Auditory Processing Evaluation and Treatment

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Building Sound Foundations to Complete the Circle of Communication

Auditory Processing

Information for parents

Dr. Jack Katz

Not only Parents, but also many professionals, have difficulty understanding Auditory Processing (AP). (Also known as Central Auditory Processing or Auditory Perception) This confusion is caused, in part, because AP problems are heterogenous, so they may look quite different in one child than the next. To add confusion there are many approaches in evaluating these children and in dealing with their problems. It is also confusing to see the variety of tests that claim (probably correctly) to evaluate AP Dysfunction or AP Disorder (APD). Finally, it is often hard to see how the school/ communication problems of the child relate to the tests administered, and therapy or management strategies that are recommended.

This brief review will present the Buffalo Model to help clarify these issues. It should help in understanding what our tests do and to relate the findings to the appropriate remedial approaches. This should enable parents to ask informed questions and ultimately to help them to get the kind of services that their child needs.

The Buffalo Model begins with a simple definition of AP. ***AP is what we do with what we hear.*** It is not something we can measure with a simple hearing test. Rather, it is the efficiency with which individuals are able to manage the more complex auditory information that they hear.

The Central auditory system is extensive and requires exquisite precision; little wonder that there is such diversity in AP problems, depending on where the breakdown/ difficulty may be. However, based on the child's auditory test performance, we can predict with good accuracy the difficulties that he or she has in learning and communication. This relationship between the child's problems and the test results adds confidence in the methods we use. Importantly, it helps us to develop an effective program of remediation and support based on the specific test findings.

Auditory Functions:

Our central system helps us to focus on what we want to hear, block out background noise and other things that we don't want to hear, as well as to identify the sounds and words of our language quickly and accurately. In addition, it assists us in combining auditory with visual information, remembering what we have heard, retrieve what we have stored, and to maintain the information in its proper order. To make sense of the variety of problems a child has, the auditory processes can be categorized within 4 types. Most have more than 1 of the types of AP, but some may have all four types.

AP Categories:

When the auditory system is not efficient, characteristic listening deficits can be observed. These test signs were originally based on the responses of adults with brain disorders, which helped in mapping the auditory brain to correlate the signs and symptoms of auditory skills to the specific area of the brain. Based on these findings, we are now able to relate these test signs in children with learning disabilities. This does not mean that these children have a brain damage of any sort, but rather it indicates an inefficient physiology of the system related to those anatomical structures.
APD is likely due to differences in central nervous system function. It thus behooves use to identify these children as soon as possible in order to capitalize on nature's time-table for developing auditory skills. Knowing what to work on depends on the specific auditory problems the child is having.
This classification was first tested around 1985-86. It is developed into a complete system over the years with the help of many Speech-Language Pathologists and Audiologists.

Global Auditory Processing Deficits can result in general auditory skills weakness because the brain does not process the auditory information effectively and/ or efficiently to form meaningful auditory engrams **Manifests in a variety** of weaknesses in the areas of language processing, emotional regulation, social engagement, and academic achievement.
Decoding weakness *Primary Auditory Area* **Decoding weakness can result in** ability to quickly and accurately understanding the speech sound features that provide meaning. Difficulty in meaningfully and accurately analyzing the physics of sound in the brain. **Difficulty with** phonics, articulation, reading accuracy, understanding directions, etc. May have been observed when child was younger, may continue to be noticed at present or may manifest in future
Tolerance-Fading Memory weakness *Primary Auditory Area/ Amygdala/ Hippocampus* **Tolerance-Fading Memory weakness can result in** poor understanding of speech in a background of noise as well as difficulty with short-term auditory memory. language issues are common in this group (spoken, written or both). **It is likely to** show in reading comprehension difficulty and in remembering directions. Expressive language issues are common in this group (spoken, written or both).
Integration weakness *Multiple systems including corpus collosum* **Integration weakness can result in** a wide variety of symptoms and problems that differ from child to child. The basic characteristic appears to be difficulty in bringing information together. **May manifest as s**evere reading and spelling problems in some, while in others it is simply associated with very poor spelling.
Organization Weakness *Precentral/ Postcentral gyrus and central sulcus* **Organization Weakness can result in difficulty with** organizing thoughts and to sequence information. Difficulty with organizing term papers, expressing ideas in an organized way and spelling reversals are often seen. **It is a labor-intensive problem**, requiring a great deal of monitoring of both incoming and outgoing information both in spoken or written expressions. This takes away brain capacity from other important tasks. It reduces the person's capacity and increases frustration and confusion.

Early intervention is highly preferred to facilitate long lasting and complete results. Sensory-Integration therapy may be useful for those with Integration difficulty (often diagnosed as Dyslexic). The brain always tries to compensate for internal deficits and/ or weaknesses; however, the efficiency is compromised. As issues increase the ability to compensate becomes more tedious and futile.

Summary

CATEGORY	AUDITORY DIFFICULTIES/ CHALLENGES	ACADEMIC/ COMMUNICATION DIFFICULTY	USEFUL REMEDIAL APPROACHES
DECODING	Quickly and accurately understanding speech	Oral reading, spelling, phonics, articulation, receptive language	Train with speech sounds, phonemic synthesis and analysis Lindamood approach
TOLERANCE-FADING MEMORY	Understanding speech in noise, poor short-term memory	Disrupted by noise, short-term memory, reading comprehension	Noise desensitization, Rote memory work, assistive listening device
INTEGRATION	Often combining auditory and visual information. Delays in processing	Often severe reading and spelling, in addition to other challenges in the other category	Work on the other categories and other Auditory-Visual integration tasks.
ORGANIZATION	Maintaining proper sequence and keeping self-organized	Disorganized, spelling/ language reversals, effort needed to self-monitor	Sequencing drills using numbers, words, and sentences.

Checks and Balances

Regardless of which approach was used in the past, the bottom line for both the parents and the professional should be, "What can we do for the child?" Obviously, the child is having academic/ communication challenges, otherwise an evaluation of sorts would not have been initiated. The chances are past treatment and managements have not been effective. The goal for Buffalo Model Therapy protocol is to reduce the burden of the individual by improving auditory skills. We use the diagnostic material to retest after each round of therapy to assess improvement objectively and subjectively. All children may not obtain the same amount of improvement, but it should be commensurate with the time and effort in therapy. Other coexisting conditions have to also be factored when expecting changes in the auditory system. Intellectual disabilities and other conditions such as Autism can affect the rate of progress. However, some improvement is almost always noted post therapy. Therapy is most effective when a professional is monitoring progress in therapy consistently each session. Without a professional involvement the therapy becomes a mundane drill. Therapy has to be individualized to meet the highest potential.

The Buffalo Model Therapy is a coherent system, used to develop an effective management program.

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SUGGESTIONS FOR THERAPY AND MANAGEMENT OF CENTRAL AUDITORY PROCESSING DISORDERS

Based on the SSW-Plus Program created by Jack Katz, CCC/A-SLP

Decoding management and procedures

1. Methods for Decoding therapy are based on the belief that poor phonemic decoding is a result of slow, inefficient processing of speech information.
    - This difficulty is primarily the result of problems at the speech-sound level of processing.
    - The individual does not have a sufficiently clear concept of certain speech sounds imprinted on the brain.
    - They are slower and/or less accurate in digesting speech, especially if spoken rapidly.

2. Speech sounds are learned early in life. Children in every community and country learn their special language and dialect.
    - As we get older, there appears to be less room for change in speech patterns.
    - The earliest years are the most important for rapid and complete learning language and phonemic (speech-sound) processing.
    - Preschool and primary grades are the optimal time periods to alter faulty phonemic concepts.
    - However, adolescents and adults can successfully be motivated to improve their listening skills.

3. The purpose of phonemic Decoding therapy is to improve the brain's concepts of the sounds of English.
    - This requires clear speech sounds, generally spoken in isolation.
    - The therapy room should be quiet.
    - The therapist, tape player, or CD that presents the sounds should be within a few feet of the individual to provide the best fidelity.
    - An auditory trainer can be used to assist the person under less than optimal listening conditions.

Decoding therapy procedures

1. Therapy that permits a person to hear and respond to speech sounds in an organized way is likely to aid the person in establishing an improved conception of what speech sounds should sound like.
2. Some methods that are very helpful for phonemic Decoding problems are:
    - sound blending
    - speech-sound discrimination training
    - speech-sound memory training
3. Depending on the severity of the problem, the following steps may be followed:
    - introduction of phonemes
    - discrimination of phonemes
    - focusing attention
    - short-term memory
    - interference memory
    - phonemic synthesis
    - phonemic analysis
    - other speech tasks

Noise Desensitization or Speech-In-Noise therapy programs

1. Noise desensitization is an effective way to deal with both poor understanding in noise and intolerance for noise.
2. The purpose of noise desensitization therapy is to improve the ability of the auditory system to:
Deal effectively with background noise.
Understand speech-in-noise.
Help the person take a less emotional approach and be more tolerant of noise.
3. This generally requires a systematic rather than a random exposure to noise when listening to and responding to
speech.
The therapy room should be quiet in order to avoid unwanted noise.
The speech presented should be recorded because it will not be as affected by the level of ambient noise, and it will maintain consistency from one presentation to the next.
4. Speech-In-Noise therapy permits a person to gradually become accustomed to background noise while responding to speech.
It is likely to aid the person in tolerating background noise so it is not so disruptive.
It can improve the accuracy of speech understanding when noise is present.
5. Some methods that are helpful for Speech-In-Noise programs are:
Increasing the listening challenge gradually from less to more disruptive competing noise (note that there are individual differences in what is most disruptive).
- Mild noises (e.g. melodic music or low pitched hum) may be useful initially.
- However, if one begins with these easier challenges, therapy should increase the challenge by use of cafeteria or other speech noises.
- Even more disruptive noises may be used in the later stages of therapy (e.g. jarring music with a heavy beat or unpredictable noise in the speech frequencies).
Teaching the person to relax and then introducing noise while the person tries to maintain a relaxed state is valuable training.
Giving the patient control over presentation of the noise is a useful strategy because it is generally less threatening to them than when the noise is administered by someone else.
6. For each noise that is used, the signal-to-noise ratio should increase gradually from barely audible competition to
unfavorable S/N ratios.
7. Throughout therapy, the level of speech is generally maintained at the same comfortable loud level. Only the level
of the noise varies.
8. Any speech material can be used, however, single-syllable words are best as they require the most precision, many
can be given in a short period of time and they are easy to score.

Short-Term Memory therapy programs

1. Short-term memory responds well to therapy especially in the early years. However, adolescents and adults can
also benefit from these activities.
2. In addition to drills to expand memory, strategies such as mnemonics can also aid a person in dealing with a memory deficit.
3. The purpose of short-term memory therapy is to improve the person's memory span and ability to effectively retrieve information.

4. This generally requires a systematic rather than random series of memory tasks so that the person can adopt and practice a useful strategy for dealing with this challenge.
5. Short-term memory therapy permits a person to gradually develop the techniques of remembering longer and longer material. For example, building confidence that one can remember a string of numbers is one of the desired results of these programs.
6. For short-term memory problems, digits and sentences are particularly useful materials.
Start easy and gradually increase digit or sentence length.
Begin with predictable sentences (e.g. Put on your shoes in the morning.) or easy number combinations (e.g. 5, 10, 3, 6).
Work up to longer and more challenging sentences (e.g. When people leave work and shop downtown, they have to get in their cars.) or more difficult number combinations (e.g. 4, 9, 5, 8, 6, 2).

Integration therapy and management

- Integration Although therapy methods are very much the same as for those with just Decoding signs alone, those who have this type of Integration deficit have tenacious problems and require more therapy and review.
- These individuals present with more severe visual perception problems as well as Decoding issues, reducing benefits from compensatory and auditory training therapies.
- Therapy methods are similar as those used for Tolerance-Fading Memory problems, however, the limitations are more tenacious and require more therapy and review.
- Testing results may indicate one ear being much more affected than the other.
- Due to the severity of their problems, in addition to Tolerance-Fading Memory therapy they may benefit from lip-reading therapy (if auditory-visual skills are intact).

Organization therapy and management

- Organization problems involve both sequencing difficulty and poor organization (not just auditory) and are rarely found alone without some other kind of central auditory processing deficit.
- Although Organization problems alone do not qualify as a learning disability or produce a significant communication deficit, they are frustrating, and in conjunction with other problems can contribute to learning disabilities.
- Organization problems require constant monitoring by the individual, which can be difficult when tired, bored, sick, etc.
- This problem can be seen from childhood to adulthood.
- It is often obvious in a person's appearance, work and living space, calendar, etc.
- Tasks can be trained that maintain proper sequencing for auditory information and manage an individual's life
- The purpose of Organization therapy is to improve the ability of the auditory system to maintain correct sequences.
- To be able to keep auditory information in the correct order.
- To develop routines
- To develop good organizational skills in other aspects of life.
- Therapy requires systematic training to improve sequencing ability.
- For practical purposes, exercises are often limited to short sets of numbers and sentences.
- Rarely in everyday life are individuals required to recall long strings of words without utilizing a written list.

- Organization therapy should be done in a quiet room to minimize other demands on the person's attention.
- It is important to begin with slow clear speech, which will help maintain the sequence (too slow however, is not advantageous to a person who also has a short-term memory deficit).

Organization therapy programs

1. Organization therapy permits an individual to gradually improve their sequencing for longer and more complex material.
2. For therapy exercises, it is helpful to begin with slow speech with ample pauses and work toward faster speech with shorter pauses.
3. As improvement is maintained with faster materials, then more digits or longer sentences can be introduced.
4. Visual aids can help keep the sequences in order.

Other Approaches

Auditory Decoding Deficit

This is the "classic" CAPD. These children are typically described as having a hearing problem even when no physical evidence exists. They process information in a way that is slow and inaccurate. This inefficiency in processing means that they are working harder to interpret what they hear.

The deficit is thought to be in the primary auditory cortex, in the left hemisphere. This deficit has been considered the most "classic" manifestation of an auditory processing disorder and is linked to significant language deficits in most individuals. The deficit has characteristics similar to those for high frequency hearing loss.

Characteristics

* Tend to mis-hear words eg: mouth for mouse, eighteen for eighty, park for bark. They have difficulty with differentiating and analyzing the differences between speech sounds.
* Weak vocabulary, syntax (plurals, verb tenses), and semantics (multiple meaning words, understanding who, what, why, when and where questions).
* Difficulty in situations in which information is presented without sufficient contextual or visual cues.
* Difficulty understanding speech in noisy environments.
* Becomes overloaded in an auditory situation. Listening behavior deteriorates over time.
* Performs better in subjects where phonic/phonological decoding is not requires – for example math computations.
* Usually poor readers, spellers, and note-takers. They cannot divide their time appropriately between listening and writing.

Diagnostic Identification

* Poor performance on monaural low-redundancy speech tests.
* Poor performance on speech in noise tests.
* Poor auditory closure abilities noted on other tests where the errors are similar to the target word.
* Poor performance on Phonemic synthesis test.

Classroom Strategies

* Change the physical environment to decrease noise level.
* Improve acoustic access by seating the child appropriately, by blocking out other noise with personal FM system or implementing a Sound field amplified classroom.
* Repeat information only if you can say the information more clearly.
* Provide visual cues.
* Use attention-focusing devices.
* Pre-teach (using an aide or parent) new information, particularly vocabulary.
* Use clear, concise, and explicit language. Provide a copy of instructions (for example) in writing as well as audibly (auditory). Use a buddy if necessary.
* Modify oral tests. (For example - always give spelling words in a sentence)
* Use assistive technologies (computers, books on tape and note takers). Give children 2 sets of text so they have one at home.

Teaching your child how to:

* Listen (active versus passive listener)
* Recognize adverse listening conditions and how to address them.
* Methods of clarifying auditory instructions.
* How to use visual cues to augment auditory information.
* How to advocate on their own behalf.

Associative Deficit Tolerance Fading Memory

These children have difficulties applying the rules of language to sounds they hear. They often have intolerance for background noise and their understanding of speech declines markedly when noise is present. These children tend to perform less well with language demands in the classroom.

The deficit is thought to be in the left auditory association areas of the cortex and forward through the arcuate fasciculus. These are the regions in which the acoustic properties and meaning come together and syntactic analysis occurs. This may be more properly considered an "auditory language" deficit rather than a specific auditory deficit. It often involves the inability to apply the rules of language to incoming auditory input.

Characteristics

* Poor auditory memory.
* Poor receptive vocabulary.
* Poor vocabulary skills.
* Difficulty understanding complex sentences (Their language is very concrete - little syntax)
* May have language difficulties with: categories and labels, multiple meaning words, negative wh-questions, antonyms, synonyms, and homonyms.
* Difficulty following directions.
* Poor reading comprehension.
* Difficulty in making the necessary associations in order to understand verbal jokes, riddles, jargon.
* Usually asking for clarification.

Diagnostic Identification

* Diagnosis is usually not until 3rd or 4th grade when language requirements become more difficult.
* Good performance on temporal pattering.
* Good sound decoding and discrimination but word recognition may be poor.
* Bilateral deficits on dichotic listening talks.
* Poor performance on speech in noise discrimination tasks.

Classroom Strategies

* Change the physical environment (as above).
* Improve acoustic access to auditory (as above).
* Have the child in an educational environment that uses a structured, systematic, multi-sensory, rule-based approach to language and learning.
* Avoid or minimize classroom techniques that require self-monitoring of learning behavior.
* Impose external organization and structure.
* Pre-teach new vocabulary
* Use clear concise and explicit language

* Obtain attention
* Use assistive technologies
*Provide quiet study areas
* Check comprehension by having child paraphrase or demonstrate what is expected.

*Training in use and meaning of words that imply relationships such as tag words (first, last, next), casual words, (because, since), adversative words, (but however although).

* Strategies that aid in retention of complex messages such as chunking, verbal rehearsal, and paraphrasing.
* Metacognitive strategies.
* Methods to improve noise tolerance skills.
* Auditory memory enhancers. * Develop problem-solving skills

Compensation Strategies

* These children should be encouraged to "talk themselves through" homework (example: draw diagrams, highlight, makes notes in the margin in effort to provide a framework to understand the message).
* Use of organization aids such as:
* Calendars
* Checklists
* Assignment notebooks
* Dictionaries *Computer

Output-Organizational Deficit

These children have trouble organizing, sequencing, recalling, and/or expressing an answer. They have listened to, analyzed, correctly connected, and pulled together the information but still have difficulty responding correct. In general these children have difficulty on tasks where success is dependent on motor and or planning skills.

Characteristics

* Difficulty following directions, particularly if they are long.
* Difficulty in starting assignments, remembering homework, taking notes, or organizing their papers or work.
* Difficulty with sound blending.
* Receptive auditory skills are good, however they have difficulty acting upon incoming information (such as memory based skills such as work retrieval abilities).
* Weaknesses often in expressive language skills and or speech articulation.

Diagnostic Identification

* Good performance on monaural low redundancy speech talks.
* Poor performance on tests that require a response that has multiple elements such as the frequency and duration pattern tests, or dichotic speech tests, or phonemic synthesis test.
* Poor performance on tests with background noise.
* Other indicators are omitting words on tests, using words that were given on a previous test item and difficulty with sequencing words in a response.

Classroom Strategies

* Repetition is useful but only if the information in broken down into small units.
* Use of tag words when giving instructions and information
* Use of organizational tools such as consistent routines, outlines, calendars, checklists, and assignment notebooks.
* Pre teach new information.
* Avoid situations requiring self-monitoring.
* Use of visualization and visual imager.
* Training metacognitive techniques to strengthen memory based skills, which in turn help item recall.

Compensation Strategies

* Use of computer technology and organizational aids.
* Learning good study skills.

Integration Deficit

These children demonstrate difficult across modalities with any task that requires efficient inter-hemispheric communication. They have trouble tying together auditory and visual information. They frequently exhibit long delays in responding.

Characteristics

* Difficulty with multi-modality tasks.
* Difficulty with sound-symbol relationships.

* Reading and spelling difficulties related to difficulty recognising and using the patterns of 'wholes" necessary for word recognition and spelling.
* Motor skills that require bimanual or bipedal co-ordination may be affected.
* Difficulty determining how to do a task, may need a lot of extra time and practice to complete, tasks, or may have a great deal of difficulty getting started on tasks.

Diagnostic Identification

* Left ear deficits on dichotic speech tasks.
* Bilateral deficits on tests of temporal patterning in the linguistic labelling condition.
* Scores within normal range for monaural low-redundancy speech tests.

Classroom Strategies

* Reduce or avoid multi-modality cues - present information via one modality at a time.
* Provide note takers.
* Pre teach new information.
* Tape record classes. R
* Reader for tests and/or a scribe.
* Texts on tape.
* Word processors with audio spell-check.
* Never rephrase (this is confusing) rather repeat and emphasise key points.
* Test should not be timed.
* Multi-sensory integration and non auditory inter-hemispheric activities to improve corpus callosum function.
* Auditory inter-hemispheric activities.

Compensation Strategies

* Avoidance of division of attention.
* Focus attention on the task they are presently doing.