal instructions.** Provide both written and verbal instructions to aid the student in following directions and completing tasks.
- **List the steps.** To help the student learn multi-step sequences, list the steps on a reference card. As the student becomes more familiar with the sequence, steps in the written directions may be omitted gradually and systematically until the student is able to complete the sequence automatically without referring to the written cues.
- **Encourage the student to ask for clarification.** Encourage the student to ask questions for clarification of information. It may be necessary to rephrase the information to ensure that the student with a CAPD is able to comprehend. Also, some students with a CAPD have a language deficit and may not be familiar with key words. By substituting words and simplifying the grammar, the intended meaning may be conveyed and understood more easily.
- **Repeat or paraphrase.** Have the student repeat the content of the instructions to provide the comprehension feedback. This technique allows the teacher to see which parts of the instruction need to be corrected or repeated. Ask for verbal accounts rather than a "yes" or "no" response. Reinforce listening for *meaning* rather than *exact repetition*.
- **Give positive feedback.** It is important that students receive positive feedback to ensure understanding of the message or instruction correctly. Feedback is important even if the student understood only a portion of the message.
- **Boost self-confidence.** Many students with a CAPD lack of self-confidence due to comparisons made by themselves or others about their performance. Reinforcing all work performed successfully will help to alleviate this problem.
- **Check instruction comprehension.** Check the student's work after the first few items to ensure that the student understood and retained the instructions. The teacher should watch for signs of inattention, decreased concentration, or understanding. Periodic comprehension checks (e.g., paraphrasing instructions, main idea, key points) are helpful to keep the student on task.
- **Allow subvocalization.** To help with reading comprehension, the student could be allowed to subvocalize while reading until such time as this is unnecessary.
- **Allow reauditorization.** Some students have a need to reauditorize information as they formulate their response. This strategy also strengthens the memory trace.

Preview and Review

- **Review, preview, and summarize class lessons.** For all class lessons, review previous material, preview material to be presented, and help students summarize the material presented. Discuss new and previously introduced vocabulary words and concepts. Whenever possible, relate new information to the student's previous experiences and environment.
- **Provide pre-teaching materials and assignments.** Provide preassigned readings and home assignments to help introduce new concepts and topics.
- **Avoid divided attention.** Avoid asking students with a CAPD to divide their attention between listening and taking notes at the same time. Allow students to tape record lessons or provide students with a detailed outline of the information presented in the class lesson.
- **Review and orient.** Provide a short review statement about the topic(s) to be discussed to orient the student. Write a brief outline and list key vocabulary on the board or an overhead projector. Provide the student with a copy of the outline and key vocabulary to use in following the discussion and for review.
- **Frequently summarize key points.** Repeat and summarize key points frequently. Emphasize key vocabulary words during the discussion.
- **Give salient clues.** Give salient clues to identify and emphasize important information (e.g., "This is important," "The main points are…," "This could be a test question.").
- **Use verbal review strategies.** Use verbal review strategies to ask questions periodically about the material being presented. This is a helpful topic maintenance strategy. Verbal review questions should include language required for description, explanation, exemplification, comparison, and relating real events to abstract principles.
- **Give individual attention.** Students with a CAPD often need individual attention. Inform resource personnel and parents of planned vocabulary and curriculum topics to be covered in the classroom to allow opportunity for pre-teaching as a supplement to classroom activities.
- **Reference important pages.** Refer students to important textbook pages for less review and preview.
- **Encourage class participation.** Encourage participation in expressive language activities related to each lesson. Reading is especially important, since information and knowledge gained through reading help compensate for what may be missed because of auditory difficulties.

Time

- **Avoid fatigue.** Students with a CAPD often become fatigued more easily than their peers. It is often difficult for the student to attend because of the effort required to keep up and compete in classroom activities. To minimize fatigue, consider the following suggestions.
  - Give several short classroom activities instead of one long activity.
  - Provide short periods of instruction with breaks so the student can move around if needed.
  - Alternate activities requiring greater auditory processing requirements with those that are less demanding.
  - Avoid higher level auditory tasks when the student is already fatigued. (Consider presenting high-auditory content information during the morning.)
- **Allow extended time.** Students with a CAPD should be given adequate time to comprehend and complete tasks. Avoid giving penalties for not completing assignments in the prescribed classroom time. Whenever possible, give students fewer items to complete in the amount of classroom time available or give them additional time in the resource room to complete the assignment.
- **Give adequate response time.** It may be necessary to allow students with a CAPD more time to formulate responses to verbal questions, especially questions that include comparisons, generalizations, and explanations requiring lengthier and more complex language organization.

Classroom Adaptations

- **Record instructions.** Class lessons or instructions can be recorded so that the student can listen to and review the material later.
- **Sound tune the classroom.** Acoustical modifications may be implemented to create a positive acoustical listening and learning environment (e.g., carpeting, drapes, sound absorbing materials).
- **Arrange classroom.** Structure the classroom to reduce background noise, reverberation, and distractions. Noise interferes with reception of auditory information and distracts the listener from the complex task of processing (e.g., organizing and interpreting) information. Special areas for small group instruction that are relatively quiet and distraction free are helpful for many students.

- **Avoid open classrooms.** Avoid open classroom settings for students with a CAPD. In these settings, reduce distractions by using sound barriers (e.g., bookshelves, flannel boards) and other modifications to improve the listening environment.
- **Close windows and doors.** Keep doors and windows closed to reduce external noise entering the classroom.

Self Advocacy

- **Encourage self-monitoring.** Encourage the student to self-monitor the listening environment and identify any problems that may be interfering with the learning process.
- **Encourage self-advocacy.** Encourage the student to self-regulate by using strategies to modify conditions and situations that may compromise effective learning. This will assist the student in learning self-regulation strategies and becoming an effective manager of his listening and learning environment.
- **Suggest counseling.** If necessary, the student should be referred for counseling for social/emotional concerns as part of the management plan. The student (and parents) needs to understand the nature of the CAPD and why it is essential to develop compensatory strategies.

Organizational Strategies

- **Encourage the use of agenda book or other organizer.** Encourage the student to consistently use an agenda book (or other organizer or calendar) to ensure that assignments, upcoming events, and other important class information are recorded.
- **Clearly present organizational expectations.** Ensure that the student understands specific organizational expectations for the classroom (e.g., where to place homework, use of folders, required classroom tools). Use cue cards as reminders.

References
Bellis (1996, 1999); Chermak & Musiek (1997); Boswell (1988); Chermak & Musiek (1997); Colorado Department of Education (1997); Educational Audiology Association (1996); Ferre (1999); Florida Department of Education (1995); Hall & Mueller (1997); Johnson, Benson & Seaton (1997); Keith (1996); Matkin (1985); Mayer (1996); Schneider (1992); Strand & West (1994).

Central Auditory Processing (CAP) Management Tips for Parents

Parents of a child with a central auditory processing disorder (CAPD) face many challenges. The management process will be much easier when parents can accept that their child may have a style of learning and listening that is different from other children. The following are some suggestions to assist parents with the management process.

- Learn as much as possible about CAPD and the nature of your child's deficits. Be knowledgeable about your child's individual strengths and weaknesses. This will assist you in effectively implementing management strategies.

- Really listen to your child. Simplify your language if your child does not seem to understand. Enjoy communicating during your time together.

- Really talk with your child for a few minutes each day. Give your child your full attention and listen carefully. You will learn more about your child's processing deficit(s) as well as the strategies your child is using to cope and compensate.

- Be honest with your child and take a positive approach. Avoid saying there is nothing wrong. Help your child understand that he or she may learn a little differently than other children. Stress that you are there to help him or her learn.

- Have a specific time each day to work alone with your child. You will have greater success in communicating with your child if there are no competing activities (e.g., other children or adults laughing or talking, television or stereo playing, dishwasher or vacuum cleaner running).

- Gain your child's visual as well as auditory attention before proceeding with a conversation. Your child will get information from watching as well as listening.

- Start with short work periods and gradually increase time. A good rule is to stop when your child is at the peak of success. Avoid pushing your child to the point of frustration.

- It is important to be as objective and patient as possible. Speak to your child in a quiet, firm voice.

- Give short and simple directions. When necessary, divide multi-step instructions into brief, logical steps. Allow your child time to complete each step before proceeding to the next part. *Example: Put your homework in your backpack. Make your bed. Brush your teeth. Put on your shoes.*

- A child with a CAPD may seem to hear inconsistently. If your child seems to hear some things but not others, do not assume that your child is purposely ignoring you. Ask your child to repeat or paraphrase the directions to check for understanding.

- If a task is too difficult for your child, move on to something easier. Then return to the first task after changing it so that your child can be successful.

- Encourage your child to ask for information to be repeated if he or she does not understand. Encourage your child to use compensatory strategies learned in school to help complete tasks.

- Help your child become independent in carrying out daily routines. Use a card with pictures or key words to assist in sequencing tasks (e.g., getting ready for school, preparing for bedtime, cleaning the bedroom, setting the table).

- Insist that your child complete activities when he or she is capable of doing them. Make sure that your expectations are reasonable.

- Praise your child for even the smallest success and do not emphasize failures. It is not helpful to compare your child's performance to that of other children.

- Slow down your rate of speech and pause between utterances if your child continues to have trouble under standing.

- If you have to repeat something for your child, try to rephrase it in a different way (e.g., different words, different type of sentence).

- Children with a CAPD often need extra time to organize their thoughts and process information. Allow your child adequate time to process information and respond.

- Avoid having discussions when you and your child are in separate rooms. A child with a CAPD processes information more easily when both visual and auditory information is available.

- Your child may need time to rest and recuperate after school. Allow time for realization before asking your child to do homework or chores.

- Help your child create a quiet study area away from noise and distractions such as widows or doorways.

- Read aloud to your child and discuss what you have read.

- Your child may have difficulty processing information when upset or excited. Help your child to calm down by speaking in short clear sentences. If discipline is required, use simple sentences with clearly stated cause-and-effect explanations. At a later time you may explain the situation in greater detail.

- Ask the audiologist, speech-language pathologist, or other professionals for a list of listening activities and strategies that can be done at home. Then practice improving your child's listening skills.

References
Boswell, 1988; Colorado Department of Education, 1997; Educational Audiology Association, 1996; Edwards, 1991; Johnson, Benson & Seaton, 1997; Keith, 1996; Mayer, 1996; Strand & West, 1994; Truesdale, 1990.

Modifications That Improve Classroom Acoustics

Noise and reverberation degrade the acoustic signal and adversely affect comprehension of spoken language. The effects are exacerbated for listeners with CAPD in whom auditory system deficits compound the difficulties presented by a degraded signal with decreased redundancy (Chermak & Musiek, 1997). Reducing classroom noise and reverberation helps all children and the teacher enjoy a more pleasant listening, learning and teaching experience. A quieter school environment also improves student and teacher motivation and morale.

Certain materials in the school and classroom environments can absorb sounds and decrease the effects of noise and reverberation on speech perception. Sound and noise control in the classroom and school environment is both a science and an art. This discussion will address acoustical treatments and modifications in the following areas: external to the classroom, ceilings, floors, windows, walls and doors, and other internal classroom areas.

External Modifications

The school's location in the community may be responsible for many external noise sources. Exterior detached walls can serve as partial noise barriers and absorb noise en route to the classroom, particularly if the classroom is within the shadow of the barrier. Landscaping also helps in noise abatement. Earth mounds, trees, and shrubbery provide noise barriers. However, the effect is increased by using hedges rather than an occasional shrub or tree to deflect and absorb unwanted exterior sounds. Carpeting exterior corridors next to classrooms also helps to reduce external noise.

Ceilings

Installing acoustical ceiling tile is the most effective way of absorbing distorted middle and high frequency noise and improving speech perception ability. A ceiling height less than 12 feet is optimal for the listening environment. Often this is achieved by suspending the acoustical tile ceiling. Banners, student work, and hanging plants suspended from the ceiling also assist in reducing noise and reverberation.

Floors

Carpeting, particularly if it is installed over a pad, is the most efficient and effective acoustical modification for absorbing excessive reverberation of high frequency consonant sounds and dampening noise from students and movement of classroom furniture. By extending the carpeting onto the bottom portion of wall surfaces, noise will be further reduced. If part of the floor is tiled, rubberized or resilient tile will absorb more noise than a flat and more reflective tile surface. In instances where the classroom is uncarpeted, area rugs or carpeting are useful in reducing the amount of reflective floor surface area.

Windows

Windows are highly reflective surfaces and acoustical treatment may be provided by adding draperies, blinds or shades. Double-pane windows offer more protection from outside noise than traditional windows. Cloth draperies *without* rubberized backing are more effective in reducing noise and reverberation. If it is not possible to provide draperies, blinds, or shades, applying student artwork or charts to the window surfaces will provide some acoustical modification. Of course, closed windows allow far less noise to enter the classroom from adjacent or external noise sources.

Walls and Doors

Reflective wall surfaces may be treated in a variety of ways to reduce classroom noise and reverberation. If it is not possible to treat all wall surfaces, modifications to opposing wall surfaces will provide the greatest dissipation of reflected sound and promote improved listening, learning, and teaching. Cork bulletin boards, felt or flannel boards, and acoustical or fabric-covered surfaces on walls are not only useful in reducing noise and reverberation but also allow display of teaching aids and student work. A solid core-door will provide greater acoustical treatment than a hollow-core door. Doors should fit well in the doorway and a noise lock or treatment to the doorway help to lessen noise from external or adjacent sources. If installing a noise-lock seal is not possible, a felt lining around the

doorway will help. If a vent in the door lets in external or adjacent noise, try to mask the noise by covering the vent or inserting a filter. Of course, replacing vented classroom doors would be the preferred alternative.

Other Interior Classroom Modifications

Seating and Furniture Arrangement

The human body absorbs sound. When desks and tables are staggered, sound will not travel directly to hard reflective surfaces such as walls, chalkboards, and windows. Putting felt or rubber caps or tennis balls on chair and table legs will help to reduce noise in uncarpeted classrooms. Arranging the classroom so that instruction occurs away from noise sources is also helpful.

Ventilation

Supply and return ducts for heating and cooling systems may be treated with acoustical duct lining. Duct silencers help to eliminate crosstalk from adjacent classroom areas. If the classroom has an external heating, ventilation, and air conditioning (HVAC) system, as is the case with most portable classrooms, the main instructional areas should be planned away from this area if the HVAC system is a source of noise.

Lighting

Some fluorescent lighting systems emit a constant noise. Their hum may be partially eliminated if ballasts are changed on a regular basis. If the lighting is housed above the acoustical tile ceiling the noise level will be lessened.

Special Purpose Areas

Mobile bulletin boards and bookcases may be placed at angles to the walls to decrease reverberation in the classroom. This may also be useful in partially blocking noise from the computer, bathroom, or learning center areas. In areas where younger children are handling manipulatives or playing with toys, covering the table surface with fabric will reduce noise levels. Study carrels can be lined with acoustic tiles to reduce equipment noise in these areas.

If specific noise sources are located in the classroom, such as noisy lighting, a noisy ventilation system, or even a noisy wall clock, contact the school principal or school plant engineer to discuss correcting the problem. For additional information on classroom acoustics, refer to the *IMPROVING CLASSROOM ACOUSTICS Inservice Manual (1995).*

An Inservice for Staff and Students on Personal FM Systems

Rationale: It is sometimes difficult to find time during a busy day to provide inservice training to the staff. Inservice can be provided to the teachers in the classroom. In effect, you are maintaining classroom control by teaching an FM system lesson. This way the teachers, parents, and students all learn at the same time. The real advantage to this approach is that the FM system recipient is not left to defend or answer questions about the system but instead becomes the "star" of the class by assisting you, the presenter/teacher. The classroom atmosphere is much calmer and the teachers and parents are able to experience the excitement and fun of the FM system.

Participant Objectives:

- to gain knowledge about personal FM systems
- to experience personal FM system technology
- to receive information concerning benefits of using FM system technology in the classroom

Materials needed: demonstration FM system equipment that is identical to what the student and teachers will be using

Introductions (5 minutes): Explain who you are, what your job is, and why you are there.
Example: "Hello children, my name is Ms. Cox, and I am an audiologist. Does anyone know what an AU-DI-OL-O-GIST does? (Writing the word on the board may be helpful.) Audiologists help people hear better. At times everyone needs to hear better. Can you think of times when its difficult for you to hear and you wish you could hear better? In the lunchroom?…On the playground?…In a noisy classroom?…Sometimes people have a difficult time listening in classrooms when there's even a small amount of noise present. You and I share a friend in your classroom who is having a hard time hearing the teacher when there's noise in the room. Today, I'm here to show you some equipment that helps people hear really well in noisy classrooms. It's called an FM system, and it's like a little radio between the teacher and the student."

System Overview (15 minutes): Identify the transmitter, microphone, microphone clips or headband, windscreen, antenna, batteries, and on/off switches of the teacher's unit. Identify the receiver, headset (Walkman head/earphones, earbud(s), etc.), antenna, batteries, and on/off/volume control switch on the student's unit. Demonstrate the proper way to wear the equipment. Give microphone positioning and speaking techniques. Demonstrate how to plug the units into the charger. Explain equipment care and maintenance tips.

Benefits (10 minutes): Explain the benefits and advantages of the FM system in classrooms where noise and distance from the teacher make listening more difficult.

(OPTIONAL EXPERIMENT – 3 minutes): Ask the FM RECIPIENT child to pick a boy and a girl volunteer to help perform an experiment in "SUPER LISTENING." With the RECIPIENT child wearing the FM receiver and YOU wearing the transmitter send the volunteers to a location that is visible to the students in the classroom but out of earshot. Then explain to the classroom students, "We are going to see which student has the very best hearing now." Ask the RECIPIENT child wearing the FM receiver to do something observable such as stomp his or her feet, then ask the volunteer boy or girl to do something different, such as cross their arms. Of course, the FM RECIPIENT child will comply immediately while the two volunteers will look bewildered, or they may even copy what the FM RECIPIENT child did. Repeat this a couple of times and then ask them all to come back into the room and take their seats. Thank the volunteers for being such good sports, and explain what you had asked them to do. Ask the class as a group, "Who had the best hearing in our experiment?" Give the volunteers a round of applause.

Demonstration (10-15 minutes for class of 30 students): Divide the class into two groups (girls and boys) and have then form a line at different far corners of the classroom. Best practice is to allow the teacher to "suit up" first with the receiver/headset while you are using the transmitter/microphone. Now demonstrate to the teacher the advantages of the FM system. While the children are awaiting their turn and talking in line, you can speak to the teacher from a distance and in the presence of background noise! Once the teachers have had a chance to experience the receiver/headphones, swap positions with them and let them hold the microphone for the students. Tell the students

to say something nice to the volunteers wearing the headset/earphones. Guide the students to say something that will lead to an observable action ("stomp your feet…touch your nose, ear, or eye…clap your hands…scratch your head…cross your arms...stand on one foot...wave to me…etc. if you hear me.") As the boys and girls finish experiencing the FM receiver, they will go to the end of the other line where they will wait in line to try the transmitter/microphone and visa versa.

Summary (5 minutes): Explain the appropriate times when the student will be wearing the FM system (all academics and specials to include art, music, assemblies, field trips) and when the student will not be wearing the equipment (lunchroom, playground, recess, home). Explaining the cost of the FM system is sometimes helpful in showing that FM equipment is not a toy and that it is about equal in price to a classroom computer. Finally, field any questions about the equipment and thank everyone for their attention and participation.

Total Time: 45-50 minutes