How Sound Therapy can help children recover from Language Deficits resulting from Covid Lock Downs

Presented to Equipping Minds Conference 2023

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Abstract

The early years of a child's development have the greatest impact on their future, as all later learning is based on these early foundations. During the Covid lockdowns, young children missed out on many normal social experiences at crucial times in their development. Research has been undertaken in the UK where professionals and parents in 96% of the schools surveyed raised serious concerns about their children's communication and language development, and were also concerned about social and emotional development and the flow on effects for literacy and academic performance (Bowyer-Crane et al, 2021). Although these issues may not have received the same attention in the US, it seems likely that a similar impact has occurred. Tomatis Sound Therapy has proven effective in addressing a wide range of learning and developmental issues including speech and language development. A literature review of 112 studies was undertaken to summarize findings on the benefits of the Tomatis method, and its adaptation by Joudry and Joudry for portable use as the Sound Therapy International program. While language and speech were some of the greatest benefits observed, the studies also highlighted improvements in state of mind, academic performance, cognitive ability, motor skills and coordination, focus and concentration, social skills, laterality and self-regulation. Therefore Sound Therapy could be an important method to mitigate the impacts of lockdowns on language development.

Introduction

Concerns have been raised internationally about the impact of Covid lockdowns on early language development. The early years of a child's development have the greatest impact on their future, as all later learning is based on these early foundations. Due to the way the brain develops, if speech acquisition is delayed during the key formative years, it can impact children's development significantly.

How the brain develops language

Just like a tree, the brain must develop trunks and main branches, before the more delicate twigs can be added. The development of language skills depends on exposure to multiple environments, interaction with a variety of people, seeing facial expression, interacting and having the opportunity to practice hearing and making sounds in a wide range of activities prior to entering the classroom, where more complex language skills must be mastered.

Language and learning specialists have been aware for some decades that the early stages of development have a great impact on a child's future. Brain pathways and language skills develop sequentially, with each new skillset depending on the previous one. Therefore if certain skills are missed, such as crawling, facial identification or babbling, it sets the child back in the next stages of development. Therefore, if children miss out on social contact, conversation and normal interactions during their early formative years, catching up to fill these gaps may be slower than expected. Researchers say the first 1001 days after a child is born are crucial for laying the foundations for later development.

It has been very difficult for parents raising their children during lockdowns, as they could not access many activities that help to develop vocabulary, such as visiting a farm or seeing the grandparents.

Extensive evidence, described below, is now showing that children are suffering developmental delays due to the recent lockdowns, and the children who are already at risk are the most severely affected. It is very important to enrich a child's environment with added opportunities to rectify the losses and delays of lockdowns. This paper argues that one easy and accessible way of doing this, which will dynamically enhance other supports, is Sound Therapy, which stimulates the activation of speech and language pathways.

The impacts of lockdowns on language development

During the Covid lockdowns, young children missed out on many normal social experiences at crucial times in their development. Studies by a range of organisations in different countries have reached similar conclusions.

A recent survey of schools and parents, conducted by the Education Endowment Foundation in the UK, has found that children who started school in 2020 needed more support than in previous years. Of the schools surveyed, 96% raised serious concerns about communication and language development, while 91% were concerned about social and emotional development and 89% raised concerns about literacy. Mask wearing has also impacted language development, as children who are learning to speak rely a great deal on lip reading to help them in learning how to form sounds, such as 'p' or 't'. Facial expression is a key to language, to help us understand the meaning of words, and this too has been limited by mask wearing during a child's formative months and years.

A study of over 500 parents in the UK, by the University of Oxford and four other leading universities looked at social development in children under three. Charity Speech and Language UK said that Covid restrictions affected some children's development by limiting socialising and new experiences, which helps them learn new words. This is important as we know that vocabulary levels at age two predict children's performance at school entry, which itself is predictive of later outcomes.

Research in the UK suggests that up to 1.5 million children face being left behind in their speaking and understanding due to disruption caused by Covid, and a majority of teachers are worried that children who are behind will not be able to catch up.

Similar findings are published in the US where an article in Education Week reported: "To avoid widespread school readiness gaps, experts say teachers and parents need to give children born since the pandemic an immediate language infusion". (Sparks 2022, Amplify, 2021.)

A report by the University of Oregon noted that the percentage of students who were far behind at mid-year in learning to read had increased across all demographics, but that learning losses due to Covid 19 were greater among Black and Hispanic students in the early grades. The report issued a call to action saying we have a once in a generation opportunity to catch up for students who have fallen behind due to the impacts of Covid (Amplify, 2021).

In an article in Otolaryngology, Charney, Camarata and Chern, stated “The COVID-19 pandemic has led to many unintended, long-lasting consequences for society. Preventative practices such as mask wearing, social distancing, and virtual meetings and classrooms to address contagion concerns may negatively affect communication, particularly in the paediatric population, as schools have begun to open this fall.”

These concerns have caused a number of groups and researchers to lobby governments to take more action. More than 100 charities and parent and carer organisations have written to the UK government to say long-term investment is needed to plug gaps in the specialist workforce supporting children in schools - including speech and language therapists.

Jane Harris, Chief executive of I CAN (Institute for the Clinical Advancement of Neuroplasticity) said: "For 1.5 million children to be struggling to be able to speak and to understand what is being said to them should be a wake-up call to government and the education sector.” Figures show that nearly one in five children are not meeting expected development standards by the time they reach two-and-a-half, making gaps 'more difficult to close'.

While much of the concern has been focussed on speech delay, we know that speech delay is also an indicator of other types of learning difficulties or sensory processing difficulties which will affect children once they enter school.

Due to the increased demand, waiting times for remedial services are growing, and for many families the wait is too long to meet the pressing needs of children who require immediate support.
The chief executive of the Royal College of Speech and Language Therapists, (RCSLT) Kamini Gadhok said: 'Our members tell us that growing lists and waiting times for speech and language therapy are

dramatically impacting on their ability to provide the support which children need for the best start in life.'

As remedial specialists and Speech Pathologists struggle to catch up with the unprecedented backlog, looking for more time-effective methods that can be used at home could help fill the gap. Tomatis Sound Therapy has proven effective in addressing a wide range of learning and developmental issues including speech and language development.

History and development of Dr Tomatis's Sound Therapy

In the early 1950s a Paris based ear specialist, Dr Alfred Tomatis, opened a new field of pursuit in the therapeutic application of music, which has become known as Sound Therapy, Audio-psycho-phonology, or Tomatis therapy (Tomatis, 1991).

He went on to develop a method of treatment which addresses hearing and listening from both the physical and the psychological aspects. Through his experiments he also discovered that high frequency sounds, softly played stimulate and replenish brain energy, and are in fact essential for optimum functioning of the cortex.

The Tomatis method of Sound Therapy applies gating and frequency filtration, combined with right ear emphasis, to achieve enhanced integration in not just the auditory pathways but also many other parts of the nervous system. This produces auditory stimulation through the use of music that has been electronically modulated by a device of Tomatis's invention called the Electronic Ear, which uses a gating system to deliver alternating high and low frequencies in order to activate the middle ear muscles, and in turn the entire auditory pathway. For a therapeutic application, the sound must be listened to through headphones to facilitate transmission of the delicate, high frequencies, and in order to deliver the built-in right-ear emphasis.

Research on the Tomatis method has been underway since the mid-1970s, spanning five decades of exploration into this multi-faceted method (Joudry, 2023).

The Self Help Method

Patricia Joudry, a Canadian author, underwent the Tomatis treatment in the late 1970s and experienced total relief of her chronic insomnia, exhaustion, writers block and the listening disorder for which she was first referred to the treatment. This is known as "The Cocktail Effect", which is the inability to discriminate between different sounds in a noisy environment.

Patricia and her daughter, Rafaele Joudry, then released the self-help Sound Therapy audio program along with their book: ***Sound Therapy: Music to Recharge your Brain***. Rafaele has since published two further books entitled ***Triumph Over Tinnitus*** and ***Why Aren't I learning?***

In 2011 the Sound Therapy SYNERGY practitioner program was launched, providing a clinical program that can be offered by a range of allied health practitioners and educators to their clients.

Confirmation of Stephen Porges work

In the last few decades, Stephen Porges developed the Polyvagal theory and confirmed how animating the middle ear muscles turns on the Social Engagement nerve. This gave confirmation in modern scientific techniques of Dr Tomatis' original findings. His theory and explanation of vagal nerve function has given us great insights into self-regulation and neural development.

Stephen Porges has developed his own listening program. However, he didn't include several key elements of Tomatis work such as using classical music, and using language programs, which are included in Sound Therapy SYNERGY. Perhaps the greatest contribution of the Joudry method has been to show how extended listening, over several years, produces ever-increasing results.

The self-help program was made so pleasant to listen to that both adults and children enjoy using it for years and years. This means that when it is calculated over time, the cost per hour of listening is far less than other programs. Also it is supplied on robust, portable equipment, making it more convenient than any other program.

There is a wide range of ways Sound Therapy helps children. In the last few decades there have been numerous controlled studies, surveys, clinical experiments and case histories, which confirm the benefits of the Tomatis method, and it's evolution into the portable program developed by the Joudrys, for a variety of conditions. The main topics that have been studied are: auditory processing, speech and language development, learning difficulties, attention and focus, autism spectrum, coordination and motor skills.

Meanwhile, extensive research has been taking place in fields of relevance such as the evolution of the nervous system, brain plasticity, speech and language development, the causes and treatment of tinnitus, anxiety, sleep, autism, ADHD, focus and brain performance. This background research has given a level of understanding and scientific explanation for many of Tomatis's theories which occurred through clinical observation, prior to this scientific understanding being available.

The present aim is to review the literature in order to demonstrate the usefulness of Tomatis therapy for a range of learning and developmental difficulties, and support the claim that Sound Therapy can assist in overcoming the delays caused by lockdown.

Method

A literature review of 112 studies was undertaken to review findings on the benefits of the Tomatis method, and its adaptation by Joudry and Joudry for portable use as the Sound Therapy International program. These range from single case studies to some large-scale studies covering several hundred such as the Eurocopter study in France, involving 580 participants, or the study of 408 autistic children done at Azad University in Iran, or the Polish school study of 1330 pupils by the Institute of Physiology and Pathology of Hearing. This paper is limited to studies relevant to children.

The total number of studies reviewed that related to the relevant conditions was fifty eight. These were sourced via internet searches on Tomatis Research, sometimes using the key words for the particular conditions. Studies were also included which had been undertaken by colleagues who use the SYNERGY program, including Dr. Carol Brown.

We included all of the studies which undertook to measure the impact of Tomatis or Joudry therapy on listeners with the relevant conditions relating to learning and developmental challenges.

The total number of participants recorded in all of the included studies was 3695. This number is certainly underestimated as some studies worked with a number of schools but did not specify the number of participants.

The studies were grouped into six categories for the purpose of analysing the different impacts of the therapy. (Figure 1)

Some studies were not restricted to focusing on solely one of the conditions named. It is for the purpose of analysis that we have grouped them in order to do some comparisons, but there are often overlaps as each study may include children with multiple deficits. Due to the overlaps between deficits that were being studied and benefits found in the subjects, the categories of studies are not mutually exclusive.

Research Results

The review identified studies on six main conditions, being: auditory processing, learning disabilities, Attention Deficit Disorder, autism, coordination and motor skills, speech and stuttering. A summary discussion of the results from these studies now follows. First each of the conditions is described with the associated findings. Then the insights from the pattern across conditions is examined.

Studies on Auditory processing

On the topic of Auditory Processing, ten studies were reviewed, with a total of over 300 participants. Auditory processing is the key component of many developmental disorders which respond positively to Sound Therapy. Most of them have a component of auditory processing difficulty, which, when it is addressed, makes life, learning and skills development easier for the individual.

Tomatis found that sound perception, discrimination and hierarchical processing - which are facets of auditory processing - can be improved by stimulating and re-educating the listening function. Tomatis was unique in his claim that high frequency sound is an essential component of this rehabilitation, enabling the brain to improve its sound processing. The following studies confirm these findings. He also found that when the right ear takes the primary organising, role language processing improves.

The studies on Tomatis therapy for auditory processing found the following:

- Self-regulation was enhanced for University students who used Sound Therapy (Bonthuys, 2016).
- Children with auditory processing problems showed improved performance on auditory and spatial tasks, pitch discrimination, and lateralisation (Tinkl, 2011, Skrodzka et al, 2015).
- Benefits from the treatment included improved academic skills, leadership, attention and productivity (Young, 2013).
- Left lateralisation correlated with dyslexia and processing problems (Kurkowski, 2000, Szkielkoswska et al, 2008.)
- In studies across dozens of schools in Poland it was found that the improvements applied to children both with and without learning delays, and that results ranged across age groups from primary to university (Bonthuys, 2016, Konarski and Ratynska 2014).

Studies on Learning Disabilities and Behavior problems

Fifteen studies were reviewed with a total of 1724 participants. Studies on learning disabilities and behavior problems include some longitudinal, some targeting larger populations and many comparing small treatment and control groups. Most focus on children with a variety of learning disabilities and behavior problems, many of whom are from disadvantaged backgrounds. The Polish schools study (Konarski and Ratynska 2014) involving over 1300 students for a three year period is of particular note. The common factors found among all these studies are statistically significant improvements in language skills, attention, academic performance, self-esteem and behavior.

The studies on Tomatis therapy for children with learning disabilities found the following:

- When combined with the Equipping Minds program, Sound Therapy helped improve academic performance, verbal and non-verbal abilities and IQ, (Brown, 2018).
- This combined program also assisted assisted visual spatial skills, reading comprehension, spelling, writing and maths (Brown, 2018).
- Sound Therapy proved beneficial for the whole school population, including children with or without special needs (Konarski and Ratynska, 2014).
- Sound Therapy was beneficial to assist reading fluency students form a non-English speaking background (Chou, 2012).
- The treatment enhanced audio vocal control and phonological processing (Malak et al, 2017, Lozano, 2009, Wilson, 1982, Roy and Neysmith Roy, 1980).
- Literacy and language gains were retained 14 months after treatment (Lozano, 2009).
- Right ear training enhances reading (Gilles and Sidlauskas, 1978).

Studies on Attention Deficit Disorders

Three studies were reviewed with a total of 27 participants.

ADD/ADHD is a particular deficit which affects capacity for learning, focus and socially acceptable behaviour. Although the diagnosis is formally based purely on clinical observations by a doctor on a very basic scale of behaviours, researchers are now identifying measurable brain anomalies in

children with this condition. Quantitative analysis of EEGs and ERP (event related potentials) can now give clues into the underlying brain dysfunction behind this condition. Perhaps because ADD/ADHD was not a known condition during Tomatis's era, studies on this condition have been relatively few. However, strong anecdotal plus clinical research evidence has shown that Sound Therapy can significantly reduce ADD/ADHD symptoms, calming behaviour, reducing oppositional behaviour, anger, distractibility and hyperactivity. The studies outlined in Appendix 1 now give some research confirmation of these observations.

The studies on Tomatis therapy for children with ADD/ADHD found the following:

- Tests using Quantitative EEG (QEEG) and Event Related Potential (ERP) showed an increase in slow brain activity for the group receiving Tomatis treatment, along with statistically significant improvements including enhanced processing speed, phonological awareness, reading, behavior and auditory attention (Sacarin, 2013).
- Improvements were measured in the treatment group in cognition, attention and behavior (Sacarin, 2013).
- The results indicate that Sound Therapy is potentially a brief and effective approach to benefit ADD/ADHD (Sacarin, 2013).
- Parents noted 73% improvement on a range of abilities after Tomatis treatment (Davis, 2005).
- A boy progressed from 2nd to 5th grade in phonological awareness following Tomatis treatment (Tatum, 2004).

Studies on Autism

Fourteen studies were reviewed with a total of 244 participants. On the topic of autism, Tomatis was widely criticized in the 1980s and '90s for his theories about the contribution of the mother's behavior to the development of autism. Likely founded on Freud's theories, these views were a product of his time. More recent research is revealing both the genetic and environmental (chemical toxicity) contributions to autism spectrum disorders (Volk et al, 2022).

There is now a much greater understanding of sensory processing and awareness in particular of the strong correlation of auditory hypersensitivity with autism. As the causes are progressively more clearly understood, the common factor is that Sound Therapy is found to be very beneficial for those with autism. Some of the improvements most commonly observed include: reduction and normalization of auditory sensitivity and of sensory processing in general; reduction of stress and social discomfort; an increase in the capacity to make eye contact, connect, converse and socially engage with others.

Work by Stephen Porges in recent decades on polyvagal theory and sound therapy has confirmed that rehabilitation of the middle ear muscles enhances vagal response and is beneficial for those on the autism spectrum. This modern scientific exploration is a significant step in objectively proving the veracity of Tomatis's hypothesis that enhancing ear function with sound is beneficial for those with autism. The following studies demonstrate these findings.

The studies on Tomatis therapy for children on the autism spectrum found the following:

- Sound Therapy acts on the Cranial nerves to cause the middle ear muscles to block the perception of low frequency sounds, thereby creating a greater feeling of safety in the environment (Porges, 2003).
- The stimulation of the middle ear muscles with dynamically activated sounds enhanced vagal regulation (Porges, 2003).
- Living skills improved after Sound Therapy treatment (Gerritsen, 2010, Corbett et al, 2008, Davis, 2005).
- Autism symptoms, anxiety and hyperactivity were significantly reduced following treatment Pralong et al, 2014, Abedi Koupaeia et al, 2013, Torres de Carrell, 2009, Neysmith-Roy, 2001).
- Social skills and self-confidence and relationships were enhanced by the treatment, (Tatum 2004).
- Normalisation of brain activity was shown on EEG and Auditory Evoked Potentials (Vervoort et al, 2008).
- Parents reported 64% improvement in a wide spectrum of children's abilities (Davis, 2005).
- Interpersonal communication, increased eye contact and improved posture were noticed, Nel, 2005, Maudale, 1997).

Studies on coordination and motor skills

One of the interesting aspects of Sound Therapy is its benefits for balance, coordination and muscle tone, as well as small and gross motor skills. The field of sensory processing disorders gives rise to the understanding of how all sensory inputs are gathered and assimilated in the cerebellum, which then re-routes them to other areas. While it was initially thought that the cerebellum was primarily a centre for physical coordination, it was later determined that it is in fact the initial processing centre for all sensory inputs. While it was observed in some of the early Tomatis literature that sudden improvement sin posture are often seen in Tomatis listeners, the benefits for global developmental delay is amore complex issue, bringing together improvements in vestibular function and spatial perception while also assisting with hypertonic or hypotonic muscle tone to enhance fine and gross motor skills.

Number of studies

Six studies were reviewed with a total of 277 participants.

The studies on Tomatis therapy for coordination and motor skills found the following:

- Treatment helped to restore mobility after cerebellar ataxia due to inflammation of the cerebellum, enabling the boy to overcome the need for a wheelchair (Le Roux, 2008).
- Psycho motor improvement was a common response (Gilmor, 1999, Vervoort, 2008).
- Visual motor delays and sensory processing disorder improved (Hall, 2009).
- Improved motor skills impacted on daily living (Gerritsen, 2010).

Studies on Speech and stuttering

Eleven studies were reviewed including 1140 participants.

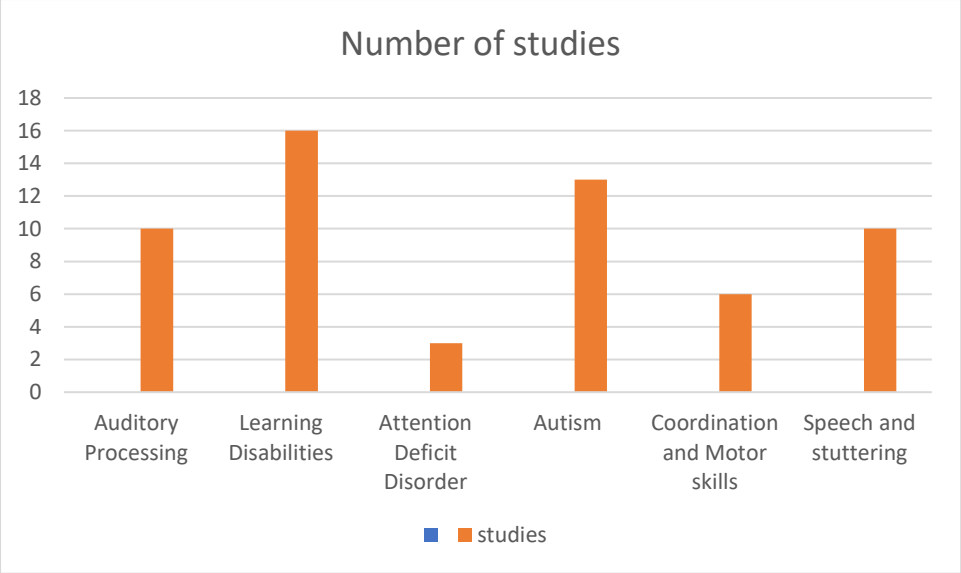
Speech and language development are one of the most significant treatment areas of Tomatis's discoveries in relation to the impact of Sound Therapy. Speech involves many different body systems, including the breathing, lungs, vocal apparatus as well as the hearing and language pathways. It requires gross and fine motor skills of the tongue and throat, plus all the neural requirements for expressive and receptive language in five areas: pragmatics – semantics – syntax – morphology and phenology. Sound Therapy has proven to have benefits in a wide range of speech and language difficulties as it provides stimulation through the whole auditory system and extends through the neural, cognitive and emotional system, due to the deep involvement of the ear and hearing in all of these brain areas. In recent decades, advances in awareness of auditory processing disorders and its progressive inclusion into audiological practice has facilitated awareness of Tomatis' pioneering actions in this field. Of particular note, Sound Therapy is effective for stuttering as it streamlines auditory processing by training for the right ear to be the directing ear.

The studies on Tomatis therapy for speech and stuttering found the following:

- The Forbrain vocal feedback device improves vocal parameters and speech quality Escera et al (2018) -- Tinyurl.com/forbrain-st
- The treatment rendered significant relief for stuttering- which proved to be related to laterality Kurkowski (2000) Van Jaarsveld, (1973, 1974) (Van Jaarsveld 1976 and 1988)
- Helps various neuropsychological speech impediments Mojos et al (2011)
- Enhances fluency, sound localisation, and self listening Mojos et al (2011) Kurkowski et al (2004)
- Improved linguistic memory Nicoloff (2004)
- Improves dyspraxia, dyslalia and motor planning disorder Kurkowski et al (2004) Nicoloff (2004)
- Improvements occurred in hearing speech and voice disorders Zdzisław et al (2002)
- Those with right sided deafness had more language disorders Kurkowski (2000)nodules
- Vocal fold nodules were reduced by 83% Szkiełkowska et al (2003)

Figure 1 shows the number of studies conducted on each category of condition.

Figure 1



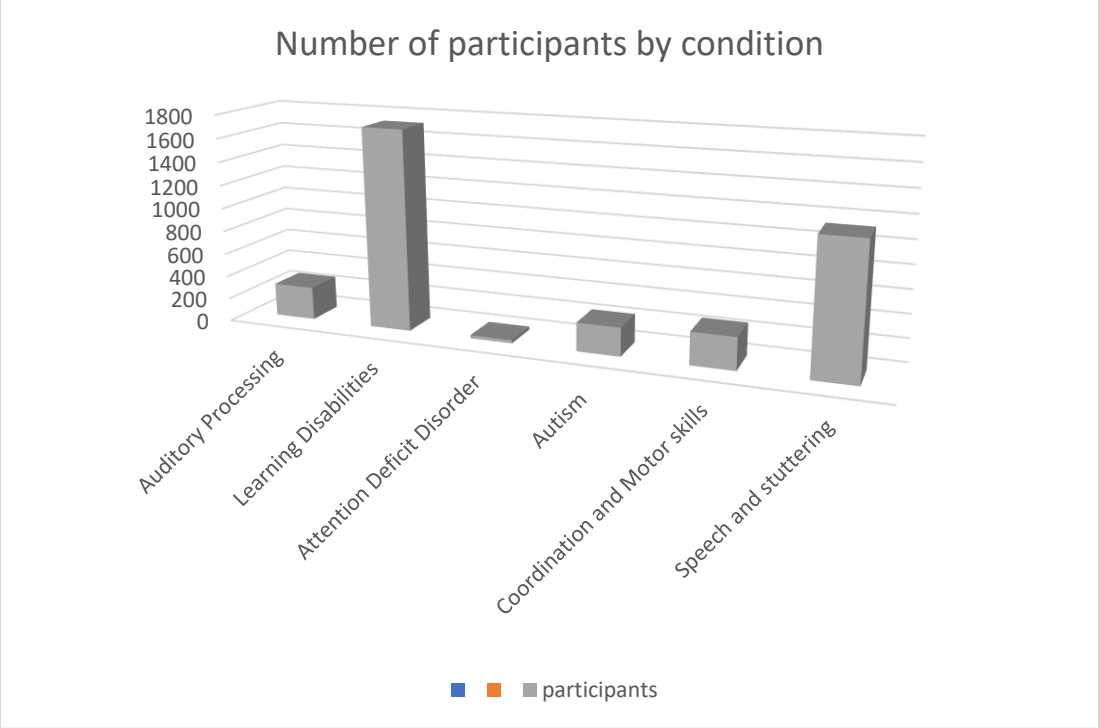
The number of studies in each category is an indication of which areas have attracted the most attention of researchers. It may not necessarily mean it that this is where the therapy is most effective.

The reasons for variation in the size of categories of studies include:

1. Real world impact of the condition, therefore leading to a large number of studies
2. The evolution of identification of functional disorders (EG: ADHD was not a widely recognised condition in the first few decades of research on Tomatis)
3. An artefact of the categorisation of condition and overlap between groupings

The number of participants in each study (Figure 2) again shows how the studies were grouped for analysis, with Leaning Difficulties being a bit of a general catch all. The number of children studied with ADD is quite small, possibly reflecting the fact that during the early years of Tomatis research this condition had not yet been identified, so there was a greater focus on autism and dyslexia.

Figure 2



Categories of benefits

The studies of the effects of Tomatis therapy demonstrated a wide variety of benefits, and each category of benefits contained several sub-categories, as shown in Table 1.

Table 1- Types of benefits

Language includes: Language skills, verbal auditory tasks and auditory processing
Internal state includes: confidence, stress, anxiety, body image, self-esteem, personality, mood, wellbeing and emotional adaptability.
Academic skills includes: reading spelling writing and math
Cognitive skills includes: learning ability memory, comprehension and visual processing
Coordination includes: movement, posture, sports, rhythm, balance and motor skills
Speech and sound perception includes: pitch discrimination, music fluency, sound localisation and stuttering
Focus includes: attention, concentration and reaction time
Social skills includes performance, productivity, leadership, creativity, responsibility, socialisation, behaviours and attitude
Laterality includes: improved laterality, confirmation of importance of laterality, and spatial sense
Self regulation includes: self regulation, hyperactivity, measures of slow brain activity and EEG.

(see detailed chart in appendix for sub categories of benefits.)

Figure 3

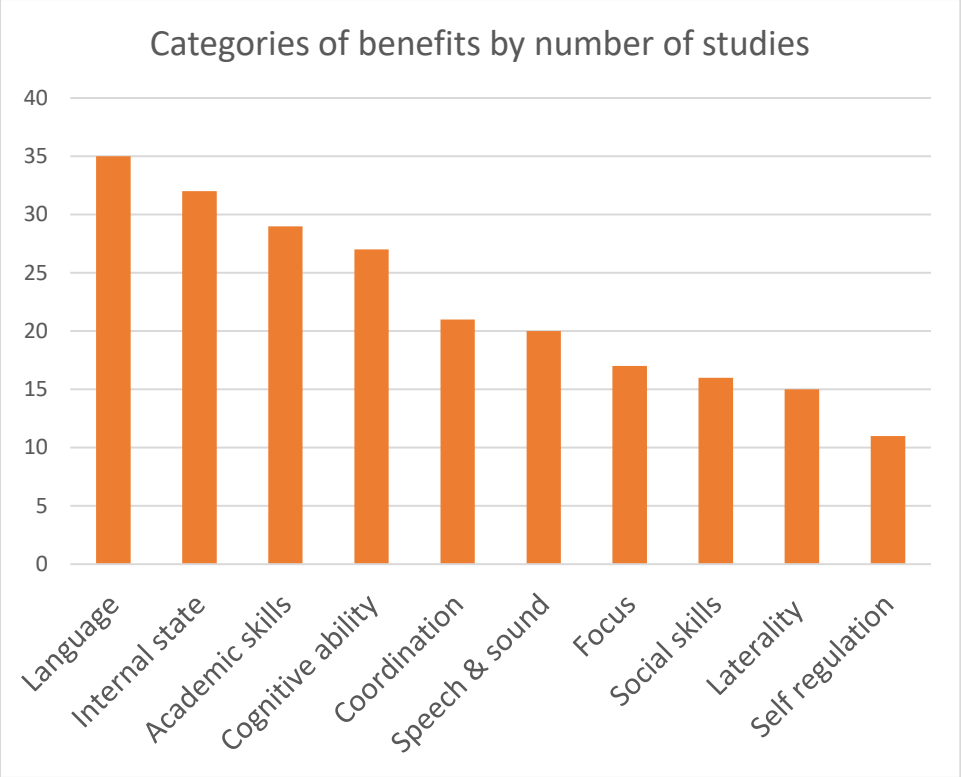


Figure 3 shows the size of each category of benefit, by measuring the number of studies it included. It is not surprising that language is the highest category, since Sound Therapy is known to significantly impact speech, hearing and auditory processing. It is a little surprising to see so much focus on internal state. This is probably an indicator that some of the most important benefits of Sound Therapy are how it makes the listeners feel and how it improves peace of mind, mood, self-esteem, confidence and wellbeing, although these benefits may not be what the researchers set out to identify.

One of the main factors affecting the strength of each category is how many different sub-groups it contains. For instance, the category of 'Speech' includes: timbre, vocal control, fluency, stuttering, localisation and pitch discrimination. The category 'Inner State' includes: stress, emotional adaptability, mood, wellbeing and self esteem.

It should be noted that the benefits selected were derived through several processes.

1. the researchers decided to measure for them and or report on them
2. measurable changes were found
3. these changes were named and identified in the written results of each study
4. these changes were then chosen as significant enough to be listed in compiling this summary

There may have been biases in the categorisation process, resulting in some important impacts not having been sufficiently highlighted. An example of a high impact category that may not have been well represented is self-regulation, which appears as a fairly small group. However, given our recent knowledge about the importance of self-regulation, it seems highly likely that that is at the base of most other improvements, but may not have been something that researchers specifically highlighted in most studies. For example, even in the studies on autism, where self-regulation must be a very significant factor, the areas most highly reported were language skills and social skills. This

may reflect the fact that these are easy for outsiders to observe, whereas self-regulation, which is a key underlying aspect of performance, is more subtle and harder to measure. This is also something that would likely show up more in studies on ADHD, but only three studies specifically on ADHD were found.

What is interesting, in all of the studies reviewed, is not only the fact that the majority of participants showed improvement, but the great range of conditions which proved responsive to the stimulation of Sound Therapy.

Benefits by participants

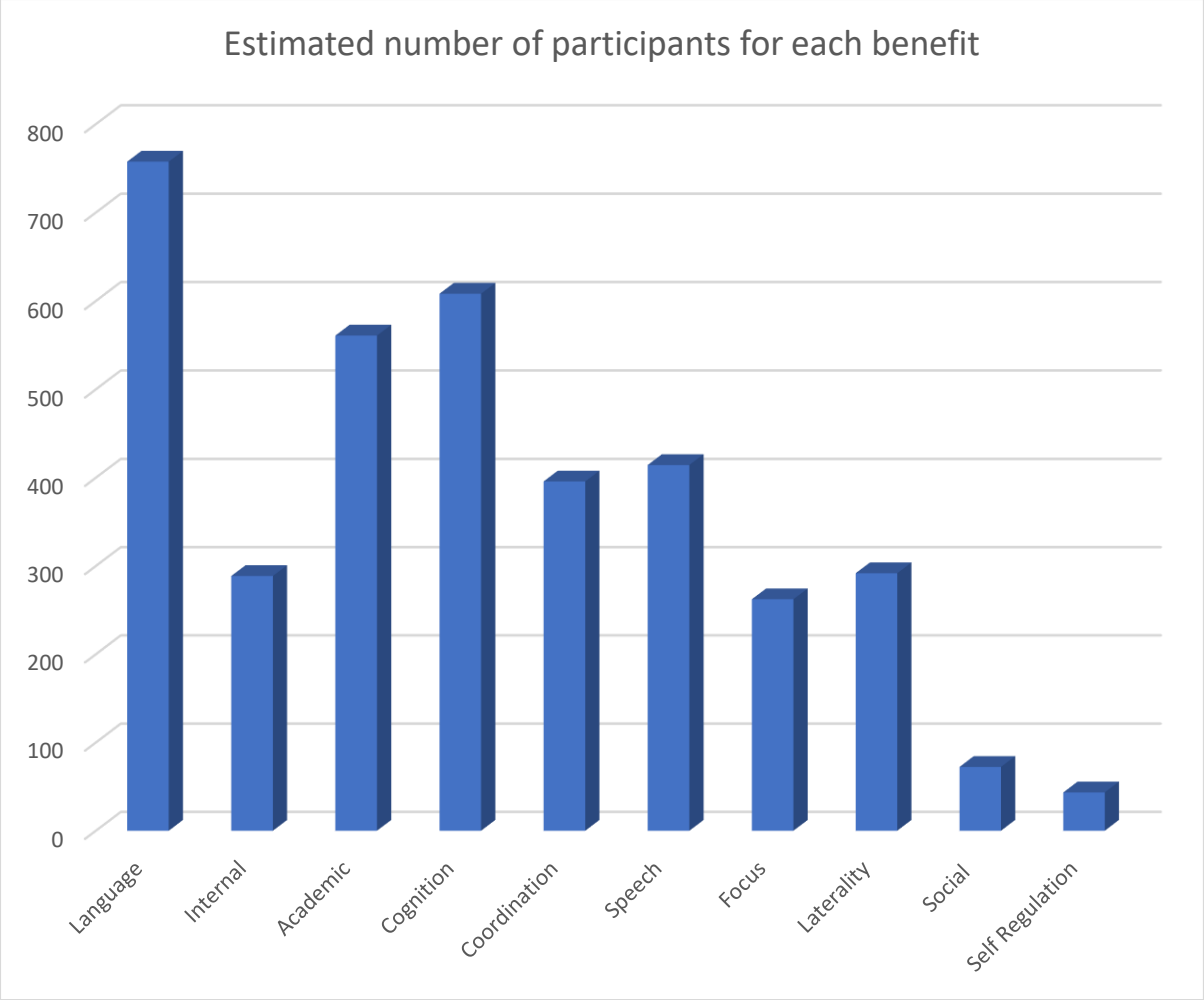
Figure This blue chart **4** "Estimated number of participants for each benefit" looks at how many participants were in the studies that picked up each particular group of benefits.

It shows that in the largest studies—for example the school study in Poland-- language was the area in which most participants improved. Next was cognition, followed by academic skills, then speech and then coordination.

These larger studies often included children who did not have learning difficulties or delays, so this is probably an indication of how Sound Therapy may benefit children in general, no matter what their level of academic performance.

This would be of interest to parents just wanting to give their children that extra head start.

Figure 4



In comparing benefits per participant to benefits per number of studies, the most obvious difference is that inner state is much smaller in the participants per benefit figure. Social skills is also notably smaller.

This is mainly due to the fact that the two types of study which picked up most strongly on internal state and social skills were those on Auditory Processing and Autism. Although these two categories of study each included ten or more studies, the number of participants was small compared to most other categories of study. This shows that although the researchers felt these benefits were important to study, they represent a smaller population niche than for instance, academic and language skills.

Benefits by condition studied

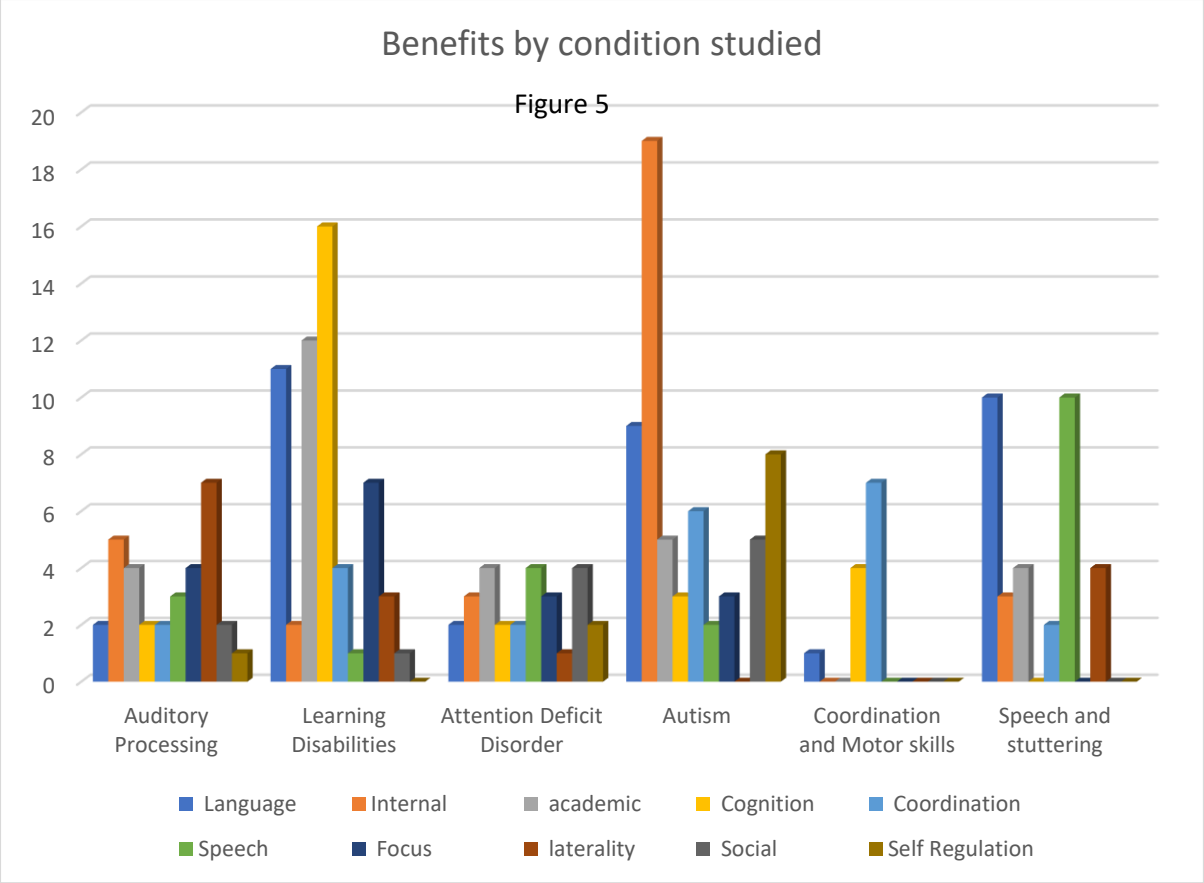


Figure 5

This chart (Figure 5) shows which benefits were found most often in each group of studies. Some of the benefits were fairly diverse and quite different to the condition that the study was aiming to investigate. This is an indication of the wholistic impact of Sound Therapy, which seems to help children in a broad array of skills and processing abilities.

For example, in the Autism group of studies we see that Internal state (orange) is very important. This is an interesting insight, as children with autism are not always able to communicate their experience. Language is almost as strong, with self regulation coming next.

In the Learning Difficulties group we see Cognition, academic skills and language rating most highly, which is a good indicator that fundamental mental processing ability, as well as language is being improved for these children.

In the Speech and stuttering group we see, not surprisingly high percentages for both Speech and for Language. In the Auditory processing group, laterality is the stand-out benefit.

In the Coordination group both Coordination and Cognition rate highly. These results are interesting as they draw out the close relationship between certain types of functionality—EG Coordination and Cognition.

The important conclusion from this data is that when you set out to study one area, it overlaps in so many ways. We are studying complex, integrated beings and it's clear that Sound Therapy enhances a great many aspects of their development. When you see it that it impacts so many areas of

function, it is clear why it is so important to include Sound Therapy in any remedial treatment program in order to optimise results.

Sound Therapy

Using a home-based program may be a perfect option to help fill the gap left by lockdowns and stimulate greater language development. Portable listening programs have been developed based on Dr Tomatis's research on auditory development which begins in the womb at 4.5 months. Tomatis's ground-breaking discoveries showed that the ear is an active organ whose development can be accelerated with the right auditory input. Sound Therapy enhances the ear brain connection, stimulating brain plasticity and increasing both receptive and expressive language skills.

The Sound Therapy SYNERGY program offers a range of children's and family packages which include the spoken word in the form of classic stories and poetry interspersed with filtered Sound Therapy music.

Listening to the filtered sounds activates the ear muscles while increasing the connections between at least ten different brain centres needed for language. Thus, the ear-brain connection is enhanced, and children often make leaps and bounds in their language development.

A special needs educator said, "the child is using longer sentences with more detail in speech" and a grateful grandparent said "our grandson was not speaking at age 5 after experiencing a trauma. He is now eight, and speaking normally, and I don't believe he would be speaking today if it weren't for Sound Therapy."

Sound Therapy SYNERGY is unique because:

1. It comes on its own dedicated high quality sound player.
2. We have a wide range of music and language programs for adults and children which are enjoyable to listen to over and over again.
3. It is designed to fit into daily life so it takes no time out of your day.
4. Our support materials mean that families can use the program at home, only requiring minimal instruction from their practitioner.

5. It is a low-cost entry point for families and practitioners
6. The training is quick and easy so you can get started with helping your clients right away.

Sound Therapy is affordable and accessible, and can be offered by practitioners to help their clients anywhere with no delays. It is the ideal early intervention, as it is beneficial for any child, whether they have a language difficulty or not. No specific testing is required, and families can take the program home and start using it right away. While waiting for other treatments, Sound Therapy may be a good way to give the child a head-start, as it will immediately begin correcting neural language deficits so that any future intervention is likely to be more successful.

Since we see results like this with Sound Therapy alone, think what it can do when combined with a comprehensive retraining program like Equipping Minds?

To purchase the program and try it out for yourself and your clients, contact Dr Carol Brown as she keeps a stock of our Family Programs and can supply you right away.

If you later want to become a Sound Therapy SYENRGY Consultant yourself you can do so by putting in an enquiry on our website

www.soundtherapysynergy.com

Choose the practitioner tab and enquire about becoming a Sound Therapy SYNERGY Consultant

We offer a short self-study online training program. I will be happy to speak with you directly about how Sound Therapy could fit into your practice.

But in the first instance, follow through with Carol and get your program from her.

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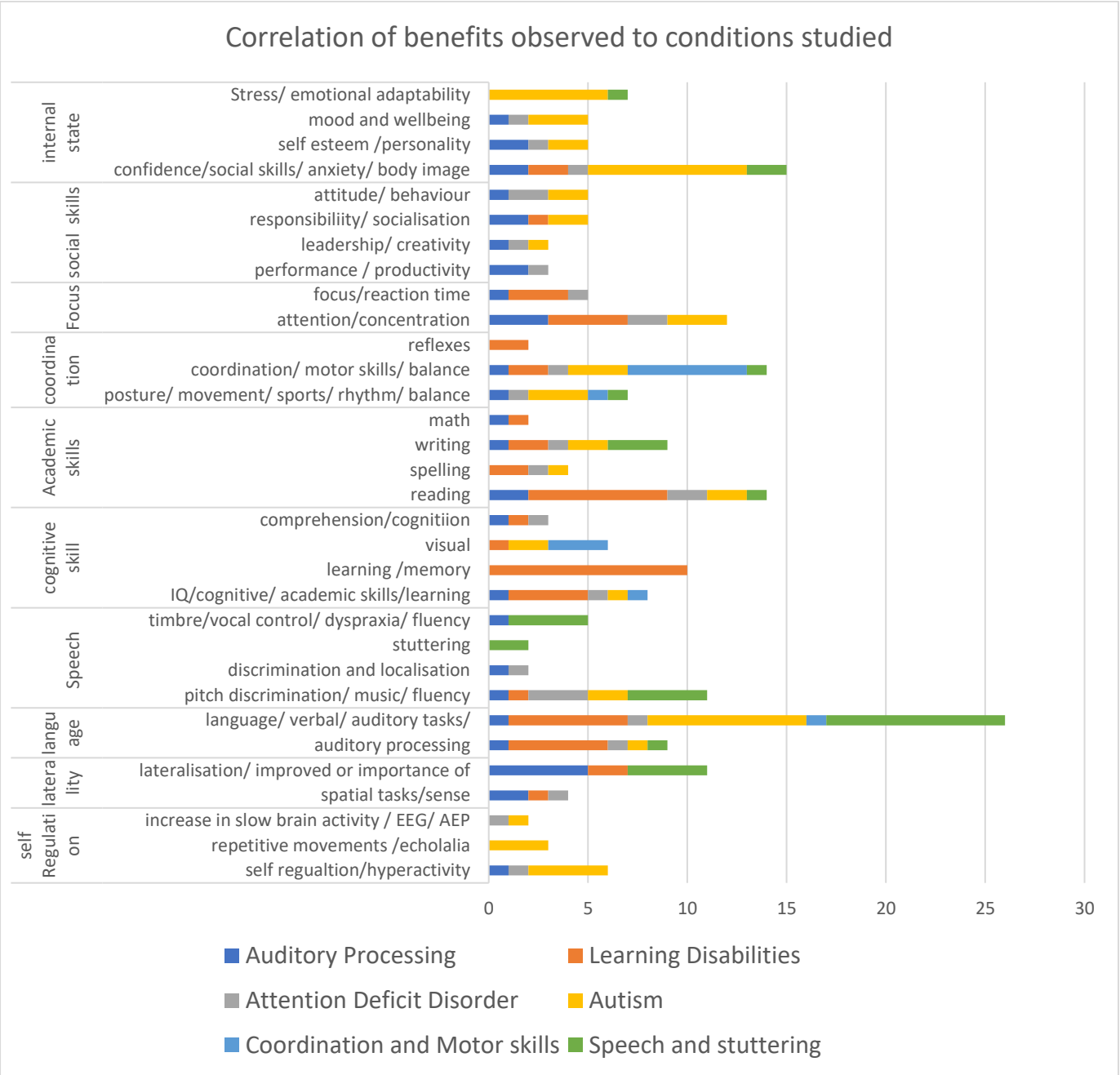
Appendix I

More detail on the benefits groupings

Each label of benefits combines fairly broad categories, for the sake of creating an overview.
Here are the graphs showing which sub-categories comprised each of the major categories of benefits.
The colours are linked to a key which indicates the extent that each type of study contributed to this group of benefits.
EG anything yellow was derived from studies on autism. Anything orange was derived from studies on learning difficulties.



Detailed Analysis of chart correlating conditions studied to benefits observed

Improvements in INTERNAL STATE we see lots of yellow- which is coming from studies on autism. There is also a fair bit of dark blue which comes from studies on auditory processing.

For improvements seen in SOCIAL SKILLS we see a fair bit of yellow which again, comes from studies on autism, plus some dark blue from studies on auditory processing, and some grey which represents studies on Attention Deficit Disorder

For improvements in COGNITIVE SKILLS we see a lot of orange which is from studies on learning disabilities plus some light blue for coordination, some grey for ADD and some yellow in the visual group, which comes from studies on autism.

Looking at improvements in SPEECH, we see a fair bit of green, from studies on speech and stuttering, plus dark blue for auditory processing in the categories of voice quality and pitch perception. Also some grey for ADD and yellow for autism under the category of pitch and fluency.

In the LANGUAGE improvements group we see lots of orange, coming from studies on LD, and lots of yellow, from autism studies and also some blue, green and grey from auditory processing, speech and ADD.

The LATERALITY improvements came from studies on auditory processing speech and learning disabilities.

And improved SELF REGULATION was seen mainly in studies on autism, with some elements from ADD and auditory processing.

Appendix II

List of studies and major findings of each study

Studies on Auditory processing, speech and language

Bonthuys (2016) tested 26 students against a control group and found that Tomatis therapy was effective in enhancing self regulation in University students.

Skrodzka et al (2015) tested 55 subjects in treatment and control groups and found improved performance on auditory and spatial tasks including pitch discrimination, timbre, categorisation, and lateralisation of sounds.

Young (2013) Found Tomatis treatment benefitted all of the 23 students tested in academic skills including reading, writing, math, attention, focus, comprehension, auditory processing, classroom attention and productivity. They also showed enhanced leadership, responsibility, posture, attitude , confidence and self esteem.

Mularzuk et al (2012) analysed auditory attention and hearing lateralisation of students receiving Tomatis treatment. The results indicated improvements in all the measured parameters, including auditory attention, internal auditory attention, sound discrimination and sound localisation.

Du Toit et al (2011) compared nine language interpreters to a control group and found significantly enhanced performance, personality, attention, concentration, mood and wellbeing.

Tinkl (2011) used spatial tests and found improvements in short and long term spatial sense in 30 Tomatis treatment subjects against a control group.

Callaghan (2009) did a range of studies of 1st and 5th grade students, who gained up to 34 months learning age, finding significant improvements in learning, socialisation and motor skills.

Szkielkoswska et al, (2008) studied auditory discrimination in 20 confirmed dyslexic children against a control group. 80% of the test group exhibited left ear dominance versus 10% in the control group, corroborating Tomatis's assertion that left auditory laterality is associated with auditory processing problems.

Kurkowski (2000) compared right versus left side deafness in 110 children. They confirmed Tomatis's assertion that right sided deafness is characterised by more serious linguistic difficulties, dyslexia, poor spelling and a lower standard of academic achievement. They found that left sided deafness was associated with emotional problems, nervousness and lower performance in humanities subjects.

Gillis and Sidlauskas (1977) tested ten 8 year old children using Sound Therapy activation of the voice to the right ear, and confirmed that right ear lateralisation increased reading speed.

Studies on Learning Disabilities and Behavior problems

Brown, 2018, studied 32 students with a selective learning disorder who were randomly assigned to training or control groups. The program aims to develop cognitive skills that can be transferred to other tasks. Pre and post tests included TerraNova academic test, Kaufman Brief Intelligence Test, the Automated Working Memory Assessment.
Over a seven week period, participants in the training group were instructed by a qualified mediator in using the Equipping Minds Cognitive Development Curriculum, including the use of Joudry's Sound Therapy program, for one hour per day while doing exercises for primitive reflexes, sensory-motor development, and cognitive development.

Students in the training group showed improvement on most academic tests. Researchers concluded that the intervention made a significant difference in verbal, non-verbal abilities and IQ.

Brown, 2018, documented five case studies where participants underwent the Equipping Minds Cognitive Development Curriculum, including the use of Joudry's Sound Therapy program, while doing exercises for primitive reflexes, sensory-motor development, and cognitive development.

Cognitive and academic gains were demonstrated in all five of the case studies documented.

8 yo boy with language and coordination disorders. Visual and verbal memory, visual- spatial memory, and reasoning skills and attention to detail have developed significantly.

11 yo boy with autism and verbal apraxia. Showed academic and cognitive gains in reading, comprehension, spelling and maths.

15 yo girl in low academic range, with reduced cognitive deficits processing, working memory, comprehension, and perceptual reasoning. Made significant and unexpected gains in oral and written language, maths, writing and memory.

Boy in high school with borderline IQ, mild Autistic Disorder, language problems and executive dysfunction. Results included reduced anxiety, increased eye contact, more socially aware, more alert, oriented, interactive as well as motivated. His language arts and maths abilities have improved, and no longer needs ADHD medication.

18 yo boy with head injury. Results included decreased fogginess, increased concentration and attention plus memory improvements, enjoying learning, greater stamina and energy.

Mojs et al (2017) in a study of forty children with normal IQ observed improved reaction time, hearing, attention, plus verbal fluency, memory and cognitive function.

Malak et al (2017) investigated the reading ability of 78 children, and found that selective attention and phonological memory are improved by Tomatis therapy.

Van Velze (2016) studied six disadvantaged children and found that Tomatis therapy made them more motivated and mature with better concentration, balance and language skills.

Kim and Sun (2016) Studied 26 high risk high school students and found improvement in reading, decoding and auditory processing following Tomatis treatment.

Konarski and Ratynska (2014) studied 1330 pupils from 62 schools over a three year period. Statistically significant improvements in learning skills and social skills were observed following Tomatis treatment. Researchers concluded the program was beneficial for children with and without special needs.

Chou (2012) Studied eight Taiwanese learners for reading fluency, and concluded there is huge potential for the Tomatis method for language learning.

Lozano (2009) studied the impact of Tomatis treatment versus music on literacy, comparing three groups of 25 students. The Tomatis group showed the most improvement in language narrative skills, phonological processing, awareness and memory, and in reading skills. Most of the improvements were retained 10 to 14 months after treatment.

Kati (2002) tested 8 children and found significant improvement in phonological and lexical elements of reading disorders following Tomatis treatment.

Rintel (1995) studied 6 children in need of remedial assistance who received treatment from the Joudry Sound Therapy program, against a control group. Five normed tests plus teacher observations were used to measure focus, memory, reading and writing skills. Researchers concluded it appeared that the children who received the high frequency music showed more rapid advances than the control group.

Rourke et al (1982) followed 25 learning disabled children for a year and found the Tomatis group performed better on all aspects of a standardized test battery.

Wilson (1982) studied 26 language impaired children for nine months. The Tomatis treatment group exceeded the control group on most measures, including communication, auditory closure, sound mimicry and articulation.

Mould (1985) compared a treatment group of 12 severely dyslexic boys to a control group. The treatment group progressed significantly faster on several standard tests.

Kershner et al (1986) followed 32 learning disabled children who received multiple interventions, while a portion of the group also received Tomatis treatment. Although the Tomatis group advanced more than the control group, the differences were not seen as significant initially. However, subsequent analysis has found design flaws that gave other advantages to the non-treatment group.

Roy and Neysmith Roy (1980) examined the effect of the Tomatis method on five dyslexic boys over fourteen months and showed improved cognitive control and audio-vocal control in four of the subjects, in line with their age and intellectual potential.

Gilles and Sidlauskas (1978) studied the impact of aural laterality on reading ability in ten dyslexic children. They established that reading was 5% more rapid when feedback was given exclusively to the right ear, supporting Dr Tomatis's theory of preferential right ear dominance.

Studies on Attention Deficit Disorders

Sacarin (2013) compared a treatment group of 15 children with ADHD to a control group of 10, who received medication. Tests included QEEV and ERP. Results revealed statistically significant improvements for the Tomatis group, including improvement in processing speed, phonological awareness, reading, behavior, and auditory attention. In this study, researchers observed a statistically significant increase in slow brain activity at central and parietal midline recording sites in the Tomatis group when they compared pre-and post-treatment theta/beta ratios within each group. Sacarin concludes that the significant improvements measured in cognition, attention and behavior, indicate that the Tomatis Method can be a brief and effective approach which has positive effects in children with ADD/ADHD.

Davis, (2005) studied the impact of Tomatis treatment on eleven children with ADD/ADHD. All of the parents reported improvements in their children after receiving Tomatis sound therapy, at the rate of an average of 73% improvement on a range of abilities.

Tatum (2004) reported on the effects of Tomatis therapy on a 9 year old boy with ADHD who progressed from a 2nd grade to a 5th grade level in his phonemic awareness, which is faster than the normal progression.

Studies on Autism

Porges (2003) undertook a series of experiments using modulated frequencies, which confirmed the physiological bases for Tomatis's observations. He showed that Stimulation with high frequency sounds enhances the ability of the cranial nerves to act on the middle ear muscles, enabling them to block out low frequencies. This process also reduces stress and enhances communication and emotional adaptability, and calms thoughts and feelings (behaviour and physiology). He thus demonstrated that improvement in vagal regulation enhances communication and emotional adaptability.

Davies and Smith (2016) did a case study of an 18 year old male diagnosed with Aspergers, OCD and anxiety, and found his functionality and living skills improved significantly after Tomatis treatment.

Pralong et al (2014) conducted a qualitative study on an 8 year old child with autism. Tests included the SCAS Spence Children's Anxiety Scale and Vanderbilt TDHAS which evaluates hyperactivity levels. The results were that a significant evolutionary maturation was observed, anxiety was decreased while important progress was made in reading and writing skills.

Abedi Koupaeia et al (2013) studied 34 children with autism divided into a treatment and a control group. The GARS test was administered pre and post treatment. ANCOVA analysis indicated that the Tomatis treatment reduced autism symptoms and stereotypical movements, increasing social interaction, communication and self-confidence.

Torres de Carrell (2009) undertook a study of 51 children to discover the effect of Tomatis treatment on echolalia. 75% of the parents said that the Tomatis method was the most effective treatment they had tried in reducing echolalia. Many other improvements were also seen in the children in this study such as language development, attention, motor functions, body image, visual following and balance.

Vervoort et al (2008) having treated 5,000 cases presented 4 cases with severe developmental problems and autistic tendencies as an illustration. Improvements seen in both bone conduction and air conduction in this study provide support for Tomatis's theory of the filtered sound providing a gymnastic re-education of the middle ear muscles and possible restoration of processing within the auditory neural pathways and brain centres.

Enhancements in hearing perception, speech and language skills, were observed to correlate with normalisation of brain activity shown on EEG and Auditory Evoked Potentials.

The authors concluded that the Tomatis Method is an effective and harmless treatment for patients with severe psychomotor and/or neurological dysfunctions. They also noted that auditory evoked potentials and electroencephalographically based brain mapping seems to be an appropriate examination to demonstrate neurological changes after Tomatis therapy.

Corbett et al (2008) undertook a double blind, placebo controlled cross-over study of 11 children with autism. This study failed to demonstrate benefits for Tomatis treatment. However, the study was criticised (Gerritsen, 2010) for its method of allocation to treatment and control groups and the fact that a crossover study cannot allow for the impact of longer-term benefits, which are known to be significant in Tomatis treatment. Gerristen's later qualitative analysis also indicated favourable results that were not detected in the quantitative analysis. For example, one child developed verbal skills for the first time, while others improved their living skills, reduced hyperactivity, improved concentration improved motor skills and achieved toilet training. (Gerritsen, 2010)

Davis, (2005) documented how parents of 100 autistic children reported on changes they noticed in their children pre and post Tomatis treatment. Tests in the protocol include the Listening Test, laterality Test, Client Case History and Client Interview. The form that parents were asked to complete was called "Abilities to be Improved Form" and included 102 possible changes that could be noted within 12 general areas. This was completed pre and post treatment. Parents reported improvements in their children after receiving Tomatis sound therapy, at the rate of an average of 64% improvement on the full range of abilities.

Nel (2005) reported a case study with a 14 year old boy with Aspergers, in which qualitative data were gathered through semi structured interviews. Results indicated improvement in interpersonal

communication and all six domains of psychological well being according to RyfT (1995), resulting in better family relationships.2

Tatum (2004) reported on the effects of Tomatis therapy on two cases with autism. A 14 year old girl had developed no speech after eight courses of speech therapy, since the age of 4. Following Tomatis treatment she exhibited many improvements in social skills and had functional use of 34 words. A 9 year old boy progressed from a 2nd grade to a 5th grade level in his phonemic awareness, which is faster than the normal progression.

Neysmith-Roy (2001) undertook case studies of six severely autistic boys. The measure used for pre and post testing was CARS, the Childhood Autism Rating Scale. According to this scale, by the end of the study one boy was no longer autistic, score of < 30, and two were only mildly autistic, score = 31-36. The other three boys remained within the severely autistic range, score of > 36, though one of those did improve on the CARS scale.

Shiedeck (2000) studied 20 children and adolescents with mild autism divided between a treatment and control group. Significant gains were seen on all measures for the treatment group compared to the control group. The abilities tested were motor skills, visual perception and pronunciation.

Maudale, (1997) at the Listening Centre in Toronto Canada, reported on qualitative changes observed in children who have undergone treatment at The Listening Centre in Toronto. Pre-natal sound perception- listening to recordings of mother's voice. Notice increase in voice production, babbling and desire to communicate. Listening and focus- observed changes increased eye contact, more erect body posture, especially in upper body.

Spaggiari, (1995) cited by Gerritsen (2010) was a psychiatrist and Tomatis practitioner in Reggio Emilia, Italy, who evaluated the effect of Tomatis treatment on 13 children with autism and noted improvement in 54% of these cases.

Studies on coordination and motor skills

Le Roux (2008) described the case of a young boy diagnosed with cerebellar ataxia, a disorder that occurs when the cerebellum becomes inflamed or damaged, causing unsteadiness of gait. Prior to treatment he was wheelchair bound and was on medication for vertigo and nausea. He had poor coordination for fine motor tasks, blurred vision and was only able to walk with a walking frame. After 15 days of treatment, Sam was no longer using a wheelchair. The Sound Therapy consultant concluded that adding the Tomatis training to the sensory integration therapy was responsible for the remarkable progress that was achieved.

Gilmor (1999) compiled a meta-analysis of 231 children and reported that 95% of parents noted beneficial changes. As well as linguistic and cognitive changes, psychomotor improvement was also reported.

Hall (2009) studied 10 children with Sensory Processing Disorder and Visual Motor delays. Over 12 weeks, the participants exhibited significant improvement on the Sensory Profile, increasing a mean of 71 points. Parents reported improvements in their children's behaviors related to sensory processing. Scores on the VMI visual and ETCH legibility scales also improved more during the therapeutic listening phase.

Gerritsen (2010) re-analysed a previously reported study of 11 subjects with autism and noted improvements in a variety of capabilities, including motor skills and impacting on skills of daily living.

Vervoort (2008) analysed four subjects using QEEG, auditory evoked potentials, to measure the results of Sound Therapy and concluded it seemed to be an effective and harmless treatment for patients with severe psychomotor and/or neurological dysfunctions.

Schiedeck (2000) studied twenty children and teenagers with autism and found significant gains were seen on all measures including motor skills, visual perception and pronunciation.

Studies on Speech and stuttering

Escera et al (2018) studied the effect of Forbrain on six different measures of speech quality. They argue that the parameters measured and been proven to have clinical significance in a variety of vocal issues and are also pertinent to those who stutter. This study delivers precise, statistical evidence to show that use of the Forbrain device has immediate observable effect on two of the vocal parameters being measured. These were reduced breathiness and strengthening of the voice. The results obtained are said to have revealed compelling significant effects of the treatment on voice production. It is therefore suggested that such treatment would be of benefit to stutterers.

Tinyurl.com/forbrain-st

Kurkowski (2014) investigated the role of sound perception in speech production. He offers a review of published research around the world with a special focus on Poland, where the method has been trialled in 200 special schools. He states that the results from some of the key studies in Poland were not fully developed. In the Mularzuk (2003) study, including 776 school children, according to Kurkowski, 50% of the children had better scores in the control tests after treatment. The author also suggests that Tomatis treatment would likely be a valuable component of therapy for stuttering as it is likely caused at least in part by unformed laterality.

Mojos et al (2011) studied the impact of Tomatis treatment on forty-seven children who had a range of neuropsychological and speech impediments. Results showed a statistically significant improvement in most of the parameters measured such as reaction time, verbal fluency and sound localisation. Subjects demonstrated greater hearing sensitivity and better ability to localise sounds, while verbal fluency was enhanced.

Nicoloff (2007) descried the case of a girl who was born prematurely and had a history of ear infections and ruptured ear drums. She had very unclear speech and needed her mother to repeat things endlessly. After the Tomatis therapy Sue's hearing improved along with her writing and ability to complete tasks. Her verbal expression improved and she became less angry. She became more compliant, happier, and her speech improved dramatically, along with her posture. Teachers, her mother and speech pathologist all noted her huge improvements.

Nicoloff (2004) reported on two young boys with developmental dyspraxia. Following Tomatis treatment, one reported increased sentence length, more appropriate sentence structure, better comprehension, improved drawing and writing, enjoyment of language, understanding instructions easily and improved linguistic memory. The other, who had not spoken up to age 4 suddenly started speaking after 4 days of treatment. Reading and motor skills improved, he developed vocal control,

better coordination, hand writing, climbing, with a dramatic change in confidence, and normalised social interactions. The researcher concluded that the Tomatis program improves Dyspraxia associated with Motor Planning Disorder, enabling greater ability to use and control the muscles of the tongue and mouth in order to produce specific speech sounds.

Kurkowski et al (2004) studied ninety-four Polish children who had been identified as having dyslalai—difficulty speaking due to structural deficits in their speech organs. The physical deficits included hampered performance of vertical and horizontal movement of tongue, reduced precision and speed of tongue movement, malocclusion of the teeth and shortening of the tongue tie.

The aim of this study was to determine the role of auditory control in the articulation process. In particular they wished to assess the role of auditory attention and selection. The authors suggest that the emphasis in Tomatis therapy on alignment between exogenous and internal self-listening may be key to interpreting and treating many speech disorders. Disorders of sound pitch discrimination in the speech band were identified in 82.9% of cases, and above 2,000 Hz in 98.9% of cases. Authors note that left hemisphere dominance is essential for accurate speech control. By uncovering the aspect of impaired sound discrimination and self-listening in children with dyslalia, the paper points to the essential importance of Tomatis treatment to rehabilitate these children.

Zdzisław et al (2002) produced a preliminary report giving two selected case histories discussing diagnosis and treatment of children with hearing, speech and voice disorders plus reading and writing difficulties. The paper includes audiograms showing the differences before and after treatment.

Kurkowski (2000) conducted an analyasis of 110 children to compare the behaviour of people with right sided versus left sided deafness. Results indicated that in persons with right sided deafness 48.3% showed emotional disorders. They also had more serious problems with language skills and school performance.

In persons with left sided deafness, 87.1% exhibited emotional imbalance. In school these children preferred science, as information was more directly conveyed to the left hemisphere, responsible for rational thinking.

This study is interesting in light of Tomatis's emphasis on the importance of right ear dominance for language proficiency, which seems to be confirmed by these results.

Kurkowski (2000) studied forty five stutterers of varied ages. Subjects were tested for auditory laterality using Tomatis' audiolaterometer. The author concludes that the diagnosis of stuttering should include an evaluation of auditory lateralisation and that appropriate therapy should be given in cases of left side or mixed laterality. In left auditory dominance, information is delivered first to the right hemisphere, hence emotional state or disturbance is known to affect speech fluency. Stuttering is four times more prevalent in boys than in girls. This may be due to speech being more lateralised in both hemispheres in women.

Van Jaarsveld, (1973, 1974) conducted two studies on stuttering. In the first study, involving 43 participants, all clients reported symptom relief with more fluent speech and 82% of the participants were observed to have significant symptom relief. In a follow up after 12 months, 54% had maintained their improvement.

In a follow up study (Van Jaarsveld 1976 and 1988) tested 30 young adults who were severe stutterers. Several tests were used to evaluate severity of stuttering, speech fluency, oral reading, attitude towards stuttering, improved hearing in speech range in right ear and vocal output.

Szkiełkowska et al (2003) studied 30 children aged 6 to 12 with vocal fold nodules and accompanying dysphonia, plus abnormal listening ability and laterality. Following Tomatis treatment, 83% no longer had detectable vocal nodules. A significant improvement in listening attention was found in 88% of the subjects, and improved laterality was found in 90% of participants. In 80% of participants, frequency and amplitude voice parameters returned to normal, and these results were sustained on re-testing 7 months later.