

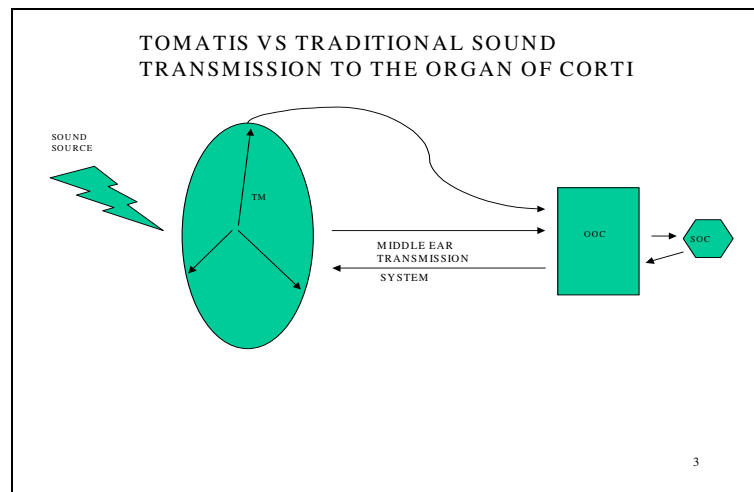
Auditory Neurology That May Support The Tomatis Theory and other Auditory Intervention Techniques.

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Call it sound therapy, auditory training or auditory intervention techniques; these therapy approaches have been the focus for investigation into many types of auditory processing disorders through out the world in prestigious institutions of higher learning by leading investigators.

Dr. Tomatis had a rather radical view of the transmission scheme that is 180 degrees out of phase from the traditional viewpoint. He believed that through a negative feedback loop originating at the level of the endolymph, hydraulic pressure was being applied to the ossicles along with middle ear muscle activity as a constant dampening and tuning of the tympanic membrane. The tympanic membrane collected the sound and transmitted it to the organ of Corti via the bony sulcus. Tomatis thus concluded it was the role of the middle ear to regulate sound transmission and provide a buffer for the shearing force required for audition. The human ear must maintain an optimal micro-homeostasis by limiting destructive shearing of the hair cells. Tomatis further believed that it was the middle ear muscles, which control high-frequency audition and have a significant role in cortical charging. (Figure 1)



(Figure 1)

Dr. Stephen Porges, at the University of Maryland (USA) working with children with autism and other related disorders, has focused on the two muscles of the middle ear. Porges states that the same nerves that control vocalization, facial expression, heart rate

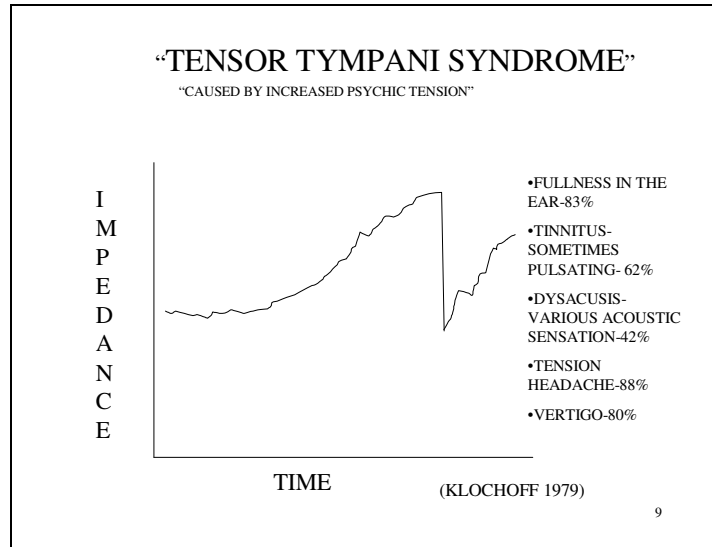
and breathing, innervate the tensor tympani and stapedius muscles. He points out that when the human organism is in a state of fear or high anxiety, the middle ear muscles lose the ability to diminish low-frequency sounds and attending to the higher frequencies of speech is thus impaired. Porges has developed an intervention protocol similar to the Tomatis method using filtered music to exercise the middle ear muscles along with whole body relaxation techniques to restore integrity to the middle ear muscle function and has reported improvements in communication skills, handwriting, balance and coordination, sensory processing, visual skill and sleep patterns. (Porges, 2003)

The research of Rideout and Laubach at Ursinus College in Collegeville, Pennsylvania required eight students to perform spatial-reasoning tasks before and after listening to a Mozart piano sonata. EEG recordings were made in each condition and an interesting correlation was observed. The music condition dramatically increased brain wave activity along with a significant increase in spatial-reasoning performance. (Rideout and Laubach 1997). Musical perception occurs in the right hemisphere of the brain, which is the same side of the brain that is involved with spatial analysis. (Roederer)

Dr. John Hughes, a neurologist at the University of Illinois Medical Center in Chicago found that music that regularly repeats every 20 to 30 seconds, just as most of Mozart's compositions do, trigger the strongest brain activity. Dr. Hughes studied the effects of listening to Mozart on 36 subjects with severe epileptic seizures and found an outstanding 29 out of the 36 patients showed significant improvement by having fewer seizures of less intensity. (Hughes, John 1998)

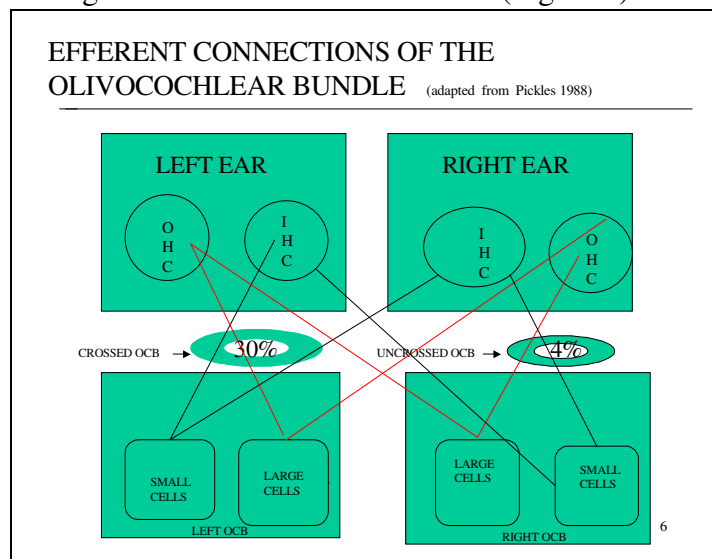
Neurobiologist Gordon Shaw of the University of California at Los Angeles using MRI studies to chart the brain wave activity of individuals listening to different types of music found that only Mozart activated areas of the brain that process fine motor coordination, vision and other higher thought processing regions. (Rauscher, Shaw and Ky, 1995)

Dr. Ingmar Klochoff of Uppsala, Sweden, describes a psychosomatic syndrome, known as the tensor tympani syndrome and is caused by increased psychic tension due to mental stress. There are individuals who do not have a constant impedance of the middle ear. The conclusion for this irregularity was spontaneous tonic tensor tympani muscle activity. The symptoms of this syndrome are often a fullness, tinnitus and dysacusis with a high relation to tension headache and vertigo. This syndrome does not in its self cause hearing loss; however, persons with this syndrome complain of difficulties in understanding what people say. This psychosomatic syndrome is likely to be caused by an inability to attend or concentrate caused by the ever-present rise in psychic tension. (Klochoff 1979) (Figure 2)



(Figure 2)

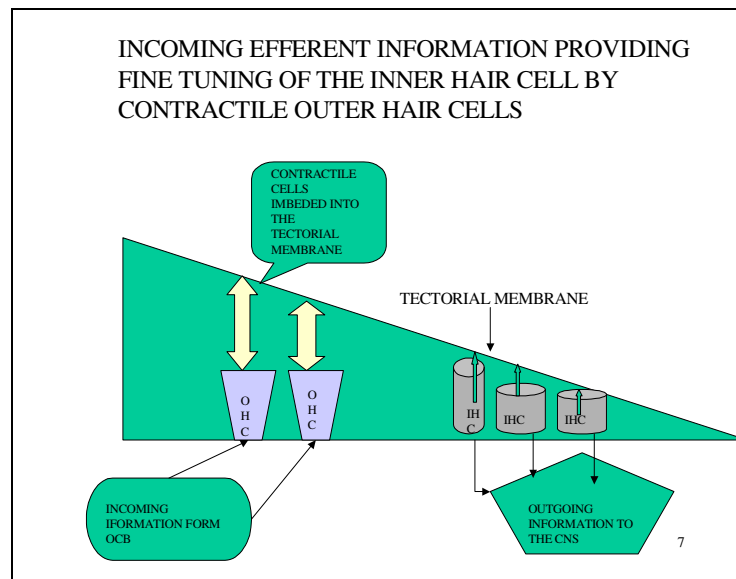
The Centrifugal Pathways are where things start to get interesting. We all struggled with the afferent or input pathways and learned how things got to the brain, but it was that efferent or feed back system that always seemed to be so elusive and not very well understood. The efferent nerves run close to, but not within, the same tracts, as do the afferent nerves. The Superior Olivary Complex is the region of the brainstem where efferent neurons arise and have their point of origin, but are not within the afferent nuclei. It is this system that is responsible for the auditory reflex activities of the stapedius and the tensor tympani muscles. Traditionally we have been taught that the contraction of these muscles causes the ossicles to become less efficient sound transmitters to the labyrinth, thus protecting the delicate hair cell structure. (Figure 3)



(Figure 3)

Unorthodox theories view this reflexive activity to be a tuning system that is continually monitoring the tension being applied to the tympanic membrane and providing protection to the hair cells from superathreshold stimuli.

The auditory efferent system is also feeding information back to the contractile outer hair cells pulling the tectorial membrane into the afferent inner hair causing a mechanical fine tuning effect as in attention and sound localization. (Figure 4)



(Figure 4)

These unorthodox theories have merit; in that a true feedback system would have a continuous flow of information that provides maximum tone to the middle ear muscles. Just like an arm or a leg that does not become completely limp when not in use, but maintains a proper tone all of the time, unless injured. This is one of the main theories of the Sound Therapy; that it will restore tone to the middle ear muscle system and in turn tunes up the entire auditory system, which is responsible for 85% of ongoing cortical activity

The system is also very global at a cortical level, sending information to the somatic and automatic nervous system. These more global responses are responsible for feelings of sadness, happiness, anxiety, flight and fight and a host of other visceral responses. It is the ears' involvement with the X cranial nerve or the vagus nerve (some times referred to as the wandering nerve) that innervates the bronchi and heart going through the diaphragm and on to the entire viscera including the esophagus to the anus. Very simply put, "We therefore have a system in which reflexes can be established at many levels, and in which the cortex controls the reflexes through descending influences.."(Pickles 1988))

Through over stimulation, sickness and disease, drug therapies and other oxidative stress, the integrity of the afferent and efferent nervous systems is compromised, with loss of muscle tone and synchrony in the synaptic firing order. This compromise manifests itself

in myriad of symptomatic maladies, such as hearing loss, tinnitus, loss of balance and coordination, loss of attention, inability to hear and understand in the presence of background noise, fatigue, tiredness, headaches, anxiety, depression and on and on. So when damage occurs to this delicate feed back system, the homeostasis of the entire organism is compromised. Thus it appears through highly organized temporal stimuli (classical music), which has undergone high band pass filtration, a restoration of aural muscle tone and synaptic firing order provides better cortical processing. Better cortical processing corrects a myriad of problems ranging from: anxiety relief, better hearing, tinnitus control, better balance and coordination, to: feelings of happiness and well being.

It seems that it is the reestablishing of the ability to listen to the higher frequency that is responsible for repairing and reorganizing cortical pathways. The energy levels coming in from the high frequency areas are more intense than for the lower frequencies. Dr. Tomatis calls the high harmonics the “charging sounds” while he describes the lower frequencies as the “discharging sounds”. The lower frequencies supply inadequate energy to the cortex and may even exhaust the individual. (Weeks)

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