The Cognitive & Behavioral Effects of the Transcendental Meditation Program & Maharishi Vedic Medicine on Children with Attention Deficit Hyperactivity Disorder (ADHD)

Alarik Arenander, Ph.D.
Director

Brain Research Institute
1000 North 4th Street, Fairfield, Iowa 52557
Voice: 515-472-1145; Fax: 472-1164
Email: bri@mum.edu

TABLE OF CONTENTS

SPECIFIC AIMS

There is a developmental problem in many schoolchildren. More than half the children referred to professionals for evaluation and treatment of behavior problems are diagnosed as hyperactive (Whalen, 1983). The percentage of the school-age population diagnosed as having Attention Deficit-Hyperactive Disorder (ADHD, ranges from 3% to as high as 15%, with males represented three to ten times more than females (Barkley, 1981; Bosco & Robin, 1980).

Although the cause of ADHD symptoms is not known, current consensus points to dysfunction in brain development, due largely to genetic differences, associated with developmental delays of inhibition and self-regulation (Barkley, 1997; Castellanos, 1999; Faraone & Biederman, 1998; Faraone & Biederman 1999; Hynd et al., 1991; Lensch, 2000; Sergeant et al., 1999; Quay 1997;). The disorder arises early in childhood and persists in over half of the cases, into adulthood, even with pharmacological intervention. Because of poor social skills and academic performance, many of these children move down a default path of antisocial behavior, substance abuse, unemployment, and conduct disorders.

Considerable progress has been made in understanding the neurological basis of this developmental disorder. Most evidence and theoretical considerations indicate that the prefrontal cortex and its executive functions play a key role in this disorder. At the core of ADHD is the deficit in the executive function referred to as response inhibition (Barkley, 1997; Pennington & Ozonoff, 1996, Quay, 1997). Secondarily, deficits in other executive functions appear including fundamental cognitive processes such working memory and sense of self, self-regulation of emotion and motivation, and self-directed play and goal-directed behavior. These cognitive deficits then cascade into areas of social intelligence and academic performance (Barkley, 1997; Barkley, 2000). Brain imaging studies and brain mapping studies support the concept of central dysfunction in the prefrontal cortex, probably secondary to developmental abnormalities in brainstem dopamine and norepinehrine control of forebrain function (Faraone & Biederman, 1999; Castellanos, 1999). Use of psychostimulant medication in children is helpful in reducing symptoms, but has questionable beneficial long-term effects and has significant negative side effects.

The purpose of this research project is to investigate the effects of an alternative, non-drug, integrated program on children with ADHD. The Maharishi Vedic Medicine (MVM) program consists, in part, of Maharishi's Transcendental Meditation® (TM®) program and recommendations for herbal supplements, diet, and daily routine. Maharishi Vedic Medicine includes the traditional knowledge and ancient technologies of Ayur-Ved which have been revived, reorganized, and restored into a comprehensive and holistic natural health care system by Maharishi Mahesh Yogi with the collaboration of leading Indian Ayurvedic physicians (Sharma & Alexander, 1996a, 1996b; Sharma and Clark, 1998). Ayur-Ved is currently practiced by over 300,000 doctors throughout the world and has been recognized by the World Health Organization for its continuing

---

®Transcendental Meditation, Maharishi Vedic Medicine, and TM are registered trademarks, licensed to Maharishi Vedic Education Development Corporation and used under sublicense or with permission contributions to health.

The Transcendental Meditation technique has been documented by scientific research to be the most effective approach to eliminate stress, reduce or reverse chronic illness (generally genetically predisposed conditions), and to develop higher levels of cognitive and emotional functioning (Orme-Johnson & Walton, 1998; Roth, 1998). The extensive benefits derived from the TM technique can be understood in terms of creating balance and integration of brain, in particular, the prefrontal cortex and its executive functions (Arenander 1996; Arenander 2000, in preparation).

The primary focus of this study will be on evaluating the effect of Maharishi Vedic Medicine in reducing a triad of symptoms commonly associated with ADHD—poor sustained attention, impulsivity, and hyperactivity. Since these symptoms tend to have a significant negative impact on school performance, the effectiveness of MVM in improving basic academic skills will be studied. The results of this research will yield much-needed information that will help direct future research on the nonpharmalogical treatment of children suffering from ADHD.

BACKGROUND AND SIGNIFICANCE

Definition & Demographics: Attention Deficit-Hyperactivity Disorder (ADHD) is characterized by developmentally abnormal levels of sustained attention, impulse control, and excessive activity (Barkley & Murphy, 1991). The *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV; American Psychiatric Association, 1994) defines three subtypes: predominantly inattentive type, predominantly hyperactive-impulsive type, and combined type. Based on SPECT neural imaging and pharmacological responsiveness, Amen has suggested there may be six subtypes (Amen, 1997). Adhering strictly to DSM–IV criteria, approximately 3% to 5% of children have ADHD. A disproportionate number of males have ADHD, with an average of 6:1 most often cited in the literature (American Psychiatric Association, 1994; see also Sandoval, Lambert & Sassone, 1980).

The predominant therapy for children exhibiting ADHD is psychostimulant medication, primarily methylphenidate (Ritalin®). In a survey of primary care physicians, 88% of children diagnosed as ADHD had received methyphenidate (Wolraich et al, 1990). Sager and Krager (1988) reported average durations of medication use of 2, 4, and 7 years for elementary, middle, and high school students, respectively. Although studies have shown that approximately 60% to 80% of school-age children respond favorably to stimulant medications, side effects are common. Adesman and Wender (1991) report that 50% or more of patients taking stimulant medication experience decreased appetite and difficulty falling asleep. Stomachaches and headaches, feelings of drowsiness, irritability and moodiness, and tics or other movement disorders are also common. Also, growth velocity may diminish when stimulant medication is used for an extended period (see Barkley, 1990 for a detailed description of the above side-effects). Current pharmacological reviews reveal the need to carefully examine the clinical symptoms and any comorbidities in the light of known unacceptable side effects and risks (Findling & Dogin, 1998; Hornig, 1998; Popper,1997).

Children having ADHD, by definition, display difficulties with attention in contrast to normal children of the same mental age (IQ) and sex (Barkley, 1991; 1997). ADHD children have their greatest difficulties with sustained attention or effort to tasks (Douglas, 1983). Difficulties are most evident in situations requiring the children to sustain attention to repetitive tasks, often found in school work (Luk, 1985; Zentall, 1985). According to Barkley (1990), the main problem associated with attention appears to be one of diminished persistence of effort in accomplishing tasks, especially with tasks of little intrinsic appeal to the child or immediate consequences for completion. Related to the difficulty of persistence of effort is the problem of impulsivity (Barkley, 1991). As a result of the problem of impulse control, ADHD children have difficulty following instructions, make careless errors in school work, fail to reflect upon the consequences of negative behavior, and engage in frequent, unnecessary risk-taking (Barkley, 1991). The third primary symptom of ADHD is excessive or developmentally inappropriate levels of motor or vocal activity. Restlessness, fidgeting, and unnecessary gross bodily movements are commonplace (Spitzer, Davies & Barkley, 1990). Observations of ADHD children find them to be repeatedly off task, out of their seat, talking out of turn, and making unusual vocal noises (Luk, 1985). Children with ADHD generally tend to fall behind in their intellectual development compared to normal children or the siblings of ADHD children. Compared to these controls, they show a lower standard IQ score of 7 to 15 points (Barkley, 1990). Ross and Ross (1982) report that ADHD children are likely to show standardized academic achievement test scores that are as much as 10 to 15 standard score points lower than normal classmates.

From 50% to 80% of children diagnosed with ADHD continue to meet the criteria for ADHD into adolescence (Barkley, Fischer, Edelbrock & Smallish, 1990; Gittleman, Mannuzza, Shenker & Bonagura, 1985). Research indicates that adolescent children previously diagnosed as ADHD or hyperactive are at higher risk for defiance, aggression, antisocial behavior, and substance abuse relative to normal or control children (Gittleman et al., 1985; Lambert & Sandoval, 1987). A significant proportion of ADHD schoolchildren continue to experience academic problems (Ackerman et al., 1977). By adolescence, 58% have been retained at least one grade, up to 40% have been in special educational services, as many as 35% have failed to finish high school (see Rostain, 1991; Brown & Border, 1986; Barkley et al., 1990; Weiss & Hechtman, 1986). For many adolescents diagnosed as ADHD, continuing problems with inattention, impulsivity, restlessness, anti-social behavior, and academic failure are common (Barkley, Anastopoulos, Guevremont & Fletcher, 1991). ADHD has been found to be a chronic problem that often continues into adolescence and even adulthood (Hechtman, 1991).

ADHD: A Multidimensional Disorder: Any understanding of ADHD and its developmental pathways requires the study of risk and protective factors. The identification of these factors reveals ADHD to be a multidimensional system (Samudra & Cantwell, 1999). This view is consistent with the diagnosis of several clinical subtypes. Abnormal brain activity in ADHD reported in Quantitative Electroencephalography (QEEG) and brain imaging research also supports a delineation of subtypes. In addition, psychiatric comorbitities in many ADHD individuals suggests further neurobiological complexity of the underlying dysfunction. Together, this understanding places restrictions on the types of therapeutic modalities and interventions strategies that will be most efficacious in treating ADHD. A successful approach to ADHD treatment must prevent or normalize the underlying brain abnormalities, while reducing risk factors and strengthening protective factors. Such an approach should also enhance resilience—the ability to successfully adapt despite prior or continued exposure to risk factors. Any risk or protective factor may in itself be rather weak in its ability to influence brain and cognitive development. Therefore, the central issue is the element of accumulation and balancing of multiple risk and protective factors in a child's life. It is the premise of this proposal that extensive research documentation supports the Transcendental Meditation technique as a candidate program that could be a successful treatment strategy through its ability to simultaneously minimize risks and maximize protective factors, while enhancing resilience.

The Role of Genes and the Environment: Risk factors and protective factors are both constituted of genetic and environmental components. Protective factors include the constitution or temperament of an individual and a supportive family and socioeconomic setting of childhood development. Genetics can contribute in some cases to about half the variance while, the remaining variance may be due to a combination of developmental factors, toxic exposure, family stress, and pre/peri-natal events. The developmental system can be quite complex with multiple genetic and environmental factors interacting over various time periods to modify each other and influence the degree of dysfunction and its duration. These findings reinforce the notion of multiple pathways leading to the development of ADHD. Neurobiological studies below implicating various brain structures and functions are also consistent with this multimodal view of ADHD.

Genetic Risk & Protection factors for ADHD: Risk factors include a strong familial transmission (Castellanos, 1999; Faraone & Biederman, 1999; Samudra & Cantwell, 1999). ADHD is more likely to occur in first-degree relatives of ADHD children than in those of non-ADHD children. Heritability of ADHD is also evident in six studies of twins, where monozygotic twins, sharing 100% of genes, have stronger ADHD linkage than dizygotic twins, sharing 50% of genes. Furthermore, molecular genetic studies support a strong genetic influence in ADHD. At least three genes seem to increase genetic susceptibility or vulnerability to ADHD. These genes code for dopaminergic receptors or transporter and are consistent with neural imaging studies and the information regarding dopaminergic control over forebrain development and cognitive processes (see below). The same altered gene form is found at high rates in ADHD children compared to non-ADHD children. Together, the persistence of ADHD symptoms into adulthood coupled with familial history of ADHD indicate the likelihood of significant brain abnormalities (Biederman, 1998). On the other hand, the primary example of a genetic protection factor is the child's constitutional basis or temperament. Temperament examined early in life may be of some predictive value (for review, see Chess & Thomas, 1996).

It is unlikely that there exists an "ADHD" gene, whose alteration results in the ADHD DSM-IV symptomatology. It is most likely that subtle changes in a number of different genes gives rise to the genetic 'susceptibility' to ADHD and to the diversity of ADHD subtypes—defined by diversity of symptom clusters, clinical pharmacological response and lifespan history of ADHD. This view is supported by recent genetic analysis (Comings et al., 2000a, 2000b).

Environmental Risk & Protection factors for ADHD: Among the most studied factors that place children at risk are pre/peri-natal events (for review see, Sumudra & Cantwell, 1999; Faraone & Biederman, 1998). Most of these events have in common chronic exposure to hypoxia, which can alter brain development. Thus, pregnancy and delivery complications are most commonly associated with increased risk of ADHD. Prenatal substance abuse (cocaine, nicotine, alcohol and heroin) generally, but due to complex issues does not always, reveal a significant correlation. Other studies suggest dietary and other environmental factors (see below) may be disruptive or toxic to the child and alter brain development. For example, chronic exposure to low levels of lead are associated with ADHD (Thomson et al., 1989; Tuthill, 1996). A review of evidence describing the contribution of toxic chemicals to abnormalities of neurodevelopment and the prevalence of childhood disorders, including ADHD, has recently been released (Schettler et al., 2000). The family environment also impacts on the child's development. Early work demonstrated the aggregation of adversity factors (large family size, low social class, paternal criminality, maternal mental disorder, etc.) correlated with impaired cognitive development. Childhood ADHD is correlated with these factors (for review, see Faraone and Biederman, 1999).

Neurocognitive Basis of ADHD: Most research has implicated dysfunction in the frontal cortical areas, in particular the prefrontal region, in ADHD (Barkley, 2000; Bradshaw & Sheppard, 2000; system; Castellanos, 1999; Benson, 1991; Faraone & Biederman, 1999; Levy, 1991; Niedermeyer, 1998). Thus, dysfunction of the orbital regions of the prefrontal cortex can lead to impulsivity and lack of normal social inhibitions, while dysfunction of the dorsolateral regions of the prefrontal cortex can lead to loss of working memory, attention, and temporal organization of behavior. Abnormalities in other brain areas have also been reported, including basal ganglia, corpus callosum, brainstem mesolimbic dopamine system, and the parietal cortex. Earlier research suggested the frontal lobe dysfunction played a central role in ADHD (Satterfield & Dawson, 1971; Dykman et al., 1971, Gortenstein & Newman, 1980; Gualtieri & Hicks, 1985; Chelune, Ferguson, Koon, & Dickey, 1986). There is compelling evidence that motor abnormalities involve right frontal lobe dysfunction (Kertesz et al., 1985; Castellanos, 1999). Probably the most consistent finding in ADHD is abnormality in the prefrontal cortex, reported across techniques, including magnetic resonance imaging (MRI), positron emission tomography (PET), single photon emission computer tomography (SPECT), and electroencephalography (EEG).

Brainwave Research: Children with ADHD are more likely to show brain wave dysfunction (for review see, Lubar 1997; see also, Chabot et al., 1999; Chabot et al., 1996; Chabot and Serfontein, 1996; Lazzaro et al., 1998; Lubar, 1991; Mann et al., 1992; Monastra 1999). Two areas of research support this finding: baseline brain wave analysis/topographic mapping patterns and evoked potentials to sensory stimuli. Additional support comes from reported successes of EEG biofeedback.

ADHD children display marked slowing of frontal cortical frequencies. Early studies (Lubar et al., 1985) showed that in many cases beta activity is diminished and theta activity is heightened. The results using all the EEG parameters could predict with 97% accuracy membership to a ADHD-Reading Disability group. Increase theta power alone predicted membership with an 80% accuracy providing the rationale to use EEG biofeedback to suppress theta activity (see below).

In general, quantified EEG analysis (QEEG) indicates reduced cortical arousal and possible maturational lag in ADHD (Chabot et al., 1996, 1999; Chabot & Serfontein, 1996; Lazzaro et al., 1998; Lubar 1991; Lubar et al., 1999). Most studies report increase slow waves (theta and/or alpha) and reduced fast waves (beta) compared to controls. Studies by Lubar and colleagues (Mann et al, 1992; Monastra et al., 1999) have shown increased theta and decreased beta in the EEG, interpreted as prefrontal developmental dysfunction. In fact, analysis indicated that these two components out of many frequencies and scalp locations could account for 82% of the total variance. ADHD group membership was predicted with 80% accuracy (Mann et al., 1992). More recent work reports QEEG sensitivity to be 86%, with 98% specificity (Monastra et al., 1999).

Large population QEEG studies by Chabot, Serfontein and colleagues (Chabot et al., 1996, 1999) show high specificity (88%) and high sensitivity (94%) for distinguishing normal and ADHD children. In these studies, two predominant QEEG signatures were reported: one subtype showed EEG slowing or low CNS arousal, especially in frontal regions, and the second showed increase EEG activity or high CNS arousal, especially in the frontal regions. These studies suggested the dysfunction may not be primarily a result of maturational lag (Chabot & Serfontein, 1996). In addition, these studies demonstrate that QEEG could be regarded as a highly accurate predictor of beneficial treatment response to methylphenidate vs. dextroamphetamine. Thus, many ADHD subjects appear to have developmental dysfunction localizable, in part, to the prefrontal cortex operating in a hypoaroused state.

Lubar hypothesizes that neocortical dynamics are disrupted in individuals with ADHD (Lubar 1997; for a historical account, see Lubar, 1991). Cortical activity, underlying nearly every conscious and most unconscious cognitive activity, can be thought in terms of resonant loops between cortical processors and between cortical and subcortical processors. Not only do these resonant loops determine the spectrum of brain wave activity but they strongly correlate with large as well as small changes in cognitive state and brain functioning. Predominant slow frequencies and poor evoked responses suggest that thalamocortical rhythms are not supporting proper sensory-motor integration. When this is found in the prefrontal regions, then one is reminded of the lack of behavior response inhibition in ADHD children (Barkley, 1997; Barkley, 2000). Resonant loops also suggest the presence of coherent interaction among neurons and among neural cell assemblies. It was predicted long ago that EEG abnormalities would be present in ADHD and be evident as inappropriate slowing of brain rhythms and the disruption of coherent neural communication. This is supported by the changes in EEG coherence and phase that accompany treatment of ADHD children (Lubar et al., 1999). As will be seen below, the application of neurofeedback is predicated on this lack of normal brain integration in ADHD. That is, by modifying these dysfunctional resonant loops, one could more directly modify the neural basis for learning and motor disorders, in particular, ADHD.

Evoked Potentials: Satterfield and colleagues were among the first to discribe abnormal scalp recorded electrical responses to sensory stimuli, or evoked potentials (Satterfield et al., 1973). Aydin et al (1987) have reported that an evoked electrical potential in frontal brain regions known as contingent negative variation (CNV) was markedly reduced in children with Attention Deficit Disorder (ADD, attention deficit without hyperactivity disorder). CNV is considered a reflection of cognitive functions such as expectancy, conation, motivation, and attention-arousal. The ADD group exhibited significantly lower CNV amplitudes than the normal group. In addition, CNVs could not be found in 44.4% of the ADD group, while they could be obtained for all cases in the normal group. A negative correlation was reported between the CNV amplitudes and hyperactivity scores, while a positive correlation was found between the CNV amplitudes and school achievement. In the 1990's Lubar and colleagues reported in three studies (reviewed in Lubar, 1991) that ADHD children had decreased P300 amplitude, indicating these children have difficulty in both stimulus discrimination and general attentiveness.

Evoked potential studies of cortical processing during the CPT testing paradigm also indicate reduced efficiency of neural networks in the prefrontal region. Compared to controls, ADHD subjects did not display the same reduction in latency of visual evoked potentials (steady state visual evoked potentials, SSVEP), particularly in the right prefrontal region (Silberstein et al., 1998). In some cortical locations, the latency actually was observed to be increased in ADHD subjects. Latency reduction, hypothesized to be related to dopaminergic activity, is considered to reflect increased efficiency of coupling in prefrontal neural networks. Furthermore, the possible lateralization of prefrontal cortical dysfunction has also been seen in functional imaging studies above (Rubia et al., 1999).

Neuroimaging: Most of the *structural* studies of the brains of ADHD subjects report abnormalities (for review see, Faraone & Biederman, 1999). The most consistent finding is an abnormal frontal cortex. *Functional* brain imaging in the study of ADHD has employed primarily SPECT (single photon emission computer tomography), PET (positron emission tomography), or magnetic resonance imaging (MRI) techniques. These imaging methods reveal a fairly consistent image of brain abnormalities in some ADHD individuals. These functional studies reflect the previous structural findings implicating a frontal-subcortical system dysfunction in ADHD.

Brain metabolism of a ADHD individual is strikingly reduced in many areas, especially in the crucial prefrontal lobes that normally provide an effective filter against impulsive behavior (see figure 1). A normal brain would display a relatively homogeneous or smooth outer surface. Through computerized thresholding, areas of unusually low blood flow and brain activity are not displayed, leaving what amount to 'virtual holes' in the 3-dimensional image. Thus, SPECT graphically reveals the presence of what can be considered “functional lesions” (regions of low metabolism and hence chronic dysfunction) in the brains of ADHD subjects. PET studies show roughly similar results. Thus, SPECT and PET imaging provide an invaluable diagnostic “window” into the dysfunctional ADHD brain.

Two recent noninvasive functional-MRI (fMRI) studies show the power of brain imaging techniques to examine the neural substrate of ADHD imbalances. One fMRI study has demonstrated hypofrontality in ADHD. While performing different motor tasks, hyperactive adolescents showed lower response activation in the prefrontal cortex (Rubia et al., 1999). This study supports the hypothesis of prefrontal dysfunction, in particular, abnormal motor response inhibition and motor timing. In a second study, the cingulate cortex is implicated in ADHD. Since ADHD subjects can have impaired attention and defective inhibition of inappropriate response (impulsivity), this experiment examined the activity of the anterior cingulate cortex of ADHD individuals (Bush et al., 1999). The anterior cingulate cortex helps to select stimuli when faced with competing streams of input and response selection as seen in the inhibition of incorrect responses and/or enhancement of correct responses. Using fMRI techniques, ADHD adults, compared to controls, displayed hypoactivity of the anterior cingulate cortex using an interference task (counting Stroop). These results are consistent with the early PET findings of hypoactivity of the cingulate in ADHD subjects (Zametkin et al,, 1990). These studies suggest that this brain area may also be dysfunctional in ADHD, contributing to the core symptoms of inattention and impulsivity.

Figure 1
SPECT brain imaging of an ADHD child.

This view of the human brain illustrates a highly variable, abnormal pattern of blood flow. Brain blood flow is related to the degree of neural activity, and hence, brain function. As is the case with some individuals with ADHD, brain activity in specific areas is greatly reduced compared to controls. Areas of chronic dysfunction (functional lesions) appear as “holes” in the brain. Dysfunction often occurs in the prefrontal areas of the brain (top of image), and thus may be expected to cause significant loss of impulse control, decision making, learning ability, and emotional stability.

Neurotransmitters systems: There are a number of candidate neurotransmitter systems that may contribute to the dysfunction of ADHD. Converging evidence suggests that dysfunction of the dopaminergic system and its influence on prefrontal cortex and nigrostriatal function play a central role in ADHD (Castellanos, 1999; Bradshaw & Sheppard, 2000; Neidermeyer, 1998). Recent PET imaging suggests that prefrontal dopaminergic dysfunction mediates ADHD symptoms in adults (Ernst et al, 1998). Furthermore, significant differences were found in male vs. female prefrontal imaging data suggesting that reported gender population differences in ADHD may be due to this dopaminergic imbalance (see also, Andersen & Teicher, 2000). Thus, maturational prefrontal dysfunction may be a secondary result of a primary dysfunction in midbrain dopaminergic developmemt and adaptation.

Animal studies have helped to understand the neural basis of stimulant medication in ADHD (for review, see Solanto, 1998). From animal studies, dopaminergic effects on the nucleus accumbens in the basal forebrain appear to be the basis for stimulant enhancement of motor activity and reinforcement processes, while noradrenergic effects from the locus coeruleus on the prefrontal cortex appear to be the basis of beneficial effects of stimulants on working memory and delayed responding. Both neurotransmitters systems are hypothesized to underlie stimulant-mediated improvements in attention and stimulus control of behavior. It seems plausible that these two monoaminergic systems project an increased inhibitory influence on the forebrain leading to hypoactivity in many regions, and even greater degrees of hypoactivity under conditions requiring effort and concentration. In this context, research in humans suggests that stimulants do not target specific neurobiological deficits in ADHD, but rather exert compensatory effects, primarily by stimulant-induced reduction in brain dopaminergic and noradrenergic systems.

Dopamine is not the only neurotransmitter system that may be abnormal in ADHD. Research, especially using genetic analysis, suggests that serotonin may also be involved in the pathogenesis of ADHD (Oades, 1987; Mefford & Potter, 1989; Comings et al., 2000a, 2000b). Research to date on the possible role of serotoninergic systems remains, however, somewhat contradictory (see Hornig, 1998; Quist et al., 2000; Conner & Steingard, 1996). The question arises whether serotonin is involved in the etiology of ADHD in the absence of any psychiatric comorbidities. These conditions include depression, aggressive behavior and substance abuse. Serotonin is implicated in major depression and noradrenaline and serotonin have been linked to aggression and impulsive antisocial behaviors. Thus, the neurobiological underpinnings of psychiatric comorbidity suggests the potential of serotonin pharmacologic agents to address comorbid states in ADHD.

Summary of the Multimodal Nature of ADHD: Research indicates that multiple influences from genetic and environmental sources contribute to the development of ADHD. By altering brain structure and function of the developing brain, these influences create the specific, yet diverse array of symptoms that are the primary diagnostic criteria. No single profile of dysfunction can be determined, yet most lines of evidence implicate brainstem monoaminergic and forebrain (frontal cortex and basal ganglia) as primary components in this disorder. The diversity and usual co-morbidity of psychiatric illness are an obstacle to successful treatment, other than suppression of some symptoms by stimulant medication. In the context of multiple etiological pathways to this developmental disorder, an approach that provides a basic integrative and balancing influence may be able to exert a beneficial impact on ADHD. The TM program, to be described below, offers such an approach, whereby, a unique state of restful alertness is gained twice a day that has been documented to reduce many acute and chronic disorders..

Psychostimulant medication: The Therapeutic "Gold Standard": The most frequently used therapy for ADHD is psychostimulant medication. The drugs most commonly used to treat ADHD are methylphenidate (Ritalin®), dextroamphetamine, (Dexedrine), amphetamine salt combination (Adderall®), and pemoline (Cylert ®) (Amen, 1997; Voeller, 1991). In a 1990 survey of primary care physicians, 88% of children diagnosed as ADHD had received methylphenidate (Wolraich et al, 1990). Sager and Krager (1988) reported average durations of medication use of 2, 4, and 7 years for elementary, middle, and high school students, respectively.

Although studies have shown that approximately 60% to 80% of school-age children respond to stimulant medications with a decrease in hyperactivity, side effects are common. Adesman and Wender (1991) report that 50% or more of patients taking stimulant medication experience decreased appetite and difficulty falling asleep. Stomachaches and headaches, feelings of drowsiness, irritability and moodiness, and tics or other movement disorders are also common. Also growth velocity may diminish when stimulant medication is used for an extended period (see Barkley, 1990 for a detailed description of the above side-effects). Because of these side effects, 20% of children discontinue medication after only four months and 50% discontinue medication after 10 months. Studies have found that psychostimulants do not improve academic achievement (Gadow, 1983; Thurber & Walker, 1983), or social problem-solving deficits that accompany the disorder (Hinshaw, Henker & Wahlen, 1984). Some have argued that the use of psychostimulants may foster externally-dependent behavior in children, undermining self-efficacy and self-concept (Whalen & Henker, 1976). Because of the potential side effects of psychostimulants, physicians often encourage parents to give their children weekend and summer “drug holidays.

In summary, considerable research suggests that stimulant medication brings significant temporary management of symptoms (average effect size of .83)(review by Swanson et al., 1993). Medication does not, however, have significant or any effect on academic performance, IQ (average effect size of .35), social skills or antisocial behavior. In addition, the side effects of stimulant medication, including tics, eating and sleeping problems and cognitive toxicity (Swanson et al., 1992) indicate the limitations of medical intervention. Because of these facts, there is an increasing emphasis in finding effective alternative, non-drug treatments for ADHD children (see e.g., Horn et al., 1991).

ALTERNATIVE THERAPIES FOR ADHD: Over the last century, alternative, and sometimes controversal, treatments have been used to help treat ADHD (Baumgaertel, 1999). The current use of alternative approaches mirrors the growing trend in society to examine and to use complementary and alternative modes of medical intervention (Eisenberg et al.,1993; American Medical Association, 2000). In the last 5 years, this trend has been accompanied by increased funding by private and government agencies of research to test the efficacy of these alternative modes of therapy. NIH established the Office of Complementary and Alternative Medicine (CAM) as a means to bring modern scientific research methods to bear on the problem of efficacy in the alternative treatment of a variety of disorders.

There are numerous reasons for the rapid increase in CAM for ADHD. The primary reason appears to be the relative lack of understanding of the cause(s) of ADHD. In addition, stimulant medication has its known side-effects, with unknown consequences over often prolonged periods of administration in children. And, in some cases, stimulants have no effect forcing parents and physicians to try other treatments. Since modern medicine can offer no cure for ADHD, parents are becoming more involved in seeking alternative and natural approaches. These alternative approaches may not only minimize negative side-effects, but more importantly, may impact on the underlying, fundamental causes of the disorder, in contrast to current long-term pharmacological treatment of symptoms.

Only in the last decade has serious funding been available for ADHD research. In the year 2000, NIH is funding about 75 ADHD research studies. More research is being targeted to non-pharmacological treatment. This is because there remains considerable disagreement over efficacy of non-pharmacological approaches. These include tradition talk therapy, restrictive or supplemental diets, allergy treatments, chiropractics, biofeedback, perceptual-motor training, inner ear treatments and pet therapy. Some would suggest that only behavior modification and/or drugs are effective treatments for ADHD approaches (Pelham & Waschbusch, 1999; Pelham et al., 1998). While it is true that alternative approaches have been less researched, or poorly researched due to past levels of interest and funding, enough research has been published to date to suggest that alternatives, when applied properly, can have a significant impact on ADHD.

Behavioral interventions: A wide variety of non-drug alternatives to stimulant treatment have been suggested. The most common alternative treatments involve the use of behavioral interventions by parents, teachers, and clinicians (Duncan, 1985; Pelham & Waschbusch, 1999). Behavioral modification treatments have been found to be effective in the short term for specifically targeted behaviors and settings (see e.g., Ross, 1979). It has been used successfully to improve on-task behavior, in-seat behavior, and attention span (see e.g., O'Leary et al., 1976). Cognitive therapy approaches, which emphasize teaching the child a generalizable set of self-control and problem solving skills have also shown some benefit (e.g., Mecihenbaum & Goodman, 1969). Effective behavior modification programs generally require considerable expertise and a major time commitment on the the part of therapists, teachers, and parents in addition to a stable and supportive family environment (Copeland & Wolraich, 1987; Barkley & Murphy, 1991). Barkley and Murphy (1991) and others (Phelham, & Waschbusch, 1999) also state that as with psychopharmalogical approaches, cessation of the behavior management strategies results in a return to pretreatment levels of misbehavior. These same criticisms also apply to the cognitive therapy approaches as well.

Dietary Management: Dietary management of ADHD continues to be the most popular alternative approach (for review see, Breakey, 1997). Research continues to be more sophisticated and, since diet and nutrition effect mood and behavior, the most useful rationales have been in terms of dietary impact on central nervous system neurotransmitters (Wurtman, 1992). The use of restrictive diets such as the Feingold additive-free diet (Feingold, 1975) and the elimination of sucrose (Krummel, et al., 1996) have been found to have limited and, in most cases, no effect in treating ADHD (see, e.g., Harley et al., 1978; Wender, 1986; Wolraich et al., 1985). It has been shown, however, that some children may have neural imbalances that make them sensitive to or allergic to food dyes (Swanson and Kinsbourne, 1980). In addition to the lack of consistent positive findings in this area, Duncan (1985) maintains that it is virtually impossible to assure compliance in a child who is of school age.

Vitamin-Mineral Supplements: Research of multivitamin therapy indicate significant benefits. Benton and Roberts (1988) found that standard multivitamin and mineral supplements given to children of average nutritional status has positive effects on IQ. In a follow-up placebo-controlled, double blind study, Benton and Cook (1991) found that children taking a vitamin-mineral supplement exhibited significant increases in non-verbal intelligence on the British Ability Scale, higher levels of concentration on a frustrating task, and less fidgeting behavior while performing a frustrating task, compared to the placebo group. Other studies found increased IQ with vitamin-mineral supplementation in elementary school children and adolescent juvenile offenders (Schoenthaler, Amos, Doraz, Kelly & Wakefield, 1991a; Schoenthaler, Amos, Eysenck, Peritz & Yudkin, 1991b; Benton & Roberts, 1988).

In the study by Schoenthaler et al. (1991a) abnormalities in the brain, as demonstrated by EEG mapping, were also found to be largely eliminated by vitamin-mineral supplementation. Schoenthaler suggests that vitamin-mineral supplementation improves brain function by providing added nourishment to the brain. Thiessen and Mills (1975) in a preliminary study of children with learning disabilities found that the use of a multi-vitamin supplement (Vitamin C, niacinamide, vitamin B6, and pantothenic acid), reduced hyperactivity, sleep disturbances, and perceptual dysfunctions. Kershner and Hawke (1979), using a similar compound, failed to find significant improvement in 20 learning disabled children on cognitive, perceptual, and behavioral measures. Other studies have shown that a broad-based vitamin-mineral supplement can positively affect mood in juvenile offenders (Schoenthaler, 1987) and subjects with low levels of blood vitamins (Heseker et al., 1990).

In epidemiological studies, deficiencies in niacin, pantothenic acid, thiamine, vitamin B6, and vitamin C have been related to aggressive behavior (see. e.g., Gelenberg, 1988; Lonsdale & Shamberger, 1980; McLaren, 1988). Lonsdale and Shamberger (1980) found that adolescents exhibiting marginal thiamine deficiency were generally impulsive, highly irritable, aggressive, and sensitive to criticism. Following thiamine supplementation, these same subjects showed improved behavior in terms of the above symptoms.

A preliminary study of iron supplementation of ADHD children noted improvements in parent behavioral ratings (Sever, et al., 1997). Magnesium supplements may also improve ADHD symptoms (Starobrat-Hermelin & Kozielec, 1997). Iron deficiencies may cause learning deficits and behavioral impairment by diminishing dopamine neurotransmission in animals (Youdim et al., 1990). Additionally, iron is needed as a co-factor for the enzymes which metabolize not only dopamine, but also serotonin and norepinephrine, which have a major on influence on behavior (Werbach, 1992). According to Levy (1991), lower levels of dopamine are associated with the ADHD syndrome. Also, there is evidence in both mice and humans that deficiency in magnesium may promote aggressive behavior by enhancing catecholamine secretion and sensitivity to stress (Izenwasser et al., 1986; Henrotte, 1986). Zinc deficiency has been hypothesized as a causative factor in ADHD. Zinc is necessary for numerous biochemical processes in the body and brain. Zinc was found at significantly lower serum levels (Kozielec, et al., 1994) and hair levels (Arnold, et al., 1990) in children with ADHD compared to controls. In rats, chronic manganese exposure has been shown to produce hyperactivity with an increased tendency to fight (Chandra, 1983). Also according to Barkley (1990) some evidence exists to show that elevated blood lead levels in children may be associated with a higher risk for hyperactivity and inattention (see e.g., Baloh et al., 1975; Needleman et al., 1979).

Deficiencies in tryptophan, an essential amino acid and a dietary precursor to serotonin (a major neurotransmitter associated with modulating aggressive behavior), has been found to be related to aggressive/violent behavior (e.g., Giammanco, 1990). In a study with social groups of vervet monkeys, males with a tryptophan-free dietary mixture exhibited higher aggressive behavior during competition for food, whereas both males and females in the high-tryptophan mixture group tended to show lower levels of aggression (Chamberlin et al., 1987). Essential fatty acids (EFAs) are essential for proper brain development and function. Several studies suggest that EFAs are correlated with ADHD symptoms, in particular, hyperactivity (see, Stevens, et al., 1995).

In summary, the above findings show preliminary evidence that broad-based vitamin-mineral supplements may have a positive affect on the behavior, personality, and cognitive functioning of children, who show deficits in these areas.

Herbs and Antioxidants: Most cultures have traditional medicines for various disorders. Recent examination of many of the herbs and/or their 'active' ingredient suggest some of these may be useful for treating ADHD. These compounds/herbs include pycnogenal, melatonin, gingko biloba, and valerian. Studies are just now getting underway to examine some of these compounds (see, Baumgaertel, 1999). Homeopathy has been used for treatment of ADHD symptoms for a long time. It uses extreme dilutions of plant and mineral extracts. A recent placebo-controlled study has demonstrated significantly improved outcomes in behavior for ADHD children (Lamont, 1997).

Biofeedback and Relaxation Therapies: Numerous techniques aimed at enhancing self-regulatory brain processes are currently be used to treat ADHD. These include hypnotherapy, guided imagery, biofeedback and relaxation training. During the last twenty years, the impact of several of these approaches have been examined in ADHD populations. Research has shown that relaxation training may hold promise as a non-pharmacological means of reducing disruptive behaviors and increasing positive adaptive behaviors in hyperactive children (Downey and Poppen, 1989). Linn and Hodges (1980) found that hyperactive children who received biofeedback training exhibited improved attention span and a more internal locus of control than control subjects. Bharata, Arnold, Lorance, and Gupta (1979) found that a group of hyperactive boys who were given EMG biofeedback with supplementary home relaxation tapes, exhibited decreased frontalis EMG compared to a control group. Although parental ratings of behavior improved over the 12-week period, the children in the experimental group returned to pretest levels during the follow-up period.

Hughes, Henry, and Hughes (1980) showed that the use of EMG biofeedback with actometer feedback and contingent reinforcement (with three children exhibiting activity-level problems) increased academic performance, observed time on task, and locus of control. Other studies, using EMG-assisted relaxation training procedures, showed lower impulsivity and greater attention to task (Omizo & Michaels, 1982; Rivera & Omizo, 1980), greater subjective feelings of control (Denkowski et al., 1984), and less fidgeting (Omizo & Williams, 1981), and improved reading and language scores (Denkowski et al. 1984). Omizo et al. (1986) found, in addition to lowered muscle tension levels, increased performance in paired-associate memory tasks in the experimental hyperactive group. Denkowski and Denkowski (1984) found that progressive relaxation training resulted in a more internal locus of control in hyperactive children compared to a placebo group, whereas EMG biofeedback did not. No significant differences were found among progressive relaxation, biofeedback, and placebo groups on verbal tests and ratings of behavior. Hershey (1983) trained hyperactive children (with the use of autogenic phrases) to raise skin surface temperature (a measure of body relaxation). Hershey noted a decrease in hyperactive behaviors and concomitant increases in emotional stability and self-confidence as a result.

Behavioral Relaxation Training (BRT), consisting of ten overt postures and behaviors taught by modeling, prompting, and performance feedback (see Poppen, 1988; Schilling & Poppen, 1983) has shown promising results with hyperactive children. Studies have shown that BRT produces relaxation, as indicated by reductions in frontalis muscle tension, improves behavior, as measured by the Hyperactivity Index of the Conners Parents Rating Scale (Donney & Poppem, 1989; Raymer & Poppen, 1985), and increases performance on a complex reaction-time task (Brandon et al., 1986; Eason et al, 1986). Body movement (kinestihetic) studies, employing the use of immediate reward systems, have found that hyperactive children can limit their own overactive behavior (Ball & Irwin, 1976; Krasner & Phillips, 1980).

In summary, the results of the above biofeedback and relaxation studies indicate that providing relaxation and normalization of motor activity in ADHD children can be of value in creating neurological balance and diminish the excessive activity level of ADHD children.

Neurofeedback: By far, the most careful and extensive biofeedback work has been with electroencephalography (EEG; for review, see Lubar, 1991; Lubar, 1997). EEG biofeedback or neurofeedback is based on the studies that indicate abnormalities in the brainwaves of ADHD children. By 'feeding back' the information of brain dynamics (in the form of simple auditory or visual cues), children can easily learn to modulate their baseline EEG signatures. Altering a child's EEG frequency components in specific ways correlates with improvements in ADHD. The primary pattern that shows up in ADHD children appears to be slowing of brain activity in prefrontal regions. More specifically, ADHD subjects displayed decreased beta and increased theta activity (Lubar, 1991; Mann, et al., 1992). These two variables alone could account for most of the variance in EEG patterns of ADHD vs. control subjects (Mann et al., 1992). In contrast, Nall (1973) found that it is possible to train hyperactive children to produce EEG alpha waves, although no significant change in behavior or academic performance was noted in the subjects.

The theta/beta ratio can be used to document training progress and reduction in symptoms (Lubar, 1991). Neurofeedback beta and theta training reduced attentional difficulties (better ability to focus and concentrate) and hyperkinetic behaviors with subsequent reduction in stimulant medication. A discriminant function analysis using theta and beta activity was able to predict ADHD group membership. Intensive neurofeedback to reduce theta and increase beta activity showed significant increases in TOVA performance, parent ratings of behavior and WISC-R scores (Lubar et al., 1995).

A recent validation study of QEEG analysis indicated significant maturational effects in cortical arousal in the prefrontal cortex. There was evidence of cortical slowing for ADHD with or without hyperactivity (Monastra et al., 1999). This study of QEEG-based neurometric testing for ADHD assessment had a sensitivity of 86% and specificity of 98%. These results strongly indicate the usefulness of this approach and continued validation of the hypothetical model of developmental delay and hypoarousal in brain function underlying ADHD. Recent work suggests that methylphenidate may improve performance of ADHD children, in part, by its ability to lessen the impact of abnormalities in brain rhythms, especially EEG coherence, phase and asymmetry, on performance measures (Lubar et al., 1999; see also, Swartwood, et al., 1998).

In summary, the use of neurofeedback is growing rapidly. However, only a handful of careful research studies have been carried out that demonstrate clear clinical success. During the last 25 years, neurofeedback has applied our growing understanding of brain activity dysfunction in ADHD to help alleviate many of the symptoms. EEG biofeedback training, when properly employed can lead to significant changes in EEG parameters of the brain that correlate with improvement in psychometric tests and academic performance. More research should be carried out to delineate the variables that most effectively impact positively on each child. There are, however, several difficulties that come with this success: neurofeedback requires a the large number of training sessions to generate change, and the training sessions require considerable manpower, expensive equipment and must be carefully applied and discontinued. In addition, the nature and duration of any benefits has yet to be determined.

Maharishi Vedic Medicine: An Alternative & Complementary Treatment for ADHD

Maharishi Vedic Medicine (MVM) is one of the most widely researched alternative approaches to healthcare available today (Sharma & Clark, 1998). There are four main areas of natural health care included in Maharishi Vedic Medicine: 1) *Mental*—Maharishi's Transcendental Meditation program (Wallace, 1986; Roth, 1994); 2) *Physiological*—Maharishi Vedic Medicine Panchakarma (natural purification procedures) program (Averbach et al., 1989; Schneider et al., 1985), diet recommendations, herbal food supplements (Gelderloos et al., 1990; Glaser, 1988), and exercise (Averbach et al., 1989); 3) *Behavioral*—daily and seasonal routines taking into account chronobiological rhythms (Averbach et al., 1989); and 4) *Environmental*—collective health measures to reduce stress in society (Dillbeck et al., 1987; Orme-Johnson et al., 1988). Based upon the background research findings on ADHD, we propose to use the two MVM modalities— the Transcendental Meditation technique and recommendations for diet, herbal food supplements and daily routine.

Rationale: To date, we know of no research conducted on ADHD populations using the Transcendental Meditation technique or other aspects of MVM as interventions. This proposal is, however, based on over 40 years of research on the TM program. Over 500 studies conducted by researchers at over 200 research institutions and universities around the world indicate the effectiveness of the practice of TM in improving mental and physical health and social behavior.

Research supports the ability of MVM, in particular, the uniqueness of the TM program, to positively impact the following issues that define the ADHD population:

1) **The technique can be successfully practiced by children:** The TM technique is a natural, simple technique that is easy to learn and practice, even by ADHD individuals. Children enjoy practicing twice a day.

2) **<u>The technique has the ability to influence the whole individual</u>:** The TM technique generates a holistic effect on the physiology and psychology and its practice by children should significantly reduce all 3 main symptoms of ADHD.

3) **<u>The technique can do more than just reduce symptoms</u>:** The TM technique is one approach that impacts fundamental patterns of brain function and thus, simultaneously should alleviate symptoms while enhancing cognitive and behavioral development.

4) **<u>The technique is without negative side-effects:</u>** The TM technique, because of its natural influence of increased order and integration based on the body's own inner intelligence, has no undesirable side effects. This is in contrast to the usual psychostimulant treatment.

5) **<u>The technique can impact genetic disorders</u>:** The TM technique, because it provides deeply restful and coherent influence on body and mind appears capable of normalizing many chronic disorders which generally have strong genetic associations, not unlike ADHD genetically linked vulnerabilities.

6) **<u>The technique can have beneficial effects on developmental processes</u>:** The TM technique enhances child development, increasing intelligence, creativity, moral reasoning, impulse control, and academic performance.

7) **<u>The technique can impact prefrontal cortical executive functions</u>:** The TM technique has been shown to improve the functioning of prefrontal cortex processes, and alter brainstem and basal forebrain control mechanisms that are implicated in the neurobiological abnormalities of ADHD. It should therefore help normalize developmental imbalances.

8) **<u>The inclusion of MVM recommendations will facilitate the process of normalization</u>:** The recommendations of MVM, including herbal formulations, diet, and daily routine, are capable on their own of helping to bring balance to the mind and body, and should provide a synergistic, beneficial effect with the practice of the TM technique.

The Transcendental Meditation Technique: The Transcendental Meditation program represents an important modality of Maharishi Vedic Medicine and the one that has been most thoroughly researched. The following review shows the positive impact of TM on brain activity and hence on cognitive functioning, behavior, academic achievement, and personality characteristics—the four main areas of disruption in ADHD. While many of these studies have design limitations in that they lack random assignment and some were uncontrolled, the fact that these effects have been repeatedly observed in many settings offers cross-validation for the findings. In addition, meta-analyses on TM research that have assessed strength of research design have found that results are as or more significant in studies with strong design (See below; Eppley, Abrams, & Shear, 1989; Alexander, Rainforth, & Gelderloos, 1991; Orme-Johnson & Walton, 1998).

A summary of the balancing effects that are predicted in ADHD children practicing the TM technique in presented in figure 2. The three main diagnostic symptoms from DSM-IV are listed with a parallel, one-to-one assignment of benefits documented from research on the TM technique, with selected references. A more comprehensive research analysis is found below.

Figure 2
Restoring Balance in ADHD Children: Summary of Benefits of the Transcendental Meditation Program.

Research on the Transcendental Meditation Technique and its Potential Impact on ADHD

Anecdotal Reports on the TM Technique & ADHD: There are no reports of research studies examining the cognitive and behavioral effects of the TM technique on ADHD individuals. However, over the last 40 years of teaching the TM program around the world, it is estimated that over 1000 ADHD children (3% of children instructed) have been instructed and many have reported benefits from the twice daily practice. During this period, no systematic examination of reported experiences by child or parent have been attempted to document results, primarily due to confidentially.

There are, however, numerous anecdotal experiences during the last 40 years. Many teachers of the TM technique who have taught hyperactive children have found noticeable effects within the first few of weeks of practice. Parents have reported that their ADHD children easily learn to meditate and experience immediate relaxation of the body and increased calmness of mind. For example, a 14-year old boy diagnosed with ADHD was taught the TM technique. The TM teacher reported the same effects noted above. In addition, this child’s parents reported that the boy’s behavior and mood was dramatically improved, while an aunt of the boy reported increased pro-social behavior within the first week of instruction. In another situation, a child diagnosed as ADHD completely discontinued methyphenidate psychostimulant medication within three and a half months of starting the practice of TM without return of pretreatment symptoms.

Detailed Summaries of Research: In the next section, research will be presented indicating that the TM technique, because of its ability to create widespread coherence and balance in brain physiology, can impact on nearly every aspect of physiological and psychological dysfunction associated with ADHD. These include areas of brain integration, neuroendocrine patterns, attention, behavior, academic achievement, and personality development.

Research on Brain Integration and Balance: The practice to the TM technique leads to rapid and high levels of brain integration. For example, Banquet (1973) was the first of many to report increased frontal central alpha power during TM. An important parameter, probably more important than EEG power variable, in measuring and understanding brain integration, is EEG coherence, a measure of overall stable integration of brain processing (Levine et al., 1976). During the TM technique EEG coherence is found to rapid appear and spread across the frontal regions of the brain (Levine, 1976; Levine et al., 1976). Dillbeck & Vesely (1982) reported increased frontal coherence during sessions when individuals were acquiring information in a concept learning task. R. Nidich, et al., (1989) showed that length of time practicing TM was positively correlated with higher EEG coherence in the frontal lobes.

These high levels of cortical integration are not reported for any other technique (see Levine et al., 1976; Banquet & Sailhan, 1974; Banquet et al., 1977). Higher levels of EEG coherence measured during the practice of the Transcendental Meditation technique are significantly correlated with increased fluency of verbal creativity, higher IQ, higher academic achievement, increased neurological efficiency, more principled moral reasoning, decreased neuroticism, increased efficiency in learning new concepts, and clearer experiences of self (Dillbeck et al., 1981; Haynes et al., 1976; Nidich et al., 1989; Nidich et al., 1983; Orme-Johnson & Haynes, 1981). Figure 3 illustrates the high correlation between brain coherence and the above mentioned cognitive and behavioral measures. These correlations collectively suggest an significant increase in orderly brain functioning associated with the practice of the TM technique. It is important to note that levels of coherence of frontal lobe functioning have been related to pro-social behavior and higher levels of moral reasoning (Nidich et al., 1983; 1989), which have been found to be problem areas in ADHD children (Mefford & Potter, 1989; Hinshaw, et al. 1984).

Figure 3
EEG Coherence Correlations with Physiological and Psychological Measures.

EEG Evoked Potentials: Since some ADHD children can have altered neural processing of sensory stimuli, especially CNV, it is significant to note that students practicing TM display increased levels of neurophysiological efficiency in sensory processing measured by event-related potentials. For example, compared to controls, TM practitioners display increased CNV amplitude and decreased distractibility (Travis and Tecce, 1998; Travis & Miskov, 1994). Research on the elderly indicate that practice of the TM technique reduced age-related declines of P300 indicating the ability of TM to enhance brain functioning and faster processing of cognitively complex information (Goddard, 1989). Lyubimov (1992, 1994) forund that during the TM program some of the early sensory components of the brain's response to somatosensory stimulation (0-100msec) are more widely distributed across the cortex. These results suggest that during the TM technque there is an increase in the areas of the cortex taking part in perception of specific information and an increase in the functional relationship between the two hemispheres.

Other research has shown improved efficiency of information transfer, increased vigilance and improved capacity for selective attention in the brain. These studies include, for example, shorter latencies of auditory evoked potentials, both during and outside the practice of Transcendental Meditation (Kobal et al, 1975; Wandhofer et al., 1976), changes in brainstem auditory evoked potentials following the Transcendental Meditation and TM-Sidhi Program (McEvoy et al., 1980), and faster reactions with fewer mistakes (visual choice reaction time) correlated with shorter latency and larger amplitude of visual evoked potentials (Banquet and Lesevre, 1980).

Together, these studies indicate that the experience of TM improves brain processsing of information. In the light of the reduction in evoked potential activity in ADHD, especially the late components correlated with selective attention, stimulus detection and discriminating between stimuli, meditation could have beneficial effects on information processing in these students.

Neuroendocrine Reseach: A number of neuroendocrine factors have been implicated in ADHD dysfunction including serotonin, dopamine, and norepinephrine brainstem (Castellanos, 1999; Hynd, et al., 1991). Comings (1990) reported significantly decreased plasma tryptophan (the metabolic precursor to serotonin) in ADHD patients. He suggested a dysregulation of serotonin metabolism as the basic defect in ADHD. Bujatti & Reiderer (1976) reported an increased rate of excretion of 5-HIAA, the principal metabolite of serotonin, during individual TM sessions, and other studies suggest higher average serotonin availability with regular practice of TM (Loligerr, 1990; MacLean et al, 1992; Walton, et al, 1990; Walton et al., 1983). These findings suggest a possible mechanism through which practice of TM may directly benefit children with ADHD.

Furthermore, long-term reduction of plasma cortisol is the expected result of greater serotonin availability. Cortisol, which has been associated with aggressive behavior in non-human primates (Sapolsky, 1990), drops acutely during TM and is maintained at lower average levels in regular meditators (Jevning, Wilson, & Davidson, 1978). Decreased baseline cortisol and increased serotonin availability reflect a more adaptive neuroendocrine profile (MacLean et al, 1992). After four months of practicing TM, a group of young males exhibited lower baseline cortisol with higher response to acute challenge (MacLean, et al., 1992). This suggests that TM improves adaptive mechanisms and homeostasis (Werner et al., 1986). Other cross-sectional studies have also reported such effects (Dillbeck & Orme-Johnson, 1987; Goleman & Schwartz, 1976).

More stable balance of the physiology as measured by plasma hormone levels and reactivity to stress has also been documented (Hill, 1989). Finally, increased plasma levels of arginine vasopressin, associated with body fluid balance and with learning and memory, are reported during the TM technique (O'Halloran et al., 1985).

Research on Attention: Several studies have found that practice of the TM technique increases attention, as measured by simple reaction time, choice reaction time, and standard error of reaction time (Cranson et al., 1991; Appelle & Oswald, 1974). TM improves attention to a visual task with distractors (Dillbeck, 1982; Pelletier) and inceases alertness (Williams & West, 1975). In other cognitive areas, practice of the TM technique has been found to enhance problem-solving ability (Dillbeck, 1982), improve secondary organization memory (Miskiman, 1977), increase perceptual motor speed (Jedrczak, 1986), and enhance originality and flexibility of thinking (Travis, 1979, Schecter, 1978). Research also shows an increase in analytical intelligence and general fluid intelligence (Dillbeck et al., 1990).

Research on Behavior: In studies of behavior, practice of the TM technique has been shown to lessen overactive and impulsive behavior in psychiatric patients (Candelent & Candelent, 1975), improve echolalic behavior in an autistic student (Wood, 1981), decrease temper tantrums and irritability in a mentally retarded woman (Eyerman, 1981), and increase positive behaviors of juvenile offenders, as assessed by a parent-report questionnaire (Childs, 1977). Throll (1989) also found a significant decrease in the abuse of drugs, while Nidich and Nidich (1987) found higher levels of pro-social behavior in adolescents practicing the TM technique.

Research on Academic Achievement: Studies have also found that practice of the TM technique improves overall academic performance in elementary and middle school students (Nidich et al., 1986; Kory & Hufnagel, 1977), in secondary school students (Nidich & Nidich, 1989) and in college students (Kember, 1985; Collier, 1977; Heaton & Orme-Johnson, 1977). Additional research shows improved reading comprehension, ability to concentrate, and memory in a group of secondary school students practicing TM compared to controls (Nataraj & Radhamani, 1975).

Studies of students during their first year at the Maharishi International University laboratory school, where all students practice the TM technique, found significant improvement in their academic achievement. The first study on 37 students in grades 3 to 8 found a median increase of 15 pecentile points on the Iowa Tests of Basic Skills (ITBS) Composite scale (Nidich et al., 1986). Students increased from a percentile rank of 51 (almost the norm) to a percentile rank of 66. In addition, the percentage of students at grade level or higher on the Composite scale increased significantly by 24%. Forty-two percent of the new students were below grade level at the beginning of the school year with only 18% still below grade level by the end of the school year. As cited above, children with ADHD tend to fall behind in their academic achievement, many failing to graduate from high school. The data on the percentage of students below grade level is particularly significant since it shows that students who were below grade level and practiced TM tended to gain at least a grade level competence in academic achievement.

In a replication study on students in grades 3 to 11, Nidich and Nidich (1989) found that 42 new students to the laboratory school exhibited a significant improvement in academic achievement as measured by the Composite scale of ITBS. Also, with regard to academic achievement, it was reported length of time in terms of months and years practicing TM was significantly related to academic performance (Muehlman et al., 1988). These studies indicate that practice of TM may have a significant impact on the academic achievement level of the children in our study.

Research on Personality Development: A number of studies have been published that involving factors associated with ADHD. These factors include immature levels of personality and social development. Research in the area of personality has found that practice of the TM technique enhances self-concept (Nystul, 1977), increases internal locus of control and inner-directedness (see below, Hjelle, 1974; Seeman et al.,1972; Nidich et al., 1973), develops a sense of autonomy and self-sufficiency (Geisler, 1978; Gelderloos, 1987), increases time competence (Nidich et al., 1973), and improves self-image, tolerance, and sociability (Hanley & Spates, 1978). Studies have also found significant decreases in neuroticism (Tjoa, 1975), anxiety (Dillbeck, 1977), hostility and depression (Hahn & Whalen, 1989), social inadequacy (Penner et al., 1974) and social inadequacy (Hanley & Spates, 1978). A study on students with learning disorders showed increased inner-directedness, self-regard, and acceptance of aggression compared to controls (Jackson, 1977). Another study involving students with learning problems showed decreased neuroticism, general anxiety, manifest anxiety, examination anxiety, and school-dislike as compared to controls (Overbeck & Tonnies, 1989).

Seeman, Nidich, and Banta (1972) found that 15 undergraduate students who began the practice of TM showed a higher level of self-actualization over a two-month period compared to 20 non-meditating controls. TM subjects showed significantly higher levels of inner directedness, self-actualizing values, self-regard, capacity for intimate contact, and acceptance of aggression. Nidich, Seeman, and Dreskin (1973) in a replication study found that nine undergraduate students who practiced TM over a 10-week period showed a significantly higher level of self-actualization than nine non-meditating controls, using the Personal Orientation Inventory. TM subjects were found to exhibit increased inner-directedness, increased time competence, increased feeling reactivity, capacity for intimate contact, and acceptance of aggression. In addition, TM subjects showed higher levels of self-regard and self-acceptance.

In summary, since the dysfunctioning of temporal sequence and lack of goal-orienting and inner control are central deficits of ADHD, these studies suggest the TM technique can provide a fundamental ordering influence on these children. In addition, the findings on increased inner-directedness is relevant to the proposed study because there is concern over the fact that the use of treatments, such as stimulant medication, may produce a greater external locus of control (Horn et al., 1991). These studies suggest that practice of TM results in an increased internal locus of control (see also Hjelle, 1974). The findings on self-regard and self-acceptance indicate that practice of TM produces a more positive self-concept. ADHD children have been found to have a lower self-concept compared to normals (Horn et al., 1991; Barkley, 1990). Also improvement on the capacity for intimate contact and acceptance of aggression scales suggest that ADHD children may experience improved social behavior as a result of practicing TM.

Uniqueness of the TM Program to Enhanced Brain Development: There are numerous methods currently purported to reduce stress and improve brain and cognitive development. Although any stress-reduction technique will lead to some alteration in experience and hence brain function, different methods produce strikingly different results (Orme-Johnson & Walton, 1998). Thus, the choice of methods utilized to alleviated brain and cognitive dysfunction in ADHD is critical for optimal effectiveness in reversing the neurophysiological and psychological basis of the disorder.

Early research found marginal or insignificant results for some of the procedures once thought to decrease stress (Fodor & Chockalingam, 1990; Fredrikson & Matthews, 1990; HTCR Group, 1992). For instance, Eisenberg et al., who conducted a meta-analysis of 26 studies that evaluated Benson's relaxation technique, progressive muscle relaxation, biofeedback, meditation (excluding TM) and other "stress management" procedures, found that the efficacy of these approaches in reducing hypertension was equivalent to that of placebo techniques (Eisenberg et al., 1993).

Comparative studies suggest that Transcendental Meditation technique is the most effective, scientifically-studied stress-reduction program, as measured by many physiological and psychological parameters (Alexander et al., 1993; Alexander et al., 1991; Alexander et al., 1994; Dillbeck & Orme-Johnson, 1987; Eppley et al., 1989). For example, in a meta-analysis of 146 independent outcomes, Eppley found the TM technique was significantly more efficacious than other relaxation techniques in reducing anxiety (Eppley et al., 1989). Additional studies also showed the TM technique was the most effective in improving physical (Alexander et al., 1989; Schneider, et al., 1995) and psychological health (Alexander et al., 1991; Brooks & Scarano, 1985; Eppley et al., 1989; Orme-Johnson & Walton, 1998).·

A more recent summary of 8 meta-analyses of 597 studies, comparing the TM program and other stress-reduction techniques, further confirms the TM program's effectiveness (see figure 4). It shows that the meditation technique is the most effective technique in reducing trait anxiety, reducing blood pressure, producing deep physiological relaxation, increasing self-actualization, improving psychological outcomes, and decreasing cigarette, alcohol and drug use (Alexander et al., 1994; Orme-Johnson & Walton, 1998).

Figure 4
Comparison of the Transcendental Meditation Program and Other Stress-Reduction Techniques: Results of Eight Meta-Analyses

In conclusion, comparative research studies indicate that the TM program is the most effective program to reduce stress and anxiety, and to enhance the overall quality of physiological and psychological functioning. The TM program is thus capable of providing the maximum impact on the physiological and psychological abnormalities of ADHD while improving the overall quality of life.

Maharishi Vedic Medicine Herbal Formulations

General Reseach on Herbal Formulations: Maharishi Vedic Medicine Rasayanas are herbal food supplements traditionally recommended to maintain good health and promote longevity (Sharma, 1983; Sharma & Clark, 1998). Rasayanas are natural herbal preparations of fruits, herbs, and minerals whose unique formulas provide synergistic effects. Maharishi Vedic Medicine herbal food supplements are preparations from India's Vedic tradition, discovered thousands of years ago and maintained over the generations by Ayurvedic physicians (*vaidyas*). It should be understand that the Maharishi Vedic Medicine herbal food supplement program is a different approach to treatment than restrictive diets such as the Feingold diet and sugar elimination diets.

Rasayanas have been found to have a positive effect on the functioning of the immune system, the cardiovascular system, and on factors associated with the development and suppression of cancers. The specific herbal food supplement that we propose to use in our study is Maharishi Amrit Kalash (MAK). MAK has been shown to improve cognitive factors associated with deficits experienced by ADHD children. Of particular importance to this study is research indicating positive effects of Maharishi Vedic Medicine herbal food supplements on cognitive performance, psychological functioning, and behavior (see Sharma, 1992). Initial studies on MAK indicate that it significantly improve cognitive functioning (Nidich et al., in press; Gelderloos et al., 1990) and produce a powerful anti-antioxidant effect, which is suggested to improve the functioning of the brain (e.g., Kauffman et al., 1993; Bondy et al., 1991). Other studies indicate that MAK may have a modulating effect on anxiety, depression, aggression and hostility (Hanissian et al., 1988; Sharma, Hanissian et al., 1991).

MAK Effects: Excessive oxidation, occurring at the cellular level, has been suggested to negatively affect the functioning of the brain. Excessive oxidation occurs through free radicals—fragments of atoms or molecules with highly reactive unpaired electrons—that attack nucleic acids, proteins, fats, and carbohydrates, altering their structure and function. A number of factors, including poor diet, pollution, infection, inflammation, and stress, are known to contribute to uncontrolled or excessive formation of free radicals (see e.g., Richards, & Sharma, 1991; Blake et al., 1987). Niwa (1991) found that MAK markedly decreased superoxide, hydrogen peroxide and hydroxl radical generation in both neutrophil chemotaxis and xanthine-xanthine oxidase systems. Both products also were found to significantly reduce lymphocyte blastogenesis responses to phytohemagglutinen, concanavillin A, and pokeweed mitogen. Fields et al. (1990) also showed the complete scavenging of superoxide ions in MAK treated polymorphonuclear leucocytes without compromise of white cell viability or respiration when cells were stimulated by phorbol myristate acetate or xanthine-xanthine oxidase.

Sharma et al. (1992) demonstrated an anti-oxidant effect of MAK on human low-density lipoproteins (LDL). They showed that these preparations cause concentration-dependent inhibition of LDL oxidation as assessed by thiobarbituric acid-reactive substances and electrophoretic mobility. These preparations showed more anti-oxidant potentcy in preventing LDL oxidation than ascorbic acid, alpha-tocopherol, or probucol. Bondy et al. (1990) found that MAK provided almost 100% protection from toulene vapors. Toulene is a widely used industrial solvent which has been demonstrated to produce damage to the cerebellum by free radical mechanisms. This study suggests that MAK may be useful in preventing on-going damage to the brain caused by free-radical generation in toxic environments.

Other research indicates a link between ongoing free radical damage sustained by the brain tissue and impairments in cognitive processing ability (Carney et al., 1991; Bourre, 1991; Qian et al., 1992; Dettaan et al., 1992). These studies suggest that anti-oxidant compounds may have a salutary influence on cognitive abilities that are related to the kinds of cognitive deficits experienced by ADHD children.

Gelderloos et al. (1990), using a randomized, double-blind, placebo-controlled study of 48 adults, found that the use of MAK over a 3- and 6-week period of treatment significantly increased performance on a visual discrimination task. Because successful performance on this visual processing task requires sustained attention in the midst of task distractors, this study indicates that MAK may have a valuable effect in ameliorating the attention deficits of ADHD children.

The effect of Herbal Formulations on Serotonin Metabolism and Mood: Studies by Hanissian et al. (1988) and Sharma, Hanissian et al. (1991) investigated the interaction of MAK with opioid receptors in the brain. Tests with MAK showed generalized inhibition of neural opioid receptor activity, suggesting that MAK may produce positive emotions and have a calming effect on the nervous system. Hauser et al. (1988) found that MAK interacts with the same serotonin receptor on blood platelets as imipramine. Given the suggested relationship of imipramine with serotonin, this study suggests that MAK may increase serotonin levels and thus provide a positive effect on aggression, hostility, and mood. Also, self-reports by human volunteers indicate that MAK improves psychological well-being (Sharma et al., 1991b). A self-assessment survey of 659 individuals taking MAK also indicated less fatigue and greater clarity of mind (Blasdell et al., 1991).

MAK has been shown to produce a striking inhibition of [3H]-imipramine binding to human blood platelet membrane receptors (Hauser et al., 1988). Numerous studies have suggested the role of serotonergic activity in various behaviors such as depressive illness, anxiety, learning, and memory. The ability of MAK to interact with platelet imipramine receptors, and therefore theoretically block serotonin uptake, may partially explain the ability of MAK to reduce depression and psychiatric distress in general (Sharma et al., 1991b).

In summary, the above studies on MAK indicate some of the beneficial effects of Maharishi Vedic Medicine herbal food supplements. The use of MAK is expected to improve brain functioning, which should be reflected in the amelioration of cognitive deficits experienced by ADHD children, as well as improve their mood and behavior.

Conclusion of Background and Significance

Research supports the idea that the Transcendental Meditation program can help counteract the effects of brain dysfunction evident in ADHD children. Research has shown the ability of the TM technique to enhance orderly function and balance in numerous physiological and psychological disorders, many of which have genetic associations.

Modern physiological research on the causes of ADHD behavior have

identified two strong neurophysiological correlates: abnormal prefrontal cortical processes and abnormal neurotransmitter metabolic patterns. These systems are responsible for proper developmental expression of attention and motor control. Recent research using PET, SPECT and MRI technology has discovered metabolic abnormalities (functional lesions) in the brains of some ADHD individuals. Since the TM technique produces marked improvements in brain function and cognitive abilities, we anticipate that these abnormalities will be rebalanced by the Transcendental Meditation technique.

Therefore, the Maharishi Vedic Medicine program is expected to help restore normal neural and cognitive function. Specifically, it is predicted that this MVM treatment combination will result in improved attention, reduced impulsivity and hyperactive behavior, and improved academic performance in ADHD children as compared to controls. By reversing the functional lesions observed in the brains of ADHD students, the Transcendental Meditation technique should provide an effective, much-needed non-pharmacologial approach to treating ADHD.

Literature Cited:

Abikoff, H., & Gittleman, R. (1985). Hyperactive children treated with stimulants: is cognitive training a useful adjunct? *Archives of General Psychiatry,* 42: 953-961.
Ackerman, P. T., Dykman, R. A., & Peters, J. E. (1977). Teenage status of hyperactive and nonhyperactive learning disabled boys. *Amercian Journal of Orthopsychiatry,* 47: 577-596.
Adesman, A. R., & Wender, E. H. (1991). Improving the Outcome for Children with ADHD. *Contemporary Pediatrics,* March Issue 122-139.
Alexander, C. N., Beto, Z., Gerace, D., & Rainforth, M. (in press). Higher States of Consciousness in light of Maharishi's Vedic Psychology: Theory, personal experiences and research. In J. Gachenbach, H. Hunt, & C. N. Alexander (Eds.), *Higher States of Consciousness: Theoretical and experimental perspectives.* New York: Plennum.
Alexander, C. N., Langer, E. J., Newman, R. I., Chandler, H. M., & Davies, J. L. (1989). Transcendental Meditation, mindfulness, and longevity: An experimental study with the elderly. *Journal of Social Behavior and Personality,* 57(6): 950-954.
Alexander, C. N., Rainforth, M. V., & Gelderloos, P. (1991). Transcendental Meditation, Self Actualization, and Psychological Health: A Conceptual Overview and Statistical Meta-Analysis. *J Soc Behav Personality,* 6(5): 189-247.
Alexander, C., Robinson, P., Orme-Johnson, D., Schneider, R., & Walton, K. (1993). The effects of Transcendental Meditation compared to other methods of relaxation and meditation in reducing risk factors, morbidity, and mortality. *Homeostasis*, 35(4-5), 243-264.
Alexander, C. N., Robinson, P., & Rainforth, M. (1994). Treating and preventing alcohol, nicotine, and drug abuse through Transcendental Meditation: A review and statistical meta-analysis. *Alcohol Treatment Quarterly* 11, 13–87.
Alexander, C.N., Swanson, G.C., Rainforth, M.V., Carlisle, T.W., Todd, C.C., & Oates, R.M. (1993). Effects of the Transcendental Meditation program on stress reduction, health, and employee development: A prospective study in two occupational settings. *Anxiety, Stress, and Coping: An International Journal*, *6*:245-262.
American Medical Association Staff (2000), *Alternative Medicine: An Objective Assessment*. Ed., P.B. Fontanarosa, Chicago, Ill. American Medical Association.
American Psychiatric Association (1987). *Diagnostic and Statistical Manual for Mental Disorders* (3rd revised ed.). Washington, D.C.: Psychiatric Press, Inc.
Andersen, S.L. & Teicher, M.H. (2000). Sex differences in dopamine receptors and their relevance to ADHD *Neuroscience and Biobehavioral Review* 24:137-141.
Angeli, N., Christy,J., Howe, J., & Wolff, B. (1994). Facilitating parenting skills in vulnerable families. *Health Visitor* 67: 130-132.
Appelle, S., & Oswald, L. E. (1974). Simple reaction time as a function of alertness and prior mental activity. *Perceptual and Motor Skills,* 38:1263-1268.
Arenander, A.T. (1996). Global Neural Ground State: Coherent brain mechanisms associated with Transcendental consciousness, *Toward a Science of Consciousness 1996*, Tucson, AZ.
Aron, A., Orme-Johnson, D., & Brubaker, P. (1981). The Transcendental Meditation program in the college curriculum: A 4-year longitudinal study of effects on cognitive and affective functioning. *College Student Journal*, *15*, 140-146.
Arnold, L.E., Votolato, N.A., Kleykamp, D. et al., (1990). Does hair zinc predict amphetamine improvement of ADD/hyperactivity? International Journal of Neuroscience 50:103-107.
Asakawa, Y., Matsuda, R., & Takemoto, T. (1982). Mono- and sesquiterpenoids from Hydrocotyle and Centalla species. *Phytochemistry*, 21:2590-2592.
Aydin, C., Idiman, G., & Idiman, E. (1987). Contingent negative variation in normal children and in children with attention deficit disorder. *Advanced Biological Psychiatry,* 16:178-190.
Badawi, K., Wallace, R.K., Orme-Johnson, D.W.and Rouzere, A.M. (1984) Electrophysiologic characteristics of respiratory suspension periods occuring during the practice of the Transcendental Meditation program. *Psychosomatic Medicine*, 46, 267-276.
Ball, T. S., & Irwin, A. E. (1976). A portable automated device applied to training a hyperactive child. *Behavior Therapy and Experimental Psychiatry,* 7:185-187.
Baloh, R., Sturm, R., Green, B., & Gleser, G. (1975). Neuropsychological effects of chronic asymptomatic increased lead absorption. *Archives of Neurology,* 32:326-330.
Banquet, J. P. (1973). Spectral analysis of the EEG in meditation. *Electroencephalography and Clinical Neurophysiology,* 35:143-151.
Banquet, J. P. & Lesevre, N. (1980). Event-related potentials in altered states of consciousness. *Motivation, Motor and Sensory Processes of the Brain, Progress in Brain Research* 54: 447–453.
Banquet, J-P. & Sailhan, M., (1974). Quantified EEG spectral analysis of sleep and transcendental consciousness. In D.W. Orme-Johnson & J.T. Farrow (Eds.), *Scientific Research on the Transcendental Meditation Program: Collected Papers*. (pp. 182-186). Rheinweiler, W. Germany: MERU Press.
Banquet, J. P.; Haynes, C.; Hebert, R.; And Reber, B. (1977). Analysis of sleep in altered states of consciousness by classical EEG and coherence spectra. *Electroencephalography and Clinical Neurophysiology* 43(4): 503, E 203.
Barkley, R.A. (1981). *Hyperactive Children: A handbook for Diagnosis and Treatment.* New York. The Guilford Press.
Barkley, R. A. (1990). *Attention-Deficit Hyperactivity Disorder—A Handbook for Diagnosis and Treatment*. New York: The Guilford Press.
Barkley, R.A. (1991). The ecological validity of laboratory and analogue assessment methods of ADHD symptoms. *J Abnorm Child Psychol,* 19(2):149-178.
Barkely, R.A. (1997). *ADHD and the nature of self-control*. Guilford Press, New York.
Barkley, R.A., Anastopoulos, A.D., Guevremont, D.C., & Fletcher, K.E. (1991). Adolescents with ADHD: Patterns of Behavioral Adjustment, Academic Functioning, and Treatment Utilization. *J Am Acad Child Adolesc Psychiatry,* 30(5):752-761.
Barkley, R. A., & Edelbrock, C. S. (1987). Assessing situation variation in children's behavior problems: the Home and School Situations Questionnaires. In R. Prinz (Eds.), Advances in Bahavioral Assessment of Children and Families (pp. 157-176). Greenwich, CT: JAI Press.
Barkley, R.A., Fischer, M., Edelbrock, C.S. & Smallish, L. (1990). The adolescent outcome of hyperactive children diagnosed by research criteria. I. An 8 year prospective follow-up study. *Jouurnal of Child Psychology and Psychiatry,* 26: 705-715.
Barkley, R.A., & Murphy, J.V., (1991). Treating attention deficit hyperactivity disorder: Medication and behavior management training. *Ped Annals,* 20(5):256-266.
Bender, B., & Milgrom, H. (1992). Theophylline-Induced Behavior Change in Children. *JAMA,* 267(19):2621-2624.
Benson, D.F., (1991). The Role of Frontal Dysfunction in Attention Deficit Hyperactivity Disorder. *J Child Neurol,* 6(Suppl):S9-S12.
Bentler, P.M. (1970). A Comparison of Monotonicity Analysis with Factor Analysis. *Educational and Psychological Measurement,* 30(2):241-250.
Benton, D., & Cook, R. (1991). Vitamin and mineral supplements improve the intelligence scores and concentration of six-year-old children. *Personality and Individual Differences,* 12(11):1151-1158.
Benton, D. & Roberts, G. (1988), Effect of vitamin and mineral supplementation on intelligence of a sample of schoolchildren. *Lancet* 1: 140-143.
Bhatara, V., Arnold, L.E., Lorance, T., & Gupta, D. (1979). Muscle relaxation therapy in hyperkinesis: Is it effective? *Journal of Learning Disabilities,* 12:49-53.
Biederman, J. (1998). Attention-deficit/hyperactivity disorder: A life-span perspective. *Journal of Clinical Psychiatry* 59(Supplement 7):4-16.
Blake, D.R., Allen, R.E., & Lunec, J. (1987). Free radicals in biological systems— A review oriented to inflammatory processes. *British Medical Bulletin,* 43:371-385.
Blalock, H. (1972). Social statistics. New York: McGraw-Hill.
Blasdell, K. S., Tomlinson, P. F., & Wallace, R. K. (1991). Subjective survey, blood chemistry, and complete blood profile of subjects taking Maharishi Amrit Kalash (MAK). Journal of the Federation of American Societies of Experimental Biology, 5(5).
Blondis, T.A. (1989). Measures of Attention, Part I: Questionnaires. *Clin Pediatr,* 28(50):222-28.
Blondis, T.A. (1989). Measures of Attention, Part II: Clinical Perspectives and Test Interpretation. *Clin Pediatr,* 28(6):268-76.
Bondy, S., Hernandez, T. M., & Mattia, C. (1991). Anti-oxidant properties of two herbal preparations. Biochemical Archives.
Bosco, J., & Robin, S. (1980). Hyperkinesis: How common is it and how is it treated? In Whalen, C.K. & Henker, B. (Eds.), *Hyperactive children: The social ecology of identification and treatment.* New York: Academic Press.
Bradshaw, J.L.& Sheppard, D.M. (2000) The neurodevelopmental frontostriatal disorders: Evolutionary adaptiveness and anomalous lateralization. *Brain and Language* 73:297-320.
Brandon, J.E., Eason, R.L., & Smith, T.L. (1986). Behavioral relaxation training and motor performance of learning disabled children with hyperactive behaviors. *Adapted Physical Activity Quarterly,* 3: 67-69.
Brooks, J., & Scarano, T. (1985). Transcendental Meditation in the treatment of post-Vietnam adjustment. *Journal of Counseling and Development* 64, 212-215.
Brown, R. T., & Borden, K. A. (1986). Hyperactivity at adolescence: some misconceptions and new directions. *Journal of Clinical Child Psychology,* 15:194-209.
Bujatti, M., & Reiderer, P. (1976). Serotonin, noradrenaline, dopamine metabolites in Transcendental Meditation technique. *Journal of Neural Transmission,* 39:257-267.

Bush, G., Frazier, J.A., Rauch, S.L., Seidman, L.J., Whalen, P.J., et al, (1999). Anterior cingulate cortex dysfunction in attention-deficit/hyperactivity disorder revealed by fMRI and the counting Stroop. *Biological Psychiatry* 45:1542-1552
Candelent, T., & Candelent, G. (1975). Teaching Transcendental Meditation in a psychiatric setting. Hospital and Community *Psychiatry,* 26(3):156-159.
Carney, J.M., Starke-Reed, P.E., Oliver, C.N., Landum, R.W., Cheng, M.S., Wu, J.F., & Floyd, R.A. (1991). Reversal of age-related increase in brain protein oxidation, decrease in enzyme activity, and loss in temporal and spatial memory by chronic administration of the spin-trapping compound N-tert-butyl-a-phenylnitrone. *Proc Natl Acad Sci,* 88:3633-3636.
Cattell, R.B., & Cattell, A.K.S. (1960). Culture Fair Intelligence Tests. Champaign, IL: Institute for Personality and Ability Testing.
Chabot, R.J. & Serfontein, G. (1996). Quantitative electroencephalographic profiles of children with attention deficit disorder. *Biological Psychiatry,* 40(10):951-63
Chabot, R.J., Merkin, H., Wood, L.M., Davenport, T.L. & Serfontein, G. (1996). Sensitivity and specificity of QEEG in children with attention deficit or specific developmental learning disorders. *Clinical Electroencephalography* 27:26-34.
Chabot, R.J., Orgill, A.A., Crawford, G., Harris, M.J. & Serfontein, G. (1999). Behvarioral and electrophysiologica predictors of treatment response to stimulants in children with attention disorders. *Journal of Child Neurology* 14:343-351.
Chamberlain, B., & et al. (1987). The effect of raising or lowering tryptophan levels on aggression in vervet monkeys. *Pharmacol Biochem Behav,* 28(4):503-510.
Chandra, S.V. (1983). Psychiatric illness due to manganese poisoning. *Acta Psychiatr Scand,* 303(Suppl:S49-S54.
Chelune, G.J., Ferguson, W., Koon, R., & Dickey, T.O. (1986). Frontal lobe disinhibition in attention deficit disorder. *Child Psychiatry and Human Development,* 16:221-232.
Chess S. & Thomas, A. (1996). Temperament. In M. Lewis, ed*, Child and Adolescent Psychiatry: A Comprehensive Textbook.* (2nd edition, pp. 170-181), Baltimore, Williams & Wilkins.
Childs, J.P. (1973) The use of the Transcendental Meditation program as a therapy with juvenile offenders. Doctoral thesis, University of Tennessee.
Collier, R.W. The effect of the Transcendental Meditation program upon university academic atainment. Department of English as a Second Language, College of Arts and Sciences, University of Hawaii, Honolulu, Hawaii, U.S.A.
Comings, D.E. (1990). Blood serotonin and tryptophan in Tourette Syndrome. *American Journal of Medical Genetics,* 36:418-430.
Comings, D.E., Gade-Andavolu, R., Gonzalez, N., Wu, S., Muhleman, D., et al., (2000a). Multivariate analysis of associations of 42 genes in ADHD, ODD, and conduct disorder. *Clinical Genetics* 58:31-40.
Comings, D.E., Gade-Andavolu, R., Gonzalez, N., Wu, S., Muhleman, D., et al., (2000b). Comparison of the role of dopamine, serotonin, and noradrenaline genes in ADHD, ODD, and conduct disorder: Multivariate regression analysis of 20 genes. *Clinical Genetics* 57:178-196.
Conners, C.K. (1973). Rating Scales for Use in Drug Studies with Children. *Psychopharm Bull* (Special Edition), pp. 24-84.
Conners, C.K. (1993). *CPT Computer Program*. Toronto: Multi-Health Systems.
Conners, D.F. & Steingard, R.J. (1996). A clinical approach to the pharmacology of aggression in children and adolescents. *Annuals of the New York Academy of Science* 794:290-307.
Copeland, L., , & Wolraich, M.L., (1987). Attention Deficit Disorder—Hyperactivity. In Wolraich, M.L. (Ed.), *The Practical Assessment & Management of Children with Disorders of Development & Learning.* (pp. 269-95). Chicago: Year Book Medical Publishers, Inc.
Cory, R. and Hufnagel, P. The Effect of the Science of Creative Intelligence course on high school students: A preliminary report. American Foundation for the Science of Creative Intelligence, Hartford, Connecticut, U.S.A., 1974
Cranson, R.W., Orme-Johnson, D.W., Gackenback, J., Dillbeck, M.C., Jones, C.H., & Alexander, C.N. (1991). Transcendental Meditation and improved performance on intelligence-related measures: A longitudinal study. *Person. individ. Diff.,* 12(10):1105-1116.
Denkowski, K.M., & Denkowski, G.C. (1984). Is Group Progressive Relaxation Training as Effective with Hyperactive Children as Individual EMG Biofeedback Treatment? *Biofeedback and Self-Regulation,* 9(3):353-364.
Denkowski, K.M., Denkowski, G.C., & Omizo, M.M. (1984). Predictor of success in the EMG biofeedback training of hyperactive male children. *Biofeedback and Self-Regulation,* 9(3):253-262.
Dettaan, J.B., Newman, J.D., & Kola, I. (1992). Cu/Zn superoxide dismutase mRNA and enzyme activity, and susceptibility to lipid peroxidation, increases with aging in murine brains. *Brain Research,* 13(3):179-187.
Dillbeck, M.C., Assimakis, P.D., Raimondi, D., Orme-Johnson, D.W., & Rowe, R. (1986). Longitudinal effects of the Transcendental Meditation and TM-Sidhi program on cognitive ability and cognitive style. *Perceptual and Motor Skills*, *62*, 731-738.
Dillbeck, M., & Vesely, S. A. (1982). Participation in the Transcendental Meditation program and frontal EEG coherence during concept learning. *International Journal of Neuroscience,* 29:45-55.
Dillbeck, M.C. (1977). The Effect of the transcendental meditation technique on anxiety level. *Journal of Clinical Psychology,* 33(4):1076-1078.
Dillbeck, M.C. (1982). Meditation and flexibility of visual perception and verbal problem solving. *Memory and Cognition,* 10(3):207-215.
Dillbeck, M.C. and Bronson, E.C. Short-term longitudinal effects of the Transcendental Meditation technique on EEG power and coherence. *International Journal of Neuroscience* 14: 147-15, 1981.
Dillbeck, M.C. and Vesley, S.A. (1986) Participation in the Transcendental Meditation program and frontal EEG coherence during concept formation. *International Journal of Neuroscience*, 29, 45-55.
Dillbeck, M.C., & Orme-Johnson, D.W. (1987). Physiological differences between Transcendental Meditation and rest. *American Psychologist,* 42:879-881.
Dillbeck, M.C., Msemaje, H.I., Clayborne, M.B., & Dillbeck, S.L. (1990). Effects of the Transcendental Meditation program with low-income inner-city children. Presented at the Annual Convention of the American Psychological Association, Boston.
Dillbeck, M.C., Orme-Johnson, D.W. and Wallace, R.K. Frontal EEG coherence, H-relflex recovery, concept learning, and the TM-Sidhi program. *International Journal of Neuroscience* 15: 151-157, 1981.
Dillbeck, M.C.; Cavanaugh, K.L.; Glenn, T.; Orme-Johnson, D.W.; & Mittlefehldt, V. (1987). Consciousness as a field: the Transcendental Meditation and TM-Sidhi program and changes in social indicators. *The Journal of Mind and Behavior* 8(1):67–104.
Donney, V.K., & Poppen, R. (1989). Teaching Parents to Conduct Behavioral Relaxation Training with their Hyperactive Children. *J Behav Ther & Exp Psychiat,* 20(4):319-325.
Douglas, V.I. (1983). Attention and cognitive problems. In M. Rutter (Ed.), *Developmental Neuropsychiatry* New York: The Guilford Press.
Dulcan, M.K. (1985). Attention Deficit Disorder: Evaluation and Treatment. *Ped Annals,* 14(5):383-99.
Dunn, F.M., & Howell, R.J. (1982). Relaxation training and its relationship to hyperactivity in boys. *Journal of Clinical Psychology,* 38:92-100.
Dykman, R.A., Ackerman, P.T., Clements, S.D., & Peters, J.E. (1971). Specific learning disabilities: An attentional deficit syndrome. In H. R. Myklebust (Eds.), *Progress in learning disabilities* (pp. 56-93). New York: Grune & Stratton, Inc.
Eason, R.L., Brandon, J.E., Smith, T.L., & Serpas, D.C. (1986). Relaxation training effects on reaction/response time, frontalis EMG, and behavioral measures of relaxation with hyperactive males. *Adapted Physical Activity Quarterly,* 3:329-341
Eisenberg, D., Delbanco, T., Berkey, C., Kaptchuk, T., Kupelnick, B., Kuhl, J., & Chalmers, T. (1993a). Cognitive behavioral techniques for hypertension: Are they effective? *Annals of Internal Medicine* 118(12), 964—972.
Eisenberg, D.M., Kessler, R.C. Foster, C. et al., (1993b) Unconventional medicine in the United States: Prevalence, costs, and patterns of use. *New England Journal of Medicine* 328:246-252.
Eppley, K., Abrams, A., & Shear, J. (1989). The differential effects of relaxation techniques on trait anxiety: A meta-analysis. *Journal of Clinical Psychology,* 45(6):957-974.
Ernst, M., Zametkin, E.M., Matochik, J.A., Johns, P.H. & Cohen, R.M. (1998). DOPA decarboxylase activity in attention deficit hyperactivity disorder in adults. A [fluorine-18]fluorodopa positron emission tomographic study. *Journal of Neuroscience* 18:5901-5907.
Eyerman, J., (1981). Transcendental Meditation and Mental Retardation. *Journal of Clinical Psychiatry,* 42(1).
Faraone, S.V. & Biederman, J. (1998). Neurobiology of attention-deficit hyperactivity disorder. *Biological Psychiatry* 44:951-958.
Faraone, S.V. & Biederman, J. (1999). Neurobiology of attention deficit hyperactivity disorder. In DS Charney, E.J. Nestler & B.S. Bunney, eds. *Neurobiology of Mental Illness.* New York, Oxford University Press.
Feingold, B. *Why Your Child is Hyperactive.* New York, Random House.
Fields, J.Z., Rawal, P.A. Hagen, J.F., Wallace, R.K., Tomlinson, P.F. & Schneider, R.H. (1990). Oxygen free radical (OFR) scavenging effects of an anti-carcinogenic natural product, Maharishi Amrit Kalash (MAK). Abstract submitted to the Annual Meeting of the *American Society for Pharmacology and Experimental Therapeutics* (ASPET).
Findling, R.L. & Dogin, J.W. (1998). Psychopharmacology of ADHD: children and adolescents. *Journal of Clinical Psychiatry* 7:42-49.
Fodor, J., & Chockalingam, A. (1990). The Canadian consensus report on non-pharmacological approaches to the management of high blood pressure. *Clinical and Experimental Hypertension* A12, 729-743.
Fredrikson, M., & Matthews, K. (1990). Cardiovascular responses to behavioral stress and hypertension: A meta-analytic review. *Annals of Behavioral Medicine* 12(1), 30—39.
Frew, D.R. (1974). Transcendental Meditation and Productivity. *Academy of Management Journal* , *17*, 362-368.
Gadow, K.D. (1983). Effects of stimulant drugs on academic performance in hyperactive and learning disabled children. *Journal of Learning Disabilities,* 16:290-299.
Gadow, K.D. (1985). Relative efficacy of pharmacological, behavioral, and combination treatments for enhancing academic performance. *Clinical Psychology Review,* Special Issue: Attention Deficit Disorder: Issues in Assessment and Intervention, pp. 479-512.

Gaylord, C., Orme-Johnson, D., & Travis, F. (1989). The effects of the Transcendental Meditation technique and progressive muscle relaxation on EEG coherence, stress reactivity, and mental health in black adults. *International Journal of Neuroscience*, *46*, 77-86.
Geisler, M. (1978). Therapeutische Wirkungen der Transzendentalen Meditation auf Drogenkonsumenten. *Zeitschrift fur klinische Psychologie,* 7(4):235-255.
Gelderloos, P. (1987). *Valuation and Transcendental Meditation*. Lelystad, Netherlands: Soma Scientific Publisher.
Gelderloos, P., Ahlstrom, H.H.B., Orme-Johnson, D.W., Robinson, D.K., Wallace, R.K., & Glaser, J.L. (1990). Influence of a Maharishi Ayur-Vedic Herbal Preparation on Age-Related Visual Discrimination. *International Journal of Psychosomatics,* 37(1-4):25-29.
Gelderloos, P., Lockie, R.J., & Chuttoorgoon, S. (1987). Field Independence of students at Maharishi School of Age of Enlightenment and a Montessori school. *Perceptual and Motor Skills*, *65*, 613-614.
Gelenberg, A.J. (1988). Psychiatric Disorders. In Paige, D.M. (Ed.), *Clinical Nutrition* (pp. 242-51). St. Louis: The C.V. Mosby Company.
Giammanco, S., et al. (1990). Short term diet of precooked corn meal almost lacking in tryptophan and interspecific rat-mouse aggressive behavior. *Arch Int Physiol Biochim,* 98(1):23-26.
Gittelman, R., Mannuzza, S., Shenker, R., & Bonagura, N., (1985). Hyperactive Boys Almost Grown Up I. Psychiatric Status. *Arch Gen Psychiatry,* 42:937-947.
Glaser, G.L. Maharishi Ayurveda: an introduction to recent research. *Modern Science and Vedic Science* 2(1): 89-108, 1988.
Glaser, J.L., (1988) Maharishi Ayur-Ved: An introduction to recent research. Modern Science and Vedic Science, 2(1): 89-108
Glaser, J.L., Robinson, D.K., & Wallace, R.K. (1991). Improvement in Seasonal Respiratory Allergy With Maharishi Amrit Kalash 5, an Ayurvedic Herbal Immunomodulator. *Proceedings of the American Association of Ayurvedic Medicine,* 7(1):6.
Goddard, P.H. (1989). Reduced age-related declines of P300 latency in elderly practicing Transcendental Meditation. *Psychophysiology* 26: S29.
Goleman, D.J., & Schwartz, G.E. (1976). Meditation as an intervention in stress reactivity. *Journal of Consulting and Clinical Psychology,* 44:456-466.
Gordon, M. (1983). *The Gordon Diagnostic System.* DeWitt, NY: Gordon Systems.
Gortenstein, E.E., & Newman, J.P. (1980). Disinhibitory psychopathology: A new perspective and a model for research. *Psychological Bulletin,* 87:301-315.
Gualtieri, C.T., & Hicks, R.E. (1985). Neuropharmacology of methylphenidate and a neural substitute for childhood hyperactivity. *Psychiatric Clinics of North America,* 8:875-892.
H P C R Group.(1992). The effects of nonpharmacologic interventions on blood pressure of persons with high normal levels: Results of the Trials of Hypertension Prevention, Phase I. *Journal of the American Medical Association* 267:1213—1220.
Hahn, H.R., & Whalen, T.E. (1974) The effects of the Transcendental Meditation program on levels of hostility, anxiety, and depression. Master's thesis, California State University at Hayward.
Halperin, J.M., Matier, K., Bedi, G., Sharma, V., & Newcorn, J., (1992). Specificity of Inattention, Impulsivity, and Hyperactivity to the Diagnosis of Attention-deficit Hyperactivity Disorder. *J Am Acad Child Adolesc Psychiatry,* 31(2):190-196.
Hanissian, S.H., Sharma, H.M., & Tejwani, G.A. (1988). Effect of Maharishi Amrit Kalash on brain opioid receptors. *Journal of the Federation of American Societies of Experimental Biology,* 2(4).
Hanley, C.P., & Spates, J.L. (1978). Transcendental Meditation and social psychological attitudes. T*he Journal of Psychology,* 99:121-127.
Harley, J.P., Ray, R.S., Tomasi, L., Eichman, P.L., Matthews, C.G., Chun, R., Cleeland, C.S., & Traisman, E. (1978). Hyperkinesis and Food Additives: Testing the Feingold Hypothesis. *Pediatrics*, 61(6):818-828.
Hauser, T., Walton, K.G., Glaser, J., & Wallace, R.K. (1988). Naturally occurring ligand inhibits binding of [3H]-imiprramine to high affinity receptors. Presented at: Society for Neuroscience, 18th Annual Meeting, Toronto, Ontario, Canada.
Haynes, C.T.; Hebert, J.R.; Reber, W., & Orme-Johnson, D.W. (1976). The psychophysiology of advanced participants in the Transcendental Meditation program: Correlations of EEG coherence, creativity, H-reflex recovery, and experience of transcendental consciousness. In D.W. Orme-Johnson & J.T. Farrow (Eds.), *Scientific Research on the Transcendental Meditation Program: Collected Papers*. (pp. 208-212). Rheinweiler, W. Germany: MERU Press.
Heaton, D.P. and Orme-Johnson, D.W. The Transcendental Meditation program and academic achievement. International Center for Scientific Research, Maharishi International University, Fairfield, Iowa, U.S.A., 1974.
Hechtman, L., (1991). Resilience and Vulnerability in Long Term Outcome of Attention Deficit Hyperactive Disorder. *Can J Psychiatry,* 36:415-421.
Heilman, K.M., Voeller, K.K.S., & Nadeau, S.E., (1991). A Possible Pathophysiologic Substrate of Attention Deficit Hyperactivity Disorder. *J Child Neurol,* 6(Suppl):S76-S81.
Henrotte, J. G. (1986). Type A behavior and magnesium metabolism. *Magnesium*, 5:201-210.
Heseker, H., Kubler, W., Westenhofer, J., & Pudel, V. (1990). Pstchische Veranderungen als Fruhzeichen einer suboptimalen *Vitaminversorgung. Ernahrungs-Umschau,* 37:87-94.
Hill, D.A. (1989). Beta-adrenergic receptor sensitivity, autonomic balance and serotonergic activity in practitioners of Transcendental Meditation. *Dissertation Abstracts International* 50(8): 3330-B.
Hjelle, L.A. (1974). Transcendental Meditation and psychological health. *Perceptual and Motor Skills,* 39:623-628.
Hoegerman, G., MD (1991). Cerebral Glucose Metabolism in Hyperactivity. *N Engl J Med,* 324(17):1216.
Holmes, D.S. (1984) Meditation and somatic arousal reduction: A review of the experimental evidence. *American Psychologist,* 39, 1-10.
Horn, W.F., Ialongo, N.S., Pascoe, J. M., Greenberg, G., Packard, T., Lopez, M., Wagner, A., & Puttler, L., (1991). Additive Effects of Psychostimulants, Parent Training, and Self-Control Therapy with ADHD Children. *J Am Acad Child Adolesc Psychiatry,* 30(2):233-40.
Hornig, M. (1998). Addressing comorbidity in adults with attention-deficit/hyperactivity disorder. *Journal of Clinical Psychiatry*. 59:69-75.
Hughes, H., Henry, D., & Hughes, A. (1980). The Effect of Frontal EMG Biofeedback Training on the Behavior of Children with Activity-Level Problems. *Biofeedback and Self-Regulation,* 5(2):207-219.
Hynd, G.W., Lorys, A.R., Semrud-Clikeman, M., Nieves, N., Huettner, M.I.S., & Lahey, B.B., (1991). Attention Deficit Disorder without Hyperactivity: A Distinct Behavioral and Neurocognitive Syndrome. J *Child Neurol,* 6(Suppl):S37-S43.
Izenwasser, S.E., et al., (1986). Stimulant-like effects of magnesium on aggression in mice. *Pharmacol Biochem Behav,* 25(6):1195-1199.
Jackson, C., Bee-Gates, D., & Henricksen, L. (1994). Authoritative parenting, child competencies, and initiation of cigarette smoking". *Health Education Quarterly*, 21(1):103-116.
Jackson, Y. (1977) Learning disorders and the Transcendental Meditation program: Retrospects and prospects—a preliminary study with economically deprived adolescents. Doctoral thesis, University of Massachusetts.
Jastak, S., & Wilkinson, G.S. (1984). *The Wide Range Achievement Test-Revised* 2. Wilminton, DE: Jastak Associates, Inc.
Jedrczak, A., Beresford, M., & Clements, G. (1985). The TM-Sidhi programme, pure consciousness, creativity, and intellegence. *The Journal of Creative Behavior*, *19*, 270-275.
Jedrczak, A., Toomey, M., & Clements, G. (1986). Reduction in aging effects as assessed by perceptual/motor speed and non-verbal intelligence. J*ournal of Clinical Psychology,* 42:161-164.
Jevning, R., Wilson, A.F., & Davidson, J.M. (1978). Adrenocorticol activity during meditation. *Hormones and Behavior,* 10:54-60.
Kapoor, L.D. (1990). *CRC handbook of medicinal herbs*. Boca Raton, FL: CRC Press.
Kar, D.K., & Sen, S. (1986). Content of sapogenins in diploid, tetraploid and hexaploid asparagus. *International Journal of Crude Drug Research,* 23:131-133.
Kauffman, E.M., Hanna, A.N., Newman, H.A. , & Sharma, H.M. (1993). In-vitro and In-vivo Free Radial Scavenging Effects of the Maharishi Ayur-Veda Herbal Compound Student Rasayana. *FASEB Journal,* 7(3):A347.
Kember, P. (1985). The Transcendental Meditation technique and academic performance: A short report on a controlled longitudinal pilot study. *British Journal of Educational Psychology,* 55:164–166. (Abstract)
Kember, P. (1985). The Transcendental Meditation technique and postgraduate academic performance. *British Journal of Educational Psychology*, 55, 164-166.
Kershner, J., & Hawke, W. (1979). Megavitamins and learning disorders: a controlled double-blind experiment. *Journal of Nutrition,* 109:819-826.
Kertesz, A., Nicholson, I., Cancelliere, A., Kassa, & Black (1985). Motor impersistence: A right hemisphere syndrome. *Neurology*, 35:662-666.
Kobal, G.; Wandhöfer, R. A.; And Plattig, K.-H. (1975). EEG power spectra and auditory evoked potentials in Transcendental Meditation (TM). *Pflügers Archive,* Supplement 359: 191, R 96.
Kozielec, T., Starobrat-Hermelin, B. & Kotkowiak, L. (1994) Deficiency of certain trace elements in children with hyperactivity. Psychiatr. Pol 28:345-353.
Krasner, P.R., & Phillips, S. (1980). The control of hyperactivity in neurologically impaired children using a point system and stabilimeter feedback. *Proceedings of the Biofeedback Society of America,* Eleventh Annual Meeting, 76-80.
Krummel, D.A., Seligson, F.H., Guthrie, H.A. (1996), Hyperactivity: Is candy causal. *Critical Reviews in Food Science and Nutrition* 36:31-47.
Lamont, J. (1997). Homeopathic treatment of attention deficit disorder. *British Homeopathic Journal* 86:196-200.
Lazzaro, I., Gordon, E., Whitmont, S., Plahn, M., Li, W., Clarke, S., Dosen, A., & Meares, R. (1998). Quantified EEG activity in adolescent attention deficit hyperactivity disorder *Clinical Electroencephalography* 29:37-42.
Levine, P.H. (1976). The coherence spectral array (COSPAR) and its applicatioan to the study of spatial ordering in the EEG. *Proceedings of the San Diego Biomedical Symposium,* 15:237-247.
Levine, P. H.; Hebert, J. R.; Haynes, C. T.; & Strobel, U. (1976). EEG coherence during the Transcendental Meditation technique. In D.W. Orme-Johnson & J.T. Farrow (Eds.), *Scientific Research on the Transcendental Meditation Program: Collected Papers*. (pp. 187-207). Rheinweiler, W. Germany: MERU Press.

Levy, F. (1991). The Dopamine Theory of Attention Deficit Hyperactivity Disorder (ADHD). *Australian and New Zealand Journal of Psychiatry,* 25:277-283.
Linn, R.T., & Hodge, J.K. (1980). Use of EMG biofeedback training in increasing attention span and internalizing locus of control in hyperactive children. *Proceedings of the Biofeedback Society of America,* Eleventh Annual Meeting, 81-84.
LÖLIGER, S.A. (1990). Relationship between subjective bliss, 5-hydroxy-3-indoleacetic acid and the collective practice of Maharishi's Transcendental Meditation and TM-Sidhi program. *Dissertation Abstracts International* 52: 551.
Loney, J., & Milich, R. (1982). Hyperactivity, inattention, and aggression in clinical practice. In Routh, D. & Wolraich, M. (Eds.), *Advances in developmental and behavioral pediatrics* (pp. 113-147). Greenwich, CT: JAI Press.
Lonsdale, D., & Shamberger, R. (1980). Red cell transketolase as an indicator of nutritional deficiency. *American Journal of Clinical Nutrition,* 33(2):205-211.
Lubar, J.F., (1991). Discourse on the development of EEG diagnostics and biofeedback for attention-deficit/hyperactivity disorder. *Biofeedback and Self-regulation* 16:201-225.
Lubar, J.F., (1997) Neocortical dynamics: Implications for understanding the role of neurofeedback and related techniques for the enhancement of attention. *Applied Psychophysiology and Biofeedback* 22:111-126.
Lubar, J.F., Bianchini, K.J., Calhoun, W.H., Lambert., E.W., Brody, A.H.& Shabsin, H.S. (1985). Spectral analysis of EEG differences between children with and without learning disabilities. *Journal of Learning Diabilities* 18:403-408.
Lubar, J.F., Swartwood, M.O., Swartwood, J.N. & O'Donnell, P.H., (1995). Evaluation of the effectiveness of EEG neurofeedback training for ADHD in a clinical setting as measured by changes in T.O.V.A. scores, behavioral ratings, and WISC-R performance. *Biofeedback and Self-regulation* 20:83-99.
Lubar, J.F., White, J.N., Swartwood, M.O. & Swartwood, J.N. (1999). Methylphenidate effects on global and complex measures of EEG. *Pediatric Neurology* 21:633-637.
Luk, S. (1985). Direct observation studies of hyperactive behaviors. J *Am Acad Child Adolesc Psychiatry,* 24:338-344.
Lyubimov, N.N. (1992). *Electrophysiological characteristics of sensory processing and mobilization of hidden brain reserves*. 2nd Russian-Swedish Symposium New Research in Neurobiology, Moscow, Russia: Russian Academy of Science Institute of Human Brain.
Lyubimov, N.N. (1994). *Electrophysiological characteristics of mobilization of hidden brain reserves*. International Symposium 'Physiological and Biochemical Basis of Brain Activity, St. Petersburg, Russia: Russian Academy of Science Institute of Human Brain.
MacLean, C.R.K., Walton, K.G., Wenneberg, S.R., Levitsky, D.K., Mandarino, J.V., Waziri, R., & Schneider, R.H. (1992). Altered cortisol response to stress after four months' practice of the Transcendental Meditation program. *Society of Neuroscience Abstracts,* 18:1541.
Maharishi Mahesh Yogi (1969) *On the Bhagavad Gita: A new translation and commentary.* Harmondsworth, England: Penguin
Mann, C.A., Lubar, J.F., Zimmerman, A.W., Miller, C.A. & Muenchen, R.A., (1992) Quantitative analysis of EEG in boys with attention-deficit-hyperactivity disorder: Controlled study with clinical implications. *Pediatric Neurology* 8:30-36.
Maclean, C. R. K.; Walton, K. G.; Wenneberg, S. R.; Levitsky, D. K.; Waziri, R.; And Schneider, R. H. (1992). Alterations in Plasma Serotonin Reactivity to Laboratory Stress after Four Months Practice of the Transcendental Meditation (TM) program. Second International Symposium on Serotonin from All Biology and Pharmacology Therapeutics. Houston, TX.
McEvoy, T. M.; Frumkln, L. R.; And Harkins, S. W. (1980). Effects of meditation on brainstem auditory evoked potentials. *International Journal of Neuroscience* 10: 165–170.
McLaren, D.S. (1988). Clinical manifestations of nutritional disorders. In Shils, M.E. & Young, V.R. (Eds.), *Modern Nutrition in Health and Disease.* Philadelphia: Lea & Febiger.
Mefford, I.N., & Potter, W.Z. (1989). A Neuroanatomical and Biochemical Basis for Attention Deficit Disorder with Hyperactivity in Children: A Defect in Tonic Adrenaline Mediatred Inhibition of Locus Coeruleus Stimulation. *Medical Hypothesis,* 29:33-42.
Meichenbaum, D., & Goodman, J. (1969). Reflection-impulsivity and verbal control of motor behavior. *Child Development,* 40:785-797.
Merrill, K.H. (1985). *Analysis: the new WRAT-R compared with Woodcock-Johnson achievement and WISC-R*. Mesa, AZ: Mesa Public Schools.
Milich, R., Roberts, M.A., Loney, J., & Caputo, J. (1980). Differentiating practice effects and statistical regression on the Conners Hyperkinesis Index. *Journal of Abnormal Child Psychology,* 8:549-552.
Miskiman, D.E. (1977). Performance on a learning task by subjects who practice the Transcendental Meditation technique. In D.W. Orme-Johnson & J.T. Farrow (Eds.), *Scientific Research on the Transcendental Meditation Program: Collected Papers*. (pp. 382-384). Rheinweiler, W. Germany: MERU Press.
Monastra, V.J., Lubar, J.F., Linden, M. VanDuesen, P., Green, G. et al., (1999) Assessing attention deficit hyperactivity disorder via quantitative electroencephalography: An initial validation study. *Neuropsychology* 13:424-433.
Muehlman, J. M., Nidich, S. I., Reilly, B., & Cole, C., (1992). Relationship of the practice of the Transcendental Meditation technique to academic achievement. In R.K. Wallace, D.W. Orme-Johnson, & M.C. Dillbeck (Eds.), *Scientific Research on the Transcendental Meditation and TM-Sidhi Program: Collected papers* (pp. 3071). Fairfield, Iowa: MIU Press.
Muehlman, J.M., Nidich, S.I., Reilly, B., & Cole, C. (1988). Relationship of the practice of the Transcendental Meditation technique to academic achievement. Paper presented at the Annual Meeting of the Mid-Western Educational Research Association, Chicago, Illinois.
Nall, A. (1973). Alpha training and the hyperkinetic child—is it effective? *Academic Therapy,* 9:5-19.
Nataraj, P. and Radhamani, M.G. The Transcendental Meditation program and its effects on psychological functions in secondary school students of a rural Inidan high school. Department of Psychology, Maharani's College, Mysore, India. Research presented at the International Conference on 'Veda and Science', Bangalore, Karnataka, India, 25-30 June 1975
Nataraj, P., and Radhamani, M.G. (1975). The Transcendental Meditation program and its effects on psychological functions in secondary school students of a rural Indian high school. Department of Psychology, Maharani's College, Mysore, India. Research presented at the International Conference on 'Veda and Science', Bangalore, Karnataka, India.
Needleman, H.L., Gunnoe, C., Leviton, A., Reed, R., Peresie, H., Maher, C., & Barrett, P. (1979). Deficits in psychologic and classroom performance of children with elevated dentine lead levels. *New England Journal of Medicine*, 300:689-695.
Nidich S. I., and Nidich, R. J. (1989). Increased academic achievement at Maharishi School of the Age of Enlightenment: a replication study. *Education* 109(3): 302–304.
Nidich S.I, Nidich, R. Rainforth M., 1986 School effectiveness: acheivement gains at Maharishi School of the Age of Enlightenment. *Education* 107(1): 49-54.
Nidich, R., Nidich, S. I., Orme-Johnson, D. W., & Wallace, R. K. (1989). EEG coherence and the length of practice of the Transcendental Meditation program. In Chalmers, R., Clements, G., Schenkluhn, H., & Weinless, M. (Eds.), *Scientific research on the Transcendental Meditation and TM-Sidhi program: Collected Papers* Vlodrop, The Netherlands: MERU Press.
Nidich, S. I., Nidich, R., Abrams, A., Orme-Johnson, D. W., & Wallace, R. K. (1989). Frontal lobe functioning: EEG coherence as a predictor of highly pro-social behavior in subjects practicing the Transcendental Meditation and TM-Sidhi program. In R. Chalmers, G. Clements, H. Schenkluhn, & M. Weinless (Eds.), *Scientific research on the Transcendental Meditation and TM-Sidhi program: Collected Papers* Vlodrop, The Netherlands: MERU Press.
Nidich, S. I., Ryncarz, R. A., Abrams, A. I., Orme-Johnson, D. W., & Wallace, R. K. (1983). Kohlbergian cosmic perspective responses, EEG coherence, and the Transcendental Meditation and TM-Sidhi Program. *Journal of Moral Education,* 12(3):166-173.
Nidich, S. I., Schneider, R. H., Sharma, H. M., Nidich, R. J., Foster, G., Robinson, C., & Goodman, R. (in press). Effect of Maharishi's Transcendental Meditation on intellectual development and lipid peroxides levels in community dwelling elderly adults.
Nidich, S. I.; Nidich, R. J.; & Rainforth, M. (1986). School effectiveness: achievement gains at the Maharishi School of the Age of Enlightenment. *Education* 107:49–54.
Nidich, S. Seeman, W. and Dreskin, T. Influence of Transcendental Meditation on Self-Actualization: A replication. *Journal of Counseling Psychology* 20: 565-566, 1973.
Nidich, S., Seeman, W., And Dreskin, T. (1973). Influence of Transcendental Meditation on Self-Actualization: A replication. *Journal of Counseling Psychology,* 20:565–566.
Nidich, S.I., & Nidich, R. (1989). Increased academic achievement at Maharishi School of the Age of Enlightenment: A replication study. *Education*, 109, 3, 302-304.
Nidich, S.I., Nidich, R.J. (1987). Holistic student development at Maharishi School off the Age of Enlightenment: Theory and research. *Modern Science and Vedic Science*, 1(4): 433-468.
Nidich, S.I., Smith, D.E., Sands, D., Sharma, H.M, Nidich R.J., Barnes, V., Jossaaug, S. (in review). Effect of Maharishi Ayur-Ved Panchakarmaa purification program on speed of processing ability. *Perceptual and Motor Skills*.
Niwa, Y. (1991). Effect of Maharishi 4 and Maharishi 5 on inflammatory mediators- with special reference to their free radical scavenging effect. *Indian Journal of Clinical Practice,* 1 (8):23–27.
Norwicki, S., Jr., & Strickland, B. R. (1973). A locus of control scale for children. *J Consult Clin Psychol,* 40:148-154.
Nunn, G.D. (1988). Concurrent validity between the Nowicki-Strickland Locus of Control Scale and the State-Trait Anxiety Inventory for Children. *Educational and Psychological Measurement,* 48:435-438.
Nunn, G.D., Montgomery, J.D., & Nunn, S.J. (1986). Criterion-related validity of the Nowicki-Strickland Locus of Control Scale with academic achievement. *Psychology: A Quarterly Journal of Human Behavior,* 23:9-11.
Nystul, M.S., & Garde, M. (1977). Comparison of self-concepts of Transcendental Meditators and nonmeditators. *Psychological Reports,* 41:303-306.

Oades, R.D. (1987). Attention deficit disorder with hyperactivity (ADDH): The contribution of catecholaminergic activity. *Progresss in Neurobiology* 29:365-391.
O'Halloran, J.P.; Jevning, R.; Wilson, A.F.; Skowsky, R.; Walsh, R.N.; And Alexander, C. (1985). Hormonal control in a state of decreased activation: potentiation of arginine vasopressin secretion. *Physiology and Behavior* 35: 591-595.
O'Leary, K.D., Pelham, W.E., Rosenbaum, A., & Price, G.H. (1976). Behavior treatment of kinetic children: An experimental evaluation of its usefulness. *Clin Pediatr,* 15:510-515.
Omizo, M.M., & Michael, W.D. (1982). Biofeedback-induced relaxation training and impulsivity, attention to task, and locus of control among hyperactive boys. *Journal of Learning Disabilities,* 15:414-416.
Omizo, M.M., & Williams, R.E. (1981). Biofeedback training can calm the hyperactive child. *Academic Therapy,* 17:43-46.
Omizo, M.M., Cubberly, W.E., Semands, S.G., & Omizo, S.A. (1986). The effects of biofeedback and relaxation training on memory tasks among hyperactive boys. *The Exceptional Child,* 33:56-64.
Orme-Johnson, D.W. (1973). Autonomic stability and Transcendental Meditation. Psychosomatic Medicine, 35:341-349.
Orme-Johnson, D.W. and Haynes, C.T. (1981) EEG phase coherence, pure consciousness, creativity and TM-Sidhi experience. *International Journal of Neuroscience*, 13, 211-219.
Orme-Johnson, D.W.; Alexander, C.N.; Davies, J.L.; Chandler, H.M.; & Larimore, W.E. (1988). International peace project in the Middle East: The effect of the Maharishi Technology of the Unified Field. *Journal of Conflict Resolution*, 32(4):776–812.
Orme-Johnson, D. W., & Walton, K. G. (1998). All approaches to preventing or reversing effects of stress are not the same*. American Journal of Health Promotion* 12(5), 297–299.
Overbeck, K.D., & Tonnies, S.E. (1975) Einige effekte der Transzendentalen Meditation bei lernbehinderten sonderschülern. Diplomarbeit, University of Hamburg.
Pelletier, K.R. (1974). Influence of Transcendental Meditation upon autokinetic perception. *Perceptual and Motor Skills,* 39:1031-1034.
Penner, W. J., PhD, Zingle, H. W., PhD, Dyck, R., B.A., & Truch, S. (1974). Does an in-depth Transcendental Meditation course change in the personalities of the participants? *Western Psychologist,* 4:104-111.
Pennington, B.F. & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry an Allied Disciplines* 37:51-87.
Piers, E. V. (1984). *Manual for the Piers-Harris Children's Self-Concept Scale (The Way I Feel About Myself).* Los Angeles, CA: Western Psychological Services.
Poppen, R. (1988). *Behavioral Relaxation Training and Assessment*. New York: Pergamon Press.
Popper, C.W. (1997). Antidepressants in the treatment of attention-deficit/hyperactivity disorder. *Journal of Clinical Psychiatry* 14:14-29.
Qian, Z.N., Gu, Z.L., Jin,L., Xie, M.L., & Chen, B.Q. (1992). Effects of piracefam on Na(+) - K(+) - ATPase and monoamine oxidase in rat brain and its oxidation effect. *Chung Kao Li Hsueh Pao,* 13(1):48-50.
Quist, J.F., Barr, C.L., Scharchar, R., Roberts, W., Malone, M.T., Tannock, R., et al., (2000). Evidence for the serotonin HTR2A receptor gene as a suspectibility factor in attention deficit hyperactivity disorder (ADHD). *Molecular Psychiatry* 5:537-541.
Raine, A., Reynolds, G.P., & Sheard, C. (1991). Neuroanatomical correlates of skin conductance orienting in normal humans: a magnetic resonance imaging study. *Psycophysiology*, 28:548-558.
Raymer, R., & Poppen, R. (1985). Behavioral relaxation training with hyperactive children. *Journal of Behavioral Therapy and Experimental Psychiatry,* 16:309-316.
Rigby, B. R. (1988). New Perspectives in Medical Practice: The Psychophysiological Approach of Maharishi Ayurveda. *Modern Science and Vedic Science*, 2(1):76-87.
Rivera, E., & Omizo, M.M. (1980). An investigation of the effects of relaxation training and biofeedback on attention to task and impulsivity among hyperactive male children. *Exceptional Child,* 27:41-51.
Roberts, M.A., Milich, R., & Loney, J. (1984).*Manual for the Structured Observation of Academic and Play Settings*. Iowa City, IA: University of Iowa.
Ross, A.O. (1979). *Psychological Disorders of Children: A Behavioral Approach to Theory, Research, and Treatment* (2nd ed.). New York: McGraw-Hill.
Ross, D. M., & Ross, S. A. (1982). *Hyperactivity*. New York: Joh Wiley & Sons.
Rostain, A.L., (1991). Attention Deficit Disorders in Children and Adolescents. *Pediatric Clinics of North America,* 38(3):607-635.
Roth, R.A. (1994). *Maharishi's Transcendental MeditationTechnique*, Primus, New York.
Rubia, K., Overmeyer, S., Taylor, E. Braimmer, M., Williams, et al., (1999) Hypofrontality in attention deficit hyperactivity disorder during higher-order motor control: A study with fMRI. *American Journal of Psychiatry* 156:891-896.
Sapolsky, R.M. (1990). Adrenocortical function, social rank, and personality among wild baboons. *Biological Psychiatry,* 28:862-878.
Satterfield, J.H. & Dawson, M.E. (1971). Electrodermal correlates of hyperactivity in children.*Psychophysiology* 8:191-197.
Satterfield, J.H., Lesser, L.I., Saul,R.E., & Cantwell, D.P. (1973). EEG aspects of hyperactivity in children. Annals of the New York Academy of Science, 205:274-282.
Schecter, H.W. (1978). A psychological investigation into the source of the effect of the Transcendental Meditation technique. *Dissertation Abstracts International*, *38*(7), 3372B-3373B.
Schettler, T. , Stein, J., Reich, F,. Valenti, M., & Wallinga, D. (2000). *In Harm's Way: Toxic Threats to Child Development*. Greater Boston Physicians for Social Responsibility, Cambridge, MA.
Schilling, D., & Poppen, R. (1983). Behavioral relaxation training and assessment. *Journal of Behavioral Therapy and Experimental Psychiatry,* 16:309-316.
Schneider, R.H., Kavanaugh, K.L., Kasture, K.S., Rothenberg, S., Averbach, R., Robinson, D., Wallace, R.K. (1990). Health Promotion with a traditional system of natural health care, Maharishi Ayur-Veda. *Journal of Social Behavior and Personality*, 5(3), 1-27.
Schneider, R.H.; Orme-Johnson, D.W.; Kesterson, J.; & Wallace, R.K. (1985). Physiological and psychological correlates of Ayurvedic psychosomatic types. Presented at the 8th World Congress of the International College of Psychosomatic Medicine, Chicago, USA.
Schneider, R., Staggers, F., Alexander, C., & al., e. (1995). A randomized controlled trial of stress reduction for hypertension in older African Americans. *Hypertension* 26(5), 820—827.
Schoenthaler, S. (1987). Malnutrition and maladaptive behavior: two correlational analyses and a double-blind placebo-controlled challenge in five states. In W.B. Essman (Eds.), *Nutrients and Brain Function* (pp. 198-218). Basel: Karger.
Schoenthaler, S.J., Amos, S.P., Doraz, W.E., Kelly, M.A., & Wakefield, J. (1991). Controlled trial of vitamin-mineral supplementation on intelligence and brain function. *Personality and Individual Differences,* 12:343-350.
Schoenthaler, S.J., Amos, S.P., Eysenck, H.J., Peritz, E., & Yudkin, J. (1991). Controlled trial of vitamin-mineral supplementation: effects on intelligence and performance. *Personality and Individual Differences,* 12:351-362.
Seeman, W., Nidich, S. and Banta, T. Influence of Transcendental Meditation on a measure of self-actualization. *Journal of Counseling Psychology* 19: 184-1287, 1972.
Seeman, W., Nidich, S., & Banta, T. (1972). Influence of Transcendental Meditation on a measure of self-actualization. *Journal of Counseling Psychology,*19:184–187.
Sever, Y., Ashkenazi, A., Tyano, S. et al., (1997) Iron treatment in children with attention deficit disorder: A preliminary report. Neuropsychobiology 35:178-180.
Sharma, H. (1993). *Freedom from disease: How to control free radicals, a major cause of aging and disease*. Toronto, Ontario: Veda Publishing.
Sharma, H. & Alexander, C.N. (1996a) Maharishi Ayurveda: Research Review, Part 1. *Complementary Medicine International* 3:21-28.
Sharma, H. & Alexander, C.N. (1996b) Maharishi Ayurveda: Research Review, Part 2. *Complementary Medicine International* 3:21-28.
Sharma, H. & Clark, C. (1998*), Contemporary Ayurveda: Medicine and Research in Maharishi Ayur-Veda*, Series Ed: M. Micozzi, Churchill Livingstone, Philadelphia.
Sharma, H. M., Dwivedi, C., Satter, B. C., Gudehithlu, K. P., Abou-Issa, H., Malarkey, W., & Tejwani, G. A. (1990). Antineoplastic Properties of Maharishi-4 Against DMBA-Induced Mammary Tumors in Rats. *Pharmacology Biochemistry & Behavior,* 35(4):767-773.
Sharma, H.M., Hanissian, S., Rattan, A.K., Stern, S.L., & Tejwani, G A. (1991). Effect of Maharishi Amrit Kalash on brain opioid receptors and neuropeptides. *Jour. Res. Edu. Ind. Med.,* 1-8.
Sharma, H.M., Hanna, A., Kauffman, E.M., & Newman, H.A.I. (1992). In-vitro inhibition of microsomal lipid peroxidation by MA-631, Student and Ladies Rasayana (SR & LR) and Maharishi Coffee Substitute (MCS). T*he Pharmacologist*, 34(3):184.
Sharma, P. V. (1983). Caraka Samhita. Dehli: Chaukhambha, Orientalia.
Shecter, H.E. (1978). A psychological investigation into the source of the effect of the transcendental meditaton technique (PhD dissertation, York University). *Dissertation Abstracts International,* 38(7-B):3372-3373.
Shinn, M. (Ed.). (1989). *Curriculum-based measurement: Assessing Special Children.* New York: The Guilford Press.
Silberstein, R.B., Farrow,M., Levy, F., Pipingas, A., Hay, D.A., Jarman, F.C. (1998) Functional brain electrical activity mapping in boys with attention-deficit/hyperactivity disorder *Archives in General Psychiatry* 55:1105-1112.
Smith, J.C. (1976) The psychotherapeutic effects of Transcendental Meditation with controls for expectation of relief and daily setting. *Journal of Consulting and Clinical Psychology*, 44, 630-637.
Solanto, M.V. (1998) Neuropsychopharmacological mechanisms of stimulant drug action in attention-deficit hyperactivity disorder: A review and integration. *Behavioral Brain Research* 94:127-152.
Sorsdahl, S. & Sanche, R. (1985). The effects of classroom meetings on self-concept and behavior. *Elementary School Guidance And Counseling*

20:49-56.
Spitzer, R.L., Davies, M., & Barkley, R.A. (1990). The DSM-III-R field trial of disruptive behavior disorders. *J Am Acad Child Adolesc Psychiatry,* 29:690-697.
Srinivas, N.R., Hubbard, J.W., Korchinski, E.D., & Midha, K.K. (1993). Enantioselective Pharmacokinetics of dl-threo-Methylphenidate in Humans. *Pharmaceut Res,* 10(1):14-21.
Starobrat-Hermelin, B. & Kozielec, T. (1997). The effects of magnesium physiological supplementation on hyperactivity in children with attention deficit hyperactivity disorder (ADHD): Positive response to magnesium oral loading test. *Magnesium Research* 10:149-156.
Stevens, L.J., Zentall, S.S., Deck, J.L., et al., (1995). Essential fatty acid metabolism in boys with attention-deficit hyperactivity disorder. American Journal of Clinical Nutrition 62:761-768.
Swanson, J. and Kinsbourne, M., (1980). Food dyes impair performance of hyperactive children on a laboratory learning test. *Science* 207:1485-1487.
Swanson, J.M, McBurnett, K., Wigal, T., Pfiffner, L.J., Lerner, , M.A., et al. (1993). Effect of stimulant medication on children with attention deficit disorder: A
review of reviews" *Exceptional Children* 60:154-162.
Swanson, J.M, Cantwell, D. Lerner, M. McBurnett, K,. Pfiffner, L. & Kotkin, R. (1992). Treatmetn of ADHD: Beyond medication. *Beyond Behavior* 4:13-22.
Swartwood, M.O., Swartwood, J.N., Lubar, J.F., Timmermann, D.L., Zimmerman, A.W., & Muenchen, R.A. (1998) Methylphenidate effects on EEG, behavior, and performance in boys with ADHD. *Pediatric Neurology* 18:244-250.
Thiessen, I., & Mills, L. (1975). The use of megavitamin threatment in children with learning disabilities. *Orthomolecular Psychiatry,* 4:228-296.
Thomson, G.O.B, Raab, G.M., Hepburn, W.S., Hunter, R., Fulton, M. & Laxen, D.P.H. (1989). Blood lead levels and children's behavior—Results from the Edinburgh Lead Study. *Journal of Child Psychology and Psychiatry* 30:515-528.
Throll, D.A. (1989). The effects of the Transcendental Meditation technique upon adolescent personality. In R.A. Chalmers, G. Clements, H. Schenkluhn, & M. Weinless (Eds.), *Scientific research on the Transcendental Meditation and TM-Sidhi programme: Collected papers, Vol. 2* (pp. 1087-1095). Vlodrop, The Netherlands: MIU Press.
Thurber, S., & Walker, C.E. (1983). Medication and hyperactivity: A meta-analysis. *J Gen Psychol,* 108:79-86.
Tjoa, A. (1975). Increased intelligence and reduced neuroticism through the Transcendental Meditation program. Findings previously published as "Meditation, neuroticism and intelligence: A follow-up" in Gedrag: Tijdschrift voor Psycchologie (Behavior: Journal of Psychology) 3: 167-182.
Tolonen, M., Halme, M., & Sarna, S. (1985). Vitamin E and selenium supplementation in geriatric patients. *Biological Trace Element Research,* 7:161-168.
Travis, F. (1979). The TM technique and creativity: A longitudinal study of Cornell University undergraduates. *The Journal of Creative Behavior,* 13:169-180.
Travis, F. (1998). Cortical and cognitive development in 4th, 8th, and 12th grade students: The contribution of speed of processing and executive functioning to cognitive development. *Biological Psychology* 48, 37-56.
Travis, F. And Miskov, S. (1994). P300 latency and amplitude during eyes-closed rest and Transcendental Meditation practice. *Psychophysiology* 31:S67.
Travis, F. & Tecce, E., (1995). Increased attention to task and decreased distractibility in an odd-ball paradigm. *Psychophysiology* 35:S76.
Tuthill, R.W. (1996). Hair lead levels related to children's classroom attention deficit behavior. *Archives of Environmental Health.* 51:214-220.
van Rhijn, A.G., Prior, C.A., & Corrigan, F.M. (1990). Dietary supplementation with zinc sulphate, sodium selenite and fatty acids in early dementia of Alzheimer's type. *Journal of Nutritional Medicine,* 1:259-266.
Voeller, K.K.S., (1991). Clinical Management of Attention-Deficit Hyperactivity Disorder. *J Child Neurol,* 6(Suppl):S51-S67.
Wallace, R.K. (1987) The Maharishi Technology of the Unified Field: The neurophysiology of enlightenment, Fairfield, IA: MIU Press.
Walton, K., Pugh, N., Gelderloos, P., Macrae, P., MacLean, C., & Brown, G. (submitted). Optimizing adaptive mechanisms: A stress-related, neuroendocrine basis for disease-prevention through Transcendental Meditation. *Psychoneuroendocrinology.*
Walton, K. G.; Francis, D.; Lerom, M.; And Tourenne, C. (1983). Behaviorally-induced alterations in human urinary 5-hydroxyindoles. *Transactions of the American Society for Neurochemistry* 14:199.
Walton, K. G.; Gelderloos, P.; Pugh, N.; Macrae, P., Goddard, P.; Maclean, C. & Levitsky, D. (1990). Stress and serotonin turnover in normal subjects: relation to serotonin deficiencies in mental disorders. 5th International Congress of Psychophysiology, Budapest, Hungary..
Wandhofer, A., Klobal.G., & Platting, K.-H. (1976). Shortening of latencies of human auditory evoked brain potentials during the Transcendental Meditation technique. *Zeitschrif fur Electroenzephalographie und Elektromyographie EEE-EMG.* 7:99-103.
Webb, T.E., & Oski, F.A., (1974). Behavioral Status of Young Adolescents with Iron Deficiency Anemia. *Journal of Special Education,* 8(2):153-56.
Weiss, G., & Hechtman, L.T. (1986). *Hyperactive Children Grown Up*. New York: Guilford Press.
Wender, E. (1986) The food additive-free diet in the treatment of behavioral disorders: A review. *Journal of Developmentl and Behavioral Pediatrics* 7:35-42, 1986.
Werbach, M.R., (1992). Nutritional Influences on Aggressive Behavior. *Journal of Orthomolecular Medicine,* 2(1):45-51.
Werner, O.R.; Wallace, R.K.; Charles, B.; Janssen, G.; Stryker, T. & Chalmers, R.A.,(1986) Long-term endocrinologic changes in subjects practicing the Transcendental Meditation and TM-Sidhi program. *Psychosomatic Medicine* 48:59-65.
Whalen, C.K., & Henker, B. (1976). Psychostimulants and children: a review and analysis. *Psychol Bull,* 83:1113-1130.
Whalen, C.K., Henker, B., & Hinshaw, S.P. (1983). Child and adolescent perceptions of normal and atypical peers. *Child Development*, 54:1588-1598.
Williams, P., & West, M. (1975). EEG responses to photic stimulation in persons experienced at meditation. *Electroencephalography and Clinical Neurophysiology* 39:519–522.
Wolraich, M., Milich, R., Stumbo, P., & Schultz, F., (1985). Effects of sucrose ingestion on the behavior of hyperactive boys. *J Pediatr,* 106(4):675-82.
Wolraich, M.L., Lindgren, S., Stromquist, A., Milich, R., Davis, C., & Watson, D. (1990). Stimulant medication use by primary care physicians in the treatment of attention-deficit hyperactivity disorder. *Pediatrics*, 86:95-101.
Wood, M.F. (1981). The effectiveness of Transcendental Meditation as a means of improving the echolalic behavior of an autistic student. Presented at the International Symposium on Autism Research, Boston.
Wurtman, R.J. (1992). Effects of foods on the brain: Possible implications for understanding and treating Tourette syndrome. *Advances in Neurology* 58:293-301.
Youdim, M.B., et al., (1990). Putative biological mechanisms of the effect of iron deficiency on brain biochemistry and behavior. *Am J Clin Nutr,* 50(3 Suppl):607-615.
Zametkin, A.J., Nordahl, T.E., Gross, M., King, A.C., Semple, W.E., Rumsey, J., et al. (1990). Cerebral glucose metabolism in adults with hyperactivity of metabolism in adults with hyperactivity of childhood onset. *New England Journal of Medicine* 323:1361-1366.
Zentall, S.S. (1985). A context for hyperactivity. In Gadow, K.D. & Bialer, I.(Eds.), *Advances in Learning and Behavioral Disabilities.* Greenwich, Conn.: JAI Press.