

The Emerging Field of Sound Training

Technologies and Methods for Impacting Human Development through Sound Stimulation

Sound stimulation impacts 20th century human life in myriad ways, from sonic booms to the high-quality technological capture and delivery of music and voice through a variety of media. This article describes the emerging field of "Sound Training," which is a newly proposed name that encompasses the current and evolving sound-based technologies and methodologies. The applications of these technologies are many, with current uses in education, health, and human development. Sound training and its technology are based on the observations that 1) people of all ages can be trained to process incoming sound more effectively and that 2) many people have weaknesses or problems in their ability to process sound (listening disabilities), which affects them in a multitude of ways [1].

Sound-training technology consists of equipment and materials that have been designed to produce specific effects in the listener when following recommended methods. In educational, business, and clinical settings worldwide, sound stimulation is used with different types of individuals (e.g., those with learning disabilities or developmental delays, or those with a desire to learn a second language or to sing better) to achieve a host of performance goals that have listening as their foundational skill.

There is a sizable group of professionals now working with numerous methods, materials, and machines of sound stimulation. They comprise the evolving field of sound training. The field can be defined as including a group of professionals who are trained, and ultimately may be certified, to work with the technology and methods of sound stimulation for the purposes of improving or enhancing the following:

- Neuro-developmental maturation (of speech, language, motor skills, etc.)

- Communication skills (language-based, social, and business applications)
- School learning skills and abilities
- Attention and the organization of behavior
- Social relationships and self-esteem
- Foreign language learning
- Musical applications for singers and musicians
- Relaxation
- Neurological rehabilitation for head injuries, strokes, etc.

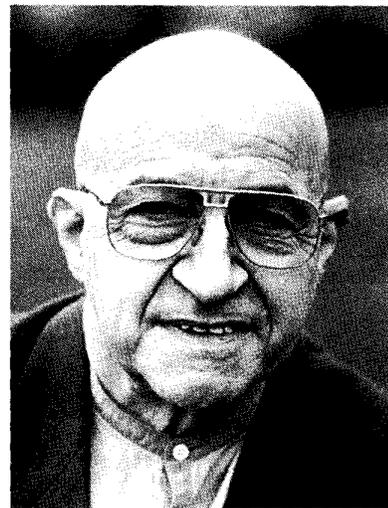
The field is rapidly growing and can be expected to develop new directions for professionals in several fields as more professionals and the public learn about the benefits of improved listening through sound stimulation or sound training.

To understand the potential impact of this field, one needs to explore its origins in the work of Dr. Alfred A. Tomatis (Fig. 1). Tomatis is a retired French ear, nose, and throat specialist who pioneered the use of sound stimulation, and whose theories and method have achieved both

**Billie M. Thompson¹ and
Susan R. Andrews²**

¹Sound listening and Learning Center,
Phoenix, AZ and Pasadena, CA

²Tomatis Listening Centre, Metairie, LA



1. Dr. Alfred A. Tomatis.

controversy and acclaim. His publications, honors, and patents have been listed in the English translation of his autobiography, *The Conscious Ear* [2]. The Tomatis Method is becoming better known in the US following over a decade of access to his method in a few private centers (five of them directed by the authors) and after numerous English publications and radio, television, and conference presentations. Professionals worldwide are now creating other technologies and methods whose basis can be clearly traced to Tomatis. This article describes the Tomatis Method and the many new methods and technologies that comprise the field of sound training.

The Tomatis Method: Methods and Materials

The Method

The Tomatis Method is a noninvasive program of sound stimulation, audio-vocal activities, and consultation. It is used to enhance abilities or overcome problems that are listening-related, such as speech and language, learning, attention, and communication, among others. The method was developed by Alfred A.

Tomatis over 50 years ago and has been used throughout the world with both children and adults.

A Tomatis Method program stimulates the ear, provides a supportive listening environment, and develops inner motivation to listen, correct audio-vocal control, and enhance the ear-voice relationship essential to the receiving and self-monitoring of speech and the singing voice. The components of the Tomatis Method are many and integrated, and they differ slightly for individual and group programs. The method is not *the Method* unless all components are included.

The evolution of Tomatis' theories, philosophy, inventions, discoveries, and experience is documented in some five books that he wrote over the course of his career. There are translations in several languages for most of his books. Three were translated into English (the latter two translations were edited by Thompson, co-author of this article): *Education and Dyslexia* [3], *The Conscious Ear* [2], and *The Ear and Language* [4]. Only the third book is still in print.

The scope of this article does not allow a review of the research on the effective-

ness of sound stimulation in general or the Tomatis Method in particular. For that, the reader is referred to the currently available literature for listings of the research [1, 2]. Carefully controlled studies are currently underway. Gilmor has submitted for publication a meta-analysis of significant changes on scores of standardized pre- and postinstruments of children with learning disabilities who underwent the Tomatis Method [5].

Technology Used in the Tomatis Method

The Tomatis Method includes multiple proprietary components of equipment and materials (the Electronic Ear (EE) or a machine for educational applications, special earphones for bone and air conduction, Listening Test Machine or computer-based media for giving a listening test), enhanced recordings (music tapes/CDs, including Mozart, Gregorian chant, and a variety of active voice tapes), and program protocols for machine settings and tapes to use with different types of applications and individual users.

The most essential part of the Tomatis Method is the EE. This device is con-

Table 1. Needs Addressed by the Tomatis Method by Specific Technology and Methodology

| Need | Technology | Method |
|---|--|--|
| Restore less perceived frequencies to ear & voice to have good quality voice | Highpass and bandpass filters | Filter music and voice to provide the missing frequencies |
| Establish right-ear dominance for efficient feedback to speech center in brain | Right & left volume controls are separate | Gradually reduce volume output to left ear |
| Maintain gains of sound training | Attach microphone for voice input through EE and tapes/CDs that have one repeat words, phrases, hum, sing, or read aloud | Sufficient conditioning of hearing own voice with a good quality through EE, developing skill in memory, sequencing, and listening and self confidence in speaking |
| Rapidly analyze incoming sounds | Output sound through two channels with a gate between | Emphasize different ranges with each channel so ear constantly adapts |
| Hear higher frequency sounds gradually more easily than lower frequency sounds | Filters and channel settings set to train for the ideal slope of sound reception | Sufficient passive and active listening to ideal settings for individual's needs |
| Differentiate between different sounds | Gates and content of sound | Set gating and select music to train ear to differences |
| Prepare the ear to receive incoming sound information | Earphones with bone and air conduction used with delay between bone and air sound input | Gradually normalize timing delay between bone and air for specific application & /or language |
| Perceive specific rhythm and range of frequencies for a language and be motivated to listen | Channel, delay, and filter settings specific for an application (including language spoken by native speaker or by a mother for her child) | Sufficient conditioning to distinguish sounds and ranges desired and desire to tune in |
| Sound that helps to organize thinking, energize, relax, attend, and develop rhythm | Select music, such as Mozart, Gregorian chant, and waltzes; prepare for EE use | Provide variety of selections via a specific program designed for the person |
| Identify the listening strengths and weaknesses of a person | Provide listening test equipment and protocol for a person's age and goals which uses sound, observation, and laterality activities | Do assessment and consultation with person (and family if it is a child) to review results, set goals, and develop sound training program |
| Communicate with person doing sound training | Use a soft communication technology to reframe & provide supportive listening & learning environments | Provide periodic consultation to inform, guide, model, train to used new strategies, and recommend supportive activities |

nected to a good-quality tape player or other media that allows high frequencies of at least up to 16,000 Hz to 20,000 Hz to be heard. The EE can filter recordings of music and voice, and the sound travels through two channels, with different settings. A gating mechanism alternates the sound between the channels when it reaches a specific intensity. The sound is delivered through special earphones with bone and air conduction.

The EE is designed to educate the ear to its full functions as a receptor, a mechanism to make subtle discriminations, and an energy generator. The right ear is trained to be the leading or dominant ear, to make for the most efficient processing of speech directly by the speech center in the left hemisphere of the brain. Through a microphone connected to the EE, one's ear can receive good quality audio-vocal feedback of one's voice. Table 1 summarizes the technology of the machine and methodology used to accomplish specific needs. Figure 2 displays the basic structure of how the technology works. The Tomatis Method continues to evolve as technology changes.

The Tomatis Method Methodology

The Tomatis Method begins with an initial assessment to identify listening strengths and weaknesses. The assessment, which includes completion of a battery of tests, a detailed history, observation, and consultation, typically requires one to three hours to complete. A trained professional works with the adult or family of a child to define appropriate goals and to determine the most appropriate length and type of listening training for an individual's specific needs. If an individual is unable or unwilling to complete the test battery, a decision about the appropriateness of using the Tomatis Training is made by the consultant following observation of the individual, a review of his or her personal history, and a consultation with the parents or guardians.

Individuals typically listen from one to two-and-one-half hours daily to unfiltered and/or filtered music and voice processed through the EE in order to achieve specific goals. Programs for individuals, schools, companies, and other groups are developed to meet their particular application and schedule and resource needs. While listening, individuals participate in creative activities such as drawing or painting, putting puzzles together, playing games, conversing, or simply relaxing.

The Tomatis Method is a noninvasive program of sound stimulation, audio-vocal activities, and consultation.

Many of the activities help to integrate reflex and tactile sensory systems.

The listening program has both passive and active phases provided over several intensives. One goal of the passive phase of listening is to encourage creativity and experimentation with new activities. During the passive phase, the individual listens to sounds, primarily the music of Mozart, which stimulates the development of thinking and rhythm abilities, and Gregorian chants, which possess stimulating overtones. When available, and of good quality, children hear the filtered mother's voice reading a story in order to stimulate their curiosity and reintroduce the rhythm and intonation patterns of the native language.

During the active phase, the individual speaks into a microphone as his or her voice is played back to his/her own ear through the EE. The individual may sing; hum; repeat words, phrases and chants; and read aloud with music. The conditioning of one's ear to one's voice heard with good quality is an essential part of the program. The active work can progress from basic sounds and speech for some chil-

dren with developmental and learning disabilities, to the highly effective, self-monitored oral activities of professional speakers, singers, actors, musicians, salespeople, teachers, and others who routinely depend on their voice to earn a living. French actor Gerard Depardieu has described his experience with the Tomatis Method as helping him achieve his acting status [6].

A minimal program typically occurs within two or three intensives covering at least 60 to 75 hours. The length of the first intensive is usually 30 hours. Three- to six-week breaks for integration of changes separate the first two to three intensives.

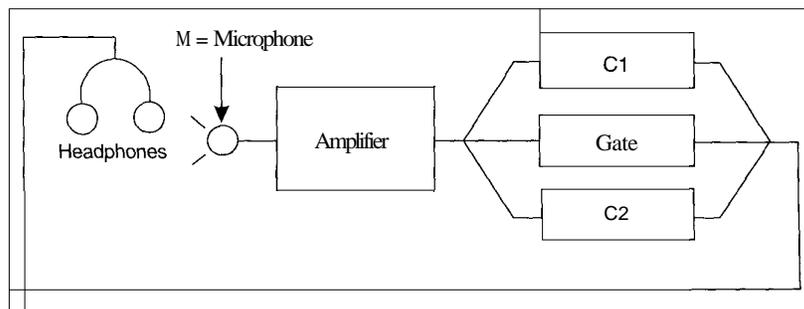
When persistent, long-standing, developmental and/or learning problems exist, longer programs are recommended, until full potential is achieved. Additional intensives of 16 to 30 hours several times a year can assist the person to further improve abilities and achieve goals.

The Tomatis Method basically trains or conditions the ear until the individual is capable of retaining the benefits without the training. The EE does not become a replacement for one's own good listening; instead, it becomes the conduit for the education, or re-education, of one's ears to their greatest potential.

The consultant provides consultations throughout the program, teaching effective communication, social interaction, and accelerated learning strategies to use with one's newly enhanced listening. Meetings with families provide effective strategies for individual support within the group and consistent structure for children so they can develop their abilities.

Assumptions Underlying the Tomatis Method

As a physician, Tomatis treated opera singers who had discovered that they could no longer produce certain sounds with their voices. Medicine failed to provide an ef-



2. Tomatis' Electronic Ear design.

fective solution. Tomatis also was treating ammunition factory workers with sensori-neural hearing loss, and he observed similarities between their hearing tests and those of the opera singers. The sounds missing from the singers' voices were missing from their hearing as well. This led to his hypothesis that the voice could only produce what the ear could hear and to the distinction between hearing and listening. This hypothesis later became known as the "Tomatis Effect," and was independently confirmed at the Sorbonne in 1957 [7]. Two corollaries to the Tomatis Effect led to the development of the Tomatis Method: 1) if the sounds are restored to the ear, they will be immediately restored to the voice, and 2) with sufficient conditioning of one's ear to one's own voice heard with good quality, the changes can be maintained and strengthened.

The Tomatis Method is based on a number of assumptions about how people develop, process information, and learn, including the following:

1. Hearing is different from listening. Hearing is the passive reception of sound, while listening is the active motivated tuning in and tuning out at choice. Good listening results in well-organized auditory processing and vestibular control of information.

2. Listening plays the fundamental role in processing all language information, and hence all information learned through language.

3. The motivational and emotional need for communication begins with listening.

4. One role of the auditory system is to connect or relate self to self, to others, and to the environment.

5. The brain needs sound energy to enable the thinking processes and the development of intelligences.

6. Sound stimulation technology can be used as a tool by professionals with different backgrounds to assist people of all ages to improve their listening.

7. Listening is a skill that can be both lost and recovered.

8. Poor listening can begin at any age and for any number of reasons. It might result from a health problem, an accident, a major lifestyle disruption, or from stress. A checklist of symptoms of poor listening is given in Fig. 3 to provide a guideline for self-assessment.

Listening actually begins in the womb, and the ear plays a vital role in developing human potential. The mother's voice is heard by the fetus at least by the fifth month in utero, when the auditory nerve is fully functioning. (In fact, it is the only sensory system to achieve this level at this time of fetal development.) According to Tomatis [8], the filtered mother's voice reading a story can be used as a simulation of what would have stimulated the brain of the fetus before birth. Research by Abrams, Hutchison, and McTiernan [9] with fetal sheep supports the contention that normal growth and maturation of the brain depends on an intact auditory system. Research by Querleu and Renard [10] using interuterine microphones shows that the attenuation of

| | |
|--|--|
| <p>Receptive Listening to incoming sounds, tuning in to what is outside oneself, such as spoken requests and information given at home, work, or school.</p> <ul style="list-style-type: none"> <input type="checkbox"/> short attention span <input type="checkbox"/> distractibility <input type="checkbox"/> specific sound avoidance <input type="checkbox"/> misinterpretation of questions, requests <input type="checkbox"/> confusion of similar sounding words <input type="checkbox"/> frequent need for repetition <input type="checkbox"/> inability to follow more than 1 or 2 sequential instructions <input type="checkbox"/> Poor sense of timing <input type="checkbox"/> Unattuned to the rhythms & intonations of the language <p>Expressive Listening to one's own voice, focusing on what is within, monitoring and reproducing correctly what one hears, especially one's own voice.</p> <ul style="list-style-type: none"> <input type="checkbox"/> flat and monotonous voice <input type="checkbox"/> hesitant speech <input type="checkbox"/> weak vocabulary <input type="checkbox"/> poor sentence structure <input type="checkbox"/> overuse of stereotyped expressions <input type="checkbox"/> inability to sing in tune <input type="checkbox"/> confusion or reversal of letters <input type="checkbox"/> poor reading comprehension <input type="checkbox"/> poor reading aloud <input type="checkbox"/> poor spelling <p>Motivation & Responsibility to lead a fulfilling life.</p> <ul style="list-style-type: none"> <input type="checkbox"/> difficulty getting up <input type="checkbox"/> tiredness at the end of the day <input type="checkbox"/> frequent procrastination <input type="checkbox"/> inability to maintain focus <input type="checkbox"/> tendency toward misery and being a victim <input type="checkbox"/> feeling overburdened with everyday tasks' <input type="checkbox"/> difficulty planning and organizing <input type="checkbox"/> low interest in, negative attitude toward school/work | <p>Behavioral and Social Relationships</p> <ul style="list-style-type: none"> <input type="checkbox"/> low tolerance for frustration <input type="checkbox"/> poor self-confidence and self-image <input type="checkbox"/> shyness, difficulty making friends <input type="checkbox"/> tendency to withdraw, avoid others <input type="checkbox"/> irritability <input type="checkbox"/> immaturity <input type="checkbox"/> non-collaborative problem solving <p>Rhythm, Motor Skills, listening to the body, its balance and coordination and development of body image.</p> <ul style="list-style-type: none"> <input type="checkbox"/> poor upright stance <input type="checkbox"/> fidgety behavior <input type="checkbox"/> clumsy, uncoordinated movements <input type="checkbox"/> poor sense of rhythm <input type="checkbox"/> messy handwriting <input type="checkbox"/> hard time with organization, structure <input type="checkbox"/> confusion of left and right <input type="checkbox"/> mixed dominance <input type="checkbox"/> poor athletic skills <p>Developmental History, accidents, illnesses, or emotional or physical trauma that makes one want to tune out, such as the following:</p> <ul style="list-style-type: none"> <input type="checkbox"/> a stressful intrauterine development <input type="checkbox"/> difficult birth <input type="checkbox"/> adoption <input type="checkbox"/> early separation from the mother <input type="checkbox"/> delay in motor development <input type="checkbox"/> delay in language development <input type="checkbox"/> recurring ear infections <input type="checkbox"/> multisensory system disorder diagnosis <input type="checkbox"/> history of stressful life experiences |
|--|--|

3. Checklist of symptoms of poor listening.

sounds above 2000 Hz have previously been overestimated, which supports Tomatis' contention that the fetus hears high-frequency sounds. The number of nerve cells in the cochlea responding to high-frequency sounds is four times greater than those stimulated by low-frequency sounds, under 3000 Hz. Thus, human neurology alone suggests the importance of high-frequency stimulation, which also represents the overtones of music and voice. When the mother's voice is not available or for some reason not recommended for use, filtered Mozart is used instead.

The objectives for Tomatis Method training are based on his views that the human ear has at least the following seven functional capabilities, which can be altered at any age:

1. Ability to select/distinguish tonal differences and the direction of the differences between sounds. Sequenced pure tones are presented to both the right and left ears through air and bone conduction. This ability is linked to reading, letter and number confusion, sequencing problems, self-confidence, music ability, memory, and lack of access to clear information about one's past experiences. Regarding reading, poor sound distinction makes it difficult to transform sounds into symbols and symbols into sounds, and to see relationships between words that have similar sounds. On one end of this ability spectrum is someone with a partially or totally closed (nondistinguishing) ear, who cannot discriminate between some or all sounds. On the other end is someone who can distinguish between isolated individual sounds. (Some people with hearing loss who listen through bone conduction can perceive sound vibrations through the vestibular system, despite the conduction loss in the middle ear. Bone conduction bypasses the middle ear to directly vibrate the inner ear.)

2. Ability to attend consistently to incoming sounds more easily than one's own thoughts and to tune out distractions. This ability is related to problems with attention span, memory, behavior, following instructions, and relationships with others.

3. Ability to process information similarly with both ears. This relates to one's ease with comprehending incoming information, sense of organization, and rhythm.

4. Ability to identify the source of direction where sounds originate. As tones are presented to the right and left ears through air and bone conduction, the person must identify the source of the sound. This ability is related to problems with reading pro-

It was not until Tomatis that a technology-based training method was created using sound as a therapeutic and educational intervention.

cessing, sequencing, confusion of left and right, and spatial organization.

5. Ability to process information so that highly energizing consonant and overtone sounds are gradually more easily perceived than lower frequency sounds. An ideal response curve is established for a good musical ear (Fig. 4). Ideal curves are also established for different languages because each has a specific frequency range and intonation pattern that is emphasized [2, 4, 11, 12]. This relates to ease of comprehending incoming information, one's musical ear, voice quality and clarity, speech clarity, thought clarity, creativity, level of energy, and sense of well being.

6. Right-ear dominance. This relates to processing timing delays, one's ability to sing on key, academic problems, and relationship problems.

7. Listening threshold within normal hearing range. Variance from the ANSI hearing norm is within normal limits. Reported in research as early as 1962, hearing loss has been correlated with lower IQ scores on standardized tests, at the rate of 5 IQ points loss for every 5 dB hearing loss [13]. If a listening problem is coupled with a sensory hearing loss, one may not use well what one has.

Historical Perspective Development of the Tomatis Method

Therapeutic uses of sound in the form of music or chants have been known for centuries. The chanted hymns of the Vedas in India and the Gregorian chant of the monks have an energizing effect. Mothers sing to their children to soothe crying. Our body can feel sounds we can-

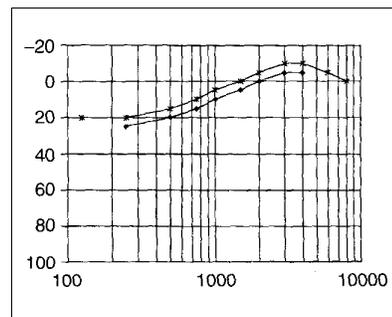
not even hear, as in a very low-frequency bass rhythm. Low-frequency sound waves resonate in the lower parts of the body, while high-frequency sound seems to affect the brain and upper body.

It was not until Tomatis, however, that a systematized training method with technology as its base was created using sound as a therapeutic and educational intervention.

From his original application to help professional singers with an early model of the EE, the Tomatis Method evolved to today's multiple educational and clinical applications using a more technologically sophisticated EE. Tomatis left the medical profession at age 50 to pursue further development of the EE and of what he called the science of audio-psycho-phonology (APP). He was awarded seven US patents, as well as patents in other countries, with the patent, trademark, and proprietary rights now held by the Paris-based international organization he began, Tomatis International, S.A. (TISA). In a recent popular book called *The Mozart Effect* [14], Campbell details Tomatis' contributions to the field.

TISA and its subsidiaries and representatives in different countries provide training and credentialing programs for interested professionals who want to use the Tomatis Method. Research continues by TISA and by users in many countries to document the effects of the method in many applications, and to expand the method as new technology becomes available. Nearly 150 dissertations and theses with the Tomatis Method as its subject have been accepted by universities worldwide, including some in the US.

The further evolution of the Tomatis Method now falls to Alfred Tomatis' son, Christian Tomatis, who assumed control of TISA in 1994 upon his father's retirement. Christian Tomatis reorganized the company and its approach to worldwide



4. Ideal response curve for the musical ear on the Tomatis Listening Test (reprinted with permission from [4]).

expansion. Following discussions with the FDA regarding the many claims made worldwide by those who used the Tomatis Method as a tool, or those who benefitted from it as clients, TISA acknowledged the FDA's request to refrain from making clinical/medical claims until they could be proven using FDA-approved research designs. The authors of this article are developing research collaborations with universities and health organizations to address the clinical claims.

Extensions of Tomatis' Work

Several offshoots or extensions of the Tomatis Method have been developed by individuals familiar with the work. Table 2 presents a summary of these extensions, along with a means of comparing the methods and/or technology. Some new extensions are in development and are mentioned without full details.

One of the earliest extensions was made by Joudry [15], a former patient of Tomatis. She made four tapes from the output of an early model of the EE to play on a Sony Walkman. They are marketed, along with a book, as "Sound Therapy for the Walkman" (tm). Joudry also now markets what she calls a portable "Electronic Ear."

Another Tomatis patient, student, and colleague, Dr. Guy Bérard [16], borrowed parts of Tomatis' technology in the public domain, proposed his theory about "hear-

ing equals behavior," developed a machine called the Audiokinetron, and applied a substantially different method. This method is called Auditory Integration Training (AIT), and many have lumped it with Tomatis, without distinction. The AIT method was researched by Rimland, Edelson, and others for its effects on autistic/PDD children [17].

Stehli reported on the success of the AIT Method to "cure" her autistic daughter [18], and she oriented the use of AIT primarily toward autistic children. This stimulated the development in the US of another AIT machine by Bill George, called the Audio Tone Enhancer/Trainer, (manufactured by BGC Enterprises, which is no longer in business). Both BGC and Bérard's manufacturer declined to pursue FDA approval following the FDA's decision that proof of clinical claims was insufficient. Stehli reports the development of a new machine [19], though claims are not yet clearly defined for it.

The Society of Auditory Integration Training (SAIT) was organized for those providing AIT using both the BGC and Bérard machines, but the organization's activities declined following a 1996 incident in Florida that resulted in confiscation of equipment and the FDA's decision to stop importation of the Audiokinetron.

Steinbach [20], a German sound engineer, musician, and teacher of music and

physics, now offers training for professionals in his Samonas Sound Therapy method. He claims to have refined the "famous Electronic Ear" of Tomatis and added an "Envelope Curve Modulator" to emphasize certain ranges of sounds. His CDs are played on normal CD players and are available from professionals who are trained to use them.

Weil [21], a Harvard-trained physician who is director of the Program in Integrative Medicine of the College of Medicine at the University of Arizona, recently published CDs with acknowledgment to Tomatis' theory and philosophy.

Lowrey [22], developed a patent to work the oscillation of waves between higher and lower sounds. He claims his method is "better than Tomatis" for exercising the middle-ear muscles. His patent was recently declassified following its use in the Iraqi war in 1994, when sound was broadcast to enemy troops using his technology.

Madaule, who works with the Tomatis Method in Canada, recently announced a portable EE machine with an air conduction output [23].

Tallal has long been involved in research about auditory processing and, with Merzenich, recently co-developed the Fast Forward CD-ROM program [24]. Adaptive training exercises are presented as computer games to train young children with language-based learning im-

Table 2. Extensions from the Tomatis Method: How Others Are Similar and Different

| | Tomatis | Berard AIT | BGC | Samonas | Joudry | Lowrey | Madaule | Thompson |
|------------------------------------|---------|------------|-----|---------|----------|--------|---------|----------|
| Patented equipment | X | | | | | X | | X |
| Proprietary equipment | X | X | X | | X | X | X | X |
| Standard CD/tape player | X | X | X | X | X | X | X | X |
| Proprietary sound | X | | | X | X | X | X | X |
| Off-the-shelf CDs/tapes | | X | X | | | | X | |
| Mozart/Classical | X | | | X | X | | X | X |
| Gregorian Chant | X | | | | | | X | X |
| Folk songs/rock | | X | X | | | | | |
| Passive listening | X | X | X | X | X | X | X | X |
| Active listening with microphone | X | | | | Optional | | X | |
| Claims – clinical | X | X | X | X | X | X | | |
| Claims – educational | X | X | X | X | X | X | X | X |
| Claims – foreign language | X | | | | | | | X |
| Claims – musical | X | | | | | | X | X |
| Portable | X | | | X | X | | X | X |
| Air conduction | | X | X | X | X | X | X | |
| Air and bone conduction | X | | | | | | | X |
| Listening Assessment | X | X | X | X | X | | X | |
| Research published – peer review | X | X | X | | | | | |
| Research published – university | X | X | | | | | | |
| Pursuing FDA approval for clinical | X | | | | | | | |

Table 3. Technology of Each Method: Similarities and Differences Among the Various Technologies in the Field of Sound, Showing the Highest Levels Attained for Each

| Levels (Levels 2, 3, 4, 5 progressively are more complex, with each adding a capability to those before it) | Tomatis EE/educ | Joudry tapes | Berard/BGC AIT | Samonas | Madaule & Joudry machines | Thompson |
|---|-----------------|--------------|----------------|---------|---------------------------|----------|
| Selection of appropriate music content by producer | X | X | X | X | X | X |
| 1. Passive – no special equipment | | X | | X | | |
| 2. Passive, equalized, air conduction earphones | | | | | | |
| 3. Passive, equalized, air conduction earphones, Filtered | | | | X | | |
| 4. Passive, equalized, air conduction earphones, Filtered, Gated | | X | X | | X | |
| 5. Passive, equalized, air & bone conduction earphones, Filtered, Gated, Delayed Air Conduction | X | | | | | X |
| 6. Portable | X | X | | X | X | X |
| 7. Microphone for active voice work | X | | | | X | |

pairments to improve their temporal processing skills.

While not directly related to the Tomatis Method or theory, the impact of sound on the entire body is fully demonstrated by Jenny's work [25], called *Cymatics*, and by Manners' therapy training, which uses these principles [26]. Jenny shows that sound, rhythm, and movement create the form of all matter, including humans. In this context, humans depend on the ear to organize and analyze sound, rhythm, and movement. Sharry Edwards [27], who has the ability to hear in extraordinary ranges of sound, created a method to identify the missing sounds in a person's voice and a machine to generate that vibratory sound in order to bring systemic balance to that person.

Finally, work at the Monroe Institute continues with hemi-sync pulses within music to balance the brain and to improve focus and learning [28]. Carefully researched sound blends, sequences, and patterns are embedded in tracks underneath music in order to synchronize the two hemispheres of the brain. Leeds [29] now also produces music with hemi-sync and promotes psychoacoustics to train people to relax and concentrate.

The Field of Sound Training Today

Over the past 20 to 30 years, researchers and clinicians have developed a wide range of applications for sound-based methods, ranging from correction to enhancement of skills. The Tomatis Method has been listed as a resource in both *Superlearning 2000* [30] and *Alternative Medicine: The Definitive Guide* [31]. In general, several levels

of evolution can be observed and defined as levels of listening training, as graphically presented in Table 3.

The demand for more sound-based services in the US is increasing as individuals recognize that these methods offer a new solution for disabilities and deficits that have heretofore resisted change or been untreatable. However, just as the demand is increasing, the supply of machines and properly trained educators and trainers is decreasing.

One reason for this disparity is because of the lack of funded research to prove efficacy. For clinical claims, the FDA requires a specific type of research to prove claims about human functions that change with the use of a machine. Research needs to be done with the rigor of double-blind, placebo control-group studies, or using pre- and post-treatment analyses of change in single-subject design studies. The research must define the expected or predicted changes in defined populations and demonstrate that the device was actually responsible for the changes seen in the patients. This research also must have institutional review board (IRB) approval prior to importing technology to do the research.

While the FDA requires that clinical products be safe for the US public, educational products do not fall under its control. TISA has committed to both the FDA process for clinical claims and to establishing a distinct educational technology, methodology, and product name for educational applications. As this process unfolds, it likely will have implications in

setting standards for future professional training in the field of sound training.

It is essential to explore who gets trained as well as how much training, and of what type, they receive. Historically, training has lasted anywhere from one day to several weeks, depending on the method. In general, both educational and clinical professionals who hold degrees and certifications in a field of practice have been accepted for training by trainers of the methods. Currently, there is no broad-based credentialing process that includes examination on a representative and agreed-upon body of knowledge. Additionally, franchise laws may come into effect, depending on how the person is required to pay for training, equipment, and the use of a trademark name.

Conclusions and Further Requirements

The pioneering work of Dr. Tomatis has led us to understand listening as a basic communication skill, the ear as a major integrator for the nervous system, and sound-training technology as a valuable tool for use by many different professionals. New research, theory, patents, technology, and training efforts are expanding upon Tomatis' original concepts, technology, and methods. The educational and clinical applications of sound stimulation are in their infancy yet growing rapidly, as more is learned of the brain and how we process information.

The kinds of changes being experienced with sound training do not necessarily fit within our current educational paradigm. Yet, integrating the hard and

soft technologies of sound-based training with our evolving understanding of how humans respond to sound stimulation can have tremendous impact on the ability of each individual to reach his or her own potential. To say that technology is a valuable tool goes without saying; to say the same thing about sound-training technology may go outside the comfort zone of many professionals.

Calls for more precise assessments for pinpointing auditory processing and listening problem sources are now coming from clinical and university researchers. Researchers such as Lauter, et al. [32], and Jones [33] are now recommending specific integrated auditory, speech, and brain diagnostic procedures that can further refine our understanding of the effect of sound on people and can provide specific training protocols for different needs.

Ultimately, we must thoroughly investigate how and why sound training works. Rigorous research to compare the different methods is needed as well. There is a need for evaluation of how each of the different methods works, and for assessment of the differential effectiveness of each method and technology (for example, Tomatis vs. Samonas) for different problems and different populations. The essential features of the different methods need to be identified and understood for their individual and collective component effects.

The immediate implications of sound training are simple: this evolving, scientifically based body of work presents professionals in education, health, and human development with transformative tools for developing individual potential.



Dr. Billie M. Thompson was trained by Dr. Tomatis and has worked with his techniques for over a decade. She hosted the 1991 TISA training in the US and has published and spoken widely in the US about the Tomatis Method. She edited two of Tomatis' English translations. She provides outreach educational Tomatis Method programs in addition to directing four centers. In addition, Dr. Thompson has received two patents for sound technology that may be developed to help in expanding the field to more users.



Dr. Susan R. Andrews was trained by Dr. Tomatis and has worked with his techniques for over a decade. She is a clinical developmental neuropsychologist who was initially attracted to the Tomatis Method because of her work with developmentally delayed and/or learning-disabled infants and children. Dr. Andrews also treats adults and children with neurological injury and has over a decade of experience in neurological rehabilitation for stroke and head injury. She sees a tremendous application of the field of sound to these problems. Over the years, Dr. Andrews has devoted herself to finding ways to help people reach and increase their human potential. She was among the early researchers of the Head Start Program and the Parent-Child Development Center, whose goals were to break the cycle of poverty by helping youngsters reach their potential.

Address for Correspondence: Billie M. Thompson, Sound Listening and Learning Center, 2701 East Camelback Road, Suite 205, Phoenix, AZ 85016. Tel: (602) 381-0086. Fax: (602) 957-6741. E-mail: drbthmpsn@aol.com.

References

1. **Thompson, BM:** Listening disabilities: the plight of many, in Wolvin A. Coakley C (Eds): *Perspectives on Listening*. Norwood, NJ: Ablex Publishing, pp. 124-168, 1993.
2. **Tomatis A:** *The Conscious Ear*. Barrytown NY: Station Hill Press, 1991 (out of print).
3. **Tomatis AA:** *Education and Dyslexia*. Fribourg, Switzerland: Association Internationale di Audio-Psycho-Phonologie, 1978 (out of print).
4. **Tomatis AA:** *The Ear and Language*. Norval Onatrio: Moulin Press, 1996.
5. **Gilmer T:** The efficacy of the Tomatis Method for children and communication disorders: a Meta-analysis (work in press).
6. **Chutkow P:** *Depardieu*. New York, NY: Alfred A. Knopf, 1994.
7. **le Gall A:** The correction of certain psychological and psychopedagogical deficiencies by the Electronic Ear using the Tomatis Effect. Office of the Inspector General of Public Instruction, Paris. March. 1961.
8. **Tomatis, AA:** Ontogenesis of the faculty of listening, in T.R. Verny (Ed.), Pre- and peri-natal psychology: An introduction. New York: Human Sciences Press. 23-35. 1987.
9. **Abrams RM, Hutchison AA, McTiernan MJ, et al.:** Effects of cochlear ablation on local cerebral glucose utilization in fetal sheep. *American J. Obstet. Gynecol.*, 157: 1438-42, 1987.
10. **Querleu D, Renard X:** Bouteville, Claudie: Crepin, Gilles. Hearing by the human fetus? *Seminars in Perinatology*. 13(5): 409-420, 1989.
11. **Tomatis AA:** *L'Oreille et le Langage*. Paris. France: Éditions du Seuil, 1963.
12. **Tomatis AA:** *L'Oreille et la Vie*. Paris. France: Éditions Robert Laffont, 1977.
13. **Wrightstone JS, Aronow MS, Moskowitz S:** Development of reading test norms for deaf children. Bureau of Educational Research. Board of Education. PN 22-262. NY. NY, 1962.
14. **Campbell D:** *The Mozart Effect*. New York, NY: Avon Books, 1997.
15. **Joudry P:** *Sound Therapy for the Walkman*. Dalmeny, Saskatchewan: Steele and Steele. 1989.
16. **Berard G:** *Hearing Equals Behavior*. New Canaan CT: Keats Publishing Inc., 1993.
17. **Edelson S, Rimland B:** The effects of auditory integration training on autism, *Amer. J. Speech-Language Pathology*, 3(2): 16-24. 1994.
18. **Stehli A:** *The Sound Of A Miracle: A Child's Triumph over Autism*. New York. NY: Doubleday, 1991.
19. **Stehli A:** www.aitauditoryinregrurion.com
20. **Steinbach I:** *Samonas Sound Therapy*. Kellinghusen. Germany: Techau Verlag, 1994 (German). 1997 (English).
21. **Weil A:** *Sound body, sound mind: music for healing with Andrew Weil, MD.* (CD with book) New York. NY: Upaya, Tommy Boy Music. 1997.
22. **Lowrey, B:** Personal communication from OM (Bud) Lowrey. Lowrey Associates. 5188 Falconwood Court. Norcross GA 30071, 1995.
23. **Madaule, P:** The listening cure. *Equinox* 92(XVI:2): 64-77, 1997.
24. **Tallal P, Miller S, Bedi G, Byma G, Wang X, Ky KW, et al.:** Language comprehension in language-learning impaired children improved with acoustically modified speech. *Science*, 271, January 5, 1996.
25. **Jenny H:** *Cymatics*. Basel, Switzerland: Basilius Presse AG. 1974.
26. **Manners G:** *Cymatics: The Healing Nature of Sound* (videotape). Brookline, MA: MACROmedia, 1986.
27. **Edwards S:** *Bridging the Gap Between Psychic and Science: Proposing a Unifying Field Theory for Energy Medicine and Energy Science*. Athens. OH: Dimensional Resources, 1990.
28. Monroe Institute web site: <http://www.eu.spiritweb.org/Spirit/monroe-inst.html>
29. **Leeds J:** *Sonic Alchemy*. Sausalito, CA: InnerSong Press, 1997.
30. **Ostrander S, Schroeder L, Ostrander N:** *Superlearning* 2000. New York NY: Dell Publishing, 1997.
31. **Burton Goldberg Group (Eds):** *Alternative Medicine, the Definitive Guide*. Puyallup, WA: Future Medicine Publishing. 1993.
32. **Lauter JL, Richey H, Gilmore S, Lynch O:** Putting the "central" hack in central auditory processing. *J. Developmental and Learning Disorders*. 2(1): 51-106, 1998.
33. **Jones G:** Personal communication from Dr. Greg Jones, Ctr. for Advanced Medical Technologies, University of Utah. 729 Arapeen Dr. Salt Lake City UT 84108, 1998.