universität wien

DISSERTATION

Titel der Dissertation

EFFECTS OF AN AUDIO METHOD ON SUSTAINED ATTENTION AND ANXIETY IN CHILDREN WITH ADHD

Verfasserin

Mag.phil. Marta Avelina Toro

angestrebter akademischer Grad

Doktorin der Naturwissenschaften (Dr. rer.nat.)

Wien, 2012

Studienkennzahl (lt. Studienbuchblatt):	A 091 439
Dissertationsgebiet (lt. Studienblatt):	Zoologie
Betreuer:	V.-Prof. DDr. Fred Bookstein

Special thanks to:

- The University of Vienna, Faculty of Life Science, and specially to Prof DDr. Bookstein for his sage advice and guidance, which have absolutely been key to this dissertation.

- The "Dionisia Plaza School" – "Centro de Rehabilitación Médico Psicopedagógico Dionisa Plaza", Madrid, Spain, to the staff, specially to Isabel Juárez and to the children for their unconditional support to the clinical trial.

- My family for their trust in me, specially to my parents, Daniel and my children, Jon and Paula.

ABSTRACT

Music and relaxation improve sustained attention and reduce anxiety in children with ADHD.

The purpose of this dissertation was to determine if a specific Audio Method (AM) developed by myself could contribute to increasing (1) sustained attention and (2) decreasing anxiety in a group of children (7 to 12 years) with ADHD. And if so, (3) to what extent (dose-effect).

The participants in the study were 156 children aged 7 to 12 who have been diagnosed with ADHD, who attend the Spanish State School "Dionisia Plaza" – "Centro de Rehabilitación Médico Psicopedagógico Dionisa Plaza", in Madrid, Spain. The 156 children were distributed in two groups A and B. Initially, my intention was to apply a full crossover design with the two groups, however after completing the tests, I decided to focus the doctoral work only on the results of group A. A total of 79 children participated in the study, divided into four years, from second to sixth grade, and between seven and twelve years old. There was a total of 13 females and 65 males, and all were diagnosed with ADHD. The distribution was as follows: fourteen children in second grade, fourteen in third grade, sixteen in fourth grade, seventeen in fifth grade and 18 in sixth grade. 36 of the children in Group A were undergoing medical treatment, with methylphenidate (Ribufen, Concert or Medikinet) and atomoxetine (Strattera). The testing period for group A represented nine weeks: first three-week period + second three-week period + third three-week period. The design was as follows: The group was treated with AM in the first 3 week period and in the third 3 week period. During the treatment period, children listened to the AM in their classroom before starting lessons, first thing in the morning every day. There was also a 3-week post-treatment data collection period to determine if the results obtained after treatment varied or remained unchanged. These were A's second 3 week period. So there were three interval change scores, corresponding to the change from test 1 to test 2, test 2 to test 3, or test 3 to test 4, and there was also an overall change score from test 1 to test 4. Testing with Subtest Coding (WISC) for sustained attention followed four times: at

the beginning and end of each 3-week period. Testing with STAIC and CAS to establish the anxiety levels of the children with ADHD followed at the beginning and the end of the 9-week testing period. In this case were two interval change scores: test 1 to test 2. After the first three weeks of treatment, the mean attention score of these 78 students (78 subjects in Group A who had all four test scores) shifted by 1.62; over the second interval, by 2.17. From measurement 2 to 3, interval with no musical stimulus, the scores did not decrease on average. By the end of the clinical trial, of 78 children with complete data, 71 showed an improvement over the nine weeks. The median change was 4, matching the computed mean change of 4.2. This meant that the effect size of the net treatment was about 1.07 as normalized, which is unprecedented in the literature of music therapy. Similarly, the two intervals of musical stimulus showed similar increments, which implies a dose-response relationship for the treatment as a whole, whereby doubling the dose doubles the effect on the outcome score.

Concerning anxiety, after the nine weeks of treatment, the mean anxiety score of 28 students (aged 7 to 8) tested with CAS in Group A shifted by 18.75 and the effect size was about 0.74; by the end of the clinical trial, 19 out of 28 children had reduced anxiety, and 7 had a change score below zero. 48 children aged 9 to 12 with complete data were tested with STAIC. 24 showed a reduction in State Anxiety, but only 8 had a change in score below zero, 27 improved in Trait Anxiety and 14 had a change score below zero over the nine weeks. The median change was 11.75 and 11.2 respectively, This meant that the effect size of the net treatment for children aged 7 to 8 was about 0.96 and for children aged 9 to 12, 0.96 in State anxiety and 0.40 in Trait anxiety, as normalized. According to these findings, the treatment with AM clearly provides a valid therapeutic alternative to improve sustained attention and to reduce anxiety in children with ADHD.

Zusammenfassung

Musik und Entspannung verbessern ausdauernde Aufmerksamkeit und reduzieren Ängste bei Kindern mit ADHS.

Zweck dieser Dissertation war die Feststellung, ob eine spezifische, von mir selbst entwickelte Audiomethode (AM) dazu beitragen kann, in einer Gruppe von Kindern (7 bis 12 Jahre) mit ADHS (1) die ausdauernde Aufmerksamkeit zu erhöhen und (2) das Angstniveau zu senken; und bei positivem Ergebnis, bis zu welchem Grad (3) (Dosis-Wirkung).

An der Studie nahmen 156 mit ADHS diagnostizierte Kinder im Alter von 7 bis 12 Jahren teil, welche in Madrid die spanische öffentliche Schule und das medizinisch-psychopädagogische Rehabilitationszentrum „Dionisia Plaza - Centro de Rehabilitación Médico Psicopedagógico Dionisa Plaza" besuchen. Die 156 Kinder wurden in zwei Gruppen A und B eingeteilt. Zu Beginn hatte ich die Absicht, mit den beiden Gruppen eine komplette Doppelcrossover-Studie durchzuführen. Nach Abschluss der Tests habe ich mich jedoch dafür entschieden, für die Doktorarbeit lediglich die in der Gruppe A gewonnenen Ergebnisse zu verwenden. Insgesamt nahmen an der Studie 79 Kinder im Alter von sieben bis zwölf Jahren teil, die in vier Jahrgangsstufen von der zweiten bis zur sechsten Klasse eingeteilt wurden. Davon waren 13 Mädchen und 65 Jungen, alle mit ADHS diagnostiziert. (Die Primärdiagnose basierte auf der Definition von Aufmerksamkeitsdefizit/Hyperaktivitätsstörung gemäß DSM-IV-TR oder ICD-10.) Die Einteilung war wie folgt: Vierzehn Kinder in der zweiten Klasse, vierzehn Kinder in der dritten Klasse, sechzehn Kinder in der vierten Klasse, siebzehn Kinder in der fünften Klasse und 18 Kinder in der sechsten Klasse. Aus der Gruppe A wurden 36 der Kinder mit Methylphenidat (Rubifen, Concerta oder Medikinet) und Atomoxetin (Strattera) medikamentös behandelt. Der Testzeitraum für Gruppe A umfasste neun Wochen: Drei Wochen + drei Wochen + drei Wochen. Der Ablauf der Studie wurde wie folgt festgelegt: Die Gruppe wurde im ersten und dritten Drei-Wochen-

Zeitraum mit der AM behandelt, wobei die Kinder während des Behandlungszeitraums die Kinder jeden Morgen als erstes vor Unterrichtsbeginn in ihrem Klassenzimmer der AM anhörten. Im Anschluss an die Behandlung folgte ein Drei-Wochen-Zeitraum zur Zusammenstellung der Daten und Feststellung, ob die nach der Behandlung erhaltenen Ergebnisse variierten oder gleich blieben. Dieser Zeitraum war für die Gruppe A der zweite Drei-Wochen-Zeitraum. Es gab somit drei Intervalle zur Bewertung von Veränderungen, für die Veränderung von Test 1 zu Test 2, von Test 2 zu Test 3 und von Test 3 zu Test 4. Des Weiteren wurde eine Gesamtbewertung der Veränderung von Test 1 zu Test 4 vorgenommen. Es wurde vier Mal zu Beginn jedes Drei-Wochen-Zeitraums der WISC-Zahlen-Symbol-Subtest für ausdauernde Aufmerksamkeit durchgeführt. Zu Beginn und am Ende des neunwöchigen Testzeitraums wurden Tests unter Verwendung der STAIC- und CAS-Skalen zur Bestimmung der Angstwerte von Kindern mit ADHS durchgeführt. In diesem Fall gab es zwei Bewertungsintervalle: Von Test 1 zu Test 2. Nach den ersten drei Behandlungswochen veränderte sich der Aufmerksamkeitswert für diese 78 Schüler (78 Schüler in Gruppe A, die alle vier Testergebnisse hatten) um 1.62, über das zweite Intervall um 2.17. Von Messung 2 zu 3, d.h. dem Zeitraum ohne musikalische Stimulierung, sanken die Werte im Durchschnitt nicht. Am Ende der klinischen Studie wiesen 71 der 78 Kinder mit vollständigen Testdaten über neun Wochen eine Verbesserung auf. Die durchschnittliche Veränderung betrug 4, was mit der Gesamtveränderung von 4.2 übereinstimmt. Das bedeutet, dass der Netto-Nutzen der Behandlung gemäß der Norm einem Wert von 1.07 entspricht. Ein Wert in dieser Höhe ist bisher in der Literatur zu Musiktherapie noch nicht festgestellt worden. Die beiden Intervalle mit musikalischer Stimulierung zeigten ähnliche Anstiege, was eine Beziehung zwischen Dosierung und Wirkung der Behandlung in ihrer Gesamtheit bedeutet, das heißt, dass bei doppelter Dosierung eine Verdoppelung des Ergebnisses hinsichtlich der Wirkung erreicht wird.

Im Bezug auf die Angstwerte veränderte sich der durchschnittliche Angstwert von 28 Schülern (im Alter von 7 bis 8 Jahren) der Gruppe A, die unter Verwendung der CAS-Skala getestet wurden, um 18.75 und die Wirkungsgröße betrug 0.74. Am Ende der klinischen Studie wiesen 19 von 28 Kindern geringere Angstwerte und 7 einen Veränderungswert von unter null auf. Eine Gruppe von 48 Kindern im Alter von 9 bis 12 mit vollständigen Testdaten wurde unter Verwendung der STAIC-Skala

getestet. Bei 24 Kindern wurde eine Senkung des State-Angst-Werts nachgewiesen, wobei lediglich 8 eine Veränderung des Wertes unter null aufwiesen. 27 Kinder verbesserten ihren Trait-Angst-Wert und 14 wiesen während der neun Wochen einen Veränderungswert von unter null auf. Die mittlere Veränderung betrug jeweils 11.75 und 11.2. Das ergibt gemäß der Norm Werte für den Netto-Nutzen der Behandlung von Kindern im Alter von zwischen 7 und 8 Jahren von 0.96 und für Kinder zwischen 9 und 13 Jahren von 0.96 für State-Angst und 0.40 für Trait-Angst. In Übereinstimmung mit diesem Befund stellt die AM eindeutig eine wirkungsvolle Therapiealternative zur Verbesserung der ausdauernden Aufmerksamkeit und Reduzierung des Angstniveaus bei Kindern mit ADHS dar.

1. INTRODUCTION

2. THE AUDIO METHOD (AM)

3.THREE HYPOTHESES, METHODS AND MATERIALS

1. INTRODUCTION

Music and relaxation improve sustained attention and reduce anxiety

The purpose of this dissertation is to determine if a specific Audio Method (AM) developed by myself could contribute to increasing (1) sustained attention and (2) decreasing anxiety in a group of children (7 to 12 years) with ADHD. And if so, (3) to what extent.

The participants in the study were 156 children aged 7 to 12 who have been diagnosed with ADHD, who attend the Spanish State School "Dionisia Plaza" – "Centro de Rehabilitación Médico Psicopedagógico Dionisa Plaza", in Madrid, Spain. The Dionisia Plaza School has a total of 300 students, and is comprised of three units of childhood education and thirteen units of primary school. (In each unit there are approximately 25 children). Primary school in Spain lasts for six academic years and ordinarily begins at age six and ends at age twelve. The school has a sanitary accreditation from the Madrid Government (Madrid Community) as a "Day Centre" for the medical-psycho-pedagogic rehabilitation of childhood disorders. Children in this school receive their rehabilitation treatment together with the ordinary curriculum that corresponds to their age and year, according to the dispositions of the current Spanish educational law (LOE). In its function as a rehabilitation center, the school has the goal of normalizing the children for their adaptation into the school system. The profile of the children is diverse: children with learning disabilities, physical disabilities, behavioral problems, with a high rate of failure or inadequacy in other schools, or come from a difficult social environment. In many cases, children require specific and personalized work in specific areas of immaturity. The majority also require extensive work to improve self-esteem due to past experiences or social environment. Some children are able to transfer to other schools after resolving some of their specific disabilities.

The school requires every incoming student to undergo a medical and psycho-pedagogical study in order to establish both a possible diagnosis and corresponding treatment. The medical study includes the following areas: neurology, pediatrics, child psychiatry, ORL, ophthalmology, neurophysiology and rehabilitation. The school then makes a general distribution of the students in three groups: A, B and C.

The psycho-pedagogic aspect of the study includes intelligence, laterality, body scheme, psychomotor behavior, visual-motor perception, psycholinguistic test, grapho-lexical test, conduct and personality study, attention tests and hyperactivity. Once the study is completed and the treatment has been established, the children are placed into the corresponding year and groups. Group C includes children with low IQ (borderline), severe learning disabilities and a limited capacity to join a normal school. These students usually present a two-year gap when compared to those in normal schools. In this group, the goal is to make it possible for them to live as independently as possible and aims to prepare them for family, social and future labor integration. Group B has the same academic program as Group A. Children in Group B have been shown to have sufficient IQ conditions so as to follow a normal class. However, they usually present learning disabilities and a difficult social background that requires a slower learning pace and more specific and individualized work. During the six years in Primary School, many of these children show a positive evolution and are able to pass to Group A. Children in group A show some areas that need special attention (like ADHD) which do not impede them from being able to follow a normal school year. When assigned to group A and in order to guarantee a more efficient and personalized treatment, the children have to go through an evaluation of Intelligence (IQ) with the Wechsler Intelligence Scale for Children (WISC-IV), evaluation of their curriculum, considering the initial curriculum level according to the age, the style and learning pace of the child and the relationship to peers and teachers and considering the capacities for personal and social development, like motivation and self-esteem and attention levels. Although the three groups (A, B, C) have a high number of children diagnosed with ADHD, the clinical trial of this thesis is focused on children in groups A and B who present standardized IQ levels. Initially, my intention was to apply a full crossover design with the two groups, however after completing the tests and since different designs were applied in each of them and since it was not possible to randomize any of the groups for the sake of the study, I decided to focus the doctoral work only on the results of group A.

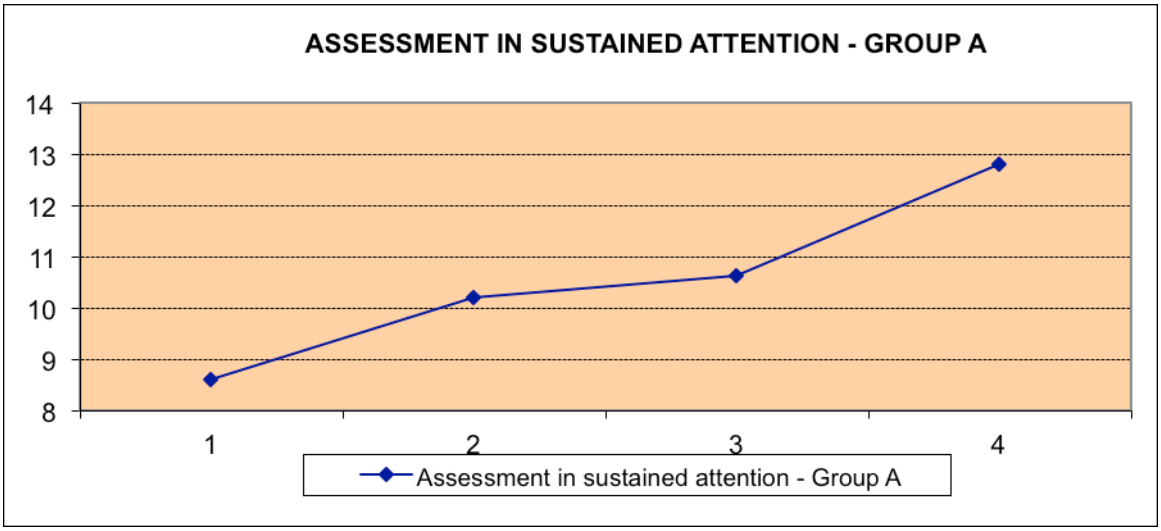
A total of 79 children participated in the study, divided into four years, from second to sixth grade, and between seven and twelve years old. There was a total of 13 females and 65 males, and all were diagnosed with ADHD. (Primary diagnosis based on definition of Attention-Deficit/Hyperactivity Disorder according to DSM-IV-

TR or ICD-10.) The distribution was as follows: fourteen children in second grade, fourteen in third grade, sixteen in fourth grade, seventeen in fifth grade and 18 in sixth grade. 36 of the children in Group A were undergoing medical treatment, with methilphenidate (Ribufen, Concert or Medikinet) and atomoxetine (Strattera).

The testing period for group A represented nine weeks: three weeks + three weeks + three weeks. The design was as follows: The group was treated with AM in the first 3 week period and in the third 3 week period. During the treatment period, children listened to the AM in their classroom before starting lessons, first thing in the morning every day,. There was also a 3-week post-treatment data collection period to determine if the results obtained after treatment varied or remained unchanged. These were A's second 3 week period. So there were three interval change scores, corresponding to the change from test 1 to test 2, test 2 to test 3, or test 3 to test 4, and there was also an overall change score from test 1 to test 4. Testing with **Subtest Coding (WISC)** for sustained attention followed four times: at the beginning and end of each 3-week period. Testing with **STAIC and CAS** to establish the anxiety levels of the children with ADHD followed at the beginning and the end of the 9-week testing period. In this case were two interval change scores: test 1 to test 2.

The results obtained were excellent. After the first three weeks of treatment, the mean attention score of these 78 students (78 subjects in Group A who had all four test scores) shifted by 1.62; over the second interval, by 2.17. From measurement 2 to 3, interval with no musical stimulus, the scores did not decrease on average. By the end of the clinical trial, of 78 children with complete data, 71 showed an improvement over the nine weeks. The median change was 4, matching the computed mean change of 4.2. This means that the effect size of the net treatment is about 1.07 as normalized, which is unprecedented in the literature of music therapy. Similarly, the two intervals of musical stimulus showed similar increments, which implies a dose-response relationship for the treatment as a whole, whereby doubling the dose doubles the effect on the outcome score.

Graphic shows Group's A evolution of data in the whole trial,



Concerning anxiety, after the nine weeks of treatment, the mean anxiety score of 28 students (aged 7 to 8) tested with CAS in Group A shifted by 18.75 and the effect size is about 0.74; by the end of the clinical trial, 19 out of 28 children had reduced anxiety, and 7 had a change score below zero.

48 children aged 9 to 12 with complete data were tested with STAIC. 24 showed a reduction in State Anxiety, but only 8 had a change in score below zero, 27 improved in Trait Anxiety and 14 had a change score below zero over the nine weeks. The median change was 11.75 and 11.2 respectively, This means that the effect size of the net treatment for children aged 7 to 8 is about 0.96 and for children aged 9 to 12, 0.96 in State anxiety and 0.40 in Trait anxiety, as normalized.

According to these findings, the treatment with AM clearly provides a huge therapeutic alternative to improve sustained attention of children with ADHD. The findings also establish that the AM reduces considerable state anxiety in children with ADHD.

1.2 ADHD definitions

This review begins with some definitions of ADHD, its pathophysiology, social impact, etiology, a view of anxiety as a dependent variable and its management.

ADHD, its diagnosis and treatment have been considered controversial since the 70s. (Parrillo, Vicente, 2008) The controversy has been held among clinicians, teachers, parents, politicians, media. It includes the actuality of the condition, the

causes, the diagnosis criteria and the treatments. (Mayes, 2008, Cohen, 2006). Nevertheless, many healthcare providers accept it as a genuine disorder with debate centered on diagnosis and treatment. (Schonwald et al. 2006). Other debates focus on whether ADHD is a disability or whether it is a neurological description or a human condition. The hunter vs. farmer theory is a hypothesis proposed by Thom Hartmann about the origins of ADHD and ADD, suggesting that these conditions may be a result of a form of adaptive behavior: "represents otherwise normal behavioral strategies that become maladaptive in such evolutionary novel environment as the formal school classroom". (Hartmann) Some researchers used this theory as a working hypothesis about the origin of ADHD.

ADHD has been described as "a paradigm for a true bio-psychosocial disorder, raising critical questions concerning the relations between genetic, biological, and environmental factors" (Tannock 1998, p.65), as a neurobehavioral (NINS, 2007) developmental disorder (Zwi et al. 2000) characterized by attentional problems, hyperactivity and symptoms, which start before seven years old (Biedermann ,1998). It may affect certain areas of the brain that allow problem solving, planning ahead, understanding other's actions and impulse control. (American Academy of Child Adolescent Psychiatry, 2009). It has been described as a developmental disorder in which certain traits, such as impulse control, lag in development. With an MRI of the prefrontal cortex, this developmental lag has been estimated to range from 3 to 5 years. (Science daily, 2009) ADHD does not imply a neurological disease and (CG72, ADHD 2008) and is often classified as a disruptive condition along with oppositional defiant disorder, conduct disorder and antisocial disorder (Wiener, Jerry M, 2003).

1.3 ADHD – Definition according to DSM-IV-TR and ICD-10.

In order to evaluate a child with a diagnosis of ADHD, the Centro de Rehabilitación Médico Psicopedagógico – (from now on) Dionisia Plaza School, (educational and rehabilitation center in which the clinical trial of this dissertation was held) considers the interviews with the children and families, the history (former schools and possible diagnoses) of the child and a psychiatric assessment to rule out other potential causes or comorbidities, physical examination and radiological imaging. The school categorizes the children with ADHD according to DSM-IV-TR

(2000) or ICD-10. DSM-IV-TR defines ADHD as follows: (The DSM-IV-TR, was published in 2000 as a text revision of the DSM-IV. The diagnostic categories and the vast majority of the specific criteria for diagnosis were unchanged -APA Summary of Practice-Relevant Changes to the DSM-IV-TR) The text sections giving extra information on each diagnosis were updated, as were some of the diagnostic codes to maintain consistency with the ICD:

Persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequently displayed and is more severe than is typically observed in individuals at comparable level of development.

Three Subtypes are classified:

-Attention-Deficit/Hyperactivity Disorder Predominantly Inattentive Type: This subtype is used if six (or more) symptoms of inattention (but fewer than six symptoms of hyperactivity-impulsivity) have persisted for at least six months.

-Attention-Deficit/Hyperactivity Disorder Predominantly Hyperactive-Impulsive Type: This subtype should be used if six (or more) symptoms of hyperactivity-impulsivity (but fewer than six of inattention) have persisted for at least six months.

-Attention-Deficit/Hyperactivity Disorder Combined Type: This subtype should be used if six (or more) symptoms of inattention and six (or more) symptoms of hyperactivity-impulsivity have persisted for at least six months.

Diagnostic Criteria for the three subtypes of Attention-Deficit/Hyperactivity Disorder according to DSM-IV:

A. Individual must meet criteria for either (1) or (2):

(1) Six (or more) of the following symptoms of inattention have persisted for at least six months to a degree that is maladaptive and inconsistent with developmental level:

Inattention

(a) often fails to pay close attention to details or makes careless mistakes in schoolwork, work or other activities,

(b) often has difficulty sustaining attention in tasks or play activity,

(c) often does not seem to listen when spoken to directly,

(d) often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behavior or failure to understand instructions).

(e) often has difficulty organizing tasks and activities.

(f) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework),
(g) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books or tools),
(h) is often easily distracted by extraneous stimuli,
(i) is often forgetful in daily activities.
(2) Six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least six months to a degree that is maladaptive and inconsistent with developmental level:
Hyperactivity
(a) often fidgets with hands or feet or squirms in seat,
(b) often leaves seat in classroom or in other situations in which remaining seated is expected,
(c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness),
(d) often has difficulty playing or engaging in leisure activities quietly,
(e) is often “on the go” or often acts as if “driven by a motor”,
(f) often talks excessively,
Impulsivity
(g) often blurts out answers before questions have been completed,
(h) often has difficulty awaiting turn,
(i) often interrupts or intrudes on others (e.g., butts into conversations or games).
B. Some hyperactive-impulsive or inattentive symptoms that caused impairments were present before age 7 years.
C. Some impairment from the symptoms is present in tow or more settings (e.g., at school [or work] and at home).
D. There must be clear evidence of significant clinical impairment in social, academic or occupational functioning.
E. The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder and are not better accounted for by another mental disorder (e.g., Mood Disorder, Anxiety Disorder, Dissociative Disorder, or a Personality Disorder). Recent research by Jensen,

Martin and Cantwell (1997) suggests that there is evidence for two new subtypes of ADHD, i.e. an aggressive subtype and an anxious subtype.

ICD-10 or CIE-10

The International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10), of 1992, is a medical classification list by the World Health Organization (WHO), for the coding of diseases, signs and symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or diseases. CIE-10 stands for the Spanish version of ICD-10. In the tenth edition of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) the signs of ADHD are given the name "Hyperkinetic disorders". When a conduct disorder (as defined by ICD-10 ICD Version 2006: F91. WHO) is present, the condition is referred to as "Hyperkinetic conduct disorder". Otherwise the disorder is classified as "Disturbance of Activity and Attention", "Other Hyperkinetic Disorders" or "Hyperkinetic Disorders, Unspecified". The latter is sometimes referred to as, "Hyperkinetic Syndrome". (ICD-10 ICD Version 2006: F91. WHO). In North America, the DSM-IV criteria are often the basis for a diagnosis, while European countries usually use the ICD-10. If the DSM-IV criteria are used, rather than the ICD-10, a diagnosis of ADHD is 3-4 times more likely. (Singh, 2008). The Dionisia Plaza School tends to use more often the DSM-IV-TR than the ICD-10.

1.4 Pathophysiology

Research on children with ADHD has shown a general reduction of brain volume, especially in the volume of the left-sided prefrontal cortex. Features like inattention, hyperactivity and impulsivity reflect frontal lobe dysfunction, but other brain regions as the cerebellum are also affected. (Krain et al., 2006). Visual imaging techniques have enabled researchers to determine the involvement of the lateral prefrontal cortex, dorsal anterior cingulate cortex, caudate and putamen. Berquin et al. (1997, in Douglas, 1999) found neuroimaging evidence to support dysfunction in a cerebello – thalamo -prefrontal circuit, which may subserve the motor control and inhibition, and/or executive function deficits encountered in ADHD. These findings are

congruent with symptomatic behavior in ADHD, as the pre-frontal cortex is associated with planning for voluntary activity, resisting distractions, decision making, and developing an awareness of self and time. Rubia et al. (2003) suggest that abnormalities in prefrontal brain regions are related to motor timing deficits that may underlie the behavioral impulsiveness of children who have ADHD. SPECT scans found people with ADHD to have reduced blood circulation and a significant higher concentration of dopamine transporters in the striatum, which is in charge of planning ahead. (Dressel et. al, 1998). Although a study conducted by Mount Sinai School of Medicine and US Department of Energy's Brookhaven National Laboratory found that it was not the transporter levels that indicated ADHD, but the dopamine itself.

1.5 Epidemiology and Social Impact of ADHD

ADHD affects 3% to 5% of children globally (NIMH+ADHD,2077) (Nair J, Beitman, Nair SS, Lavin, 2006). Nevertheless there is certainly a geographic variability among studies. It seems that Africa and the Middle East have lower rates of ADHD than North America and Europe (Polancyik, 2007); studies have found rates of ADHD of 2% to 14% among school aged children (Loni 1008). The rate in Spain is considered to be between 3% and 7%. It is diagnosed 2 to 4 times more frequently in boys than in girls (Dulcan, 1997) (Singh, 2008) though studies suggest this could be due to subjective bias of referring teachers. (Sciutto, 2004). According to the National Health Interview Survey, 1998–2009 (Lara J. Akinbami et al.) the percentage of children who have at some point been diagnosed with ADHD increased from 7% to 9% from 1998–2000 through 2007–2009 in the United States. According to the study done by Polanczyk et al (2007), the worldwide prevalence estimates of attention deficit hyperactivity disorder (ADHD)/hyperkinetic disorder (HD) are highly heterogeneous. The study showed that ADHD/HD worldwide-pooled prevalence was 5.29%. and suggested that geographic location plays a limited role in the reasons for the large variability of ADHD/HD prevalence estimates worldwide. Instead, this variability seems to be explained primarily by the methodological characteristics of studies.

ADHD is one of the most important topics of child psychology and psychiatry. Meanwhile ADHD has become a major economic focus for the pharmaceutical

industry. Treatment for ADHD often includes medication to help control symptoms as: Methylphenidate, brand names include Ritalin, Concerta, Metadate, Daytrana and Methylin. Dexmethylphenidate, brand name is Focalin. Amphetamine-Dextroamphetamine often marketed under the name Adderall. Indeed there is a huge controversy worldwide, especially in the USA and in some European countries, on the proliferation of the ADHD diagnosis and the rise of "cosmetic psychopharmacology" (Diller, L 2011). The US and Canada account for 95% of worldwide Ritalin consumption (Richard Degrandpre, 2001). Author Peter Bregging (2011) justifies the rise of psychiatric drugs to children as the result of simple marketing strategies in a competitive world. He likens the pharmaceutical industry to the tobacco or alcohol industry, in that it is constantly searching for new markets, with anti-depressant drugs like Prozac and Zoloft responsible for the trend´s beginning.

There is no doubt of ADHD´s huge economic (Matza et al. 2005) and societal impact (Pelham et al. 2007). A 2004 study (Biedermann et al.) estimated that those diagnosed with ADHD with a college diploma earned $4,334 less per year than those without the diagnosis, while high school graduates with ADHD earned $10,791 less than their counterparts.The study estimates a total loss in productivity in the US of over $77 billion USD. By contrast, loss estimations for drug abuse are $58 billion; for alcohol abuse are $85 billion; and for depression are $43 billion. The direct and indirect costs associated with it and the corresponding social expense are important indicators for the need for proper treatment for children and young adults with ADHD, considering the fact that ADHD is seen as a chronic disorder (Van Cleave J, Leslie LK, 2008). Bernfort, et al. (2008) analyzed the impact of ADHD from a socio-economic perspective, and investigated the effects of costs, such as, increased educational expenses, costs of addressing drug and substance abuse, increased traffic accidents, employment and, health care, and concluded that ADHD is a considerable societal burden. Another review by Pelham and coworkers (2007) investigated costs associated with pediatric and adolescent ADHD, such as special educational needs, loss of work to parents of ADHD children, impacts on the juvenile justice system, and health-care costs, and placed the overall cost per individual with ADHD to be almost $15,000 annually. These numbers suggest the significant burdens that can be placed on both family members and their health care providers surrounding their relationship with ADHD individuals. Not surprisingly, this financial

worry is another facet of this condition that can act as another source of stress for parents and other family members of ADHD children. ADHD persists into adulthood in about 30-50% of cases (Balin et. al, 2008). Barkley states that adult ADHD impairments affect education, occupation, social relationships, marriage, parenting, drug abuse, crime, financial management, and health.

1.6 History Review of ADHD

Approximately 2500 years ago, the great physician-scientist Hippocrates described a condition that is quite compatible with attention-deficit/hyperactivity disorder (ADHD). He described the patient as having “quickened responses to sensory experience, but also less tenaciousness because the soul moves on quickly to the next impression,” and attributed these symptoms to an “overbalance of fire over water.” According to this description, it seems that hyperactivity has long been a part of the human condition.

In 1798, Sir Alexander Crichton (1763–1856) described a mental state similar to the inattentive subtype of ADHD in his book “An inquiry into the nature and origin of mental derangement”: he described it as "mental restlessness” (1798). Crichton wrote about the salient features of this condition, including attention problems, restlessness, early onset, and how it can affect schooling, without any of the moralism introduced by George Still and later authors.

George Still and Alfred Tredgold are considered to be the first authors to focus serious clinical attention on the behavior of children that most closely approximates what is today known as ADHD. Still described (1902) 43 children in his clinical practice with serious problems with sustained attention and claimed that they showed a “defect in moral control” that was chronic in most cases. He proposed that a defect in moral control “could surge as a function of three impairments: a defect of cognitive relation to the environment; a defect of moral consciousness, and a defect in inhibitory volition”.

Several investigators, such as Levin (1938), postulated that severe restlessness in children might well be the result of pathological defects in the forebrain structures. Later investigators (e.g., Barkley, 1997; Chelune, Ferguson, Koon, & Dickey, 1986;

Lou, Henriksen & Bruh, 1984; Lou, Henriksen, Bruhn, Borner, & Nielsen, 1989; Mattes, 1980) would return to this idea. In the 60 and 70s the condition was labelled as "hyperkinetic impulse disorder" and it was attributed to cortical overstimulation due to poor thalamic filtering of stimuli entering the brain (Knobel, Wolman & Mason, 1959; Laufer, Denhoff & Solomons, 1957). This perspective gave rise to the diagnostic term "Hyperactive Child Syndrome" (Burks, 1960, Chess, 1960). The psychoanalytic thought sustained that environmental factors, particularly early events in the family life of the child, were important as a source to cause the condition. The second edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-II; American Psychiatric Association, 1968) described this condition as "Hyperkinetic reaction of childhood". The work of Douglas was so influential that the condition was renamed Attention Deficit Disorder (ADD) in 1980 with the publication of DSM-III (1980). Here, deficits in sustained attention and impulse control were considered of greater significance in the diagnosis. The shift to attention deficit rather than hyperactivity was important, for hyperactivity was not considered specific to this particular condition, but is present in other disorders like anxiety, mania, etc., initiated substantial research. Some research would show that at least deficits in sustained attention could be used to discriminate the condition from other psychiatric disorders (Werry, 1988). In 1987 the definition was changed to ADHD in the DSM-III-R and subsequent editions. (Kaddy, 2009)

1.7 Etiology of ADHD

There is no specific cause of ADHD. But there are a number of factors that probably contribute to it: genetics, social, diet and environment (Bailey, 2005). Today ADHD is seen primarily as a polygenic condition that can be minimized or exacerbated by environmental factors. Jonathan Mills and Arturas Petronis (2008) consider in their study "Pre- and perinatal environmental risks for ADHD: the potential role of epigenetic processes in mediating susceptibility" the important role of epigenetics in ADHD. It is known that epigenetic processes can be induced following exposure to a range of external factors, and thus provide a mechanism by which the environment can lead to long-term alterations in phenotype. The study considers that epigenetic dysregulation may mediate the association observed

between early-development environmental insults and ADHD. The authors propose that understanding the epigenetic processes involved in linking specific environmental pathogens to an increased risk for ADHD may offer new possibilities for preventative and therapeutic intervention. Parent-of-origin effects seem to support the notion that genetic risks for disease process debut often interact with the social environment, i.e., the parental environment in infants and young children. The notion of *endophenotypes*, markers of an underlying liability to the condition, may facilitate detection of genetic risks relative to a complex clinical disorder.

Nevertheless some studies indicate that the condition is highly heritable and that genetics play a large role in it (DG72 ADHD). Researchers believe that many cases of ADHD are due to a combination of genes that affect dopamine transporters: adrenergic receptors, dopamine receptors (Volkow et al. 2009), dopamine beta-hydroxylase monoamine oxidase A, catecholamine-methyl tranferase, serotonin transporter promoter, 5HT receptor 2A and 1B (Roman et. al, 2004) , the 10-repeat allele of the DAT1 gene (Swanson et al. 2000) , the 7 repeat allele of the DRD4 gene, and the dopamine beta hydroxylase gene (Smith et al. 2003) . Heredity, or a positive family history, appears to be another common identifiable cause of ADHD (Comings, 2001). The frequency of the condition in siblings is much greater than in the general population. Studies of adopted children with ADHD found that ADHD occurred more often in the birthparents than in the foster parents (Barkley, 1995; Biederman et al., 1992; Comings, 2001). Studies of twins suggest that ADHD is one of the most heritable of the psychiatric disorders. (Biederman et al., 1992; Levy, Hay, McStephen, Wood, & Waldman, 1997).

But of course, simple genetic association has proven insufficient to explain the spectrum of ADHD. Non-genetic causes of ADHD are also neurobiological in nature (Nigg, 2006), consisting of such factors as perinatal stress and low birth weight (Mick et al., 2002b) traumatic brain injury (Max et a., 1998), maternal smoking during pregnancy (Mick et al., 2002a), and severe early deprivation (Kreppner et al., 2001). Complications during pregnancy and birth and in early childhood are linked to an increased risk of developing ADHD (Millichap, 2008).

Another important epigenetic cause of ADHD is fetal alcohol spectrum disorder. Its diffuse CNS neurotoxic effects include cell death and/or disruption of cell migration, proliferation, differentiation and maturation. Deficits were discovered in all

neurotransmitter systems. Dopaminergic and noradrenergic deficits are likely connected to ADHD presentation of FASD. (Bookstein, F. L., A. P. Streissguth, P. D. Sampson, P. D. Connor and H. M. Barr, 2002) . Other environmental factors like pesticide exposure are strongly associated with an increase risk of ADHD in children. (Klein et al. 2010). Researchers determined that organophosphates residues found in the urine of more than 1.100 children with highest levels of dialkyl phosphates, had the highest incidence of ADHD. Another study conducted by Southampton University in UK found a relation between the ingestion of artificial food colors, the preservative sodium benzoate and hyperactivity (Mc Cann et al 2007). Family dysfunction or inadequacies in the educational system are considered to be important factors to affect children. Some researchers believe that caregivers have a profound effect on attention activities (Finkelstein et al, 2002) Other studies found behavior typical of ADHD in children who suffered violence, abuse, or post traumatic stress (James, 2004). Between 50% and 80% of children who have ADHD also meet diagnostic criteria for other disorders, most frequently other disruptive behavior disorders, developmental learning disabilities, mood disorders and anxiety disorders.

1.8 ADHD's management

In the aforementioned condition in which Hippocrates described similar features to the current ADHD characteristics, ("quickened responses to sensory experience, but also less tenaciousness because the soul moves on quickly to the next impression,") he recommended a treatment of "barley rather than wheat bread, fish rather than meat, watery drinks, and many natural and diverse physical activities." His dietary prescription interestingly anticipated modern theories of the benefit of a gluten-free diet and essential fatty acids in brain-behavior functions.

Nevertheless, the most usual intervention for ADHD generally involves some combination of behavior modification, counseling, life-style changes and medication. The most commonly prescribed medications for attention deficit hyperactivity disorder (ADHD) are psycho-stimulants, including methylphenidate (Ritalin, Metadate, Concerta), dextroamphetamine, mixed amphetamine salts (Dexedrine and Adderall), and lisdexamphetamine (Vyvanse). Medication has been shown to modify behavior when taken over the short term, but it has not been found to alter long-term outcomes (Yamada et al 2990). A 2007 drug class review found a lack of studies that

compare the effectiveness between various drugs for ADHD, and there is no evidence on their effect on academic performance and social behavior (Mc Donagh, 2007). Side effects of ADHD medication may be troublesome depending on the child: these may include weight loss, appetite changes, insomnia and nervous tics." (Jefferson, 2002). Stimulants raise the extracellular concentrations of the neurotransmitters dopamine and norepinephrine, which cause an increase in neurotransmission. Some studies have shown that stimulant medications temporarily improve working memory abilities. They improve the physiological arousal of these children, increasing their alertness (Gretchen et al 2010). However other studies have observed higher rates of schizophrenia and bipolar disorder in adult individuals with a past history of stimulant use to control ADHD in childhood (Ross, 2006). On the other hand, the use of atypical antipsychotic drugs as an off-label treatment has been rising (Silberman, 2008) because of their effects on blocking dopamine and their success in blocking addictions to stimulants. This has created a controversy since the blocking of dopamine function, affects the reward system and may cause a stage of dysphoria. This may lead some adolescents to compensate for their dopamine deficiency with drugs or alcohol.

Other interventions for ADHD include "tutoring and special education, behavioral therapy and family-group psychotherapy" (Jefferson, 2002), interpersonal psychotherapy, school-based interventions. Experts place a great amount of significance on the need to have "structured home and school environment" in order to inculcate various coping skills, suitable study habits and a sense of discipline and responsibility for the children.

Many parents are concerned about giving their children a psychoactive medication and try to find other possibilities to it. In terms of educational interventions and other behavioral therapies, there are many alternatives, including: environmental supports for children with ADHD, support at home, in school, instructional strategies, teaching self-monitoring, positive behavioral intervention and support, movement therapy, "brain gym", program sensory integration therapy and activities in which children can train other "senses" like vestibular, proprioceptive, tactile, and motor planning. It is thought to compensate the difficulties children with ADHD might have in one more areas of sensory integration.

Other therapies focus on nutrition and diet. There are several theories regarding diets and ADHD, not always with conclusive scientific results. The main proposals focus on -diets low in sugar and refined carbohydrates with high quality protein, on eliminating or reducing dietary allergens and food additives, nutritional supplementation, detection of heavy metal toxicity and measures to reduce toxic burden.

-Carbohydrate/Protein-balanced Diet: A detailed review of the controlled scientific literature regarding the role of diet and behavior in childhood (Breakey,1997) has shown that diet definitely affects some children. Although it appears from several studies that sugar consumption is not the primary causative factor of ADHD, there are some children for whom hypoglycemia and/or dysinsulinemia play a critical role. Beyond the issue of sugar reactivity, the health consequences of a diet high in "empty calories" may contribute to the malnutrition and nutrient deficiencies commonly seen in these children.

- Management of Food Sensitivities: Several double-blinded dietary trials have shown that food sensitivities may sometimes provoke hyperkinesis and other ADHD behavior changes, and that elimination of the identified foods has caused an improvement in behavior. (Boris; Schmidt; Carter; Egger 1985) Therapies are generally focused on removal of common or identified allergens and food sensitivities from the diet, and substitution with foods of low antigenic potential. Some common allergenic foods are wheat (or refined flour), peanuts, milk, cheese, sugar, corn syrup, barley, eggs, corn, rye, chocolate, soy and oats.

- Treatments for Intestinal Permeability or "Leaky Gut Syndrome": This is based on the finding that reactive and inflammatory bowel states sometimes cause damage to the brush-border lining of the intestine, leading to a high concentration of dietary protein and food antigens crossing over into the blood stream and consequently triggering multiple allergies. The therapy consists of special supplements containing probiotic factors such as amino acids, glutamine, hydrolyzed whey protein (globulins, lactoferrin), gamma oryzonol from rice oil, and other essential nutrients and EFAs. As the gut lining repairs itself, the propensity toward allergy is diminished.

- The Feingold Diet for ADHD, a food elimination program developed by Ben F. Feingold, MD to treat hyperactivity. It eliminates a number of colors and artificial flavors, aspartame, three petroleum-based preservatives, and certain salicylates.

There has been much debate about the efficacy of this program. Many researchers who have set out to test the Feingold hypothesis have either failed to confirm the findings or have produced inconclusive results. (Mattes; Adams; Stare; Harner; Harley, 1981). The National Advisory Committee on Hyperkinesis and Food Additives to the USA Nutrition Foundation in 1980 filed a negative report about the role of food additives and hyperactivity.

- Nutritional Supplementation: According to human physiology and nutrition theories, cellular function, and particularly brain function, is partially dependent upon nutritional status (Essman, 1987). The stages of nutrient deficiency, from low intake through low blood nutrient concentrations to eventual compromised function are well documented for selected nutrients. For example, pyridoxine deficiency may cause impairment of neuronal activity, neurotransmitter imbalances, poor conversion of tryptophan to serotonin, and eventually may manifest as EEG abnormalities.(Sizer)

- Mineral Deficiencies: Studies of hair and blood have demonstrated mineral deficiencies in ADHD. The most consistent findings are low magnesium (Kozielec 1994; Kozielec 1997; Starobrat-Hermelin) and low zinc (Barlow; Bekaroglu M; Kozielec 1994). Iron deficiencies have also been linked to certain cases of ADHD (Kozielec 1994; Sever; Tu; Burattini). Studies of mineral status have also revealed patterns of toxic mineral burden, most notably manganese (Barlow 1983; Collipp), lead (Needleman;Tuthill;Eppright), cadmium (Ward; Stewrt-Pinkham) and aluminum (Barlow 1986; Howard; Ward).

-Essential Fatty Acids: Zinc is required for conversion of EFAs to prostaglandins. It may be helpful to supplement zinc along with essential fatty acids. In one study addressing this consideration, ADHD children were found to be significantly low in both zinc and serum-free fatty acids (Bekaroglu, 1996) compared to control children.

- Disturbances in Amino Acid Metabolism: Research in the area of amino acids and ADHD point to a defect in metabolism of and synthesis of neurotransmitters. Simply loading the amino acid precursors to neurotransmitters appears to be of limited clinical benefit, perhaps owing to the failure of such therapies to address the underlying errors of metabolism involved.

- Heavy-Metal Toxicity, Lead exposure is associated with hyperactivity. (Barlow, 1983)

- EEG Biofeedback presents another alternative for ADHD; it is not considered to be a cure, but can help these children to improve their academic performance, social skills, and most of all their self esteem (Othmer and Othmer, 1992). The goal of EEG Biofeedback training is to alter abnormal brain waves by decreasing theta waves, while simultaneously increasing beta waves. (Lubar and Shouse 1976).

-Herbal Treatments, herbal formulas and chinese herbs propose alternative solutions for ADHD. Studies on the physiological effects of herbs point to potential benefits for several brain, neurological and performance parameters. Many of these benefits may well extend to ADHD patients. Several herbal remedies for the nervous system are known for their stimulating effects. Frances Brinker, (1995) ND, classified this category of herbs as 'alertness enhancers.' (Breggin, 1998)

-Homeopathic Treatments, a long list of homeopathic products are proposed as suitable for ADHD. The study undertaken by Heiner Frei, et al. (2005) suggests scientific evidence of the effectiveness of homeopathy in the treatment of attention deficit hyperactivity disorder, particularly in the areas of behavioral and cognitive functions.

- Bach Flower Remedies. Edward Bach believed that many illnesses have their roots in our mental and emotional states. According to Bach, learning to improve our outlook could lead to good health. He postulated that disease was caused by negative aspect of emotions like anger, fear and sorrow. Nevertheless Bach flower remedies are a form of traditional, complementary medicine supported by several clinical trials. (Pintov et al. 2005)

- Musical intervention for ADHDs. There are plenty of musical strategies, therapies or interventions for children with different disorders (Kodály, Ward, Dalcroze, Martenot, Orff, Tomatis, Campbell, Willems). However, there are few scientific studies with significant results about music therapy or music therapy interventions for ADHD. Even though music therapists often use a number of musical strategies in the treatment of children with ADHD. Those interventions often address multiple goals, and outcome is generally perceived as positive. (Jackson NA, 2003). In general terms the beneficial effect that music has on children with disabilities, could be summarized as follows (Lacarcel, 1990): (1) music favors emotional development, (2) favors the manifestation of tensions, problems, concerns, fears, blocks, etc., thus decreasing anxiety, (3) achieves a better balance psychophysical and emotional, (4)

rhythmic stimuli increase physical performance and cerebral blood flow and, (5) in children with difficulty of communication has been shown to respond to musical stimuli rather than to any other kind of stimulus. Some studies maintain that the use and practice of rhythmic tasks leads to an improvement in the internal organization and control of behaviors called impulsive (Gibbons, 1983; Thaut, 1992). Given this data and the fact that some studies have used rhythmic tasks to improve body awareness (Wigram, Pedersen and Bond, 2002) and motor coordination (Gibbons, 1983; Howell, Flowers and Wheaton, 1995; Mathenius Moore, 1987; Thaut, 1985), Rickson (2006) performed a study with 13 ADHD. The study set forth two conditions: one in which participants played percussion instruments following a particular rhythm pattern proposed by the therapist, and the other in which the children improvised using the same instruments. Overall, both groups improved their ability to listen, respond and engage in group activities, demonstrating that the music therapy sessions increased levels of sustained attention, concentration and self control in other types of tasks. Another interesting study (Rett and Seidler 1990) with children with Down syndrome showed their high responsiveness to music, especially to rhythm and melody.

Management of ADHD in Spain:

The management of ADHD in Spain is not very different from what was related above. The most usual intervention for ADHD involves generally some combination of behavior modification and medication. The most commonly prescribed medications for attention deficit hyperactivity disorder (ADHD) are psycho-stimulants, including methylphenidate (Ritalin, Ribufen, Metadate, Medikinet, Concerta), and atomoxetine (Strattera), mixed amphetamine salts (Dexedrine and Adderall). Diagnostic criteria are made according to DSM-IV-TR or to CIE-10 (ICD-10). Like in the US and in other Western European countries, there is a big concern in Spain about the increasing diagnosis of ADHD. Some critics (FEAP, 2010), are thrown to the media who have disclosed the issue as if it were a real epidemic: Despite the scientific discussion about the contraindications of the different medications used in cases of ADHD (Carey, W, 1998, 1999, 2000, 2001, Diller, L, 2003) the insistence with which the media advertise consumption of medication as major therapeutic indication against the symptoms of ADHD is stricking (Clarín, 2004, La Nación, 2004, Safer, D, 1996; El

País 2010). According to FEAP, very often, the way to diagnose has been trivialized as a resource for medication with a tendency to simplification and a reductionist conception of children and youth issues. As a result, children are medicated at early ages, or subjected to interventions based on non-pharmacological approach (brain wave driving, etc) ignoring the impact of their familiar, social context, which is known to be important for their evolution. (Armstrong, 2000; Berger 2005).

1.9 Anxiety, another dependent variable of ADHD

Although anxiety is a separate condition from ADHD, in this particular case study the tested group was scrutinized by the diagnosis of ADHD. The Anxiety Test CAS and STAIC was carried out with children from this group, i.e. those who already had an ADHD diagnosis. Nevertheless, and in order to evaluate a child with a diagnosis of anxiety, the Dionisia Plaza School considers not only the scores of the anxiety tests, but has a more general assessment derived from the familiar and social context of the childen, the interviews with their families, former medical records, the psychiatric assessment to rule out other potential causes. In the following chapter I shall try to explain how anxiety was managed by the school in the tested group. The school categorizes the children with anxiety according to DSM-IV-TR (2000) or ICD-10.

According to DSM-IV-TR, Generalized Anxiety Disorder has been characterized as follows.

A. Excessive anxiety and worry (apprehensive expectation), occurring more days than not for at least 6 months, about a number of events or activities (such as work or school performance).

B.The person finds it difficult to control worry.

C. The anxiety and worry are associated with three or more of the following six symptoms (with at least some symptoms present more days than not for the past 6 months). Note: Only one item is required in children.

1. restlessness or feeling keyed up or on edge
2. being easily fatigued
3. difficulty concentrating or mind going blank
4. irritability

5. muscle tension

6. sleep disturbance (difficulty falling or staying asleep, or restless unsatisfying sleep)

D. The focus on the anxiety and worry is not confined to features of an Axis I disorder, e.g., the anxiety or worry is not about having a Panic Attack (as in Panic Disorder), being embarrassed in public (as in Social Phobia), being contaminated (as in Obsessive-Compulsive Disorder), being away from home or close relatives (as in Separation Anxiety Disorder), gaining weight (as in Anorexia Nervosa), having multiple physical complaints (as in Somatization Disorder), or having a serious illness (as in Hypochondriasis), and the anxiety and worry do not occur exclusively during Posttraumatic Stress Disorder.

E.The anxiety, worry, or physical symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

The disturbance is not due to the direct physiological effects of a substance (e.g., a drug of abuse, a medication) or a general medical condition (e.g., hyperthyroidism) and does not occur exclusively during a Mood Disorder, a Psychotic Disorder, or a Pervasive Developmental Disorder. (American Psychiatric Association, 1994).

1.9.1 Pathophysiology of anxiety

Fear and anxiety were crucial for the survival of species and natural selection because they provided a phylogenetic connection with evolutionary ancestors. Fear is an emotion that shows strong cross-species parallels, from humans to mammals. (Ollendick, March, 2004). Despite its adaptive function, the pathological manifestations of fear have been studied. Psychoanalysis (Freud, 1964) is one of the theories regarding the development and maintenance of anxiety. Behavioral theories have been criticized for not paying sufficient attention to cognitive, social and physiological aspects of human anxiety. Then social and cognitive theories evolved: cognitive theories (Eysenck 1992) defended that expectation and interpretation of events rule the experience one has of them. Social theories pointed to the interaction between behavior and its controlling influences (Ollendick, 2004).

Earlier neuroscientific approaches in neuroanatomy and psychophysiology have helped to identify the physical structures, chemical messengers, and correlates of anxiety: Neuroscientific studies emphasized the role of the limbic system (amygdala, hypothalamus, septum, hippocampus and cingulum) in anxiety, with the amygdala playing a central role in fear and anxiety. (LeDoux, 1998). The application of new brain imaging technologies on anxiety disorders has led to a better definition of the neurobiological basis of these disorders. The pathophysiology of anxiety includes: abnormal function of noradrenergetic, serotonergetic, GABAergic, dopaminergic neural system and an abnormal chemoreceptor reactivity. Functional imaging data have revealed abnormal patterns of cortical and subcortical activity (Johnson, Lydiard, 1995). Studies have linked the insular cortex to modulation of affective processing, to cognitive and affective processes during learning, and to aversive interceptive processing, e.g., synesthesia, noxious heat or cold stimuli, coding of pain intensity, and expectation of painful stimuli. These and other studies clearly demonstrate that the insular cortex is important for linking emotions to cognitive processes and behavioral responses (e.g., see Nitschke et al. 2006). There is evidence of altered insular functioning in patients with anxiety disorders. Symptom provocation in individuals with obsessive-compulsive disorder, simple phobia, or post-traumatic stress disorder has been shown to be associated with increased cerebral blood flow in bilateral insular cortex (Rauch et al 1997). Panic disorder patients show a dramatic down-regulation of GABA(A) receptors in the right insular cortex (Malizia et al 1998). Social phobia patients show differential blood flow reduction in the insular cortex during a public speaking task (Lorberbaum et al 2004). Individuals with specific phobia show an exaggerated right insular response to fearful faces (Wright et al 2003). Patients with generalized anxiety disorder (GAD) show a reduced activation in the insular cortex after symptom reduction by citalopram (Hoehn-Saric et al 2004).

Recent epidemiological studies (Michael, Zetsche, Magraf, 2007) examining anxiety disorders in the general population demonstrate that anxiety disorders are widespread, with lifetime prevalence rates ranging between 13.6% and 28.8% in Western countries. Comorbidity among individuals with an anxiety disorder is high: three out of four people with a lifetime anxiety disorder experience at least one other mental disorder in their lifetime. There is a particularly strong association between

anxiety disorders and affective disorders and a considerably lower, but still substantial, relation between anxiety disorders and substance use disorders. Individuals between the ages of 10 and 25 seem to be at the highest risk for developing an anxiety disorder. Other risk factors comprise female gender, behavioral inhibition and negative life events.

However, the diagnosis of child anxiety include some unresolved issues as: the high levels of comorbidity of anxiety with other behavioral/emotional problems; the inadequate reliability in children's self reports and the lack of discriminant and predictive validity across specific diagnostic categories. Silverman and Saavedra (1998) asserted that in order to understand anxiety disorders in children, it will be necessary to examine developmental changes in terms of cognitive, emotional and social development. The ability to reason, to form concepts develops rapidly (Bee &Mitchell, 1980). But most of the information obtained during an assessment is influenced by the sensitivity of the particular measure to these cognitive abilities. Most self-report probes of children's anxiety are modified versions of adult probes (Taylor, 1953), and children and adults have a different understanding of the language used in them. In order to report on internal state, children must have developed a concept of the self, an understanding of emotion, and have some insight into processes within themselves. Research indicates that distinct changes occur in children's understanding of themselves (Damon & Hart, 1982). But children have little interest in observing, understanding and evaluating internal processes until adolescence. (Harter, 1990). Children are not able to provide accurate reports of their emotions until they are 8 to 9 years old, (Stone and Lemanek, 1990), even If they are experiencing anxiety disorders, they may be unable to name their experiences (Qua, La Greca, 1986) .

ADHD may accompany other disorders such as anxiety or depression, which can complicate diagnosis and treatment. Anxiety has been found to be common in girls diagnosed with the inattentive subtype of ADHD (Faraone, 2003). Pliszka et al (1999) suggested that approximately 25% of children with ADHD and had anxiety disorder. He reported that ADHD subjects with anxiety had a significantly poorer response to stimulant medication than those without anxiety, suggesting they might represent children who develop secondary inattentiveness, or perhaps a different type of ADHD. Studies have suggested that children with anxiety and ADHD are less likely to display

off-task and hyperactive behavior and have longer reaction times than those children with pure ADHD. (Schatz DB, Rostain AL. 2006). Anxiety in ADHD may inhibit impulsivity, so children with ADHD and anxiety may have less impulsivity but more inattention. For this reason, it is possible to overlook ADHD (especially the inattentive type) in children with anxiety. Children with anxiety are often preoccupied with fears, which impair their ability to focus on the task at hand. For anxious children who do not have ADHD, when their anxiety improves, their attention improves, whereas children with ADHD/anxiety will continue to struggle with inattention even in the absence of anxiety. Some have suggested that the anxiety associated with ADHD is a product of an inability to function in daily life because of social and cognitive limitations associated with ADHD, rather than typical phobic/fearful behavior. (Schatz DB, Rostain AL. 2006).

1.9.2 Management of ADHD and anxiety – The presence of an anxiety disorder may influence how children respond to medication treatment. Stimulant treatment for those children with both conditions has been shown to increase side effects, such as tics and sadness, in other studies it has been suggested, that stimulant treatments may worsen symptoms of anxiety. One study, however, found no difference in treatment response between children with anxiety and those without. (Diamond IR, Tannock R, Schachar RJ, 1999). In contrast, the NIMH Multimodal Treatment of Children with ADHD looked at a subgroup of children who had anxiety symptoms at the beginning of the study and found that methylphenidate (Ritalin) did not exacerbate but reduced anxiety symptoms with some children following treatment. (MTA Cooperative Group, 1999). Some clinical studies that have looked at children with both conditions have found that the addition of an SSRI to stimulant treatment has been helpful.

In this clinical trial, the tested group in anxiety was scrutinized by the diagnosis of ADHD. So, the Anxiety Test CAS and STAIC were undertaken with children who already had a ADHD diagnosis. Nevertheless, the Dionisia Plaza School insists that in order to evaluate a child with a diagnosis of anxiety, it is necessary to have a general assessment of the child, not only the test scores which are considered a mere indicator of anxiety. But, according to tests scores 25% of the tested children with

CAS (7 to 8 years) and 98% in State Anxiety and 85% in Trait Anxiety in STAIC (9 to 12 years) presented in the beginning, and before the musical intervention, a score higher than 50, which is considered to be over the threshold for one of the diagnosis criteria of the disorder. None of the tested children from the Dionisia Plaza School received medical treatment specifically for anxiety. ADHD medicated children (39 in Group A) with methylphenidate and atomoxitine received a periodical monitoring by the team of psychologists and neurologists on the proper implementation and effects of the medication. According to the school atomoxitine was prescribed for children with ADHD and some anxious features. Some children received psychotherapeutic treatment when and if needed. The need of psychological intervention is considered in each case by a team consisting of a psychologist, a neurologist and usually the teacher of the specific child who contributes with the point tutoring view. The school has an open and effective policy of immediate problem solving of their children. Any state of anxiety, worry or conflict identified in a child is immediately attended to. The child goes to the psychology department to tell them the problem he or she has, and is seen by the psychologists at once. If possible, an immediate solution to the conflict is sought. In the case of an issue related to family or social background, the problem is exposed to the parents or caretakers by the psychologists.

If necessary, the team helps with specific long-termed cognitive and behavioral therapy.

2. THE AUDIO METHOD

2.1 Description

The Audio Method involves 7 different musical and linguistic presentations with a duration of 5 to 8 minutes. The pieces contain a guided oral text read over music. The AM consists of specific sounds, guided texts and cyclical rhythms that aim to create a specific environment to help listeners relax and focus on concrete exercises. The pieces are primarily percussive and specifically contain metallic sounds, such as xylophone, gongs, bells or drums, yet some even include string sections. Each piece is tuned to a specific pentatonic scale.

The CD is annexed to this dissertation.

This method was inspired by the extensive work of some brain and music researchers and by the compilation of diverse techniques on different topics that I shall try to refer to as follows: music and relaxation, the tradition of pentatonic scales, research studies on brain waves, the analysis and importance of the hearing process for brain activation, the effects of meditation and relaxation on the brain, the study of the brain evolutionary stages in a human being, the study of different musical interventions (or music methods) and their effects on children and education. All of this information may not always have presented a sufficient scientific or biological basis, yet given the social impact, acceptance and long experience in practical application, it caused me to think that by using music, I could try to create a method capable of achieving practical results. These results could have some effects on a specific group and I could measure them within the frame of a clinical trial. Therefore, my mentor, Prof. Dr. Dr. Bookstein, suggested that I find out if my musical intervention could make a difference in attention and anxiety of children with ADHD diagnosis. The question was a real challenge to me: As mentioned previously, ADHD remains a controversial topic, I had to find an appropriate school in Spain with a large enough sample of children with these characteristics, the right tests to measure anxiety and attention, the adequate balance

between the Spanish (country where is trial was done), Austrian (country where the dissertation was handed out) and US (country where my mentor, Prof. Bookstein came from) laws, and proceedings so that the study was possible in the three scenarios. Finally, I didn't know what effect size I would get in the trial. In the following chapter I shall focus on the aforementioned topics, referring to the authors and theories that inspired me to do this work.

2.2 The brain vibrates with music

The Method relies on the power of music and its capacity to affect the brain in different ways. Music is typically viewed as a cultural invention that emerged early in human evolution. It is present in human development, it has a great emotional impact and has its seat (partly) in specialized areas as I shall explain as follows. Two important evolutionary theories have tried to explain its function. Darwin (1871) suggested that music served to attract sexual partners, while Miller (2000) proposed that the impulse to make music was to impress prospective partners. However, the dominant view lies at the group rather than the individual level, in the level of group-cohesion (Wallin et. al 2000). The group dimension of music creates the so-called emotional contagion, which is defined as the tendency to automatically mimic and synchronize vocalization and movements with those of another person and to converge emotionally (Hatfield, Cacioppo, & Rapson, 1994). As proposed by Blacking (1987), the power of music (and dance) is generated by the extension of individuality in community. Music has an important adaptive value for the group, as it affects contagion or communion.

Cognitive scientists (Bregman 1990, Handel 1989) consider music the product of a general-purpose cognitive architecture or as assembled from other faculties that were not originally designed for its purposes (Pinker, 1997). Musicologists see music as a social construct that varies from culture to culture (Blacking 1990), but there might be common principles underlying musical cultures. Music might be in our nature so it might have a biological function (Wallin, Merker & Brown, 2000). Although only a minority of people fully develop their musical capacity, it seems that almost everyone is able to carry a tune (Dalla Bella, Giguère & Peretz) and move to

music. Scientists maintain different positions on this: for some, the capacity for acquiring musical abilities is seen as an evolutionary adaptation, shaped by natural selection and governed by genes. Whereas others view musical abilities as the result of general-purpose learning capacities that are shaped by environment – the ''blank slate'' or the tabula rasa scenario (Pinker, 2002). Both views have radically different explanations regarding the origin of music, and this has therefore affected the way in which scientists study and assess musical abilities and the use of music, in addition to how societies apply musical disciplines in their systems. It means these two different views affect the way scientists or musicologist interpret/apply music or musical interventions.

There has been important progress in determining the musical abilities of children (e.g., Trehub & Hannon) and in exploring the musical brain (e.g., Peretz & Zatorre, 2005) and musical emotions (e.g., Juslin & Sloboda, 2001). Various recent studies have shown that music has a biological basis, and that the brain exhibits a functional organization in processing it. Current studies indicate that music has a biological basis and that the brain has a functional organization for music. Many brain regions participate in specific aspects of music processing, whether supporting perception or evoking emotional reactions. Musicians appear to have additional specializations of some brain structures. Lerdahl and Jackendoff (1983; Jackendoff, 1987), Dowling (2001, 2005,) and Peretz (Peretz, 2001a, 2001b; Peretz & Coltheart, 2003) have proposed that music-processing components, especially those involved in pitch-based computations, rely on domain-specific mechanisms and specialized neural networks. The tonal hierarchical organization of pitch is important because it facilitates perception, memory and performance by creating expectancies about future auditory events (Tillmann et al., 2000). It seems that this ability may be lost or compromised as a consequence of brain damage (Peretz, 1993) or a congenital neural anomaly (Peretz & Hyde, 2003). This seems to result from a deficient connectivity with the inferior frontal gyrus (Hyde, Zatorre, Griffiths, Lerch, & Peretz,), a brain region that is critically involved in working memory for musical pitch (Zatorre, Evans, & Meyer, 1994) and the perception of harmonic violations (Koelsch et al., 2002; Tillmann, Janata, & Bharucha, 2003). The ability to encode pitch appears to have an important genetic contribution. A twin study performed by Drayna, Manichaikul, de

Lange, Snieder & Spector, (2001) indicated a hereditability of 70 to 80 %. Some authors pose the question if music has a domain-specific component. Pinker (1997) suggests that the music processing system might be assembled from processors that are not specialized for music but for something else. Nevertheless, cases of impairment of musical abilities suggest that some processing components must be both essential and music-specific, for instance in cases of autism (Heaton, Hermelin & Prin, 1998) and tone-deaf cases (Grant-Allen, 1878). It seems that there are anatomically and functionally segregated systems for music and speech in which both systems can function independently. Skeptics argue that it may be a unitary system with a damaged connectionism that causes double dissociations (Plaut, 1995). It seems that rhythm, considered the essence of music, can show impairments independently from a pitch disorder (DiPietro, Laganaro, Leeman & Schnider, 2004).

Mari Riess Jones and her colleagues (Drake, Jones, & Baruch, 2000; Jones, 1990, 2004; Large & Jones, 1999; McAuley, Jones, Holub, Johnson, & Miller) have an interesting point of view regarding music processing, as they view it as the result of the fine-tuning of general-purpose brain oscillations. According to this theory, infants rely mainly on relatively fast periodicities that permit initial tuning into the rapid auditory events in our environment (e.g., phonemes, brief tone patterns), and maturation generates a gradual shift to slower oscillations. Thus, learning depends on these maturational constraints and the innate tendency to rely on certain (simple) time ratios among internal attending oscillations. According to Jones' rhythmic dynamic model, music is not special because timing and rhythmic information are used in many different domains. Although the oscillations may vary across domains, with some varying in their potential for synchronizing with the external world and for synchronizing with other brain oscillations, speech and music processing both fall outside of these dynamics. Music and speech reflect different ways of exploiting and refining basic innate tendencies regarding rhythmic dynamics.

Music evokes emotion (Levitin et al 2008). A performer will experience emotion while playing, whereas a listener will experience emotions perceived to be inherent to the music. Musicians can elicit psychological mood changes, physiological changes, for example in heart rate and respiration. (Krmhansi et al. 2001). Music-induced

emotion has been shown to recruit the reward-motivational circuit, including the basal forebrain, insula, midbrain, orbito-frontal regions and amigdala (Blood, Zatorre et al.2001). Studies have found that cerebral blood flow changes while listening to music and that consonant chords activate the orbitofrontal area (part of the reward system) of the right hemisphere and also part of an area below the corpus callosum. In contrast, dissonant chords activate the right parahippocampal gyrus. Musical emotion occurs with immediacy (Peretz et al., 1998), through automatic appraisal, and with involuntary changes in physiological and behavioral responses. With limbic mediation, consistency and precociousness, musical emotions resemble other important classes of biological stimuli, such as facial emotions (Peretz, 2001). Children at the age of three show the ability to recognize happiness in music, and by the age of six they are able to identify sadness, fear and anger in music. They are even able to recognize mode and tempo. (Cunningham & Sterling, 1988; Dolgin & Adelson, 1990; Terwogt & van Grinsven, 1991). Studies of children suggest that early musical experience may facilitate development. In 2004 Antoine Shahin, Larry E. Roberts and Laurel J. Trainor of McMaster University in Ontario recorded brain responses to piano, violin and pure tones in four- and five-year-old children. Youngsters who had received greater exposure to music in their homes showed enhanced brain auditory activity, comparable to that of unexposed kids about three years older.

2.3 Developmental stages and constructivism

The work of Piaget, was one the crucial references to my work. In general, Piaget set the basis of child development and many extensions of it have been affected in the areas of science, mathematics, language, art and music. (e.g. Fletcher and Walker, 1970). His work focused on how the mind gradually comes to be capable of thought, language, and knowledge, i.e. on the cognitive structures. With his interest in language and logical thinking, he studied the development of these capabilities from birth to adolescence and made an enormous contribution to the field. Two aspects that I have applied in my work are his theory of stages and structuralism. Piaget established that the mind of a child is qualitatively different at various stages throughout development. Three-year-old children apply different modes of thinking

than 8 year olds. (Zimmerman, 1993). The differences are in the child´s cognitive structures in the different stages. He defined four stages in cognitive development. 1- Sensorimotor stage (Infancy). In this period (which has 6 stages), intelligence is demonstrated through motor activity without the use of symbols. Knowledge of the world is limited (but developing) because it is based on physical interactions and experiences. Children acquire object permanence at about 7 months of age (memory). Physical development (mobility) allows the child to begin developing new intellectual abilities. Some symbolic (language) abilities are developed at the end of this stage. 2- Pre-operational stage (Toddler and Early Childhood). In this period (which has two sub-stages), intelligence is demonstrated through the use of symbols; language use matures; and memory and imagination are developed. Yet thinking is done in a non-logical, non reversible manner with a predominance of egocentric thinking. 3- Concrete operational stage (Elementary and early adolescence). In this stage (characterized by 7 types of conservation: number, length, liquid, mass, weight, area, volume), intelligence is demonstrated through the logical and systematic manipulation of symbols related to concrete objects. 4- Formal operational stage (Adolescence and adulthood). In this stage, intelligence is demonstrated through the logical use of symbols related to abstract concepts. Early in the period, there is a return to egocentric thought. (Genetic Epistemology: J. Piaget, 2008).

I decided to focus on the years of middle childhood (Piaget's Concrete operational stage) because, in general, this stage has garnered less attention in music education research than the previous stages. This is likely due to the rapid development and voracious inquisitiveness, wonder and excitement that children show in early childhood, which then ends in a more sedate rate of learning. (Marilyn Zimmerman, 2002). Constructivism is another of Piaget´s theories that has played an important role in my AM. He believed that, in searching for the development of knowledge, although important, empiricism and innate factors did not sufficiently explain the issue, so he added another factor that he called equilibration or self-organization (Chapman 1988, 1991, Piaget 1970). The essential characteristics of constructivism include the assumption that knowledge is constructed by the active child through interactions with environment. For Piaget, our knowledge of reality is constructed from our ability to transform reality by interacting with it. Children

construct a model of the external world from their experience that fits with their experience. Once it is constructed, they assimilate their experience to this model. Assimilation is defined as the application of an established invariant pattern or schema to a present experience regardless of discrepancies (von Glasersfeld 1979.) According to Piaget, assimilation and accommodation are processes working together to compensate for temporary states of equilibrium in knowledge. Disequilibrium may develop into re-equilibration, which can turn into a better form of knowledge. In the AM, children not only listen to sounds and rhythm, but also listen to oral texts that are trying to make them think of (imagining) themselves in certain situations in which they may decide how to feel or perceive the imagined space. According to Piaget, operational thinking develops in this stage (mental actions that are reversible), and egocentric thought diminishes. He believed that reality was a dynamic system of continuous change. Specifically, he argued that reality involved transformations and states and proposed that operative intelligence was responsible for the representation and manipulation of the dynamic or transformational aspects of reality and that figurative intelligence was responsible for the representation of the static aspects of reality. (Piaget, 1973) So for Piaget operative intelligence was the active part of intelligence that involved actions undertaken in order to follow, recover, or anticipate the transformations. Figurative intelligence is the static aspect of intelligence that involves all means of representation used to keep the states that intervene between transformations in mind. That is, it involves perception, imitation, mental imagery, drawing and language. Therefore, the figurative aspects of intelligence derive their meaning from the operative aspects of intelligence, because states cannot exist independently of the transformations that interconnect them. Piaget believed that the figurative or the representational aspects of intelligence were subservient to their operative and dynamic aspects, and therefore, understanding essentially derived from the operative aspect of intelligence. Operative intelligence frames how the world is understood, and it changes if understanding is not successful.

2.4 Models of music interventions

Before starting the AM, I tried to gather some of the most significant

theories and methods developed around the effects of music on the brain, the learning of different skills, and on optimizing child development. Among the most prominent studies on the influence of music in language learning, we can find doctors, researchers and educators like Carl Orff, Alfred Tomatis, Don G. Campbell, Edward Willems, Rudolf Steiner, Zoltán Kodály, Justine Ward, Jaques Dalcroze and Maurice Martenot. Carl Orff made an important contribution to music and language: he thought that verbal and musical structure had the same origin and that language and folklore were the essential elements of musical socialization. He believed that the rhythmic and expressive value of spoken language, along with the musical language, were essential and claimed that the main purpose of music education was to stimulate creativity in children. (Conde et al. 2004, p. 29). Orff considers speech a form of music, as in the spoken word there are rhythmic patterns, dynamics and expression (Conde et al., 2004).

The French physician and educator, A. Tomatis, linked the processes of listening to language, and in doing so demonstrated that modifying the hearing abilities of a person obtained changes in behavior and language (Silva, 2007). He coined the term Mozart Effect, and used Mozart's music as the listening stimulus to attempt to cure a variety of disorders. The approach has been popularized by Don Campbell, and is based on an experiment published in Nature suggesting that listening to Mozart temporarily boosted scores on one portion of the IQ test. (Don Campbell, 1999). Some research has indicated that listening to Mozart's music may cause a short-term improvement on the performance of certain kinds of mental tasks known as "spatial-temporal reasoning **(**William Pryse-Phillips , 2003). The researcher Don G. Campbell (1997) reviewed the operation of hearing, and proposed that the ear incorporates information conveyed by sound and organizes language; thus information spoken rhythmically can be easily retained in memory.

Emile Jacques Dalcroze (1865-1950), was the first to introduce body movement in teaching music, and he became the promoter of a basic educational revolution. The Dalcroze Method involves teaching musical concepts through movement. It consists of three equally-important elements: eurythmics, solfège and improvisation. (Musical Therapy improvisation is the use of live music-making, usually by therapist and

client, as the focus of therapeutic work- Bruscia, 1987). Together, according to Dalcroze, they comprise the essential musicianship training of a complete musician.

Kodály (1882-1977) and Suzuki, (1898-1998) developed their own musical methods. Suzuki developed the term tonalization, or the student's ability to produce and recognize a beautiful, ringing tone quality on their instrument. The Kodály Method, also referred to as the Kodály Concept, is an approach to music education developed in Hungary during the mid-twentieth century by Zoltán Kodály. Kodály, along with his colleague Jeno Adám,embarked on a long term project to reform music teaching in the lower and middle schools. The first music primary school, in which music was taught daily, opened in 1950. The school was so successful that over one hundred music primary schools opened within the next decade (Eösze 1962). After about fifteen years approximately 50% of the schools in Hungary were music schools (Russell-Smith 1967:44). The Kodály Method uses a child-developmental approach to sequence, introducing skills in accordance with the capabilities of the child (Choksy 1999). Children are first introduced to musical concepts through experiences such as listening, singing, or movement (Wheeler 1985). It is only after the child becomes familiar with a concept that he or she learns how to notate it (Landis 1972). During the elementary school years (age 7–14), learning is artistic and imaginative, and is guided and stimulated by the creative authority of teachers. In these years, the approach emphasizes developing children's emotional life and artistic expression across a wide variety of performing and visual arts. During adolescence, to meet the developing capacity for abstract thought and conceptual judgment, the emphasis shifts to developing an intellectual understanding and ethical ideals such as social responsibility.

In Waldorf school, children normally enter elementary education when they are nearing or already seven years of age (Ernst-Michael Kranich, 1990), The elementary school centers around a multi-disciplinary arts-based curriculum that includes visual arts, drama, artistic movement (eurythmy), vocal and instrumental music, and crafts (Carlo Willmann) The gestures in the eurythmist's movement repertoire relate to the sounds and rhythms of speech, to the tones and rhythms of music and to soul experiences, such as joy and sorrow. Rudolf Steiner described eurythmy as an "art of

the soul". When performing eurythmy with music (also called *tone eurythmy*), the three major elements of music, melody, harmony and rhythm, are all expressed (Thomas William Nielsen, 2004) The melody primarily expressed its rise and fall; the specific pitches; and the present intervallic qualities. Harmony is chiefly expressed through movement between tension and release; it expresses dissonance and consonance between the more inwardly directed minor mood and the outwardly directed major mood. Rhythm is fundamentally characterized by livelier movements for quick notes and slower movements for longer notes. In addition, longer tones tend to move into the passive backspace, and quicker tones into the active frontspace. Pauses are expressed through larger or smaller movements in space; then new impulse is given to what follows. Beat puts greater emphasis on downbeats, or those beats upon which stress is normally placed. Beat is generally treated as a subsidiary element, but it plays a large role in eurythmics. Elements such as the major or minor key, the shape of the melody line, the interplay between voices or instruments and the relative dominance of one or another voice or instrument are usually expressed in a piece's choreography.

Some authors have developed different models of improvisation and creative music intervention. Dorothy Crocker (1957) developed a method for using improvisation projectively with emotionally disturbed children. “Creative Music Therapy” fosters self-expression through musical objectives. It is an improvisational model designed by Paul Nordoff and Clive Robbins; the original design was for handicapped children but it is able to be used with adults, as well. Juliette Alvin (1975, 1976, 1978) used "free improvisation" as part of a comprehensive approach to music intervention that employed various other musical activities as well. In her work with autistic children, Alvin (1978) planned therapy according to three developmental stages: relating self to objects, relating to self and therapist, and relating self to others. Analytical music therapy was originally conceived and developed in the early 1970's by Mary Priestley, Peter Wright, and Marjorie Wardle. (1975, 1980). It is defined as the use of words and symbolic music improvisations as a means of exploring the client's inner life and facilitating growth. It was originally developed by Anne Riordan as a method of teaching dance improvisation to handicapped persons, and was later adapted by the present author for music therapy (Bruscia, 1987).

Paraverbal therapy is a method of psychotherapy developed by Evelyn Heimlich (1965, 1972, 1980, 1983, 1985) that utilizes both nonverbal and verbal channels of communication, and employs various expressive media (viz., speech, language, music, mime, movement, psychodrama, painting, drawing) in unorthodox and nontraditional ways. The Improvisation Assessment Profiles (IAP) were developed by Bruscia (1987) to provide a comprehensive model of client assessment and evaluation. They can be used with children or adults at various developmental levels and with varying handicaps and diagnoses. Integrative Improvisation therapy was developed by Peter Simpkins (1983) as a result of his work with atypical children having various diagnoses, which he then adapted to psychiatric adults. Its main goal is to integrate various aspects of the client's world, including: the various senses, the body with the psyche, the ego with the id and superego, the unconscious with the conscious and the here-and-now, the nonverbal experience with the verbal, and the self with other. Musical psychodrama is an approach developed by Joseph J. Moreno (1980, 1984) and uses musical improvisation as a means of facilitating the group warm-up and enhancing the enactment of the psychodrama itself. Lisa Sokolov (1984) developed a model that uses breathing, toning, vocal improvisation, singing, body alignment, touch, verbal imagery, and psychotherapeutic techniques. Rolando Benenzon (1982) developed an approach that employs the isoprinciple in designing improvisations and other musical activities for the patient. In comparing the various models, two basic kinds of improvisatory sessions can be discerned: structured and free-flowing (Bruscia, 1987).

After analyzing the different developmental stages and learning about the strategies of different musical methods and intervention used for children and about the capacity of music to affect the whole neural structure, I decided to start configuring the AM:

2.5 A method to listen to

I decided to select an acoustic medium for the method, because I thought that since children in this age (7-12 years) have to understand, organize and integrate a lot of audio-visual information (computer, television, videogames, etc.) that it could

be interesting to focus and train the hearing process without the constant overlay of the visual external images. The brain establishes mental images through each of the senses it perceives the world and the mental images associated with acoustic signals are certainly of no less importance than those associated with visual, verbal, olfactory and tactile sensations. Damasio uses the term image to refer to a mental image as a synonym for mental pattern. He distinguishes between this mental pattern or "image" (as in feeling states) and the neural pattern or map of the processing of neural activities as studied in current neuroscience. Damasio's notion of mental images refers to unconscious and conscious images that are only accessible through first-person perspective. Consciousness is an entirely private, first-person phenomenon which occurs as part of the mind (Damasio,1999). Neurologists are able to access neural patterns and maps through advanced technologies so that most individuals will never see this image of their own neural architecture (Damasio, 1999). The brain is constantly constructing mental images or mental patterns with a structure composed of 'visual, auditory, olfactory, gustatory and somatosensory modalities'. So these images are in no way limited to visual pictures. For Damasio, the notion of the mind is a process of continual flow of mental images that becomes conscious and may be logically interrelated. He uses the notion of thought to describe this flow of mental images that moves forward in time concurrently, convergent or divergent (1999). Aldo Mosca (2000) exposes two interesting critics of some aspects of Damasio's theory of mental pattern build with sensory modality, acknowledging a gap between neurobiology and the "sensory qualities" of experience; even though Damasio is confident that scientific research will at some point be able to save this bridge: According to Mosca, (2000) Damasio claims that the brain forms neural maps (a) of an object, whether perceived or remembered and (b) of the organism (this collection of maps being the proto-self). Both (a) and (b) are called first-order maps. He also explains that the sensory-motor maps pertaining to the object (a) cause changes in the maps pertaining to the organism (b) because the maps pertaining to the organism register the organism's responses to the object, or more accurately to the map of it. So the changes in the organism-maps, and the object-maps as well, are in turn represented in, or by, second-order maps (c), which constitute the core self or core consciousness. Mosca summarizes then that according to Damasio, even though all maps are neural patterns, and all can become "mental images", he does

not tell us how this happens. Another critical point is that Damasio focuses his work on second-order consciousness, which brings him to say for example that "the experience of a particular stimulus, including color, depends not just on the formation of an image (a mental pattern), but also on the sense of self in the act of knowing" (p. 308). Mosca (2000) claims that Damasio does not sufficiently differentiate between perception and sensation in his theory, moreover, he thinks Damasio views them as the same thing.

The idea behind the AM was to try to create better personal references images or mental patterns or perceptions of feelings through the auditory processing system. The AM aims to create a relaxed state of mind and experience through sounds and oral texts. The idea is that, if practiced with certain routines, the brain will learn how to work in this brainwave at will. In 1999 Andrea R. Halpern of Bucknell University and Robert J. Zatorre of the Montreal Neurological Institute at McGill University conducted a study in which they scanned the brains of non-musicians who either listened to music or imagined hearing the same piece of music. Many of the same areas in the temporal lobes that were involved in listening to the melodies were also activated when those melodies were merely imagined. According to this study, just as some training increases the number of cells that respond to a sound, when it becomes important, prolonged learning produces more marked responses and physical changes in the brain.

Physiologically, the inner ear responds to sound-induced vibrations of less than a nanometer, can amplify signals by more than 100-fold, and has a wide dynamic range enabling humans to perceive frequencies from 20 Hz to 20 kHz. (Schwander et al. 2010) The hearing process is initiated when oscillations in air pressure are transformed into fluid pressure that travel down the cochlear duct and induce vibrations in the basilar membrane. The vibrations are passed to hair cells, leading to deflection of the hair bundles, the opening of mechanically gated ion channels and hair cell depolarization. Because of gradual changes in the features of the organ of Corti, such as the height of stereocilia and the width and thickness of the basilar membrane (Lim, 1980), hair cells at different positions along the cochlear duct are tuned to different frequencies: those at the base of the duct respond to highest high

frequencies, while those at the apex to the low frequencies (Liberman, 1982; Müller, 1991, 1996). Active feedback mechanisms must amplify basilar membrane motion because viscous damping in the cochlea would otherwise dissipate sound energy. The underlying process is called the cochlear amplifier and depends on OHCs (Outer Hair Cells) (Kiang et al., 1986; Dallos, 1992). When passive basilar membrane resonance is induced by a pure tone at its corresponding frequency position along the cochlear duct, OHCs are locally activated and enhance basilar membrane vibration (Rhode, 1971). IHCs (Inner Hair Cells) detect these vibrations and activate afferent neurons. The cochlear amplifier has a remarkable compressive nonlinearity; this ensures that soft sounds are amplified more strongly than loud sounds (Robles and Ruggero, 2001; Hudspeth, 2008).

2.6 Cyclical Rhythms and brainwaves

The auditory procession stream is known for being a hierarchical system in which several pathways emerge from the primary auditory cortex, projecting towards different targets (Rauscheker et al.2000). As previously mentioned, one of the most salient features of sound relevant for music is pitch. In addition to pitch or melody, music relies on rhythm. The concept is that the analysis of rhythm may depend to a large extent on interactions between the auditory and motor systems. (Jones, et al. 2002). In some studies, therapists have noted that many children and adolescents exhibit disordered impulsive beating, and are unable to sustain a steady beat or an organised rhythm due to poor impulse control (Nordoff & Robbins, 1977; Perilli, 1995). Timing is impaired in ADHD (Barkley, 1998; Barkley, Murphy, & Bush, 2001; Smith et al., 2002; Toplak et al., 2003) and there is a link between this impaired timing and impulsive behaviour (Smith et al., 2002; Toplak et al., 2003). Measuring beat reproduction accuracy is likely to lead to useful and efficient information concerning the child's behaviours. Therefore, rhythm and timing are very important aspects of the AM that were created with the intention of connecting the listener with their motor systems and with time patterns. The AM contents clear cyclical systems: acoustically, a cycle refers to one complete vibration, one cycle per second (Randel, 1986). Theoretically, an interval cycle is a collection of pitch classes created by a sequence of identical intervals (Alison Latham 2011). Cycles may be melodic (like the

one used in the first piece), harmonic (using different pentatonic scales with a cyclical basis in all pieces) and rhythmic (present in all pieces to establish a clear sense of time). This part has been inspired by the structure of Indian classical music and the tala, a structure repeated through the length of a raga, with special regard to the gamelan music of Indonesia, that uses nested gong cycles which determine the rhythmic framework of the piece. The *colotomic* structure, a term coined by Jaap Kunst, describes the rhythmic patterns of the gamelan. The gamelan, a musical ensemble from Indonesia, features a variety of instruments such as gongs, drums, flutes, strings etc. that I have used in the pieces as special and playful sounds to catch the children's attention. In the background of each piece, there is always a rhythm expressed by percussion instruments that is constant and cycling in an attempt to maintain a rhythmic pattern. According to Sterieade (1990), the coordinated, rhythmic activity of neuronal populations gives rise to oscillations in local field potentials (LFP) and electroencephalograms at a broad range of frequencies.

These oscillations potentially constitute clocking mechanisms against which to reference and coordinate the timing of neural firing. Synchronization of these rhythmic activities is likely to underlie functional interactions between neurons within a defined brain structure, or between disparate populations in distinct structures (Singer, 1990 and Varela et al. 2001). Mann et al. (1992) and Willis, Weiler (2005) both establish that an analysis of EEG in boys with an abnormal synchronization may impair functional interactions and contribute to complex cognitive disorders such as ADHD. The correlated firing of cortical neurons is involved in visual processing (Singer, Gray, 2004), attention (Steinmetz, 2000), and motor learning (Laubach et al. 2000). Theta rhythms are 4 to 12-Hz oscillations consistently associated with complex behaviors presumed to require mnemonic processing and/or decision-making, (Kahana, Sekuler, Caplan, Kirschen, Madsen, 1999). Dynamic, behavioral modulation of theta rhythms may therefore indicate or mediate cross-neuronal and/or cross-structural interactions during these behaviors. Neural oscillation is rhythmic or repetitive neural activity in the CNS. Neurons in the prefrontal cortex fire in unison and send signals to the visual cortex to do the same, generating high-frequency waves that oscillate between these distant brain regions. The waves, also

known as gamma oscillations, have long been associated with cognitive states such as attention, learning and consciousness (Robert Disemone, Doris and Don Berkey).

Electrical activity in the brain can be detected and mapped using sensitive medical equipment such as an EEG. It has been found that distinct brainwave patterns are produced during different mental activities and at different ages. Infants have been shown to spend a great deal of time in slow-wave sleep, and thus have more delta wave activity. In an analysis of the waking EEG of a newborn infant indicates that delta wave activity (0 to 4 hertz) is predominant in that age, and still appears in a waking EEG of five-year-olds. (Taylor, 2002) Delta wave activity during slow-wave sleep declines during adolescence, with a drop of around 25% reported between the ages of 11 and 14 years. Alpha waves are neural oscillations in the frequency range of 8–12 Hz arising from synchronous and coherent electrical activity of thalamic pacemaker cells in humans. They are present at different stages of the wake-sleep cycle: during the relaxed mental state; this alpha activity is centered in the occipital lobe. The wave begins to appear at around four months, and is initially a frequency of 4 waves per second. The mature alpha wave, at 10 waves per second, is firmly established by age 3. (Niedermeyer, 1997). The second occurrence of alpha wave activity is during REM sleep and is located in a frontal-central location in the brain. The third occurrence of alpha wave activity is the alpha-delta or slow-wave state. This activity spreads across the brain in an anterior-posterior gradient. (Pivik, 1995). Low amplitude beta waves with multiple and varying frequencies are often associated with active, busy, or anxious thinking and active concentration.[Over the motor cortex, beta waves (range of human brain activity between 12 and 30 Hz) are associated to muscle contractions that happen in isotonic movements and are suppressed prior to and during movement changes (Baker, 2007). Beta activity is increased when movement has to be resisted or voluntarily suppressed (Zhang, 2008). The artificial induction of increased beta waves over the motor cortex by a form of electrical stimulation called Transcarnial alternating-current stimulation consistent with its link to isotonic contraction produces a slowing of motor movements. (Pogosyna, Gaynor, Eusebio, Brown, 2009). Researchers such as V.S.Ramachandran have suggested that EEG oscillations in the mu wave range reflect mirror neuron activity. (Lindsay, Hubbarda, Mc Cleery, Altschulera, Ramachadran, Pineda, 2005) Recently, based on

the conflicting evidence presented by mu-wave suppression experiments, Patricia Churchland has cautioned that "studies indicate that mu-suppression turns out to be the same in both high-functioning ASD subjects and healthy controls, hence disconfirming the hypothesis that mu-suppression is an index of mirror neuron activity.

The question is that if external stimulus is applied to the brain, is it possible to 'entrain' or change the dominant brain frequency from one stage to another. Stemming from the point that different brainwave frequencies show synchronies related to different perceptual, motor or cognitive states and that brainwaves have also been shown to synchronize with external stimuli with repetition rates of ca. 10–40 Hz, Will and Berg (2007) compared responses to periodic stimulations, (drum sounds and clicks with repetition rates of 1–8 Hz) silence, and random noise. Reported inter-trial coherence measures taken at the Cz-electrode show a significant increase in brainwave synchronization following periodic stimulation. Specifically, a tonic synchronization response in the delta range with a maximum response at 2 Hz, a phasic response covering the theta range, and an augmented phase synchronization throughout the beta/gamma range (13–44 Hz) produced through increased activity in the lower gamma range and modulated by the stimulus periodicity. According to the study of Will and Berg (2007) periodic auditory stimulation produces a mixture of evoked and induced, rate-specific and rate-independent increases in stimulus related brainwave synchronization that are likely to affect various cognitive functions. The synchronization responses in the delta range may form part of the neurophysiological processes underlying time coupling between rhythmic sensory input and motor output; the tonic 2 Hz maximum corresponds to the optimal tempo identified in listening, tapping synchronization, and event-interval discrimination experiments. In addition, synchronization effects in the beta and gamma range may contribute to the reported influences of rhythmic entrainment on cognitive functions involved in learning and memory tasks.

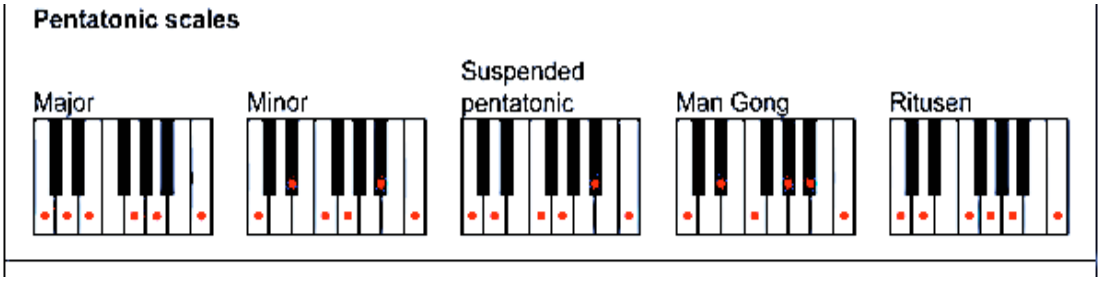
Studies (Monastra, 2002) (Fuchs et al. 2003) have shown that persons with ADHD, learning disabilities, and head injuries tend to have excess slow waves (usually delta, slow theta, and sometimes excess alpha). When excess slow wave activity is

present in the executive (frontal) part of the brain, it is difficult to control attention, behavior, and emotions. Such persons may have serious problems with concentration, memory, controlling impulses and moods, or with hyperactivity. They can't focus well and exhibit diminished intellectual efficiency. Several scientific studies, which I shall refer to in the next chapters, have revealed that relaxation techniques induce to functional and structural changes in the brain. These findings can have a double use: they confirm the use of relaxation to reduce stress and improve intellectual performance and prove long-life neuroplasticity or continued neural development. Most research is focused on melody, but rhythm (the relative lengths and spacing of notes), harmony (the relation of two or more simultaneous tones) and timbre (the characteristic difference in sound between two instruments playing the same tone) are also relevant. The rhythms in the AM are thought to continuously connect the children to their motor systems. Studies of rhythm have concluded that one hemisphere is more involved: The left temporal lobe seems to process briefer stimuli than the right temporal lobe and so would be more involved when the listener is trying to discern rhythm while hearing briefer musical sounds.

2.7 The tradition of pentatonic scales

I decided to use pentatonic scales in the AM because they have a strong tradition in musical education (Orff based and Waldorf methodologies) at the primary/elementary level, to improve creativity [1]through improvisation and because pentatonic scales are the most widely employed modes in Western, traditional India, Chinese and Arabic music over the last centuries. (Touma HH, 1996) (Mukherjee, 2004).

[1] Theories of creativity have focused on different aspects as: process, product, person and place (Kozbelt, 2010). A focus on *process* is displayed in cognitive approaches that try to describe thought mechanisms and techniques for creative thinking (such divergent and convergent thought - Guilford). A focus on creative *product* usually appears in attempts to measure creativity in people (psychometrics), or in creative ideas framed as successful memes (Gabora, 1997). A focus on the nature of a creative *person* considers more general intellectual habits, such as openness, levels of ideation, autonomy expertise, behavior. A focus on *place* considers the best circumstances in which creativity flourishes.



The figure above shows a series of pentatonic scales: The five pentatonic scales are modes of the same set of notes, the only difference being the starting note or tonic. The minor pentatonic scale, one of the most widely used five-note scales (Day-O'Connell J 2007). The Ritusen scale, a pentatonic mode used in traditional Chinese and Indian music (Mukherjee P (2004) (Broughton S, Ellingham M, Trillo R , 2000). The third and fourth pentatonic scales are the ascending forms of two ragas (Candrika todi and Asa-gaudi) used in classical Indian music, although we can often find similar melodies in Western music. The fifth pentatonic scale is identical to the Ritusen scale (known as the Durga raga in classical Indian music) except that the fifth scale degree (17:10 in this case) is ~34 cents sharp (i.e., higher in frequency) compared to the 5:3 major sixth in the Ritusen scale.

The AM presents a diversity of the pentatonic scales mentioned above with a focus on major mode. The intention was to give the children a feeling of confidence about listening to predictable pentatonic scales and simultaneously approaching them through the subtlety of these sounds to tonal languages or cultures, explained as follows. Although it is known that scales divide octaves into specific intervals and that the human ear can identify approximately 240 pitches over an octave in the mid-range of hearing (Zwicker, 1999), one would tend to think that theoretically one could chose among a big number of tone combinations to make music. The fact is that compositions (in Western culture and in others) tend to use mainly scales of five to seven notes (Patel, 2008). Some studies trying to analyze this fact (Kamraan Z. Gill, Dale Purves) show that the component intervals of the most widely used scales throughout history and across cultures are those with the greatest overall similarities to a harmonic series. According to them, there may be a preference for the biological significant spectral features that characterize conspecific vocalizations. A study done by Shui er Han et al. (2011) analyses the tonal differences and pitch intervals between

Eastern and Western music. Interestingly enough, they found a general tendency of melodic intervals in the music of tone and non-tone language cultures and distinguished between non-tone languages (English, French and German) and tonal languages (Chinese, Vietnamese, Thai) that use several tones to convey the lexical meaning of syllables. The study compares the melodic intervals in both groups with the size of prosodic intervals in speech. In tone language cultures, intervals smaller than a major second (200 cents) occur less often (15.8% vs. 36.2%; $t = -11.4$, $P<0.001$), whereas intervals equal to or larger than a major second occur more often (84.2% vs. 63.8%; $t = 11.4$, $P<0.001$). The only exception in this overall pattern is major thirds (400 cents), which are more frequent in the music of non-tone language cultures (7.7% vs. 2.3%). There are fewer melodic major thirds in the music of tone language cultures. The music of the tone language speaking cultures tends to use pentatonic scales, while the traditional music of non-tone language speaking cultures tends to use heptatonic scales. Scale preferences in one or the other culture appear to be based on the similarity of a set of tones to a harmonic series. (Gill, 2009) There is a preference for pentatonic major scales in the music of the tone language speaking cultures that indicates a coherence in music and speech.

In Waldorf education, pentatonic music is considered to be appropriate for young children due to its simplicity and unselfconscious openness of expression. Pentatonic music centered around intervals of the fifth is often sung and played in early childhood; progressively smaller intervals are emphasized within primarily pentatonic as children progress through the early school years. Orff believed it to be the native tonality of children. He believed that the use of the pentatonic scale at a young age was appropriate to the development of each child, since the nature of the scale meant that it was impossible for the child to make any real harmonic mistakes. Furthermore, the use of the scale gave the students confidence (instantaneous musical feedback) and contact song (reciprocal musical expression) (1998). The "Orff-Schulwerk" is a philosophy of music education that has been incorporated into music therapy by Gertrude Orff (1980), Carol Bitcon (1976), and Irmgard Lehrer-Carle (1971). A core concept in Orff's philosophy is "elemental music," which is defined as the universal tendency to create music out of the natural rhythms inherent in movement and speech. Elemental music develops in individuals in stages that

correspond to the evolution of music in the species. In Waldorf education (Rudolf Steiner 1861-1925), pentatonic music is considered to be appropriate for young children due to its simplicity and unselfconscious openness of expression. In their study "Tonal synchrony in mother–infant interaction based on harmonic and pentatonic series", (2010) Martine Van Puyvelde, Pol Vanfleteren, Gerrit Loots, Sara Deschuyffeleer, Bart Vinck, Wolfgang Jacquet, Werner Verhelst, report about the occurrence of 'tonal synchrony' as a new dimension of early mother–infant interaction synchrony. The findings are based on a tonal and temporal analysis of vocal interactions between 15 mothers and their 3-month-old infants during 5 min of free-play in a laboratory setting. In total, 558 vocal exchanges were identified and analyzed, of which 84% reflected harmonic or pentatonic series. Another 10% of the exchanges contained absolute and/or relative pitch and/or interval imitations. The total durations of dyads being in tonal synchrony were normally distributed (M = 3.71, SD = 2.44). Vocalizations based on harmonic series appeared organized around the major triad, containing significantly more simple frequency ratios (octave, fifth and third) than complex ones (non-major triad tones).

2.8 Effect of relaxation and meditation in the brain

The underlying changes in biological processes associated with reported changes in mental and physical health in response to meditation or relaxation intervention continue to be explored. The AM tries to create a certain stage of relaxing, and relies on the results achieved in different studies in form of brain alterations through mindful meditation, relaxation techniques, etc. As a reference I am going to mention two related studies with interesting findings: a controlled study (Sushilkumar S. Khemka, Negendra H. Rama Rao and Raghuram Nagarathn) that compared immediate effects of two relaxation techniques on state anxiety and sustained attention in healthy subjects. 86 volunteers (56 men and 30 women) divided into two groups: the first 43 volunteers (age range 18 to 64) practiced 20 minutes of yoga-based Deep Relaxation Technique (DRT), the second group of 43 volunteers (same age range), practiced 20 minutes Supine Rest (SR). State anxiety was assessed using the State Trait Anxiety Inventory (STAI A-State), and sustained attention was assessed using the Six Letter Cancellation (SLC) and Digit Letter

Substitution (DLS) tests. All tests were administered immediately before, and immediately after, practice. A significant reduction in State Anxiety score ($P<0.001$) and a size effect of 0,50 of standard deviation was observed for the group practicing DRT, but not for the group practicing SR. For the sustained attention tests, however, there were significant increases in scores by both DRT and SR groups ($P<0.001$) and an effect size of 0.86 and 0.40 in SLC and 0.58 and 0.56 in DLS. The results suggest that both interventions improve attention, but that only DRT reduces State Anxiety.

Another reference study is the one made by R Rangan, H R Nagendra, and Ramachandra Bhatt (Effect of yogic education system and modern education system on sustained attention). Forty-nine boys (11-13 years) were selected from two residential schools, one MES (conventional education program) and the other GES (educational program based on integrated yoga modules), providing similar ambiance and daily routines. The boys were matched for age and socioeconomic status. Sustained attention was assessed using the SLCT at the start and end of an academic year. Within groups, the pre-post test differences were significant for both groups. However, the between groups result showed improvement in the GES group compared to the MES group at a $P < 0.001$ significance level. The GES group displayed a size effect of 1.58 of standard deviation in sustained attention.

3. THREE HYPOTHESIS, METHODS AND MATERIALS

3.1 Three hypotheses were posed in this dissertation:

1) The Audio Method is capable of improving sustained attention in the tested group of children seven to twelve with ADHD. Using these children as convenient sample, the first null hypothesis of this thesis would be:

There will be no statistically significant difference at p<=.05 between the impact of the AM on the level of sustained attention displayed by children with Attention Deficit Hyperactivity Disorder (ADHD) as measured by

a. sustained attention scores at the WISC IV- scale (Coding test).

2) There should be a dose response effect in sustained attention in the tested group of children seven to twelve with ADHD. The null hypothesis would be:

There will be no statistically significant difference at p<=.05 between the impact of the AM on the dose response in sustained attention displayed by children with Attention Deficit Hyperactivity Disorder (ADHD) as measured by

a. sustained attention scores at the WISC IV- scale (Coding test).

3) The Audio Method is capable of lowering anxiety levels in the tested group of children seven to twelve years with ADHD. The null hypothesis would be:

There will be no statistically significant difference at p<=.05 between the impact of the AM on anxiety displayed by children with Attention Deficit Hyperactivity Disorder (ADHD) as measured by

a. STAIC (for children 9 to 12 years)

b. CAS (for children 7 to 8 years).

3.2 The effect size

Very often, in order to measure the effect of a treatment in a population, the Student t-test was used to test if the means of the tested groups of a clinical trial were equal before and after a treatment, (null hypothesis). Nevertheless it seems that this procedure is very controversial and has been heavily criticized by many

authors over the years (Derrick, 1976; Carver, 1978). *Educational and Psychological Measurement,* volume 60, number 5, 2000 contains a series of articles about statistical significance and the treatments used nowadays; in spite of their clear importance to determine the credibility of the results, (Onwuegbuzie and Levin, 2003), they even consider the suppression or rethinking of the tests of statistical significance in psychological and educational practice (Sullivan, 2000; Gliner, Leech y Morgan, 2002). One of the main critics maintains that it is possible to have an identical difference between two media that correspond to completely different t- values, because these values are affected by typical deviations and number of subjects. "The potential problem in instances of very large samples is the simple fact that statistical significance is in large part a function of sample size" (Smart, 2005). Another criticism is that t- values indicate if the difference is probable or not probable but fails to say anything about the magnitude of the difference. There´s also the possibility that it could create confusion between a statistic relevant difference and a relevant difference. A statistic significant difference can be small and irrelevant in practical terms, nevertheless, it can be relevant to explain and confirm some theories. Another controversial point is that the difference between two media in absolute terms is not easy to interpret because it will depend on the testing scale. (Kirk, 1996, Rosnow y Rosenthal: *surely God loves the.06 nearly as much as the .05* (Rosnow y Rosenthal, 1989, p. 177)

In order to minimize these problems and to be able to interpret the results in an easy and practical way, I decided to use the size effect for this clinical trial. Cohen encouraged authors to supplement their statistical tests with "simple, flexible, and graphical techniques" aimed at "understanding the set of data in hand" (Cohen, 1994, p. 1001). He recommended the use of the effect size to describe the *practical significance* of a statistical test result, independent of the sample size and the measurement scale (Vaske, Gliner & Morgan, 2002). The effect size is the standardized effect observed. By standardizing the effect, the effect size becomes dimensionless. The effect size then becomes a generic term for the estimate of effect for a study. A dimensionless measure of effect that is typically used for continuous data when different scales are used to measure an outcome; it is usually defined as the difference in means between the intervention and control groups

divided by the standard deviation of the control or both groups, as below, but there are other ways to calculate effect size in other circumstances.

Effect size = (mean of experimental group - mean of control group)/standard deviation.

In 1996, Kirk identified nearly 40 different types of measures of "effect magnitudes." He grouped these into three general categories that include measures of relational strength, practical mean differences, and an 'other' category of effect size measures appropriate for more complex statistical tests. An effect size of 0.0 indicates that the mean of the treatment group is at the 50th percentile of the control group, and that the two distributions overlap each other completely. An effect size of 0.5 indicates that the mean of the treatment group is at the 69th percentile of the control group and that the non-overlap is 33%. Generally, the larger the effect size, the greater the impact of an intervention. Jacob Cohen has written the most copiously on this topic. In his book (Statistical power analysis for the behavioral sciences, Cohen J. 1988) he suggested, that a correlation of 0.5 is large, 0.3 is moderate, and 0.1 is small (Cohen, 1988). In keeping with this idea, the usual interpretation of effect size is that anything greater than 0.5 is large, 0.5-0.3 is moderate, 0.3-0.1 is small, and anything smaller than 0.1 is trivial.

Thus when I began with the clinical trial, I used the following formula to calculate the possible size effect of the musical intervention, as I thought it the most appropriate:

Sample of 156
N = 156 2/sqrt(156) = 2/12,489 = 0,1601
0,16 x 1,4 = 0,224
EES (expected effect size)/ sqrt 1 + (EES)^2 = expected correlation
X/sqrt 1 + x^2 = 0,224
X^2/(1+x^2) = 0,224 ^2
X^2 = (0,224)^2 (1+x^2)
X = 0,245

I calculated that with a sample size of 156 and the musical intervention having an effect size of 0.245 standard deviations, the study would have 80% power with 0.5 correlation significance (an 80% chance of getting a result significant at 0.05). The projection was based on the results of a study by Sushilkumar et al. (2009) that compared immediate effects of two relaxation techniques on state anxiety and sustained attention in healthy subjects.

3. 3 Description of the Sustained Attention and Anxiety Tests

In searching for the most common tests for sustained attention and anxiety, it was easy to find anxiety tests that were recognized and accepted by most of the experts, the STAIC and the CAS. However, it took me a while to find adequate tests to measure sustained attention that could be easily implemented in a large group at school without causing further consequences among children and parents. After considering some readings like CCPT (Shalev L, Ben-Simon A, Mevorach C, Cohen Y, Tsal Y.) or the study by Oades (2000) on Differential measures of 'sustained attention' in children with attention-deficit/hyperactivity or tic disorders; SART by Daniel Smilek, Jonathan Carriere, Cheyne, the study by Hagen, Flehmig, Steinborn, Langner, Scholz, Wasthoff on the variability in sustained attention or the TEA by Ian H. Robertson, Tony Ward, Valerie Ridgeway, Ian Nimmo-Smith, 1994) and being conscious of the difficulty of finding one valid attention test, I decided to consult the teams of experts at the school in which I was going to undertake the clinical trial.

The team consisted of three psychologists, a neurologist and a psychiatrist led by neuropsychologist Isabel Juárez. They proposed using the Coding WiSC Subtest to measure sustained attention because this is one of the tests (beside the rest of diagnostic tests) they usually and periodically use with their children. They have a record of the evolution of each of the children in the WISC test, commencing when they enter and continuing until they exit the school. Let me first define sustained attention as "the ability to direct and focus cognitive activity on specific stimuli." If it is necessary to complete any cognitively planned activity, any sequenced action, or any thought, one must use sustained attention. DeGangi and Porges (1990) indicate there are 3 stages to sustained attention, which include: attention getting, attention

holding, and attention releasing. Sustained attention is an important and basic requirement for information processing and cognitive development. When a person has difficulty sustaining attention, often presents with an accompanying inability to adapt to environmental demands or modify behavior. (DeGangi, Georgia and Porges, Stephen 1990, Neuroscience Foundations of Human Performance. Rockville, MD: American Occupational Therapy Association Inc.). Now I am going to describe the tests I used to measure both sustained attention and anxiety.

3.3.1 The Tests

The **STAIC** (Spielberger et al, State-Trait Anxiety Inventory Test) and **CAS** (Child Anxiety Scale, Gillis) were used in order to establish levels of anxiety in the experimental groups; and **WISC-IV** (subtest Coding) was used in order to establish the effect of the Method in specific sustained attention.

Sustained attention with WISC IV - The Wechsler Intelligence Scale for Children, abbreviated as the WISC-IV, (Edith Kaplan, Deborah Fein, Joel Kramer, Dean Delis, Robin Morris) is an intelligence test administered to children between six and sixteen years eleven 11 months old. The WISC-IV generates an IQ score that represents a child's general cognitive ability. For this clinical trial, I used the Spanish version (Copyright 2005 by Tea Ediciones SA. Translated and adapted with the permission of the original owner, Harcourt Asssessment Inc., Edited by Tea Ediciones SA., Madrid, Spain). The WISC IV derives from former revisions since its first publication in 1949. The WISC-III was printed in 1991, and the latest version, WISC-IV, was released in 2003. The WISC-IV is used by the school to establish an IQ score or part of the evaluation to determine a child´s possible difficulties.

The WISC-IV adds five new tests to the former version. The new scale has increased to a total of 15 tests, 10 of which are compulsory and 5 optional. The optional tests provide additional information on a subject´s cognitive and intellectual functioning and can be used to replace one of the main tests. In this version, different data are grouped into four specific and one general: 1 - Verbal Comprehension (VC) 2 - Perceptual Reasoning (PR) 3 - Working memory (MT) 4 - Speed Processing (VP) 5 - Total IQ (CIT). According to the authors, the scale´s expansion sought (Wechsler Intelligence Scale for Children® — Fourth Edition, David

Wechsler) a detailed analysis of the different processes involved in intellectual performance and relationships with different clinical conditions and learning.

The results of the WISC-IV are analyzed at several levels. Both before and after evaluation, it is necessary to move the different results of each subtest to the first page (page summary). Raw scores are converted to scalar (or typical) as the conversion set forth in the test manual and perform the appropriate sums. From this total, the scores obtained on each scale are transformed back (as scales manual) into a composite score. There are 5 core values of the test (CV, PR, MT, VP and CIT.). With these final values (composite scores), we obtain the percentile for each scale, as well as the confidence interval.

Here is a quick description of the tests (Wechsler, 2005) of WISC IV:

Block Design measures an individual's ability to analyze and synthesize an abstract design and reproduce that design from colored plastic blocks. Spatial visualization and analysis, simultaneous processing, visual-motor coordination, dexterity, and nonverbal concept formation are involved. **Similarities** measures logical thinking, verbal concept formation and verbal abstract reasoning. Two similar but different objects or concepts are presented, and the student is asked to tell how they are alike or different. Similarities is an untimed core Verbal Comprehension subtest. **Digit Span** measures short-term auditory memory and attention. The digits have no logical relationship to each other and are presented in random order by the examiner. Digit Span is an untimed core Working Memory subtest. **Picture Concepts** measures categorical and abstract reasoning and is an untimed core Perceptual Reasoning Subtest.

Coding measures visual-motor dexterity, associative nonverbal learning, nonverbal short-term memory, and is a timed core Processing Speed subtest. Fine-motor dexterity, speed, accuracy and ability to manipulate a pencil contribute to task success, as does perceptual organization, visual attention, and the capacity for sustained attention or to persevere in the task. **Vocabulary** measures the students' verbal fluency and concept formation, word knowledge, and word usage. It is an untimed core Verbal subtest. **Letter-Number Sequencing** measures attention span, short-term auditory recall, processing speed and sequencing abilities. Letter-Number Sequencing is an untimed core Working Memory subtest. **Matrix Reasoning** measures visual processing and abstract, spatial perception and may be influenced

by concentration, attention, and persistence. Matrix Reasoning is an untimed core Perceptual Reasoning subtest. **Comprehension** measures common-sense social knowledge, practical judgment in social situations, and level of social maturation, along with the extent of development of moral conscience. **Symbol Search** requires the student to determine whether a target symbol appears among the symbols shown in a search group. Perception and recognition are the two prime requirements for success, yet accuracy, attention, concentration and speed also play a role. Memory is not a primary requirement. **Picture Completion** measures a student's ability to recognize familiar items and to identify missing parts. Picture Completion is a timed supplemental Perceptual Reasoning subtest. **Animal Cancellation** measures visual vigilance/neglect, selective attention, and speed in processing visual information in accordance with previous attempts along the same line. This is a timed supplemental Processing Speed subtest. **Information** measures general cultural knowledge, long-term memory, and acquired facts. **Arithmetic** measures reasoning, numerical accuracy, and mental arithmetic ability. It is a supplemental Working Memory subtest. **Word Reasoning** measures verbal abstract reasoning and requires both analogical and categorical thinking, and verbal concept formation and expression. It is a supplemental Verbal Comprehension subtest.

The total IQ index sums the final results of all tests and is a global measure of IQ scores of the subject being tested. The scores on the WISC-IV have been included in the *Technical Manual interpretation* annexed to the test in several panels. Its purpose is to provide information about the specificity of the tests and their clinical utility and diagnostic evaluation. The panels have included cases of autism, Asperger Syndrome, expressive language disorder, high ability, mental retardation by moderate or mild hyperactivity and attention deficit with learning disabilities, traumatic brain injury and motor impairment. Its aim was to detect the strengths and weaknesses in each disorder. Concerning the chapter on ADHD, the authors distinguish between the pure group (only ADHD) with another group (ADHD + Learning Problems). Thus higher scores in the group without learning problems are given in Picture Concepts, Picture Completion, and Word Reasoning in this order with an average in the group studied of approximately Pe = 10.5 and 10. (Pe = scalar score is the result of half of the same.) Meanwhile, tests with lower scores are given in Animal Cancellation, Coding and Arithmetic with an average of Pe = 9.1 the

first and Pe = 9.7. For the group with learning disabilities and ADHD, the differences increased considerably. The best results were obtained in Picture Completion (Pe = 10.3), Block Design (Pe = 9.5) and Word Reasoning (Pe = 9.4). At its opposite: Arithmetic (Pe = 7.7), Letter-Number Sequencing (Pe = 7.7), Coding (Pe = 7.5). In short, according to this data, it can be expected that ADHD cases show strengths in areas of verbal and perceptual reasoning (since their attention problems are not so large as to interfere with the completion of the test). For its part, the weaknesses in arithmetic, Animal Cancellation and Coding can be related to the emphasis these tests place on attention, concentration and speed, all critical issues in this group.

The subtest Coding used in this clinical trial is part of the processing speed index (coding and symbol research) and consists of children under 8 years old marking rows of shapes with different lines according to a code; children over 8 transcribe a digit-symbol code. The task requires visual organization, perception and scanning and the efficient production of multiple motor responses. It also requires executive control of attention and sustained effort for a two-minute period of time while working with visual material as quickly as possible. Performance on coding is also dependent on paired-associative learning. Visual attention is involved, the capacity for sustained attention or to persevere in the task. Errors can provide clues about different degrees of impulsivity or ADHD. The WISC-IV includes a Coding version for children from 6 to 7 and another one for children 8 to 16 years old. Both versions were applied in this trial, each one corresponding to the age of the children. The tests were handed out in each class; the teacher carefully explained the instructions. After testing that all children had understood the instructions perfectly, the teacher gave the start order and measured the time with a stopwatch. As soon as the two minutes passed, the tests were collected. The total recount, the direct score, is the number of hits or correct symbols written in 120 seconds. The score of each of the tests is checked on the table of the scalar scores divided by ages. The scalar scores go from 1 to 19.

Fig. Example of a table of scalar scores divided by ages corresponding to the direct scores of the tests. Table for age range 10.8 to 10.11 years.

Tabla A.1. Puntuaciones escalares

Edad 10:8-10:11

Puntuación escalar	CC	S	D	Co	CI	V	LN	M	C	BS
1	-	0-1	0-5	0-4	0-14	0-8	0-4	0-2	0-4	0
2	0-12	2-3	6-7	5	15-17	9-11	5-6	3-4	5	1-3
3	13-14	4-7	8	6-7	18-25	12-15	7	5-6	6-7	4-8
4	15-17	8-9	9	8	26-28	16-20	8-9	7-9	8-11	9-11
5	18	10-11	10	9-10	29-30	21-23	10-12	10-12	12-13	12-13
6	19-22	12-13	11	11-12	31-34	24-25	13	13	14-15	14-15
7	23-25	14	12	13-14	35-37	26-28	14	14-15	16	16-18
8	26-29	15-16	13	15	38-41	29-31	15	16-18	17-18	19
9	30-32	17-18	14	16	42-44	32-35	16	19-20	19-20	20-22
10	33-37	19-20	15	17	45-47	36	17	21	21	23-24
11	38-39	21	16	18	48-50	37-39	18	22	22-23	25-26
12	40-42	22-25	-	19	51-53	40-43	-	23-24	24-25	27-28
13	43-46	26	17	20	54-58	44	19	25	26	29
14	47-49	27	18	-	59	45-46	20	26	27-28	30
15	50	28-31	19-21	21	60-66	47-48	21	27-28	29-30	31
16	51-55	32-33	22	22	67-68	49	-	29	31-32	32-34
17	56-57	34	23	23	69-76	50-51	22	30	33	35-36
18	58	35	24	24	77-79	52	23	-	34	37
19	59-68	36-44	25-32	25-28	80-119	53-68	24-30	31-35	35-42	38-60

In order to measure anxiety levels, I used STAIC and CAS. Anxiety is often considered a umbrella that covers several different forms of abnormal and pathological fear and anxiety, and came under the aegis of psychiatry at the very end of the 19th century. Gelder, Mayou & Geddes (2005) explain that anxiety disorders are classified in two groups: continuous symptoms and episodic symptoms. The term anxiety covers four aspects of experiences an individual may have: mental apprehension, physical tension, physical symptoms and dissociative anxiety (symptoms associated with hyperventilation). Anxiety disorder is divided into generalized anxiety, phobic, and panic disorders; each has its own characteristics and symptoms, and each requires different treatment (Gelder et al 2005). The emotions present in anxiety disorders range from simple nervousness to bouts of terror (Barker 2003).

There was an clear consensus among the school team to use these tests for the trial: **STAIC** (Spielberger et al, State-Trait Anxiety Inventory Test) and **CAS** (Child Anxiety Scale, Gillis, Institute for Personality and Ability Testing, Champaign, Illinois, USA) in order to establish the levels of anxiety in the experimental groups.

CAS, forth edition (Cuestionario de Ansiedad Infantil, adapted into Spanish version by Domingo E. Gómez; Departamento de Psicología Clínica y Psicobiología, Univesidad de Santiago and María Teresa Pulido, Consellería de Educación. Xunta de

Galicia. Santiago, Spain) from Child Anxiety Scale, by John S. Gillis, Institute for Personality and Ability Testing. Champaign, Ilinois, USA, 1980; edited by Tea Ediciones, SA: with the permission of the original owner IPAT, Institute for Personality and Ability Testing (Illinois, USA) was used in this clinical trial in order to establish the level of anxiety Child Anxiety Scale, children 7 to 8/9 years. (Gillis, John S. Purpose: Designed to detect "anxiety-based disturbances in young children." Acronym: CAS).

The CAS consists of 20 brief items that can be administered individually or in groups. Questions are presented by a standardized audio recording with children indicating their responses by marking an “X” on either a square or a circle. To assist children in marking their answers in the appropriate place, each pair of circles is accompanied by a small drawing designed to be highly interesting to young children, such as a birthday cake or a lion. Immediate test-retest reliability coefficients of the CAS have been found to range between .82 and .92 for grades one through three. Internal consistency estimates and concept validity measures suggest that the CAS has psychometrically acceptable characteristics in a variety of cultural settings (Argulewicz, Abel & Schuster 1985; Gillis, 1980). The test was applied following the instructions in the manual. Initially, the test and the way in which it could be solved were explained to the children. Before starting, it took us a while to clear up some questions in every class. Most of the questions showed doubt and concern about if they were being evaluated for some reason. Then the test started with a group of 2 or 3 children. The groups were small because the children’s age was 7. The CAS test distributes some questions that indicate anxiety throughout the test in no specific order. The children have to choose their answers between a circle and a square. The test´s correction requires a lot of care, as one must ensure that the students have understood all the questions posed. Once the test is finished, the correction is done with a transparent template on the test. The score is determined by the number of correlations of the template with the results marked by the children. The obtained score is analysed by a crossed criterion, made up of gender (M+F), year (year 1: 6 years; Year 2: 7 years, Year 3: 8 years). Each group has a specific scale. In the base of each table we can find the statistical (media) arithmetical media and (Dt) standard deviation. The scale is shown in its original version.

Fig. Scale adapted to Spanish version of CAS.

PD	GRUPO TOTAL		POR SEXOS				POR CURSOS					
			Niños		Niñas		1.º EGB (1.º Primaria)		2.º EGB (2.º Primaria)		3.º EGB (3.º Primaria)	
	Dec.	Cent.	Dec.	Cent.	Dec.	Cent.	Dec.	Cent.	Dec.	Cent.	Dec.	Cent.
1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	2	1	2	1	1	1	1	1	2	1	1
3	1	4	1	4	1	5	1	4	1	6	1	2
4	2	10	1	9	2	10	2	11	2	11	2	11
5	3	17	2	17	2	18	3	21	2	19	2	13
6	4	27	3	27	4	31	4	31	3	31	2	19
7	4	38	4	38	4	39	5	44	4	42	3	30
8	5	51	5	51	5	52	5	60	5	53	4	42
9	6	64	5	64	5	65	6	74	5	66	5	53
10	6	76	6	76	6	75	7	83	6	78	6	66
11	7	84	7	84	7	89	7	89	7	85	7	78
12	8	91	8	84	8	91	8	95	8	90	8	87
13	8	95	9	91	9	96	9	97	8	94	8	93
14	9	98	9	94	9	97	10	99	9	97	9	98
15	10	99	9	98	10	99	10	99	9	98	10	99
16	10	99	10	99	10	99	10	99	10	99	10	99
17	10	99	10	99	10	99	10	99	10	99	10	99
18	10	99	10	99	10	99	10	99	10	99	10	99
19	10	99	10	99	10	99	10	99	10	99	10	99
20	10	99	10	99	10	99	10	99	10	99	10	99
N	1.754		1.032		722		542		621		591	
Media	8,38		8,34		8,42		7,86		8,21		9,05	
Dt	2,96		2,97		2,96		2,69		3,20		2,90	

.

The STAIC was used for the children 9 to 12 years in the clinical trial (STAIC, State-Trait Anxiety Inventory for Children, CD Spielberger; in the Spanish version redacted by Nicolás Seisdedos Cubero, copyright 1990, 1998, 2001, 2009 by TEA Ediciones SA, Madrid, Spain).

While it is an instrument designed to measure anxiety and to be used with upper elementary or junior high school aged children, it can be used with younger children as well when administered verbally. It consists of two twenty-item scales. Individuals respond to each item on a three-point rating scale, checking one of three alternatives that describes him or her best or indicates frequency of occurrence. Children generally require eight to twelve minutes to complete each scale, and less than twenty minutes to complete both. The test measures State Anxiety and Trait Anxiety.

STAIC State Anxiety - Here the test evaluates how respondents felt at a particular time in the recent past and how they anticipate they will feel either in a specific situation that is likely to be encountered in the future or in a variety of hypothetical situations. Scores can be used to determine actual levels of S-Anxiety

intensity, as an index of drive level, or as an indicator of changes in transitory anxiety experienced by children in counseling, psychotherapy, and behavior-modification programs. It also assesses the level induced by stressful experimental procedures and by unavoidable real-life stressors such as school integration, examinations, dental treatment or imminent surgery. The S-Anxiety scale consists of twenty statements that describe how respondents feel « right now, at this very moment ».

1. I feel very relaxed relaxed not relaxed
2. I feel very upset upset not upset

Each answer has a different score value: it goes from 1 to 3.

STAIC Trait Anxiety: Here the test is proven useful for identifying children with high levels of neurotic anxiety and for selecting subjects for psychological experiments who differ in motivation or drive level. It also serves for evaluating the immediate and long-term effectiveness of clinical treatment procedures designed to reduce neurotic anxiety in children. The T-Anxiety scale consists of twenty statements that describe how respondents « usually feel ».

1. I worry too much hardly ever sometimes often
2. I notice my heart beats fast
   hardly ever sometimes often

Each answer has a different score value. It goes from 1 to 3.

The test has been validated with 737 male and 814 female school children age 9 to 11 years. Based on the same theory as the STAI, the State-Trait Anxiety Inventory for Children (STAIC) distinguishes between a general proneness to anxious behavior rooted in the personality and anxiety as a fleeting emotional state. It was applied according to the instructions in the manual. Initially, the test, its intention and its procedure was explained to the children. Then it took us some time to answer specific doubts concerning the test. Then the test commenced, taking special care that the questions were completely understood. The tested groups were children aged 9 to 12, from Year 3 to Year 6. 3 to 5 children were in each group. The questions were read aloud and each child had to mark the answer on the evaluation

sheet. In every group, some questions needed to be cleared up because the children did not exactly understand their meaning. Once the test was finished, the direct score was calculated. Considering that the application field is usually schools, two derived scales were applied to obtained the scores: the percentile ordinary scale (1 to 99) and the typical "S" with a media of 50 and a standard deviation of 20 (which in a normal distribution also extends from 1 to 99) and can be easily translated into other common scales. In the following table the scales corresponding to gender are included; in the bases we find the basic statistics of the normal groups. N (cases); M (arithmetic media) and Dt (standard deviation). With the direct scores (PD) of the anxiety test, it is possible to check the percentile score or S score that corresponds to the direct value obtained in the test on the corresponding gender table.

Fig. Conversion table of STAIC scores.

Tabla 7. Conversión de puntuaciones

PUNTUACIONES DIRECTAS								
Cursos 4º a 6º Primaria (4º a 6º EGB)				Cursos 1º ESO a 1º Bachill. (7º EGB a 3º BUP)				
Varones		Mujeres		Varones		Mujeres		Punt. S
A-E	A-R	A-E	A-R	A-E	A-R	A-E	A-R	
50-60	50-60	49-60	51-60	48-60	49-60	49-60	53-60	97
47-49	49	46-48	50	47	48	47-48	52	91
46	48	44-45	48-49	44-46	47	46	51	87
--	47	42-43	47	43	46	45	50	85
45	46	40-41	46	42	45	44	49	83
37-44	43-45	35-39	44-45	38-41	43-44	40-43	46-48	76
35-36	42	34	42-43	36-37	42	38-39	44-45	71
34	40-41	33	41	35	41	37	43	67
33	38-39	32	39-40	34	40	35-36	42	63
32	37	31	38	--	39	34	41	60
--	36	30	37	33	38	33	40	58
31	35	--	36	32	37	32	39	55
--	34	--	35	--	36	--	38	52
30	33	29	34	31	35	31	37	50
29	--	28	33	30	34	30	36	48
--	32	27	32	--	33	--	35	45
28	31	--	31	--	32	--	34	42
27	30	26	--	29	31	29	33	40
26	29	--	30	28	30	28	32	37
25	28	25	29	27	29	27	31	33
24	27	24	28	26	28	26	30	29
22-23	26	23	26-27	24-25	26-27	25	28-29	24
21	25	22	25	23	25	24	27	17
--	24	21	--	22	24	23	--	15
--	--	--	24	--	--	22	26	12
20	23	--	23	21	23	21	25	9
--	20-22	20	20-22	20	20-22	20	20-24	3
191	193	427	452	258	263	580	599	N

3.4 The Dionisia Plaza School

3.4.1 The founder

Dionisia Plaza School is a private institution that contributes and has a legal

agreement with the public school system of the Ministry of Health and Education. The school was named in honor of its founder, Dionisia Plaza, who was a pioneer of the equal treatment and inclusion of children with special needs, and who founded the Residencia Escuela Infantil de Psicopedagogía y Rehabilitación in 1954. Dionisia Plaza School was founded as an institution dedicated to the prevention of childhood deficiencies through a medical and psycho pedagological treatment of those disorders that interfere in childhood development, and to foster the mental, social and workplace integration of the child. When it was founded, Spain was experiencing the social, cultural and economic hardship of the post-war era, one marked by isolation and in which the development of public education lagged until the 1970s to modernize.

After nineteen years of exclusively private funding coming, Dionisia Plaza School was integrated within the state system for the medical and psycho-pedagological treatment of children with special needs, through an agreement with the National Forecasting Institute (INP) (which is today the National Institute of Health or INSALUD). In 1980, the school was designated as *hospitilaria*, within the administrative nomenclature Group II, Level II, and in 1981, this designation was made permanent. In 1996, the Ministry of Education granted three sections of preschool (or kindergarten) education and thirteen units of primary education of the normal regime, but of a private character. In 2006, the General Direction of Quality, Accredidation, Evaluation and Inspection of the Health Ministry granted the school the authorization to function as a hospital by day for the following care: pediatrics, ophthalmology, otolaryngology, neurology, psychiatry, rehabilitation, occupational therapy, psychology, speech therapy, nursing and radiology. That same year, another agreement was signed with the Health Service of Madrid to administer counseling for medical rehabilition for children from three to fourteen years old. Currently, a multidisciplinary team of 85 professionals work at the center and attend 300 children. At one point the school provided board for children who lived outside of Madrid; however, now it functions only during the day.

Dionisia Plaza studied in Madrid in the Escuela Superior de Magisterio, where she later was later chair of the Natural Science department. She graduated with a degree in psychology and was a partner-founder of honor of the Speech Therapy and Audiology Societies and of the Spanish Society of Psychology.

Perhaps the most relevant event of her formative years was her inclusion in a prestigious program for gifted students that the government promoted under the Second Republic (1931-1936). It was called the Junta de Ampliación de Estudios e Investigaciones Científicas, and its purpose was to elevate the scientific level of Spanish society through scholarships for the academic elite to attend the world´s most prestigious universities. Through the program, Dionisia Plaza was sent to Paris to expand her studies with Henri Wallon (1879-1962), a professor of psychology at the ¨Institut d´Árts et Métiers¨ and Theodor Simon (1872-1961) a French psychiatrist and psychologist in order to study language and phonetics in the Medical School of Paris (Hospital Lariboisière).

After returning to Spain, she focused on various activities, including those related to the deaf, ¨borderline¨blind, and to speech therapy. Over the years she directed numerous psychological research projects for professionals and authored the following methods: ¨Escribir y Leer¨ (Write and Read), the ¨Iniciación al Cálculo¨ Method, ¨Escalas de habilidad manual¨ and "Trastornos del aprendizaje escolar: dislexias, disgrafías y disortografías". She also gave profesional development classes to psychologists on varied topics, such as: "Aspectos psicopedagógicos del aprendizaje del cálculo", "Las discalculias y su rehabilitación" y "La Rehabilitación psicopedagógica en los trastornos del aprendizaje escolar." Furthermore, she was a speaker at the National Technical Conference for Education in Barcelona in 1980. She gave practical theory classes to graduating seniors in the Psychology and Pedagogy Department at the Universidad Complutense in Madrid.

Her enterprising and pioneering spirit and commitment to pedagogy led her to work until 94 years old. In 1975, the Spanish government honored her with the Gold Medal of Outstanding Commitment to Work.

3.4.2 School organization

The Dionisia Plaza School (Centro de Rehabilitación Médico Psicopedagógico Dionisia Plaza) has a total of 300 students and is comprised of three units of childhood education and thirteen units of primary school. (In each unit there are approximately 23 children). Primary school in Spain lasts for six academic years and ordinarily begins at age six and ends at age twelve. The school has a sanitary

accreditation from the Madrid Government (Madrid Community) as a “Day Centre” for the medical-psycho-pedagogic rehabilitation of childhood disorders. Children in this school receive their rehabilitation treatment together with the ordinary curriculum that corresponds to their age and year, according to the dispositions of the current Spanish educational law (LOE). In its function as a rehabilitation center, the school has the goal of normalizing the children for their adaptation into the school system. The profile of the children is diverse: children with learning disabilities, physical disabilities, behavioral problems, with a high quote of failure or inadequacy in other schools, or come from a difficult social environment. In most cases, children require specific and personalized work in specific areas of immaturity. Some children are able to transfer to other schools after resolving specific disabilities.

The school is divided in three different areas: medical, psychopedagogic and administration. Both, the medical and psychopedagogic areas are coordinated by Isabel Juarez. The medical area consists of a number of departments: neurology, psychiatry, pediatry, otolaryngology, ophthalmology, neurophysiology, radiology, restorative traumatology (kynesitherapy, five physiotherapists), three on-call doctors, five nurses and a pharmacy. The psychopedagogic area consists of the following staff: three psychologists, 13 school teachers, specialized in Primary School (11) and kindergarten (2), eight speech therapists, 5 graphotherapists, a motor coordinator, three occupational therapists, two psychomotricists, seven occupational monitors, eleven clinical assistants.

DIONISIA PLAZA: ORGANIGRAMA

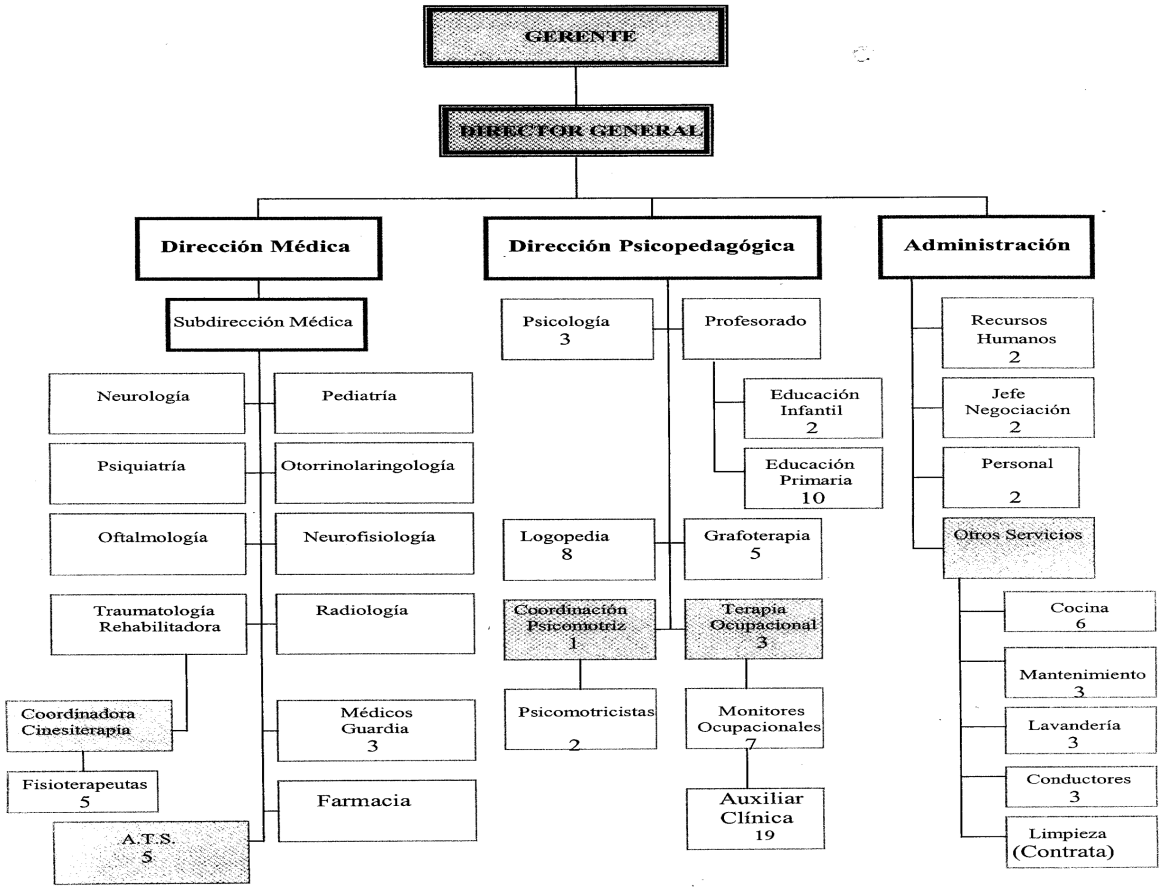


Fig. Organigram of Dionisa Plaza

The school´s professionals provide office hours for parents who seek guidance in his/her child´s management; the service is overseen by Isabel Juarez, the general coordinator of the center. After the initial consultation, the parents are normally asked to complete a thorough and multidisciplinary analysis of their child in order to find the best possible solutions, along with the staff. Additionally, the school undertakes a medical and psycho-pedagogical study of each incoming child in order to establish both a possible diagnosis and corresponding treatment and follow-up. The medical study includes the following areas: neurology, pediatrics, child psychiatry, ORL, ophthalmology, neurophysiology and rehabilitation. The psychopedagogic aspect of the study includes intelligence, laterality, body scheme, psychomotor behavior, visual-motor perception, psycholinguistic test, grapho-

lexical test, conduct and personality study, attention tests and hyperactivity. Both medical and psychopedagogic studies are individually analyzed by the team of psychologists and the general coordinator. Following this, the general coordinator establishes a time to meet with the parents or legal guardians in order to review the results of each one of the tests and to explain the school´s general psychopedagogic recommendation, based on each. During the appointment, the coordinator proposes possible solutions that the school can offer the child. The school values these parental interviews and feedback sessions, as it offers a more comprehensive view of the child and his/her familial background.

The school typically enrolls children in September, the beginning of the school year, although it admits children at any point during the year. Just before the start of the school year, the school distributes the students into one of three groups: A, B and C and in each of the grades. The distribution is completed by a School Committee formed by the medical and psychopedagogic departments and based on the children´s reports. Although there is continuous follow-up of the children in the centre, as well as additional meetings for particular cases, both departments officially meet once a year to evaluate the children´s progress and to suggest changes into a more suitable group, if need be.

In order to guarantee a more efficient and personalized treatment, the children have to go through an evaluation of Intelligence (IQ) with the Wechsler Intelligence Scale for Children (WISC-IV), an evaluation of their curriculum, which considers the initial curriculum level according to the age, the style and learning pace of the child and the relationship to peers and teachers. It also considers the capacities for personal and social development, like motivation and self-esteem and attention levels. Each child receives individual treatment: he or she gets placed into an appropriate group and has an individual program according to his or her needs (logopedic, psychometrics, psychotherapeutic therapies, physiotherapeutic rehabilitation, kinesitherapy, graphotherapy, etc.) Distribution in group A, B or C is done according to the results of all these elements. Group C includes children with low IQ (borderline), severe learning disabilities and a limited capacity to join a normal school. These students usually present a two-year gap when compared to those in normal schools. In this group, the goal is to teach them how to live as independently and autonomously as possible and aims to prepare them for family,

social and future labor integration. Group B has the same academic program as Group A, which is the normal academic program in every Spanish primary school. Children in Group B have been shown to have sufficient IQ conditions so as to follow a normal class. However, they usually present learning disabilities and a difficult social background that requires a slower learning pace and more specific and individualized work. They usually show a twelve-month learning gap. During the six years in primary school, many of these children show a positive evolution and are able to pass to Group A. Children in group A usually show some areas that require special attention (like ADHD or some kind of dyslexia, dyscalculia or other disorders associated with general learning dishabilities), yet which do not impede them from being able to follow a normal school year. Although the three groups (A, B, C) have a high rate of children diagnosed with ADHD, the clinical trial of this thesis was originally focused on children in groups A and B who present standardized IQ levels. Initially, my intention was to apply a full crossover design with the two groups, however, after completing the tests and since different designs were applied in each of them and since it was not possible to randomize any of the groups for the sake of the study, I decided to focus the doctoral work only on the results of group A, as I shall explain as follows.

3.5 Written consent for the clinical trial- Approval from the parents

Before starting the clinical trial, I had to solve a crucial point: what is the human subject regulation in clinical trials in Spain, considering I would be dealing with children? The Spanish legislation concerning interventional clinical trials on investigational medicinal products (IMPs) is reflected in *Real Decreto 223/2004, de 6 de febrero*, by which clinical trials with medication are regulated, as published in the Spanish Boletín Oficial del Estado Num. 33 of 7 February 2004.

3. In 1978, the Royal Decree 944/1978 established the functions and the composition of the so-called "Comités de Ensayos Clínicos (CEC)" (Clinical Trials Committees). In 1990, with the introduction of the "Ley del Medicamento", the name, composition, and responsibilities of these CEC were updated.

4. These CEICs were independent from each other and thus, up to the introduction of the new Directive (20/2001), multicentre clinical trials required a

positive opinion from each of the CEICs involved in order to perform the clinical trials in every centre.

This Royal Decree covers all interventional clinical trials including trials involving medical devices and genetic or other biomedical research. It is subdivided in XII chapters covering the following aspects:

I General disposition (scope and definitions), "*Ensayo clínico: toda investigación efectuada en seres humanos para determinar o confirmar los efectos clínicos, farmacológicos y/o demás efectos farmacodinámicos, y/o de detectar las reacciones adversas, y/o de estudiar la absorción, distribución, metabolismo y excreción de uno o varios medicamentos en investigación con el fin de determinar su seguridad y/o su eficacia."* (translation: "Clinical trial: any investigation in humans to determine or verify the clinical, pharmacological and / or other pharmacodynamic effects, and / or to identify any adverse reactions, and / or to study absorption, distribution, metabolism and excretion of one or more drugs in research to determine their safety and / or efficacy.")

II Protection of subjects involved in clinical trials,

a) *Si el sujeto del ensayo es menor de edad:*

1.o Se obtendrá el consentimiento informado previo de los padres o del representante legal del menor; el consentimiento deberá reflejar la presunta voluntad del menor y podrá retirarse en cualquier momento sin perjuicio alguno para él. Cuando el menor tenga 12 o más años, deberá prestar además su consentimiento para participar en el ensayo.

2.o El menor recibirá, de personal que cuente con experiencia en el trato con menores, una información sobre el ensayo, los riesgos y los beneficios adecuada a su capacidad de entendimiento.

3.o *El investigador aceptará el deseo explícito del menor de negarse a participar en el ensayo o de retirarse en cualquier momento, cuando éste sea capaz de formarse una opinión en función de la información recibida.*

4.o *El promotor pondrá en conocimiento del Ministerio Fiscal las autorizaciones de los ensayos clínicos cuya población incluya a menores.*

(translation:a) If the test subject is a minor:

1st Prior informed consent of parents or legal representative will be obtained;

the permission must represent the minor's presumed will and may be withdrawn at any time without detriment to him. When the minor is 12 or older, he/she must also give consent to participate in the trial.

2nd The child will receive information about the trial, the risks and benefits according to its capacity of understanding from staff with experience with minors.

3rd The researcher will accept the child's expressed desire to refuse to participate in the trial or to withdraw at any time when he/she is capable of forming an opinion based on the information received.

4th The developer shall inform the prosecutor about authorizations of clinical trials whose population includes juveniles.

III Ethics Committees, IV Procedures for conducting clinical trials (AEMPS and EC), V Compassionate use, VI Economic aspects, VII investigational medicinal products (manufacture, importation, labelling), VIII Good Clinical Practice, IX Procedures to verify compliance with GCP (inspections, audits), X Databases, XI Safety requirements related to investigational medicinal products, XII Punishments.

5. In Spain there are about 140 Ethics Committees (ECs). There has to be a research ethics committee (CEIC) in every health centre that intends to carry out a clinical trial. Institutions responsible for the ECs provide the funding (i.e. regional governments and public hospitals) in varying amounts. The competent authority that authorises clinical research ethics committees (CEICs) is the regional (autonomous) government (there are 18 CEICs over the country).

B.An 'Ethics Committees Coordinating Centre' is also described in the new legislation (Royal Decree 223/2004) but is not yet operational. There are internal standard operating procedures and inspections from regional governments.

C. The procedure for authorising the performance of a clinical trial in Spain is the following: For all trials, be they single- or multi-site, the application must be submitted to all CEICs covering the areas where the trial will be performed (between the 1st to the 5th day of the same month) and to the responsible authority, the Spanish Medicines Agency (Agencia Espanola de Medicamentos y Productos Sanitarios - AEMP). One CEIC is the 'reference committee', and the rest are the so-called 'involved committees'.

D. Before starting with the clinical trial and once I had studied the current law in Spain on this matter, I prepared to meet all requirements. However, the school

was unaware of the necessity to form an Ethics Committee for a case like this, i.e. a clinical trial for a doctoral thesis consisting in a musical intervention. In addition, I was unable to locate any similar trial in the Spanish universities that required an Ethics Committee. The practice in Spain establishes that it is not necessary to create an Ethics Committee in a case like this, however, the school is required to notify the possibility of a trial and obtain consent from the parents of those involved in the study. Therefore, the school had to inform the parents of all children in the school whether they were within the experimental group or not. For this purpose a letter was written explaining the musical intervention during school, its goals, daily duration and extent. The letter was circulated to all parents of the students. There were some calls (about 10) asking when the trial began. After three/ four weeks, the response from all of the parents was positive. No one testified against the test, and they all agreed. What follows is a letter from the Dionisia Plaza School expressing the matter in these terms:

(English translation from the letter displayed below)

Dear Ms. Toro,

This letter shall assure the readers of this dissertation that the research into musical interventions upon the students of the Dionisia Plaza School has met all of the ethical requirements that we place upon research of this sort of institution. Specifically,

a) the prior informed consent of parents or legal guardians of minors on the clinical trial.

b) the minor has been adequately informed about the trial, its risks and benefits.

c) the researcher will accept any minor's explicit desire to refuse to participate or withdraw at any time from the study.

Madrid, September, 2011

(signatures)

Isabel Juárez Casado
Director of Psychology Department
Centro de Rehabilitación
Médico Psicopedagógico SA.
Dionisia Plaza

Enrique Plaza Cano
General Manager
Centro de Rehabilitación
MédicoPsicopedagógico SA.
Dionisia Plaza

CENTRO
DIONISIA PLAZA

C/ Espinos, 10
Teléfs. 91 307 93 42*
Fax: 91 357 35 45
28023 MADRID
www.crdionisiaplaza.es

Sra. Toro:

Esta carta certifica a los lectores de su tesis doctoral que el ensayo clínico realizado a los estudiantes del Dionisia Plaza ha cumplido todos los requisitos éticos exigidos de un Centro escolar en España. Específicamente,

A) La debida notificación previa a los padres o los representantes legales del menos sobre la intervención musical.

B) La debida información al menor sobre el ensayo, sus riesgos y los beneficios del mismo.

C) La absoluta aceptación del deseo explícito de los niños menores de negarse a participar en el ensayo o de retirarse en cualquier momento.

En Madrid a Septiembre de 2011

CENTRO DE REHABILITACION
"DIONISIA PLAZA"
MEDICO PSICOPEDAGOGICO, S. A.
Isabel Juárez Casado
DIRECTORA DPTO. DE PSICOLOGIA

CENTRO DE REHABILITACION
"DIONISIA PLAZA"
MEDICO PSICOPEDAGOGICO, S. A.
Enrique Plaza Cano
DIRECTOR GENERAL

Inscrita en el Registro Mercantil de Madrid con fecha 2-3-81, Tomo 5617 general - 4858 de la Sección 3.ª del Libro de Sociedades - Folio 80 Hoja nº 47840 Inscripción 1ª - C.I.F. A-28650950

fig. The copy above shows the original letter handed out by the School

4.DESCRIPTION OF THE CLINICAL TRIAL

4.1 Preliminaries

From a total of 300 students, a group of 156 children aged 7 to 12 diagnosed with ADHD were recruited. (Primary diagnosis based on definition of Attention-Deficit/Hyperactivity Disorder according to DSM-IV-TR.) As to gender, 39 female, 117 male. Primary diagnosis was based on definition of Attention-Deficit/Hyperactivity Disorder according to DSM-IV-TR. 51 of the children were undergoing medical treatment: 43 took methilphenidate (Ribufen, Concerta or Medikinet); 8 took atomoxetine (Strattera). Before starting with the clinical trial, the school had to inform and ask for permission to the parents of all the children involved in the trial. A written permission was handed out to each of the parents one month before the trial started in order to give the parents enough time to answer. The school did not get one negative answer. On the contrary parents with children who were not included wanted them to be in the project. The clinical trial generated a lot of positive feelings, expectations and the sense that the school was trying some new interventions that could benefit their children.

The original design of the study included children in Group A and Group B. The children were distributed from Year 2 to Year 6, Primary School. The testing proceeded in the following manner: There were two experimental groups. Group A (79 children) and B (77 children) were already classified by the school itself according to their specific criteria. As mentioned before, Group B had the same academic program as Group A. Children in Group B had been shown to have sufficient IQ conditions, so as to follow a normal class. However, they usually presented learning disabilities and a difficult social background that required a slower learning pace and more specific and individualized work. During the six years in Primary School, many of these children are able to pass to Group A.

Children in group A showed some areas that need special attention, like ADHD, which do not impede them from being able to follow a normal school year. When assigned into Group A, children had to go through an evaluation of Intelligence (IQ) with the Wechsler Intelligence Scale for Children (WISC-IV), evaluation of their curriculum, considering the initial curriculum level according to the age, the style and learning pace of the child and the relationship to peers and teachers and considering

the capacities for personal and social development, like motivation and self-esteem and attention levels. The condition of hyperactivity and high scores in anxiety levels were very common among these children.

156 children with ADHD were also tested for anxiety disorder using STAIC (for children 9 to 12) and CAS (for children 7 to 9) to establish a second group of children with a comorbid anxiety disorder.

The testing period for the main group represented 9 weeks: 3 weeks + 3 weeks + 3 weeks. The design was as follows:

GROUP A:

GROUP B:

 represents the 3 week period where AM is applied.

A1, A2, A3, A4 and B1, B2, B3, B4 related to specific test applications. Group A was treated with AM in the first 3-week period and in the third 3-week period. Group B was treated with the AM in the second 3-week period. During the treatment period, children were listening to the AM every day, first thing in the morning, in their classroom before starting lessons. This time of the day was considered the most interesting one, because teachers would view the start of the school day as the most difficult to calm the children to begin the lessons. Children listened to a musical piece every day, which was 6 to 7 minutes. The teachers could decide from the seven musical pieces, which one to listen to every day, considering the children's feedback. I found that the teachers attitude was fundamental for the positive evolution of the trial. The teachers were the first who had to understand the

intervention and agree with it. They knew their children; the children trusted their teachers, therefore the teacher´s positive attitude and feedback were essential for the intervention. Before starting with the musical intervention, the teachers were explained the goals of the intervention, including what I was looking for and they were made aware that I considered them key elements for the success of the whole intervention, because I would leave the practice to them and return punctually or to complete the testings. The only condition I required was that they began with piece number one, which introduces the method to the children and the idea of creating a personal space. By listening and paying attention to the reactions of the children, they had to find out what piece would have more impact on them. I told them to feel free to determine which piece would suit them better and would catch their attention. I gave them a short manual of how to use the musical method with some key objectives and a proposal with 10 questions dedicated to each one of the pieces that the teachers could use with the children if they felt like verbalizing whatever they had imagined and felt during the hearing. I let them decide whether to pose the questions daily, to distribute them over several days or not to pose them at all. Their general reaction was very positive, although some were very skeptical about the idea of being able to calm the students down for the duration of each piece. Some liked the whole idea very much. There was also a 3-week post-treatment data collection period to find out if results obtained after intervention varied or remained unchanged. These are A's second 3 week period and B's third 3 week period.

Testing with **Subtest Coding (WISC)** for sustained attention followed 4 times/per group; at the beginning and end of each 3 week period. It started on 5/9/11 (A1, B1), then 5/30/11 (A2, B2), 6/20/11 (A3, B3) and 7/4/11 (A4, B4). The sub-tests Coding consists in children under 8 mark rows of shapes with different lines according to a code, children over 8 transcribe a digit-symbol code. The tests were handed out by the teacher to the whole class, a quick explanation followed by some examples that the children could use by themselves to practice. After checking that the whole class had understood the instructions of the test, the teacher told them to start with a stopwatch in the hand. The test had to be accomplished in 2 minutes. At the end of this timespan the tests were collected.

Testing with **STAIC and CAS** to establish the anxiety levels of the children with ADHD followed at the beginning and the end of the 9-week testing period. In this case, tests were undertaken on 5/9/11 and 7/4/11 by both A and B groups. The tests were done in small groups (4 to 5 children). Since children in Group B had more difficulties in understanding the question of the STAIC test, the groups were formed by 1 or 2 individuals. The tests were administered verbally to the children who responded to one of each of the items, checking all the alternatives in the test.

My initial intention was to apply a full crossover design with Group A and Group B. Nevertheless, when the tests were completed I found that it was not possible to randomize any of the groups for the sake of the study, probably because different designs were applied (Group B had only one stimulus interval instead of two) in each of them. In order to make a coherent interpretation of the findings (I did not have enough background information about children in Group B) I decided to focus the doctoral work only on the results of group A. For some uncertain reason, the number of children who took all the four tests in Group B was 49. The fact was that due to illness, special classes, rehabilitation programs, holidays, 28 children in Group B were not able to complete the trial.

4. 2 THE CLINICAL TRIAL - GROUP A

A total of 79 children participated in the study, divided into four school years, from second to sixth grade, between seven and twelve years old. There was a total of 13 females and 65 males, and all were diagnosed with ADHD. (Primary diagnosis based on definition of Attention-Deficit/Hyperactivity Disorder according to DSM-IV-TR.) The distribution was as follows: fourteen children in second grade, fourteen in third grade, sixteen in fourth grade, seventeen in fifth grade and eighteen in sixth grade. 36 of the children in Group A were undergoing medical treatment, with methylphenidate (Ribufen, Concert or Medikinet) and atomoxetine (Strattera). Group A had one drop out, the trial involved 78 children. This case was due to a change of residence and city.

The testing period for group A represented nine weeks: three weeks + three weeks + three weeks. The design was as follows: The group was treated with AM in the first 3 week period and in the third 3 week period. During the treatment period, children listened to the AM in their classroom before starting lessons, first thing in the morning every day. This time of the day was agreed upon with the teachers, because they considered it to be the most difficult moment to calm their students down. Before starting the clinical trial, I had a meeting with the teachers in order to explain the goals, application and possible benefits of the method. They were very receptive, starting an interesting discussion on the main problems they found teaching children with ADHD.

Children listened to a musical piece every day, (6 to 7 minutes) first thing in the morning before starting lessons. The teachers could decide which piece to listen to every day considering the children's feedback. The only condition was to start with piece number one, which introduces the method to the children. There was also a 3-week post-treatment data collection period to determine if the results obtained after treatment varied or remained unchanged. These were A's second 3 week period. So there were three interval change scores, corresponding to the change from test 1 to test 2, test 2 to test 3, or test 3 to test 4, and there was also an overall change score from test 1 to test 4. Testing with **Subtest Coding (WISC)** for sustained attention followed four times: at the beginning and end of each 3-week period. Testing with **STAIC and CAS** to establish the anxiety levels of the children with ADHD followed at the beginning and the end of the 9-week testing period.

Before looking at the findings, the general feeling I had about the evolution of the trial with the tested group was very positive. In the beginning, the children were very excited about the musical method, yet the teachers expressed concern that the children might not be able to do it correctly. Both teachers and children were very positive about the musical intervention. The children would tell me which of the pieces they liked better and why and the teachers reported the reactions of the group in class and were satisfied with the results and felt part of the success.

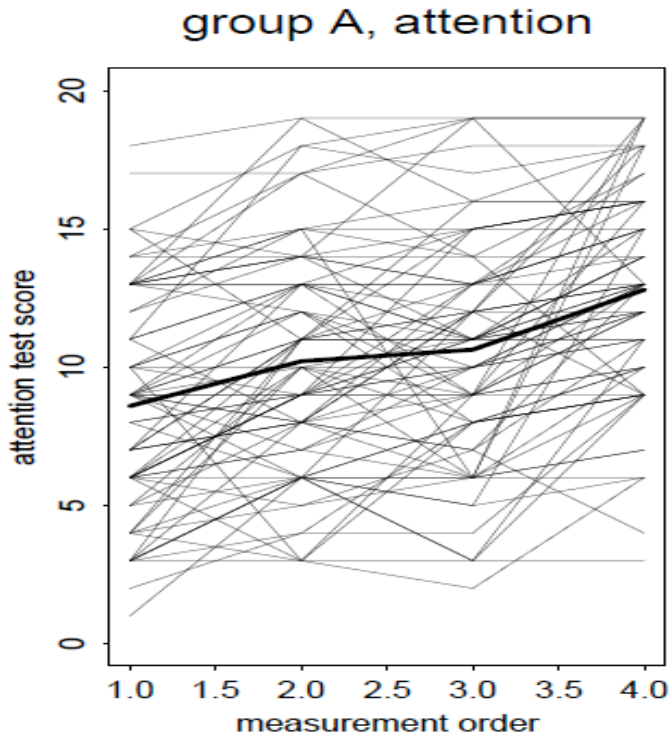
5. FINDINGS AND CONCLUSIONS OF THE CLINICAL TRIAL

5. 1 Sustained Attention in Group A

Group A was exposed to the training tapes over two separate time intervals, weeks 1 through 3 and weeks 7 through 9, and were tested at four equally spaced intervals every 21 days.

So there were three interval change scores, corresponding to the change from test 1 to test 2, test 2 to test 3, or test 3 to test 4, and there was also an overall change score from test 1 to test 4.

I begin my report with the change from test 1 to test 4, as shown in Figure below.



The dark line is the average for each test score; it shows a extraordinary progression upward, with solid changes over the two periods of exposure to the stimulus tapes and no evident regression to a mean during the interval from measure 2 to measure 3, when there was no musical stimulus.

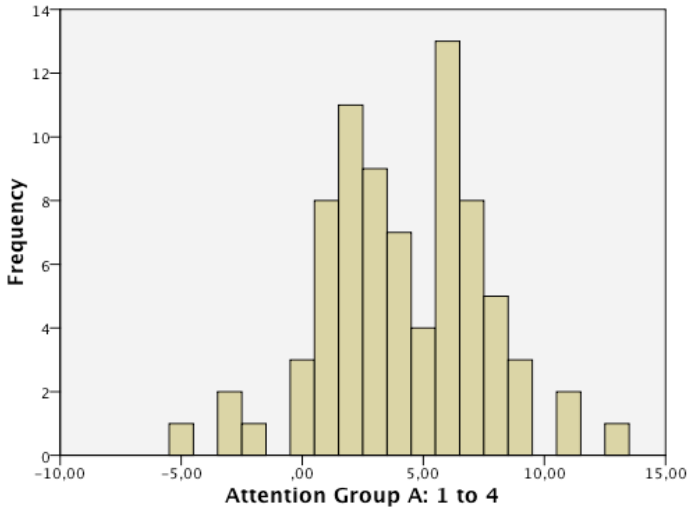
All the raw data for the 78 subjects in Group A who had all four test scores are plotted above. The scores use the full range of the Attention scale, from 1 to 19 (range of raw Wechsler scores on any subscale).

The prevalence of scores for the first test fall below the level of 10, the middle of this scale range, whereas the prevalence of the scores at the fourth measurement fall above ten.

The following table plots the change scores for each child separately.

Change Score	-5	-3	-2	0	1	2	3	4	5	6	7	8	9	11	13
Count of Children	1	2	1	3	8	11	9	7	4	13	8	5	3	2	1

The same information can be displays in the following histogram:



Of the 78 children with complete data, only 4 had a change score below zero; for 3, the score was unchanged; but for the other 71, there was improvement over these nine weeks. The median change was 4, matching the computed mean change of 4.2.

Moreover, the study displayed other important conclusion:

-The effect size of the net treatment was about 1.07 as normalized, which is huge.

-The average child has been moved by more than the baseline standard deviation (which is 3.9 on this same scale).

-The t-statistic was 11.2, which corresponds to a very small p-value.

A permutation test was used, which randomizes the order of measures over this series of 78 pairs 1000 times and compares the observed mean difference of 4.2 to the distribution of these pseudo values.

- The largest of the 1000 was 1.82, versus the observed difference of 4.2; so the statistical significance of the treatment effect is evident.

This assessment displayed meaningful statistical and clinical results, so I continued with the analysis of more detailed sequences of measurements:

- From measurement 2 to measurement 3 (the middle interval), that is, the interval without music stimuli, the mean attention score of these 78 children did not decrease on average.

- It is remarkable that the increments to the attention score during the two periods of musical stimulus (first and third interval with music stimuli) are not significantly different: this shows a dose-response relationship for the treatment as a whole. That means that doubling the "dose" (the number of minutes of net exposure to the stimuli) effectively doubles the effect on the chosen outcome score.

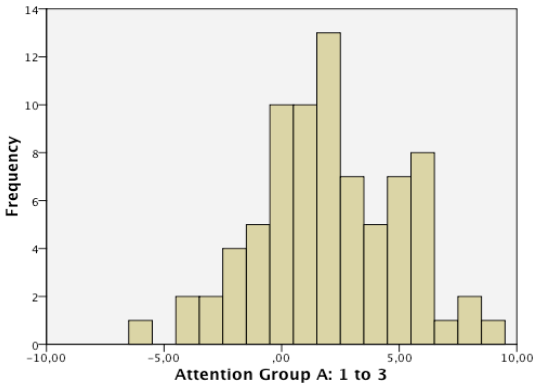
It is of possible interest to analyze how these findings distribute within the different subgroups: children with and without medication, gender or school years and age.

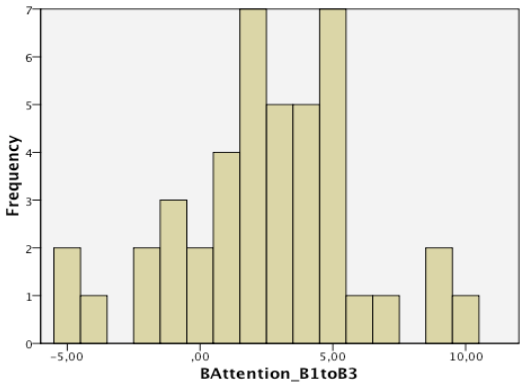
Group A was analyzed in subgroups distributed by gender, school year, medicated and non medicated children.

This information can be found in the appendix of this chapter.**

5.2 SUSTAINED ATTENTION IN GROUP B

Just a brief mention of Group B, which I decided not to include in the dissertation, because it was a different design, mainly because it had only one stimulus interval instead of two, and there was a shortage of information on children in Group B to help interpret the findings. It is still reasonable, though, to turn to the null hypothesis and ask if the effect in group B was the same as the effect of the first interval in group A. Considering the "crossover version," time 3 minus time 1, where group A had the stimulus first, and group B the silence first. Indeed those net change scores, 2.0 and 2.2 were not meaningfully different.





5.3 ANXIETY IN GROUP A

5.3.1 EFFECTS ON ANXIETY IN CHILDREN 7 TO 8 YEARS

Group A was tested twice, at the beginning and at the end of the clinical trial with STAIC and CAS to establish the anxiety levels of the children.

So there are two interval change scores, corresponding to the change from test 1 to test 2.

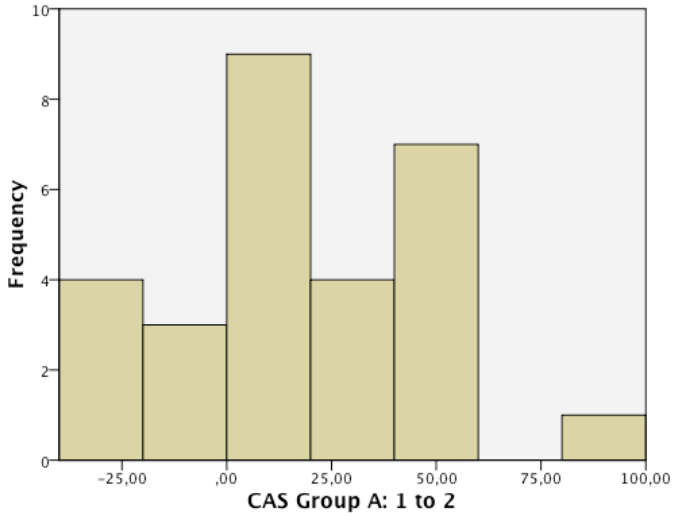
I shall start this report with the change from test 1 to test 2 in Years 2 to 3 Primary School, corresponding to children aged 7 to 8. The figures shows all raw data for the 28 subjects in this group who had the two test scores.

The following table plots the change scores for each child separately:

Count of children: 28

Change Score	-40	-24	-23	-19	-11	-1	0	11	12	17	18	19	31	34	36	40
Count of Childre	1	1	2	1	1	1	2	2	1	1	1	2	1	2	1	1

Change Score	45	47	48	55	56	58	86
Count of Childre	1	2	1	1	1	1	1



Of the 28 children with complete data, 7 had a change score below zero; for 2, the score was unchanged; and for the other 19, there was a reduction of anxiety levels over the nine weeks. The median change was 18.75 and the effect size was about 0.74, which was a considerable effect. A conventional t-test finds a t-statistic of 3.32 corresponding to a small p-value. Over the entire study the mean anxiety score of these 28 students fell by 18.72.

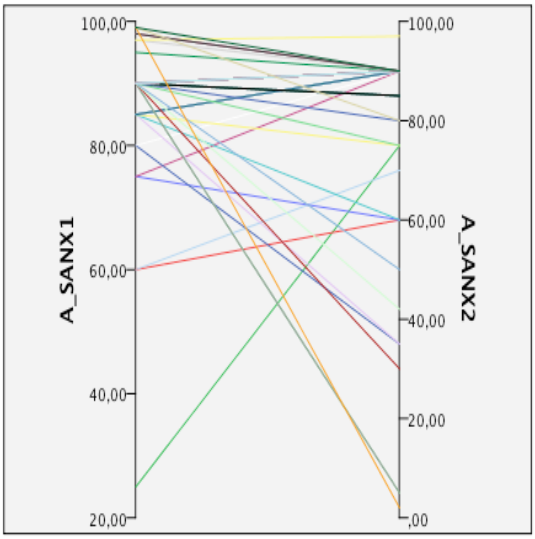
5.3.2 EFFECTS ON ANXIETY IN CHILDREN 9 TO 12 YEARS

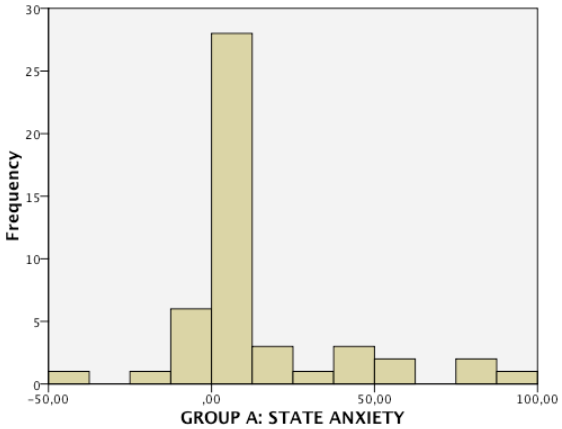
School Years 4 to 6 were tested with STAIC anxiety test. Now I shall continue this report with the change from test 1 to test 2 in children aged 9 to 12. The figure below shows all raw data for the 48 subjects in Group A who had the two test scores.

You can see that these scores use the full range of the STAIC scale, from 1 to 100. Two values were measured: State Anxiety and Trait Anxiety.

You can see that these scores use the full range of the CAS scale, from 1 to 100.

State anxiety:





The histograms above plot the change scores for each child separately. The same information can be displayed in the following table:

Change Score for State Anxiety: 48 children

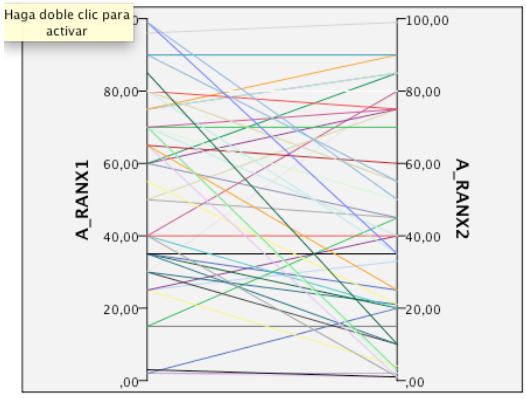
Change Score	-50	-15	-10	-5	0	5	7	8	9	10	15	19	25	40	45	48
Count of Childr	1	1	2	4	16	5	1	2	1	2	2	1	1	1	1	1

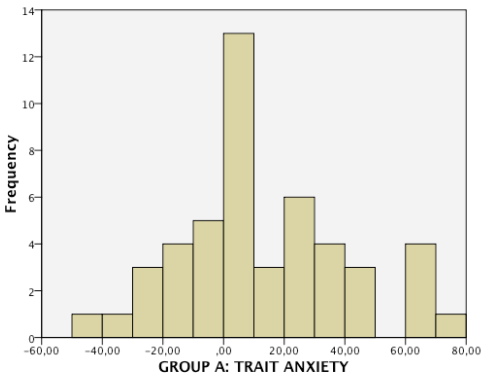
Change Score	50	60	85	97
Count of Childr	1	1	2	1

Of the 48 children with complete data, 8 had a change score below zero; for 16 the score was unchanged; and for the other 24, there was a reduction on the state anxiety levels over these nine weeks. The median change was 11.75, and the effect size was about 0.96, which is a considerable effect. A conventional t-test finds a t-statistic of 3,01 corresponding to a small p-value.

Over the whole study with two musical stimuli and one with no musical stimulus, the mean anxiety score of these 48 students fell by 11.75.

Trait anxiety:





The histograms above plot the change scores for each child separately. The same information can be displayed in the following table:

Count of children: 48

Change Score	-50	-40	-30	-25	-1	-15	-10	-8	-5	-3	0	1	2	5	9	10
Count of Childre	1	1	1	1	1	1	1	1	1	1	7	1	1	3	1	1

Change Score	15	20	21	25	30	34	35	39	40	45	49	64	67	68	75
Count of Childre	2	3	1	2	1	1	1	1	1	1	1	2	1	1	1

Of the 48 children with complete data, 14 had a change score below zero; for 7 the score was unchanged; and for the other 27, there was a reduction on the state anxiety levels over the nine weeks. The median change was 11.22, and the effect size was about 0.40, which is a moderate effect. A conventional t-test finds a t-statistic of 2,706 corresponding to a p-value of 0.005.

Over the whole study with two musical stimuli and one with no musical stimulus, the mean anxiety score of these 48 students fell by 11,22, which is not a relevant reduction of Trait Anxiety in the group.

Concerning anxiety, the findings on the effects of the musical intervention in reducing anxiety are considerable: 28 children aged 7 to 8 show a size effect of 0.74, which is considerably high. 48 children aged 9 to 12 show a higher size effect on state anxiety (0.96) than on trait anxiety (0.40).

**APPENDIX – SUBGROUPS A: GENDER, YEARS AND MEDICATION/NO MEDICATION

5A.1.1 SUBGROUP A: MALES AND FEMALES

Group A can also be devided by gender: 64 males and 14 females.

The following table plots the change scores for each child separately in the subgroup of males:

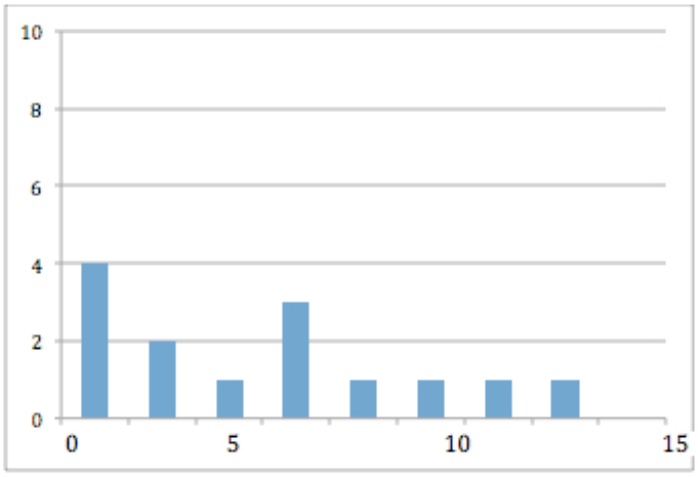
Change Score	-5	-3	-2	0	1	2	3	4	5	6	7	8	9	11
Count of Childre	1	2	1	3	8	7	9	5	3	10	7	4	3	1

Of the 64 male in Group A, 4 had a change score below zero; for 3 the score was unchanged, but for the other 57, there was improvement over these nine weeks. The median change was 3,9 and the effect size of the net treatment is about 1.02 as normalized.

For the females (14), 100 % of the group improved attention. The median change was 5.57 and the effect size of the treatment in group of females was higher than with the males, about 1.28 as normalized.

Change Score	2	4	5	6	7	8	11	13
Count of Childre	4	2	1	3	1	1	1	1

The following histogram plots the change scores for each girl separately.



5.1.2 SUBGROUP A- DISTRIBUTION BY YEARS

The tested group includes 5 years of Primary School: from year 2 until year 6. The distribution was as follows: 13 children in second grade, 14 in third grade, 16 in fourth, 17 in fifth and 18 in sixth grade

Of 13 children in Year 2, aged 7 to 8, 11 improved attention, with a median score of 4.53 and an effect size of 1.35.

Year 2 data:

Change Score	-3	0	1	4	5	6	8	11	13
Count of Childre	1	1	4	1	1	1	1	2	1

Year 3 data:

Change Score	-2	1	2	3	5	6	7	9
Count of Children	1	1	3	3	2	2	1	1

Of a total of 14 children in Year 3, aged 8 to 9, 12 improved attention, with a median score of 3.71 and an effect size of 1.

Year 4:

Change Score	-3	4	6	7	8	9
Count of Children	1	4	2	4	3	2

Of a total of 16 children in Year 4, aged 9 to 10, 16 improved attention with a media score of 6,312 and an effect size of 2.54 which is a huge effect. The following histogram plots the change scores for each child separately in Year 4.

Year 5:

Of a total of 17 children in Year 5, aged 10 to 11, 13 improved attention with a median score of 3.176 and an effect size of 0.70. The following histogram plots the change score of Year 5.

Change Score	-5	0	1	2	3	4	6	8
Count of Children	1	1	2	4	1	2	5	1

Year 6:

Of a total of 18 children in Year 6, aged 11 to 12, 16 improved attention with a median score of 3.44 and an effect size of 1.41. The following histogram plots the change score for each child separately in Year 6.

Change Score	−3	0	1	2	3	5	6	7
Count of Children	1	1	1	4	4	1	3	3

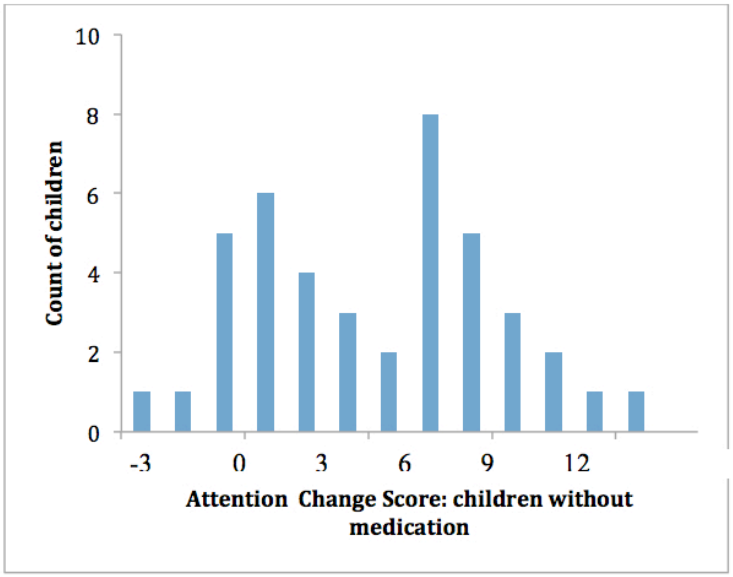
The size effect from Year 2 to Year 6 went from 0.7 up to 2.54, which makes a huge score in all years.

5.1.3 SUBGROUP A : CHILDREN WITH/WITHOUT MEDICATION

In Group A, 36 children were medicated with methilphenidate (Ribufen, Concert or Medikinet or atomoxetine (Sttatera). 42 were not medicated.

Of the 42 children with complete data who had no medication, only 2 had a change score below zero; for the other 40, there was improvement over these nine weeks. The median change was 4.5 matching the computed mean change of 4.6. The effect size of the net treatment is about 1.24 as normalized, which is huge.

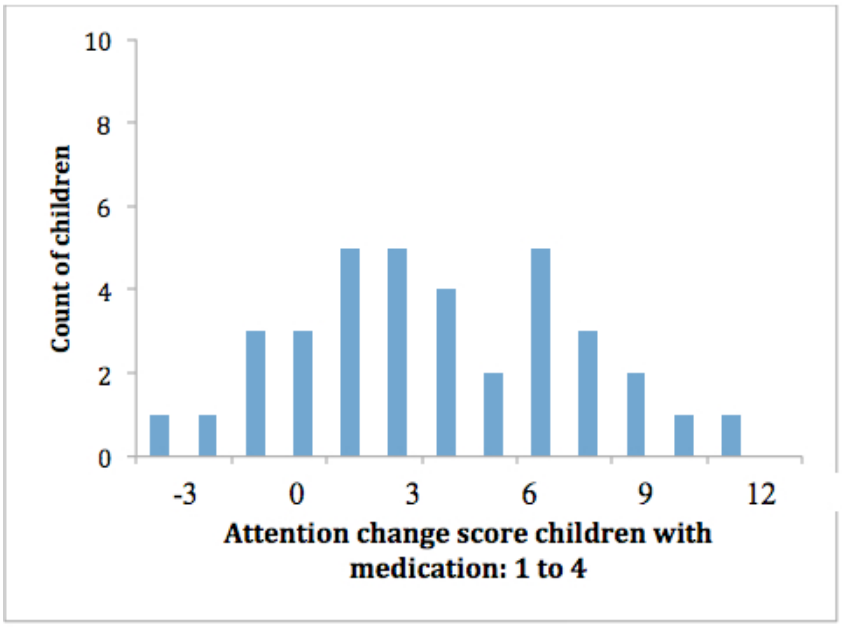
The following histogram corresponds to the group of children who were not medicated during the study:



Change Score	-3	-2	1	2	3	3	5	6	7	8	9	11	13
Count of Childre	1	1	5	6	4	3	2	8	5	3	2	1	1

Here again, of the 36 children with complete data who had medication, only 2 had a change score below zero; for 3, the score was unchanged; but for the other 31, there was improvement over these nine weeks. The median change was 3.7. The effect size of the treatment in this subgroup is about 0.9, which is high, but slightly lower than the effect size in the subgroup without medication. Even though the effect is higher in the non medicated group, both groups benefit from the use of the AM.

Change Score	-5	-3	0	1	2	3	4	5	6	7	8	9	11
Count of Childre	1	1	3	3	5	5	4	2	5	3	2	1	1



6. DISCUSSION

All of the three hypotheses in this study have been supported. There was a statistical difference on the measures used in this study between the impact of the AM on the level of attention and anxiety by children aged 7 to 12 years who were diagnosed with ADHD. According to these findings, the treatment with AM clearly provides a valid therapeutic alternative to improve sustained attention and to reduce anxiety in children with ADHD. By the end of the clinical trial, 71 showed an improvement nine weeks out of 78 children with complete data. The effect size of the net treatment was about 1.07, as normalized, which is unprecedented in the literature of music therapy. Similarly, the two intervals of musical stimulus showed similar increments, which implies a dose-response relationship for the treatment as a whole, whereby doubling the dose doubles the effect on the outcome score.

In order to delve deeper into the findings, I would like to comment on them in view of other parameters like gender, age or medication. We mustn't forget that the school did not previously select the children, nor did it adapt the groups to meet any specific criteria of the clinical trial. The trial was simply adapted and completed according to the distribution criteria of the school, by the intellectual capacity of children and curriculum, into groups A, B and C.

Let me start by analyzing the data of the children with and without medication. As previously mentioned, 36 children were medicated with methylphenidate or atomoxetine, two medications that are usually given in cases of ADHD diagnosis. The effect size for the medicated group was 0.9, a large value (Cohen, 1998). Furthermore, the effect size obtained in the non-medicated group (n = 42 total) was 1.24, which is an enormous effect. We can conclude that children with no medication were more receptive to the musical intervention than medicated children. However, it is clear that the difference is not significant, since both groups show an important effect. When I performed the intervention, I did not know which children were medicated. The school provided me with this information once the trial was finished. Interestingly enough, the school staff often feared that the results of the tests could be affected by some children who might not have taken the medication during the weekend. During the week the school itself rigorous monitors the medication taken by each student, but on the weekends the school cannot guarantee compliance with medical guidelines. Three

of the four tests (5/9/2011 first, second and third 5/30/2011 5/30/2011) were performed on a Monday (which is immediately following the weekend), and according to their fears, this would be the most variable day with the possibility of children having lower doses of medication. The last test was made on 6/20/2011, a Wednesday. This fear of some teachers seems not to be justified since the trial resulted with a dose-effect, i.e. doubling the dose doubles the effects of the resulting score.

I have also conducted a gender distribution of those involved in the study. Group A contained 64 males, resulting in an effect size of 1.02, and 14 female subjects, with an effect size of 1.28. Though the sample of girls seems small, it is consistent with the reports reviewed in an earlier chapter that ADHD is 2 to 4 times mores frequent in boys than in girls (Dulcan, 1997, Singh, 2008).

I also distributed the results by courses and age, trying to establish whether there was a greater receptivity to a method like this at a certain age. We had an effect size of 1.35 in Year 2, i.e. in children aged 7 and 8. In this case, we doubted that children in this age group were receptive to this type of intervention and were able to maintain attention for seven minutes, be quiet and not get bored. In one of my visits to the school, I could see that this was not justified: the children had perfectly integrated the music intervention into their school day; I was able to verify that they were able to relax, be silent and follow the method. The children in this age group showed a positive reception to the AM. In the group of Year 3, the effect size was 1, also an important result. This group of children aged between 8 and 9 years was also very homogeneous, with a teacher very much in favor of such methods. The group of Year 4, children aged 9 to 10 scored an effect size of 2.54, which is huge. In Year 5, children 10 and 11 years, the effect size was 0.70, somewhat lower than in other courses but still high (Cohen, 1988). According to the teacher, this class had more difficulties in maintaining order and silence in general, Actually it was the group of children that asked me the most questions on the different pieces. Year 6, at 11 and 12 years year old, had an effect size of 1.41, which was also important. As I mentioned in a previous chapter, in order to offer a coherent interpretation of the findings, I decided to focus the doctoral work on the results of group A. From a total of 77 students in Group B, the number of children who completed all four tests was 49,

which means that 28 children did not complete the trial as a result of illness, special classes, rehabilitation programs and holidays. The findings of these 49 children, which I briefly mention in Chapter 5, were splendid and they would have contributed to a bigger sample.

An important aspect of the trial relates to the teachers at this school. I must highlight their collaboration and positive predisposition to the intervention, as the result was that the children were very collaborative and excited to participate in the study. It is noteworthy that the teaching staff in this school had very specific training for children with learning disorders and had a high degree of dedication; they considered this kind of musical training suitable and useful in the school context. Hence, the acceptance by the teachers, an essential part of the implementation and effectiveness of the AM, enabled the teachers to transmit information, stimulation and enthusiasm to the students.

As a result of the current economic downturn in Spain, the government has made sizeable budgetary cuts to education. The resulting effect on teachers has been a longer work day, less assistance from aides, an increased student-to-teacher ratio, and less ability to offer individualized attention to pupils. Very often, the presence of children with learning disabilities or ADHD slows down or interrupts the pace of the class and prevents the teachers from achieving their goals. This circumstance has been exacerbated. With this in mind, the intervention was designed to meet the teachers´ needs by using a clear and simple methodology and an easy application that did not require much additional work from their part. The teacher had to give a brief explanation of the method to the children: something like “the music is a time you are to enjoy and relax”. Then they had to play the music, and, if the children requested, they could have a short discussion with them about the piece they had just heard.

One unexpected consequence of the method was its effective implementation at school, or in larger groups. When I conceptualized it, I thought of its possible application in smaller groups, but I never thought it would work as it did (maintaining the children´s quiet and attentive throughout the seven-minute piece) with a larger group in a school classroom. Additionally, I did not expect an effect like this on hyperactive or inattentive children. Surprisingly enough there was a contagion effect among the students of the trial, which led me to immediately think of Wallin's view of

music lying at the group level, group-cohesion, rather than at the single (Wallin et al. 2000). There was a clear case of emotional contagion, a tendency to automatically mimic and synchronize movements with others and emotional convergence, as described by Hatfield et al. in their study (1994). Also, Blacking (1987) proposed that the power of music was generated by the extension of individuality in community, and that music had an important adaptive value for a group, as it affected contagion or communion.

I was not sure of getting a dose-response effect, to this extend: whereby doubling the "dose" (the number of minutes of net exposure to the stimuli) of the musical intervention effectively doubled the effect on the chosen outcome score. That is to say that increased exposure to AM was associated with increased attention. And the difference between the increments of attention scores in first and the second musical intervention were not significantly different.

A similar study done by Gold et al. (2008) aimed to establish the dose-response relationship in music therapy for people with mental disorders (psychosis, depression) displayed significant dose-effect relationships for general, negative, and depressive symptoms, as well as functioning, with explained variance ranging from 73% to 78%. Small effect sizes for these outcomes were achieved after 3 to 10 sessions and large effects after 16 to 51 sessions. The study suggested that music therapy was an effective treatment that helped people with psychotic and non-psychotic severe mental disorders to improve global state, symptoms, and functioning. Slight improvements could be seen within a few therapy sessions, but longer courses or more frequent sessions were needed to achieve more substantial benefits.

Anxiety is a separate condition from ADHD, but in this particular case, all children tested for anxiety were diagnosed as ADHD. In any case, none of children tested had any specific medication or long term psychological treatment for anxiety. As stated in a previous chapter, the school intervenes immediately or with short-term psychological attention if needed. So, CAS or STAIC scores in this case simply show a specific snapshot of the entire picture of anxiety and ADHD. Nevertheless, during the tests I had the opportunity of talking to the children, because we had to do the tests in small groups due to the frequent lack of comprehension and the questions raised by the tests. The CAS test did not pose these kinds of problems; the questions seemed

straightforward and clear to the children. Yet the STAIC often posed comprehension problems due to the formulation of the questions, which very often was considered confusing. In this context, I learned the major concern of many of the tested children: their family and social environment. Many of the tested children had a difficult family environment: either they lived with their grandparents, their parents had problems, they lived in shelters or in environments in which they themselves were considered problems. Concerning the findings of anxiety, after the nine weeks of musical intervention, the effect size of 28 students (aged 7 to 8) tested with CAS in Group A was about 0.74; 48 children aged 9 to 12 with complete data were tested with STAIC obtaining an effect size in State Anxiety of 0.96 and of 0.40 in Trait Anxiety. All three indices are considered from moderate to large according to Cohen (1998). State Anxiety scores displayed a better effect than Trait Anxiety, which seemed to match with other studies like (Mok, Wong, 2003), in which the effects of music on patient anxiety were researched. State anxiety considered a transitory state, which occurs in response to a stimulus, is more likely to vary in intensity as a function of the stimulus. State anxiety, discomfort, satisfaction, and perceived compliance with future screening were measured after the procedure. Trait anxiety is related to anxiety proneness, which is a relatively unfluctuating condition of an individual. It identifies children with high levels of neurotic anxiety.

In examining ADHD, one must contend with the unavoidable fact that after years of research, a definite consensus has yet to be reached. The debate surrounding ADHD remains an important social issue and involves clinicians, teachers, parents, media, policymakers, and the children. The concerns range from those who do not believe ADHD exists to those who believe that there are genetic, epigenetic or psychological bases for the condition (Parrillo 2008, Cohen 2006, Safer 2000), and still others are concerned about overdiagnosis of ADHD, the use of stimulant medications in children, and the methods by which the disorder is diagnosed and treated. (Cormier, 2008). The DSM-IV accepts that ADHD is a disorder while disputing the methods of diagnosis and treatment. But some of the principal critics on the issue rely on the fact that diagnostic criteria have frequently changed, that the clinical diagnosis is made without laboratory or radiological confirmatory tests or specific physical features, that the rates of diagnosis and treatment differ across countries, that therapy often includes stimulant drugs with possible side effects, and that there is a need for long-term therapies.

Stimulants are controlled psychotropic substances, classified as Schedule II substances (Schedule II: potential for abuse, potential for psychological or physical addiction; currently accepted medial use) (Rosack). Methylphenidate, the most commonly used pharmacological treatment for ADHD, has yet to be evaluated in controlled clinical trials for longer than 4 weeks (Schachter, 2001). Although the National Institute of Mental Health recommends stimulants for the treatment of ADHD and states that "under medical supervision, stimulants are considered safe" (Nimh ADHD), side effects, uncertain long term effects of drugs used with children who, due to their age are unable to give informed consent to one treatment or the other, constitute a big responsibility for their legal guardians. Although the safety profile of short-term methylphenidate, an amphetamine derivative and potent central nervous stimulant (Auriel et al. 2008, Abramowicz et. al 2003) has been well established, chronic or repeated use of psychostimulants is less clear. Concerns have been raised about long-term therapy causing paranoia, schizophrenia and behavioral sensitization.

High rates of childhood stimulant use have been noted in patients with a diagnosis of schizophrenia and bipolar disorder independent of ADHD. (Ross, 2006, DelBello, et al. 2001, Soutullo et al 2002). Stimulant medication may also inhibit cartilage growth, liver development and central nervous system growth factors (Joshi et al.2002). The majority of studies that have assessed its abuse potential, rate it on a par with cocaine and d-amphetamine (Kollins, 2001). Between 16 and 29 percent of students who are prescribed stimulants report diverting their prescriptions. Between 5 and 9 percent of grade/primary and high school children have used non-prescribed stimulants to concentrate, improve alertness, get high or to experiment (Wilens et al 2008). However, studies to investigate whether stimulant medication can lead to drug abuse later in life found that when used in childhood did not affect or lowered, the risk for substance of abuse in adulthood compared to unmedicated individuals with ADHD. (Kollins, 2008). But a 2006 study and a 2009 review found that those who had received stimulants during childhood showed the highest number of cocaine abusers in adulthood. (Davinson, 2009, Lambert et al. 2006).

In September 2008, the FDA sent notices to Novartis Pharmaceutical and Johnson

& Johnson regarding advertisings of Focalin XR and Concerta accusing them of overstating products' efficacies (Focalin XR 2008, Concerta 2008). In the 90s, the US used 90% of the stimulants produced globally, and in the 2000s 80%, due to an increased use in other areas of the world (Marwick, 2003). Nevertheless there is a clear and objective point of view on that controversy: The economic impact and cost of the treatments. Pelham et al. (2007) established costs associated with pediatric and adolescent ADHD, and placed the overall cost per individual with ADHD to be almost $15,000 annually. Let's focus again on medication, which despite all the doubts is the most widely used treatment for ADHD. What are the health-care costs? How much ADHD medication is sold and how much does it cost? We shall consider figures that focus on several European countries and Spain. The data was given by IMS Health and refers to ADHD drugs sold in 2010 in the related countries. The table displays total sales per country, SU (sold units), in retail and hospitals and makes a sales distribution for each medication: Methilphenidate: Concerta, Medikinet and Rubifen; Atomexetina: Strattera.

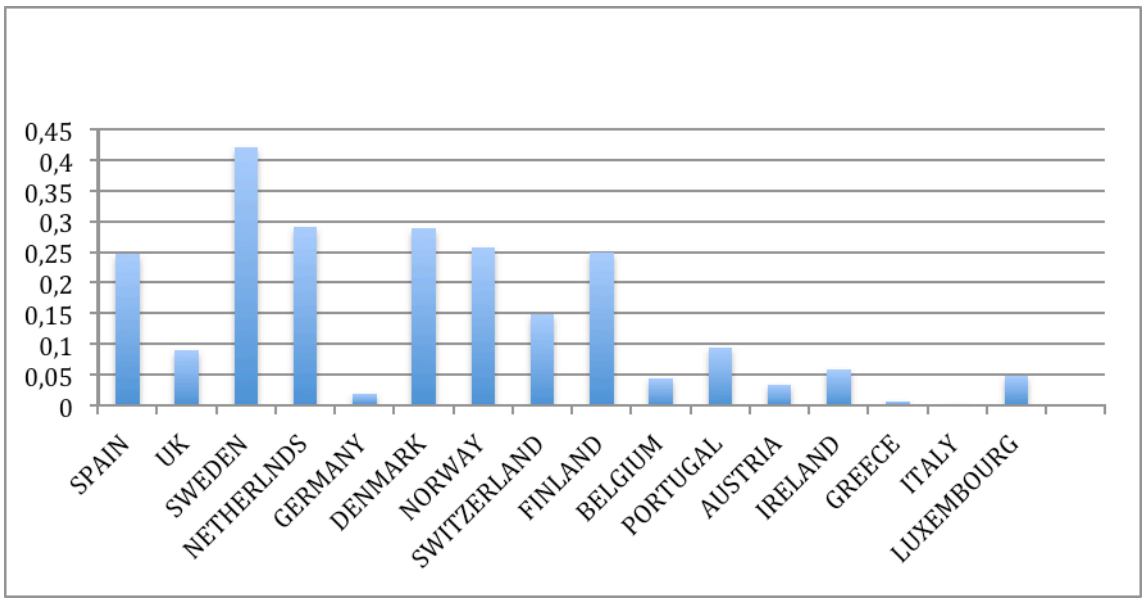
Data from ISM Heal	SU /2010 (Thousands		
UK RETAIL	5,234	UK HOSPITAL	24
CONCERTA	3,988	CONCERTA	16
STRATTERA	1,247	STRATTERA	7
SWEDEN COMBINED	3,969		
CONCERTA	2,843		
STRATTERA	672		
MEDIKINET	454		
NETHERLNDS XPONEN	4,877		
CONCERTA	3,613		
STRATTERA	255		
MEDIKINET	1,009		
GERMANY RETAIL	1,555	GERMANY HOSPITA	4
STRATTERA	1,555	STRATTERA	4
DENMARK COMBINED	1,570		
CONCERTA	942		
STRATTERA	396		
MEDIKINET	231		
NORWAY RETAIL	1,296	NORWAY HOSPITA	1
CONCERTA	996	CONCERTA	7
STRATTERA	264	STRATTERA	4
MEDIKINET	36	MEDIKINET	0

SWITZERLAND RETAIL	1,123	SWITZERLAND HOS	2
CONCERTA	889	CONCERTA	2
STRATTERA	119	STRATTERA	2
MEDIKINET	116		
FINLAND RETAIL	662	FINLAND HOSPITA	1
CONCERTA	531	STRATTERA	6
STRATTERA	57	CONCERTA	7
MEDIKINET	74	MEDIKINET	2
BELGIUM RETAIL	467	BELGIUM HOSPITA	7
CONCERTA	372	CONCERTA	5
STRATTERA	95	STRATTERA	2
PORTUGAL RETAIL	1,053		
CONCERTA	556		
RUBIFEN	494		
STRATTERA	3		
AUSTRIA RETAIL	280	AUSTRIA HOSPITA	4
CONCERTA	178	STRATTERA	3
STRATTERA	100	CONCERTA	1
MEDIKINET	3	MEDIKINET	0
IRELAND RETAIL	269	IRELAND HOSPITA	1
CONCERTA	185	STRATTERA	1
STRATTERA	84	CONCERTA	1
LUXEMBOURG RETAIL	24		
CONCERTA	19		
STRATTERA	4		
GREECE RETAIL	67		
STRATTERA	34		
CONCERTA	33		
ITALY RETAIL	33	ITALY HOSPITAL	8
STRATTERA	33	STRATTERA	8

The figure below shows the total sales (retail and hospitals) of ADHD drugs (Rubifen, Medikinet, Strattera, Concerta) distributed by the listed countries and in relation to the population of each country. Countries like Sweden with a 0.42 SU/capita, or Netherlands with 0.29 SU/capita, Denmark with 0.26 US/capita or Spain with 0.24 SU show the highest rates of ADHD drug sales.

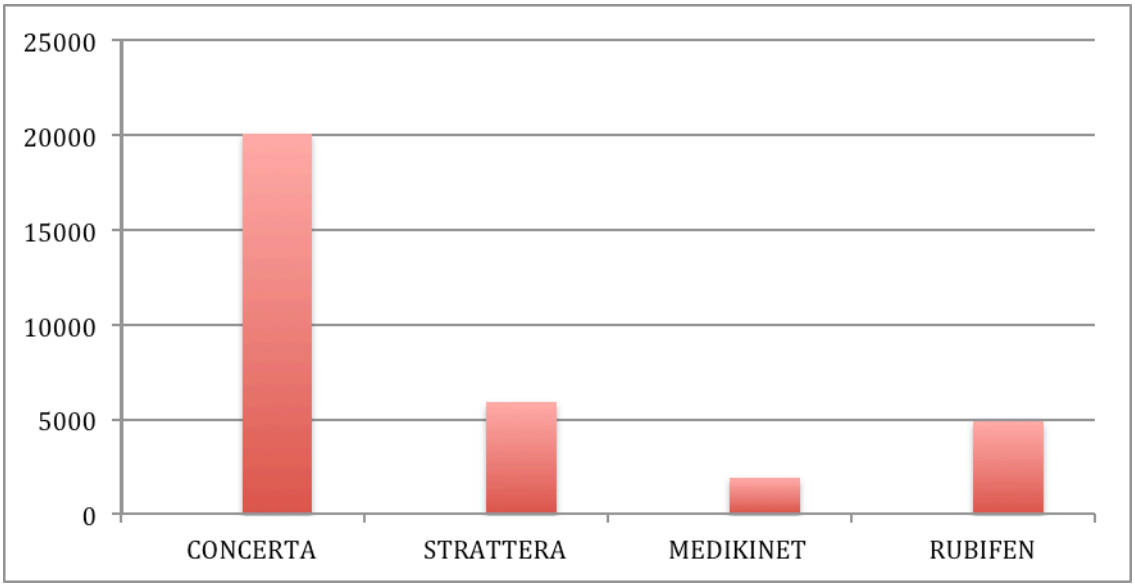
These data displayed in a table:

COUNTRIES	TOTAL SU	POPULATIO	SU/POP
SPAIN	11,654,00	47,190,19	0.2469580
UK	5,475,00	61,284,80	0.0893369
SWEDEN	3,969,00	9,415,295	0.4215481
NETHERLNDS	4,877,00	16,785,08	0.2905555
GERMANY	1,601,00	82,604,00	0.0193816
DENMARK	1,570,00	5,422,366	0.2895415
NORWAY	1,281,00	4,973,000	0.2575909
SWITZERLAND	1,140,00	7,725,200	0.1475699
FINLAND	1,338,00	5,375,276	0.2489174
BELGIUM	474000	11,071,50	0.0428126
PORTUGAL	1,053,00	11,317,19	0.0930442
AUSTRIA	284000	8,334,325	0.0340759
IRELAND	270000	4,581,269	0.0589356
GREECE	67000	11,260,40	0.0059500
ITALY	41000	60,776,53	0.0006746
LUXEMBOURG	24000	502,000	0.0478087



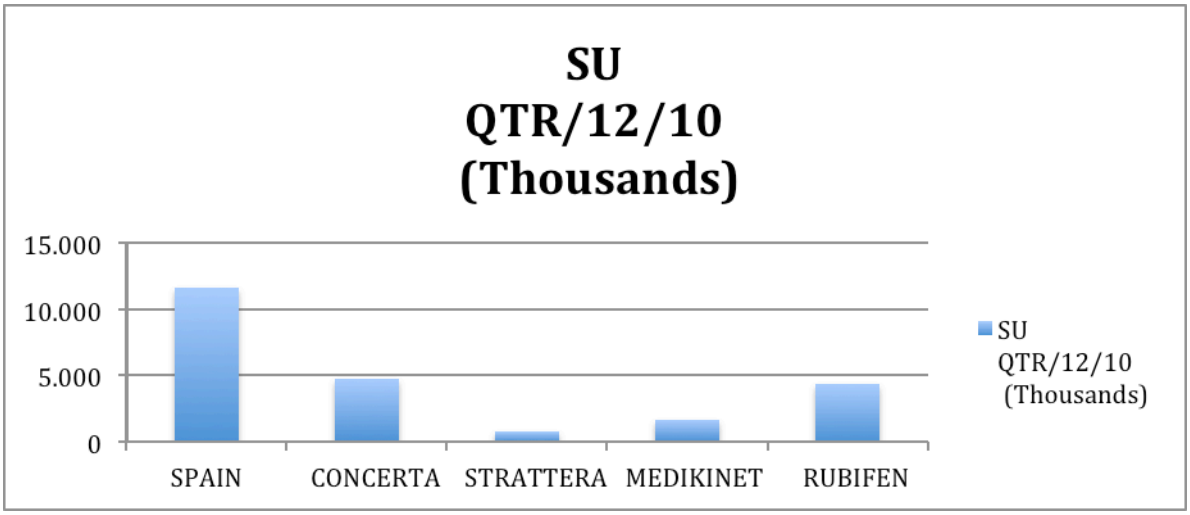
The following table displays the total sales (2010) of Concerta, Medikinet, Strattera and Rubifen in the countries listed above. Concerta with a total of 20,070 SU is the most sold drug, followed by Strattera with 5918 SU, Medikinet with 1925 SU and

Rubifen (Methilphenidate) with 4873 SU and only sold in Spain and Portugal. The leading position of Concerta is striking, more so when considering the price differences per box.



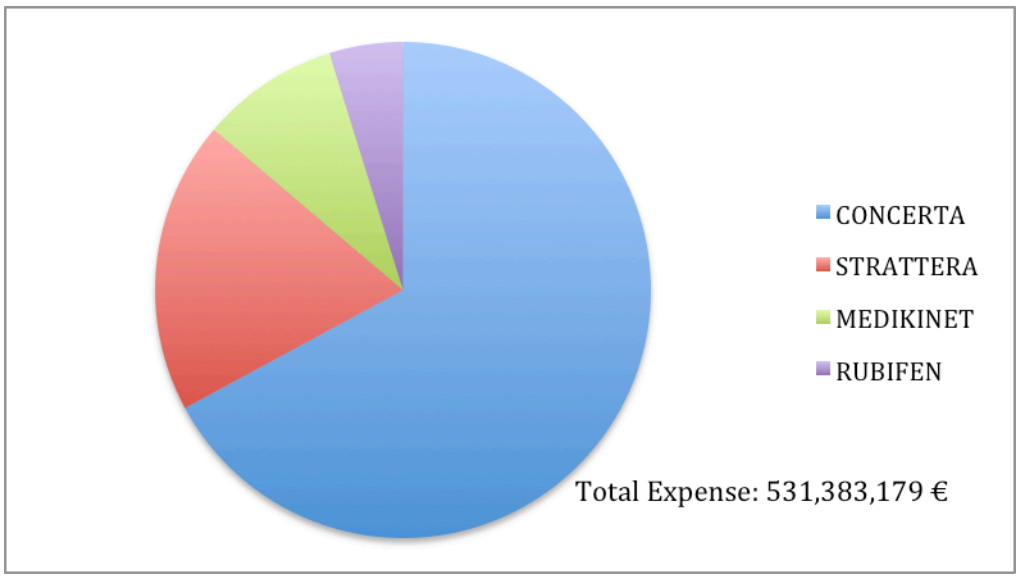
In order to calculate the cost of these medicines, I prefer to focus on Spain as a sure reference sample. The health care system varies from country to country. The figure below shows the data in Spain. The total sold units in 2010, 11,654,000/by the total Spanish population 47,190,195 which results in 0.25 unit/year/capita. According to these data (IMC) 4,704,000 boxes of Concerta, 833,000 boxes of Strattera, 1,703,000 of Medikinet and 4,371,000 boxes of Rubifen (Methilphenidate) were sold in Spain in 2010.

Data from I Health	SU /2010 (Thousands)		
SPAIN RETA	11,611		
CONCERT	4,704	SPAIN HOSPITAL	43
STRATTER	833	STRATTERA	24
MEDIKINE	1,703	CONCERTA	11
RUBIFEN	4,371	RUBIFEN	9
		MEDIKINET	1



The individual prices in Spain for Concerta 76.02€, Strattera 121€, Medikinet 28 € and Rubifen, 5.79 €. In 2010 the cost for Concerta was 357,598,080€, for Strattera 100,793,000€, for Medikinet 47,684,000€ and for Rubifen 25,308,090€. The total expense for these medicines in Spain was 531,383,179 € in 2010. 60% of the cost was paid by the Spanish health system, which makes 318,829,907.40 € and 40% by private clients 212,553,271.60€.

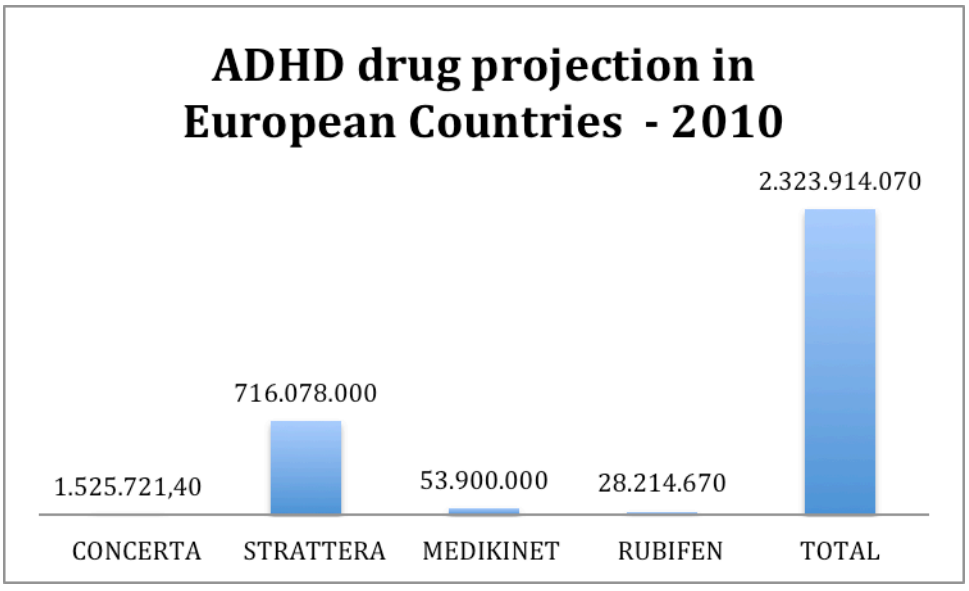
Fig.: Total expense ADHD drugs in Spain in 2010: 531,383,179 €



The price disparity between products consisting of the same active ingredient, methylphenidate, is striking. Concerta costs 76.02€; while Medikinet costs 28€ and

Rubifen costs 5.79€. The most significant cost by far is Concerta, which differs from the other drugs only in a time-release technology. This means that while Concerta and Rubifen sell roughly the same number of units, the cost difference is vast – 329,289,990€ in 2010. It would prove interesting to conduct a separate study to analyze this data more extensively, as undoubtedly the price difference and decision to prescribe one drug or the other involves serious repercussions to the Spanish health care system. This is especially important at present when considering the ongoing Spanish budgetary cuts due to the financial crisis, because the public health care system´s budgets are being reduced.

If we make a projection of SU of Concerta in the 16 countries listed above and presume that the cost of each box (SU) is similar than in Spain (76.02 €) we would have a total expense of Concerta in these countries of 1,525,721,400 €; for Strattera (Atomexetine hci) 716,078,000 €, for Medikenet, a total of 53,900,000€ and for Rubifen, 28,214,670 €. This makes total sales expenses for ADHD medication in these 16 countries 2,323,914,070 € in 2010 alone. (The projection is approximate; there may be price variations in different European countries.)



In comparison, the AM, including CD and manual, costs from 15 to 16 €. One AM can be used at home, individually, in a group, in a class of 20 children, etc. The alternative is effective, economic and has no unknown side effects. It seems obvious

that children with the condition labeled ADHD, invented or discovered, which is mainly characterized by a degree of attention deficit, which is essential for the adequate development of a human being, are responsive to this kind of musical intervention. I invite people to test and use the AM. If the diagnoses of ADHD continue their increasing trend, the national health care systems are going to strain without a more-cost effective alternative. The pharmaceutical companies´ profit will increase, the state will have to allocate more money to pay for drug-based treatment, and no long-term conclusive studies have been conducted to verify the safety or effectiveness of the medication. Although a lot of literature and scientific studies exist surrounding music intervention and brain development with concrete therapeutic goals, I invite the scientific community to continue searching in this direction to try to find long-term multidisciplinary interventions to help children grow and develop in a positive and healthy way. This will surely require the responsible involvement of clinicians, teachers, parents, media outlets and policymakers.

At this point, I must offer my sincere appreciation to those who have supported me throughout the process of the clinical study and doctoral dissertation – without their help this work would not be what it is. First off, I wish to touch on the fact that this work has been performed in two different countries, and has involved the unconditional support and understanding from various professionals in a number of institutions. The original idea of the dissertation was mentioned to Professor José Antonio Portellano, a reknowned pediatric specialist in Madrid, whose enthusiasm and help in the initial stages of the project offered me a solid base. The idea to present the dissertation in Vienna stems from the fact that I lived and studied in the city for ten years, and my ties with it remain firm, but more importantly, I was attracted to a number of conferences on Consciusness (Vienna Conference on Consciousness 2007) organized by the Natural Science Department I contacted Professor Dittami to expound my hypothesis and to determine the viability of initiating a clinical study and doctoral dissertation with the support and guidance of the University. Professor Dittami expressed his sincere interest, however, due to several circumstances it was considered more appropriate for me to study with my mentor, Professor DDr Bookstein, Professor of Anthropology, Faculty of Life Sciences, University of Vienna, and Professor of Statistics, Faculty of Arts and Sciences, University of Washington. His sage advice and guidance have been absolutely key to my work. It was he who

suggested that I find out if my musical intervention could make a difference in attention and anxiety of children with an ADHD diagnosis, and he helped me with the design of the clinical trial, the statistics and with the focus of this dissertation. As I mentioned before, the issue was a real challenge to me. Considering the topic´s controversy, I had to find an appropriate school in Spain (willing to cooperate with the trial) who had a large enough sample of children with the necessary characteristics. Hence I wish to offer my most sincere appreciation to Dionisia Plaza School, without whose unconditional support this study and research would not have been possible. All of the school´s fine professionals exhibited their trust, openness and willingness to give their all at every moment of the process. The teachers´ help and excellent disposition was essential, as they acted as wonderful catalysts in getting the children to participate. The school´s psychologists were also a fundamental support at the school and were there for me to help resolve any doubt that arose during the study. Furthermore, the school´s administration, with Enrique Plaza Jr. and Enrique Plaza Senior at the helm, were generous and excellent. Finally, I must emphasize the help of Isabel Juárez, the school´s clinician and director of the psychology department, who is an absolute professional – without her support, this research would not have been possible. Her efficiency, understanding and resolute commitment have elevated this work to another level.

Additionally, I wish to thank all of the children from Dionisia Plaza School for their enthusiasm and effort, fundamental pieces to this research, and their parents for their faith and interest. Also, thanks to Margarita Sánchez for her statistical help, to my brother, Javier Toro, for his organization and assessment of the clinical data, to Javier Ruiz for his all-around competence, to Naomi Osorio-Kupferblum for her unconditional support, and to Kevin Brucks for his revision of the English text. Finally, I wish to emphasize the unwavering support of my family, above all, those closest to me, my parents, Daniel and my children, Jon and Paula. Thanks to all of those who have found this work interesting and helpful.

7. BIBLIOGRAPHIC REFERENCES

1. Abramowicz MJ, Van Haecke P, Demedts M, Delcroix M (2003) “Primary Pulmonary hypertension after amfepramone with BMPr2 mutation”.
2. Adam James (2004) Clinical pshychology publishes critique of ADHD and use of medication on children. Published on Psychminden co. Uk Psychminded Ltd.
3. Adams G, (2008), “Harvard medics” concealed drug firm cash. The Independent, London.
4. Adams W, Lack of behavioral effects from Feingold diet violations. Percept Mot Skills 1981 Feb;52(1):307-13
5. Alison Latham In The Oxford Companion to Music, Oxford Music Online, 2011
6. Alvin, J. (1975). Music therapy (Revised Paperback Edition). London: John Clare Books.
7. Alvin, J. (1976) Music for the handicapped child (Second Edition). London: Oxford University Press.
8. Alvin, J. (1978). Music therapy for the autistic child. London: Oxford University Press.
9. Am J Psychiatry 1981 Aug;138(8):1082-5
10. American Academy of Child Adolescent Psychiatry ADHD – A guide for families, June 27, 2009.
11. APA Summary of Practice-Relevant Changes to the DSM-IV-TR
12. Auriel E, Hausdorff JM, Giladi (2008) “Methylphinidate for the treatment of Parkinson disease and other neurological disorders”.
13. Baker, SN (2007). "Oscillatory interactions between sensorimotor cortex and the periphery". Current opinion in neurobiology 17 (6): 649–55. doi:10.1016/j.conb.2008.01.007. PMC 2428102. PMID 18339546.
14. Balin, Lionel (225). Stimulant medication of the treatment of attention-deficit hyperactivity disorder. Evidence-b(i)ased practice?”
15. Barbaresi WJ, Olsen RD, An ADHD educational interview for elementary school teachers: a pilot study J Dev Behav Pediatr 1998 Apr; 19(2): 94-100
16. Barkley, 1997b; Chelune, Ferguson,Koon, & Dickey, 1986; Lou, Henriksen, &Bruh, 1984; Lou, Henriksen, Bruhn, Borner, & Nielsen, 1989; Mattes, 1980
17. Barlow PJ A pilot study on the metal levels in the hair of hyperactive children. Med Hypotheses 1983 Jul;11(3):309-18
18. Barry RJ, Clarke AR, Johnstone SJ (2003) A review of electrophysiology in attention-deficit/hyperactivity disorder: I. Qualitative and quantitative electroencephalography. Clin Neurophysiol 114: 171–183.
19. Bee & Mitchell, SK. (1980). The developing person: A life-span approach. New York: Harper & Rock.
20. Bekaroglu M, et al. Relationships between serum free fatty acids and zinc, and attention deficit hyperactivity disorder: a research note. J Child Psychol Psychiatry 1996 Feb;37(2):225-7
21. Benenzon, R. (1982). Music therapy in child psychosis. (Translated by Wanda Grabia). Springfield, IL: Charles C. Thomas.
22. Benton D et al. Effect of vitamin and mineral supplementation on intelligence of a sample of school children Lancet 1988;I:140-143
23. Bernfort L, Nordfeldt S, Persson J., Acta Paediatr. 2008 Feb;97(2):239-45.ADHD from a socio-economic perspective,
24. Bitcon, C. (1976). A like and different: The clinical and educational use of Orff-Schulwerk. Santa Ana, CA: Rosha Press.
25. Bookstein, F. L., A. P. Streissguth, P. D. Sampson, P. D. Connor and H. M. Barr. Corpus callosum shape and neuropsychological déficits in adult males with heavy fetal alcohol exposure. {\sl NeuroImage} 15:233--251, 2002.

26. Boris M, Mandel FS. Food and additivies are common causes of attention deficit hyperactivity disorder in children. Ann Allergy 1994 May;72(5):462-8
27. Boxill, E. (1985). Music therapy for the developmentally disabled. Rockville, MD: Aspen Systems.
28. Brain Wave Changes In Adolescence Signal Reorganization Of The Brain". ScienceDaily. 2006-12-08. Retrieved 2008-03-24
29. Breakey J The role of diet and behavior in childhood J Paediatr Child Health 1997 Jun; 33(3):190-4
30. Breggin, Peter;Talking Back to Ritalin; Common Courage Pr; 1998
31. Brenner A, Wapnir RA A pyridoxine-dependent behavioral disorder unmasked by isoniazid. Am J Dis Child 1978 Aug;132(8):773-6
32. Brenner, A A study of the efficacy of the Feingold diet on hyperkinetic children Clin Pediatr (Phil) 1977 Jul; 16(7):652-6
33. Brinker, F; Formulas For Healthful Living; Eclectic Medical Publications, 1995; pp 115-18
34. Brinker, F; Herb Contraindications And Drug Interactions, Second Edition ; Eclectic Medical Publications, 1998
35. Broughton S, Ellingham M, Trillo R (2000) World music: The rough guide. London: Rough Guides Publishing Company.
36. Bruscia, 1987, Improvisational models of music therapy. Springfield III: Charles C. Thomas.
37. Bruscia, K. (1987). improvisational models of music therapy. Springfield, IL: Charles C Thomas Publishers.
38. Burks, 1960, Chess, 1960
39. Bussing R, Schoenberg NE, Perwien AR Knowledge and information about ADHD, Soc Sci Med 1998 Apr; 46(7): 919-28
40. Carlo Willmann, *Waldorfpädogogik*, ISBN 3412167002. See "Ganzheitliche Erziehung", 2.3.3"
41. Carter CM et al. Effects of a "few food" diet in attention deficit disorder, Arch Dis Child 1993 Nov;69(5): 564-8
42. CDC Government/ www.cdc.gov./nchs/data/series/sr_10_221.pdf
43. Chabot RJ, Merkin H, Wood LM, Davenport TL, Serfontein G; Sensitivity and Specificity of QEEG in Children with Institute of Psychiatry, London, UK; 2Centre for Addiction and Mental Health, Toronto, Canada
44. Chartered Clinical Psychologist – Hull and East Riding Community Health NHS Trust Honorary Clinical Lecturer – The University of Hull
45. Cohen, Donald J: Cicchetti, Dante (2006). Developmental sychopathology. Chichester: John Wiley & Sons.
46. Comings DE, Blood serotonin and tryptophan in Tourette syndrome. Am J Med Genet 1990 Aug;36(4):418-30
47. Conners CK et al. Food additives and hyperkinesis Pediatrics1976 Aug;58(2): 154-66
48. Conners CK Reported in Med Tribune Jan 8, 1985
49. Conners CK, Blouin AG Nutritional Effects on Behavior of Children J Psychiatr Res 1982-83; 17(2) :193-201
50. Conrad, 1975; Schrag & Divoky,
51. Continuing EdCourses.net
52. Controversies Surrounding ADHD – ADHD diagnosis, history (http://www.mentalhelpnet/poc/view.)
53. Cormier E, (2008) "ADHD a review and update" J Pediatri Nurs 23
54. Crocker, D. (1957). Music as a therapeutic experience with the emotionally disturbed child. In E. T. Gaston (Ed.), Music Therapy,.7, 114-119.
55. Crombie I , et al Effect of vitamin and mineral supplementation on verbal and non-verbal reasoning of schoolchildren Lancet 1990;335:744-7
56. Damasio, Antonio R. 1999. The Feeling of What Happens: Body and Emotion in the Making of

Consciousness. New York: Harcourt.
57. Damon and Hart (1982). The development of self-understanding from infancy through adolescence. Child Development, 53, 841-864.
58. Daniel Smilek, Jonathan S. A. Carriere, J. Allan CheyneFailures of sustained attention in life, lab, and brain: Ecological validity of the Department of Psychology, University of Waterloo, Canada
59. David Aldridge, PhD Chair of Qualitative, Research in Medicine University Witten Herdecke Alfred Herrhausen Strasse 50, 58448 WITTEN, Germany davida@uni-wh.de
60. Day-O'Connell J (2007) Pentatonicism from the eighteenth century to Debussy. New York: University of Rochester Press.
61. DelBello MP, Soutullo CA, Hendricks W, Niemeier RT, McElroy SL, Strakowski SM (2001). "Prior stimulant treatment in adolescents with bipolar disorder: association with age at onset".
62. Department of Clinical Psychology, The University of Hull, Cottingham Road, Hull, HU6 7RX
63. Development of DSM. Kadi.myweb.uga.edu. Retrieved 2009-05-25.
64. Egger J et al. Controlled trial of oligoantigenic treatment in the hyperkinetic syndrome Lancet 1985 Mar 9;1(8428):540-5
65. Egger J et al. Effect of diet treatment on enuresis in children with migraine or hyperkinetic behavior Clin Pediatr (Phila) 1992 May;31(5) :564-8
66. Erich Harth, Professor of Physics at Syracuse University, Windows on the Mind , William Morrow & Co; 1st edition (December 1981)p.170
67. Ernst-Michael Kranich, "Anthropologie", in F. Bohnsack and E-M Kranich (eds.), *Erziehungswissenschaft und Waldorfpädagogik*, Reihe Pädagogik Beltz, Weinheim 1990, p. 126, citing F. Ilg and L. Ames (Gesell Institute), *School Readiness*, p. 236ff and Diss. Cornell U. Silvestro, John R. 1977. "Second Dentition and School Readiness." New York State Dental Journal 43 (March).
68. Essman W Nutrients and Brain Function Karger Press, Basil, Swittzerland, 1987
69. Esther Mok "Effects of music on patient anxiety - Research". AORN Journal. FindArticles.com. 12 May, 2012.
70. Familiy therapy ofr ADD or ADHD in children and adolescents. The Cochrane Collaboration, April 20, 2005. Retrieved 2008-09-19.
71. Feingold BF. Hyperkinesis and learning disabilities linked to the ingestion of artificial food colors and flavors J Learn Disabil 9(9) 551-9, 1976
72. Ferguson HB et al. Plasma free and total tryptophan, blood serotonin, and hyperactivity syndrome: no evidence for the serotonin deficiency hypothesis Biol Psychiatry 1981 Mar;16(3):231-8
73. Fitzsimon M, Holborow P, Berry P, Latham Salicylate sensitivity in children reported to respond to salicylate exclusion. Med J Aust 1978 Dec 2;2(12):570-2
74. Fuchs, T. Birbaumer,N., Lutzenberger, W., Gruzelier, J. H., & Kaiser, J. (2003). Neurofeedback Treatment for attention deficit/hyperactivity disorder in children: A comparison with methylphenidate. Applied Psychophysiology & Biofeedback, 28, 1-12.
75. Gabora, Liane (1997). "The Origin and Evolution of Culture and Creativity". Journal of Memetics - Evolutionary Models of Information Transmission 1.
76. Gill KZ, Purves DA. Biological rationale for musical scales. PLoS ONE. 2009;4:1-8.
77. Glover, Sarah Ann (1845). A Manual of the Norwich Sol-fa System: For Teaching Singing in Schools and Classes, Or, a Scheme for Rendering Psalmody Congregational. Jarrold & Sons
78. Glozer DE, Freedberg KA, Bauchner H Management of childhood lead poisoning: clinical impact and cost-effectiveness Med Decis Making1995 Jan-Mar;15(1):13-24
79. Gretchen J Bjornstad, Paul Montgomery, Family therapy for attention-deficit disorder or attention-

deficit/hyperactivity disorder in children and adolescents, Editorial Group: Cochrane Developmental, Psychosocial and Learning Problems Group, Published Online: 17 MAR 2010.

80. Grinnell, B. (1980). The developmental therapeutic process: A new theory of therapeutic intervention. (Doctoral dissertation, Bryn Mawr College, PA). Available from University Microfilms.

81. HAGEN C. FLEHMIG1, MICHAEL STEINBORN2, ROBERT LANGNER3, ANJA SCHOLZ4 & KARL WESTHOFF, Psychology Science, Volume 49, 2007 (2), p. 132-149 Assessing intraindividual variability in sustained attention: reliability, relation to speed and accuracy, and practice effects.

82. Harley JP et al Hyperkinesis and food additives: testing the Feingold hypothesis Pediatrics 1978 Jun; 61(6) :818-28

83. Harner IC, Foiles RA Effect of Feingold's K-P diet on a residential mentally handicapped population J Am Diet Assoc 1980 Jun; 76(6) :575-8

84. Harter (1990). Issues in the assessment of the self-concept of children and adolescents. In A.M. La Greca (Ed.), Through the eyes of the child: Obtaining self-reports from children and adolescents (pp. 292-325). Boston: Allyn & Bacon.

85. Heimlich, E (1981). Patient as assistant therapist in Paraverbal therapy with children. American journal of Psychotherapy, 35 (2), 262-267.

86. Heimlich, E. (1965). The specialized use of music as a mode of communication in the treatment of disturbed children. Journal of the American Academy of Child Psychiatry, 4 (1), 86122.

87. Heimlich, E. (1972). Paraverbal techniques in the therapy of childhood communication disorders. International Journal of Child Psychotherapy, I (1), 65~3.

88. Heimlich, E. (1980J. Paraverbal techniques: A new approach for communication with children having learning difficulties. Journal of learning disabilities, 13 (9), 16-18.

89. Heimlich, E. (1983). The metaphoric use of song lyrics as Paraverbal communication. Child Psychiatry and Human Development. 14 (2), 67-75.

90. Heimlich, E. (1985). Methods of Paraverbal communication. Unpublished manuscript.

91. Hindle RC, Priest J The management of hyperkinetic children: a trial of dietary therapy N Z Med J 1978 Jul 26;88(616) :43-5

92. Hoehn-Saric R, Schlund MW, Wong SH (2004): Effects of citalopram on worry and brain activation in patients with generalized anxiety disorder. Psychiatry Res 131:11-21.

93. Howard JMH: Clinical import of high levels of aluminum Clin Chem 1984; 30(10):1722-3

94. Hughes EC et al. Food sensitivity in attention deficit disorder with hyperactivity (ADD/HA): a procedure for differential diagnosis Ann Allergy 1982 Nov; 49(5):276-80

95. Ian H. Robertson, Tony Ward, Valerie Ridgeway, Ian Nimmo-Smith, Thames Valley Test Company, 1994, Reviewed by Dr. Andrew W. McAnespie, THE TEST OF EVERY DAY ATTENTION (TEA).

96. ICD Version 2006: F91. World Health Organization. Retrieved on December 11, 2006. COPYRIGHT 2003 Association of Operating Room Nurses, Inc.

97. Irwin M, et al. Tryptophan metabolism in children with attentional deficit disorder.

98. J Appl Behav Anal 1978 Winter; 11(4): 439-46

99. J Learn Disabil 8:354, 1975

100. Jackson NA .La Universidad de Temple, EE.UU..

101. Jensen PS, Martin D, Cantwell DP. Comorbidity in ADHD: implications for research, practice, and DSM-V. J Am Acad Child Adolesc Psychiatry. 1997;36:1065-1079. Abstract

102. Jim Rosack "Controversy Erupts Over Ads for ADHD Drugs".

103. Johnson MR, Lydiard RB., The neurobiology of anxiety disorders. Source, Department of Psychiatry, Medical

University of South Carolina, Charleston, USA.
104. Jones MW, Wilson MA (2005) Theta Rhythms Coordinate Hippocampal–Prefrontal Interactions in a Spatial Memory Task. PLoS Biol 3(12): e402. doi:10.1371/journal.pbio.0030402, 2005;
105. Joseph Biederman, M.D., professor of psychiatry, Harvard Medical School, and Chief, Clinical and Research Programs in Pediatric Psychopharmacology and Adult ADHD, Massachusetts General Hospital, Boston; Rafael Klorman, Ph.D., professor of psychology, director of Clinical Training, University of Rochester, New York; Edward Hallowell, M.D., director, Hallowell Center, Sudbury, Mass.; David L. Katz, M.D., M.P.H., director, Prevention Research Center Yale University Schools of Public Health and Medicine, New Haven, Conn.; Sept. 9, 2004, American Medical Association press conference on ADHD, New York City.
106. Joshi SV, Adam, H, M (2002). "ADHD, grow deficits, and relationships to psychostimulant use.
107. Journal of Child Psychology and Psychiatry (2008), pp, Jonathan Mill1 and Arturas Petronis, J Música Ther. de invierno de 2003; 40 (4) :302-23.
108. Kahana MJ, Sekuler R, Caplan JB, Kirschen M, Madsen JR (1999) Human theta oscillations exhibit task dependence during virtual maze navigation. Nature 399: 781–784.
109. Kanarek RB. Does sucrose or aspartame cause hyperactivity in children? Nutr Rev. 1994 May;52(5):173-5.
110. Kaplan BJ et al. Dietary replacement in preschool-aged hyperactive boys. Pediactrics 1989 Jan;83(1): 7-17
111. Kaplan BJ, McNicol J, Conte RA, Moghadam HK, Overall nutrient intake of preschool hyperactive and normal boys. J Abnorm Child Psychol 1989 Apr; 17(2):127-32
112. Katsh, S., & Merle-Fishman, C. (1984). The musical metaphor: A model for music therapy in community practice. Paper presented at the annual conference of the American Association for Music Therapy, New York City, NY.
113. Kershner J, Hawke W Megavitamins and learning disorders: a controlled double-blind experiment J Nutr 109(5):819-26
114. Klein, Sarah, Study: ADHD linked to pesticide exposure (2010).
115. Knobel, Wolman & Mason, 1959; Laufer, Denhoff & Solomons, 1957
116. Kodály, Zoltán (1971) Folk Music of Hungary. New York: Praeger (Werry, 1988).
117. Kollins SH (2008). "ADHD, substance use disorders, and psychostimulant treatment: current literature and treatment guidelines". Journal of Attention Disorders 12.
118. Kozbelt, Aaron; Beghetto, Ronald A. and Runco, Mark A. (2010). "Theories of Creativity". In James C. Kaufman and Robert J. Sternberg. The Cambridge Handbook of Creativity. Cambridge University Press. ISBN 978-0-521-73025-9.
119. Kozielec T, Starobrat-Hermelin B Assessment of magnesium levels in children with attention deficit hyperactivity disorder (ADHD) Magnes Res 1997 Jun;10(2):143-8
120. Kozielec T, Starobrat-Hermelin B, Kotkowiak L Deficiency of certain trace elements in children with hyperactivity Psychiatr Pol 1994 May-Jun;28(3):345-53
121. Krain, AL; Castellanos FX (2006). "Brain development and ADHD". Clinical Psychology Review 26.
122. Krummel DA, Seligson FH, Guthrie HA. Hyperactivity: is candy causal? Crit Rev Food Sci Nutr. 1996 Jan;36(1-2):31-47.
123. Laboratory of Neuro Imaging: Retrieved 2088-09-19.
124. Lambert NM, Mc Leod M, Schenk S (2006). "Subject responses to initial experience with cocaine: an exploration of the incentive-sensitization theory of drug abuse."
125. Lara J. Akinbami et al., M.D.; Xiang Liu, M.Sc.; Patricia N. Pastor, Ph.D.; and Cynthia A. Reuben, M.A National Health Interview Survey, 1998–2009

126. Lara J. Akinbami, M.D.; Xiang Liu, M.Sc.; Patricia N. Pastor, Ph.D.; and Cynthia A. Reuben, M.A, National Health Interview Survey, 1998-2000.

127. Laubach M, Wessberg J, Nicolelis MA (2000) Cortical ensemble activity increasingly predicts behaviour outcomes during learning of a motor task. Nature 405: 567-571. http://www.plosbiology.org/article/findArticle.action?author=Laubach&title=Cortical ensemble activity increasingly predicts behaviour outcomes during learning of a motor task.Steriade M, Gloor P, Llinas RR, Lopes de Silva FH, Mesulam MM (1990) Report of IFCN Committee on Basic Mechanisms. Basic mechanisms of cerebral rhythmic activities. Electroencephalogr Clin Neurophysiol 76: 481-508.

128. Lehrer-Carle, 1. (1971). Group dynamics as applied to the use of music with schizophrenic adolescents. Journal of Contemporary Psychotherapy, 3 (2), 111-116.

129. Lehrer-Carle, 1. (1982). Music therapy in a different key. Music therapy: Journal of the American Association for Music Therapy, 2, 73-71.

130. Levy F et al. Hyperkinesis and diet: a double-blind crossover trial with tartrazine challenege Med J Aust 1978 Jan 28; 1(2):61-64

131. Lorberbaum JP, Kose S, Johnson MR, Arana GW, Sullivan LK, Hamner MB, Ballenger JC, Lydiard RB, Brodrick PS, Bohning DE, George MS (2004): Neural correlates of speech anticipatory anxiety in generalized social phobia. Neuroreport 15:2701-2705.

132. Lubar, J. F. (1991). Discourse on the development of EEG diagnostics and biofeedback for attention-deficit/hyperactivity disorders. Biofeedback and Self-Regulation, 16, 202-225.

133. Lubar, J.F., and Bahler, W.W. (1976a). Behavioral management of epileptic seizures following biofeedback training of the sensorimotor rhythm. Biofeedback and Self Regulation, 1, 77-104.

134. Lubar, J.F., and Shouse, M.N. (1976b). EEG behavioral changes in a hyperactive child concurrent training of the sensorimotor rhythm (SMR). A preliminary report. Biofeedback and Self Regulation, 9(1), 1-23.

135. Lubar, J.O., and Lubar, J.F. (1984). Electroencephalographic biofeedback of SMR and beta treatment of attention deficit disorders in a clinical setting. Biofeedback and Self Regulation, 9(1), 1-23.

136. Lubar, J.O., Bianchini, K., Calhoun, W., Lambert, E., Brody, Z and Shabsin, H. (1985). Spectral analysis of EEG differences between children with and without learning disabilities. Journal of Learning Disabilities, 18, 403-408.

137. Malizia AL, Cunningham VJ, Bell CJ, Liddle PF, Jones T, Nutt DJ (1998): Decreased brain GABA(A)-benzodiazepine receptor binding in panic disorder: preliminary results from a quantitative PET study. Arch Gen Psychiatry 55:715-720.

138. Mann CA, Lubar JF, Zimmerman AW, Miller CA, Muenchen RA (1992) Quantitative analysis of EEG in boys with attention-deficit-hyperactivity disorder: Controlled study with clinical implications. Pediatr Neurol 8: 30-36.

139. Marilyn P. Zimmerman, An Overview of Developmental Research in Music, Bulletin of the Council for Research in Music Education, No. 116 (Spring, 1993), pp. 1-21

140. Marni Finkelstein, Mark Wamsley, Doreen Miranda. What keeps in Foster from succeding in school? Views of Early Adolescents and the Adults in Their Lives, Vera Institute of Justice July 2002

141. Martin Schwander[1], Bechara Kachar[2], and Ulrich Müller, The cell biology of hearing, published July 12, 2010 // JCB vol. 190 no. 1 9-20

142. Martine Van Puyvelde, Pol Vanfleteren, Gerrit Loots, Sara Deschuyffeleer, Bart Vinck, Wolfgang Jacquet, Werner Verhelst Vrije Universiteit Brussel (VUB), Pleinlaan 2, B-1050 Brussels, Belgium, Universiteit van Amsterdam (UvA), Netherlands, University of Ghent (UG), Belgium, Hogeschool-Universiteit Brussel (HUBrussel), Belgium Received 8 May 2009. Revised 15 December 2009. Accepted 9 April 2010. Available online 15 May 2010.

143. Marwick, C (2003). "US doctor warns of misuse of prescribed stimulants" (http:www.bmj.com/cgi/content/extract/326/7380/67).

144. Mary L. Serafine, Piagetian Research in Music, Bulletin of the Council for Research in Music Education, No. 62 (Spring, 1980), pp. 1-21

145. Mattes JA, Gittelman R Effects of artificial food colorings in children with hyperactive symptoms. A critical review and results of a controlled study Arch Gen Psychiatry 1981 Jun; 38(6):714-8

146. Mayes R, Bagwell, Erkulwater (2008) "ADHD and the rise in stimulant use among children". Harv Rev Psychiatry 16.

147. Mc Cann D, Barret A, Cooper A (2007). "Food aditives and hyperactive behaviour in 3-year-old and 8/9-year-old children in the community: a randomized, doublé-blinded, placebo-controlled trial".

148. Mc Donagh MS, Peterson K, Dana T, Thakurta S. (2007). Drug Class Review on Pharmacological Treatments for ADHD.

149. Milichap JG (2008). "Etiological classification of ADHD".

150. Monastra, V. J., Monastra, D. M., & George, S. (2002). The effects of stimulant therapy, EEG biofeedback, and parenting style on the primary symptoms of attention-deficit/hyperactivity disorder. Applied Psychophysiology & Biofeedback, 27(4), 231-249.

151. Moreno, J J. (1980). Musical psychodrama: A new direction in music therapy. Journal of Music Therapy. 17 (1), 3~43.

152. Moreno, J. J. (1984). Musical psychodrama in Paris. Music Therapy Perspectives, 1 (4), 2-6.

153. Mukherjee P (2004) The scales of Indian music. New Delhi: Aryan Books International.

154. Nelson M, et al. Nutrient intakes, vitamin-mineral supplementation on intelligence and brain function Brit J of Nutr 1990; 64:13-22

155. Neurosci Lett. 2007 Aug 31;424(1):55-60. Epub 2007 Aug 6. Brain wave synchronization and entrainment to periodic acoustic stimuli.

156. NIMH-ADHD- The treatment of ADHD
(http:www.nimh.nih.gov/health/publication/ADHD/medications.shtml)

157. Nitschke JB, Sarinopoulos I, Mackiewica KL, Schaefer HS, Davidson RJ (2006): Functional neuroanatomy of aversion and its anticipation. Neuroimage 29:106 -116.

158. Nordoff, P., & Robbins, C. (1965). Music therapy for handicapped children. Blauvelt, NY: Rudolf Steiner Publications (out of print).

159. Nordoff, P., & Robbins, C. (1971). 'Therapy in music for handicapped children. London: Victor Gollancz, Ltd.

160. Nordoff, P., & Robbins, C. (1983). Music therapy in special Education. (Revised edition). St. Louis: MMB.

161. Nordoff, P., & Robbins. C. (1977). Creative music therapy. New York: Harper h Row Publishers.

162. Oades, Robert D. (2000) Differential measures of 'sustained attention' in children with attention-deficit/hyperactivity or tic disorders: relations to monoamine metabolism.

163. Oberman, Lindsay M.; Edward M. Hubbarda; Joseph P. McCleery; Eric L. Altschulera; Vilayanur S. Ramachandran; Jaime A. Pineda (July 2005). "EEG evidence for mirror neuron dysfunction in autism spectrum disorders". Cognitive Brain Research 24 (2): 190-198. doi:10.1016/j.cogbrainres.2005.01.014. PMID 15993757. Retrieved 5 December 2011.

164. Orff, G. D. (1988). The Orff music therapy. (M. Murray Trans.). New York: Schott Music Corporation (Original published in 1974).

165. Parrillo, Vicent (2008). Encyclopedia of Social Problems. SAGE p.63. Retrieved 2009-05-02.

166. Patel AD (2008) Music, Language, and the Brain. New York: Oxford University Press

167. Pelham WE, Foster EM, Robb JA, Pediatr Psychol. 2007 Jul;32(6):711-27. Epub 2007 Jun 7.- The economic impact of attention-deficit/hyperactivity disorder in children and adolescents.

168. Pharmalot -Florida Medicaid to review antipsychotics & ADHD (http://www.pharmalot.com/2008/01)

169. Phobic and Anxiety Disorders in Children and Adolescents: A Clinician's ... by H. Ollendick,John S. March (MD.) 2004 by Oxford University Press, Inc.
170. Piaget, J., & Inhelder, B. (1973). Memory and intelligence. London: Routledge and Kegan Paul.
171. Pliszka et al (1999)
172. Pogosyan, A; Gaynor, LD; Eusebio, A; Brown, P (2009). "Boosting cortical activity at Beta-band frequencies slows movement in humans". Current biology : CB 19 (19): 1637–41. doi:10.1016/j.cub.2009.07.074. PMC 2791174. PMID 19800236.
173. Polanczy G. De Lima MS, Horta BL, Biedermann J. Rohde AL (June 2007) "The worldwide prevalnece of ADHD: a systemic review and metaregression analysis". The American Journal of Psychiatry 164.
174. Priestley, M. (1975). Music therapy in action. St. Louis: MMB.
175. Priestley, M. (1980). The Herdecke analytical music therapy lectures Unpublished in English, German translation by Brigitte Stein (1983). Stuttgart, Germany: Klett Cotta.
176. Prinz RJ, et al. Dietary correlates of hyperactive behavior in children. J Consult Clin Psychol 48:760–9, 1980
177. Quay and La Greca (1986). Disorders of anxiety, withdrawal, and dysphoria. In H.C. Quay and J.S. Werry, Psychopathological disorders of childhood (3rd ed. Pp 71–110). New York: Wiley.
178. Randel, Don. The Harvard Dictionary of Music. Belknap, 1986. p. 218.
179. Rauch SL, Savage CR, Alpert NM, Fischman AJ, Jenike MA (1997): The functional neuroanatomy of anxiety: a study of three disorders using
180. Ritalin Addiction (http://www.drug-rehabs.org/drugs/ritalin.php).
181. Roman T, Rohde AL, Hutz MH (2004): "Polymorhisms of the dopamine trasporter gene: influence on esponse to methillphenidate in attention déficit-hyperactivity disorder".
182. Rose TL The functional relationship between artificial food colors and hyperactivity.
183. Ross RG (July 2006). "Psychotic and manic-like symptoms during stimulant treatment of ADHD. The American Journal fo Psychiatry 163.
184. Rowe KS Synthetic food colorings and "hyperactivity"; a double-blind crossover study Aust Paediatr J 1988 Apr; 24(2):143–7
185. Ruff HA et al. Declining blood levels and cognitive changes inmoderately lead-poisoned children JAMA 1993;269(13):169–81
186. Safer DJ, (2000) "Are stimulants overprescribred for youths with ADHD?" Ann Clin Psychiatry 12.
187. Schachter HM, Pham B, King J, Langford S, Moher D, (2001). "How efficacious and safe is short-acting methylfenidate for the treatment of ADHD in children and adolescents? A meta-analysis.
188. Schatz DB, Rostain AL. ADHD with comorbid anxiety: a review of the current literature. J Atten Disord. 2006;10:141–149.
189. Schatz DB, Rostain AL. ADHD with comorbid anxiety: a review of the current literature. J Atten Disord. 2006;10:141–149. "CG72 ADHD: full guideline. NHS 24 September 2008. Retrieved 2008-10-08.
190. Schauss AG Nutrition and behavior: complex interdisciplinary research Nutr Health 1984; 3(1–2):9–37
191. Schmidt MH et al. Does oligoanitgenic diet influence hyperactive/conduct-disordered children? a controlled trial Eur Child Adolesc Psychiatry 1997 Jun;6(2):88–95
192. Schwander et al.,The Rockefeller University Press, doi: 10.1083/jcb.201001138, © 2010
193. Sciencedaily.com 2007-11-13. Retrieved 2009-05-25."Brain Matures a Few Years Late in ADHD, But Follow Normal Pattern.
194. Sciutto, Nolfi&Blum 2004. Effects of Child Gender and Symptom Type on Referrals for ADHD by Elementary School Teachers.
195. Seidler Horst, Rett Andreas, Das hirnschädigte Kind, Jugend und Volk Wien München (1990)

196. Shalev L, Ben-Simon A, Mevorach C, Cohen Y, Tsal Y., Conjunctive Continuous Performance Task (CCPT)--a pure measure of sustained attention. Source, School of Education, Hebrew University of Jerusalem, Israel. mlilach@mscc.huji.ac.il Copyright © 2011 Elsevier Ltd. All rights reserved.

197. Shaw W, Kassen E, Chaves E. Increased urinary excretion of Krebs cycle metabolites and arabinose in two brothers with autistic features Clin Chem 1995; Aug; 41(8pt1): 1094-104

198. Silverman, W.K & Saavedra LM (1998, OctoberO. Diagnosis and classification of anxiety disorders in youth. Paper presented at the symposium, Treating anxiety disorders in youth: Current problems and future solutions. Alexandria, VA.

199. Simpkins, P. (1983). Integrative improvisation therapy: Answers to a questionnaire by Kenneth Bruscia Unpublished data.

200. Singer W (1999) Neuronal synchrony: A versatile code for the definition of relations? Neuron 24: 49–65.

201. Singer W, Gray CM (1995) Visual feature integration and the temporal correlation hypothesis. Annu Rev Neurosci 18: 555–586.

202. Singh I (December 2008). "Beyond polemics: science and ethics of ADHD". *Nature Reviews. Neuroscience* 9 (12): 957–64. doi:10.1038/nrn2514. PMID 19020513.

203. Sir Alexander Crichton, “An inquiry into the nature and origin of mental derangement” 1798, London, Printed for T. Cadell, Junior and Davies in the strand.

204. Sizer F, Whitney E Nutrition Concepts and Controversies West Publishing Company, St. Paul, MN 1994

205. Smith KM, Daly M, Fischer M et al. “Association of dopamine beta hydroxylase gene with attention déficit hyperactivity disorder: genetic analysis of the Milwaukee longitudinal study.”

206. Sokolov, L. (1984). Vocal improvisation therapy: Answers to a questionnaire by Kenneth Bruscia Unpublished data.

207. Soutullo CA, DelBello MP, Ochsner JE, et al. (2002). “Severity in bipolarity in hospitalized manic adolescents with history of stimulant or antidepressant treatment”.

208. Stare FJ, Whelen EM, Sheridan M Diet and Hyperactivity: is there a relationship? Pediatrics 1908 Oct; 66(4):521-5

209. Starobrat-Hermelin B The effect of deficiency of selected bioelements on hyperactivity in children with certain specified mental disorders Ann Acad Med Stetin 1998;44:297-314

210. Stein TP, Sammaritano AM Nitrogen metabolism in normal and hyperkinetic boys Am J Clin Nutr 1984 Apr;39(4) :520-4

211. Steinmetz PN, Roy A, Fitzgerald PJ, Hsiao SS, Johnson KO, et al. (2000) Attention modulates synchronized neuronal firing in primate somatosensory cortex. Nature 404: 187–190.

212. Stephen V. Faraone, p (2003). Retrieved from Medscape Today: Medscape .com /viewarticle/461543.

213. Stephens, G. (1983). The use of improvisation in developing relatedness in the adult client. Music Therapy: Journal of the American Association for Music Therapy, 3 (1), 29-42.

214. Steriade M, Gloor P, Llinas RR, Lopes de Silva FH, Mesulam MM (1990) Report of IFCN Committee on Basic Mechanisms. Basic mechanisms of cerebral rhythmic activities. Electroencephalogr Clin Neurophysiol 76: 481–508.

215. Stone and Lemanek (1990). Developmental issues in children’s self-reports. In A. M. La Greca (Ed.) Through the eyes of the child: Obtaining self-reports from children and adolescents (pp. 292-325). Boston: Allyn & Bacon.

216. Swanson JM, Flodman P, Kennedy J, et al. “Dopamine Genes and ADHD.” Neuroscience Biobev. Rev. 2000.

217. Swanson JM, Kinsbourne M Food dyes impair performance of hyperactive children on a laboratory learning test Science 1980 Mar 28;207 (4438):1485-7

218. Taylor J.A: (1953). A personality scale of manifest anxiety. Journal of Abnormal Psychology, 48, 285-190.

219. Taylor, Eric; Rutter, Michael (2002). Child and adolescent psychiatry. Oxford: Blackwell Science. p. 162.

ISBN 0-632-05361-5.
220. The truth about North America's greatest drug problem (http://www.laleva.cc/choice/ritalin.html).
221. The Worldwide Prevalence of ADHD: A Systematic Review and Metaregression Analysis (Polanczyk; Silva de Lima; Lessa Horta; Biederman, 2007
222. The Worldwide Prevalence of ADHD: A Systematic Review and Metaregression Analysis (**Guilherme Polanczyk; Maurício Silva de Lima; Bernardo Lessa Horta; Joseph Biederman; Luis Augusto Rohde, Am J Psychiatry 2007;164:942-948. 10.1176/appi.ajp.164.6.942
223. Touma HH (1996) The music of the Arabs. Portland OR: Amadeus Press.
224. Treatment of Attention-Deficit/Hyperactive Diosrder. US Department of health and human services. Retrieved 2008-10-02.
225. Udo Will, Eric Berg, Brain wave synchronization and entrainment to periodic acoustic stimuli School of Music, Cognitive Ethnomusicology, Ohio State University, 110 Weigel Hall, (2007)
226. Volkow, ND; Wang, GJ, Kollins, SH; Wigal; Newcorn; Telang; Fowler; Zhu, et al (2009)"Evaluating Dopamine Reward Pathway in ADHD."
227. Walker S III. Drugging the American Child: We're too cavalier about hyperactivity.
228. Ward NI Asessment of chemical factors in relation to hyperactivity J Nutr Environ Med 1997;7:333-42,
229. Weiss B et al. Behavioral responses to artificial food colors Science 1980 Mar 28; 207(4438):1487-9
230. Wiener, Jerry M, Editor 2003. Textbook of Child& Adolescent Psychiatry. Washington DC; American Pyschiatric Association, ISBN 1-58562-057-2.
231. Will U, Berg E. School of Music, Cognitive Ethnomusicology, Ohio State University, 110 Weigel Hall, 1866 College Road, Columbus, OH 43210, USA.
232. William Pryse-Phillips (2003). Companion to Clinical Neurology. Oxford University Press. ISBN 0195159381., p. 611
233. Willis WG, Weiler MD (2005) Neural substrates of childhood attention-deficit/hyperactivity disorder: Electroencephalographic and magnetic resonance imaging evidence. Dev Neuropsychol 27: 135-182.
234. Yamada A. Takeuchi H, Miki H, Touge T, Deguchi K (July 1990) "Accute transverse mielitis associated with ECHO-25 virus infection"
235. Zametkin AJ, Karoum F, Rapoport JL Treatment of hyperactive children with D-phenylalanine. Am J Psychiatry 1987 Jun;144(6):792-4
236. Zhang, Y; Chen, Y; Bressler, SL; Ding, M (2008). "Response preparation and inhibition: the role of the cortical sensorimotor beta rhythm". Neuroscience 156 (1): 238-46. doi:10.1016/j.neuroscience.2008.06.061. PMC 2684699. PMID 18674598.
237. Zhang, Y; Chen, Y; Bressler, SL; Ding, M (2008). "Response preparation and inhibition: the role of the cortical sensorimotor beta rhythm".
238. Zwicker E, Fastl H (1999) Psychoacoustics. Germany: Springer-Verlag.

„Ich habe mich bemüht, sämtliche Inhaber der Bildrechte ausfindig zu machen und ihre Zustimmung zur Verwendung der Bilder in dieser Arbeit eingeholt. Sollte dennoch eine Urheberrechtsverletzung bekannt werden, ersuche ich um Meldung bei mir."

CURRICULUM VITAE

Name: Marta A. Toro

Date of birth: 05/08/1962

Nationality: Spanish

2009-2012	**Dr. Rer. Nat. University of Vienna, Austria**
2005-2007	**Masters in Neuroscience, University of Barcelona**
1997-1998	**PDD, IESE, Postgraduate in Business Administration**
1985-1992	**Mag. Phil. University of Vienna, Austria**
1982-1984	**Liberal Arts, Villanova University, Penn. USA**
1977-1979	**COU, Instituto de Bilbao, Spanien**
1970-1982	**Studies in piano and solfège, Conservatorio de Música San Crisóstomo de Arriaga, Bilbao, Spain**
1968-1977	**Primary School to High School in Deutsche Schule San Bonifacio in Bilbao, Spain**

Working experience

2011	**CD"Viaje a Damasco", author and composer**
2011	**Edition of the book "Crecer con confianza", Editorial CCS**
2010	**CD "*Musica Tropica*" a composition for the Botanical Garden in Madrid, Spain**
2008	**CD "Sin fronteras", author and composer**
2006-2011	**Music therapist in Centro de Rehabilitación Dato – working with adults physical impairment (cerebral palsy) and with children.**
1987-2010	**Freelance conference interpreter (Spanish, German, English, French)**
1999-2002	**Franchiser of Opening Vitoria and Opening Pamplona**
1993-1995	**Head of promotions in Canal +, Madrid, Spain**
1992	**Head of PR, Auditorio Expo'92, Seville, Spain.**