

## Sound bodies through sound therapy

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### Abstract

Sound therapy supports more than one's hearing skills. Davis has created *The Tree of Sound Enhancement Therapy* as a model for understanding the many different existing sound-based therapies as they relate to how the body hears, processes, understands, and modifies our response to sound. The *Diagnostic Evaluation for Therapy Protocol*, a test battery, was developed to identify the most appropriate sound-based therapies for each individual. The Tree and diagnostic battery support the five laws connecting the voice, ear, brain connection as established in the *Tomatis Effect* and the *Davis Addendum to the Tomatis Effect*. This overview shares the foundations for understanding why maximum learning is supported by maximum wellness with the use of sound-based therapies.

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### 1. Introduction

Sound impacts our whole being, our emotions, and how we learn. Sound must be heard correctly and then perceived correctly in order to listen, comprehend, and follow through with what was learned or asked. Sound also provides us with information for survival. Man has intuitively understood this, starting with our earliest ancestors, when sound might indicate the coming of an enemy. In today's world, sound is all around us, from the fan noises of our heating systems, to nature's constant symphony of animal/bird sounds. We are constantly being impacted by sound. Some sounds are pleasant to hear and others are not. Not everyone has the same response to the sounds around them.

Our immersion in the sound world can have positive and negative responses. Positive responses are noted as: feeling more relaxed, being more focused, feeling more energized, being more aware of the surrounding world, having responsiveness enhanced, or being more motivated. Negative responses can be demonstrated as: irritability, avoidance of noisy situations, difficulty listening in background noise, trying to hog conversations/or avoid speaking at all, or anxiety. For the developing child, negative impacting sound can be demonstrated by: covering the ears, social withdrawal, sensory overload, screaming, temper tantrums, tuning out the world, turning up the volume of the TV, acting 'deaf', ignoring sound, or showing fear to sounds.

Sound impacts the entire body. We process or use sound information received not only through the cochlea of the ear. We also process sound through our bone structure—our skeleton, our sense of touch, and our body's cell structure. We have to hear these sounds correctly in order to process what is being received. This does not mean that the deaf do not perceive sound. They understand sound because of the different ways that our bodies perceive and receive sound stimulation. They often vibrationally respond to sound received, for example, through bone conduction.

### 2. The ear

The ear appears to be the major sensory stimulator for the body. It is known that the ear is our hearing mechanism, but it hasn't been recognized as often for its other sensory connections. In reviewing the anatomy and physiology of the ear, one can begin to see how the entire body is stimulated, not only through sensory stimulation, but also through neurological stimulation.

Sound travels down the ear canal and vibrates the eardrum, which in turn, vibrates the three smallest bones of the body. Then sound vibrations travel through a fluid in the inner ear which stimulates sound reception through the cochlea and body responsiveness through the semi-circular canals and vestibule. Attached to the third bone of the middle ear is a muscle, the stapedius muscle, sometimes known as 'the acoustic reflex' muscle. This muscle is a protective muscle and protects our bodies from excessively loud sound reaching the cochlea and creating damage to the cochlea. When this muscle is over-reactive, the sound vibrations received in the ear are over-stimulated. This over-stimulation also affects the semi-circular canals and the vestibule. It is this phenomenon that creates one type of hearing hypersensitivity.

The semicircular canals provide us with the perception of motion and turning. The semicircular canals are at right angles with each other covering all the dimensions in space. They impact proprioception, or how the body feels in the time and space surrounding it. The vestibule houses our balance center. From these 2 areas, sound's stimulation responses are then sent to the brain.

From the cochlea, sound is sent to the brain for interpretation, but on the way there, sound's responses travel through the Superior Olivary Complex, a relay center for auditory information. It is helpful in the integration and interpretation of binaural listening, sound localization, and two ear integration. The Lateral Lemniscus is the primary auditory pathway within the brain stem. It lies between the Superior Olivary Complex and the Inferior Colliculi. The Inferior Colliculus is the largest auditory structure in the brain stem, and has auditory fibers, and sensory

receptors for body movement, skin, hearing and vision. It is the relay system to higher levels of the brain, and is important for frequency specific information, time and space information, eye, head, and body movement towards sound localization, and binaural hearing. The Medial Geniculate Body, in the thalamus, acts as a relay station for auditory information. It transmits information to the auditory cortex via the internal capsule to Heschl's gyrus and via the external capsule to the Insula. It responds to acoustic stimuli, responds to sensory and acoustic stimuli, and transmits auditory discrimination information, auditory attention information, and multisensory arousal information. The auditory system continues from the thalamus to the cerebral cortex. The neurons originate in the Medial Geniculate Bodies and branch outward to the auditory areas of the brain. This area is the covering of the surface of the brain. Heschl's gyrus is the main auditory area of the cortex, and is the site of auditory sensation and perception. It can retain frequency specific or tonotopic information from the cochlea.

The thalamus in the brain controls the rhythm of the brain waves. The thalamocortical neurons release the brain waves and allow them to spread throughout the brain, the nervous system, and to every part of the body. They regulate the sensitivity and activity of the nervous system. The entrainment of brain waves sets the overall responsiveness of the nervous system to stimulation. Because of this, the neurological system becomes even more important to the responsiveness of sound through the ear.

### 3. The neurological system

The brain is comprised mostly of neurons, or nerve cells. The neuron is the functional unit of the brain. It receives information from the dendrites, processes the information within the cell body, and then sends the information to the other neurons and cells along its axon. The axon then separates into small fibers that have terminals that form a connection to another cell. This connection is called a synapse. Neurons communicate through these synaptic connections. Their job is to process information and convey this information to other neurons in order to establish behavior and experience. These neurons are always working and networking with other neurons.

The fundamental interaction among neurons occurs at the synapse. It is possible to develop new synapses and it is these connections between the neurons that form the networking activity of the brain. These new synapses are what allow us to continually learn and grow. The brain takes in the external stimuli through its sensory system: touch, smell, taste, vision, and hearing. Without the proper stimulation, the connections that allow brain cells to process become distorted or confused.

There are many cranial nerves. Cranial Nerves 2-11 are directly or indirectly connected to the ear through their branching of neurons [1]. Four of these nerves seem to be impacted by sound stimulation more than the others. They are the Trigeminal, Facial, Glossopharyngeal, and Vagus nerves.

The trigeminal nerve, or fifth cranial nerve, has three branches: the ophthalmic, maxillary, and mandibular nerves. It impacts many portions of the face: jaw, lips, nasal passages, palate, and more. It helps control pain, temperature, touch, proprioception from the head, and supplies sensation to the motor nerves of the muscles of the head. It innervates the chewing

muscle. Tactile sensation from the nasal cavities and oral cavities are also carried by this nerve.

The seventh cranial nerve or facial is a motor nerve that supplies proprioceptive and motor fibers to the stapedius muscle, posterior digastric muscle (allows the opening of the mouth), stylohyoid muscle, and muscles of facial expression. It has four types of nerve fibers that supply 1: the sensation of pain, temperature, and touch to portions of the ear canal, 2) sympathetic innervation to the lacrimal gland, nose, and salivary glands, 3) sensation of taste from front two thirds of the tongue, and 4) motor innervation to muscles of second branchiogenic origin.

The glossopharyngeal nerve, or ninth cranial nerve has a connection with the ear via the eustachian tube. It supplies sensation to the pharynx, soft palate, posterior third of the tongue, tonsils, eustachian tube, and tympanic cavity. It also has reflex control of respiration, blood pressure, and heart rate. It supplies the taste buds in the posterior third of the tongue.

The vagus nerve, or tenth cranial nerve, is often overlooked in relation to the ear because it does not play a part within audition. It contains motor, sensory, and parasympathetic fibers and extends from the head to the gastrointestinal tract. It stimulates many muscles (in the pharynx, larynx, esophagus, lungs, and the intestine), glands, and glandular organs (most major organs including the spleen, pancreas, kidney, gallbladder, liver, small intestine). It regulates the function of the pharynx, larynx, thorax, and abdomen. Additionally it conveys information about nutrient and mineral balance, gut distension, local hormone secretions, and immune and inflammatory signals. It carries the sensation of nausea, and impulses regulating respiration and blood pressure. It has implications for understanding the physiology and pathophysiology of functions such as pain sensitivity, mood disorders, feeding behavior, and acute and chronic inflammatory diseases [2]. When this nerve is overactive, it can disrupt one's well-being with states of anxiety, stomach distress, angina, or lack of appetite [3].

### 4. Cochlear emissions

The ear also generates a sound. This is known as an otoacoustic emission. Knowledge about this subject was reported by David Kemp in 1978. He reported that a weak acoustic signal emanated from the cochlea about 6 ms after the presentation of a click introduced to the ear. Spontaneous otoacoustic emissions, or natural emissions from the ear, have also been measured. It is thought that the source of these otoacoustic emissions are within the cochlea. To date, researchers say that they may be present in one or both ears for some people and absent in others [4].

Kirchhoff's Principle states that the frequencies absorbed by a molecule are identical with the frequencies emitted when the molecule is excited. It is the reciprocity of the absorption and emission that forms Kirchhoff's principle. The energy is absorbed by the reverse of the process by which the emissions are produced. Perhaps this can be related to otoacoustic emissions? When we excite the cochlea, we emit the same frequency that it is responding to [5]?

## 5. Hearing vs. listening

The ear is responsible for hearing and listening. Hearing is the physical act of receiving sound in the cochlea. Listening involves a mental process. It is a motivated, active process of tuning into what one wants to hear and tuning out what they don't want to hear. Perception is how the brain receives and uses sound. What happens when these skills do not develop appropriately?

## 6. Auditory deprivation

For some, the connections between the voice, the ear, and the brain are never fully established. And for others, the sensory stimulation necessary to establish these connections was never fully received. The connective networks are not enhanced. This is called Auditory and/or Sensory Deprivation. As a result of this deprivation, misperceptions of sound occur.

Misperceptions of sound result in poor skill development and overall body imbalances. The following are often seen as a result of misperceptions of sound:

- **Hypersensitivity to sound:** Davis Centers, Inc has identified 3 different types of hearing hypersensitivities to sound. The person may respond negatively to sudden loud sounds, certain pitches, people talking, babies crying, reverberant rooms, low frequency sounds, and more. Their responses often interfere with their ability to pay attention, tune in, and respond to what is necessary.
- **Stilted learning:** If the full sensory message is not received in the ear or the brain, then only bits and pieces of the message will be processed. As a result, the person can only respond, interpret, and learn from pieces of information, not wholes, and learning is accomplished in chunks. This limits how much information can be processed at one time and retained.
- **Disconnected speech:** With the same principle as above, the voice-ear-brain connection must receive good input with the rhythm, timing, inflection, prosody, and tone of the voice, as well as the sequence of the phonemes within words. When these are not perceived properly, speech can become choppy or disconnected.
- **Difficulty listening in background noise:** Background noise masks the person speaking so that the listener has to work extra hard to listen to foreground speech. This is difficult because of an inability to discriminate sounds well, an inability to differentiate sound far and near, and/or an inability to tolerate extraneous sound.
- **Auditory processing timing lag:** This can be minimal or significant, yet impact the listener's response skills. One example is the child who is asked to do something, and after many seconds, hasn't responded. An assumption occurs that he did not hear the request, so the person begins to do something else, and then the child responds. This is a significant delay but there are many individuals who need to sort out all the pieces to process before being able to respond. Sometimes it is like putting together a puzzle in the brain. Whereas, some people can do the puzzle in 2 steps, another person may need 8 steps to accomplish the same thing.
- **Weak auditory discrimination skills:** Understanding speech includes the ability to discriminate between the speech sounds

within words. The difference for example between a /t/ and a /d/ sound can be major for comprehension. If a child is told, "The bat is in the closet.", and instead hears, "You're bad and go to the closet.", the child will become very confused for many reasons—i.e., knowing that he heard the second sentence and then arguing with the speaker that it was what they said.

- **Localization of a sound:** Knowing where a sound comes from is important not only for survival in a frightening situation but also for comprehension in a noisy classroom. Sometimes, once the listener has identified from where the person is speaking, it is too late to identify what they are talking about.
- **Emotional Instability:** As sound is processed from the cochlea to the brain, it passes through the limbic system. This system is responsible for our emotional responses. People who have misperceptions of sound, often demonstrate emotional instability.
- **Attention/focusing weaknesses:** If sound is uncomfortable, not clearly heard, difficult to understand, distracting, or overwhelming to a person, it is very difficult to maintain attention, and stay focused when one's attention is not fully there.
- **Vestibular/balance disorders:** Because of the semi-circular canals, all sensory integrations skills will impact overall body responses. The vestibular imbalances will impact balance, coordination, oral motor skills, gross and fine motor skills, eye-hand coordination, handwriting, and the need for or the exclusion of sensory input: touch, taste, smell, sound, and vision.
- **Health and well-being issues:** When the body is constantly working with inefficient processes, it does not function maximally. Eventually this plays havoc on the person's wellness.

## 7. The Tree of Sound Enhancement Therapy®

Sound-based therapies have become one solution for making change for people whose perceptions of sound are not fully functioning or established. Davis Centers, Inc has created The Tree of Sound Enhancement Therapy as a developmental flow chart for the correct administration of the various sound therapies that exist today.

The 'Tree' is divided into parts. The 'Roots' system encompasses one's sense of hearing, not so much hearing loss, as over-reactions to sound. The 'Trunk' represents general sound processing connections, incorporating all the anatomy and physiology of the ear and its related functions. The 'Leaves and Branches' includes specific auditory processing skill weaknesses, such as auditory discrimination, sequencing, memory, etc., but also includes skills such as reading, spelling, and handwriting. The 'Maintenance' of the 'Tree' is accomplished by the voice, either by knowing how to use one's own voice to support the body, or by using vocal analysis to determine how to support the body. This 'Tree' analogy uses the power of sound to enhance the Voice-Ear-Brain Connection to make positive change in auditory processing, learning, development, and wellness.

## 8. Diagnostic Evaluation for Therapy Protocol (DETP®)

How does one know where to start on The Tree of Sound Enhancement Therapy? Davis Centers, Inc uses the Diagnostic Evaluation for Therapy Protocol (DETP) to help determine the

starting place. Tests from the different therapies as well as standardized audiological tests are used to determine if a sound based therapy can be supportive for an individual. If more than one therapy is needed, the correct order for the therapies to be administered can also be determined from the DETP.

## 9. Root System

The ‘Root’ System encompasses one’s sense of hearing. Typically the person has normal hearing thresholds but also demonstrates hypersensitivity to sound. There is only one therapy identified to date that addresses the sense of hearing. It is Dr. Berard’s Auditory Integration Training (AIT). It was developed by a French Ear, Nose, and Throat physician who studied under Dr. Alfred Tomatis, the founder of sound therapy, but came away with a different method. Davis Centers, Inc has researched this method for 12 years and determined that it’s main purposes in making change in individuals is in retraining the acoustic reflex muscle in the middle ear. Consistently 91% of individuals tested pre and post AIT, have demonstrated change in this muscle from very low levels to normal levels after 10 days of listening. The program last 10 days and the individual listens to specially chosen music played through an approved device that, through a system of high and low pass filtering, gating, loud sound, and between ear sound changes accomplishes a permanent change in how the muscle reflex works. A Hearing Sensitivity Audiogram is administered pre, mid, and post sessions to monitor changes and set programs appropriately. Results have demonstrated: a decrease in hypersensitivity to sound (only one type of hearing hypersensitivity), an improvement in attention to auditory stimuli, an increase in eye contact, an interest in communication, a decrease in lethargy, a decrease in restlessness, an improved ‘sense of self’, longer sentence length, better auditory comprehension, and fewer perseverative behaviors.

## 10. The Trunk

The Trunk of the ‘Tree’ includes all body processes associated with the anatomy and physiology of the ear including branchial stimulation of the cranial nerves. There is only one method that addresses all of these sensations by using the Voice-Ear-Brain Connection established by Dr. Alfred Tomatis. The method is the Tomatis Method<sup>®</sup>, a method of sound stimulation affecting the entire body. Dr. Tomatis began researching sound’s impact on the body in the late 1940’s to early 1950’s. In 1957, the French Academie of Science established 3 laws known as ‘The Tomatis Effect’. Those laws state:

1. The voice only contains the harmonics that the ear can hear.
2. If you give the possibility to the ear to correctly hear the distorted frequencies of sound that are not well heard, these are immediately and unconsciously restored into the voice.
3. The imposed audition sufficiently maintained over time results in permanently modifying the auditory and phonation.

The Tomatis Method uses a special device to play appropriate musical selections during a specific program established

after a careful evaluation that determines the individual’s listening skills. The intensive sessions stimulate the voice-ear-brain over many days. The typical program is for 15 consecutive days, listening 2 hours per day, then waiting one month and returning for another 15 consecutive days, listening for 2 hours per day. The second session may be divided into 8 and 7 days with various spacing intervals between them. Some individuals need more than this basic program to get them to the stage where the voice will be able to support them. These additional sessions are only determined after continued testing and monitoring of progress. A few of the reported benefits are: decreased hearing hypersensitivities (the other two types), improved language skills, less aggressive behaviors, a sense of well-being, a sense of being more connected to the world, better eye contact, improved social skills, enhanced self image, improved academics such as reading, writing, and spelling, improved posture/balance/coordination, better organizational skills, and improved attention.

## 11. The Leaves and Branches

The ‘Leaves and Branches’ portion of the ‘Tree’ addresses the specific auditory processing skills that are important for learning and development. When at this level, it is extremely important that both the ‘Roots’ and ‘Trunk’ have a sufficient foundation to support the changes that will occur at this level. The term ‘auditory’ throughout the entire framework of what the ‘Tree’ incorporates is more than just language and responsiveness to ‘hearing’ sound. The word ‘auditory’ for all levels of the ‘Tree’ encompasses everything that the ear does, including vestibular function. The development of the vestibular function is a precursor to the development of language so it is important to see enhancement in all areas.

The specific therapies incorporated at this level are working on separate skill sets. The first therapy is Fast ForWord<sup>®</sup>, a computer based program that enhances temporal sequencing of sounds. This skill is important for language development, and subsequently with reading development. The program is typically 6 to 8 weeks in length, lasting from 1½ to 1¾ hours per day, and incorporates various learning game activities intended to challenge and improve temporal sequencing. The reported benefits have been: improved temporal sequencing, faster response time to input, enhanced overall learning skills, improved reading skills, and improved listening in background noise.

Another therapy is Interactive Metronome<sup>®</sup>, which uses a metronome beat and an interactive response to develop rhythm and timing. Rhythm and timing is key to understanding the subtleties of language, as well as being able to maintain focus and attention, or planning and sequencing an activity. This program is computer based but the person uses interactive sensors to respond to a steady metronome beat. The program typically lasts 15 days for 1 hour per day, after which individuals report: increased attention without distraction, improved planning and sequencing skills, improved mental concentration, improved physical motion skills, improved cognition and academic performance, and better control of aggression.

Other therapies that can be included at this level of the ‘Tree’ are: The Listening Program<sup>®</sup>, the Listening Fitness Training Program (LiFT<sup>®</sup>), and the Samonas Method. At the

very top of the ‘Tree’ is the program “Read, Spell, Comprehend<sup>®</sup>” by Davis Centers, Inc. as a way to pull all of the foundational skills to completion for learning.

## 12. Body Maintenance

The ‘Tree’ must be maintained in order for it to thrive and maintain the learning changes accomplished through the development of the other ‘Tree’ portions—Roots, Trunk, and Leaves and Branches. The Voice-Ear-Brain Connection again plays a pivotal role at this level because as Dr. Tomatis demonstrated, the voice is key to the body’s stability. Therefore, it is the voice at the ‘Body Maintenance’ level that helps the body reach its maximum potential. Without this level working appropriately, the learning changes cannot be maximally supported. Until such time that the individual can be trained to monitor his own voice continuously, the science of BioAcoustics becomes the method of choice to accomplish a balancing of the body.

BioAcoustics, means ‘life sounds’, and the science of Human BioAcoustics<sup>®</sup> was established by Sharry Edwards. This science explores the potential that the voice is a mathematical representation of the body. Through vocal analysis, Human BioAcoustics has supported the notion that the body is a mathematical matrix of predictable frequency relationships [6]. When frequencies that are out of balanced are identified through vocal analysis and placed within the mathematical matrix, ways to support body change can be accomplished through a frequency specific sound protocol. This sound protocol helps enhance and maintain the learning and developmental changes obtained with the other sound based therapies. The benefits are numerous and help people with learning, developmental, and wellness issues.

## 13. Davis Addendum<sup>®</sup> to the Tomatis Effect

Sound and vibration touches every part of our physical being. Sound is not only heard through the ear but through every cell of the body. There is a continuous inter-connected web of cells called ‘the living matrix’ [7] that allows sound energy vibration to channel information to all parts of the body. Every cell is a sound resonator and responds to sounds outside the body. All parts of the body respond to vibrations and affect physical, emotional, and mental states. When the frequencies of the body become distorted, a voiceprint displays these distortions.

The body has a distinct combination of frequencies for each structure and process within the body. These frequencies must be present to maintain the body’s integrity. The body can diagnose itself but is incapable of self-generating frequencies for corrective purposes. The voice is the most obvious and readily available frequency source for obtaining information about the body. The voice is the sound source and the ear is the receiver. Together they form a dynamic system. The ear establishes the foundation for energy patterns and the voice displays the patterns.

Davis Centers, Inc has studied the connections between the frequency output of Spontaneous Otoacoustic Emissions and the frequency output of the voice through vocal analysis and after noticing 100 % correlation between stressed frequencies

from both outputs, has created “The Davis Addendum<sup>®</sup> to the Tomatis Effect” [8]. These are 2 new laws to be added to Dr. Tomatis’ original laws that state:

1. The ear emits the same stressed frequencies that are emitted by the voice.
2. When complementary frequencies of stressed frequencies are introduced, vocal patterns regain coherence.

This happens through brain waves. Brain waves are a bio-electrical source for sending vibration through the circulatory system, the peripheral nerves, and the perineural system. These brain waves regulate the nervous system operation. They create the energy field around neurons to change, thereby determining sensitivity. They only respond when the energy field is sufficient to create a response. The science of Human BioAcoustics entrains brain waves to assist the body in supporting its own natural form and function through non-intrusive analog sound frequency presentation.

## 14. Summary and Conclusion

Our bodies search for stability between external sound sources and internal body vibrations to create balance. Our bodies react physically and psychologically. Sometimes the body cannot make the change by itself and needs a sound based therapy to accomplish the change.

“The Tree of Sound Enhancement Therapy” becomes a developmental flow chart for the sound therapies when the need for a sound therapy is determined by the Diagnostic Evaluation for Therapy Protocol (DETP). Everyone will benefit from a sound based therapy when it is identified as needed, but the entire sound therapy protocol established by the ‘Tree’ requires completion! It is formulated on adherence to the entire protocol in order to maximize the development of an individual’s overall auditory processing skills. If the protocol is interrupted, maximum benefit is not achieved.

Davis Centers, Inc’s Philosophy is based on a ‘total person approach’. Maximum learning is supported by maximum wellness. This is accomplished by using the interventions described in ‘The Tree of Sound Enhancement Therapy’. This combination maximizes and maintains the body’s responses.

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