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## Central Auditory Processing Disorders: An Overview

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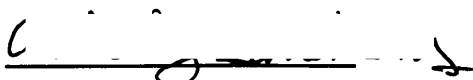
**Central Auditory**  
**Processing Disorders:**  
**An Overview**

Amberly Thiemens  
Honors Senior Project  
Spring 2007



## HONORS THESIS

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## *What is Central Auditory Processing Disorder (CAPD)?*

According to the American Speech-Language-Hearing Association (ASHA) Task Force on Central Auditory Processing Consensus Development (1996), central 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
  - temporal ordering
- Auditory performance decrements with competing acoustic signals
- Auditory performance decrements with degraded acoustic signals

Therefore, according to the Task Force, “a Central Auditory Processing Disorder (CAPD) is an observed deficiency in one or more of the above-listed behaviors. For some, CAPD is presumed to result from the dysfunction of processes and mechanisms dedicated to audition; for others, CAPD 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 CAPD to reflect coexisting dysfunctions of both sorts” (ASHA, 1996).

A slightly more functional definition comes from Bellis (2003): CAPD is a deficit in neural processing of auditory stimuli that is not due to higher order language, cognitive, or related factors. Despite the clarity of this definition as compared to ASHA’s, there is still confusion in the field as to what CAPD is exactly. Therefore, many times CAPD is defined by a set of typical characteristics and behaviors often demonstrated by children with known auditory processing disorders. The following is a compiled list of those characteristics and behaviors most commonly agreed upon as typical for children with CAPD (Bellis, 1996, 2003; Friel-Patti, 1999; Keith, 1995, 1999; Nye & Hasbrouck, 2006):

### General Characteristics:

- Normal hearing yet still experience difficulty understanding language presented orally
- Short attention spans and fatigue easily when confronted with long or complex activities
- Difficulty remembering spoken information
- Exhibit difficulty following multi-step directions
- Say “huh” and “what” frequently; ask speaker to repeat
- Poor language and/or listening skills
- Easily distracted, especially in background noise
- Difficulty sequencing auditory material
- May exhibit behavior problems
- Reduced tolerance to loud noises

- Generally respond inconsistently to auditory stimuli. They often respond appropriately, but at other times they seem unable to follow auditory instructions.
- They may have trouble with auditory localization skills.

#### Academic Characteristics:

- Poor academic performance
- Reading, writing, spelling difficulties
- Not attending to classroom material presented orally
- Language comprehension measured in a quiet, highly structured, one-to-one testing situation is better than functional performance in the classroom
- Demonstrate significant scatter across subtests within domains assessed by speech-language and psychoeducational tests, with weaknesses in auditory-dependent areas
- Require high degree of external organization in the classroom
- Difficulty with group participation
- Slow or delayed responses when called upon
- Problems with note-taking

#### Social Characteristics:

- Difficulty with social interactions
- Difficulty maintaining friendships
- Shy or socially withdrawn
- Low self-esteem
- Daydream

## *Screening for CAPD:*

### *Why do we screen?*

The primary purpose of Central Auditory Processing Disorder screening is to determine whether or not there is a need to refer for additional diagnostic testing.

### *Why have a screening program?*

Screening children for CAPD is rarely discussed in the educational setting, much less implemented. However, developing a screening program and executing it has tremendous benefits for a majority of school districts. The rationale behind creating such a program is similar to that of other screening programs, not the least of which is the reduction in the number of inappropriate referrals for comprehensive CAPD testing. A CAPD screening program would, ideally, effectively select the most appropriate children for comprehensive assessment, thus reducing overall costs and improving the efficiency of identification and rehabilitation (Bellis, 1996).

Musiek, Gollegly, Lamb, and Lamb (1990) provide several reasons why a CAPD screening program is necessary. According to their rationale, accurate screening and identification of CAPD would:

- Help identify conditions that may require medical attention
- Foster increased educators' and parents' awareness of CAPD
- Reduce the shopping around associated with attempts to determine the cause of a particular child's listening and learning difficulties
- Minimize psychological factors on the part of the child arising from anxiety, stress, and fear of the unknown
- Allow for insightful educational planning based upon the individual child's auditory strengths and weaknesses

The authors add to this list by pointing out that audiologists' have a basic responsibility to evaluate the entire auditory system. Thus, although the peripheral auditory system has traditionally been the focus of audiological evaluation, the central auditory system must also be considered.

Additional rationale for developing a CAPD screening program comes from Bellis (1996), who reasons that such a program would reduce time and cost investments on the part of the school by decreasing the number of inappropriate referrals for comprehensive CAPD assessment. Bellis also argues that the number of children potentially affected by this disorder must also be taken into account. It has been estimated that "3 to 7% of all school-age children exhibit some form of learning disability. Although it is true that, due to the lack of adequate identification procedures to date, the number of children with CAPD within this population cannot be stated with any certainty, it is likely to be quite high" (Bellis, 1996). Therefore, without a proper screening program in place, numerous children exhibiting the disorder may be unidentified.

Moreover, the need for a CAPD screening program is justified when one thoughtfully considers the presented rationale. The potential impact of such a disorder on a child's learning, as well as the prevalence of Central Auditory Processing Disorders in the educational setting, also provide evidence for the importance of implementing a CAPD screening program.

### *Who will be screened?*

There are many different populations that could be screened for CAPD, ranging from broad to narrow. Cherry (1992) explains that a mass screening of all children in a particular educational placement would constitute a broad group, whereas a narrower population would be to screen all children demonstrating typical characteristics and/or behaviors of CAPD. Children in a narrow population are generally identified based on parent or teacher concerns. Several questionnaires have been created in order to help identify children at risk for CAPD, who are therefore prime candidates for inclusion in a screening program.

### *Who is involved in the screening process?*

Bellis (1996) emphasizes assembling a multidisciplinary CAPD team in order to conduct screenings. The rationale behind this approach is that it "allows for the gathering of information regarding educational, social, speech-language, cognitive, and medical characteristics, and helps to reduce the time demand placed upon any one individual" (Bellis, 1996). Bellis includes the following professionals as part of the screening team:

- o Audiologist: manages and coordinates CAP effort; performs audiological evaluation to rule out peripheral hearing loss
- o Speech-Language Pathologist: defines child's receptive and expressive language skills, as well as written language and associated abilities
- o Educator: provides information regarding child's listening and learning behavior in the classroom
- o Psychologist: determines child's cognitive skills and capacity for learning
- o Parents: provides information regarding developmental milestones, auditory behavior in the home, and medical and academic history
- o Physician: rules out presence of pathology that may affect learning abilities

### *Screening Test Tool Considerations*

The time involved in screening a child is a key factor in determining what tests to administer. As a rule of thumb, the time it takes to screen should never be longer than the time needed for a comprehensive assessment. Fortunately, in many cases the tests recommended as screening tools will already have been administered as part of a special education referral. Therefore, much of the information needed in order to make a referral for comprehensive CAPD testing may already be available for review. It should be noted that many of the tests recommended as screening tools are not specifically designed to evaluate Central Auditory Processing Disorders, but rather are used to eliminate the possibility of speech, language, cognitive, or other disorders. Consequently, these test tools should only be used for screening purposes and should never be applied as CAPD diagnostic material. Bellis (1996) provides the following list of suggested tests to include in the screening process:



- Audiologic Tests: The first step in administering a screening is a complete audiological assessment to rule out the possibility of a peripheral hearing loss. Once this possibility has been ruled out, then further testing may take place. To date only one audiological test has been developed as a screening tool for CAPD, it is the Screening Test for Auditory Processing Disorders (SCAN). It is designed for quick and easy administration, and can be done so by nearly anyone on the CAPD screening team. A correlation between results of the SCAN and findings on selected tests of auditory processing has been shown (Bellis, 1996). However, it is important to view results of the SCAN in light of other data for determining if diagnostic evaluation is needed. The SCAN should not stand alone when making this decision.
- Speech-Language and Psychoeducational Tests: In addition to standard measures of speech, language, cognitive, and academic ability, completing one or two of the following test tools may help provide further auditory-related data:
  - 1) Test of Auditory Perceptual Skills (TAPS)
  - 2) Goldman-Fristoe-Woodcock Auditory Skills Battery (GFWB)
  - 3) Lindamood Auditory Conceptualization Test (LAC)
  - 4) Auditory Discrimination Test (ADT)
  - 5) Carrow Auditory Visual Abilities Test
  - 6) Token Test for Children
  - 7) Flowers-Costello Test of Central Auditory Abilities
  - 8) Auditory Sequential Memory Test (ASMT)
  - 9) Woodcock-Johnson Psychoeducational Battery-Revised
  - 10) Clinical Evaluation of Language Fundamentals-Revised

### *Interpreting the Results of a Screening – Should a referral be made?*

The purpose of screening is to determine whether or not it is necessary to refer an individual for comprehensive diagnostic assessment. Thus, once the screening tests have been completed, it is necessary to make a decision regarding whether or not an individual should receive additional testing. This decision should be based upon data and information collected by all members of the screening team. Bellis (1996) asserts that, in general, in order to make this decision the following three questions must be answered:

- 1) Is there a reasonable likelihood that the child exhibits CAPD?  
 This question can be answered by reviewing all of the data collected during the screening process, as well as comparing the child's behaviors to those listed as typical characteristics of children with auditory processing disorder.
- 2) Are the results of comprehensive CAP evaluation likely to lead to recommendations for management that are not already in place with the child?  
 It is possible that an evaluation confirming the presence of a CAPD may result in little or no changes to the overall management of the child. In this situation the time and cost investments of performing a comprehensive evaluation may outweigh the potential benefit.

3) Does the child have the capacity to participate in comprehensive central auditory assessment procedures?

At the present time an age of 7 or 8 is required in order to receive accurate results for most tests of central auditory processing. Therefore, diagnosis of very young children is not possible at this time. Significant cognitive or behavioral disorders may also interfere with testing.

Referral for comprehensive central auditory evaluation is warranted if the answer to all three questions is affirmative (Bellis, 1996).

## *Comprehensive Diagnostic CAPD Assessment*

### *Why conduct audiologic auditory processing evaluations?*

The primary reason for conducting a CAPD evaluation is to help determine whether a student requires special services or assistance to meet their educational needs. According to Florida Department of Education (2001) other reasons for completing an audiological auditory processing assessment include the following: to determine if there are medical aspects of the disorder that require treatment; to increase awareness of the presence of a disorder that can truly affect a student's ability to learn; and to minimize psychological factors affecting the student and family. Furthermore, an AP evaluation may help to determine and implement effective educational interventions for the student diagnosed with Central Auditory Processing Disorder.

### *Factors to be Considered before Administering an Evaluation*

During the comprehensive evaluation process, it is important to maximize the child's ability to perform. This can be achieved by controlling confounding factors, such as environmental distractions, attention, and fatigue, as well as taking into account individual characteristics and abilities of the student. Florida (2001) emphasizes the following student-related factors that must be taken into consideration before administering an assessment:

- Age of student: Caution must be taken in the assessment of younger students due to the neuromaturation of the central auditory pathways. This lack of maturation in students under the age of 7 results in a high degree of variability in their performance on CAP tests. Therefore, caution is recommended when attempting to conduct audiologic auditory processing evaluations on students younger than 7 years of age.
- Peripheral hearing: Many CAPD tests cannot be administered to students with peripheral hearing loss or asymmetry between the ears. Moreover, hearing sensitivity must be within normal limits, or the student must be cleared by an audiologist, for the evaluation to take place.
- Cognitive ability: Cognitive ability greatly affects performance on auditory tasks, therefore, it is recommended that the learning potential of any student assessed falls within the normal range.
- Language competence: Auditory processing tasks that require sophisticated language processing (i.e., linguistically loaded tasks), prove very difficult for students with weak language skills. Thus, when evaluating students with language delays or disorders, or students for whom English is a second language, results must be interpreted with caution.
- Phonology: The student's speech must be highly intelligible due to the fact that the majority of CAPD tests require a verbal response.

- Other presenting conditions: Neurological conditions, social/emotional maturity, attention span, motivational level, and other special needs or conditions (e.g., attention deficit hyperactivity disorder [ADHD]), should all be taken into consideration before beginning the assessment (Florida, 2001).
- AP screening: Careful consideration should be given as to whether a comprehensive diagnostic audiological AP evaluation is necessary if the student has already passed a CAPD screening.
- Multidisciplinary assessment: Other psycho-educational and psycho-linguistic evaluations should occur along with the audiological AP assessment. All factors affecting a student's performance need to be taken into account in order to determine the student's individual strengths and weaknesses. Florida (2001) emphasizes that "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)."

### *Protocol for a Comprehensive Diagnostic Audiological Auditory Processing Evaluation*

1. Referral
2. Case History/Interview
3. Complete Audiologic Evaluation
4. Auditory Processing Test Battery

**Referral:** A referral for comprehensive CAPD assessment may be initiated by anyone. Information accompanying the referral may include: results from a screening, evaluation data (e.g., psycho-educational evaluation, speech-language evaluation, specific learning disability testing, or medical information), anecdotal records, and classroom and auditory behavior observation checklists.

**Case History/Interview:** The first step in the diagnostic process should be an interview with the child and accompanying parent(s) or caregiver(s). During this time the evaluation procedures should be explained to the child and parent in order to provide them with expectations and to reduce apprehension. During the interview it is also very important to review and discuss the child's background information, including a complete medical, communication, psychological, and educational history. Some of this information may also be obtained from referral reports. In addition, the presence of a family history of learning and/or hearing problems should also be discussed during this time. The interview should be individualized to the client; questions and comments should be made based on the presenting attitudes, openness, and education of the child and parents regarding the diagnostic implications and procedures of CAPD. Case history information can be vital in helping interpret the auditory processing evaluation, and will most likely offer guidance for management of students with CAPD.

**Complete Audiologic Evaluation:** Prior to administering tests specific to Central Auditory Processing Disorder, a complete audiologic evaluation of the student's peripheral hearing must be conducted. This evaluation is necessary in order to rule out conductive and sensorineural hearing losses, which Stecker (1992) asserts have been shown to influence central auditory test results. Additionally, Keith (1995) stresses that a single hearing test on a student may not be adequate. Fluctuating hearing loss associated with colds or allergies make it unwise to plan a student's educational plan based on the results of a single hearing test.

**Auditory Processing Test Battery:** A question often asked is, "What is the best test of central auditory processing?" Unfortunately the answer is not nearly as simple as the question, as Bellis (1996) explains, "there is no one test that is sufficient in scope to address the complexities of the CANS [central auditory nervous system]." Furthermore, in order to identify the underlying deficient process and create a specific management plan, CAPD assessment must investigate a variety of mechanisms within the auditory system. Thus, a test battery approach is strongly recommended.

Chermak and Musiek (1997) highlight the importance of not using the same test battery in every situation. They encourage the clinician to choose tests that best fit the specific child or test situation. This requires the examiner to understand the strengths and weaknesses of each available test. When choosing the test battery for a specific child there are a variety of factors to take into consideration. ASHA (1996) states that "the following principles should be applied when determining the composition of a central auditory test battery:"

- 1) The test battery process should not be test-driven but motivated by the referring compliant and the relevant information available to the clinician.
- 2) A central auditory test battery should include measures that examine different central processes.
- 3) Tests should generally include both nonverbal (e.g., tones, clicks, and complex waveforms) and verbal stimuli to examine different levels of auditory processing and the auditory nervous system. Until tests incorporating verbal stimuli are available in other languages, evaluation of the non-native listener may require reliance on nonverbal stimuli.
- 4) Factors to consider in the selection of test procedures include information on the test sensitivity and specificity, test reliability and validity, and age appropriateness.
- 5) The duration of the test session should be appropriate to the person's attention, motivation, and fatigue.
- 6) It is important that the person who administers and interprets the central auditory test battery have both theoretical and practical knowledge. Typically, audiologists have such knowledge and are qualified to administer and interpret the central auditory test battery.

7) Speech-language pathologists should collaborate in the assessment of Central Auditory Processing Disorders, particularly in cases in which there is evidence of speech and/or language deficits or other communication disorders.

8) Central Auditory Processing Disorders are most easily defined in the absence of peripheral hearing loss.

Tests of central auditory function have historically been categorized in a variety of ways. The following is one widely accepted categorization:

- Dichotic Speech Tests
- Monaural Low-Redundancy Speech Tests
- Temporal Ordering Tasks
- Binaural Interaction Tests
- Electrophysiological Procedures

Each of these categories focuses on a different component of auditory processing, and therefore a well-chosen test battery for CAPD should include at least one test from each category (a description of these categories and a discussion of the different tests that fall under each one will be addressed shortly). Moreover, the audiologist needs to take into consideration the eight principles that ASHA (1996) provides, as well as the test categories listed above when determining what tests to include in an CAPD test battery. Only through the use of a well-chosen test battery, along with information provided by associated professionals in a multidisciplinary approach, will the audiologist administering the CAPD assessment be successful. This success implies determining those processes that are dysfunctional in the student, evaluating the impact of that dysfunction on the child's educational, medical, and social status, as well as making appropriate recommendations for deficit-specific management that addresses the individual student's strengths and weaknesses (Bellis, 1996).

### *Description of Test Categories*

Dichotic Speech Tests: "Dichotic protocol pits a signal presented to one ear against a different signal simultaneously presented to the opposite ear, and the listener is asked to repeat the signal in one or both ears. The two-ear procedure usually involves signals presented at equivalent loudness levels, whereas the single-ear procedure may be arranged in various signal-to-competition ratios" (Willeford & Burleigh, 1985). Moreover, dichotic speech tests assess either binaural integration or binaural separation:

- *Binaural integration*: requires the listener to repeat the stimuli presented to both ears
- *Binaural separation*: requires the listener to repeat only the words heard in one ear and ignore those in the other

Many authors advise the use of one linguistically loaded and one non-linguistically loaded dichotic test within a CAPD test battery. The following are examples of dichotic CAPD tests followed by what specific aspect they test (Florida, 2001):

- *Dichotic Digits Test*: binaural integration
- *Competing Sentences*: binaural separation
- *Dichotic Rhyme*: binaural integration
- *Dichotic Consonant-Vowels*: binaural integration

- *Dichotic Sentence Identification (DSI)*: binaural integration
- *Synthetic Sentence Identification (SSI) w/CCM*: binaural separation

**Monaural Low-Redundancy Speech Tests**: “These tests involve modification (distortion) of the acoustic (extrinsic) signal to reduce the amount of redundancy” (Florida, 2001). If the listener presents with central auditory system pathology that reduces the intrinsic redundancy of the signal, then processing of the signal cannot take place. Bellis (1996) explains that characteristics of the auditory signal itself provide extrinsic redundancy, whereas repeated representation of that signal throughout the CANS (central auditory nervous system) is what is referred to as intrinsic redundancy. Monaural low-redundancy speech tests therefore assess auditory closure, or the ability to fill in missing components (e.g., phonemes, syllables, words). Such tests include low-pass filtered speech, time-altered speech, and speech-in-noise tests. The following are examples of monaural low-redundancy speech tests followed by what specific aspect they test (Florida, 2001):

- *Filtered Speech*: auditory closure
- *Time Compressed Speech*: auditory closure
- *Compressed Speech with Reverberation*: auditory closure
- *SSI w/ICM*: auditory closure
- *Speech-in-Noise*: auditory closure

**Temporal Ordering Tasks**: Monotic tone tests use tones rather than speech as stimuli to measure the listener’s ability to use each ear independently. “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” (Florida, 2001). The following are examples of temporal ordering tasks followed by what specific aspects they test:

- *Pitch Pattern Sequence*: frequency discrimination, temporal ordering, linguistic labeling
- *Duration Pattern Test*: duration discrimination, temporal ordering, linguistic labeling
- *Auditory Fusion Test-Revised*: temporal discrimination

**Binaural Interaction Tests**: Tests of binaural interaction present complementary but separate information to each ear. Unlike dichotic listening tasks, the information is presented in either a nonsimultaneous, sequential condition, or a portion of the message is presented to each ear (Florida, 2001). Therefore, in order to perceive the whole message, these tasks “require the two ears to effect closure for dichotic signal information separated by time, frequency, or intensity factors” (Tobin, 1985). Examples of binaural interaction tests and what specific aspect they test include (Florida, 2001):

- *Rapidly Alternating Speech Perception (RASP)*: binaural interaction
- *Binaural Fusion*: binaural interaction
- *Masking Level Difference (MLD)*: binaural interaction

**Electrophysiological Procedures**: Although further development and refinement are needed, electrophysiological measures can be a welcome addition to a CAPD test battery. As Willeford and Burleigh (1985) emphasized, electrophysiological procedures are objective tests,

therefore, “these measures are free of the contaminating influences that may affect subjective (behavioral) tests.” These procedures evaluate the maturation and plasticity (ability to form new connections) of the central auditory pathways, and are important in the differential diagnosis process for some students (Florida, 2001). The electrophysiological tests most commonly used during CAPD evaluation include:

- Auditory Brainstem Response (ABR)
- Middle Latency Response (MLR)
- Late Evoked Potential (LEP)
- P300
- Mismatch Negativity (MMN)
- Otoacoustic Emissions (OAE)

### *Interpreting the Results of a Test Battery*

As discussed early, the main goals of conducting a CAPD test battery are to determine whether or not CAPD is present, how the educational goals of the student can be met, and whether or not additional referrals are necessary. Answering these questions is not as simple as it appears on the surface. However, before a discussion of diagnosing CAPD can begin, the term “differential diagnosis” must be understood. According to the Parkinson Alliance (2004), differential diagnosis is defined as: “Distinguishing between two or more diseases and conditions with similar symptoms by systematically comparing and contrasting their clinical findings, including physical signs, symptoms, as well as the results of laboratory tests and other appropriate diagnostic procedures.” In other words, differential diagnosis as discussed here means determining whether a student has Central Auditory Processing Disorder, has another disorder with similar symptoms, or has a combination of the two.

Interpretation of test findings depends largely on a clinician’s understanding of how each task relates to the student’s ability to process speech and other sounds necessary for academic and communicative success (Medwetsky, 2002: Central auditory processing testing: A battery approach). The difficulty of determining a diagnosis is only increased by the fact that, “the same findings on a test can result from different underlying causes. In these instances, only by looking across tasks can one discern which cause it might be” (Medwetsky, 2002: Central auditory processing testing: A battery approach). In other words, differential diagnosis is necessary. It is for this, and various other reasons, that Chermak (2002) advocates for a team approach to diagnosis. This approach includes assigning a team leader, who is responsible for ensuring that evaluations are conducted in various specialties, and the resulting data compiled appropriately. The leader also participates in ensuring that the differential diagnosis, or possible multiple diagnosis, leads to appropriate management planning (Chermak, 2002). Another important point is brought forth by Page (1985), who warns against team members assuming that they have a complete understanding of a particular student. Page emphasizes that the “clinician does not see the child as his parents and teachers see him.” Thus, clinicians must rely on parents and caregivers to help determine whether the behaviors and performances exhibited during the evaluation process are representative of the child’s true abilities. If they are not representative, then a diagnosis should not be made at the present time. Instead, additional testing should be done in hopes of revealing the child’s true abilities.



It is important to understand that the identification of CAPD will depend on the criterion selected for determining abnormal performance on a central auditory test battery. Bellis (1996) recommends that “the criterion for presence of CAPD be relatively lax, necessitating abnormal performance on one or more tests of central auditory function combined with significant educational and behavioral findings.” In addition, the process of interpreting central auditory assessment results varies according to the goals and desired outcome. Bellis (1996) contends that a simple diagnosis of CAPD is not sufficient enough information on which to base a rehabilitative program. Instead, all aspects of assessment data should be analyzed in a manner so that the greatest amount of information regarding the child’s strengths and weaknesses can be gathered. Bellis also argues that in order to develop an individualized management plan, the clinician must determine what auditory process or processes are most likely dysfunctional in a given child. By identifying the area(s) of dysfunction, a management program can be established that utilizes the child’s strengths while specifically targeting their weaknesses.

Moreover, Bellis asserts that the identification of a Central Auditory Processing Disorder is only the first step in the overall interpretation process. The disorder must be described in functional, process-based terms, and the findings must be tied to the child’s presenting educational and behavioral complaints in order to determine the relative impact of a given auditory processing disorder on a child’s education and behavioral functioning, as well as to develop a plan for management (Bellis, 1996). Subprofiles have been created in order to classify children based on the functional, process-based interpretations of their test results. These auditory profiles help clinicians categorize the child’s auditory strengths and weaknesses, and thus are beneficial when deciding on management programs. It is important to keep in mind that these subprofiles may exist singularly or in any combination; rarely does a child fit perfectly into one category. The following are the five subprofiles presented by Bellis (2003):

<b>Type:</b>	<b>Primary Difficulties:</b>	<b>Central Test Findings:</b>
Auditory Decoding Deficit	Sound recognition, blending, reading, writing/spelling skills, vocabulary, syntax, and semantic skills adversely affected. Difficulty understanding speech in noisy listening environments and often may ask for repetition.	Poor performance on monaural low-redundancy speech tests and speech in-noise.
Prosodic Deficit	Comprehending main idea of spoken or written narrative, mathematics calculation, taking notes during lecture, perception and use of prosodic cues (e.g., rhythm, stress, intonation), and social communication skills will all prove difficult. Poor music skills.	Left ear deficit on dichotic speech tasks combined with deficit on temporal patterning tasks in both labeling and humming conditions. Poor temporal integration.

Integration Deficit	Difficulty in multimodality tasks, reading, spelling, writing, and use of symbolic language (e.g. math) and prosody (e.g. rhythm, stress, and intonation). Poor music skills.	Left ear deficit on dichotic speech tasks combined with bilateral deficit on tests of temporal patterning requiring verbal report.
Associative Deficit	Receptive language deficits in language, semantics, and syntax; pragmatic and social communication skills may also be poor. Academic difficulties may not become apparent until the 3 <sup>rd</sup> grade.	Bilateral deficit on dichotic speech tasks, poor word recognition skills.
Output-Organization Deficit	Deficit in sequencing, planning, and organizing responses. Poor organizational skills, difficulty following directions, reversals, poor recall and word retrieval abilities. Motor planning abilities may be affected, resulting in poor fine and gross motor skills.	Difficulty on any task requiring report of more than two critical elements.

### *Differential Diagnosis – CAPD vs. ADHD*

Perhaps the most difficult differential diagnosis involving CAPD is that between CAPD and ADHD-PI (attention-deficit hyperactivity disorder-predominately inattentive type). ADHD-predominately inattentive type is a category of ADHD, in which behaviors cluster around difficulties in maintaining attention or responding to particular tasks (DSM IV; as cited in Medwetsky, 2002: Central auditory processing). The complexity of accurately diagnosing CAPD and ADHD disorders stems from the fact that there is significant overlapping symptomatology between them (Keller, 1992). In fact, checklists designed to characterize behaviors exhibited by individuals with CAPD and ADHD-PI include a number of similar symptoms, including: attention and listening problems, distractibility, difficulty following instructions, and associated language and academic problems (Chermak, Somers, & Seikel; as cited in Chermak, Tucker, & Seikel, 2002). These two disorders present with such similarities that some people have argued that they are indeed the same disorder; that is that what psychologists/physicians have traditionally diagnosed as ADHD-inattentive type may really be an underlying disorder or process and what audiologists have diagnosed as CAPD (Medwetsky, 2002: Central auditory processing). This view, at least from most audiologists' perspectives, has essentially been refuted, but there are still professionals out there that believe they are one and the same.

The following chart compares common characteristics of CAPD and ADHD-PI (Killingsworth & Zeitlin, 2006; Keller, 1992, 1998):

Common Characteristics of CAPD and ADHD-PI	CAPD	ADHD-PI
Says “huh” or “what” frequently	X	X
Has poor auditory attention, easily distracted	X	X
Gives inconsistent responses to auditory stimuli	X	X
Gives slow or delayed response to verbal stimuli	X	X
Constantly requests that information be repeated	X	X
Has difficulty listening in background noise	X	X
Withdraws in noisy environments	X	
Has difficulty with phonics and speech-sound discrimination	X	
Has weak phonology and articulation problems	X	
Has poor auditory memory, forgets what is said	X	X
Has difficulty following oral instructions	X	X
Has reading, spelling, and other academic problems	X	X
Learns poorly through the auditory channel	X	X
Misses jokes and can’t carry a tune	X	

CAPD-specific characteristics: “Students with [C]APD demonstrate deficits in their ability to attend selectively to the auditory modality, especially in the presence of background noise. Children with [C]APD ask for frequent repetition, often misunderstand or can’t follow verbal directions, and struggle with phonics and speech sound discrimination” (Killingsworth & Zeitlin, 2006).

ADHD-specific characteristics: “A student with ADHD may exhibit difficulty with sustained attention manifesting itself across all sensory modalities. Children with ADHD have difficulty with maintenance of attention and self-control during activities that are auditory, visual, or motor, poor turn-taking skills, inability to follow rules and routines, excessive talking or interrupting, and off-task behavior. Frequent forgetfulness including daily routines, losing items, lack of attention to detail, and careless mistakes in schoolwork are all typical behaviors of children with ADHD” (Killingsworth & Zeitlin, 2006).

One key distinction between ADHD and CAPD is the way in which these disorders are traditionally diagnosed. In general, ADHD is a medical diagnosis made by pediatricians or psychologists, whereas CAPD is an audiologic diagnosis made by audiologists. Furthermore, there are no empirical markers that identify ADHD, so it is diagnosed on the basis of behaviors. On the other hand, CAPD is diagnosed on the basis of performance on a battery of tests (Chermak et al., 2002). Despite the difference in methods of diagnosing, the difficulty in differential diagnosis remains the same. As illustrated by Keller’s (1992) expression of his belief that “all too often the differential diagnosis of [C]APD or ADD [ADHD] may be determined largely by whether or not the family consults with an audiologist or psychologist.”

Various suggestions have been made to increase the successfulness of differentiating CAPD from ADHD-PI. Based on evidence that CAPD includes deficits in the auditory modality alone, whereas ADHD manifests itself across all sensory modalities, Shapiro and Herod (as cited

in Cacace & McFarland, 1998) encourage the use of both auditory and visual tasks to improve delineating CAPD from ADHD. Combining auditory and visual tasks helps discriminate between an isolated auditory problem or a general problem across various sensory inputs (i.e. CAPD or ADHD). Gascon, Johnson, and Burd (as cited in Cacace & McFarland, 1998) support this suggest by proposing that “CAPD should be definable by test criteria other than performance on central auditory tests alone.” Moreover, when attempting to make a differential diagnosis of a child with possible CAPD and/or ADHD, it is imperative that skills in multiple sensory modalities are evaluated. Medwetsky (2002: Central auditory processing) argues that the best way to achieve accurate differential diagnosis of CAPD and ADHD is through interdisciplinary efforts involving both audiologists and psychologists/physicians.

Differential diagnosis is necessary in order to create the most appropriate management plan for an individual. With an inaccurate diagnosis successful management is nearly impossible. It is for these reasons that Keller (1992) advocates that “considerable effort needs to be placed into being able to better determine when [C]APD is really ADD, when ADD is really [C]APD, and when [C]APD and ADD are coexisting. Being sensitive to the existence of both disorders certainly provides a good start.”

## *Management of CAPD*

Management of Central Auditory Processing Disorders, just like CAPD assessment, should be multidisciplinary in nature. There is a range of listening and learning disabilities associated with CAPD, therefore comprehensive management must occur (Florida, 2001). The nature and functional manifestations of the disorder determine the extent to which each person (e.g., audiologist, speech-language pathologist, psychologist, learning disabilities specialist, social worker, regular classroom teacher, parent, etc.) is involved (Bellis, 1996). Moreover, in order to produce the best results for the student, an integrated collaborative management approach is suggested (Florida, 2001).

Improving the ability of a student with CAPD to process or use auditory information is generally the primary goal of CAPD management. Thus, management should focus on improving the student's learning and listening skills, remediating the disorder, and providing accommodation strategies in the environment (Bellis, 1996). Bellis asserts that every CAPD management program should include components from each of these three categories; however, the overall management plan should also be individualized based on the specific presenting profile of the student.

### *What are some factors to be considered in developing a management plan for a student diagnosed with CAPD?*

- **Student's Internal Motivation:** The success of any management plan is contingent on a motivated client (Chermak & Musiek, 1997). Many students diagnosed with CAPD are described by their parents, teachers, and peers as passive listeners, or listeners who do not take an active part in their own comprehension, because they cannot attend selectively and utilize comprehension strategies (Bellis, 1996; Chermak & Musiek, 1997). By the time a child is identified with CAPD, he or she may have experienced failure in listening situations for so long that a prevailing attitude exists in which the child does not feel successful in school or at home as a participant in discussions (Bellis, 1996; Florida, 2001). It is important that the child is helped to understand the nature of his or her CAPD deficits. "The student will need assistance analyzing difficult listening situations, learning how to become an active participant, and learning self-advocacy skills" (Florida, 2001). Such support will help to improve the student's motivation and sense of control.
- **Not a "One-Size-Fits-All" Management Plan:** It is not acceptable to make blanket statements or recommend a preprinted "one-size-fits-all" list of suggestions to parents and teachers of students with CAPD (Florida, 2001; Nye & Hasbrouck, 2006). Lengthy lists of recommendations tend to be overwhelming or confusing, thereby resulting in inappropriate accommodations made by teachers and parents (Florida, 2001). Instead, it is important to specify the nature of CAPD in order to choose the most suitable remediation procedures (Nye & Hasbrouck, 2006).
- **Partnership with the Classroom Teacher:** In order to ensure that effective classroom management recommendations are implemented, it is critical to have the support and

cooperation of the classroom teacher. Therefore, the classroom teacher should be included in the management team during both assessment and management of CAPD (Florida, 2001). In addition, providing classroom teachers with information about the nature of the student's CAPD, including specific strengths and weakness, as well as discussing the underlying theoretical basis for suggested management approaches, will encourage appropriate execution of specific management strategies suggested by the management team.

- Parents as Partners in CAPD Management: Parents have the opportunity to play an extremely important role in the management of their child with CAPD. However, this opportunity can only be taken advantage of by providing parents with information about the nature of their child's CAPD, including specific strengths and weakness, as well as discussing the underlying theoretical basis for suggested management approaches.

### *What are some management approaches or strategies that may be used with students with CAPD?*

The following are four interrelated management approaches that may be used with students with CAPD (ASHA, 1996; Bellis, 1996, 2003; Chermak, 2002; Chermak & Musiek, 1997; Florida, 2001; Keith, 1999).

- Environment
- Remediation
- Accommodations/Modifications
- Compensatory Strategies

Environment: Improving the quality of the acoustic signal in the classroom is one approach to CAPD management. An audiologist should evaluate the classroom environment and identify elements and conditions that may cause challenges for the student with CAPD. This information may then be used to improve the acoustical environment (Florida, 2001). There are two ways that this improvement can be achieved. One way is by reducing competing acoustic signals in the listening environment (i.e., reducing background noise and reverberation (echo) time). The second way is by enhancing the intensity of the signal to the student through preferential seating or the use of assistive devices such as FM systems or soundfield systems (ASHA, 1996). Such assistive devices should be recommended and evaluated by an audiologist to ensure optimal fitting and to minimize possible detrimental effects (ASHA, 1996).

Remediation: Remediation activities are designed to attempt to alleviate the disorder through deficit specific training (Bellis, 1996). The degree to which the dysfunction will be ameliorated varies from individual to individual, and therefore cannot be estimated for any given child (Bellis, 1996). Remediation activities should always be recommended based on the presenting strengths and weaknesses of the child. Bellis (1996) provides the following activities as examples of techniques that may be used for children with CAPD.

- *Auditory Closure Activities*: the purpose of these activities is to assist the child in learning to fill in the missing parts of a message in order to perceive a meaningful whole. Activities include the following (listed from least to most difficult):
  - Missing Word Exercises (e.g., Twinkle, twinkle, little \_\_\_\_)
  - Missing Syllable Exercises (e.g., Sports: base\_\_\_\_, soc\_\_\_\_, ten\_\_\_\_)
  - Missing Phoneme Exercises (e.g., I like to \_atch \_ele\_ision)
  - Speech-in-Noise Training (e.g., above activities can be undertaken in distracting or noisy situations to increase the difficulty)
  - Vocabulary Building:
    - Reauditorization: the child should learn to say the word aloud a few times
    - Actual definition of the word should be provided: immediate problem solving in the form of proving the definition, rather than telling the child to look it up in the dictionary, is necessary
    - Define the new word in their own way: this assures that comprehension of the provided definition has been achieved
    - In summary: the child learns to recognize the new word visually and auditorily, utilize contextual cues to achieve closure, and add a new word to their internal vocabulary.
- *Binaural Separation/Integration*: the purpose of these activities is to assist the child in attending to and processing a target signal while ignoring a competing signal delivered to the opposite ear (binaural separation) or in attending to and processing signals delivered to both ears (binaural integration). This is accomplished through following two exercises:
  - Dichotic Listening Training:
    - Step 1: Establish beginning target-to-competition ratio
    - Step 2: Reduce target-to-competition ratio over time
    - Step 3: Readjust target-to-competition ratio as needed
  - Localization Training:
    - In the clinical environment, stimuli (either speech or non-speech) can be delivered through multiple speakers set at various vertical and horizontal planes. The child's task is to point to the speaker from which the target signal came.
    - Children's games such as "Blind Man's Bluff" and "Marco Polo" can be used in more informal settings.
- *Prosody and Temporal Patterning*: the purpose of these activities is to assist the child in recognizing and using prosodic aspects of speech, such as rhythm, stress, and intonation (suprasegmental) cues. Activities include the following:
  - Prosody Training:
    - Words in which change in syllabic stress alters meaning (e.g., *convict* vs. *convict*)
    - Sentences in which change in stress alters meaning (e.g., He saw the *snowdrift* by the window vs. He saw the *snow drift* by the window).
    - Role playing or charade games focusing on prosodic and non-verbal expression of emotion

- **Basic Temporal Patterning Training:**
  - Same/different judgments of non-speech or speech patterns differing in:
    - Pitch
    - Stress
    - Loudness
  - Imitation of non-speech or speech patterns differing in:
    - Pitch
    - Stress
    - Loudness
  - Identification of stressed words within sentences (or stressed elements within a non-speech pattern)
- **Phoneme Discrimination Training:** the purpose of these activities is to help the child learn to develop accurate phonemic representation and to improve speech-to-print skills. Activities are designed not only to teach children to discriminate speech sounds correctly, but also to help them know when they have perceived a sound incorrectly or are unsure. This is achieved through the following steps:
  - Step 1: Present minimal contrast phoneme pairs, or phoneme pairs that are very similar
  - Step 2: Move to discrimination of minimal contrast pairs of phonemes in consonant-vowel and vowel-consonant syllables, and then words of increasing complexity
  - Step 3: Finally, focus on speech-to-print skills which involves demonstrating the connection between the phoneme segments previously trained auditorily with their corresponding printed letter symbols
- **Interhemispheric Exercises:** the purpose of these activities is to stimulate the corpus callosum (located between the two hemispheres of the brain) in order to improve interhemispheric transfer of information. In other words, these activities help the two sides of the brain communicate with one another. These activities are especially appropriate for home-based therapy activities and lend themselves easily to parent or sibling involvement. Activities include the following:
  - Verbal-to-motor Transfers: children are instructed to find a particular object or shape with the left hand from a grab bag or behind a screen, where they cannot see the objects
  - Motor-to-verbal Transfers: children find objects with the left hand and are instructed to label them verbally in terms of shape, texture, identification, etc.
  - Music Therapy: musical instruments that require coordinated movements of the hands are most useful (e.g., playing a piano requires that the musician be able to both read treble and bass clefs and engage in bimanual coordination abilities simultaneously).
  - Singing Therapy: useful because it requires a linguistic output (left-hemisphere function) and melodic expression (right-hemisphere function). Also, listening to popular songs for purposes of answering content questions about the lyrics themselves also requires activity from both hemispheres of the brain.



- Video Games: use those that require visual and auditory vigilance and bimanual coordination.
- Dance Lessons: use those dances that require bipedal coordination
- Drawing Pictures: draw from verbal directions (or have child describe the pictures as they draw them).
- Extracurricular Sports: require bipedal or bimanual coordination.

Accommodations/Modifications: “*Accommodations* are provisions made in *how* a student accesses and demonstrates learning. That is, accommodations provide adjustments to presentation to or responses from a student that do not change the content or the intended outcome” (Florida, 2001). Examples of accommodations include the following:

- Provision of a note-taker
  - Receiving notes from another student or aide will help reinforce the information presented verbally and provide a study guide for later review
- Providing visual supplements
  - Such supplements are especially helpful for those with good visualization skills
- Pre-teaching new information and vocabulary
  - Teachers should be encouraged to provide introductory information and new vocabulary before presenting the subject in the classroom
  - The subject to be discussed will be familiar, thus increasing the external redundancy of the information
- Repetition or rephrasing
  - Repetition is good for children who have missed a portion of the message the first time it was presented and who have difficulty filling in the missing components
  - Rephrasing involves using smaller linguistic units and simpler speech, which is appropriate for children with language deficits or delays
- Multimodality cues and hands-on demonstrations
  - Multimodality cues should match precisely in content and timing (e.g., the teacher cannot discuss types of cars and present a slide of a truck)
- Regularly planned “listening breaks”
  - This will help avoid auditory fatigue

“*Modifications* are changes in *what* a students is expected to learn and demonstrate and includes changes in content, requirements, or expectations” (Florida, 2001). Some examples of modifications include the following:

- Reducing the difficulty of the material
- Shortening assignments
- Giving alternative assignments
- Using alternative grading systems

Compensatory Strategies: CAPD management must focus on teaching the child to become an active rather than a passive listener. Learning to accept responsibility for his or her listening comprehension and to invoke compensatory strategies for determining and retaining the content and meaning of each message is vital for the child (Bellis, 1996). Chermak, and Musiek

and Chermak (as cited in Bellis, 1996), outlined several strategies, including metacognitive, linguistic, and metalinguistic abilities, that encourage effective listening for children with CAPD. These strategies are intended to facilitate active monitoring and self-regulating of the child's own message comprehension abilities, as well as the development of general problem-solving skills (Bellis, 1996). The following are several strategies that can be taught to children with CAPD to encourage responsibility for their own comprehension (Bellis, 2003):

○ Principles of Active Listening

- *Attribution Training*: teaching children to attribute listening failures to factors under their immediate control
  - It requires children to acknowledge that a listening or communication failure was due, in part, to insufficient effort
  - Children also learn not to attribute every communicative or related failure to their disorders but, instead, learn to work harder to overcome the limitations imposed by the disorder
- *Whole Body Listening*:
  - Step 1: placing the body in an alert posture by straightening the spine
  - Step 2: inclining the upper body and head toward the speaker
  - Step 3: keeping the eyes firmly on the speaker
  - Step 4: avoiding any activity that can detract attention from the speaker, such as excess movement or fidgeting
- *Analysis*: teach children to analyze their listening and learning environments and take proactive steps to correct any impediments to their success instead of waiting for others to act on their behalf
  - This requires recognition and identification of possible adverse listening conditions and the development and implementation of solutions to the problem

○ Metacognitive Strategies

- *Self-instruction and step-by-step reauditorization*: a "Talk Out Loud" approach
  - Step 1: The clinician models the process of "talking out" while simultaneously demonstrating the steps he or she is taking to complete a project
  - Step 2: The clinician verbalizes the steps as the child engages in performing them
  - Step 3: The child is taught to self-instruct or "talk out" the steps of the procedure on their own
  - Step 4: The child repeats this but speaks in a whisper
  - Step 5: The child repeats this but silently self-instructs
- *Self-regulation and problem solving*: the child is taught to anticipate difficult listening or learning situations and to develop plans for avoiding or alleviating them. Requires the following:
  - An understanding of the nature of the problem (e.g., inability to hear clearly, lack of comprehension of spoken instruction)

- The determination of possible causes for the problem (e.g., adverse signal-to-noise ratio because of extraneous noise sources, incomplete information)
  - The generation of possible solutions (e.g., move to another location, ask for repetition or clarification of instructions)
  - Implementation of the most appropriate solution
  - Evaluation of the effectiveness of the solution
  - Self-reinforcement if the solution was successful or reanalysis of the problem if the solution was unsuccessful
- *Self-reflection*: the child is taught to review (and possibly write down in a journal for that purpose) the characteristics of the communicative problem and the effectiveness of solutions to the problem. This can assist them in planning for future potential communication breakdowns and difficult listening situations
- *Meta-memory Strategies*: many children with APD may expend so much effort just trying to comprehend the message in the first place, that very little energy may be left over for remembering what was said
  - *Chunking*: involves breaking down long messages or lists into smaller components and grouping similar concepts or objects together
  - *Elaboration*: using analogies and acronyms
- *Pictorial Representation*: recording information into a pictorial representation is good for children with good visualization and art skills
  - *Auditory memory enhancement*: this strategy involves reducing the overall message into one picture that illustrates the main concept and then drawing that picture on a notepad.
- *Set the steps of a task to music or motion*: often we remember best when words are accompanied by a catchy tune or by illustrative hand movements
- *Verbal rehearsal and reauditorization*: involves having children repeat the message over and over again in order to reinforce the memory trace
- Linguistic and Metalinguistic Strategies
  - *Training in the rules of language*: some children may benefit from specific training in the use and meaning of tag words that help them to order or sequence steps of a task (e.g., first, last, next, before, after), adversative terms (e.g., but, however, although), and other terms that imply relationships among parts of a message
    - *Discourse cohesive devices*: types of linguistic forms that connect portions of the complex message, including referents (e.g., pronouns), additives (e.g., and), and causal terms (e.g., because, therefore)
  - *Formal schema induction*: the linguistic markers will serve to organize information and to predict relationships among elements of a message
    - For example, if a speaker says during a lecture “The first point I’d like to make is...” then this would imply that at least one or more additional points will follow

- Learning to be on the lookout for formal schemata will assist children in organizing and comprehending complex messages
- *Content (or contextual) schemata*: these are scripts based on context and experience that assist in interpreting messages
  - For example, when we enter a restaurant and are greeted by the waiter, there are certain communications that we could expect based on experience with the restaurant environment. If the waiter said “I have an extra golf ball in my pocket,” this would probably lead us to believe that we must have misheard him, as such an utterance would not conform to our expectations or acceptable messages for restaurants. Therefore, we would request a repetition of the message.
  - Content schemata allow us to make predictions about the likelihood that certain types of messages will occur and help us to achieve auditory closure when we miss portions of the spoken communication.

### *Developing CAPD Management Based on Deficit Subprofiles*

#### **CAPD subprofiles and management suggestions (Bellis, 2003):**

- Auditory Decoding Deficit
  - *Primary deficit area*: Auditory Closure
  - *Possible secondary or associated deficit areas*: Speech sound discrimination, temporal processes
  - *Environmental modifications that may be appropriate*:
    - Acoustic modifications
    - Use of assistive listening devices
    - Preferential seating
    - Frequent checks for comprehension
    - Employment of multimodality cues
    - Repetition
    - Pre-teaching of new information/vocabulary
    - Provision of a note-taker
    - Gaining attention prior to speaking
    - Generous use of positive reinforcement
    - Avoidance of auditory fatigue
  - *Remediation activities that may be appropriate*:
    - Auditory closure activities
    - Phoneme training and speech-to-print skills
    - Temporal processing training
  - *Compensatory strategies that may be appropriate*:
    - Attribution training (if secondary motivational concerns are evident)
    - Whole body listening techniques

- Self-instruction, self-regulation, and problem solving (if analyzing, developing, and carrying out solutions are areas of concern)
  - Self-reflection and journaling
  - Mnemonic devices (if secondary “auditory memory” difficulties are present)
  - Recording information into pictorial forms
  - Setting steps to music or motion (if secondary “auditory memory” difficulties are present)
  - Formal and content schema induction (if not automatically employed)
- Prosodic Deficit
- *Primary deficit area:* Auditory temporal patterning
  - *Possible secondary or associated deficit areas:* non-speech discrimination
  - *Environmental modifications that may be appropriate:*
    - Acoustic modifications
    - Preferential seating
    - Frequent checks for comprehension
    - Employment of multimodality cues
    - Repetition or rephrasing (if prosodic cues are rendered more salient)
    - Pre-teaching new information/vocabulary
    - Provision of a note-taker
    - Gaining attention prior to speaking
    - Generous use of positive reinforcement
    - Placement with an “animated” teacher
  - *Remediation activities that may be appropriate:*
    - Prosody training and key word extraction
    - Basic temporal patterning training
    - Auditory discrimination using non-speech stimuli (e.g., frequency, intensity, duration of different tonal glides)
    - Speech-language intervention for pragmatics
  - *Compensatory strategies that may be appropriate:*
    - Attribution training (if secondary motivation concerns are evident)
    - Whole body listening techniques (emphasizing attention to facial expression and body-language cues)
    - Self-instruction, self-regulation, and problem solving (if analyzing, developing, and carrying out solutions are areas of concern)
    - Self-reflection and journaling
    - Mnemonic devices (if secondary “auditory memory” difficulties are present)
    - Formal and content schema induction (particularly focusing on key words and social communication expectations)

○ Integration Deficit

- *Primary deficit areas:* Binaural separation, binaural integration
- *Possible secondary or associated deficit areas:* Sound source localization
- *Environmental modifications that may be appropriate:*
  - Acoustic modifications
  - Use of assistive listening devices
  - Frequent checks for comprehension
  - Repetition
  - Pre-teaching new information/vocabulary
  - Provision of a note-taker
  - Gaining attention prior to speaking
  - Generous use of positive reinforcement
  - Avoidance of auditory fatigue
- *Remediation activities that may be appropriate:*
  - Inter-hemispheric exercises
  - Dichotic listening techniques
  - Speech-in-noise training
  - Localization training
- *Compensatory strategies that may be appropriate:*
  - Attribution training (if secondary motivational concerns are evident)
  - Self-instruction, self-regulation, and problem solving (if analyzing, developing, and carrying out solutions are areas of concern)
  - Self-reflection and journaling
  - Mnemonic devices (if secondary “auditory memory” difficulties are present)
  - Formal and content schema induction (if not automatically employed)

○ Associative Deficit

- *Primary feature:* Difficulty applying rules of language to incoming message
- *Environmental modifications that may be appropriate:*
  - Acoustic modifications
  - Preferential seating
  - Frequent checks for comprehension
  - Employment of multimodality cues
  - Pre-teaching new information/vocabulary
  - Provision of a note-taker
  - Gaining attention prior to speaking
  - Generous use of positive reinforcement
- *Remediation activities that may be appropriate:*
  - Speech-language intervention focusing on receptive language skills
- *Compensatory strategies that may be appropriate:*
  - Attribution training (if secondary motivational concerns are evident)

- Whole body listening techniques
  - Self-instruction, self-regulation, and problem solving (if analyzing, developing, and carrying out solutions are areas of concern)
  - Self-reflection and journaling
  - Recording information into pictorial forms
  - Mnemonic devices (if secondary “auditory memory” difficulties are present)
  - Setting steps to music or motion (if secondary “auditory memory” difficulties are present)
  - Formal and content schema induction (particularly focusing on metalinguistic, including discourse cohesion, devices)
- Output-Organization Deficit
- *Primary feature:* Difficulty acting on/responding to auditory output
  - *Environmental modifications that may be appropriate:*
    - Acoustic modifications
    - Use of assistive listening devices
    - Preferential seating
    - Frequent checks for comprehension
    - Employment of multimodality cues
    - Rephrasing using smaller linguistic units
    - Pre-teaching of new information/vocabulary
    - Provision of a note-taker
    - Gaining attention prior to speaking
    - Generous use of positive reinforcement
    - Avoidance of auditory fatigue
  - *Remediation activities that may be appropriate:*
    - Speech-in-noise training
    - Speech-language intervention focused on expressive language skills
  - *Compensatory strategies that may be appropriate:*
    - Attribution training (if secondary motivational concerns are evident)
    - Whole body listening techniques
    - Self-instruction, self-regulation, and problem solving (focusing on planning and implementing steps of a procedure or solution)
    - Self-reflection and journaling
    - Mnemonic devices (focusing on sequencing steps of a process)
    - Formal and content schema induction (if not automatically employed)

### *Management Summary*

The most important aspect of management to remember is that all management strategies and programs must be individualized and as deficit-specific as possible in order to attain the greatest amount of success. The most effective management is achieved through a

multidisciplinary approach that includes more than just the audiologist. All CAPD management programs should include four essential parts: environmental modifications to improve the child's access to auditory information, deficit-specific remediation activities designed to overcome or remedy the disorder, accommodations and modifications to improve the child's opportunities to learn, and compensatory strategies to aid the child in becoming an active listener (Bellis, 1996; Florida, 2001). The management program can not be considered comprehensive if any of these components are missing.



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