

ZDZISŁAW MAREK KURKOWSKI

Maria Curie-Skłodowska University in Lublin
Department of Logopedics and Applied Linguistics

Tomatis method applied in the diagnosis and speech therapy

SUMMARY

In audiology over the last few years much attention is given to the diagnoses of the Central Auditory Processing Disorders. These dysfunctions are also identified in people with language disorders. There exists therefore a need for effective methods to improve auditory perception. The Tomatis method is one of such proposals. For this reason, in Poland it is used more and more often as a support for the speech therapy. The study indicates the potential use of the Tomatis method in the treatment of people with dyslalia, delayed speech development, stuttering, dyslexia, and dysarthria.

Keywords: Tomatis method, auditory processing disorder, auditory stimulation, linguistic communication disorders, difficulties in learning.

PREAMBLE

The sound perception is an important element of the process of speech, because it has significant influence not only in the speech reception process but also to speak.

In speech therapy diagnosis we concentrate mainly on ability of diversify of the sounds forming implementation of the various phonemes (phonemic hearing) and various spellings of the same phoneme (phonetic hearing) as well as the prosodic elements (prosodic hearing.) We estimate ability of voice segmentation also, first of all on the syllables and the phones. The ability of phone analysis and synthesis is associated with acquiring of the reading and writing capacity, first of all. We do not investigate deeper into analysis of the perceptual processes, however. The most often we content with ascertainment of the difficulties in phonematic

perception (in case of the articulation disorders) or in range of the voice analysis and synthesis (by difficulties with reading and writing).

Alfred Tomatis, as first, pointed to need of not only hearing process diagnosis but also listening process diagnosis. Listening is dependence on a well-functioning peripheral organ of hearing and characteristics of external stimuli, while central processes of auditory processing as well as auditory skills related with psychic human activity are responsible for hearing.

AUDITORY PROCESSING AND ITS DISORDERS

In studies on the speech processes the increasingly complex mechanism of auditory perception, which is somewhat analogous to the processing of other categories of sounds: these (surrounding world) and the sounds of music is recognized. Both the auditory processes (biological level) and the auditory skills (mental level) consist on the auditory processing. This fact is underlined in the definition of the auditory processing given by ASHA (The American Speech-Language-Hearing Association).

The auditory processes and mechanisms as well as the the behavioral phenomenon (auditory behaviours) replaced by an idea of the skills and the abilities are separated in the ASHA definition. The following mental activities supported by the central auditory processing processes are specified:

- location and laterity of sound;
- hearing discrimination (differentiation);
- recognizing of hearing pattern characteristics;
- time aspects of hearing, including:
 - time differentiation,
 - time masking,
 - time integration,
 - time arrangement;
- ability to recognize the competitive acoustic signals;
- ability to recognize the degraded acoustic signals.

For detailed analysis of speech sounds perception various division of the skills is proposed. In range of the speech perception a three following hearing functions are discriminated for needs of the diagnosis and logopedic therapy.

– *reception of speech sounds* – consisted in perceiving of the acting stimulus or that the stimulus stopped to act (this is base function – commonly known as hearing and auditory analyzer involving the low brain floors is responsible for this function); a formation of auditory sensations is the result (a term “physiological audition” is used often also);

– *location* – possibility of space localization of the sound source, particularly a place of the speaking person, this function facilitate looking at speaking person;

- *extracting of the distinctive features of speech sounds (selection)*;
- *distinguish of speech sounds (discrimination)* - identification of at least two sensations (different phonologically and phonetically) as different. The function of the extraction of the acoustic characteristics, and distinguishing of the speech sounds can be defined as a speech auditory. It is distinguished here:

- phonemic audition – distinction/identification of two expressions phonologically different/the same,

- phonetic audition – distinction of the various phone realisations constituting the same class of the phones (phoneme),

- proshodic audition – differentiation of the proshodic elements of expressions (accent, melody, rhythm),

- phone/syllabic analysis and synthesis – skill of the conscious distinction of the phones/syllables in the expression and connection of the phones/syllables in the tonal whole,

- auditory memory of the expression – makes possible to recall the speech sounds images, the auditory patterns of expressions, syllables and phones as well as the patterns of the proshodic structures fulfil the important role in perception process, they are responsible for perception of the elements order also,

- semantisation of speech sounds – skill of matchmaking of the speech sounds and they meaning, as result combining of the auditory patterns of the expressions with proper definitions, assigning meanings to the expression, and thus the formation of the different responses to discernable stimuli,

- auditory control of expression – auditory perception of the own expressions require simultaneously commitment of the structures responsible for auditory perception, kinesis and kinesthesia, usually speech consumes the most energy of the child, thus auditory control an noble insufficient,

- hearing lateralization – activity of the specific hemisphere associated with dominance of the ear (Kurkowski 1997).

A part of the functions is congenital meaning that, with maturation of the auditory system the specific skills appear. There is no doubt that a reception and location of sounds is such capacity. The function of speech sound differentiation awakes discussion (so called categorial perception).

Due to various reasons, the particular functions are not formed often. The process of auditory processing without special methods of the stimulation is stopped or limited if peripheral damages of the auditory organ causing reduction of the reception function. However the limit of acquisition of the others auditory functions skills by proper hearing is possible. In these causes so called central auditory processing disorder are pointed. Nowadays the audiology diagnosis bases on getting richer test set allowing to evaluate the particular processes of auditory processing both on biological level (electrophysiological studies) and mental level (psychoacoustic studies).

Following are used in range of behavioural tests:

1. The tests measuring the time aspects of auditory information development as well as the short-lived auditory memory. In range of this group following are used first:

– FPT (*Frequency Pattern Test*) – this test relies on diversification of sequence of the tones sequence of various heights. It serves to estimation of tones height, time ordering as well as language determination of sounds height.

– DPT (*Duration Pattern Test*) – this test relies on diversification of sequence of the tones sequence of various lengths. It serves to estimation of tones height distinction, time ordering as well as language determination of sounds length.

– GDP (*Gap Detection Test*) – this test relies on detection of the pauses in the noise.

2. Tests estimating interear integration and separation:

– DDT (*Dichotic Digit Test*) – test of dichotic hearing – digital;

– TRS (*Dichotic Hearing Test*) – verbal.

3. Tests of understanding of distorted speech:

– SPN (*Speech in Nois*) – test of understanding of speech in the noise;

– FWT – test of filtered speech;

– CWT – test of time compressed speech.

First of all the measurements of the wave P-300 (potential of auditory attention) and P-400 (semantic potential) are used in electrophysiological tests.

The symptoms of the auditory processing disorders, on which audiologists take notice, deserve attention also. The following behaviours are observed for children with auditory processing disorders:

– occlusal and language problems occur often;

– many school-age children has problems with reading;

– responses to stimuli are impermanent;

– children have problem with concentration and tire easily in case of activities demanding of long-term or complex activity during the auditory learning;

– children are distracted by auditory stimuli;

– children may have a difficulty with localisation of the sound;

– children have a difficulty with the distinction of the sound volume, they are scared and nervous as well as clog ears with hands when the loud sounds occur;

– children may have difficulties with understanding of the long and complex commands despite careful listening;

– children often ask for repetition of information;

– memorize the information given in words makes children difficult;

– children are slower to respond to verbal information as if they need more time to absorb and process information came to them (Keith 2005).

THE TOMATIS METHOD

As mentioned before, first A. Tomatis paid attention to need of the diagnosis of the auditory processing (hearing), because he perceived a significant impact of disorders in this range on the human social functioning and first of all on skills of the language communication (speech as well as reading and writing). As first he sought the efficient ways to removal of these disorders also. The method developed by him included not only the diagnosis but also, first of all, a program of therapy using the specified tools (a device called the “electronic ear”).

Alfred A. Tomatis (1920–2001) was a medical doctor, a specialist in the field of audio-psycho-phonology and psycholinguistics. He created the Paris Centre Audio-Psycho-Phonology, and later inspired a number of resorts in the world, also in Poland. His father was an opera singer. Frequent trips with his father for concerts formed his hearing and allowed to observe huge influence of music on human well-being as a result. After Second World War he examined and treated the military pilots and the workers of the flight halls as a doctor, specialist otolaryngologist. Repeatedly reported symptoms of hearing loss in certain frequencies by these patients marked the beginning of a deeper reflection on the relationship between hearing, the environment, the psyche and the voice of a man.

Contacts with the world of art, and the world of music meant that great opera singers, musicians as well as actors were often Tomatis patients. When Tomatis stated any disorders in an intonation and a voice of his patients without finding of the organic diseases, he started hearing test with audiometer. The discovery of regularities that the voice contains only those frequencies that are recognized aurally was a result of this test. This dependence is determined as the **First Tomatis Rule**.

Upon discovery of a relationship between hearing and voice, Tomatis asked yourself, how to improve the patient’s voice. Then implementing this idea he constructed a prototype of an apparatus later called the electronic ear.

Functioning of this apparatus relied that the patient sang to a microphone and simultaneously heard by the earphones own voice, wherein its voice was modified. Too strong frequencies were decreased and to weak frequencies were increased. Enable of hearing of the frequencies worse recognized or not recognized caused the appearance of this frequencies in the voice immediately and unconsciously. This phenomenon has been called the **Second Tomatis Rule**.

The fact, that after putting the headphones out voice difficulties came back, induced Tomatis to further search. Following this searches Tomatis constructed the automated electronic ear. Middle ear accommodative mechanisms are trained as result of the continuous exercises of tensioning and relieving of the middle ear muscles. Tensioning and relieving determining improvement of the phonation can be achieved if the patient is encouraged to give a strong voice, rich in high

frequencies. The voice (and the music) with the higher intensity pass by a channel C1 of the electronic ear while the voice (the music) with the lower intensity pass by a channel C2.

Based on above mentioned tests leading to the permanent improvement of the hearing and the voice Third Tomatis Rule was formulated: repeated for some time acoustic stimulation of the ear leads to a permanent improvement in hearing and phonation.

Therapy preceded by the exact diagnosis of hearing (auditory attention), the discrimination of the sound height as well as lateralization allowed a selection of a program of the stimulation according to the level of difficulty of a person's perception. The program of the stimulation covers usually from 69 to 120 seances executed in three sessions. One session is a 30 minute block of sound.

First session covers so called passive phase of the therapy. Applied in this session the Gregorian music is used primarily to the silence and the regulate of breathing. The frequency band responsible for an activity of the auricle is stimulated. Attention is drawn to the correct posture while listening. Using filtered music and mother's voice, we attempt to get the child auditory experience from the period of gestation, and then gradually widening range of hearing in order to simulate the "birthplace of hearing" child. The child's attention focused on the right-ear perception is increased gradually. This fact dues to the assumption that the right-ear perception play the significant role in the language and cognitive development of the child.

Second and third session constitutes the active phase of the therapy and is enhanced with the stimulation within important ranges for the language. Appropriate phonetic recordings, songs as well as texts read by father are used. It is advisable to include mother in a program of therapy also, if the disturbances occurring in a child are associated with an abnormal relationship with its mother. Therapy should be combined with other specialized interactions on the difficulties of the child (with the speech-, educational-, psychological therapy, etc.).

THE TOMATIS METHOD IN POLAND

Tomatis method is becoming more widespread in Poland, both in practice and in research. The introduction of this method on Polish soil I assign myself immodestly. It has, however, possible thanks a private grant and research resources obtained on realization KBN research grant in 1996-98 (at the Maria Curie-Skłodowska University in Lublin), dedicated to the research of speech perception, with particular emphasis on attention and auditory laterality. This made possible to hold a full three-step training Tomatis Center in Paris, led primarily by its creator – A. Tomatis, as well as practical training that I had in two Tomatis

centers in Switzerland. Whereas, the prevalence of this method has been made possible thanks to the commitment in this project of the Institute of Physiology and Pathology of Hearing in Warsaw, in particular prof. H. Skarzyński, Assoc. A. Szkielkowska, Dr. J. Ratyńska.

Interest in this method has increased primarily due to providing of nearly 300 educational institutions in diagnostic and therapeutic equipment. In Poland this method is used primarily in the treatment of people with speech disorders, difficulties in reading and writing, voice disorders, difficulties in the emotional and cognitive development (Kurkowski 2003; Kurkowski et al. 2002; Szkielkowska et al. 2003; 2004).

Young Digital Planet of Gdańsk involved in the dissemination of this methods also, by organization of trainings and distribution of equipment. The project "Attention! The way to success", which allowed to the use of the Tomatis method within the framework of of the Innovative Education Program in primary schools in Classes I-III, deserves a special attention. This program was realized commonly with Institute of Physiology and Pathology of Hearing (IFPS) in Warsaw. The activities of a growing number of private centers using the Tomatis method is unfortunately often focused only for commercial purposes.

Changes in terminology accompanied introduction of the Tomatis method in Poland. I made them trying to customize the diagnostic and therapeutic actions to the audiophonological terminology. Listening (listening intently) [fr. *ecouter*], which was a key term in the Tomatis method, I defined by the term "auditory attention", while the assessment of auditory "selectivity" [fr. *selectivite*] I described as an assessment of "sounds height discrimination" because the test that Tomatis applied to the evaluation of this function, according to the psychocastic terminology was the measurement of discrimination rather than auditory selectivity. Air conduction was described as "outside attention", while bone conduction was described as "internal attention". I developed a Dichotic Hearing Test also to modify the program of therapy (stimuli of right-ear perception) in patients with different model of asymmetry (right-hemisphere lateralization in the field of speech perception). I also proposed the name of therapy: Audio-Psycho-Linguistics Stimulation (SAPL). This name allowed for emphasizing basic scheme of therapy: by improving auditory perception developing mental efficiency and regulation of emotional behaviour – which should lead to the creation of appropriate conditions for the development of language skills.

Modification of terminology also aimed to divert attention from unfavorable climate in the years 80-90-s among otolaryngologists, who did not accept ideas of Tomatis, because he believed his method as a treatment of persons with auditory disorders. Only the results of audiology studies in recent years over central disorders of auditory processing and finding of the ways for effective rehabilitation of people with these problems allowed to see Tomatis pioneering actions in this field,

and his method, and a number of therapies derived from the program (method of Warnky, Johansen, Sonas Samonas, Auricula – see review Skoczylas and others 2011) considered as the possible rehabilitation methods for use in improving people with speech disorders and learning disabilities. We see today the Tomatis method rather as a method of therapy (rehabilitation) and no treatment.

In audiological practice, it is therefore possible use the aforementioned diagnostic techniques to assessment of the disturbances of the central auditory processing techniques including these proposed by Tomatis to assessment of the auditory disorders. So we can control the advances in therapy not only with the Tomatis test, but also with the audiological tests.

APPLICATION OF THE TOMATIS METHOD IN THERAPY OF PERSONS WITH THE SPEECH DISORDERS

Research on the efficacy of the Tomatis method in speech therapy have diverse methodologies and usually does not affect only the language of communication disorders, but also learning disabilities. Therefore they are more pedagogical than speech research. In addition, speech therapy covers a diverse range of activities in different countries. Typically, it is narrowed to improve articulation. Poland is one of the few countries in which concept of linguistic improvement in a wide dimension is assigned to speech therapists: developing of auditory perception, developing of linguistic, communication and cognitive competence as well as improving of speaking skills.

There are a few studies showing the use of the Tomatis method in the treatment of children with learning and communication disabilities. T. Gilmore (1999) presented the results of a meta analysis of treatment efficacy by assessing of linguistic knowledge, psychomotor, social maturity, cognitive skills and hearing abilities for 231 children. The results show the positive effects of the use of the Tomatis method, however, the occurrence of an excessive number of variables made it difficult to randomization results.

Studies on the effects of the Tomatis method in disorders of listening and verbal communication were presented in the Tomatis Center in Toronto based on the analysis of 400 children and adults. The improvement was showed in 95% of the cases (Sollier 2005).

D. Ross-Swain presented the results of research into the effectiveness of therapy in 41 patients with auditory processing disorders (2007). Improvement of short-term memory, auditory perception of sound sequence, location, discrimination and auditory integration was found to all respondents. Differences in the results before and after the Tomatis therapy were statistically significant.

Tomatis method in the school teaching was used in a few centers in the world. The research project “Wiennie” held in Colombia by Helge Lopez Vasques in

2006, including a comparative study of five groups of 12 children, and studies conducted by Sylvie Lozano (2006) where the test group consisted of 78 children divided into three groups – for one of them was used the Tomatis method, for the music therapy for the second, and for the third is not used any auditory therapy deserve attention. The project showed a significant gain from the application of the Tomatis method in the linguistic, communication, emotional and cognitive development.

Research on the efficacy of the Tomatis method in Polish schools deserve special attention. The first studies involve the use of the Tomatis method in 200 special schools primarily involving children with autism, mental disabilities and holistic developmental disorders. But the test results of studies were not fully developed.

The “Attention! The way to success “, realized by Young Digital Planet, in which the Tomatis therapy covered of 776 schoolgoers from 57 primary schools was another the research experiment in Poland. In this group there were 275 persons with speech disorders. Improving auditory attention in different frequency bands was included in the results of studies first. Overall, we can conclude that more than 50% of the children had better scores in the control tests. Unfortunately, the author of the analysis (Mularzuk 2013) did not submit the percentage statements and statistical analysis of the results.

In the literature, the results of the application of the Tomatis method in the treatment of people with autism are given also. However the problem of Autism is the issue proximal psychological therapy.

Above history of the use of the Tomatis method in Poland shows that it was primarily used as adjunctive therapy speech therapy, teaching and phoniatic.

The use of the Tomatis method in speech therapy has a similar use in Poland and in other countries in the world. It concerns the language of communication disorders in which a limitation of perception of the speech sounds affect the acquisition of language skills. It is difficult to indicate in which people with language disorders support by the Tomatis method is the most important, but it seems that it is mostly used in patients with delayed speech development, dyslalia, stuttering and dyslexia.

Delayed development of speech and dyslalia may be due to limitations discernment of the phones, which usually limits the development of the phonological system. Limited ability to distinguish and differentiate the sounds height (frequency), volume (intensity) and the duration may be underlying cause of these difficulties. The ability to differentiate the sounds height is the most important, because the sounds distinctive features are encoded in the so-called formant characteristics, i.e. clusters of acoustic energy in selected frequency bands.

Tomatis considered that the ability to discriminate of the sounds height develops gradually and lasts for several years. Inhibition of this process, for example by

periodically ear disease or negative emotional experiences can affect the acquisition of skills in the perception of speech sounds.

Scientific studies confirm the significant difficulties in differentiating the sounds height in children with delayed speech development (Włodarczyk 2013) and children with dyslalia (Szkiełkowska et al. 2009; Kurkowski 2013).

In children with dyslalia difficulties in acquiring of the articulation skills may be associated with uneducated sufficient auditory self-monitoring. L. Kaczmarek (1998) drew attention to this problem distinguishing between phonemic hearing (the ability to perceive speech of others) and phonetic hearing (distinguishing utterances of their own). This theory, however, had no practical application because of the lack of the diagnostic tools indicating the difficulties in this respect. It was only possible to assess the auditory attention by air (outside attention) and by bone (internal attention - auditory self-monitoring) allowed to diagnose problems in some children with dyslalia. Studies confirms that such problem occurs significantly more often in children with dyslalia (Kurkowski 2013).

Diagnosing the difficulty in differentiating pitch and lowered self-monitoring auditory it must be expected that the use of the Tomatis method, which uses stimulation to distinguish the sounds height by using a filtered sound program, will bring improvements in this area. However, this requires specially prepared verification tests.

There is no doubt that abnormal auditory perception may affect the ability to read, especially on the development of analysis and synthesis of the phones (Kurkowski 2013). Application of the method of improving the skills of differentiation of the sounds height should facilitate the study of analysis and synthesis of auditory (Tomatis 1991).

The therapy of stuttering people deserve special attention. It is possible that one of the pathomechanism of this disorder is not formed auditory laterality. The results presented by Ratynski and co-authors (2003), giving an assessment of lateralization in 122 people who stutter allow to conclude the presence of 68% of left-ear domination. ZM Kurkowski (2013) obtained similar results in a study group of 200 people who stutter. It therefore seems reasonable to use the Tomatis method in the treatment of stuttering. It should be remembered, however, about the fact that stuttering is a disorder of complex and requires a comprehensive therapy and the Tomatis therapy may be an important link in the process of treatment.

S. Mihilewicz (2003) drew attention to auditory processing disorders in children with cerebral palsy. Dysarthria often occurs in this group. Different ways to improve auditory perception also in this group are certainly worth attention.

Application of Tomatis in patients with impaired voice brings very satisfactory results. A. Szkiełkowska (2012) applied a slightly modified method and obtained a significant improvement in the voice of the majority of patients.

To conclude that the Tomatis method, although, unfortunately, very few scientific studies assessing its efficacy is used in speech therapy, and can be one of the professionally designed ways to support speech therapy in the streamlining of auditory perception, if it is not sufficiently formed or disturbed. Auditory processing disorders should properly diagnosed, with the audiological methods in such cases .

BIBLIOGRAPHY

- ASHA, 2006, *Central Auditory Processing, Current status of research and applications for clinical practice*, "Am. Journal of Audiol.", 5, s. 41–53.
- Fuente A., McPherson B., 2007, *Ośrodkowe procesy przetwarzania słuchowego, wprowadzenie i opis testów do zastosowania u pacjentów polskojęzycznych*, „Otolaryngologia”, 6(2), s. 66–76.
- Gilmor T., 1999, *The efficacy of the Tomatis Method for children with learning and communication disorders: A Meta-Analysis*, "International Journal of Listening", 13, 1, s. 12–23.
- Kaczmarek L., 1988, *Nasze dziecko uczy się mowy*, Lublin.
- Keith R. W., 2005, *Zaburzenia procesów przetwarzania słuchowego*, [w:] *Audiologia kliniczna*, red. M. Śliwińska-Kowalska. Łódź, s. 367–375.
- Krasowicz-Kupis G., 1997, *Język, czytanie i dysleksja*, Agencja Wydawniczo-Handlowa AD, Lublin.
- Kalinowski J., Armson J., Stuart A., Graco V., 1993, *Effects of alterations in auditory feedback and speech rate on stuttering frequency*, "Language and Speech", 36, s. 1–16.
- Kehoe T. D., 1997, *Stuttering: Science, Therapy and Practice*, Casa Futura Technologie.
- Kurkowski Z. M., 1997, *Audiogenne uwarunkowania zaburzeń mowy*. „Audiofonologia”, 10, s. 103–110.
- Kurkowski Z. M., 2000, *Auditory lateralisation vs. speech disorders*. Ed. K. Jahnke, M. Fischers, 4th European Congress of Oto-Rhino-Laryngology Head and Neck Surgery, t. 1, s. 113–116.
- Kurkowski Z. M., 2001, *Stymulacja audio-psycho-lingwistyczna – Metoda Tomatisa*, „Audiofonologia”, 19, s. 197–202.
- Kurkowski Z. M., Szkiełkowska A., Ratyńska J., Markowska R., Mularzuk M., 2002, *Zastosowanie metody Tomatisa w terapii osób z zaburzeniami komunikacji językowej. Doniesienie wstępne*, „Audiofonologia”, 22, s. 203–210.
- Kurkowski Z. M., 2013, *Audiogenne uwarunkowania zaburzeń komunikacji językowej*, Wyd. UMCS, Lublin.
- Estudio acerca de los Efectos del Método Tomatis en las Habilidades Lozano S. (2006). *Tomatis for School: A Research Projekt*. Materiały z Konferencji IARTC w Meksyku.
- Mihilewicz S., 2003, *Zaburzenia przetwarzania słuchowego u dzieci z porażeniem mózgowym*, Wyd. Uniw. Wrocławskiego, Wrocław.
- Mularzuk M., 2013, *Skuteczność terapii Tomatisa u dzieci ze specjalnymi potrzebami nauczania na podstawie wyników badań własnych*, [w:] *Metoda Tomatisa. Publikacja końcowa projektu „Uwaga! Sposób na sukces”*, Gdańsk.
- Ratyńska J., Szkiełkowska A., Kurkowski Z. M., Markowska R., 2003, *Zastosowanie testu uwagi słuchowej i lateralizacji słuchowej A. Tomatisa w diagnostyce i terapii osób jękających się*. „Audiofonologia”, 24, s. 137–143.
- Ratyńska J. [red.], 2013, *Metoda Tomatisa. Publikacja końcowa projektu „Uwaga! Sposób na sukces”*, Gdańsk.
- Ross-Swain D., 2007, *The effects of auditory stimulation on auditory processing disorder. A summary of the Findings*, "International Journal of Listening", 21, 2, s. 140–155.

- Skoczylas A, Lewandowska M., Pluta A., Kurkowski Z. M., Skarżyński H., 2011, *Ośrodkowe zaburzenia słuchu – wskazówki diagnostyczne i propozycje terapii*, „Nowa Audiofonologia”, 1(1), s. 11–18.
- Springer S. P., Deutsch G., 1998, *Lewy mózg, prawy mózg z perspektywy neurobiologii poznawczej*, Pruszyński i S-ka SA, Warszawa.
- Szeląg E., 1999, *Nowe metody terapii wyzwaniem dla logopedii XXI wieku*, „Logopedia”, 26, s. 215–225.
- Szkiełkowska A., Ratyńska J., Barański B., Kurkowski M., Markowska R., 2003, *Wyniki stymulacji audio-psycho-lingwistycznej u dzieci z guzkami głosowymi*, „Otolaryngologia”, 2(4), s. 180–184.
- Szkiełkowska A., Ratyńska J., Kurkowski Z. M., Markowska R., Kazanecka E., Skarżynski H., 2004, *Analiza testów uwagi i lateralizacji słuchowej u wokalistów*, „Audiofonologia”, 26, s. 69–71.
- Szkiełkowska A., 2012, *Ocena wyższych procesów słuchowych w dysfonii dziecięcej*, Wyd. Uniw. Med., Warszawa.
- Szkiełkowska A., Włodarczyk E., Senderski A., Ganc M., Skarżyński H., 2009, *Ocena procesów przetwarzania słuchowego u dzieci z dyslalią*, „Otolaryngologia Polska”, 63 (1), s. 54–57.
- Tallal P., 1980, *Auditory temporal perception, phonics and reading disabilities in children*, „Brain and Language”, 9, s. 182–189.
- Tallal, P., Miller, S. L., Bedi, G., Byma, G., Wang, X., Nagarajan, S. S., Schreiner, C., et al., 1996, *Language comprehension in language-learning impaired children improved with acoustically modified speech*, „Science”, 271 (5245), s. 81–84.
- Tomatis A., 1991, *Education et dyslexie*, ESF editeur, Paris.
- Tomatis A., 1991, *L'oreille et le langage*, Editions du Seuil, Paris.
- Tomatis A., 1992, *Les troubles scolaire*, Ergo Prees, Paris.
- Włodarczyk E., 2013, *Ocena centralnych procesów słuchowych u dzieci ze specyficznymi zaburzeniami rozwoju języka*, nieopublikowana praca doktorska, Uniwersytet Medyczny, Warszawa.
- Wojnowski W., Obrębowski A., Pruszewicz A., Demenko G., Wiskarska-Woźnica B., Świdziński P., Maciejewska B., 2008, *Przydatność testów utrudnionych w diagnostyce dysleksji u dzieci*, „Otolaryngologia Polska”, 7 (2), 97–100.