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Intervention Approaches for Children Diagnosed with (Central) Auditory Processing Disorders (CAPD)

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Intervention Approaches for Children Diagnosed with (Central) Auditory Processing Disorders (CAPD)

Reconsidering Intervention Approaches for Children Diagnosed with (Central) Auditory Processing Disorders (CAPD).

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CLINICAL SCENARIO:

(Central) Auditory Processing Disorder (CAPD) is a loaded term among professionals who work with children presenting with the disorder or symptoms. A review of the literature provides an abundance of disagreement among professionals within medicine, to include medical doctors, speech and language pathologists and audiologists regarding whether the diagnosis even exists (DeBonis & Moncrieff, 2008). In addition to this debate, the term is used differently across disciplines. Some professionals have dubbed CAPD as the diagnosis while using Auditory Processing Disorder (APD) as a symptom of another diagnosis (McArthur, 2009). However, there is no agreement to how the terms should be used.

In addition to disagreement regarding whether CAPD exists and the terminology usage, there is no standard for diagnosing CAPD. The Consensus Conference on the Diagnosis of Auditory Processing Disorders in School-Aged Children "emphasized the importance of establishing that poor performance on tests of auditory processing is due to 'an auditory-specific perceptual deficit in the processing of speech input' rather than due to some other factor(s)" (ASHA, 2005). Sensory processing issues were also recognized as a contributing factor to CAPD. Because sensory processing in the central nervous system involves multiple modalities supported by cognitive and language systems, some believe that complete modality specificity as a requirement for APD is not plausible (DeBonis & Moncrieff, 2008). A unimodal approach may favour sensitivity to diagnosing CAPD and lacks the specificity to capture the perceptual problems that is a hallmark of the diagnosis (Cacace & McFarland, 1998). However, using a multimodal approach may lead to misdiagnosis and false positive results as this approach is capturing a broader picture of how the senses work together in sensory processing. False positive results are typical as there is no consensus on a battery of tests that should be used in diagnosing CAPD (Cameron & Dillon, 2005).

Disagreement regarding what diagnostic tests are sensitive and specific to a CAPD diagnosis is further confounded by the issue that these tests have not been shown to be reliable and valid measurements of the disorder. Because diagnosing has not been standardized, efficacy of treatment cannot be validated. This controversy of proper diagnosis has trickled down to impact the validity and reliability of treatment strategies. For this reason, CAPD does not have systematic reviews or gold standard evidence supporting treatment strategies. The focus of this CAT is to examine the current body of knowledge that exists regarding treatment strategies, and their limitations, for children presenting with a CAPD diagnosis. This diagnosis is recognized by the American Speech and Hearing Association (ASHA) as of 2005 and is coded as International Classification Disease (ICD)-9 and is used to identify children who present with auditory perceptual problems and dysfunction of the CANS (Cable, 2008).

ASHA recognizes the diagnosis to be within the realm of an audiologist and screening along with differential diagnosis within the domain of speech and language pathologists (Bellis & Anzalone, 2008). Because of the recent acceptance of CAPD as a diagnostic category, implications may still be unclear to occupational therapists working with children regarding the efficacy of treatment.

Occupational therapists work with children that have been diagnosed with CAPD, may be diagnosed with CAPD (upon attainment of age 7 when the diagnosis can be made by an audiologist) and children who present with an auditory processing disorder as a co-morbid symptom under an umbrella of symptoms related to a differential diagnosis. Once diagnosed, occupational therapists are involved in top-down and bottom-up approaches in the treatment of these children. Of most importance, are the specific environmental modifications as interventions needed by children with CAPD.

Occupational therapists are part of an interdisciplinary team addressing issues such as improving the classroom listening environment, recruiting supramodal cognitive resources, the use of FM systems to optimize hearing potential and reduce background noise, provide intervention strategies for improving both auditory attention and auditory memory, educate regarding CAPD and strategies to compensate and co-treating with speech and language pathologists to address language and organizational skills. School-aged children usually experience a variety of learning challenges that requires an interprofessional approach to intervention (Lagace et al., 2008). These children can present with other co-morbid learning difficulties in addition to CAPD such as handwriting, organizational issues associated with hearing and understanding language that falls within the treatment realm and domain of an occupational therapist (Lagace et al., 2008).

Additionally, occupational therapist can become certified in programs such as Tomatis therapy that have been used to treat auditory processing disorders.

FOCUSED CLINICAL QUESTION: What interventions are being used and what are the limitations for the treatment of children diagnosed with (Central) Auditory Processing Disorder (CAPD)?

Level IV Evidence

- The expert opinion paper entitled, *Intervention Approaches for Individuals with (Central) Auditory Processing Disorder* (Moncrieff & Wertz, 2008), provides a framework for diagnosing and treatment of CAPD. It outlines that screening of the disorder is in the realm of speech and language pathology and diagnosis is in the professional realm of an audiologist. The paper states that treatment should be provided by a multidisciplinary team. Intervention is not a one size fits all approach and must be tailored to the individual. Once a diagnosis has been made, intervention must be undertaken immediately. A diagnosis cannot be made until maturation of the central auditory nervous system (CANS) at age seven. A detailed description of tests used to detect CAPD was not listed. It would have been helpful to know what tests are used and if there is any evidence of their reliability and/or validity. The authors' discuss that a multidisciplinary approach is critical to providing interventions for children suspected of CAPD under the age of seven.

The authors describe three people with diagnosis of CAPD to illustrate the point of how different each case of CAPD is and that the approach to intervention varies widely based on the deficits presented. An important note is that the authors do not list any top-down evaluation measures used in identifying CAPD. Diagnosis is a bottom-up process using a battery of auditory tests performed by an audiologist. However, the interventions comprise a variety of top-down and bottom-up methods to include compensatory strategies, environmental modifications and direct remediation (auditory training). After training, and on retest, all three participants showed improvements. However, because the interventions were co-mingled, we cannot pinpoint the intervention variable that resulted in the improvement or compare the variables to determine the "best" intervention strategy. Therefore, the variables cannot be compared to each other as the most helpful to least helpful intervention strategies.

Because variables were not measured and they were co-mingled intervention strategies, a true picture of the intervention piece of the CAPD cannot fully be explained. In addition, there was no data provided to illustrate how much improvement was obtained by each individual.

Interventions within the three case studies that the authors illustrate as useful are as follows:

Environmental Modifications

- Acoustic-based, bottom-up modifications such as the use of hearing assistive technology.
- Architectural interventions to reduce reverberation and improve the signal-to-noise ratio.
- Preferential seating with a direct visual line to the speaker and reduction or removal of mechanical or other competing noise sources within or outside the room.
- Making frequent checks for comprehension.
- Employing visual or multimodality cues and hands-on demonstrations to augment verbally presented information, slowing speaking rate, repeating key information, rephrasing information using less complex linguistic units, providing instructions in
- Written form, pre-teaching new information and vocabulary and providing a note-taker.
- The use of these modifications should only be based on the individual's presenting difficulties and auditory deficits.

Compensatory Strategies/Central Resources Training

- Strengthening higher order, top-down cognitive, language and related abilities to become active rather than passive listeners.
- Activities include training in utilization of metalinguistic and metacognitive (including memory and attention).
- Strategies to aid listeners in actively monitoring and self-regulating their own auditory comprehension and retention abilities as well as in developing general problem-solving skills.

Direct remediation (Auditory Training)

- Auditory training that targets bottom-up activities that maximize neuroplasticity and can be formal (i.e., in a sound-treated booth with acoustically controlled stimuli) or informal (in home or school setting using targeted games and activities).
- The decision on what auditory training techniques should be employed is provided by the results of the diagnostic central auditory evaluation which reveals the specific auditory processes that are deficient in a given individual.
- It should be frequent and intense often times requiring daily sessions for several weeks.
- Training must be sufficiently challenging. This can be accomplished by working near skill threshold, or at 30%-70% accuracy level with incremental difficulty levels where 70% accuracy levels must be achieved before increasing the difficulty of the task.
- They should involve active participation on the part of the listener accompanied by provision of immediate feedback and salient reinforcement in an effort to maximize long-term potentiation in the CANS.

Intervention should include both top-down and bottom-up approaches and should address methods of modifying the listening and learning environment.

Level III Evidence

The paper entitled, *Auditory Rehabilitation for Interaural Asymmetry: Preliminary Evidence of Improved Dichotic Listening Performance Following Intensive Training* (Bellis & Anzalone, 2008), provides research on the use of dichotic listening as a treatment intervention for CAPD along with other diagnoses that include an auditory processing disorder (APD) as a symptom. In fact, the first trial solicited participants with unilateral dichotic deficits and bilateral deficits as well as participants with other co-morbid disorders in order to explore whether intensive training would facilitate dichotic listening similarly in all of the children. It was a clinical trial that offered findings from two phases. However, these trials were not randomized or controlled. The researchers suggest that this would be the next step in a phase III trial. It is important to note that the researchers were only testing interventions that included dichotic listening to improve the performance of symmetrical listening of both ears. Children who presented with dichotic listening challenges usually have a right ear advantage. This means that the participants attended and listened better with one ear, usually the right ear. Some of the participants had bilateral deficits that are more associated with co-morbid disorders and were put into a separate group. Dichotic listening skills is a performance skill of listening that an audiologist measures when determining a diagnosis of CAPD. However, it is one of many auditory skills tested in the CANS. This research specifically focuses on the diagnosis of a dichotic listening deficit independent of other diagnoses present or other auditory processing deficits. The researchers use dichotic listening interventions as the interventions to target the deficit. Reliability and validity of the interventions are not addressed.

When evaluating the findings, it is important to note that the sample sizes were small for both phase I (8) and phase II (13) trials. All participants did not receive the same amount or type of treatment as each participant advanced in training based on the child's previous performance, age, fatigue and preference if stated. Key findings were that by using the following intervention strategies unilateral deficit measured during dichotic listening tests can be eliminated following intensive training.

Single dichotic digits/Source: Auditec VA Tonal & Speech Materials;
Double dichotic digits/ Source: Auditec VA Tonal & Speech Materials;
Triple dichotic digits/Source: VA Tonal & Speech Materials;
Randomized dichotic digits/Source: Strouse & Wilson, 1999;
Competing words/Source: SCAN-C and SWW;
Dichotic words/Source: Deborah Moncrieff;
Competing environmental sounds/Source: Katz;
Dichotic spondees/Source: VA Tonal & Speech Materials;
Competing sentences/Source: VA Tonal & Speech Materials;
Cinderella segments/Source: Jerger & Moncrieff; and
Dichotic synthetic sentences/Source: VA Tonal & Speech Materials

For other children, left ear performance can improve. The fact that children with bilateral deficits, failed to make the same gains suggests that non-auditory factors related to attention, motivation, or language may inhibit success in some of these children, or that some deficits may require additional intervention beyond what was given in these trials. The continued improvement in dichotic listening observed in the children who received follow-up language therapy following the phase I trial, suggests that a combination of dichotic training and language therapy may be facilitative, especially for children with bilateral deficits together with an interaural asymmetry.

These two clinical trials were designed to test the efficacy of this new dichotic training paradigm. The changes in dichotic listening performance, and in some cases in listening and language skills, suggest that this type of training may facilitate auditory processing in children with binaural integration deficits. The results also suggest that improvements in dichotic listening may facilitate listening in general and ultimately may help children with language and learning tasks. A next step is to replicate these findings in a controlled experimental research study with standardized procedures according to the guidelines of a phase III trial.

Level of Evidence (not applicable)

The paper entitled, *Essays in Audiology, Auditory Processing Disorder-From Screening to Diagnosis and Management-A Step-By-Step Guide* (Cameron & Dillon, 2005), describes a method for diagnosing and treating APD that is congruent with the current literature. Although the guide acknowledges that the assessment and management of APD is an evolving area of practice, and one which requires much further research and evaluation. It provides a basic practical framework of what is recognized as a battery of tests to diagnose APD and treat the diagnosis. The main limitation is that there is no conclusive research confirming the reliability and validity of the methods listed for assessing and treating APD. Management for APD was discussed as follows:

Management of temporal resolution deficits:

Auditory training for temporal resolution deficits can include the following exercises:

- Phonological awareness training: phoneme discrimination, blending and segmentation.
- Temporal resolution training using non-speech sounds: Training involves "same/different" judgements of tones, or narrow or broadband sounds that differ in frequency and/or temporal gaps.

Management of temporal sequencing deficits:

Auditory training for temporal sequencing deficits can include the following exercises:

- Temporal pattern training: These activities strengthen the ability to perceive non-linguistic changes in rhythm, stress and pitch. For example, imitating the rhythm of a series of claps or tones (such as notes on a keyboard) of increasing complexity and length. The child identifies which clap is louder than the others and which tone is higher or lower than the others.
- Prosody training: Specific therapy for interpreting tone-of-voice cues, for example learning to differentiate the meaning of a sentence based on word stress. Drills are also given to make spoken language more prosodically expressive.

Management of binaural integration deficits:

Auditory training for binaural integration deficits can include the following exercises:

- Auditory binaural integration exercises, such as singing and drawing, which help the two halves of the brain work together.
- Formal dichotic listening training: These exercises are conducted over headphones using audiological equipment (a two channel audiometer is required). Training materials should be targeted towards the interests of the child undergoing the training.
- The target stimulus is presented to the weaker ear, and the competing message is presented to the stronger ear, with ear strength determined by dichotic test results.
- The child's task is to describe the target. For example, summarize the plot of a target story.
- The signal-to-noise ratio is increased if the child is unable to complete the task, and decreased with the task is accomplished.

Management of binaural interaction deficits:

Auditory training for binaural interaction deficits can include the following exercises:

- Informal auditory training in localization skills: The child is asked to close his or her eyes, and sounds are presented to his or her left or right. The child must point to the direction the sound is coming from. When this activity is mastered, the target stimulus is delivered simultaneously with noise presented at 90 degrees from the target. As the child becomes better at this task the sound and noise are brought closer together.
- Informal noise desensitization therapy: The child learns to listen to instructions and stories in the presence of background noise. The child completes the instruction or answers questions about the story. These activities can be conducted in noise at various signal-to-noise ratios and degrees of spatial separation.

Strategies to improve the listening environment and compensate for deficits

- As, in most cases, a deficit in one of the auditory skills described above will result in difficulties listening in class that will be exacerbated when the signal is masked by background noise, some general strategies can be applied to modify a child's environment in order to improve his or her access to auditory information-including recommendations for assistive listening devices. Strategies can also be taught to help the child to compensate for their listening difficulties. A review of some of these strategies is provided below.

Modification of the Environment

- Modify the classroom if acoustic characteristics do not confirm to recommended standards. For example, place mat and cloth poster boards around the classroom to minimize reverberation.
- Preferential seating in the classroom, close to the teacher will make facial expressions clearly visible, and maximise the ratio of direct sound to reverberant
- sound. The seating position should also be away from noisy equipment, such as overhead fans, to maximize the signal-to-noise ratio.
- An assistive listening device, particularly one that conveys the sound from a microphone near the teacher's mouth directly to the child, may also be helpful.

Classroom-Based Strategies

- Various classroom based strategies can also be helpful in assisting children with listening difficulties to extract as much information from the auditory signal as possible. These strategies include speaking in short, simple sentences, repeating a message if not comprehended, slowing the speed of delivery, providing visual cues and hands-on demonstrations, as multimodal cues add to the auditory information so that the whole message can be understood, pre-teaching new information/vocabulary, gaining attention prior to speaking, frequently checking for comprehension, using positive reinforcement generously, and planning regular listening breaks to avoid auditory fatigue.

Compensatory Strategies The following compensatory strategies are designed to help the child to take control of their listening environment.

- Attribution training: the child is taught to anticipate difficult listening or learning situations and develop plans for avoiding or alleviating them. This is especially important if the child has secondary motivational problems. The child should be taught to: understand the nature of the problem (for example, an inability to hear clearly, or lack of comprehension of spoken instruction), determine the possible cause of the problem (e.g., noises outside the classroom, children chatting), create a solution (e.g., move to another location, ask for repetition or clarification of instructions), apply the most appropriate solution, evaluate the effectiveness of that solution, self-reinforcement if the solution was successful, or reanalysis of the problem if the solution was unsuccessful.

- Whole body listening techniques: These techniques are especially useful if there are motivational concerns. They include: placing the body in an alert position by straightening the spine, inclining the upper body and positioning his or her head toward the speaker, keep eyes firmly on the speaker, avoid any activity, such as fidgeting, that diverts attention from the speaker.

Direct Intervention. Direct intervention strategies can also be implemented by a speech pathologist. These techniques aim to strengthen "top-down" mechanisms to assist in comprehension of the auditory signal to include context-based auditory closure training; vocabulary building, and drills in speech-to-print skills to improve any spelling and reading deficits.

Limitation of this CAT: This critically appraised topic has not been peer-reviewed by one other independent person. It is not an exhaustive search and is limited by the novice research skills of the student.

SEARCH STRATEGY:

Terms used to guide Search Strategy:

- **P**atient/Client Group: Auditory Processing Disorder
- **I**ntervention (or Assessment): Interventions (all)
- **C**omparison: This student's clinical question doesn't have a specific comparison
- **O**utcome(s): Summarize all interventions

Databases and sites searched	**Search Terms**	**Limits used**
1)EBOSCO Host 2)OT Search 3)Google Scholar 4)Medline-Science Direct 5)Medline-Elsevier Science Direct Complete 6)Cochrane Review 7)Ovid SP 8)American Speech Hearing Association 9)International Speech Communication Association 10)National Institute of Deafness and Other Communication Disorders 11)American Academy of Audiology 12)Google	"Bellis, T.J." "Moncrieff, D.W." Auditory processing disorder. Auditory processing disorder and interventions. Treatment. Audiology Children perceptual disorder. Children auditory perceptual disorder.	Intervention and Treatment & Auditory processing disorder and Central Auditory Processing Disorder.

INCLUSION and EXCLUSION CRITERIA

- Inclusion: English Speakers, K-12
- Exclusion: Autism Spectrum Disorder, hearing impairments, K-12 only, English speaking only, Sensory Processing Disorder, ADHD, Dyslexia, Speech and Language Disorders, co-morbid disorders, sensory integration.

Table 1: Summary of Study Designs of Articles retrieved

Study Design/ Methodology of Articles Retrieved	**Level**	**Number Located**	**Author (Year)**
One group, nonrandomized (e.g., before and after, pretest–posttest).	III	1	Moncrieff, D.W. & Wertz, D. (2008)
Descriptive studies that include analysis of outcomes (single subject design, case series).	IV	1	Bellis, T. & Anzalone, A. (2008)
Case reports and expert opinion, which include narrative literature reviews and consensus statements.	V	2	Dillon, C.S. (2005) McArthur, G.M. (2009)

BEST EVIDENCE

The following study/paper was identified as the 'best' evidence and selected for critical appraisal. Reasons for selecting this study were:

- It addresses common training interventions used to treat CAPD.
- It shows the diversity of understanding of what constitutes a CAPD diagnosis and treatment.
- It identifies why the research studies that have been done on training programs yield inaccurate results and therefore, do not prove to be useful as treatment strategies for CAPD.

SUMMARY OF BEST EVIDENCE

McArthur, G. M. (2009). Auditory processing disorders: Can they be treated?. *Current Opinion in Neurology, 22*, 2, 137-143.

Aim/Objective of the Study: To review training programs that claim to treat children's developmental disorders by training their auditory processing. The author reviews six studies that were published in 2007 and 2008 that trained children with developmental disorders on auditory training program.

Study Design: Expert Opinion/Review

Intervention Investigated: The author reviews recently published studies on non-speech training, simple speech training, Fast ForWord Language and Tomatis therapy. She reviews study design and evaluates each of these treatments according to whether it is a "good study"

based on the following: 1) The study should test participants for an APD before training. 2) The study should test whether participants have significantly better auditory processing after training. 3) The study should test if the participants have symptoms of specific language impairments, specific reading disability, attention deficit hyperactivity disorder and/or autism before training. 4) The study should test whether the participants' symptoms are significantly better after training; and 5) The study should test a second group of children who do no training.

Main Findings: For APD

Non-Speech Training: The study established that the participant had an APD prior to training. Participants showed significant improvements in their non-speech test scores. This suggests that non-speech training can treat a non-speech APD in children. The control group did not make the same gains.

Simple Speech: The study established that the participant had an APD prior to training. Participants showed significant improvements in their simple speech test scores. This suggests that simple speech training can treat a simple speech APD in children. The control group did not make the same gains.

Fast ForWord: The author reviewed four studies for this training. One of the studies did not include any auditory tests. Two of the studies did do auditory tests but did not determine whether the participants had an APD prior to training. One of the studies did not contain an untrained control group. One study did not have an untrained control group but did not test whether the participants had an APD prior to training. One study did establish that the participants had APD prior to training. However, it found that the training had no effect on their APD.

Tomatis Therapy: Only one recent study tested the effects of Tomatis therapy. However, the study did not test participants for an APD before or after Tomatis therapy. Therefore, we cannot tell if Tomatis therapy treats APD.

Original Author's Conclusions: The conclusion suggests that commercial training programs could increase their efficiency (and decrease their cost) by removing redundant non-speech and simple speech training components. The dearth of the well-controlled auditory training studies, paired with the misleading nature of poorly-controlled studies suggests that we need to teach parents, teachers, and the media how to separate the good training studies from the bad ones.

Critical Appraisal:

Interpretation of Results: Because of poor design methods of conducting studies on training programs specifically addressing ADP, there is no evidence to support Tomatis Therapy and Fast ForWord interventions for the treatment of APD. However, there is evidence to support the use of non-speech and simple speech training for APD treatment.

Limitations: The author does not review audiological training studies for treatment of CAPD such as programs that train temporal resolution, temporal sequencing, binaural integration and binaural interaction. These training programs are the auditory training recommended by audiologists for treatment of CAPD.

The non-speech and simple speech studies were composed of small sample sizes.

Because the author did not discuss the methods used by the researchers within each of these studies, the quality of the analysis is limited. The reader does not know much about the participants, sampling and groups within each study. In addition, it does not provide the reader with how progress was measured within these studies and whether the measures were valid and reliable. This review does not provide analysis of statistical significance or statistical comparisons between groups to critically think about the studies' outcome measures and results. For these reasons, it is not the best review of these studies that it could have been.

In addition, the author does not inform the reader how she decided the criteria for a "good study" for auditory training. This decision lacks a literature review to support the measures that she uses to analysis the studies.

Summary/Conclusion:

Although this paper evaluates the elements of a good auditory training study, it also shows the confusion that exists in determining consensus in understanding what constitutes a CAPD diagnosis and which training programs treat them.

In addition, the review of the studies lacks the scientific rigor that other topic reviews have and as a result, it is not a powerful or conclusive review of these studies.

IMPLICATIONS FOR PRACTICE, EDUCATION and FUTURE RESEARCH

The literature regarding this topic shows a substantial lack of knowledge that requires further research. Current standards in the diagnosis and treatment of APD do not meet changing evidence-based practice (EBP) principles (Moncrieff, 2007). EBP has evolved and now demands that patient perspectives and the opinions of authorities be considered only against a background of high-quality peer-reviewed research (Moncrieff, 2007). There is a need to establish reliability and validity of the diagnostic battery of test choices used for diagnosing CAPD as well as interventions (Moncrieff, 2007). In addition, audiologists need to come to consensus regarding what battery effectively diagnosis CAPD.

Regardless of the debate and confusion, parents and families will demand that intervention take place in the absence of gold standard evidence as they will not waste precious and limited early development waiting for research and science to catch up and decide on proper treatment. Therefore, the implication for practice is to inform parents of the treatment strategies that are recommended for CAPD while cautioning them that there is inadequate evidence to support the intervention approaches. The more expensive the approach, the more caution is needed in advising parents.

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