

# Application of the acoustic-vibrational Musica Medica method in medicine and special education

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## Abstract

Musica Medica is a modern method of stimulating the human body and brain with music and its vibrations. It uses two sensory inputs, touch and hearing and initiates enhanced brain reactions. As a result of this, it gives better pedagogical and therapeutic results. This stimulation causes changes within the neural network within the brain, not only temporary emotional changes but also permanent changes like the improvement of concentration or the disappearance of pain. Using the latest methods of brain research, where the activity of neurological structures can be viewed, an old truth that music is a cure for both “body and soul” has been verified.

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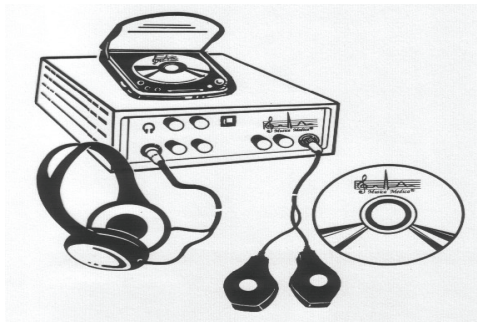
*Keywords:* acoustic-vibration therapy, somatosensory stimulation

## 1. Introduction

Music has been used therapeutically from the outset of human civilization. Music is a mirror image of the human being. It is the sum of the neuro-physiological rhythms of the person who is producing the music.

“Musica Medica” is a modern method of stimulating the human body and brain with both music and its vibrations. Because it uses two sensory inputs, hearing and touch, it initiates enhanced brain reactions. As a result of this, it gives better pedagogical and therapeutic results than other musical and non-musical techniques. This stimulation causes changes within the neural network within the brain, not only temporary emotional changes but also permanent changes like the improvement of concentration or the disappearance of pain. Using the latest methods of brain research where the activity of neurological structures can be viewed, an old truth that music is a cure for both body and soul is backed up.

**Figure 1.** Musica Medica (MM) system: MM apparatus shown along with a CD player, suitable earphones, the vibrators, and a music CD.



The Musica Medica apparatus (Fig. 1) transmits sound through earphones and simultaneously emits throbbing through two convertors (vibration transmitters), which generate music-harmonized vibration patterns derived from the music from the

CD player. The earphones should be of good quality and cover the auricle so that the patient is isolated as much as possible from external noise. The vibration transmitters should be positioned directly against the patient’s skin and either manually held in place, or secured with bands, on the appropriate body location. The Musica Medica apparatus should then be connected to the output of a CD player or another electronic sound source (e.g., cassette player, microphone, MP3 player, etc.). The therapist should select the music based on the treatment needs and the preferences of the patient and start playing the music. The method works best if the patient is in a relaxed position (either in bed or in a comfortable armchair or recliner).

When simultaneously exposed to music and the apparatus’ derived vibrations, via the Musica Medica method, the listener receives an acoustic input and the somatosensory transmission of the related fundamental human rhythms. The listener’s body oscillates until it adjusts to these rhythms. The effect is comparable with the feeling of being rocked to sleep by a mother while listening to her singing. The patient first slips into an enjoyable state of oneness, a sort of trance, which is then followed by relaxation and calm.

## 2. Applications of Musica Medica in medicine

Medical applications of the Musica Medica system include:

- **Emotional support:** Before, during and after surgical intervention and dental treatment. Also used in cases of anxiety and depression.
- **Cardiology and respiratory therapy:** Regulation of blood pressure, stabilisation of circulation, strengthening of blood vessels and the respiratory system.
- **Pain regulation:** Acute and chronic pain such as during various procedures, in rheumatism, whiplash, migraine etc.
- **Immunology:** Positive stimulation of the immune system, e.g., faster wound healing.

- **Chronobiology:** Disturbances of sleep/wake cycles, consequences of jet lag or shift-work.
- **Neuro-rehabilitation:** Patients after a stroke or suffering from lack of concentration, Alzheimer's, other forms of dementia or Parkinson's disease react positively to Musica Medica Therapy.
- **Pregnancy and giving birth:** Stimulation before, during and after birth.

### 3. Music selection in Musica Medica Therapy

The acoustic and somatosensory stimulation via Musica Medica allows the healing effect of music to penetrate the body in a reinforced way, stimulating and activating body and mind holistically.

Though the music chosen should be "soothing," the selection of music should be tailored to preferences of the individual being treated. In general, the choice ranges from the Gregorian Chant, to popular songs, works by Bach, Vivaldi, Mozart and other composers, to lullabies and to instrumental music.

### 4. Scientific background

The human organism is an extremely complex system, all parts of which are intimately interlinked and influenced by each other.

The studies by Stein and Meredith, 1984, show the potentiating effect (increased brain activation) of multisensory cells in the superior colliculus (area of the brain which organizes the integration of sensory perception). The whole body therefore reacts with a reinforced reaction to simultaneous acoustic and somatosensory stimulation.

When the body and brain are stimulated via acoustic and somatosensory stimuli, the limbic system, among others, is also excited. This system is responsible for the generation of biochemicals that regulate the "autonomic" expression of feelings and emotions. Music stimulates the production of endorphins (body's own morphines) and other neurotransmitters responsible for euphoric feelings and reduced pain perception (A. Goldstein 1981) and also activates the immune system in a modulatory way (N. Plotnikoff, 1985).

Latest evidence from the observation of patients suffering from phantom pain suggests that pain is a perception that can be changed and modulated in the somatosensory area. Consequently, pain perception has been shown to possess a certain neuroplasticity (Y. Schifitan 2001).

The study conducted by B. Maess and S. Koelsch, 2001, explains the direct effect of music on language as both are processed in the same areas of the brain, the Broca and Wernicke centers.

When the brain is stimulated by Musica Medica system, positive effects have been observed in patients who suffer from depression, stroke, Alzheimer's, dementia or Parkinson's disease. PET (positron emission tomography) has shown hypometabolism (reduced glucose and oxygen metabolism) as well as a hypoperfusion (diminished blood flow in the brain) in all these disease conditions (L.A. Marco 1995).

The appropriate use of the Musica Medica system has been shown to "reactivate" the dysfunctional areas of the brain – metabolic turnover and blood flow are increased and, at the

same time, various brain areas responsible for motricity, language, memory, and emotions start to become more active.

The Musica Medica system probably activates the mirror-cells (Rizzolatti 1998) as the learning processes are easier and the coordinated cooperation of both hemispheres is increased.

### 5. EEG (Electroencephalogram) Findings

"EEG (Electroencephalogram) and Musica Medica," authored by Chen ACN, Jones AKP (University of Manchester, U.K.), Schifitan Y (Musica Medica, Zürich, Switzerland), Rappelsberger P (University of Vienna, Austria) presents the findings of the comparative research of EEG changes influenced by music (N=12). These studies found:

1. Music only: This treatment led to enhancement of local coherence in frontal lobes;
2. Vibrations only: This treatment led to enhancement of coherence in centro-frontal lobe with additional coherence of prefrontal hemispheres; and
3. Music with vibrations (MM): In comparison with application of music only, this treatment also provided enhanced activity of alpha waves and enhanced interhemispherical coherence.

One of the most interesting tests of how the brain reacts to the application of the Musica Medica system was conducted at Manchester University in Professor Chen's research facilities. In those studies, it was found that the combination of hearing and feeling enhances relaxation and cooperation between brain's hemispheres, which in turn leads to a more effective utilization of mental and emotional potential than in the comparable studies where only the musical input was applied to the test subjects.

### 6. A Pain Minimization Study

**Test Subjects:** Three patients, aged between 20 and 25 years, having a recent amputation of a lower limb. All three suffered from severe phantom pain.

**MM Intervention:** For three months, each patient was appropriately treated with MM 3 times per week (approximately 13 sessions per month).

**Duration of the sessions:** 1<sup>st</sup> and 2<sup>nd</sup> months: 15 minutes, 3<sup>rd</sup> month: 45 minutes.

**Procedure:** The vibrators (transducers) were usually held against the amputated stump where the phantom pain was perceived. When the patients were wearing their prostheses, the vibrators were positioned on the sternum or held in the hands. Pain was monitored on a scale of 1 to 4 (1=severe, 4=no pain).

**Results after intervention with MM:** By the end of the therapy, the phantom pain had completely disappeared. During the therapy, the changes observed included: a) reduction of pain intensity, b) increased well being, c) more positive assessment of individual's life situation, and d) increase in making plans for the future.

### 7. Applications of Musica Medica therapy in special education

#### 7.1 Speech improvement in hearing impaired children

**Test Subjects:** Two girls aged 6 and 7, with verified hearing impairment.

**MM Intervention:** Three months

**Duration of the sessions:** Not provided.

**Procedure:** Not provided.

**Results after intervention with MM:**

**Case study no.1 (7 year-old girl):** Musica Medica helped to release blockages. The speech pathological assessment for the hearing impaired showed improved results. The subject exhibited greater self-confidence and increased relaxation. Her pronunciation became more accurate. The girl was more willing to talk about her problems, her vocabulary increased and she became more talkative.

**Case study no.2 (6 year-old girl):** After a number of sessions, she was able to reproduce melodies and simple rhythms and to correctly pronounce the words appearing in the songs used in the treatments. She has improved results in speech pathological evaluations and improved comprehension of language when in a relaxed state. She showed increased confidence and was more willing to communicate. Her grammar also improved as well as her pronunciation. She made less unclear sounds at the end of sentences and her range of vocabulary increased. She pronounced vowel sounds more accurately and she participated better in team activities. She was better able to concentrate, more relaxed, generally more willing to share emotions. Her sense of self-esteem was enhanced.

**7.2 Stimulation of residual hearing in children with severe hearing loss**

**Test Subjects:** Three severely hearing impaired children with hearing loss greater than 100dB, aged 8 years (Grade 2).

**MM Intervention:** Intervention period was three months with 30 sessions for each child. Each child was treated with 3 sessions per week. After 18 introductory sessions for each patient, the study interventions were initiated.

**Duration of the sessions:** Each session lasted was for 11 to 18 minutes.

**Procedure:** Not provided.

**Results after intervention with MM:** The three subjects exhibited: a) Increase in hearing sensitivity; b) Improved sound of speech; c) Improved comprehension of spoken language; d) Improved voice and speech quality, which was easier to understand, more melodious and more rhythmical; e) Improved behavior (calmer and more courteous); f) More initiative shown in starting a conversation; and Improved communication skills.

**7.3 Aggressive children with mild mental disability**

**Test Subjects:** Three children, aged 13, 14 and 16 years, were the test group. A control group of three similar children listened to the “same” music without the vibrations. All children were aggressive, violent and showed challenging behavior.

**MM Intervention:** 3 sessions per week for three months.

**Duration of the sessions:** 45 minutes

**Procedure:** Blood pressure and pulse rate were measured before and after the intervention. Vibrator placement *not* given.

**Results after intervention with MM:**

**Test group:** The test subjects exhibited: a) Reduced aggressive behavior; b) Positive emotional changes; Reduced intensity in aggression; c) Increased concentration; d) Less aggression in situations of conflict, tension and stress; e) Reduction in undesirable displays of anger and aggression; f) Enhanced ability to enter into a fantasy world; and g) Reduced pain

perception. The only less-than-positive out-come reported was an increased urge to urinate.

**7.4 Aggressive behavior in children**

**Test Subjects:** Eight students in Grade 6, four girls and four boys were assigned to the therapy group. A control group was also included in this study. The children all showed severe behavioral disturbances such as high levels of aggressiveness and maladaptation.

**MM Intervention:** 132 sessions

**Duration of the sessions:** 30 minutes each

**Procedure:** Not provided.

**Results after intervention with MM:** In the therapy group, anti-social behavior was reduced, contrary to the control group where it worsened significantly. The therapy group also showed less aggressiveness and irritability, and less negativity, mistrust, and verbal aggression. There was also a reduction in self-protective behavior. There were no differences noted between boys and girls in the degree of reduction of aggressiveness.

**7.5 Aggressiveness in adolescents with a mild mental disability**

**Test Subjects:** 4 adolescent males were treated.

**MM Intervention:** 3 sessions per week for 2.5 months.

**Duration of the sessions:** 30 to 45 minutes

**Procedure:** Every three weeks they did a questionnaire regarding their level of aggressiveness.

**Results after intervention with MM:** **Subject 1** (18-years old): Always fell asleep after 10 minutes of treatment and was sad afterwards. **Subject 2** (18-years old): Became more relaxed, chatty and trusting. **Subject 3** (19-years old): Could not always relax. **Subject 4** (20-years old): Opened up and became chattier.

**Group Findings:** In general, only a slight reduction of certain forms of aggressiveness was found. However, the Musica Medica therapy clearly had a positive influence on the sense of wellbeing, the calmness, and the relaxation of each subject.

**7.6 Anxiety**

**Test Subjects:** Three female students aged 26, and a male 25 with visible signs of high anxiety according to the Jannet Taylor questionnaire.

**MM Intervention:** From 5 December 2000 until 1 March 2001, therapy was done 2 times per week.

**Duration of the sessions:** 30-45 minutes

**Procedure:** Not provided.

**Results after intervention with MM:** The results from the Jannet Taylor questionnaire showed that the subject’s anxiety diminished significantly. In addition, the higher the subject’s initial anxiety was the larger the total reduction was at the conclusion of the study – indicating that the therapy had a normalizing effect on subject anxiety.

**7.7 Anxiety in adolescents with mild mental disability**

**Test Subjects:** Four adolescents were subjects with mild mental disabilities.

**MM Intervention:** 27 sessions (3 times a week over 2 months).

**Duration of the sessions:** 30 to 45 minutes per session.

**Procedure:** The transducers were placed on the inner side of the wrists.

**Results after intervention with MM:** All the test subjects exhibited: a) Diminution of symptoms of anxiety; b) Increased ability to communicate feelings; c) Increased social skills; d) Improved stimulation of the hearing apparatus; e) Increased creativity; f) Improved well-being; and g) Reduction in unwanted behaviors. However, two of the adolescents showed an increase in anxiety symptoms.

### 7.8 Autistic child

**Test Subjects:** A child with autism spectrum disorder. The child was withdrawn and had no verbal communication with the environment.

**MM Intervention:** This trial was conducted over four months

**Duration of the sessions:** Not provided.

**Procedure:** Not provided.

**Results after intervention with MM:** The child exhibited: a) Eye contact with self (The child knelt in front of a mirror and looked in a highly concentrated fashion at himself for 5 minutes [prior to this intervention he could do this for a maximum of 20 seconds]); b) Increased emotional contact with therapist; c) Increased inner calm; d) Improved motor skills (has learned to catch a ball); e) Improved memory and independent execution of certain exercises; f) Ability to keep eye contact with a person speaking to him; g) Visible joy at gesticulating and vocalizing; and Ability to stand in front of the mirror and hold a microphone while dancing and singing. When drawing, he sketched new shapes (such as cars, a page from a book and geometrical shapes). Subject appeared to attempt saying the sounds “a,” “ou,” and “tm.” He also lost the fear of putting on the headphones

### 7.9 Blind children with multiple disabilities

**Test Subjects:** This study was conducted with blind children with co-morbid disabilities. During the introductory phase the children systematically pulled their headphones off their heads and threw the vibrators off.

**MM Intervention:** Not provided.

**Duration of the sessions:** Not provided.

**Procedure:** Not provided.

**Results after intervention with MM:** The study subjects exhibited: a) A general calming down during the sessions; b) After two months, comments such as “that’s cool super music”; c) Increased musicality and humming of simple vocalisms; and d) Increased need for movement after the sessions. In addition, the test subjects started to bond emotionally to the therapist and exhibited positive face mimics and hand movements.

### 7.10 Speech pathology with 6-year old children with dyslalia

**Test Subjects:** Three 6-year old children with dyslalia in the “intervention group” and three children in the “control group.”

**MM Intervention:** The study was done over 2 months with twice weekly sessions.

**Duration of the sessions:** 20 minutes.

**Procedure:** Not provided.

**Results after intervention with MM:** On the positive side, the subjects exhibited: a) Slight improvement in the pronunciation of sibilant sounds; b) Slight improvement in overall pronunciation; c) Increased motivation for cooperation; d) Improvement in emotional state; and e) Smile on their faces

while moving to the rhythms of the music. On the negative side, the subjects exhibited an unwillingness to finish each session.

### 7.11 Hyperactive pre-schoolers

**Test Subjects:** Five pre-school children aged between 3 and 6 years participated. Hyperactivity was confirmed by educators and parents and verified via specific tests (measuring ten different characteristics, including, among others, restlessness, mood changes, outbursts of anger, tantrums, over-reactions, and lack of concentration).

**MM Intervention:** The intervention took place over three months with 36 sessions of for each child.

**Duration of the sessions:** 10 to 30 minutes

**Procedure:** Not provided.

**Results after intervention with MM:** Treated pre-schoolers exhibited: a) Increased relaxation and calmness; b) When physically active, less anxiety and hyperactivity; and c) Reduction in non-desired physical over-activity.

### 7.12 Children with Dyslexia

**Test Subjects:** Three children in an “intervention group” and three children in a “control group.” All the children showed disturbances of cognitive and motor function, and disturbances of visual and acoustic memory. They also had poorly developed fine motor skills, and an increased need for movement and increased verbal activity. They tended to over react and had difficulty in concentrating. They also tended to over-react with tension and restlessness.

**MM Intervention:** 24 sessions per child.

**Duration of the sessions:** Not provided.

**Procedure:** Not provided.

**Results after intervention with MM:** The subjects exhibited: a) Notable increase in reading speed; b) Improved comprehension of the text they had read; c) Improved spelling during spelling tests; d) Improved spelling during creative writing; and e) Improved copy-writing. Observation of the children during the intervention showed they worked much faster and more accurately and made fewer mistakes when analysing and synthesising longer sentences. Their apparent muscle tension was reduced, resulting in improved fine motor skills. At the end of the intervention the children were more pro-active, more disciplined and more conscientious. Their will to self-improve increased. The children were interested in the exercises and made new suggestions. At the end of the therapy intervention they showed increased perseverance, improved wellbeing, and increased interest in the exercises, greater concentration, improved verbal flow, increased originality and richer mental associations. There was an atmosphere of well-being and mutual sympathy, which had developed. The children became more trusting and were more confident.

### 7.13 Masturbation in students with Downs Syndrome

**Test Subjects:** Three children aged 12 to 13 years with Downs Syndrome. The urge for masturbation during school time made learning and socialization almost impossible for these children.

**MM Intervention:** 2–3 times per week for 3 months.

**Duration of the sessions:** Not provided.

**Procedure:** Not provided.

**Results after intervention with MM:** The subjects exhibited: a) Improvement of the frequency (less often) and duration

(shorter periods) of masturbation; c) Increased interest in the therapy sessions; d) Increased ability to “listen” to music attentively; and e) General sense of wellbeing and relaxation.

#### 7.14 Memory improvement in hearing-impaired children

**Test Subjects:** Two groups were chosen, a “test group” with 3 girls and a “control group” with 2 girls and 1 boy, all aged between 10 and 12 years. All children were wearing hearing aids.

**MM Intervention:** Two hypotheses were formulated: positive influence on visual memory and positive influence on the ability to lip-read in hearing-impaired children. Sessions were 3 times per week for 3 months.

**Duration of the sessions:** 15 to 20 minutes.

**Procedure:** Session procedure **not** provided. Memory tests were taken before the intervention, after two months into the therapy course and at the end of the therapy. The Memory tests used were: 1) Digit span test; 2) Number series test; 3) Rosanow-Test (Spatial memory, pictures hidden in 16 fields); 4) Picture memory span test (Finding a picture among 24 previously shown pictures); 5) Test of the memory for abstract shapes; and 6) Test of the memory for numbers from lip reading, single words as well as whole sentences that described a situation were tested.

**Results after intervention with MM:** Test subjects scored more points in the picture memory span test, the test on abstract shapes, and the test for spatial memory. [Overall, the test subjects had a 50% increase in points gained in comparison with the control group.] At the end of the therapy, the results of the evaluations assessing their ability to lip read showed a constant improvement during the therapy in comparison with the evaluations on the control group. [Again, the test subjects had better results in lip reading in comparison to the control group (again by “50%”)] In addition, the test group solved the problems faster with less insecurity and with less hesitation than the control group. At the end of the therapy period, a general feeling of wellbeing and activation was observed.

## 8. Discussion

In fruitful cooperation with the Academy of Special Education in Warsaw, Poland (the largest training body for special education teachers in Poland [with 7600 students]) under the direction of Professor Dr. A. Stadnicki, all the projects were conducted as empirical research projects at a Master’s or Postgraduate Diploma level. The heterogeneous nature of application of the Musica Medica method to a range of conditions, including hearing impairment, blindness, mentally disability, dyslexia, hyperactivity, aggressiveness, anxiety, speech impairment, and autism in children and adolescents, and the overall positive results, have established the importance of the role of brain stimulation via simultaneous music and music vibration in improving the performance of those with disabilities. A common denominator through all the tests and observations was the increase in apparent wellbeing, calm, level of relaxation and motivation attained by those treated, which, in turn, fosters improved conditions for numerous learning processes.

These studies are to be considered “pilot” studies because they examined small numbers of subjects and were only conducted over a short time period (three months, on average).

The results however are important indicators for the future research into the possible uses of the acoustic-vibrational Musica Medica method in the field of special education.

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