APD DEFINED

Auditory Processing Disorder – also referred to as Central Auditory Processing disorder or Auditory Processing Difficulties

When I was a child I had a friend over for the night. ‘Doesn’t that sound annoy you?’ she asked as we got into bed. ‘What sound?’ I asked her back, puzzled. ‘The clock.’ We had a big pendulum clock on the wall and I had never noticed the ticking. Suddenly it seemed louder than ever and I couldn’t get to sleep for an hour.

Why did I only hear the sound of the clock when my friend brought it to my attention? There was nothing wrong with my ears, and the sound was no louder once I noticed it than when I was oblivious to it. I had been hearing the clock all my life but had never consciously registered it until that night.

People who have normal hearing actually hear far more than they perceive. Where hearing is a function of the ear, listening is a function of the brain. Auditory processing explains what happens between the ear and the brain and describes the way the brain assigns significance and meaning to the sounds in the environment. It follows that good listening cannot occur in the absence of effective auditory processing. Auditory processing involves a relatively high speed of information transfer. It also requires a good attention span, a well-functioning memory, and sensitivity to the many subtleties of sound.

We attach meaning to sound with reference to more than just the auditory signals. For example, if someone says, ‘Look at that tree,’ the other person must do a number of things. Firstly, they must understand that they are to give visual attention to something. Then they must associate the word ‘tree’ with knowledge, stored in the brain, of what a tree actually looks like. Lastly, auditory processing allows the person to recognise the tone of voice that the statement was said in (eg. angrily or excitedly) so they can apply appropriate meaning.

From the moment we are born our auditory system begins to refine itself to direct all its attention to the sounds most often used in our native language. This adaptive mechanism allows us to make sense of spoken sounds around us and ignore those that are probably irrelevant to our language. It also explains why learning a second language at a young age is so much easier than approaching it for the first time as a teenager or an adult.

Sound can be heard in two different ways, either through air-conduction or bone-conduction. Most people are aware that sound is transmitted through the ear canal but few people realise that sound waves are also constantly hitting the body and being interpreted by the brain. There is far more to effective listening than merely having perfect hearing.

When parts of this complex system break down or don’t operate efficiently, listening is compromised. This may manifest as an inability to discriminate between sources of sound, an inability to inhibit unimportant sound from consciousness, or insensitivity to subtle properties of sound such as pitch, volume, rhythm and stress. All these problems are symptoms of Auditory Processing Disorder.

It is important to know that auditory processing problems are a feature of many other disorders. Some of these include autism, dyslexia, learning disabilities, dyspraxia, Asperger’s syndrome, developmental and speech delay, and attention deficit disorder with or without hyperactivity (ADD or ADHD). It is not unusual for the aforementioned disorders to be treated for their behavioural symptoms and for the auditory processing difficulties to be ignored. Because the auditory system influences so many other areas of functioning however, it is an ideal focal point for intervention.

Auditory Processing Disorder (APD) describes the inability to process the meaning of sound. This condition is often present from early childhood, leading to a number of difficulties as the child becomes older and messages become complex and are given more quickly. APD is also known by the following names: central auditory processing disorder (CAPD), auditory perceptual processing dysfunction, auditory comprehension deficit, central deafness or word deafness.

Deafness, however, does not play a role in APD. An important distinction with this disorder is that hearing is rarely impaired – that is, the child is able to hear the sounds perfectly but cannot process the meaning of the sound. There is no relationship between intelligence and APD as the disorder reflects a problem with a specific auditory function rather than intellectual capacity. Another feature of the disorder is that it presents itself inconsistently. On some occasions a child may have no processing problems, but other days may struggle to decode the same message.

APD is a problem in the auditory decoding of language, which very often leads to the deterioration of behaviour as a result of poor expressive and receptive communication. As children experience the discouragement of being misunderstood and the frustration of misunderstanding others, they become more disconnected from their environment and the people around them.

Many other conditions in children are made worse by an accompanying auditory processing disorder. Children who have autism, attention deficit/hyperactivity disorder, dyslexia, language problems, aphasia or learning disabilities often have concurrent problems with auditory processing. Treatments designed to deal with APD have been shown to have positive implications for these children, supporting the idea that auditory processing is central to behaviour and learning.

The term ‘auditory overload’ is often used to describe what happens to people who have APD. Auditory overload is a sense of being overwhelmed and relates to features of the information being received. If information is highly specific, spoken quickly, lacking in contextual cues, described in unfamiliar language or presented in a noisy environment, it will be very difficult for someone with APD to comprehend the message or follow through with instructions

The indicators of Auditory Processing Disorder

Children with APD may display some or all of the following signs:

* Delayed language development
* Inability to listen effectively
* Trouble in sequencing the sounds of words
* Difficulty perceiving high frequency sounds: ‘t’, ‘f’ ‘s’, ‘k’, ‘p’, ‘th’, ‘sh’
* Confusion when faced with similar sounds: eg. ‘da’ and ‘ba’
* Poor comprehension in a noisy environment
* Easily distracted by irrelevant background sounds
* Poor speech comprehension, often asking ‘What?’
* Misunderstanding and poor memory for oral messages
* Inconsistent responses to the same auditory stimuli
* Inability to follow directions
* Difficulty in expressing desires, often blaming the other person for not understanding
* Poor phonemic awareness contributing to poor reading, spelling or comprehension

Auditory Processing Disorder can lead to frustrations or feelings of incompetence which sometimes results in social isolation and in severe cases, depression. Other times it presents as aggression, disruption of others and cynicism about learning.

The difference between hearing, listening and auditory processing

There is a necessary distinction to make between the passive act of hearing and the active intention of listening. It is easy to overlook how many sounds we do not listen to because our attention is directed elsewhere. One of the best examples of listening as opposed to hearing is what happens when we sleep. Sound is still being transmitted to the ear (hearing), but the brain is not attuned to receiving the messages unless a sudden noise being transmitted is interpreted as dangerous (listening), at which point we wake up.

The ability to listen effectively is dependent on having normal hearing in the first place. Good listeners are able to concentrate on a task for an extended period of time, can focus on the given message despite background noise and can process information almost as quickly as it is given. They can also store a significant amount of recent auditory information in their short-term memory. This is not a function of the ear but a reflection of the ear’s relationship with the brain.

The Victorian Department of Education, Employment and Training (DEET) defines auditory processing as the ability to ‘hold, sequence and process’ auditory information. Auditory processing is the system that transfers and decodes what we hear into what we understand. It is, in effect, the wiring between hearing and understanding. The ear and the brain communicate with each other, not unlike two people having a conversation on a mobile phone. If there is any kind of interference on the line, the reception of the given message will be compromised. The line may cut in and out, there may be a small time delay, or there may be a lot of background noise. Where one type of interference may cause distraction, another may cause frustration, misunderstanding or confusion.

This is precisely what happens with auditory processing. Depending on the type of processing dysfunction, different problems will emerge (see APD Type Description). Ideally, auditory processing should enable people to decode auditory signals as they are delivered, integrate auditory information with other environmental cues, organise this in a meaningful way, screen incoming auditory information to sort the relevant from the irrelevant, and lastly to associate sounds with written language.

It is impossible to isolate the components of this system or to consider that any sensory system only affects its specific domain. How we make use of auditory information is a complex and interdependent network of hearing, listening, and the brain’s processing of information to produce appropriate responses. Without this ability, relationships, learning and development are all challenged.

The physiology of Auditory Processing

The ear can hear many different sounds either through air-conduction or bone-conduction. These sounds must be accurately received by the ear, then be sent to relevant parts of the brain to be analysed and acted upon. The brain is a complex neurological system so APD will manifest itself differently from person to person depending on the area of auditory weakness.

In the case of language, spoken words are received as sound pressure waves. In the middle ear the sound pressure waves are converted to vibrations of the ear bones and transmitted through the bone to the inner ear. Here the vibrations are subsequently converted into electrical impulses, which are in turn sent to the brain cortex and the temporal lobe where the signals are interpreted as words. It is at this point that the meaning of the sounds is decoded [19]. Once the meaning is assigned, the brain can then move to the task of evaluating the information and forming response strategies.

It is vital that the ear correctly perceives sound so that the organs of the inner ear, the cochlea (the decoder of every sound we hear) and the vestibule (the centre for sensory integration and motor control), can convert the sound to electrical signals for the brain to receive. If this does not occur the other stages of processing will be affected.

The cochlea and vestibule comprise the inner ear and complement each other. Where the cochlea attends to short wavelengths characteristic of external sound, the vestibule attends to the long wavelengths produced by physical movements [62]. In the case of APD it is unusual to find a person with the condition who does not suffer from the shortcomings of both the vestibular and cochlear systems. That is, a person with APD most often does not only have trouble processing auditory information (cochlear system) but also has poor motor skills and balance (vestibular system).

For detailed information on the physiological process of hearing, refer to The[Physiology of Auditory Processing.](http://www.auditoryprocessing.com.au/websites/auditory_processing/code/physiology-of-apd/)

Causes of Auditory Processing Disorder

As yet it is unclear as to how APD comes about. It has been suggested that under-stimulation (or lack thereof) of the auditory system during the important early years of development may play a role [26], but APD is a fairly new area of research and the many factors suspected to be relevant have not yet been confirmed.

It is known that the disorder has a neurological basis, but how this comes about genetically or physiologically, in the womb or after birth, is yet to be understood. To date, three types of neurological problems that contribute to APD have been suggested. These are, from most to least prevalent:

* Neuro morphological disorder (irregularities in cells in the left hemisphere or auditory area of the brain)
* Delay in development of the central auditory nervous system
* Neurological diseases/disorders

Many children with APD have a family history of auditory difficulties or partial deafness [10]. In addition, there are some developmental issues that have been shown to have a relationship to APD. These include a complicated birth, childhood ear infections or colds, glue ear, allergies, or a slow speech development [25]. Some children have early experiences with sound that involve either a lack of auditory stimulation or a noisy environment. These children may have learnt to be discouraged by listening while others block out aggressive sound if they are hypersensitive to certain frequencies. Clearly not all children who fall into the categories mentioned develop APD but many children with the disorder have experienced at least one of these issues.

Different types of Auditory Processing Disorder

Auditory Processing Disorder can manifest in a number of ways. Children may experience:

* Associative deficit – difficulty associating sounds with written language
* Auditory decoding deficit – problems recognising sounds and therefore decoding words or messages
* Auditory integration deficit – trouble combining auditory cues with other sensory cues that contribute to a message (eg. seeing a written word and knowing what it would sound like when spoken)
* Organisational deficit – difficulty in organising auditory information to effectively decode the meaning of a given message, often as a result of one of the above three problems
* Prosodic deficit – speaking in a monotone, without rhythm or intonation, and not perceiving these subtleties in other speakers
* Auditory hypersensitivity – background sounds cannot be ignored

How do children cope with Auditory Processing Disorder?

Auditory Processing Disorder Children who have APD often use short-term strategies to cope with the disorder. The problem with this is that it may be practical one day in a particular setting, but may not work when applied another day in a different place. Many children also learn to depend on their strengths and attempt to decode messages from other environmental cues – for example, what people around them are doing, or whether the teacher is holding up an example of the work to be done.

While it is essential for children to develop compensatory strategies and take note of other sensory cues, it is also vital that they are given the opportunity to refine their auditory processing. It should be ensured that their dependence on other methods of decoding does not result in further loss of auditory ability.

APD Treatment programs

Auditory Processing Difficulties are frequently treated with a range of one-on-one interventions such as speech therapy or phonemic awareness. APD can also be treated through Auditory Training.

Auditory Training is different to music therapy. Music therapy relies on the psychological role of music in aiding relaxation, energy or concentration. In terms of its effect on the ear, music therapy is like a massage, whereas auditory training can be thought of as physiotherapy. Auditory training involves exposing the ear to carefully monitored sound to strengthen neurological pathways and train the ear to listen more accurately. This has a direct and strengthening effect on the muscles in the middle ear and the central nervous system.