

Auditory Processing

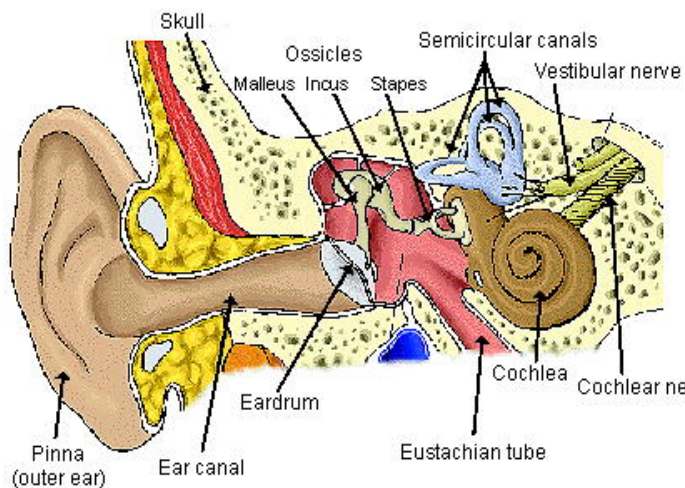
Information booklet to accompany
RTL B Cluster 30 presentation to
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Auditory Processing- What is It?

(Hearing vs Processing)

“Auditory processing”—We are hearing this term referenced more and more, and an increasing number of children are being identified as having an “auditory processing disorder.” But what does it actually mean? How can you have normal hearing and have an auditory processing disorder?



First, let's define “hearing”. The “peripheral hearing mechanism,” as it is referred to, includes the outer ear—where sound waves are collected, the middle ear—where sound is converted to mechanical energy, and the inner ear—containing the cochlea. Traditional hearing tests (audiograms) and tympanograms assess the integrity of this system. If this system is intact and functioning well, then your hearing should test normal.

But what happens when the signal leaves the inner ear?

Basically it travels along the auditory nerve, through the brainstem, and eventually reaches the brain. Auditory processing, simply defined, is what happens along this pathway and what the brain does with the auditory signal from the ears. It has a number of different aspects, listed and enumerated differently by different authors. Below we list and define aspects of auditory processing that we have found to be relevant to the children with whom we work. Also listed are additional functions that are closely tied to auditory processing.

Aspects of Auditory Processing

The term auditory processing refers to how the brain perceives and interprets sound information. Several skills determine auditory processing ability—or listening success. The entire auditory process is composed of over a dozen different aspects, each of which impacts the ability of the brain to process the information around us. These can be grouped into four main stages of auditory process, which work together and are constantly running.

1. **Auditory awareness** - the ability to detect a sound as well as its source. i.e. being able to ‘tune in’ to auditory input. This is one of the first things our minds develop as infants.
2. **Auditory discrimination** - the ability to detect differences between sounds or words.
3. **Auditory identification** - the ability to attach meaning to sounds. As well as recognising differences between sounds, your brain must be able to figure out what the sound is.
4. **Auditory comprehension** - the ability to infer and retain information from sounds.

Within the four stages of auditory processing there are further skills which are critical in the development of receptive language (understanding what we hear) and expressive language (responding appropriately to what we hear). Both receptive and expressive language create the foundation for achieving social and academic success.

- **Sound localisation** - the ability to locate the sound source
- **Auditory synthesis** – the ability to smoothly combine all the sounds or syllables of words to make them a whole, or the ability to analyse a word into separate sounds. Very important for phonemic blending and segmenting activities.
- **Auditory memory** —ability to store and recall auditory information given orally. Auditory memory problems affect the ability to recall what is heard after a period of time and includes both short-term and long-term **memory**. Students with problems will struggle remembering directions, lists, or study materials. Auditory memory along with visual spatial memory comprise working memory, a component of executive function essential for learning.
- **Auditory sequential memory and processing**—how many pieces of information can be received, stored, recalled, and utilised. Related to auditory memory. Often tested in terms of digit spans.
- **Auditory tonal processing**—the correct processing of sounds or tones; related somewhat to auditory discrimination, but takes it a step further and has a significant impact on language processing.
- **Auditory sensitivity**—perception of sound loudness; hypo-sensitive individuals have a reduced response to sound in their environment, even when hearing is “normal.” Hypersensitive individuals over-respond to “normal” sounds, often perceiving typical environmental sounds as bothersome or too loud.
- **Auditory figure-ground processing**—ability to attend to and process an auditory stimulus in the presence of background sound.
- **Auditory association** -The ability to make connections and draw relationships from what is heard, and then to respond verbally in a meaningful way to these spoken words.
- **Language processing** —processing the meaning of verbal input. This is not true auditory processing. It is the next step after auditory processing occurs.
- **Temporal processing** —related to the “time” aspect of the auditory signal; rate of processing.



Additional Functions Related to Auditory Processing:

- Short-term memory
- Working memory
- Executive function/conceptual thought
- Language development

Factors Affecting Auditory Processing

- **Hearing**

After a number of studies which scientists claimed showed no correlation between ear infections and delayed language development, recent studies have finally confirmed what many have observed all along: the reduction in hearing that is associated with chronic ear fluid or middle ear infections affects how the auditory cortex (that is, the brain) develops.

Short-term hearing loss, such as from an ear infection, causes a “weakening” in how the brain learned to process sound. The analogy used was that it is ear-equivalent to a “lazy eye.”

- **Neurological organisation**

The organisation of the brain determines the efficiency with which the brain carries out its operations. As stated by the terminology, the brain is organised or disorganised by degrees. All infants begin life with very disorganised brains, which develop and become organised as a reflection of the input and specific stimulation that the brain receives.

The more appropriate and specific the input, the more efficiently the brain/child functions, and the better the neurological organisation. This organisation, or lack of such, affects all aspects of brain function, including the ability of the brain to process and interpret sound and language.

- **Developmental issues**

Developmental issues, such as Down Syndrome, brain injuries, and autism, to name just a few, impact the brain’s ability to receive and process input to differing and varying degrees. This in turn negatively impacts neurological organisation.

Any child who has not received the necessary stimulation and opportunities that permit the brain to organise appropriately will remain neurologically disorganised. This will affect function in some significant developmental areas and thus create developmental issues.

“Developmental issues”, as a category, includes problems such as learning disabilities, ADD, ADHD, and dyslexia. Developmental issues affecting the neurological organisation can adversely affect the ability of the brain to process and interpret sound and language. Fortunately, neuroplasticity is such that at any point in the child’s development appropriate intervention can reorganise and accelerate the development and organisation of the brain.

- **Sound sensitivity**

Both hypo-sensitivity and hyper-sensitivity to sound can have detrimental effects on the development of auditory processing skills. Children who have a decreased awareness of sound, have great difficulty “tuning in” and attending to language.

At the opposite extreme, many hyper-auditory children tune out in an effort to cope with being overwhelmed by too much auditory input. They also tend to avoid situations and interactions that they know could cause them difficulty.

Causes of APD

- Hereditary factors
- Birth-related factors
- Maturation delay
- History of chronic ear infections
- Auditory deprivation during critical early developmental periods
- Diseases, toxins and neurological conditions affecting the brain
- Aging
- Traumatic brain injury
- Blast injury
- Glue ear (otitis media) in infancy or early childhood



Presentation in the classroom: (It's important to understand that APD is an auditory issue and not a cognitive, speech, or language disorder.)

- Students with APD often have difficulty recognizing subtle differences between sounds in spoken words, even when the sounds are loud and clear enough to be heard. (coat/boat ch/sh) This can affect following directions, reading, spelling, and writing
- usually happens when there's background noise, like in a typical classroom. Noisy, low-structured classrooms can be very frustrating.
- In addition, loud or sudden noises can easily distract or bother students with APD
- APD may be confused with certain learning disabilities or attention deficit hyperactivity disorder (ADHD), though it is also possible to have APD as well as language impairments, learning disabilities, or ADHD
- When a child has difficulty remembering information such as directions, lists, or study materials. It can be immediate ("I can't remember it now") and/or delayed ("I can't remember it when I need it for later").
- **W**hen a child can't stay focused on listening long enough to complete a task or requirement, such as listening to a teacher in class.
- **W**hen higher-level listening tasks are difficult. Auditory cohesion skills — drawing inferences from conversations, understanding riddles, or comprehending verbal math problems — require heightened auditory processing and language levels. They develop best when all the other skills (levels 1 through 4 above) are intact.
- If auditory deficits aren't identified and managed, many students with APD will face academic challenges – they will 'tune out' and disengage.
- Your student may feel embarrassed to let you know he or she did not understand what you said or directions you gave.



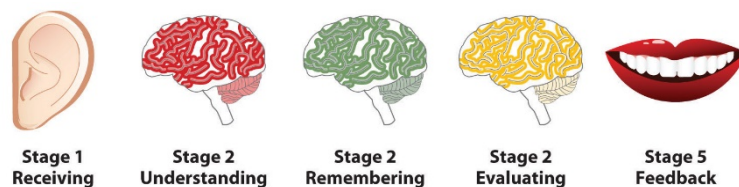
How Can Teachers Help?

Students with auditory processing problems will respond to changes in teaching and their environment in a variety of ways. Some students will appear to be helped by most suggestions; others will be very difficult to help, no matter what is tried. The best suggestion is to try these suggestions and carefully observe the student to see what works. Check in with your students.

- Speaking clearly, making sure students with APD write down the assignments, and helping them stay organised may ease their frustration and boost their self-esteem in the classroom.
- Reduce background noise, when possible – seat away from the source, headphones, close windows and doors,
- Preferential seating - in the front of the class, or near you - front left or right. Away from doorways, pencil sharpeners, computers and sources of noise.
- Stand next to the student when giving class instructions
- Encourage use of assistive devices in class, such as a personal FM system
- Let them take tests or work on assignments in an area away from distraction
- Avoid multi-step commands – use key words; repeat...say back to me...repeat
- Be distinct, clear, and precise in verbal presentation.
- Avoid extraneous gestures or excessive movement
- Review past key words and concepts before beginning a new session,
- Combine visual and auditory modes of learning
- Students with listening difficulties may fatigue more easily due to the external distractions of the classroom.
- Watch for signs of inattention, decreased concentration, or understanding. Instructions may need to be repeated, rephrased and/or simplified for the student. To check for understanding, ask the student to repeat instructions in his/her own words.
- Be supportive and encouraging when a student shows signs of a lack of confidence or diminished self-worth.
- A buddy system - pair with a student who is a strong auditory processor.

Classroom Adaptations

- Class lessons or instructions could be recorded so the student can replay the material again at a later time with headphones.
- The classroom may be sound treated to reduce background noise by adding drapes, carpets, or sound absorbing panels.



Listening

- **Active Listening** – Being curious about the information being received. Connecting it to your prior knowledge, forming your opinions about what is being said. Providing your input to the discussion.
- **Passive Listening** – You are present, listening to the information but may or may not be taking in what is being said.