



Unveiling CAPD: Evidence-Based Strategies for Enhanced Listening and Communication

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Abstract

Central Auditory Processing Disorder [(C)APD] refers to difficulties in perceptual processing of information in the Central Auditory Nervous System (CANS) and underlying neurobiological mechanisms that supports a variety of auditory behaviours like temporal processing, auditory discrimination and binaural processing. CAPD may affect a person's listening, communication abilities, academics etc thus it is paramount that individuals diagnosed with CAPD be provided significant management to conquer the deficit to the greatest degree possible. Speech and language pathologists provide several therapeutic strategies and approaches for the treatment of an individual with CAPD. The present article, therefore, reviews the therapeutic approaches offered by speech and language pathologists for the management of individuals with CAPD.

Keywords: CAPD; Management; Auditory processing; Strategies; Approaches

Abbreviations

CAPD: Central Auditory Processing Disorder; CANS: Central Auditory Nervous System; AIT: Auditory Integration Training; AT: Auditory Training

Introduction

(C)APD refers to deficits in the neural processing of auditory information in the Central Auditory Nervous System (CANS) not due to higher order language or cognition, as demonstrated by poor performance in one or more skills of auditory discrimination, temporal processing and binaural processing [1]. Prevalence of CAPD reported in different studies for school going children is 3.2% [2] and 2-3% [3], however prevalence in the older adult populace could be as high as 76% [4]. Though, both adults and school-going children are equally at risk [5].

CAPD may perhaps be associated to a specific lesion or disorder or it may possibly be unprecedented [6]. CAPD has been accounted for 55% of school going children with traumatic brain injury and 45% with injury or illness like stroke, tumours, etc [7]. Signs and symptoms of CAPD include difficulty localizing sounds; difficulty learning a new language [1], significant trouble following verbal directions particularly in noisy situation, regularly request repetitions; inattentive and easily distractible etc. [8]. CAPD may exist alone or accompany other disorders like Attention Deficit Hyperactive Disorder (ADHD), Language Impairment, Learning Disability, and Autism Spectrum Disorder.

Treatment should be started as soon as the person is diagnosed with CAPD, to utilize plasticity of Central Nervous System (CNS), and limit residual functional deficits. Treatment should be customized as per the individual's need based on his/ her strengths and weaknesses. While the management of CAPD is ill-defined

specifically in the Indian scenario and a very limited amount of information is present, thus, this review article sensitizes on different therapeutic approaches incorporating both bottom up and top down approaches used by Speech-Language Pathologists in management of people with CAPD. The bottom up approaches focuses to obtain and acquire acoustic signals whereas the top down approaches focus on the higher order central resources like memory, attention and language skills.

(C)APD management

The earliest distribution with respect to preparation of program for people with auditory processing problems in India was by Shivashankar (1998) [9] while the first observational proof of (C)APD management program was outlined by Yathiraj and Mascarenhas (2003) [10] that was later published. There have been few strategies that have been utilized consistently for management of (C)APD which might be seen as a tripod: without any one of the three “legs” (environmental modifications, remediation activity, and compensatory strategies), the tripod can’t stand [11].

Compensatory strategies

Compensatory strategies, also known as Central Resource Training is top down treatment approach [1] intended to help people in conquering residual dysfunction which cannot be treated with auditory/ direct skill training [12]. Clinician help listeners in becoming active by training them to use metalinguistic and metacognitive strategies to aid listeners in effectively checking and self-regulating their own auditory comprehension and retention abilities by reinforcing higher order central resources [1]. Metalinguistic strategies comprise of utilizing graphic organizers (like problem-solution map, story map), making use of context to understand and build vocabulary, phonological awareness, effective listening, etc whereas Metacognitive strategies includes the proper utilization of information to plan, screen, and control execution, including attention, memory, learning, and language processing [13]. These strategies don’t straightforwardly target deficient central auditory process, as such; however rather upgrade the advantage specified by direct remediation and different interventions by tending to functional deficits and advancing improved listening and spoken language comprehension [13].

Environmental modifications

Environmental modifications improves the individual’s access to acoustic information by making the acoustic signal easier

and boosting listening as well as learning in various situations [13]. It consists of both, bottom up management approach like enhancement of acoustic signal (utilizing remote microphone hearing assistive technology, individual and group assistive listening gadgets, like FM/DM) and listening environment (improving acoustics that can influence speech intelligibility like covering reflective surfaces to reduce reverberation) and top down management approaches which centres conferring and learning the data and may incorporate activities such as utilizing visual and multimodality signs, easing rate of speech, rehashing key information, pre showing new data and vocabulary, giving a note taker etc.

Using Frequency Modulation (FM) system can be effective in patients with greater severity of (C)APD and can improve their academic performance as well [14] and using ALD/FM system is found to be beneficial as it increase signal to noise ratio (SNR) in individuals have distractibility or attention issues [12].

Direct skills remediation

Direct Skill Remediation comprise of bottom up approaches intended to alleviate or resolve (C)APD [1]. Targeted bottom-up techniques augment neuroplasticity and can be formal (i.e., in a sound-treated stall with acoustically controlled stimuli) or informal (in the home or school setting utilizing targeted games and exercises) [15]. Coupling formal with informal Auditory Training (AT) ought to expand treatment adequacy [16].

Direct Skill Remediation also includes computer based training program (CBAT) which may address both auditory and language components and prepare children to process acoustic stimuli faster [11] and exercises to train interhemispheric transfer of information which underlies binaural hearing and binaural processing [17]. Interhemispheric exercises include verbal-to-motor transfer in which children are asked to locate a specific item or shape with the left hand (due to cross-hemispheric integration) from a place where they cannot see the articles; music therapy; video games etc. [11]. Earobics (comprehensive program used for training phonological awareness and auditory-language processing) was the earliest CBAT programs whereas Fast ForWord (FFW) (designed for training in temporal processing, speech perception and language comprehension skills) is now a commonly used [18]. Moreover, training must be adequately challenging which can be

practiced by working at a 30%–70% exactness level with gradual difficulty levels where 70% precision must be accomplished before increasing the difficulty of the assignment [15,16]. For the most part, more children can be relied upon to profit by AT undeniably because of neural plasticity [19]. Children whose auditory deficits are related with a neuro-maturational lag profit by intense AT.

Given beneath are depictions of the examinations that help for direct remediation to various auditory processes

- Auditory Integration Training (AIT): AIT is used to enhance the listening skills by using filtered music (manipulating narrow or broad frequency bands of acoustic spectrum) to stimulate the auditory system [20]. It is based upon the hypothesis that listening filtered music can improve the person's ability to process auditory stimuli [21]. To improve the performance of children with issues in dichotic listening tasks, several methods are found to be effective. In India, Yathiraj and Priyadarshini (2009) [22] assessed efficacy of dichotic-off-set training material on children aged 7-12 years and proved it to be effective in improving auditory integration. Also, language skills and behavioural changes can be improved by using AIT [23].
- Auditory separation/ closure training: It is the ability of a person to complete the incoming auditory information provided by the clinician when a portion of the information is missing. One of the principle difficulties found in people with issues in auditory separation/closure is perception in presence of background noise. Katz and Burge (1971) [24] stated that in such issues it is recommended to use noise desensitization (presentation of speech under noise conditions) which is performed on people with poor speech-in-noise ratio (SNR) value [6]. In India, the first report of an auditory separation program "Auditory Perceptual Training" to improve auditory perception was provided by Shivashankar (1998) in which patients are needed to identify digits or words in presence of a background passage presented using a tape recorder and was concluded to be promising. Another study by Maggu and Yathiraj (2011) [25] demonstrated the effect of noise desensitization therapy on children aged 8-11 years by using different listening activities involving speech material in presence of noise using six levels of noises and SNR and concluded it to be effective in improving auditory separation/closure.
- Temporal processing training: Temporal processing is the perception of sound or adaptation of sound within confined interval of time and its training mainly focuses on manipulation of speech specific components of speech signals. Maggu and Yathiraj (2011) [25] assessed temporal resolution by using 'Gap Detection Test'; auditory separation using 'Speech perception in noise' test; binaural integration (cognitive process involving fusion of auditory information presented binaurally) was also assessed sequencing (understanding and recalling the sequence of words) was assessed using 'Revised auditory memory and sequencing' and postulated that training in one auditory process i.e. temporal patterning does not achieve improvement in other auditory processes i.e. temporal resolution, auditory separation and binaural integration thus, training should be deficit specific [25].
- Acoustical Parameter Training: This training activity focus on discriminating between speech and tonal stimuli using acoustical parameters (frequency, intensity, temporal cues) of acoustic signal.
- Phoneme Synthesis Training: According to Sloan (1998) [26] phoneme synthesis training not just encourages the individual to separate speech sounds effectively but also helps them to know if they have perceived the sound correctly or not, by blending distinct phonemes into correctly sequenced and co-articulated sound patterns as quoted by Katz and Harmon (1981) [27]. In India, Yathiraj and Mascarenhas (2003) [10] used Phoneme synthesis training with other techniques including auditory integration, auditory separation and recognition of low redundancy speech, auditory memory (recall and sequencing) and duration pattern recognition depending on the defective process and found that this holistic training program improved the four auditory processes i.e. auditory integration, auditory separation/ closure training, duration pattern recognition and auditory memory and sequencing [28]. As this strategy was utilized alongside a few different techniques, the utility of phoneme synthesis training in isolation could not be discovered. Also, Phonemic analysis and segmentation is found to be effective in individuals with reading, spelling and listening problems [12].

Apart from above mentioned approaches, there are three approaches which are successfully used in Musiek's, (1999) [29] evaluation and treatment of patients with CAPD cases

Auditory memory enhancement

Most of the complaint regarding CAPD patient is that they have poor memory [12] (Chermak and Musiek, 1992). Thus, auditory memory enhancement strategy involves recoding the data into pictorial presentation to enhance auditory memory of an individual by decreasing the information provided by clinician into one picture having the main concept and drawing it on a notepad within a given time limit so as to make the individual perform the task in as little time as possible. Though, the efficacy on the utilization of this strategy is missing, the procedures engaged with this strategy have been appeared to enhance memory [29] whereas according to Bellis (2011) [30], this strategy is ineffective in cases of individuals with prosodic and integration deficit [15]. Also, according to Yathiraj (2015) [28], memory games and memory enhancing devices (Auditory memory enhancement training) can be helpful for person who failed in Auditory Sequence Test.

Vocabulary building for auditory closure

In this procedure, we place unknown words in an intelligible frame of reference for the child. By using contextual cues, the child gathers the meaning of the unknown content which is known as Contextual Derivation. Aim of this approach is to utilize clues that persist to auditory closure process [31]. In some uncommon cases, the child may not find the meaning of the unknown word, at this point, the passage should be read again and a short conversation should be started about the key contextual words. In this event, since there is a high probability of recurrence of mistakes, one should ensure (a) deficient number of contextual cues is not given, (b) vocabulary level of the word giving the prompts are excessively high (c) unknown words should not be excessively theoretical and (d) the syntactic structure of the material is not excessively twisted. The procedure is considered as Error Correction.

Vocabulary building can be used when a person has problems related to language, auditory closure, finding words, verbal academic issues or poor vocabulary. It is found to be more effective in children in second grade or higher [32]. According to a survey by Musiek in 1999 [29], to access the effectiveness of this approach, this approach was found to be very beneficial by 90% class Teachers,

Speech language Pathologists and Special Educators while other 10% (approx.) found it very time consuming and demanding.

Informal auditory training

Informal Auditory Training (AT) cannot be as particular as formal auditory training yet can utilize different procedures, which can be useful in training integrative procedures. Following are some informal methods recommended by Musiek (1999) [29].

Vowel training- A typical issue in most children with CAPD is trouble with identification and segregation of vowels. Generally, vowels are instructed in the classroom where there is tolerable ambient noise. As quoted by Massaro (1988) [33] this ambient noise obstruction is probably going to influence the child with CAPD more than the child without this issue which will also hamper their memory process [29]. One should incorporate training that requires the presenting vowels in the written form before the person in question and are spoken by the therapist and the child indicating long or short. Later, their acoustic highlights change marginally as the progress happens by combining vowels and consonants.

Prosodic training- Prosody is basis to communicate in language; it can bring feelings (shock, outrage, energy) to the word or sentence that can change the significance of the sentence. Since people with central auditory processing issues frequently don't have great frequency, temporal or intensity segregation, prosody and intonation regularly can't be acknowledged completely [34], thus, the requirement for preparing on these sorts of assignments.

Auditory Directives- If the completion of the directive includes a motor task, the therapist can check bit by bit mistakes also. Strikingly, the Children's Token Test in which the clinician scores the individual for feedback on the basis of following specific directions asked by the clinician, although created for diagnostic use can be utilized as AT on auditory directives.

Reading- During reading, visual and auditory zones of the cerebrum becomes active and interact, as appeared with new imaging methods [35]. Specifically, if reading is performed with speed and prosody, the auditory system can get prepared for these significant acoustic impacts on the printed word [29].

Auditory Vigilance Training- Auditory Vigilance training, also known as sustained attention helps to keep up a significant level of auditory attention for fundamental timeframes fully expecting a stimulus upgrade [36]. This sort of activity is useful for children in preschool or early rudimentary grades [29].

Conclusion

This article has presented a general overview of approaches and their efficacy for management of person with (C) APD from national and international perspective. This article also suggests on the strategies to be used based on functional deficit and test failed by individuals with (C) APD, though it does not reveal how factors like age of the patient, concurrence of different disabilities affects management of these patients.

Conflict of Interest

Authors declare no conflict of interest.

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