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Why does my child have problems at school?

A familiar presentation in a children's audiology clinic, is a concerned parent with a school-aged child. The parent expresses concern about the child's hearing and goes on to give a clear description, with anecdotal examples, of the child not hearing well in everyday listening conditions. However, when the audiologist does a full, audiological assessment, the audiogram shows normal hearing thresholds. The tympanometry results are within the normal range. Even speech discrimination testing in quiet gives normal results. The parent waits for the audiologist to describe a hearing loss, but the audiologist reports that the results demonstrate "normal hearing". The parent may initially be relieved, but is then confused as these results are not compatible with the parent's observations of the child's listening behaviour in everyday situations. There is a mutual feeling of dissatisfaction and discrepancy.

The parent re-iterates the same concerns and the observation that the child is not fulfilling his or her potential in school.

All too commonly the assessment ends here. The astute audiologist may go on to describe a condition in which children have difficulty in listening to and understanding speech in high levels of background noise or poor acoustics. The concept is introduced of an auditory processing difficulty, in which an individual has difficulty understanding speech despite having normal hearing thresholds. Many experts agree that testing should begin with a complete peripheral hearing evaluation and then proceed to a CAP assessment when results fail to explain the reported difficulty.

Why special materials are needed

If the audiologist re-assesses speech discrimination ability in wideband or speech-shaped noise, the likelihood is that the child will still demonstrate reasonable speech discrimination performance.

To demonstrate a deficit in speech understanding, sensitised test materials are required. Tests may be made up of words that have been filtered to reduce high frequency information, or that are presented in speech-babble, or as a dichotic listening task where different words are presented to each ear simultaneously. There are also timing assessment tasks based on detecting gaps in non-speech signals. All or any of these tasks may be used to verify deficits in auditory processing that can underlie the described difficulties in speech understanding. However, at present there is little consensus on the criteria that should be used to diagnose an auditory processing deficit or delay. There is a range of opinions among hearing scientists on whether deficits in auditory processing can be scientifically verified.

Influences on the interpretation of test outcomes

Language delay

Most tests of auditory processing use speech materials which therefore require some language processing and consistent application of attention, in addition to auditory processing of the test material. The use of tests of auditory processing will define a profile of auditory skills underlying speech recognition. If tests were available that used simple stimuli like pure tones and bands of noise, these would give evidence of auditory processing deficits without language and cognition effects. However at present, such tests do not have high sensitivity for the condition being assessed. Consequently, testing with speech material often does not clarify whether poor performance is due to an auditory processing deficit or is a secondary effect of perhaps a language difficulty. If there is an auditory processing disorder, did it cause a language delay, or does the language impairment underlie the poor performance in the listening task? Many children present with complex profiles of language, learning, and attention problems, but it is not easy to pinpoint which of these factors may be the primary deficit.

Maturational effects on auditory processing performance

As listening skills mature over the school years, up to and including puberty, the normative data must allow for an individual's performance to be compared to that of age-matched peers. By repeated testing it may become clear whether listening skills are delayed (and catching up over time) or disordered. However, it is very important that all other variables in testing are kept the same, such as the level of presentation and the test environment. Many of these factors are not fully defined.

Auditory symptoms in the case history

Tinnitus: The case history can give clues of secondary auditory processing symptoms. These would include tinnitus and poor tolerance for specific sounds that most people find acceptable (hyperacusis). The clearest way to ask a child about tinnitus is to ask "When it is all quiet, do your ears ever make noises?" A child who has always had tinnitus will not be aware that everyone else doesn't have it too, and is therefore not likely to complain about it. They may refer to it as "bees buzzing" or "the cat purring", which may not have been recognised as indicative of tinnitus. Most children with tinnitus do not find it bothersome, particularly if they have been aware of it from early life; but tinnitus may be an important indication of increased excitation, or reduced inhibition, somewhere in the auditory pathway.

Hyperacusis: A child may show auditory over-sensitivity, or hyperacusis, on exposure to specific sounds, by covering his ears, or becoming tearful and clingy, or possibly aggressive. It is important to be aware that while certain sounds such as banging or shouting may be tolerated at high levels without causing tolerance problems, this does not detract from the aversion seen with other sounds, perhaps the washing machine, or vacuum cleaner. More subtle symptoms of hyperacusis may be demonstrated by a child who plays well with another child, but who avoids groups of children, particularly in large, reverberant rooms. Careful questioning may highlight that a child hates school assembly, because of the acoustics, and the possibility of applause occurring and causing them extreme discomfort.

Sensory processing problems: Another symptom, which may be indicative of unusual sensory processing, is behaviour showing enhanced discrimination of other sensory modalities, including vision, taste or smell. One common association of auditory processing disorders is seen in children with reading difficulties. Indeed research has shown that children with dyslexia have a higher rate of auditory processing disorders than control children. One cause of reading disorders is the strong contrast of black print on a white page for children with enhanced visual sensitivity. Enhanced auditory sensitivity occurs with enhanced visual sensitivity for some people. The interaction effects of two sensory modalities may be predicted to impact on many aspects of complex signal processing, stemming from an increased excitation at higher central processing levels. Sensory integration difficulties have been reported as an associated disorder. A child with sensory integration problems experiences sensory overload when exposed to multiple sources of information, perhaps when music and visual information are combined. They may have difficulty doing two different actions at the same time. These profiles may not have a specific auditory processing component, but still reflect difficulty in the integration of spoken information in the classroom.

This may be an important profile to consider in excluding specific auditory-based difficulties. However, an intervention based on a sensory integration approach could be more appropriate for such a child.

Although the report of tinnitus, hyperacusis or other sensory modality enhancement does not confirm an auditory processing disorder, it does give secondary evidence of abnormality in sensory processing which may help support the case for an auditory processing component.

Another important factor from the case-history is the number of episodes of conductive hearing loss. Research has shown that children who have had frequent episodes of otitis media with effusion are more likely to have delayed auditory processing skills. Though these children may well catch up, as long as the hearing remains good, children who have had frequent episodes of conductive hearing loss may continue to have higher susceptibility to middle ear effusion and poorer hearing thresholds (albeit in the "normal hearing" range). This factor would support the recognition of poorly developing listening skills arising from auditory factors. (Of course, it would also increase the likelihood of speech and language delay.)

Diagnosis

There are many profiles of auditory behaviours demonstrated by children showing listening difficulties in the classroom. It is very hard to separate out the effects of any number of co-existing factors like mild or fluctuating hearing loss, poor attention, and difficulty using visual information to supplement hearing or delayed language development. If difficulties with speech understanding are perceived to be impacting on academic progress in school, it is likely that additional resources may be requested to improve the reception of speech information for the child. The first requirement is likely to be verification of an auditory component in the child's speech processing ability (McFarland and Cacace, 1995).

The impact of several potential factors in the causation of listening difficulties is likely to delay the process of assessment. Some auditory processing disorder (APD) assessments have strict exclusion criteria, for example the audiogram thresholds must be normal or the child shouldn't have a diagnosis of a speech and language disorder. While these are important considerations for verifying that the deficit is in auditory processing, rather than language, attention or cognition, they do not facilitate rapid intervention for the child. There is a clear need for the development of assessments with high sensitivity and specificity for auditory processing abilities, which is likely to evolve from research over the next few years.

The risk of giving a diagnosis of "auditory processing disorder" (APD) on the basis of a single test or auditory-based test battery, is that another aspect of delay in the child's development may be overlooked.

The other possibility arising from the inappropriate labelling of a child as APD is that expectations for the child's progress are lowered and the child is not given the opportunity to fulfill his or her true potential. Both of these outcomes have occurred and reflect the importance of developing tests with good sensitivity and specificity for the range of deficits currently encompassed by the term "auditory processing disorder".

Intervention

But meanwhile the child is still in the classroom, struggling to access and retain spoken information and failing in terms of academic progress and self-esteem. Where there are generalized attention deficits, these will compound listening difficulties shown by the child, regardless of whether the two factors co-occur or one is a consequence of the other. The assessment and diagnosis of APD is in its infancy, but there are children who can benefit from acoustic support for listening difficulties arising from many factors.

One way of improving the access to speech that a child has, is to reduce the sources of noise in the listening environment, thereby increasing the level of the signal to be heard (usually speech) over the noise (other sources of acoustic information). The aim is therefore to improve the signal-to-noise ratio. It is often possible to do this at home, by switching off a radio or television. However, in the classroom this is more challenging due to range of extraneous noise sources and the constraints on placement for each individual child.

If the child is at a distance from the teacher, the level of the teacher's speech will be quieter. Many children with listening problems benefit from being moved closer to the teacher. It is important to be aware of other sound sources, such as traffic noise, computer fans or playground noise and to seat the child away from distracting noise sources. The child should also have a good view of the teacher and any visual support materials, like the black board or large print books.

If a classroom is very echoey, or has a high ceiling and few soft furnishings, speech information can be degraded by the sound reflections in the room, giving rise to poor listening areas. The use of designated "quiet areas", with carpets and curtains to reduce reverberation, can help children hear more easily.

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The poor acoustic listening conditions typically found in classrooms have been well documented (Nabelek and Nabelek, 1994). One way of reducing the degrading effects of reverberation, distance and background noise is through the use of a sound field system. This technology allows speech to be picked up by a microphone worn by the teacher and transmitted through radio waves to one or two speakers situated at the back of the classroom. The aim is not to increase the amplification of the speech greatly, but to allow the teacher's voice level to be raised above the background noise.

Technological solution

Could this technology prove useful to children who have difficulties in listening in poor acoustic conditions? (Crandell, Smaldino and Flexer, 1995). Teachers in mainstream classrooms who have free-field FM systems are in no doubt of the benefit both to themselves and to the children in their care. However not all classrooms are suitable for sound-field FM systems. Schools with open-plan structures have too much potential for noise transfer between classrooms to benefit from free-field amplification. Such open-plan structured classrooms cause extremely difficult acoustics for children with listening difficulties. A personal FM system can prove helpful (Lewis, 1995).

Personal FM systems can be body-worn or ear-level BTE systems. Body-worn systems are perceived as being more stigmatic and having some practical issues. An ear-level BTE system can address these issues and decreases the effects of distance from the teacher, background noise and reverberation resulting in improved reception of the speech signal. The BTE receiver picks up the wireless transmission from the teacher's voice without having to give additional amplification of the signal. For children with mild or fluctuating hearing thresholds a small increase in amplification may also be given.

Prior to the use of any listening support strategy it is useful to get a baseline of a child's individual performance on a range of different metrics, relevant to the deficits that the child is showing. In order to assess the benefit of a listening support device, the child needs to be encouraged to participate in spoken language activities, appropriate to his/her ability. A brief listening game at

the start of the day can check the effective function of the device. As with any additional support provision it is crucial to evaluate changes in the child's progress on a systematic schedule. It is not enough to assume that a strategy is working, but to continue to monitor effects on the child's listening ability in their own educational setting. This will be very individual for each child, but can be helped through the completion of a listening questionnaire by an independent observer. Changes in reading and spelling progress, episodes of spontaneous participation by the child or incorrect listening responses may be helpful.

There are many other ways of supporting a child with listening difficulties, depending on the different features shown in the individual's own profile of behaviours. A policy of treating the individual symptoms is appropriate. Support in speech and language development is very important. Advice on management of attention deficits would be appropriate for many. Children showing enhanced sensory stimulation over one or more sensory modalities should be considered for programs of desensitization. There are programs available which aim to improve speech discrimination skills through a hierarchy of listening tasks. The option of learning a musical instrument may help supplement listening skills and self-confidence.

An almost universal presentation for children with listening difficulties, is that they have a poor self-image. They need to find an activity that they can do for enjoyment and satisfaction, without being constrained by their auditory performance.

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