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Handout One - Basis of Tomatis's Audio-Vocal Control Theories

Audio vocal control - Ear to Voice Cybernetic Loops

Tomatis based his theories of audio vocal control on neurology and on the embryological differentiation of the organs and structures involved in speech and listening. What is meant by audio vocal control?

Tomatis identified eleven ear - brain - body neurological control loops that control voice production (see Tomatis, *The Ear and the Voice,* 2005, pp. 65-76). Tomatis practitioner Paul Madaule states that these control loops regulate vocalism automatically at such a rapid speed, it's "virtually impossible to be aware of it while speaking or singing" (Madaule, *When Listening Comes Alive,* 1993, p. 166).

Tomatis stressed the importance of the middle ear muscles: the stapedius, which is the muscle of the stirrup, and the tensor tympani, the muscle of the hammer. These muscles, though they cannot be controlled voluntarily, can respond to a conscious intention to listen to particular sounds (Doidge, Norman "A Bridge of Sound" chap. 8 in *The Brain's Way of Healing,* 2015).

Tomatis further noted that the nerves which control the middle ear muscles are also involved in vocalization and articulation. He described the middle ear in terms of two neurological systems. Neurologically, the stapedius muscle in the middle ear shares a common nerve pathway with muscles in the face and in the throat above the larynx. The facial nerve, which is the 7th cranial nerve pair, innervates most of the muscles involved in facial expression, including the lips, as well as parts of the digastric and stylohyoid muscles, and the stapedius in the middle ear. This is one of the two systems Tomatis described.

The 5th cranial nerve pair connects to the hammer muscle in the middle ear as well as to the masseter and temporal muscles. This is the second system. We are sometimes aware of this ear to face reciprocity, as when we observe whether or not someone is listening by their facial expression (Tomatis, *The Ear and Language*, 1996, p. 46-47). As Tomatis described it, "The total functional whole of the middle ear infers *ipso facto* a functional unity of mouth and face, better still of mouth, face, and ear" (*Ear and Language*, p. 47).

The 10^{th} cranial nerve, or recurrent (vagus) nerve, follows divergent pathways along the left and right sides of the body. The path of the vagus nerve from the cortex of the brain to the larynx is longer on the left side of the body than on the right. Neurologically, signals between body, larynx, ear, and brain travel more quickly on the shorter, right side. Tomatis found that this neurological divergence in the vagus nerve pathway causes the right and left ear to process sound at different times. Nerve signals travelling between the ear and larynx have to travel a longer distance on the left, so they take longer to arrive. The time differential can be as much as 4 milliseconds. This is enough time difference that the right ear will receive the highest frequencies before the left. The higher frequencies are the most essential in distinguishing closely related speech sounds. Therefore, Tomatis theorized that we direct our speech and singing from the right ear, where the high frequencies can guide us. He experimented with singer patients in the 1950s, altering their self-listening through the right side, and concluded that ear dominance determines vocal quality (Tomatis, chap. 4 "Singing and the right ear," in *The Ear and the Voice,* 2005).

Cochlear and Vestibular Integrators

In Tomatis's view, the major role played by the ear is that of an integrator, integrating external and internal information (Tomatis, *The Ear and the Voice,* pp. 55-63). While the ear has traditionally been viewed analytically as consisting of three parts, external, middle, and inner ear according to its observable structures, Tomatis analyzed the inner ear in terms of a single entity comprised of four systems according to their embryological differentiation and neurological relationships. He called these systems "integrators." The integrators are neural networks that "associate muscular command paths with those of sensory responses" (Tomatis, *Ear and Language,* 1996, p. 168). Each integrator regulates a number of important functions. Two of the integrators play a particularly important role in understanding and performing music.

Those two systems are the cochlear integrator, which regulates hearing, listening, and language, and the vestibular integrator, which controls automatic motor and sensory responses. The vestibular integrator controls body movements, including the ability to maintain stillness, and it operates "outside the realm of consciousness" (Tomatis, *Ear and Language* p. 169). A "dialogue" between vestibular and cochlear integrators results in the Listening Posture – vertical alignment that includes openness and desire to listen and interact with oneself and the external world. The Listening Posture results in "good hearing, excellent listening, and perfect body control, all elements promoting good control of the voice" (Sollier, Pierre, Listening for Wellness, 1999, p. 75).