



# Texas School for the Blind & Visually Impaired

## Outreach Programs

[www.tsbvi.edu](http://www.tsbvi.edu) | 512-454-8631 | 1100 W. 45<sup>th</sup> St. | Austin, TX 78756

## **Are You Listening? Auditory Issues for Children with Visual Impairments**

by Kate Moss Hurst, Deafblind Consultant

based on material presented by Jim Durkel, Former Audiologist and  
Education Specialist for Deaf-Blind Outreach

### **HOW DO WE HEAR?**

In a normal ear, sound waves are collected by the outer ear which is made up of the pinna and ear canal. The sound wave is resonated and focused as it travels down the ear canal to the tympanic membrane (ear drum). When it strikes the ear drum the vibration produced causes the tiny bone chain in the middle ear (ossicles) to move in a pumping or rocking motion. The ossicles are attached to the window of the inner ear. The hearing mechanism of the inner ear is made up of the cochlea (sensory) and the VIIIth cranial nerve (neural). The inner ear also houses the vestibular mechanism responsible for maintaining balance.

The movement of the ossicles sets off motion in the fluid that fills the cochlea. Within the cochlea exists the organ of Corti which is lined with approximately 15,000 hair cells. These hair cells resonate at certain frequencies and convert the sound wave motion into electrical impulses.

These impulses trigger nerve impulses in the auditory nerve which in turn sends impulses to the auditory centers of the brainstem and brain. There the auditory information is processed by the brain so that we understand and respond to the sound source. (Flexer, 1994)

### **CAUSES OF HEARING LOSS**

Damage may occur at any point along the hearing mechanism and result in hearing loss. In humans there are two systems that work together to allow us to receive and process auditory signals. The outer ear, the middle ear and the inner ear make up the peripheral auditory system while the brainstem and the cerebral cortex make up the central auditory system. If there is a problem in the area of the outer ear or the middle ear it is called a conductive hearing loss. We all have experienced this type of loss when we have a bad headcold or water in our ears. If there is a problem in the inner ear, it is called a sensorineural hearing loss. This is the type of loss most typically thought of as deafness. When there is a problem which occurs at the brainstem or the cerebral cortex we consider these as auditory processing problems.

Conductive losses occur when:

- impaired movement of the bones of the middle ear (ossicles) because the bones are damaged or missing or cannot move efficiently due to fluid or infection,
- the absence of the outer ear,
- unusually small ear canal,
- obstructions in the ear canal such as wax build-up or small objects (beans, rocks, etc.),
- and damage to the tympanic membrane.

Sensorineural losses occur when:

- there is damage to the cochlea due to noise exposure, disease, or trauma, or hereditary condition;
- there is damage to the auditory nerve, because of trauma, disease, or hereditary condition.
- In auditory processing disorders, even though information seems to be reaching the brain, the individual is unable to process that information correctly. Often individuals with this type of disorder have language problems and may function as if they have some type of hearing loss.

Auditory processing disorders occur when:

- there is damage to the brainstem or cerebral cortex due to trauma or disease;
- there is underdevelopment of neural pathways.

Additionally, individuals may have combination losses which include a conductive component, a sensorineural component, and/or auditory processing component. When any part of the auditory system fails to function properly the auditory signal (words, environmental sounds, etc.) is not processed correctly and the person experiences hearing loss.

## CHARACTERISTICS OF SOUND

What do we need to know about sound to help us understand how our hearing mechanism processes it? First of all, the signal or sound has physical characteristics which can be measured: intensity (loudness) measured in decibels (dB) and frequency (pitch) measured in hertz (Hz). This holds true for any sound whether it is a sound produced by the human voice or environmental sounds.

The second thing we need to know is that these physical characteristics combine in spoken language to create what is known as segmentals (letter sounds like k, t, æ, f, th, etc.) and suprasegmentals (loudness, pitch, rhythm).

## COMPONENTS OF UNDERSTANDING THE SPOKEN WORD

### Segmental and Suprasegmental Elements

All of this linguistic (language) information is important in helping us to understand speech. We must be able to distinguish specific vowel and consonant sounds. It is important to understand the segmental aspects of speech so that we can distinguish "cat" and "bat" or "cat" and "calf" or "want" and "wanted".

We rely on information provided by the segmental elements, but we also respond to the suprasegmental elements (pitch, loudness, and rhythm) to make sense of what is said. The rise and fall of the human voice carries meaning for us. For example, "you ate this" changes from a statement to a question if the pitch of the "this" rises. ("You ate this." "You ate this?") Pitch typically helps us tell the gender and general age of a person simply by hearing their voice. Sometimes we can also get an idea about their emotional state or physical health because of the pitch, loudness, or rhythm of the voice.

This information guides us in understanding what has been said in order to respond correctly. For example, a strange, male voice shouting, "What do you want?" would get a completely different response from your mother's voice quietly asking the same question. We have to interpret more than just the words to determine what our response should be.

### Language Scheme

We also rely on our understanding of certain situations to help us in processing the information carried by the auditory signal. Take the example of the loud male voice speaking the words "what do you want." If you are in a football stadium and you see the popcorn vendor coming toward you, and your friend asked this question, you would probably respond with, "A large popcorn." If you are walking down a dark street and hear the same thing, you will probably turn and run. Our knowledge of situations, play a part in how we interpret what we hear.

This is also true of environmental sounds. If I hear a car alarm outside my bedroom it generally means that the neighbors accidentally set it off. When I hear the same sound outside my motel room in a strange town, I immediately race to the window to see if someone is stealing my rental car. I have learned how to respond to that sound based on where I am when the sound occurs. In other words, I have developed a scheme about the meaning of a car alarm at my home and one about a car alarm at a motel.

Developing scheme is also important in helping me to sort through the auditory signal coming at me to find out what is important for me to pay attention to auditorily. For example, I may not be aware of all of the sounds around me in an airport when I am waiting for a flight, but if my flight is announced, I tune into that information. Why? Because I have a scheme filed under "airports and returning home" in my experience that helps me know when to pay attention to the voice on the speaker overhead.

These scheme are very important to us in using our auditory skills. Think of all the situations we have filed away in our memory that have red flags for listening: a fire drill at school, driving around town, parties, taking a test, eating out at a restaurant. Because we know what to expect as possibilities or probabilities in those situations, we don't have to put so much of our energies into sorting out what is important to pay attention to and what can be ignored.

## OTHER FACTORS INFLUENCING AUDITORY SKILLS

### Acoustics

Sometimes our ability to pick up on key auditory information can be affected by environmental factors. For example, the amount of noise around us can drown out (mask) the sounds that are important. Reverberation (echo) can also make listening difficult.

## Competition from Other Senses

If there is too much competition from our other senses, listening can become more difficult. Think about trying to listen to what someone is saying to you on the phone while watching your child run out into the street after a ball. You are so engrossed in what you are seeing that you probably don't hear what the person says.

## Motivation

Motivation can impede or improve our ability to hear certain things in certain situations. We are all aware of the phenomenon of "selective hearing." If you are at a party and many people are talking, you may be unaware of what is being said or aware of only a general buzz of voices. However, if someone says your name, you most likely will pick up on their conversation and be able to hear it.

## Emotional State and Demand On Memory

Likewise, emotional state can be a factor. "She was so upset I don't think she heard a word I said." Additionally, the demands on our memory can have impact as well. Since I am not fluent in Spanish I have to work hard to pick out the words I might know in Spanish when someone is talking to me. Listening to an English speaker I do not have to listen as carefully to follow the conversation.

## Redundancy of Language

There is also a lot of redundancy in spoken language. For example, if I hear a sentence beginning with a "wh" word and ending with a rising pitch, I know that you are asking me a question. Even if I do not specifically hear the first word, I can make assumptions based on other features of what is said.

In order to understand spoken language or even to understand the significance of environmental sounds, we must have highly developed skills. Some of these skills are related to detecting and interpreting sound on an auditory level and some of these skills relate to more general understanding of the world around us. Even children with mild or moderate hearing loss may need specific instruction and adaptations to access this information and make meaning of it.

## THE ROLE OF VISION AND HEARING IN EARLY LEARNING

We know how important the first five years of life are in creating a basis for all learning that will take place throughout the life of an individual. Looking at a child without disabilities we can see how dramatic the development and learning process is during this time period. The foundation for all learning is laid during these critical years as the infant's body works to complete the development that began in utero. While it is easy to understand the impact of severe and profound sensory loss (vision and hearing) to a young child's development, it is often easy to overlook the impact of mild and moderate sensory loss during this same critical period of development. In thinking about a child who may also have some type of visual impairment the impact of this type of loss becomes even more dramatic.

When we are born, our hearing skills, much like our vision and our motor skills, are not fully developed. Our brains literally develop the neural pathways that will allow us to use the information coming in through our senses to comprehend ourselves and the world around us.

A hungry baby cries and mom pads across the room and talks to the baby as she picks it up to be fed. Over time the baby comes to expect this response and associates these sounds with getting fed. As most parents will tell you, after a while the baby will cry for assistance and calm the minute he hears the parent's voice or footsteps. That baby has already developed skills that allow him to:

- detect the sound of her voice or steps;
- recognize it is mom's voice and not the vacuum cleaner;
- know that mom's voice is responding to him;
- know that mom is at the door of his room;
- comprehend she said "want bottle";
- and understand all of this together means that dinner is on the way.

Beginning at birth, vision and hearing play a critical role in the overall development of a child and his ability to learn.

"Piaget describes the first two years of life as the sensorimotor stage during which time the infant progresses from reflex activity to more systematic and organized behavior. He learns that he has control over the object world and will visually search for a toy he has lost. He will reach for and grasp his toys. He learns that objects are independent of himself. He learns to imitate and to respond to people through imitative behavior. Finally, he takes the first steps toward establishing verbal communication. The acquisition of speech begins with the cooing of the infant at about 16 weeks; babbling at about 28 weeks; and putting sounds together at about 40 weeks. Language development proceeds in a similar sequential fashion. At 28 weeks the infant attends to voices and by 40 weeks responds to simple commands. By 15 months he says single words together to express ideas and by 2 years he puts words together to form simple sentences. (Scholl, 1986)

Vision and hearing are the senses that help him understand his separateness from the people and the world around him. They serve as the motivators in his exploration of his body and of the world. This leads to his ability to move his body, use his hands, walk around a room, and so forth. A child does much of his early learning by observing the sights and sounds of the world around him. Watch a group of three year olds at play and you will understand just how much they have learned simply by looking and listening in their environments.

"A greater quantity of information is gained in a shorter period of time through use of the visual system than through any other single sense organ." (Scholl, 1986)

"Auditory processing and listening for learning is the ultimate level of auditory progress and is a skill essential for academic progress and continued cognitive development of visually handicapped students." (Scholl, 1986)

" A child with a minimal, borderline, or slight hearing impairment may experience problems in the following areas: 1) hearing faint or distant speech (in fact, at least 10% of classroom instruction may be missed); 2) detecting subtle conversational cues which could cause the child to respond inappropriately; 3) keeping up with fast-paced communicative interactions; and 4) hearing the word-sound distinctions that comprise morphological markers for tense, plurality, possessives, and so on. In addition, the child may appear immature and be more fatigued than peers due to the increased level-of-effort needed to hear." (Flexer, 1994)

When you consider the importance of vision and hearing to the overall development it becomes apparent that even a mild or moderate sensory loss at this critical phase can have dramatic consequences. Even though these children are receiving a great deal of visual or auditory information, this information is distorted. They may also miss visual or auditory information that occurs at a distance from them.

## ADDRESSING THE EFFECTS OF HEARING LOSS

### Regular Periodic Hearing Screening

All children, especially children with visual impairments, should be screened for hearing impairment regularly. Many schools provide hearing screenings from time to time, but parents shouldn't rely on these screenings alone. Make hearing screenings a regular part of the yearly check-up routine.

### Medical Treatment When Appropriate

Because many mild or moderate hearing losses can be corrected or treated, good medical management is a must. Ear infections usually require medication, and if they are chronic, the insertion of tubes in the eardrum to keep fluid from impeding the movement of the middle ear bones.

Obstructions in the ear canal are also not uncommon. Young children do indeed "put beans in their ears" and some children may produce an excessive amount of earwax which builds up and creates a blockage. These types of problems can usually be corrected without extreme measures.

Modern surgical procedures have made it possible to correct problems with the ossicles in the middle ear. The chain of bones may even be replaced by prosthetics.

### Amplification

Many children with mild or moderate hearing loss can benefit greatly from the use of hearing aids and auditory trainers. It is important that these devices are monitored daily to assure that they are working properly. It is also important that the child wear the device as much of the day as possible. Specific training to help the child build tolerance for the device and to learn to use the improved signal provided by the device is critical.

### Improving the Listening Environment

Reducing noise goes hand-in-hand with improving the signal quality. The difference between the loudness of the sound and the loudness of the other noises in a listening situation is called the signal-to-noise ratio. The signal-to-noise ratio in most schools and homes is poor. Carpeting rooms, adding acoustical ceilings, closing doors to noisy hallways, and using study carrels are a few of the things that can improve the signal to noise ratio. Many homes and some classrooms may constantly have a radio, record player or television playing. Simply turning off these noise makers can greatly improve a child's ability to function auditorily.

Another problem causing auditory clutter is constant chatter. We may think that constantly talking about everything that is happening is beneficial to the child with hearing loss and especially vision loss. Rather than a constant chatter, clear and simple statements about what has or is about to happen may be more helpful to the child. This is especially true if the child has



multiple disabilities or seems to have trouble processing auditory information. Too much information makes it even more difficult to sort out what needs to be attended to auditorily.

Making the listening environment pleasant and varied is important. Total quiet is not the goal; managing noise and auditory information is.

### Ongoing Training to Develop Better Auditory Skills

Remember, in order for auditory information to be useful to us, we not only need to be aware of the sound but need to be able to attach meaning to that sound. When a child is visually impaired the need to attach meaning to the sound becomes more important. Auditory training for children with identified hearing impairment should be included as a part of each child's educational goals in school. However, parents can also be a major force in the development of these skills through the everyday activities at home.

## STRATEGIES FOR DEVELOPING LISTENING SKILLS

### Determine Current Skills

First of all, it is important to establish what the child responds to auditorily. In addition to appropriate audiological testing, parents should observe what types of sound the child responds to and how he responds. Does he respond to male or female voices better? Does he seem to search for the source of certain sounds or become animated or fussy if the sound occurs? Is there a different type of response to environmental sounds and human voice? Does the child show an awareness when the sound starts or stops? Providing a rich auditory environment and carefully observing the child's responses to that environment are key.

### Draw Attention to Sound in a Non-Pressuring Way

Consistently drawing the child's attention to the sounds in the environment in a non-pressuring way and helping him to build scheme around the sound are critical. Make listening a rewarding and pleasant experience. For example, help him find the dog when it is barking. Discuss why the dog might be barking. Let him pet the dog or give it a treat to quiet it. Imitate the dog barking and try to get the child to imitate the sound, too.

### Model A Variety of Reactions to Sounds

Model a variety of reactions to different sounds especially tuning in to the suprasegmental features of pitch, rhythm, intensity, and duration. For example, move or dance to music that alternately is fast or slow. Respond to loud and soft sounds by covering and uncovering your ears. Relax to soft, slow music and exercise or dance to faster tunes.

### Present Sound in a Variety of Contexts

Present the same sounds in a variety of contexts. For example, the keys at home, the keys at the grocery store, and the keys at grandma's house are used to cue the child that "we are about to go somewhere in the car." Your goal is for the child to react consistently and differentially to different sound classes. For example, no matter who is clapping or how the claps sound, the child knows this means "someone is about to play a game with me" and indicates he is anticipating what will come next. The sound of running water causes the child to anticipate washing his hands or bathing wherever he is when he hears the sound. He anticipates this

activity because he has heard that sound many times and developed associations related to that sound.

### Make Sound a Part of Routines

Using sound within routines to establish and reinforce the meaningfulness of sound is very important. For example, call the child's attention to the sound that the pans make when you get them from the cupboard or put them away. Have him listen for the sound of the can opener as you open up the food container. Listen to the sound of the spoon against a pan as he stirs, etc.

### Pair Visual and Tactile Cues to Sound

Pairing visual, tactile, and auditory cues within these routines is also helpful. For example, cue the child to reach for the microwave by touching his hand or get him to watch for the flashing light on the timer to get him to open the microwave as it beeps. Later on you can fade the touch and/or visual prompt, letting the auditory prompt of the beep alert him to opening the microwave door.

### Engage in Turn-Taking

Response to the human voice is a very important concern for social and communication purposes. Engaging in turn-taking routines which involve vocal play can be helpful. Having the child listen and respond vocally with the "pop" sound or its approximation in when dad sings "Pop Goes the Weasel" is an example of this type of turn-taking. Imitate the child's vocalizations whatever they are and try to get a turn-taking interaction going.

### Simple, Repetitious Language

Using simple, repetitious language within the context of routines is also important. Sometimes it helps to actually write down a script for the language you will use during a routine. Even if you stray from the script somewhat, it helps you to evaluate how complicated the language is that you are using with the child in that routine.

### Respond to the Child's Vocalizations

Whenever the child makes any type of vocalization try to respond to it. A fussy cry might be interpreted as a "no" response to the activity that is being offered. Give the child the choice of stopping or at least taking a break from the activity. In the same way a giggle or coo, might be interpreted as a positive response. Continue that activity a bit longer. You are letting the child know in this way that his voice has power in controlling the events that are occurring.

### Encourage the Child to Experiment with Sound

It is also important to provide opportunities for the child to experiment with sounds through vocal play alone or with an adult or playing with objects or toys. Singing songs together, making sounds with your voice as you swing, taking turns saying "boo" and scaring mommy, imitating the sound of a toy, or any kind of vocal play helps develop important auditory skills. Remember to allow the child the time and space to use their voice in response, especially if that child has multiple disabilities.

Playing with more environmental sounds is important as well. Let the child start and stop the blender, ring the doorbell, turn the radio up and down. This helps to build scheme around the



objects and activities and also helps him to understand he can control the occurrence of the sound.

## CONCLUSION

Auditory skills are developed; we are not necessarily born with them. Children with hearing impairment, especially mild and moderate hearing impairment, may not develop these skills readily without appropriate support.

- Make sure your child has regular and periodic hearing screening.
- Monitor medical conditions that may lead to permanent and more severe hearing loss.
- Be a good observer of the way your child uses their hearing and help them to build their listening skills.
- Use hearing aids and FM systems when appropriate.
- Provide good listening environments that are interesting, but not cluttered.
- Give your child positive and meaningful experiences in listening through play and routines.
- Encourage and reward the child's experimentation with producing and listening to sound.
- Keep your language simple and consistent in interacting with the child.

Children with visual impairment need to learn to use their hearing well. As their other distance sense it is critical for safety and is also the key to connecting with the world and the people in it.

## RESOURCES

Durkel, Jim (1986). Handout from "Auditory Assessment and Auditory Training for the Mulihandicapped" session of the Statewide Deaf-Blind Multihandicapped Conference, Austin, TX.

Flexer,Carol (1994). Facilitating Hearing and Listening in Young Children. San Diego, CA: Singular Publishing Group, Inc.

Watkins, Susan, Editor (1989). The INSITE Model - A Model of Home Intervention for Infant, Toddler and Preschool Aged Mulithandicapped Sensory Impaired Children. Logan, UT: Hope, Inc.

Scholl, G. T. (1986). Foundations of Education for Blind and Visually Handicapped Children and Youth. New York, NY: American Foundation for the Blind, Inc.