The Tomatis Method and the Genesis of Listening

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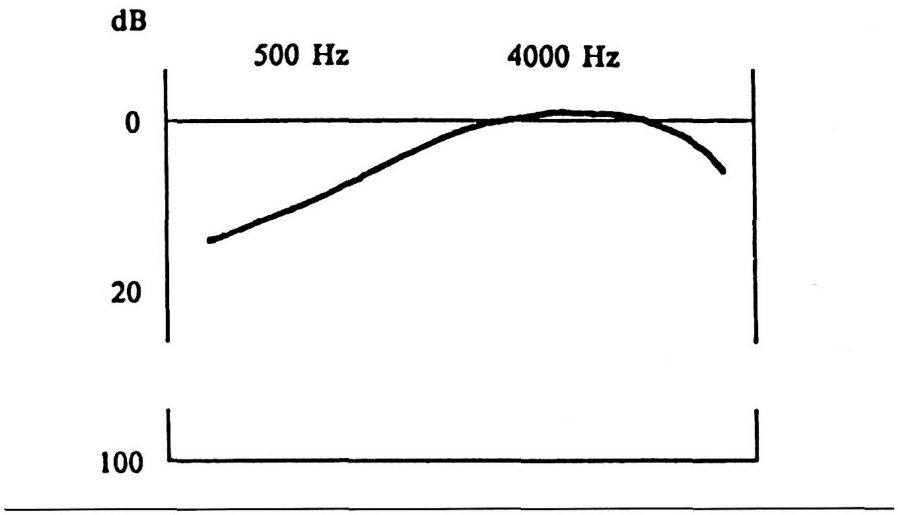
Full Text: INTRODUCTION Over the last 40 years, Dr. Alfred A. Tomatis, a French physician and specialist in Otolaryngology, has been developing a method of auditory stimulation which assists and accelerates the development of listening skills, language and communication. The Method which bears Tomatis' name has been successfully applied in North America by special education teachers, psychologists and speech and language pathologists who have been trained and certified in the application of the Tomatis Method and continue to work in association with Dr. Tomatis. There are over 80 facilities worldwide, the majority in Europe, directed by certified specialists from the fields of music, education, psychology, medicine, speech and language therapy and occupational and motor therapy. In North America, the Method's growth has been spurred on by the activities of organizations and individuals-both parents and professionals-committed to seeing it made more widely available. There are currently nine professionally directed (private and non profit) clinics or centres operating in Canada (3), the United States (3) and Mexico (3). A special group version of the Tomatis Method, the Listening Training Program, has been applied in five Canadian school boards and two private schools to help children with listening-related learning and communication disorders. Tomatis coined the term "audio-psycho-phonology" (A.P.P.) to describe his innovative and multi disciplinary approach. He has developed a comprehensive theory to explain the results obtained with his method. THE METHOD AND ITS EFFECTS The Method itself is a sensory stimulation program in which the individual listens to electronically modified (filtered) sound through headsets. The content is either music, the mother's voice, or the individual's own voice. The sound is modified by a device called the Electronic Ear. By means of filters, amplifiers and a sophisticated gating mechanism the sound is reshaped and presented to the ear in rapidly alternating forms. This auditory stimulation has a number of well documented effects (see Gilmor, 1989; van Jaarsveld &du Plessis, 1989, in press; and Stutt, 1983 for reviews of the literature). 1. There is improvement in receptive (attention span, aural comprehension) and expressive (speech, voice and language) communication skills. This is accomplished according to Tomatis through the modified sound's effect on the middle ear's focussing response which is mediated largely by the action of the stirrup and hammer muscles. 2. There is improvement in concentration, alertness, mental energy and more highly developed cognitive skills. Tomatis attributes this to the energizing effect of high-frequency sound on the central nervous system. This "charging effect" derives from the very large proportion of sensory receptor cells of Corti (located on the basilar membrane of the cochlea) which are responsive to high-frequency sound. 3. There is improvement in the emotional well-being of the individual especially in cases where the source of the emotional block or trauma occurred in early life during the prenatal period, birth experience or first years of life. Increases in the individual's communicativeness are generally observed, "more expressive verbally," "says more but talks less," "more curious," "more open." These changes are effected through a simulation of the listening development process from the earliest stages of the ear's auditory functioning during the prenatal life. This sonic journey traces the stages of listening from the mid-point of the pregnancy when the higher frequencies of the mother's voice are perceived. The "sonic birth," a transition from a liquid acoustic environment to an aerian acoustic environment (as at birth) is also recreated. Then the prelinguistic stage of listening to and playing with sounds leads to the linguistic stage during which the integration of the sounds of language occurs.This process releases blocks or obstacles which impede the desire to communicate. 4. Changes in posture, coordination, mastery of body movement and sense of rhythm have been observed and documented through the stimulation's impact on the vestibular system which mediates

these functions. 5. There is a reduction in nervous tension, irritability, somatic complaints, emotional overstimulation and startle response to loud sound. People report they are more relaxed, less easily upset, and less likely to overreact emotionally. Tomatis explains these effects as a consequence of the "toning up" action of the auditory stimulation on the ear drum (tympanum) and the consequent reduction in the activation of the auricular branch of the vagus nerve located on the tympanum. The wide range of these effects has meant the Method enjoys a very broad application from the field of learning disabilities to more severe learning and communication disorders including those associated with autism, cerebral palsy, mental retardation, perceptual handicaps and emotional/behavioural disorders. It can be used to assist children as young as two, adolescents and adults with listening-based learning and communication disorders. Individuals seeking to improve or enhance this primary communication skill for personal development, musical ability or foreign language integration can also benefit. TOMATIS' EARLY RESEARCH Tomatis' definition of listening includes both motivational and neurophysiological components. Listening involves both the desire to communicate and the ability to focus or hear actively, that is to ready the ear and the body for maximum audition. Outlined below are the steps that led him to this definition and eventually brought him to the conclusion that listening is the key to language integration and to the ultimate humanization of the individual. The "Tomatis Effect" In the late 1940's, Tomatis was commissioned by the French government to assess the problem of industrial hearing loss among munitionfactory workers exposed to loud industrial noise. At the same time, he was treating in his private practice opera singers who were having voice problems. His father was a well known opera singer in France. Several breakthroughs evolved from this work. Among the first to use audiometric testing in France, Tomatis found that the factory workers had significant hearing losses especially in the higher frequency ranges. Their complaints of fatigue and irritability and the poor quality of their voices and speech (especially for those whose hearing loss extended into the middle frequency range) did not escape Tomatis' attention. A serious problem in the interpretation of these results arose when Tomatis re-tested his sample several months later. He found the hearing losses evaluated earlier were inexplicably much worse by as much as 30 decibels. What had happened in the interim was that the government announced its intention to introduce workman's compensation. The workers who had suffered industrial hearing loss were not under threat of dismissal as they had originally feared but rather stood a good chance of being compensated. The problem Tomatis faced was to determine the true hearing loss. However, the discrepancy in the results on the audiometric testing permitted him to conclude that motivation played a role in hearing. The "psychology" of hearing would be explored further. The vocal problems of the opera singers (attributed to dysfunction of the larynx) were not responding well to the standard treatments. Tomatis played out a hunch when their complaints of fatigue and irritability as well as their voice problems reminded him of the munition-factory workers' symptomology. He gave the singers hearing tests and discovered that the pattern of response was very similar to his factory workers. The loss was not usually as severe but it led him to conclude that the intensity of their singing (up to 135 decibels at 1 metre's distance) was provoking a self-induced hearing loss and further that the range in which the vocal problem was worst was the very range of the hearing loss. "We sing with our ears" Tomatis proclaimed in 1949. The relationship between the voice and the ear was confirmed by the very high correspondence found between the hearing (auditory) pattern and voice (sonographic) pattern of his singers. In time, Tomatis' discovery that the voice can only reproduce those sounds which the ear can hear was formally verified and recognized in 1957 by the French Academy of Science. This was Tomatis' first law later known as the "Tomatis Effect." If the opera singers' vocal difficulties were not voice-related so much as hearing related, the challenge became how to train or re-educate the ear and thereby assist vocalization. Incidentally, this discovery also resolved the problem of assessing the true degree of hearing loss in the factory workers. This could be done by sonographic analysis of their voices since the frequency pattern manifested in their utterance would correspond to the frequency pattern of their audition. The Re-education of Ear Tomatis began to experiment with amplifiers and filters which permitted him to modify or boost the frequencies which were poorly perceived. The sound of the individual's own voice was

picked up by a microphone, modified through a system of filters and amplifiers and fed back instantaneously to the individual through headsets. As they heard themselves with "corrected" audition their vocalization improved significantly. This phenomenon became known as the second "Law of Restitution." Namely that "if the lost frequencies are restored to the ear, they are automatically re-integrated into the voice." The next step was to see if this restitution could be made to last without constant reliance on the amplifiers and filters which formed the beginnings of the Electronic Ear. Tomatis searched for a model or optimum pattern of audition and found it in the audiometric tests of the best musicians and singers of the time. Their auditory responses formed a pattern he dubbed the "musical ear" (see Figure 1). It is a very smooth and consistent response to sound increasing in sensitivity from the low to the medium frequency range at a minimum of 6 decibels per octave and then tapering off slightly in the highest range. This pattern of audition can be imposed via the Electronic Ear upon the ear of any client seeking help. By means of filters and amplifiers the qualities of the musical ear are reproduced. Noteworthy is the fact that Tomatis was among the very first to successfully explore and identify some qualitative dimensions of audiometrically assessed hearing. Related dimensions (auditory selectivity and auditory lateralization) will be presented later. Tomatis found that constant training of the ear led to more and more lasting benefit for his singers. His third "Law of Retention" states that auditory stimulation administered over a certain time produces lasting effects on audition and phonation. Above and beyond pure cybernetic feedback loops, more profound links between listening and phonation (self-listening) were to be found in the common neural control exercised by the 7th and 5th cranial pairs. The 7th pair controls the function of the stirrup muscle of the middle ear as well as the facial muscles (especially the lips) and the anterior digastric muscles which permit the mouth to open. The 5th cranial pair controls the hammer muscle (tensor tympani) as well as the temporal and masseter muscles which permit the mouth to close. Modifying the quality of the listening response of the ear could modify the quality of phonation (Tomatis, 1974).

Figure 1
The specific threshold curve of the musical ear
(from Tomatis, 1963, p. 101)



Tomatis' clients reported other benefits from this listening training. Not only did their voices improve in richness, control and fidelity, they also reported improvement in their concentration, attention and energy level. A NEW THEORY OF HEARING AND LISTENING Tomatis speculated on the reasons why his method was producing results. As far as explaining the effects on audition were concerned, the traditional and widely accepted theories of hearing based on von Helmholtz and von Bekesy were not helpful. It was believed and still is the widely held view that hearing is an entirely passive process in which sound is transmitted to the inner ear through a chain reaction set in motion by the vibration of the tympanum and subsequent stimulation of the ossicles of the middle

ear which in turn create waves in the fluid of the cochlea. These waves purportedly stimulate the sensory receptor cells of Corti which then transform the sound into neural impulses sent via the auditory nerve to the brain. The vestibular system, by the way, is thought to operate in complete independence of the cochlea despite the fact they share a common shell, share endolymphatic fluid and they perform the same job (analysis of movement) albeit in a different manner. This "separation" of the two systems stems from their seemingly independent functions, one of balance, the other of hearing. However, Tomatis makes the point that phylogenetically the cochlea emerges from the vestibule and that ontogenetically they develop from the same embryonic layer. There is also the anecdotal evidence that sound, especially rhythmic sound, makes us want to move (e.g. dancing or marching music). The traditional "passive hearing" theory of von Békésy and Helmholtz couldn't account for Tomatis' results. He eventually developed an alternative theory outlined in his two volume work Vers l'écoute humaine (1974) in which he ascribes an active role to the middle ear in the focussing process he defines as listening. The ear can focus or go from hearing passively to hearing actively (listening) just as the eye can shift from seeing passively to seeing actively (looking), focussing on some aspect of the visual field. Tomatis hypothesized that this focussing process necessitated an entirely different understanding of how the ear hears. Briefly, his theory states that after stimulation of the tympanum, the transmission of sound occurs not through the ossicles but rather through the hard bone surrounding the middle and inner ear. The pathway of the sound begins at the ear drum from which the bone vibrations radiate to the bone structure surrounding the ear (compact bone1). From there they go directly to the columella, the extension of the compact bone inside the cochlea. The vibrations of the columella are transmitted to the tectorial membrane which in turn stimulates the corti cells. The role of the fluid in the cochlea is to act as shock absorber to control the shearing force of acoustic vibration on the corti cells, quieting the waters and the sensory cells' rapid movement so that adequate auditory perception is maintained and the corti cells are protected. The activation of the fluid triggers a kinetic feedback via the stirrup and anvil to the hammer so that vibratory energy transmitted to the compact bone at the tympanic sulcus is reduced. The oval and round windows along with the eustachian tube provide additional protection. Thus, it is the middle ear's role to adjust conditions for maximum perception of sound. The stirrup, through the action of its muscle, adjusts the pressure level of the endolymphatic fluid and plays a crucial role in permitting audition in the higher frequency range.2 The hammer through the action of its muscle adjusts the tension of the tympanum to maximize the transmission of the sound signal from air conduction to bone conduction. It is well known that the tensor tympani plays a primary role in protecting the ear from sudden loud sound. For Tomatis, however, the middle ear not only provides protection from the adverse effects of loud sound, it also works like a telescopic lens constantly adjusting itself to accommodate the perception of low, medium and high frequency sounds. This is the basis on which he distinguishes the passive act of hearing from the active process of listening.3 Several other findings resulting from his work with singers and musicians are worthy of mention. In attempting to help opera singers produce certain foreign language sounds that were difficult for them to emit (Venetian singers had trouble vocalizing the "R" spoken in Naples), Tomatis observed that not all sounds we hear are necessarily sounds we can reproduce vocally. This is clearly illustrated in the phenomenon of "accents" that people speaking a second language often bear. They can hear the correct pronunciation but cannot necessarily reproduce it. Tomatis concluded that a very refined analysis of language sounds was necessary for proper vocal utterance of those sounds. A person must be able to make very subtle discriminations between sounds in order to listen selectively and subsequently be able to reproduce the language sounds without an accent. He went further in his analysis of this phenomenon to conclude that within each language or dialect there was a critical range of frequencies for which selective listening was essential. In fact, the pattern of this critical range permitted the identification of the language being spoken. Each language or dialect has specific sonic characteristics illustrated by what Tomatis calls the "ethnic ear." Thus, accents are a result of an ear which isn't listening sufficiently or isn't attuned to the critical frequencies of the foreign language. Another was the serendipitous finding of the importance of the right ear in the control of voice and

speech. Having observed an immediate and dramatic improvement in the vocal control of a singer from whose right ear he had removed a plug of wax, Tomatis was compelled to investigate further. He found that masking the right ear's perception of sound had immediate adverse effects on the vocal and instrumental performance of professional singers and musicians. These included diminished vocal control, tone, sense of rhythm and synchronization of body movements. His experiments led him to conclude that the right ear had a directing or leading role in the analysis, integration and control of vocal, speech and musical sounds. This made sense in the context of the shorter neural links between the right ear and those areas of the leftbrain which mediate vocal and verbal expression. The shorter links between sensory fibres serving the auricle and larynx on the right-side compared to the left-side (e.g. the shorter recurrent nerve) added weight to this hypothesis. A "right-ear" control of speech and vocal sounds is more efficient and will permit more fluent speech, greater ease of self-expression and a more rich and resonant voice. The integration of body movement in sound production (i.e. playing a musical instrument) is also facilitated according to Tomatis by a "right-ear" control. Tomatis' theory permits him to explain the results of his method. It also permits him to explain phenomena which the traditional theories cannot. One is bone conduction. Sound vibrations delivered through a bone conductor can be heard and analyzed very well although the sound would appear to by-pass the ear drum and the ossicles. It is known that when the ossicles are removed, sound can still be perceived through bone conduction (Tonndorf, 1972). Tomatis' theory can easily account for this. A second is the fact that a gap exists between the anvil and the stirrup. They are connected by cartilage which means that sounds above 800 Hz are too small to "jump" this gap between the two ossicles. The range of hearing of the human ear goes far beyond what the maximum would be if the traditional theories were true. A third is the improbability that sound is transmitted through the endolymphatic fluid which is in constant turbulence and an unlikely medium for the rapid transmission of different sounds simultaneously (see Fritze and Kohler, 1985; Howell, 1984; Juhn, 1986). For clinicians, Tomatis' theory permits an understanding of why so many children with a history of ear infections are poor listeners and later are at much higher risk to suffer language and learning disorders (Katz, 1978). The middle ear and its muscles are immobilized by the fluid build-up that comes with congestion and infections (otitis media). Like any muscle, they may weaken with disuse and consequently diminish the child's ability to listen. Other children known to have poor muscle tone or problems in muscular control as part of a genetic, physical or neurological disorder (Down syndrome, cerebral palsy) also have more difficulty in listening, paying attention and concentrating. This compounds their already significant communication difficulties. The lack of muscle tone or muscle control also affects the muscles of the middle ear and their ability to accommodate the ear for active hearing or listening. Tomatis' theory also permits us to understand why some people hear "too much." They are hyperacousic, overly sensitive to sound and easily distracted by extraneous sounds. The middle ear is not making the necessary "adjustment" to accommodate perception of specific sounds in the spectrum or to protect the ear from unwanted or assaultive sound. More commonly observed listening difficulties including poor attention span, concentration, misunderstanding or misinterpretation of aural messages can also be better understood in the context of the middle ear's active role in listening or focussed hearing. See Appendix A. These then are the principle discoveries from Tomatis' early work and the theories that developed from that work. The theory provides a framework within which to consider the ear-voice relationship, the linkage between audition and phonation, the importance of the peripheral in addition to central functions in auditory processing and the primary role of the ear in the development of language and learning. There remained the question of the motivation or desire to use one's listening and the genesis of the listening process itself. He turned his attention to these matters in the early 1950's (see Tomatis, 1963, 1981). PRENATAL INFLUENCE Through his clinical work with children, Tomatis became convinced that the process of listening began in utero. Among the sounds that the fetus hears as early as four and a half months after conception, is the sound of the mother's voice. Amid the other uterine noise, this sound has the potential to interest the fetus to focus upon it, to listen to it. Through its intonation and rhythm, the mother's voice conveys her feelings. They may stir the desire to

communicate or discourage it. Tomatis refers to this as the "first dialogue." Warmth and a sense of welcome in the mother's voice will invite the fetus to seek out this voice and stimulate the desire to communicate with it. In addition to nourishing the fetus emotionally, the maternal voice also imprints upon the fetus' nervous system the structure and rhythm of the language the mother is speaking. The higher frequencies of the mother's voice will also provide neural energy to the fetus, nourishing it in another way. Support for Tomatis' contentions can be found in research assessing the ability of the fetus to discriminate between sounds (Eisenberg, 1976) and the new-born infant's ability to identify the mother's voice (DeCasper &Fifer, 1980) and to show a preference for stories their mother read before birth (Spence &DeCasper, 1982; DeCasper &Spence, 1986). See Chamberlain (1983), Mauer and Mauer (1988), Verny (1987) and Verny and Kelly (1981) for reviews of the literature on prenatal psychology. Tomatis pursued his interest in the origins of the listening process and through his experimentation discovered that the fetus hears only the higher frequency sounds of the mother's voice. He originally hypothesized that the lower frequency sounds were filtered by amniotic fluid but later proposed that the corti cells responsive to higher frequency sounds are active long before the cells responsive to lower frequency sounds. This means that the fetus' auditory world is primarily one of higher frequency sounds. This permits dialogue with the mother's voice and at the same time prevents the fetus from being overwhelmed by the predominantly low frequency sounds heard in utero (heart beat, respiration, digestive noises, etc.). This earliest "dialogue" sets the stage for the child's readiness to open his ear (to listen) to the sounds of the world beyond the womb and prepares the nervous system for the integration of language sounds. It is further reason to appreciate the depth and critical nature of the relationship between the fetus and the mother in the development of the human being (Tomatis, 1981). Our clinical experience suggests that where there have been significant difficulties during the pregnancy for any reason (it is unwanted, mother's poor health, mother's apprehension or anxiety due to events in her immediate world), the desire to communicate and/or the child's ability to integrate language is often affected. More than that, their emotional ground is shaky and insecure. It can lead them to protect themselves by retreating from the world beyond the womb as opposed to participate actively in it and to welcome the opportunity to grow. Their energy is directed toward maintaining the status quo or retreating to an earlier more secure stage of development (i.e. returning to the womb) instead of welcoming the opportunity and challenges of growing up and moving beyond the world of the mother (first the womb, then the home) into the social world represented symbolically by the father, a world in which language is the bridge for effective communication. As clinicians, we frequently see children and adults with emotional difficulties and language and communication disorders which can be traced back to problems during the pre-natal life or birth experience itself, birth representing the first passage from the known to the unknown. The one link which is constant in this transition is the mother's voice. It provides continuity from the experience of pre-natal life to the experience of the postnatal world. When the mother's voice is absent during the first days, weeks or months of life, the infant suffers. It is not unusual to see language and learning problems associated more frequently with children whose interaction with the mother through her voice has been poor or completely breached (premature infants, adopted children, children who have not been wanted and for whom the sonic link between the mother and fetus was weak and/or devoid of emotion). On the other hand, it is common to see children of musicians, children of mothers who have spoken and sung to the fetus pre-natally adapt rapidly to the demands of language integration. It is no accident that musicians frequently come from parents who were also musical. Many hear the sounds of music during the mother's pregnancy. Tomatis would suggest that this auditory stimulation nourishes the nervous system of the fetus and prepares the ground for an easier integration of language. When the pre-natal listening experience of the fetus has been positive, hearing the mother's voice after birth will have a naturally calming and soothing effect. In the child's early life, there is no more powerful source of reassurance and encouragement than the sound of the mother's voice through which the mother's love is expressed. In the Tomatis method, the mother's voice is recorded and then played to the child through headsets after the lower frequency sounds, those below 8,000 Hertz, have been filtered out. There are often

immediate effects on the child's behaviour reported by parents. Their children are more communicative, more talkative, happier, less easily frustrated, more ready to participate, eating better and sleeping more calmly. Many autistic children are stirred to move beyond the fortress walls protecting them from the world of language. At first their desire to communicate appears in nonverbal behaviour such as greater eye contact, greater show of physical affection toward the mother, more sound-making, and, where there is some spoken language, more appropriate use of words for communication. In cases where the pre-natal experience has been negative, the mother's voice may provoke memories associated with that time. The child may become more aggressive toward the mother for a period of days, may express the emotional distress associated with the pre-natal life through dreams in a process of voiding or emptying the negative aspects or "emotional pollution" deeply embedded in the nervous system (likely the thalamus according to Tomatis). Clearing away emotional memories permits the relationship between the child and mother to improve and provides the stable ground on which more independent and more successful growth can occur. When the mother's behaviour toward the child complements this opening of communication, great strides can be made in the child's relationship with life itself. There is more confidence, a more positive attitude, a stronger desire to communicate and to grow up. POSTNATAL INFLUENCE There are other developmental factors that can affect the child's motivation to listen. The developing child's initial experience with the sound in his environment may be positive and stimulating or it may be negative and inhibit the desire to employ his listening ability. We have discussed the importance of the mother's voice but what of the other voices in the environment, siblings, the father? Was there happiness in their voices and a sense of harmony in their interaction? Was there music present in the home? Did the infant benefit from the stimulating effect of musical sounds, nursery rhymes, children's stories and songs? Sounds that are positive and stimulating will increase the desire to listen and to communicate. When these sounds are negative, they can inhibit the desire to employ the ability to listen. Cultural deprivation is frequently associated with language, learning and communication problems. Tomatis would argue it is not the presence or absence of books or educational resources which makes the critical difference. It is the absence of stimulating, nourishing sounds, first of the mother's voice and subsequently of the sonic environment into which the fetus is born. It is these sounds which will stimulate the infant's listening and permit the integration of language to occur. The desire to use language and embrace it as the tool for growth in the social world is fostered long before the child enters school, even before the child is born. There are trauma which can also affect the desire to communicate. Unsettling family moves, marital problems creating conflict in the family, the arrival of a younger sibling which destabilizes the relationship between the mother and the older child, health problems (especially those leading to hospitalization), difficult encounters with the world away from home, at school or in the neighborhood, can lead to a shutting off of the child's listening. Physical factors such as ear infections which have been mentioned earlier can also inhibit the actual ability to listen. Tomatis would even go so far as to suggest that some ear infections may have a psychogenic (i.e. psychosomatic) origin. Nor can we overlook the influence of our visually-oriented culture which does little to promote or to value listening. A good example is the poor quality low-frequency sound emitted from television or telephone speakers. They permit the sound to be heard but do little to invite the ear to listen. The essentially passive nature of much television programming watched so much by so many children does not promote listening or dialogue. Portable tape recorders rendering the loud low-frequency sound of rock music present additional risks to listening and even to hearing in adolescents and adults. The environmental noise found in classrooms, office buildings and urban centers are additional reasons for us to turn off our listening. Its many negative consequences have been documented by Cohen (1981). Lastly, the increase in attentional disorders diagnosed in children and the alarming increase in illiteracy are testimony to our culture's neglect of this vital skill.4 SUMMARY Over the last 40 years Alfred Tomatis has developed a method of auditory stimulation which assists the development of listening, language and communication skills. The method has a wide range of applications because of the wide range of functions and relationships attributable to the ear. These include its role: (a) as an organ for hearing and listening as well as

for balance, co-ordination and body image; (b) as a vector for the lateralization process and subsequently for receptive and expressive language integration; and, (c) as the fundamental sensory channel through which the communication process begins. For Tomatis, listening includes both neurophysiological and motivational elements, the latter having roots in the prenatal experience of the developing fetus. This theoretical framework opens the door to understanding both the neurophysiology and the psychology of the listening process, a process vital to the development of language skills and to the everyday use of language for learning and communication. The parsimony and heuristic value of Tomatis' theory is compelling. The usefulness of his Method has been well established and represents an even more significant contribution. Of course more research is needed. But, more to the point, what is needed is the daring and freshness of hypothesis that do not take for granted or true what has merely become habitual. Jerome Bruner References REFERENCE NOTES 1. The bone surrounding the middle and inner ear (endochondral capsule) is well suited to its task of conducting sound. It is a static medium formed from fetal cartilage and remains unchanged (no resorption) from before birth to after death. 2. The stirrup muscle is the only muscle of the body in constant tension. Tomatis explains the phenomenon of sudden vertigo or dizzy spells as a consequence of a twitch in this muscle which sends shock waves throughout the endolymphatic system. 3. Although the first with an elaborated theory, Tomatis has not been the only researcher to speculate on the role of the middle ear muscles. See Simmons (1964) and Pickles (1988). On a positive note, there is in addition to the work of Tomatis in this field an organization called the International Listening Association devoted to promoting awareness and understanding of listening. It is made up of educators, researchers and communications experts from the public and private sector. Write to Charles Roberts, Executive Director, P.O. Box 90340, McNeese University, Lake Charles, LA 70609-0340, USA. REFERENCES Bruner, J. (1966). Towards a theory of instruction. Cambridge. Harvard University Press, p. 171. Chamberlain, D.B. (1983). Consciousness at birth: A review of the empirical evidence. San Diego: Chamberlain Communications. Cohen, S. (1981). Sounds' effects on behavour. Psychology Today October, pp. 38-42. DeCasper, A., &Fifer, W. (1980). Of human bonding: Newborns prefer their mother's voices. Science, 208, 1174-1176. Eisenberg, R. (1976). Auditory competence in early life. Baltimore: University Park Press. Fritze, W., &Kohler, W. (1985). Frequency composition of spontaneous cochlear emissions. Arch. Otol, 242 (1), 43-48. Gilmor, T.M. (1989). Overview of the Tomatis Method. In T.M. Gilmor, P. Madaule, &B. Thompson (Eds.), About the Tomatis Method (pp. 15-42), Toronto: The Listening Centre Press. Howell, P. (1984). Are two muscles needed for the normal functioning of the mammalian ear? Acta Otol. (Stockholm), 98, 204-7. Juhn, S. (1986). Biochemistry of the inner and middle ear. 1983 in English, G.M., (ed.) Otolaryngology hose leaf series. (Vol. 1, chapter 60). Philadelphia: Harper &Row. Katz, J. (1978). The effects of conductive hearing loss on auditory function. ASHA, (10), 879-886. Mauer, D., &Mauer, C. (1988). The world of the newborn. New York: Basic Books. Pickles, J.O. (1988). An introduction to the physiology of hearing. San Diego: Academic Press. Simmons, F.B. (1964). Perceptual theories of middle ear muscle function. Ann. Otol. 73, 724-739. Spence, M., &DeCaspar, A. (1982). Human fetuses perceive maternal speech. Paper presented at the SRCD Conference, Austin, TX. Stutt, H. (1983). The Tomatis Method: A review of current research. Unpublished manuscript, McGill University. Tomatis, A.A. (1963). L'Oreille et le langage. Paris: Editions du Seuil. Tomatis, A.A. (1972). La libération d'Oedipe. Paris: Editions E.S.F. Tomatis, A.A. (1978). Education et dyslexic Paris: Editions E.S.F., (Translated as Education &dyslexia. Montreal: France-Quebec Editions, 1972). Tomatis, A.A. (1974). Vers l'écoute humaine (2 Vols.) Paris: Editions E.S.F. Tomatis, A.A. (1977). L'Oreille et la vie. Paris: Laffont. Tomatis, A.A. (1981). La nuit uterine. Paris: Editions Stock. Tomatis, A.A. (1987). Ontogenesis of the faculty of listening. In T. Verny (Ed.), Pre-and perinatal psychology: An introduction. New York: Human Sciences Press. Tomatis, A.A. (1987). L'Oreille et la voix. Paris: Laffont. Tonndorf, J. (1972). Bone conduction. In J.V. Tobias (Ed.), Foundations of modern auditory theory. (Vol. 2, p. 20). New York: Academic Press. van Jaarsveld, P.E. &du Plessis, W.F. (1989). Audio-psycho-phonology at Potchefstroom: A review. South African Journal of Psychology, (in press). Verny, T. &Kelly, J. (1981). The secret life of the unborn child New York: Simon

&Schuster. Verny, T. (1987). Pre-and Perinatal psychology: An introduction. New York: Human Sciences Press, Inc. AuthorAffiliation Timothy M. Gilmor, Ph.D. AuthorAffiliation Address correspondence to Timothy M. Gilmor, Ph.D., Director, The Listening Centre, 99 Crowns Lane, 4th Floor, Toronto, Ontario M5R 3P4, Canada. Appendix APPENDIX A Identification of a Listening Problem Listed below are symptoms commonly observed in individuals who have learning and communication problems. This list is not exhaustive. However, the presence of some or a majority of these symptoms should prompt consideration of the degree to which poor listening ability may be contributing to the individual's learning and communication problems. Receptive Language At the level of receptive oral language, the following can be considered symptomatic of a listening problem: * A need to have instructions repeated. * Distractibility, restlessness, daydreaming, poor attention and concentration in learning and communication situations. * A tendency to misinterpret what is being said, which produces odd reactions and impedes communication with others. * Difficulty to follow and/or participate in conversations in a noisy environment. Expressive Language At the level of spoken language, individuals with listening-based communication problems are frequently seen to have very poor audiovocal control or self-listening. Such symptoms include: * Slow, hesitant, poorly articulated speech. * Poorly modulated voice (too soft or too loud). * Poor voice characterized by a dull, monotonic and lifeless quality or other impairments of timbre, tone and fluency. * For adults, difficulty in sustaining the interest of a group while making a speech or presentation. Body Image At the level of body awareness or body image, the following can be observed: * Poor balance and coordination. * Difficulty coordinating body movement. * Clumsiness or awkwardness in body movement. * Excessive body movement when speaking or listening (fidgety). * Poor posture: overly tense and rigid (hypertonic) or insufficient tonicity (hypotonic). * Mixed lateral dominance, letter and word reversals, signs of fine motor or gross motor coordination problems such as poor handwriting. * Poor organizational and planning skills. * Poor spacial orientation and sense of time. Attitude and Motivation With respect to this aspect of listening and communication, common observations include the following: * An indifferent, negative, or antagonistic attitude toward communication and learning. * Tendency to withdraw or avoid communication in learning situations and/or social situations. * A lack of curiosity or interest in learning. * Lack of interest in oral communication and, in the extreme, avoidance or active refusal to use language as the medium through which to communicate with others. Developmental Characteristics In compiling clinical histories at Centres using the Tomatis Method, the following events have had an unusually high incidence among individuals presenting with listening-based learning and communication problems: * Difficult circumstances surrounding the pregnancy. * Difficult births or early separations from the mother as a result of illness or adoption. * Disordered sleeping and eating patterns. * Recurring ear infections in the first years of life. * The arrival of a younger sibling within two years of birth. * Slow or poorly established preference for right or left hand. * Delay in language development and, less frequently, in motor development. * Difficult adjustment to school life and the recognition of problems by the teacher or by the parent within the first two years of school. * Underachievement at school or on the job, irrespective of age.

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