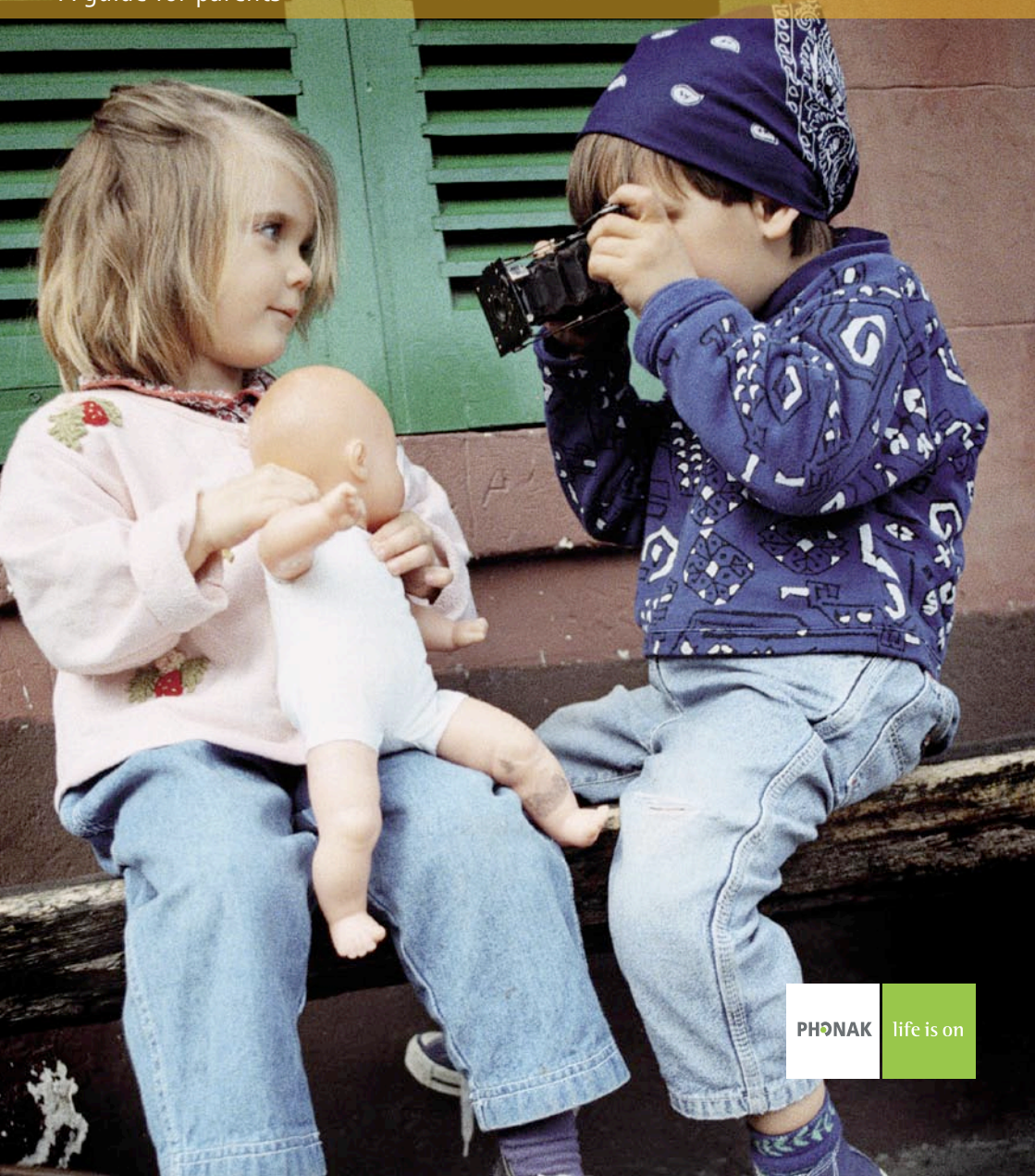


Children's hearing

A guide for parents



Content

Introduction	3
Communication milestones	4
Signs of hearing difficulties	6
How we hear	8
Children's hearing	10
Hearing loss indicators	12
What to do if you think your child has a hearing loss	14
Types of audiological evaluations	15
Technological solutions	16
Where to get help	18



Introduction

Building the future

Children are our future. By giving them access to the wealth of sounds that enrich today's world, we can help them to develop the auditory skills they need to build their future.

Phonak has been committed to providing high-tech solutions for children with hearing loss for over 35 years. Innovative technology has enabled us to successfully meet growing needs. Many of the developments in the field of pediatrics have led the way for the progress of Phonak hearing systems in general. The trail of innovation continues and it remains a priority at Phonak to help prepare today's children for tomorrow, at the same time giving practical support to their parents.

Hearing is one of a child's most precious senses. Through hearing, children develop language and communication skills, marvel at the sounds of our bustling world, learn to read, appreciate music and be warned of approaching danger.

Hearing loss does not put an end to all this if amplification is provided early. Often, by acting early and selecting the right technological solutions, such sounds, including speech can be learned. The outlook for children with hearing impairment is now bright with a full range of options. The information in this booklet is designed to help you understand:

- Children's hearing
- Speech and language development
- How to monitor hearing throughout childhood
- Types of hearing loss
- How to protect your child's hearing and prevent hearing loss

Communication milestones

The cochlea which is the sensory organ of hearing, attains full adult size and enables the child to hear by the 20th week of pregnancy. This means that children can be exposed to the sound of their mothers and other voices even before they are born.

After birth, a newborn child's cochlear sensitivity is similar to that of adults, but babies must learn how to use their hearing to form the foundations of communication.

Localization

One of the earliest and easiest auditory skills to observe in your baby is localization, the ability to pinpoint the source of a sound. Because we hear through two ears (binaurally), we can localize sounds with extreme accuracy.

Observing your child's localization ability

In general, newborns will move or widen their eyes when they hear a loud sound. This is known as the startle reflex and many loud sounds should induce this reflex. When your infant gets to about five or six months, you can better observe a true localization response by making soft sounds

behind or to the side of your infant while he or she is looking straight ahead (be sure you are out of view when making the sounds). A soft rattle shake or a whisper should prompt your baby to turn his or her head toward the sound.

While we expect infants to startle when presented with very loud sounds, it is most important to see how well your baby responds to soft sounds (such as the speech sound "s").

During the first year, your baby will refine listening skills and should alert to and look for the sources of common sounds around the home, such as a ringing doorbell or telephone, slamming door, children playing, a musical toy and speech.



Your child's speech and language development

Age developmental milestones:

9 months

Demonstrate an understanding of simple words "mommy," "daddy," "no," "bye-bye."

10 months

Babbling should sound "speech like," with single syllables strung together ("da-da-dada"). The first recognizable words emerge at about this time.

1 year

One or more real words spoken.



18 months

Understand simple phrases, retrieve familiar objects on command (without gestures) and point to body parts. Also should have a spoken vocabulary between 20 and 50 words and use short phrases ("no more," "go out," "mommy up").

24 months

Spoken vocabulary should be at least 150 words, coupled with the emergence of simple two word sentences. Most speech should be understandable to adults who are not with the child daily. Toddlers also should be able to sit and listen to read-aloud picture books.

3 to 5 years

Spoken language should be used constantly to express wants, reflect emotions, convey information and ask questions. A pre-schooler should understand nearly all that is said. Vocabulary grows from 1000 to 2000 words, which are linked in complex and meaningful sentences. All speech sounds should be clear and understandable by the end of the preschool period.

These milestones are rough "rules of thumb" for the majority of children. If your child is more than 2-3 months delayed compared to the above-mentioned age-groups, it might indicate hearing loss or delayed speech-language development.

Signs of hearing difficulties

You should always be aware when your child does not respond appropriately to sounds. Sometimes a lack of response is attributed to inattention, but it is important to determine if inconsistent or no responses actually stem from an inability to hear.

Common signs that children may not be hearing normally

- Not aware someone who is out-of-view is talking, especially when distractions are minimal
- Startled or surprised look when they realize their name has been called (at a normal or even fairly loud level)
- Using "what?" or "huh?" frequently
- Intently watching the faces of speakers
- Sitting close to the television set when the volume is sufficient for other family members
- Increasing the volume of the TV or stereo to unreasonably loud levels
- Not responding to voices over the telephone and/or switching ears continually
- Not reacting to intense, loud sounds

The single most important sign of possible hearing loss, however, is a lack or delayed development of speech and language.





How we hear

Understanding the basic anatomy and function of the ear will help you identify conditions that can affect your child's hearing.

The ear can be divided into three parts: the outer, middle and inner ear.

The outer ear

The outer ear consists of the auricle, also called the pinna. The pinna collects and channels sound into the external ear canal (auditory canal). The ear canal amplifies the sound waves and further funnels them toward the eardrum (tympanic membrane).

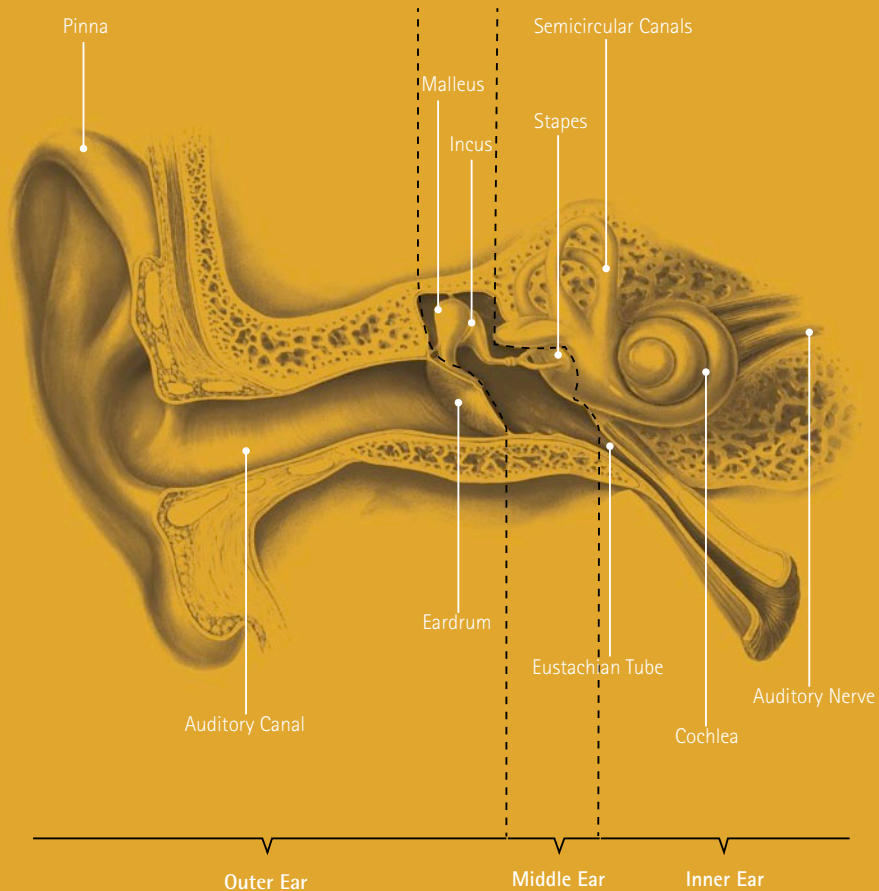
The middle ear

The eardrum vibrates in response to the movements of sound waves entering the ear canal. There are also three small bones (ossicles) in the middle ear. These bones, the malleus (hammer), the incus (anvil) and the stapes (stirrup), vibrate, magnifying the movements of the eardrum and transmitting the motions to the inner ear.

The inner ear

The cochlea is the actual sensory organ of hearing and is located in the inner ear. The chambers of the cochlea are filled with fluid. As the bones in the middle ear move in response to sound waves, they cause the fluid in the cochlea to also move. This stimulates thousands of sensory hair cells which produce small electrical charges. These electrical signals travel along the auditory nerve to the brain where they are processed as the "sounds" we hear.

Parts of the ear



Children's hearing

There are conditions which may occur before birth, during infancy or in childhood that may affect a child's ability to hear normally. Essentially, there are two types of hearing loss: conductive and sensorineural.

Conductive hearing loss (medically treatable conditions)

With a conductive hearing loss, the inner ear functions normally, but something affects the outer or middle ear, hindering sound from reaching the inner ear. Conductive hearing losses are mild-to-moderate in degree and are usually temporary and treatable.

You can simulate a conductive hearing loss by plugging your ears with your fingers. Sounds from the outside are softer while your own voice actually sounds louder than normal. The following are some common causes of conductive hearing loss.

Earwax (cerumen)

When wax becomes impacted in the ear canal, it acts as an ear plug, blocking sound waves from striking the eardrum. Excessive wax may be softened with wax-softening drops and flushed out or removed by a physician or other trained personnel. Q-tips should never be used to remove impacted wax because they may push the wax deeper into the canal or puncture the eardrum if inserted too deeply.

Foreign objects

Small objects put in the ears, such as beads or food, can block sound or rupture an eardrum.

Swimmer's ear

This painful bacterial infection can cause the ear canal to swell shut, resulting in a temporary hearing loss, this occurs when the ear canal remains wet after bathing or swimming.

Otitis media (middle ear infection)

This is the most common cause of conductive hearing loss in children. Otitis media is a general term used to describe a variety of conditions affecting the middle ear. More than 85% of all children will have at least one ear infection in childhood. In fact, ear infections are second only to well-baby checks as the reason for visits to a physician.

There are various forms and causes of otitis media. The single most frequent factor is infected adenoids which harbor bacteria or obstruct the Eustachian tube that connects the middle ear with the back of the nose (nasopharynx).

Ear infections also may result from upper respiratory infections or exposure to cigarette smoke. The two most common types of otitis media are acute otitis media and otitis media with effusion.



Acute otitis media (AOM) – ear pain, fever, restlessness and some hearing loss are common symptoms of acute otitis media (suppurative otitis media). This type of ear infection may heal by itself or respond to antibiotics.

In some cases, acute otitis media may cause the ear drum to rupture, causing fluid drainage from the ear. If left untreated, it could lead to more severe middle or inner ear conditions.

Otitis media with effusion (OME) – frequently follows an episode of acute otitis media. OME occurs when fluid remains in the middle ear, impeding ear drum vibrations and middle ear bone movement. This can cause mild-to-moderate degrees of hearing loss. In very young children, this hearing loss may hinder spoken language development.

The treatment of otitis media with effusion is controversial. Sometimes the infection heals on its own or with the help of antibiotics or myringotomy to drain the fluid, and other times it resists these conventional approaches. If the infection persists and hearing loss is present, ventilation or pressure equalizing (PE) tympanostomy tubes may be inserted to drain the fluid. This can prevent the pressure build-up which can cause further ear infections.

Tubes can restore normal hearing, prevent persistent fluid build-up, reduce the frequency of ear infections and prevent other serious ear complications.

Sensorineural hearing loss (treatable with modern technology)

Sensorineural hearing loss is caused by dysfunction of the cochlea (sensory) or auditory pathways to the brain (neural) and often is present from birth (congenital). It can also develop as a result of noise exposure, age or exposure to ototoxic medication. Sensorineural hearing losses can range from mild to profound and may affect all or only certain frequency ranges. For example, high-pitched sounds may not be detected while low-pitched sounds are heard normally.

Sensorineural hearing loss is permanent and cannot be treated with medicines or surgery. In most cases people with this type of hearing loss can be helped by hearing instruments or in some cases by cochlear implants.

Hearing loss indicators

Outlined below are factors indicating that a child is at risk for a hearing loss. If you are unsure about any of these conditions or are worried about your child's hearing, consult a medical practitioner or audiologist.

Newborns – birth to 28 days

- Failure of newborn hearing screening
- Family history of hereditary childhood sensorineural hearing loss
- In utero infection, such as cytomegalovirus, rubella, syphilis, herpes and toxoplasmosis
- Craniofacial deformities including those affecting the pinna and ear canal
- Birth weight less than 1500 grams (approx. 3,5 pounds)
- Hyperbilirubinemia at a serum level requiring transfusion (jaundice)
- Ototoxic medications (medicines that can damage hearing), including aminoglycosides (some antibiotics e.g. Gentamicin) used in multiple courses or in combination with loop diuretics
- Bacterial meningitis
- Apgar (general health) scores of 0–4 at 1 minute or 0–6 at 5 minutes after birth
- Mechanical ventilation lasting 5 days or longer
- Findings associated with syndromes known to include sensorineural hearing loss

Infants – 29 days to 2 years

- Concern regarding communication or developmental delay
- Bacterial meningitis or other infections known to cause sensorineural hearing loss
- Head trauma associated with loss of consciousness or skull fracture
- Ototoxic medications including chemotherapeutic agents or aminoglycosides used in combination with loop diuretics
- Findings associated with a syndrome known to include sensorineural hearing loss
- Otitis media with effusion (fluid) for three months or longer

Noise exposure

One of the most common, and yet completely preventable, causes of permanent sensorineural hearing loss is noise exposure. High levels of noise can cause temporary or permanent damage to the sensory hair cells within the cochlea. Vehicles, appliances and stereos, all produce noise which may be detrimental to hearing, depending on how loud the noise source is and the length of exposure. In addition, some toys or computer games and certainly rock music concerts can be loud enough to damage hearing.

Children should be taught the dangers of noise exposure and instructed to use ear protection when necessary.

Mixed hearing loss

Sometimes a combination of factors occur which affect both the outer or middle ear and the inner ear (cochlea), resulting in a mixed hearing loss.



What to do if you think your child may have a hearing loss

If you think a hearing loss may be present the first step is to ask your medical practitioner to refer your child for an audiological assessment. This assessment will determine whether a hearing impairment exists and to what degree. No child is too young to receive a thorough hearing evaluation. Today's technology even allows newborns to be tested for hearing loss.

While simple hearing screenings may be conducted by nurses or trained volunteers, a complete assessment of hearing in a child should only be completed by an audiologist.

The purpose of the audiological evaluation is to determine if a hearing loss exists, to what degree, and to help discover what type. Test results are recorded on an audiogram. If the results of the tests show that your child has a hearing loss, remember that your child is living in an age where technology ensures that children with impaired hearing can grow up to lead full and successful lives.



Types of audiological evaluations

Behavioral hearing tests

These tests usually require the child to respond to soft sounds in some way (verbally, by picture pointing, raising the hand or through a game). These tests can be fun and for infants and toddlers, a head-turn response to a test signal is usually the best and most reliable testing method.

Auditory brainstem response (ABR)

For newborns or infants and children who cannot reliably perform the behavioral test procedures, other more objective tests, such as ABR, can help determine hearing abilities. Clicks or tonal "pips" are sounded in an infant's ears through earphones. The ABR provides information about the function of the auditory pathway to the level of the brainstem. The response to the clicks or tones are recorded, providing an estimate of hearing sensitivity.

Otoacoustic emissions (OAEs)

These tests provide a unique way to examine the function of the cochlea. Sounds are sent to the child's ear with a small loudspeaker. A microphone records the response to the sound from the cochlea (known as an emission). This offers valuable information about the sensory hair cells in the cochlea.

Tympanometry (acoustic immittance testing)

This test helps determine how well the eardrum and middle ear are working. A gentle puff of air is delivered into the child's ear and the amount the eardrum moves in response to change in air pressure is recorded. If the eardrum does not move, for example, it could mean there is fluid behind the eardrum and otitis media with effusion may be present. If there is negative pressure it could mean that the child is at-risk for developing an ear infection.

Technological solutions

Today there is virtually no hearing loss that cannot benefit from the use of appropriate technology. After a clear diagnosis of hearing impairment appropriate technology should be chosen as soon as possible to ensure that your child can benefit early from auditory experience. This technology may take the form of a cochlear implant with an electrode which is surgically implanted in the inner ear and an external processor. This option is increasingly utilized in cases of severe to profound hearing loss. In many cases however, the most appropriate choice may be hearing instruments. These amplify sound and can help children of any age.

The right choice of hearing instrument can help your child develop good communication skills. A young child is usually fit with behind-the-ear (BTE) style hearing instruments. These hearing instruments come in a variety of bright, cheerful colors and can help a wide range of hearing losses – mild, moderate and profound. Older children may be candidates for the in-the-ear (ITE) style hearing instruments which are custom-made to fit inside the ear and help with mild-to-severe hearing losses.

Another option for older children's are external receiver style hearing instruments. The microphone remains in the BTE casing but the receiver is externally placed in the ear canal. This allows the hearing instrument to be smaller and more cosmetically appealing.

The decision whether the child should be fit with one or two hearing instruments depends mainly on the configuration of the hearing loss.

A wide range of hearing instrument accessories are available to help children communicate better over the phone, when listening to music and TV, with Bluetooth devices or even just check the status or adjust features.



Where to get help

While this booklet offers some general guidelines for monitoring your child's hearing and communication development, you may need further information or have questions about how to access resources regarding hearing in children.

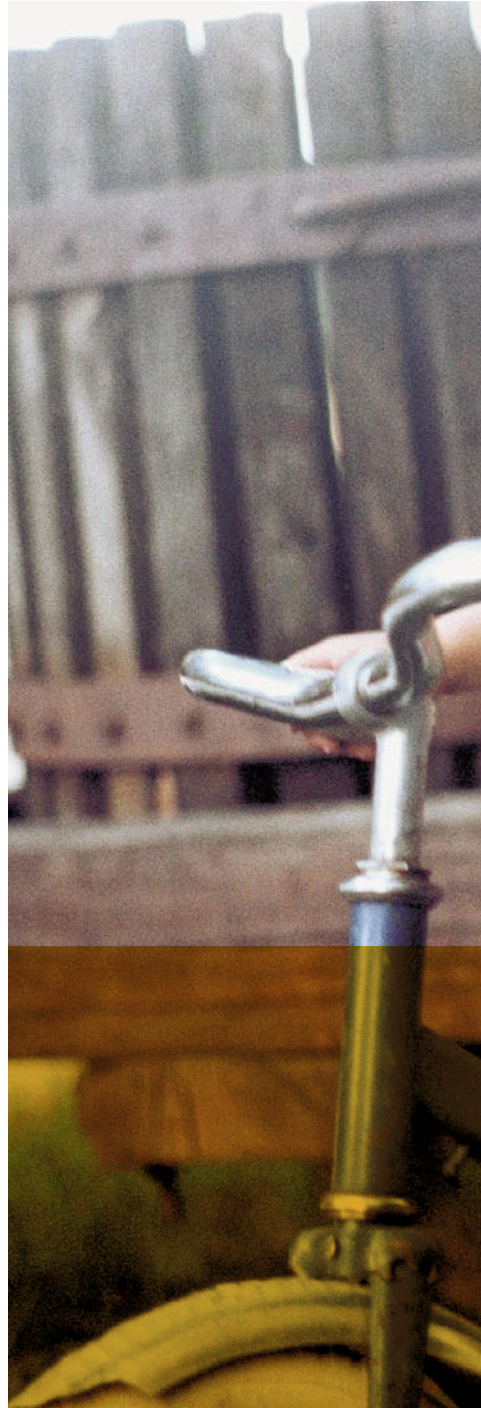
In many countries federal and state laws exist that mandate services for children who have hearing impairments.

Hearing is not an all or nothing phenomenon. Even a mild hearing loss during the crucial years for language and speech development can cause a child to misperceive speech sounds and may result in a delay of normal communication development.

Your child's hearing is the means through which spoken communication develops and flourishes.

Give hearing the attention it deserves and seek professional help immediately if you are concerned.

For further information about children's hearing visit our website at: www.phonak.com







Life is on

We are sensitive to the needs of everyone who depends on our knowledge, ideas and care. And by creatively challenging the limits of technology, we develop innovations that help people hear, understand and experience more of life's rich soundscapes.

**Interact freely. Communicate with confidence.
Live without limit. Life is on.**

www.phonak.com

