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The Effect of Tomatis Therapy on Children with Autism: Eleven Case Studies

Jan Gerritsen

This article presents a reanalysis of a previously reported study on the impact of the Tomatis Method of auditory stimulation on subjects with autism. When analyzed as individual case studies, the data showed that six of the 11 subjects with autism demonstrated significant improvement from 90 hours of Tomatis Therapy. Five subjects did not benefit significantly, at least not on the measures used in this research. The results of this study support previous findings reported in peer-reviewed research.

The benefits from the Tomatis Therapy varied from subject to subject. In this study, one subject transitioned from nonverbal to verbal, one began to spontaneously repeat words, and others increased their receptive and expressive vocabulary. Additional findings included improvements in skills of daily living, motor skills, socialization, and overall communication skills. The findings of this study also indicated reductions in hyperactivity, atypical behavior, and inattention.

INTRODUCTION

The Tomatis Method of auditory stimulation is used to improve the listening (as opposed to hearing) skills, thereby improving communication skills, especially in children and adults with disorders of communication, learning, and autism. Auditory stimulation results in myelination of the auditory pathways (Sacarin, 2009), which improves the speed of processing of the auditory signals (Kandel, 2000). In addition, the auditory stimulation results in a better integration between

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the different sensorial systems and in a more harmonious balance between the para- and sympathetic nerve system (Tomatis, 1983).

The auditory stimulation is achieved by listening to music (Mozart and Gregorian Chants) and a recording of the mother's voice processed through an electronic device of Dr. Tomatis' design, called the Electronic Ear. The subjects listen to the processed music through headphones equipped with a vibrator that transmits sound to the auditory cortex via bone conduction. The treatment also includes an active phase in which the subjects listen to their own voices as processed through the Electronic Ear. Detailed information on the Tomatis Method can be found in *Listening for Wellness* (Sollier, 2005).

The Tomatis Method is not suggested to be a cure for autism but rather is intended to be a supplemental therapeutic intervention to enhance and improve communication skills, physical and motor skills, and social and behavioral skills in children with autism. Not unlike other and more traditional treatment interventions (e.g., Applied Behavioral Analysis, Floortime, Sensory Integration Therapy, Relationship Development Intervention), a certain percentage of subjects do not respond to the intervention. Based on his extensive clinical practice, Dr. Tomatis estimated that his method of auditory stimulation appreciably improves the quality of life in approximately 60% of subjects with autism (Tomatis, 1991); the other 40% do not respond to standard Tomatis auditory stimulation. Like with other treatment interventions, no test exists to determine whether a subject will or will not respond to the Tomatis Therapy.

Research indicates that children with autism have difficulty processing sensory input, especially auditory information. It has been suggested that impaired auditory perception skills may be associated with deficits in language, communication, and reciprocal social skills seen in subjects with autism (Kellerman, 2005). Recent research has shown that Tomatis auditory stimulation improves auditory processing skills (Ross-Swain, 2007). The study showed significant improvements in immediate auditory memory, auditory sequencing, auditory discrimination, auditory cohesion, auditory latency, and interpretation of directions. Tomatis auditory stimulation may thus have a positive effect on subjects with autism.

The first study on the effects of Tomatis Therapy on subjects with autism was published in 2001 (Neysmith-Roy, 2001). She studied the effects of Tomatis Therapy on six boys with severe autism as measured by the Children's Autism Rating Scale (CARS, Schopler, 1988). Three of the six subjects demonstrated significant behavioral improvements by the end of the treatment. Upon completion of the treatment, one of the three subjects was no longer considered to be autistic as per the CARS scale. In his case the treatment consisted of 180 hours of Tomatis Therapy administered over a period of 21 months. At the completion of the intervention, the two other subjects were rated as being mildly autistic as opposed to an initial rating of moderate autism. The remaining three subjects

remained within the severely autistic range. Of particular interest were the improvements that occurred in prelinguistic areas of five of the six subjects. These improvements included Adaptation to Change, Listening Response, Nonverbal Communication, Emotional Response, and Activity Level.

A second study on the effects of Tomatis Therapy on subjects with autism was published in 2007 (Vervoort, 2007), detailing significant improvements following use of Tomatis Therapy on four subjects rated as being severely autistic. The improvements were documented by changes in the EEG Brain Maps and Auditory Evoked Potentials, which objectively assesses central auditory processing.

A third study was conducted by Corbett et al. (Corbett, 2008), studying 11 children with autism. The analysis did not show a statistically significant difference in language skills between the Tomatis treatment and the Placebo (Corbett, 2008). This finding could have been anticipated as the sample size was very small. The authors acknowledged this by stating that “the study may be underpowered due to the small sample size” (Corbett, 2008).

In addition, the sample was too heterogeneous to be analyzed as a group. For example, the study sample consisted of children with varying degrees of language skills, ranging from nonverbal to functional receptive and expressive language skills. Approximately half of the subjects demonstrated atypical behavior while the others were judged to have appropriate behavior skills. Further, approximately half of the subjects were reported to have attention deficits while the others did not. As a result, it could have been anticipated that the response to the intervention would vary from subject to subject. By averaging the results, as done when the data are analyzed as a group, the benefits obtained on an individual level would thus be obscured.

The data analysis methodology used by Corbett demonstrated significant shortcomings, invalidating the study conclusions (Gerritsen, 2008). Corbett et al. did not report or take into account that typically 40% of the subjects with autism do not respond to Tomatis Therapy (Tomatis, 1991; Neysmith-Roy, 2001). By averaging the results of nonresponders and responders, the impact of the therapy among responders was obscured. The most efficacious data analysis procedure would have been to separate the nonresponders from the responders and report the results among responders. In the present study, there were six responders. Such a small sample size does not lend itself to statistical analysis, as it does not have the power to detect even meaningful differences.

More seriously, Corbett et al. used a cross-over design that was inappropriate for this study group. While crossover designs are the method of choice to test transient effects, such as blood pressure medication whose effect wears off within a short period of time, they are inappropriate to measure the impact of interventions which have lasting or carry-over effects, as it alters the response to the subsequent treatment (Bland, 2004). The Tomatis therapy claims to have a lasting effect and should thus not have been evaluated in a study using a cross-over

design. In addition, the cross-over design was inappropriate as the impact of the Tomatis Therapy continues to build after the treatment has been completed (Extended Tomatis Effect). When examining the cell Tomatis first/Placebo second, the second period thus measures the sum of the Placebo Effect plus the Extended Tomatis Effect. The second phase thus no longer is a true Placebo. As a result, the data should not have been evaluated as a group but rather as individual case studies. Further, children with autism are a heterogeneous group and each should serve as their own baseline (e.g., case study) in order to effectively determine the effects of any therapeutic intervention.

Corbett did not report the results of the behavioral assessments that were included in the data collection, though the original objective of the research was to assess the impact of the Tomatis therapy on both communication and behavior deficits. Corbett only reported the results on expressive and receptive language skills.

The Corbett data should not have been analyzed as a group. However, in order to demonstrate the true effects of the Tomatis therapy, the data can still be analyzed and interpreted as 11 separate case studies without being confounded by the design flaws, as will be done in the current article. Because autism is a spectrum disorder, the definition by nature regards this group as being heterogeneous and an analysis on a case-by-case basis yields more information than analysis as a group, as shown in this article.

THE CORBETT STUDY

Purpose

The purpose of the Corbett study was to determine the efficacy of the Tomatis Method when treating children with autism, especially with regards to communication and behavioral deficits, as measured by standardized instruments.

Design

The Corbett study used a double-blind, placebo controlled crossover design and was conducted at the premises and under the auspices of the University of California, Davis Medical Center's M.I.N.D. Institute. Eleven subjects (nine male and two female) with autism between the ages of 3-½ and 7 were enrolled in this study. They met the DSM-IV (American Psychiatric Association, 1994) criteria for Autistic Disorder and their ADOS scores (Lord et al., 1999) fell within the range of the autism spectrum. Five of the subjects were placed in Group 0 and received the Placebo treatment first followed by the Tomatis Therapy. The other six subjects were assigned to Group 1 and received the Tomatis treatment first followed by the Placebo Treatment.

Treatments

The total duration of the Tomatis Therapy was 90 hours and conducted over a period of 18 weeks. The treatment was divided over four blocks of time (of three, two, two, and two weeks, respectively). As the beneficial effect of the Tomatis treatment builds over time, the four blocks were separated by rest periods of three weeks to allow for integration of the sensory stimulation (Sollier, 2005). In the remainder of this article, reference to the ongoing impact of the Tomatis Therapy upon completion of the treatment protocol will be reported as the Extended Tomatis Effect (ETE).

The therapy mainly consisted of listening to music processed through the Electronic Ear. As the treatment progressed, the low frequencies were filtered out progressively, ultimately filtering out all the frequencies below 8,000 Hz. Starting at the second week of block 1, the intensity of the sound to the left ear was reduced so as to promote dominance of the right ear, which is fundamental to the Tomatis Method. Towards the end of the treatment, the subjects were asked to repeat words or phrases into a microphone and to sing or hum into a microphone, connected to the Electronic Ear. This activity is designed to allow the subjects to hear their own voices.

As is usual in many Tomatis Centers, the subjects also played with toys that stimulate the sensory system, such as fidgets, squeeze balls, gel balls, etc., while listening to the modified music. There were also swings, trampolines, beanbags and a host of other toys to keep the subjects stimulated and engaged.

The Placebo treatment paralleled the Tomatis Therapy, with the exception that the music was not processed through the Electronic Ear, and that the microphone was not active. The subjects likewise were engaged in the Sensory Stimulation exercises.

The integrity of the Tomatis intervention was monitored and ensured by Dr. Deborah Swain, owner and operator of the Swain Center in Santa Rosa.

Assessment Tools

The subjects were assessed blindly at three times during the course of the study. The first assessment was done at the beginning of the program. The second was done before the cross-over between the treatments, 18 weeks after the start of the research. The third assessment was made at the conclusion of the study, 36 weeks after the start of the research. The primary assessment tools were:

- The *Peabody Picture Vocabulary Test - Third Edition* (PPVT-III; L. M. Dunn & Dunn, 1997), measuring receptive vocabulary.
- The *Expressive One-Word Picture Vocabulary Test* (EOWPVT, 3rd ed., Brownell, 2000), measuring expressive vocabulary.

- The *Vineland Adaptive Behavior Scales–Interview Edition* (VABS; Sparrow, 1984) which is a norm-referenced, standardized measure of adaptive functioning. The VABS uses a structured parent interview format designed to assess a child’s ability to perform daily activities such as communication skills, daily living skills, socialization, and motor skills.
- The *Behavior Assessment System for Children* (BASC; Reynolds et al., 1999) which is a general behavioral form completed by the parents and teachers of the research participants. It measures, among other parameters, hyperactivity, attention problems, atypical behavior, and withdrawal. Several sections of the BASC were excluded as they are not appropriate to evaluate subjects with very limited language skills, as they rely on what the subject said. The raw scores are transformed to T-scores, which have a mean of 50 and a standard deviation of 10. A score between 40 and 60 is considered normal.
- The *Short Sensory Profile* (SSP; Dunn, 1999).

EVALUATION METHOD USED IN THE CURRENT PAPER

Corbett interpreted the receptive and expressive vocabulary data as a group (Corbett, 2008) which, as argued before, could not yield reliable results. The current article analyzes the same data as 11 separate case studies, evaluating the test scores on a case by case basis. This way of analyzing the data avoids the pitfalls of the group analysis done by Corbett. In addition, the current article reports the results of the behavioral assessments, which were omitted in the Corbett paper.

When interpreting the PPVT, EOWPVT, and VABS, raw scores were used because standard scores take into account normal development rates. A zero change in the standard score thus corresponds to a normal rate of development which would be a significant advance for subjects with severe developmental delays.

To determine whether the differences between the pre- and postintervention scores are meaningful, Confidence Intervals on the pre- and postdifferences, CI(95), were calculated based of the Standard Errors of Measurements (SEMs), which are published in the test manuals. The SEMs are estimates of the standard deviation of an individual’s test scores from repeated administrations of a test under identical conditions. Therefore, the standard deviation of the difference of the pre- and postintervention scores ($SD_{pre/post}$) becomes

$$SD_{pre/post} = \text{sqrt} (SEM_{pre}^2 + SEM_{post}^2)$$

As $SEM_{pre} = SEM_{post}$, this formula becomes

$$SD_{pre/post} = \text{sqrt}(2 \times SEM^2)$$

The 95% confidence interval, CI (95), is thus:

$$\begin{aligned} \text{CI (95)} &= 1.96 \times \text{SD}_{\text{pre/post}} = 1.96 \times \text{sqrt}(2 \times \text{SEM}^2) \\ \text{CI (95)} &= 2.77 \times \text{SEM} \end{aligned}$$

In the remainder of this article, differences that are equal to or greater than the CI (95) will be called significant differences, meaning that there is a 95% probability that the differences are not due to random error.

RESULTS

Baseline Scores

All participants' ADOS scores were found to fall within the range of the autism spectrum. Nine of the 11 participants had a Stanford-Binet IQ at or below 70, which might indicate that they were low functioning. The PPVT and EOWPVT scores showed that all subjects were severely delayed in vocabulary skills. The average delay was 3.2 years. Three of the subjects were nonverbal. The SSP scores show that all but one of the subjects experienced significant sensory deficiencies. The VABS scores showed that all but one of the subjects had significant adaptive behavior deficits. The average adaptive behavior delay was 2.5 years. The BASC scores showed that most subjects had scores outside the normal range (40–60), meaning that they had significant behavior problems (attention problems, atypical behavior, hyperactivity, and/or lack of social skills).

Placebo Effect

Group 0 (Placebo first, Tomatis second) comprised five subjects. Upon completion of the Placebo phase, nine significant changes were observed; six of these were improvements and three were regressions. On average, 1.2 significant improvements and 0.6 significant regressions per subject were noted. As each subject was graded on 17 parameters, this means that the impact of the Placebo was quite small. Chance alone would result in 0.85 changes per subject. Part of the improvements measured upon completion of the Placebo phase may have been due to the sensory stimulation all subjects obtained.

Group 1 (Tomatis first, Placebo second) cannot be used to gauge the Placebo effect as it is contaminated by the carry-over effect. In addition, the Placebo in Group 1 also measures the Extended Tomatis Effect, further contaminating the Placebo.

Nonresponders

Five subjects (numbers 1, 2, 4, 7, and 11) did not seem to have benefited from the Tomatis intervention, at least not on the measures used in this research. The failure rate reflects similar findings of the Neysmith-Roy study (Neysmith-Roy, 2001) and the clinical experience of Dr. Tomatis. The results are summarized below; the numbers within the parenthesis are the pre/post intervention ratings. The postintervention numbers refer to the combined effects of the Tomatis therapy and Placebo treatment. On average, 1.2 significant improvements and 0.8 significant regressions per subject were noted. These findings did not differ significantly from the results for the Placebo treatment (1.2 significant improvements and 0.6 significant regressions per subject).

Subject 1

No significant changes were observed, except an increase in the withdrawal rate as observed by the parents (51/68). The teacher rating on withdrawal was essentially unchanged (57/55).

Subject 2

A significant increase in the receptive vocabulary (PPVT 38/52) was noted. The standard scores did not change, meaning that his vocabulary improved in an age-appropriate way. No other significant changes were observed.

Subject 4

A significant improvement in motor skills was noted, especially during the Tomatis phase (26/47). Increases in motor skills could prelude language development. In a clinical setting this would be an indication to continue therapy. Unfortunately, the motor skills of the other participants were not assessed.

Subject 7

It is unclear whether this subject benefitted from the Tomatis treatment. When measured over the total duration of the research, he improved significantly in terms of socialization (VABS, 46/62). His vocabulary improved in an age-appropriate way (PPVT 54/67; EOWPVT 40/52), which could be interpreted as significant progress as he demonstrated a language delay of more than three years at the beginning of the study. On the other hand, he significantly regressed in terms of communication (85/72) and directionally in terms of daily living skills (85/71). Without additional data, it cannot be determined whether this subject would benefit from additional Tomatis therapy. For that reason, he was included in the nonresponder category.

Subject 11

This subject improved in expressive vocabulary in terms of age level appropriate skills (EOWPVT 50/60). The teacher noted increases in attention problems (56/69) and in atypical behavior (61/80), not noted by the parents.

Responders

On average, five significant improvements and zero significant regressions per subject were noted. The individual results are summarized below. Each subject summary reports the quantitative significant changes, both improvements as well as changes that would be regarded as regressions. The quantitative data summaries are followed by the observation summaries of the research assistants and the parents. While anecdotal in nature, each observation summary highlights changes which may not have been included in the closed-ended questionnaires. The information may be useful in designing future research tools.

Responders (Group 0)

Within this group, two of five subjects responded to the Tomatis intervention. Each received the Placebo treatment first, which was thus “uncontaminated.” Hence a direct comparison between the Tomatis and Placebo treatments could be made.

Subject 6



Subject was 7.2 years at the beginning of the study. His receptive and expressive vocabulary skills had an age level equivalent of 3.1 years. He was 3.4 years delayed in adaptive behavior skill and had significant attention problems. The results have been summarized in Table 1. The numbers refer to the pre/post ratings for the specified periods.

As shown in the table, the Placebo intervention resulted in one significant improvement (PPVT 41/60) and two significant regressions (daily living skills 71/25 and socialization 61/43). The Tomatis intervention resulted in seven significant improvements and zero significant regressions. In this case, the Tomatis intervention thus resulted in more significant improvements and less significant regressions than the Placebo.

Upon completion of the Tomatis phase, the subject had demonstrated significant improvement with expressive vocabulary (EOWPVT, 32/54). He had also improved in all three areas of measured by the VABS (communication 73/86, daily living skills 25/88 and socialization 43/71). The BASC scores on attention problems (66/53), atypical behavior (62/45), anxiety (69/42), and withdrawal (58/42) all declined, with the final scores falling within the normal range (40–60), indicating that these skills were within the average range when compared to his

TABLE 1
Subject 6 Pre/Post Readings

	<i>Placebo</i>	<i>Tomatis</i>	<i>Total Period</i>	<i>CI (95)</i>
PPVT (raw)	41/60	60/65	41/65	13
EOWPVT (raw)	30/32	32/54	30/54	9
VABS (raw)				
Communication	75/73	73/86	75/86	8
Daily Living Skills	71/25	25/88	71/88	12
Socialization	61/43	43/71	61/71	12
BASC (T scores, Parent)				
Attention Problems	68/66	66/53	68/53	14
Atypicality	58/62	62/45	58/45	18
BASC (T scores, Teacher)				
Anxiety	69/69	69/42	69/42	13
Withdrawal	61/58	58/42	61/42	13
SENSORY PROFILE	109/112	112/167	109/167	?

Legend  = significant improvement.
 = significant regression.

neuro-typical peer group. His sensory profile improved significantly from the lower 2% range into the typical performance range.

The parents and research assistants observed similar changes. They reported improvements in speech intelligibility, initiating and completing tasks, focus and attention, and in overall happiness.

Subject 8

Subject was 4.0 years at the beginning of the study and was nonverbal (EOWPVT=0). He was 2.2 years delayed in adaptive behavior skills. He had significant attention deficits, was socially withdrawn, behaved atypically and demonstrated limited social skills. The testing results have been summarized in Table 2. The numbers refer to the pre/post ratings for the specified periods.

As shown in the table, the Placebo intervention resulted in two significant improvements (motor skills 48/57 and withdrawal 70/54) and zero regressions. The Tomatis intervention resulted in four significant improvements and zero regressions. In this case, the Tomatis intervention thus resulted in more significant improvements than the Placebo.

Upon completion of the Tomatis Therapy, receptive vocabulary skills (PPVT 13/30) had more than doubled, from “too low to determine age equivalency” to an age equivalency of 2.4 years. Daily living skills had improved significantly

TABLE 2
Subject 8 Pre/Post Readings

	<i>Placebo</i>	<i>Tomatis</i>	<i>Total Period</i>	<i>CI (95)</i>
PPVT (raw)	7/13	13/30	7/30	13
EOWPVT (raw)	0/6	6/6	0/6	9
VABS (raw)				
Daily Living Skills	25/24	24/46	25/46	12
Motor Skills	48/57	57/60	48/57	7
BASC (T scores, Parent)				
Attention Problems	84/80	80/65	84/65	14
Atypicality	71/71	71/56	71/56	18
BASC (T scores, Teacher)				
Atypicality	63/74	74/50	63/50	12
Withdrawal	70/54	54/44	70/44	13

Legend = significant improvement.

(24/46) and the attention rating (80/56) and the atypical behavior rating (74/50) had decreased, with the final score falling in the average range (40–60), indicating that his parent and/or teacher no longer considered him to have attention problems or to behave atypically.

During the Tomatis phase the parents and research assistants observed improvements in his ability to respond to auditory stimuli and to establish and maintain eye contact. They also noted that he was becoming less clumsy and started to point showing awareness. Toilet training was achieved during this phase of the study.

Responders (Group 1)

In Group 1, four of the six subjects responded to the Tomatis Therapy. They received the Tomatis treatment first followed by the “Placebo.” As the Placebo was thus contaminated, no direct comparison could be made between the Tomatis Therapy and its Placebo. The impact of the Tomatis Therapy was therefore compared to the average Placebo Effect of Group 0. The Placebo of Group 1 measured above all the Extended Tomatis Effect (ETE).

When children go through a period of change, it is common that behavior problems surface. Such setbacks or regressions were also observed in this study. However, many of these regressions were temporary and were no longer present upon completion of the next phase of the therapy.

Subject 3

Subject was 4.9 years at the beginning of the study. She had limited receptive and expressive vocabulary (PPVT = 3, EOWPVT = 12). She was socially withdrawn, behaved atypically, and demonstrated limited social skills. Adaptive behavior skills reflected a three-year delay. The results have been summarized in Table 3. The numbers refer to the pre/post ratings for the specified periods.

As shown in the table, when measured over the complete research period, the Tomatis Therapy resulted in five significant improvements and zero regressions (as detailed below); the Placebo would have accounted for 1.2 significant improvements and 0.6 significant regressions. In this case, the Tomatis Therapy thus resulted in more significant improvements than the Placebo.

At the end of the Tomatis phase she had improved significantly on six measures. She had improved significantly in all four areas of adaptive behavior (communication 43/53, daily living skills 35/48, motor skills 42/58, and socialization 32/49). The ratings on hyperactivity (63/47) and withdrawal (70/48) declined and at the end of the Tomatis Therapy fell within the average range (40–60), indicating that her parents no longer considered her to be hyperactive or withdrawn. The improvements that began during the Tomatis treatment continued to build during the second phase (Placebo + ETE), indicating that the improvements were sustained beyond the time period of the intervention.

The parents and research assistants reported increases in vocabulary and language (the standardized test reflected a nearly significant increase in expressive

TABLE 3
Subject 3 Pre/Post Readings

	<i>Tomatis</i>	<i>Ext. Tomatis Effect + "Placebo"</i>	<i>Total Period</i>	<i>CI (95)</i>
PPVT (raw)	3/8	8/4	3/4	13
EOWPVT (raw)	12/16	16/20	12/20	9
VABS (raw)				
Communication	43/53	53/61	43/61	8
Daily Living Skills	35/48	48/57	35/57	12
Motor Skills	42/58	58/62	42/62	7
Socialization	32/49	49/62	32/62	12
BASC (T scores, Parent)				
Hyperactivity	63/47	47/50	63/50	13
Withdrawal	70/48	48/59	70/59	13

Legend = significant improvement.

vocabulary). They also noted improved socialization with adults and peers, with appropriate use of eye contact. Parents commented on her increase in awareness, communication skills and independence. Toilet training was accomplished as well.

Subject 5

Subject was 3.9 years at the beginning of the study and completely nonverbal. Adaptive behavior skills reflected a two-year delay. His behavior was characterized as extremely atypical, was hyperactive and demonstrated poor social skills. The results have been summarized in Table 4. The numbers refer to the pre/post ratings for the specified periods.

As shown in the table, the Tomatis Therapy, when measured over the complete research period, resulted in two significant improvements and zero significant regressions. When interpreting the data solely on the evaluation tools used in this study, this subject should have been classified as a nonresponder. However, he was categorized as a responder as he started to spontaneously repeat words, which could suggest the onset of language development. In a clinical setting, continued therapy would have been warranted.

Upon completion of the Tomatis phase, he demonstrated significantly less hyperactivity (77/64) and behaved less atypically (119/86). On the other hand, he had regressed in communication skills (26/11). At the end of the second phase, this regression had been reversed. The improvements in terms of atypical behavior and hyperactivity were maintained.

The parents and research assistants observed that, at the beginning of block 3 of the Tomatis treatment, he spontaneously began repeating words. Aggressive

TABLE 4
Subject 5 Pre/Post Readings

	<i>Tomatis</i>	<i>Ext. Tomatis Effect+ "Placebo"</i>	<i>Total Period</i>	<i>CI (95)</i>
PPVT (raw)	0/1	1/2	0/2	13
EOWPVT (raw)	0/0	0/0	0/0	9
VABS (raw)				
Communication	26/11	11/22	26/22	8
BASC (T scores, Parent)				
Atypicality	119/86	86/94	119/94	18
Hyperactivity	77/64	64/60	77/60	13

Legend = significant improvement.
 = significant regression.

behaviors such as biting, hitting, kicking, and scratching had decreased significantly.

Subject 10



Subject was 3.5 years old and nonverbal at the beginning of the study. He was 1.6 years delayed in adaptive behavior skills. He scored high on atypical behavior and low on social skills. The results have been summarized in Table 5. The numbers refer to the pre/post ratings for the specified periods.

As shown in the table, when measured over the complete research period, the Tomatis. Therapy resulted in five improvements and zero significant regressions. Four of the improvements were statistically significant and one (EOWPVT), while not statistically significant, represented a functionally major improvement. The Placebo would have accounted for 1.2 significant improvements and 0.6 significant regressions. In his case, the Tomatis Therapy thus resulted in more significant improvements than the Placebo.

At the end of the Tomatis phase his expressive vocabulary was 11 words, reflecting a significant 10-word gain on standardized testing. Expressive vocabulary improved from "too low to determine age equivalency" to an age equivalency of

TABLE 5
Subject 10 Pre / Post Readings

	<i>Tomatis</i>	<i>Ext. Tomatis Effect+ "Placebo"</i>	<i>Total Period</i>	<i>CI (95)</i>
PPVT (raw)	3/4	4/11	3/11	13
EOWPVT (raw)	1/11	11/9	1/9	9
VABS (raw)				
Communication	25/32	32/40	25/40	8
Daily Living Skills	33/35	35/49	33/49	12
Motor Skills	51/46	46/56	51/56	7
BASC (T scores, Parent)				
Withdrawal	78/55	55/57	78/57	13
Social Skills	32/41	41/43	32/43	10
BASC (T scores, Teacher)				
Atypicality	72/88	88/61	72/61	12
Attention Problems	50/63	63/51	50/51	10
Social Skills	56/35	35/47	56/47	8

Legend  = significant improvement.
 = significant regression.

1.5 years. He also became significantly less withdrawn (78/55), with the final score falling in the average range (40–60), indicating that the parent no longer considered him to be withdrawn. However, his teacher noted a regression in three behavioral areas (atypicality 72/88, attention problems 50/63, and social skills 56/35). At the end of the second phase these regressions had been reversed. In addition, adaptive behavior skills significantly improved (communication 25/40 and daily living skills 33/49). The improvement in social skills, which started during the Tomatis Phase, became significant at the end of the research period (32/43).



The parents and research assistants observed important improvements during the Tomatis phase. This subject transitioned from being nonverbal to using single words and short phrases. He had become more social and showed improved motor skills.

Subject 12

Subject was 7.0 years old at the beginning of the study. His vocabulary skills were 3.0 years delayed. In terms of adaptive behavior, he was 2.7 years delayed. He was hyperactive, behaved atypically, and lacked social skills. The results have been summarized in Table 6. The numbers refer to the pre/post ratings for the specified periods.

TABLE 6
Subject 12 Pre / Post Readings

	<i>Tomatis</i>	<i>Ext. Tomatis Effect+ “Placebo”</i>	<i>Total Period</i>	<i>CI (95)</i>
VABS (raw)				
Communication	72/81	81/86	72/86	8
BASC (T scores, Parent)				
Atypicality	75/62	62/53	75/53	18
Hyperactivity	73/66	66/54	73/54	13
BASC (T scores, Teacher)				
Attention Problems	64/73	73/53	64/53	10
Atypicality	71/76	76/59	71/59	12
Hyperactivity	51/65	65/40	51/40	9
Withdrawal	61/45	45/55	61/55	13
Social Skills	36/37	37/47	36/47	8
SENSORY PROFILE	125/130	130/150	125/150	?

Legend  = significant improvement.
 = significant regression.

As shown in the table, when measured over the complete research period, the Tomatis Therapy resulted in seven significant improvements and zero significant regressions. The Placebo would have accounted for 1.2 improvements and 0.6 regressions. The Tomatis Therapy thus resulted in more significant improvements than the Placebo.

At the end of the Tomatis phase, he had improved significantly in communication skills as measured by the VABS (72/81). He also had become less socially withdrawn (61/45), with his final score falling within the average range (40–60), indicating that the teacher no longer considered him to be withdrawn. However, the teacher considered him to have become more hyperactive (51/65). By the end of the second phase, his teacher reported that the increase in hyperactivity was no longer present. By the end of the research period, both the parent and the teacher no longer considered the subject to be hyperactive as his final scores fell within the average range (parent: 73/54, teacher 51/40). The rating on atypical behavior also improved, both according to the parent (73/53) and the teacher (71/59), with the final scores falling within the average range (40–60), indicating that the subject no longer behaved atypically. The teacher rating on all behavioral aspects measured by the BASC fell within the average range at the end of the research period (attention problems 64/53, withdrawal 61/55, and social skills 36/47), indicating that in these respects the teacher consider him to behave like a “typical” child. The sensory profile also indicated an improvement (125/150).

The parents and research assistants noted that his fear of public restrooms was reduced and that for the first time he would allow other children to enter his bedroom at home. As the therapy progressed he demonstrated increased social skills. Expressive communication skills also improved, and at the end of therapy he was consistently speaking with complete sentences.

DISCUSSION

The purpose of the Corbett study was to determine the efficacy of the Tomatis Method when treating children with autism, especially with regards to communication and behavioral deficits, as measured by the results of standardized instruments. When the data on expressive and receptive vocabulary were analyzed as a group, no significant differences between the Tomatis and Placebo group were detected. When analyzed as 11 separate case studies, as represented and reflected in this article, the data indicate that six of the 11 subjects demonstrated significant improvements after receiving 90 hours of Tomatis Therapy. The remaining five subjects did not benefit significantly from the Tomatis intervention, at least not on the measures used in this research. The improvement rate demonstrated in this study reflects the findings of previous research (Neysmith-Roy, 2001).

In Group 0 (Placebo first, Tomatis second), two of the five subjects demonstrated multiple improvements following completion of the Tomatis intervention. As the Placebo in group 0 was uncontaminated, a direct comparison between the Tomatis and Placebo intervention could be made and in each case the Tomatis Therapy resulted in more significant improvements than the Placebo.

In Group 1 (Tomatis first, Placebo second), four of the six subjects responded to the Tomatis Therapy. The effect of the Tomatis Therapy was compared to the average Placebo of Group 0, as the Placebo of Group 1 was contaminated. In all four cases the Tomatis Therapy resulted in more significant improvements.

The improvements from the Tomatis Therapy varied from subject to subject. One subject transitioned from being nonverbal to developing verbal skills. Another nonverbal subject began to spontaneously repeat words. Yet others increased their expressive and receptive vocabulary, as measured by the PPVT and EOWPVT. Also, improvements in daily living skills, motor skills, socialization, and overall communication, as measured by the VABS, were noted. The results of this study also indicated reductions in hyperactivity, atypical behavior and attention problems, as measured by the BASC.

To avoid subject-to-subject variations, this study did not include listening to the mother's voice. In a clinical setting, listening to a recording of the mother's voice, filtered through the Electronic Ear, would have been used. This would have yielded better results (Tomatis, 1991; Sollier, 2005).

Also to avoid subject-to-subject variations, all children received the same treatment protocol. In clinical settings the treatment protocols are tailored to the needs of the subjects, to obtain optimal results.

In addition, the treatment time of this study was limited to the basic 90 hours. In a clinical setting, those who respond to the intervention often benefit from additional auditory stimulation (Neysmith-Roy, 2001; Vervoort, 2007).

For practical reasons, the parents were not enrolled in a Tomatis Listening Program as recommended by Tomatis (Tomatis, 1991). It would have made them more relaxed and thus would have made them better prepared to help their children as they experienced changes as a result of the auditory invention. In fact, six out of the 11 parents were experiencing clinically significant levels of stress (90th percentile or above) as measured by the Parenting Stress Index (Abidin, 1995).

Unfortunately, there are no known indicators that can predict which subjects would respond well to the Tomatis treatment. The results of this study do not provide further information relative to this issue either. Age (within the range studied) does not appear to be a predicting variable. The oldest subject, who was 7.2 years at the beginning of the research, demonstrated the most significant improvement. Gender does not seem to be a predicting variable either as the responders were both male and female. Being verbal does not seem to be a predicting variable either as both verbal and the nonverbal subjects experienced benefits. The ADOS score also does not seem to relate to the level of response to the treatment.

LIMITATIONS AND FUTURE RESEARCH

The Corbett study was not designed to be analyzed as a set of case studies and thus has some limitations. Additional research, designed properly, should be conducted to further study the impact of Tomatis Therapy on subjects with autism. Future research should avoid the limitations and pitfalls associated with the research design used in the Corbett study. In particular, cross-over designs should be avoided as the Tomatis Therapy has or could have a carry-over effect and continues to build upon completion after the intervention period (Extended Tomatis Effect). In addition, a final assessment several months after completion of the research should be included to assess whether the improvements are sustained beyond the time period of the research. It would also provide a quantitative measure of the Extended Tomatis Effect.

When conducting a quantitative study, the sample size should be large enough for meaningful differences to become statistically significant, taking into account the percentage of nonresponders. In the analysis, the first step should be to separate the responders from the nonresponders. The sample should be as homogeneous as possible, especially in terms of the parameters on which the study criteria will be based.

The assessments tools should include, in addition to standardized tests, open ended research tools, such as video tapings (to be judged by blinded experts) and open-ended questionnaires. This will permit to pick up changes which are not evaluated up by standardized tests.

Future studies should include the use of the mother's voice, as it is an integral part of the Tomatis Method and significantly improves the outcome of the intervention. It should not be eliminated to avoid subject-to-subject variations.

Future research should also try to assist in developing criteria that may determine which children with autism will improve with the Tomatis Therapy and others who would not be deemed as potential candidates. A hypothesis to be tested is that Tomatis Therapy may only be effective with autistic children who demonstrate sensory, especially auditory processing disorders.

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