THE PRINCIPLES OF DR. TOMATIS

Jean Pierre Granier

The existence is a precarious state,
which allows a few people to meet with life.

—Alfred Tomatis

Jean Pierre Granier

Jean Pierre is a 47-year-old clinical psychologist with a PhD in visual word recognition. He trained in the Tomatis® Method under Dr. Alfred Tomatis and Simone Nicoloff, and has been a practicing registered Tomatis® consultant for 22 years. He is also trained in cognitive therapy (rational emotive behavior therapy) and uses this approach with some of his clients in conjunction with the Tomatis® Method.

Based in Marseille (France), he has been involved in an important research project in collaboration with the CNRS (Centre National de Recherche Scientifique—National Center for Scientific Research) on the effect of the Tomatis® Method on the regulation of stress and emotion. The first article written on this research has been recently published in the *Journal of Emotional Disorders* under the title: "Pure tone auditory thresholds are decreased in depressed people with post-traumatic stress disorders."

Jean Pierre has worked very actively with Tomatis® Développement SA to develop the Tomatis® Method by writing new training courses and curriculums, and aiding in the birth of a new generation of programs and services. Jean Pierre is one of the foundations of the Tomatis® international training team and he conducts Tomatis® training all over the world.

INTRODUCTION

The principles of Dr. Tomatis

Dr. Alfred Tomatis was undoubtedly an amazing pioneer, and a man ahead of his time in more ways than one.

The brain: the link between perception and action

In the late 1940s, Tomatis identified the principle that was to become the very foundation of his revolutionary new system. He intuitively understood that perception and action were functionally linked in the mechanics of the brain. For Tomatis, the perception and understanding of speech were deeply rooted in its activation by the sensory motor system.

The principle he identified states that the voice can only reproduce what the ear hears well—or rather, what the ear can listen to. For Tomatis, it was not only that the perceptual system (involved in understanding speech) was closely connected to the motor system through which speech is produced, but that the same motor system in turn greatly contributed to the perception and understanding of language on a phonological, semantic and syntactic level.

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Data resulting from research in neuroscience and brain imaging has since confirmed this idea. Demonstrating, for example, that in conjunction with the prefrontal cortex and left premotor cortex, the auditory cortex is activated not only during the production of speech sounds, but also during their silent articulation, voluntary identification and differentiation—and even during purely passive exposure to these sounds.

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Time would prove him right—his intuitions have now been validated by research that has highlighted the existence of neuronal assemblies, both sensory and motor. These neurons are involved not only in the functioning of language processes, but more generally in the implementation of high-level cognitive functions, such as memory and attention, as well as in understanding the goals and intentions of another person.

These neurons, referred to as mirror neurons, are characterized by the fact that they are active both during the execution of a goal-directed action and while perceiving the same action being performed by another person. This is why the pedagogical system he developed is called audio-psycho-phonology, a name that refers to the three functions—sensory, cognitive and motor—that are functionally linked by the same neural network.

The importance of intrauterine life

Dr. Tomatis was also the first to claim that the fetus could hear its mother's voice, transmitted through bone conduction.

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Throughout the 1980s and 1990s, research in psycholinguistics on the role of the mother's voice in the development of the phonetic and prosodic aspects of language again confirmed Tomatis's theory. Briefly stated, this research showed that acoustic stimulation from the mother's voice leaves a particular linguistic imprint on the brain of the fetus. Exposure to the mother's voice *in utero* contributes to the shaping of sensory pathways, and allows for a calibration of perception in relation to the prosodic characteristics of the language to be learned after birth.

Additionally, this prosodic modeling will itself serve as a foundation for the fine mechanisms of perceptual discrimination necessary to correctly process the various phonetic contrasts found in a given language. Thus, the prosody conveyed by the mother's voice will orient the baby's listening to the sounds of the language to be learned.

The notion of listening

Tomatis's reflection on the nature of intrauterine life, and on a primary prenatal dialogue between mother and fetus, led him to develop the unique system of educational listening that now bears his name: the Tomatis® Method.

Listening can be defined as the ability to adapt to the constant changes in our acoustic environment by continuously readjusting the content and form of the messages we receive. At the same time we immediately verify the result of this adjustment for the purpose of learning, achieving a goal, or communicating. Thus, as Tomatis often liked to remind people, it is possible to have good hearing, but be a poor listener.

According to Tomatis, because it closely combines perception and action, listening is by definition sensory-motor: adapting to changes in our acoustic world is also about being able to adapt the body to these changes. The important contribution of the motor system in speech perception, itself essential to performing the function of listening, was fully explained for Tomatis by the particular way in which he conceived of the ear and its workings.

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Indeed, one of Tomatis's great merits was that he always considered the ear to be both a sensory and a motor system—that it is a sensory-motor system or, better yet, an auditory-motor system.

It is important to note that for Tomatis, the term "ear" refers not only to all the peripheral structures specializing in receiving acoustic or motor information, but also to the neural networks that connect these receptors to the central nervous system.

The auditory part of the ear, the cochlear, forms the foundation of the mechanisms of hearing. The auditory system is both afferent and efferent. This means that the auditory receptors located in the inner ear send messages to the brain (afference), and the brain, particularly under the influence of emotions, can send messages to the auditory receptors by ordering them to function more or less efficiently in return (efference).

This efferent aspect of the auditory system is one of the characteristics of listening, since it implies that the brain has a major influence on our ability

to use hearing for the purpose of communication and learning.

The vestibule is the motor part of the ear, but because it detects movement, it is also considered to be a sensory part of the ear. The vestibular system collects all kinesthetic information—in other words, all information relating to movement. It is therefore fundamentally involved in the mechanisms of balance and posture. Its primary role is to enable us to resist gravity and to keep us upright.

The vestibule's influence extends throughout the cerebral cortex and is also strongly and reciprocally connected with the cerebellum, a neural structure that is critical for motor coordination, as well as for the establishment of automation mechanisms during learning. Thus, in association with the cerebellum, the vestibule intervenes in the development of procedural memory, which is the memory of know-how ("doing" function or "how-to-do" function).

Furthermore, the vestibular system is also connected to the hippocampus, a key structure of the nervous system involved in the formation of episodic memory and spatial navigation. This part of the ear also plays a very important role in the formation of the body schema and in the construction of the body's relationship to space. Tomatis considered that these two parts, the cochlear and vestibule, were inseparable in terms of listening, because they remain in constant dialogue with each other through the activation of the vast neural circuits that connect them reciprocally.

This whole mechanism, which is formed by the vestibular and cochlear systems and their connections, is precisely what forms the listening integrators mentioned above. Tomatis linked these vast neural networks to perception, action and cognition. The integrators contain sensory-motor neurons, especially the mirror neurons, which research has brought to attention in the last few years.

The integrators are the basis for mechanisms as diverse as those involved in the perception and production of spoken and written language, in general motor skills, temporal organization, motivation, the regulation of emotions and stress, processes of attention, and verbal and visual-spatial memory.

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The integrators of the listening function help to elucidate a particularly important concept for Tomatis, the "embodiment" of language. What Tomatis meant was that a syllable, word or phrase, when uttered or heard, has a motor component on a cortical level, and that this motor component will in turn greatly contribute to the perception and understanding of speech.

Here, we return to the fundamental idea of the sensory-motor dimension of listening, which is at the basis of the audio-vocal counter-reaction phenomenon identified by Tomatis in the late 1940s: any modification perceived by a person in their voice during the act of speaking or singing automatically causes a rhythmic or spectral modification in the voice. The correspondence (perceived sound of speech/motor reaction) appears to be very fine and precise. For example, recent research has shown that the lateral premotor cortex is active both in the production and the reception of the sound "p," and that similarly, the lower premotor cortex is activated during the production or reception of the sound "t."

Conversely, the activation of the lateral part of the premotor cortex involved in the movement of the lips facilitates the identification of sounds such as "p" or "b," specifically implying the strong participation of the lips, although it hinders the identification of sounds such as "t" or "d," which involve the tip of the tongue.

The opposite pattern of results was found when stimulating the lower part of the premotor cortex, involved in the movement of the tip of the tongue: the identification of the sounds "t" or "d" is facilitated, while identification of the sounds "p" or "b" is decreased.

Today's research is therefore beginning to confirm what Tomatis claimed several decades ago—namely, the idea of a neurobiological model of

language linking perception and motor functions through the activation of vast neural networks (the listening integrators), the latter involving neurons of the recently discovered mirror neuron type.

The phenomenon of embodiment also applies on a semantic level. For example, it has been shown that the auditory perception of action verbs referring to a body part (for example, to push, to bite, to squeeze) stimulates the parts of the motor cortex involved in the muscular activations necessary for these actions.

The current research is thus establishing a proven somatic map of language, very close to that of the embodiment of language upheld by Tomatis.

An original pedagogical system

In order for the listening function to be efficient, our auditory system must not only be able to constantly adapt to the changes in the information it receives, but, based on the changes detected, must also be able to make predictions about the representation of the incoming acoustic message.

Therefore, in order to establish and develop the listening function, Tomatis created an original device called the Electronic Ear, the essential principle of which is based on the notion of "gating." Gating functions as a system of alternation between two sound sources distributing the same information, but with different timbres and intensities. Additionally, the gating is irregular in its temporal pattern.

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Gating engages our nervous system's adaptability and plasticity. The phenomenon of neural plasticity can be defined as a dynamic change of the functional and structural characteristics of neurons, which occurs in

response to modifications affecting the nature or meaning of the sensory message that activates these neurons. Gating has an effect on the two auditory muscles located in the middle ear, and Tomatis believed that the role of these muscles was not only to transmit sound to the cochlear, but also to regulate the movement in the liquids that were caused by the transmission, enabling the cochlear to quickly adapt to the incoming vibration.

If this adaptation is performed correctly, the cochlear can then begin to efficiently extract and analyze the relevant information, which is a necessary process for the accomplishment of the current action or goal that has been set. The irregularity of the alternation that characterizes gating causes the brain to trigger the adjustment mechanisms of auditory memory to the changes detected, as well as prediction mechanisms in relation to the sound information about to arrive. As a result, the gating causes the auditory system to extract patterns from the incoming sound messages and store this information for short periods in auditory memory, which is regularly updated.

It follows that the gating, by the very nature of its action, keeps the brain focused on the ever-changing information it receives. These successive phenomena of updating and prediction are the expression of the short-term auditory plasticity being implemented. Solicited repeatedly over time, the latter will lead to the establishment of a positive and lasting change of the listening function—that is, the workings of the auditory-motor circuits forming the integrators.

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In particular, on a cerebral level, the

triggering of the successive mechanisms of adjustment and prediction favors the development of selective attention, enabling the subject to focus on relevant information while dismissing information that is not relevant. In turn, enhanced selective attention will lead to improved processes of auditory perception, both centrally and peripherally, through the efferent action of the brain in relation to the hair cells of the inner ear. The principle of the gating action is therefore to involve both the mechanisms of sensory stimulation, working from the periphery of the ear to the brain (bottom up), and the mechanisms of auditory adaptation and adjustment, going from the brain to the ear (top down)—the latter mechanisms being responsible for the development and improvement of both auditory perception and attention.

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Thus, the purpose of the Tomatis® Method—through the gating system that is specific to the Electronic Ear developed by Tomatis® Développment SA—is to adapt a person to his or her acoustic environment by assisting in the development of active perception mechanisms. These are characterized by the activation of auditory-motor circuits that involve a vast vestibular-cochlear-cortical neural network containing mirror neurons. This is why the field of application for the educational listening system created by Tomatis is so broad. Indeed, it enhances the listening capability of diagnoses as varied as learning disabilities and impaired motor skills, through to major communication problems, such as autism.

The different cases presented in this book by experienced consultants illustrate the great effectiveness of this system, which, although already 60 years old, remains astonishingly modern. It is this modernity that ensures that the Tomatis® Method is an advanced methodology, conceived ahead of its time, which has assisted in many emotional and developmental situations in many countries over many years.

Dr. Alfred Tomatis was truly an incredible pioneer. In the pages that

follow, you will discover just some of what he achieved—and how the Tomatis® Method can positively impact the lives of children struggling with developmental and behavioral problems.