LEARNING AND BEHAVIORAL CHALLENGES ARE IMPROVED WITH FREQUENT COMPLEX EXERCISE

Purpose: Increase awareness and application of neurological integration exercises for improved learning, physical and mental health.

There is a variance of opinions concerning many of the behavioral problems and learning challenges associated with children, adolescents, and adults. According to some researchers, "Attention Deficit Disorder (ADD), Attention Deficit Hyperactivity Disorder (ADHD), Pervasive Developmental Disorder (PDD), Obsessive Compulsive Disorder (OCD), Asperger's Syndrome and Autism, to name but a few, may be viewed as points on a spectrum of developmental disabilities in which those points share features in common and possibly etiology as well, varying only in severity and in the primary anatomical region of dysfunctional activity". [1]

These conditions are variations of the phenomena that primarily suggest a lack of appropriate integration in higher brain centers. Those brain centers are located primarily in the prefrontal cortex involving various components; the dorsal lateral prefrontal cortex, the anterior cingalate gyrus the lateral orbital area, and deep limbic nuclei, as well as the basal ganglion.

According to Amen (2005), feeling restless and having difficulties concentrating, compulsivity and challenges with completing projects, being easily bored and quick to anger, are indications of Attention Deficit Activity. The author noted, "Attention Deficit Disorder (ADD) is the most common brain problem in children, effecting 5-10% of them in the United States and one of the most common problems in adults. The main symptoms of ADD are a short attention span, distractibility, disorganization, procrastination, and poor internal supervision. It is often but not always associated with compulsive behavior and hyperactivity or restlessness". [2]

He further noted that it was anticipated that with maturation many of these children would outgrow those disorders during their teenage years. Unfortunately, "For many this is false. While it is true that the hyperactivity lessens over time, the other symptoms of impulsivity, distractibility, and a short attention span remain for most sufferers into adulthood. Current research shows that 60-80% of ADD children never fully outgrow this disorder. Over the years I have seen thousands of children who had ADD. When I met with their parents to take a good family history I find there is about 80% chance that at least one of the parents also had symptoms of ADD as a child and may in fact be showing symptoms as an adult. Many of the parents were never diagnosed" Amen(2005).

The author continued, "Common symptoms of adult form of ADD include poor organizational planning, procrastination, trouble listening carefully to directions, and excessive traffic violations. Additionally, people with adult ADD are often late for appointments, frequently misplace things, may

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[1] Melillo, Leisman. "Neurobehavioral Disorders of Childhood". Kluwer Academic/ Plenum Publishers, New York. 2004.

[2] Amen D, MD. "Making a Good Brain Great: The Amen Clinic Program for Achieving and Sustaining Optimal Mental Performance." 1st Edition, p. 233. Three Rivers Press, New York. 2005.

be quick to anger, and have poor follow through". He further noted, "I have described six different types of ADD. The most common feature of ADD is decreased activity in the prefrontal cortex, the concentration tasks. This means the harder a person tries, the less the brain activity they have to work with". [3]

The cerebellar pathways are the primary exciting pathways into the brain and are critical in learning functions. According to researchers, "Understanding the way the cerebellum responds in novel situations to promote motor learning is important since it has been recently shown that it is also involved in higher cognitive and behavioral learning in much the same fashion". [4]

Research supports, "The concept that human learning of behavior and movement involves the cerebellum. Our cerebellum responds to novel movements that are complex rather than simple in a continuous single plane". [5] [6] [7]

A large percentage of the afferent input coming in from the outside environment into the cerebellum comes from movement receptor pathways from joint movement receptors, touch receptors in the skin, and the spindle fibers that perceive the length of a particular muscle. Accumulation of this input from all parts of the body largely drives brain function. For that reason, the majority of behavioral problems from Attention Deficit Hyperactivity Disorders to Depression, are helped with exercise, and especially complex motions.

According to Amen, when addressing healing from Attention Deficit Disorder, "In general, intense exercise helps as does a higher protein, lower carbohydrate diet". [8]

For a healthy brain and body, it is essential to maintain a sound central nervous system activated from movement receptor populations. Strive to improve the optimal function of all joints, with an emphasis on joints in the cervical, thoracic, and lumbar areas. The cervical area carries the greatest populations of movement receptors. The populations decrease when one goes from the upper neck of the spine to the lower parts of the lumbar region of the spine. Also, extremities are important for brain activation, particularly when it comes to increasing stimulation in one side of the brain more than the other. The extremity joint motion receptors may be used for balancing challenges of unequal from side to side brain activation, or patterns of hemisphericity.

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[3] Amen D, MD. "Making a Good Brain Great: The Amen Clinic Program for Achieving and Sustaining Optimal Mental Performance." 1st Edition, p. 234. Three Rivers Press, New York. 2005.

[4] Melillo, Leisman. "Neurobehavioral Disorders of Childhood". Kluwer Academic/ Plenum Publishers, New York. 2004.

[5] Leisman, Vitori. "Limb Segment Information Transmission Capacity and Infer's Integrity of Spinal Thalamic Tracts and Cortical Visual Motor Control". *International Journal of NeuroScience*. No. 50, pp. 175-183. 1990.

[6] Leisman. "Cybernetics Model of Psychophysiologic Pathways II: With the Consciousness of Effort in Kinesthesia". *Journal of Manipulative and Physiological Therapeutics*. No 12, pp. 174-191. 1989.

[7] Leisman. "Cybernetics Model of Psychophysiologic Pathways III: Impairment of Consciousness of Effort in Kinesthesia". *Journal of Manipulative and Physiological Therapeutics*. No. 12, pp. 257-264. 1989 (b).

[8] Amen D, MD. "Making a Good Brain Great: The Amen Clinic Program for Achieving and Sustaining Optimal Mental Performance." 1st Edition, p. 235. Three Rivers Press, New York. 2005.

Treatment should incorporate specific adjustments to improve intrinsic joint motions and specific therapeutic exercises to enhance strengthening of those muscles associated with the joints.

Good nutrition is also emphasized with adequate water intake (hydration), consumption of antioxidants which are best found in colored vegetables and also supplemented judiciously. According to Dr. Packer from UC Berkley: the primary antioxidants of Vitamin C, Vitamin E- including mixed Es, Alpha Lipoic Acid, Coenzyme Q10, and N-acetylcysteine (NAC) work as a "Network". With respect to meals, use moderation in the consumption of food and avoiding those foods which are known to be harmful to the nervous system such as: alcohol and refined carbohydrates. Prudence in the nutrition department, taking time for meals, and chewing food adequately to enhance absorption is important.

Rest is critical for mental processing, for learning, and for renewal. Regular sleep intervals of a minimum of7-8 hours per night has proven to be beneficial. Health is enhanced with appropriate rest.

Positive thinking is another important health component. "You are today where thoughts of yesterday have brought you and you will be tomorrow where the thoughts of today take you". James Allen in his book, *"As A Man Thinketh"* further noted, "Let a man radically alters his thoughts and he will be astonished at the rapid transformation it will effect on the material conditions of his life. Men imagine a thought can be kept secret, but it cannot; It rapidly crystallizes into habit and habit solidifies into circumstance"[9]. For emotional health, that individuals increase their spiritual involvement in whatever areas bring them spiritual understanding. Fostering meaningful social relationships, honoring commitments, and making emphasis to include positivism in language and thoughts and deeds are important to health.

Exercise is an essential requirement for a healthy mind and body. For exercise to be successful it must be performed on a regular basis. It must be enjoyable and include symmetrical motions. There must be some resistance component periodically in the exercise for strengthening and preserving lean tissue. Important exercises are: cervical extension exercises, low back extension exercises, cross-crawl re-integrative procedures, and other complex patterning motions which have been shown to be effective in increasing cerebellar activation. Also include specific eye exercises which should enhance specific cerebellar patterns with pursuits, saccades, fixations, vergence and vestibuloocular reflexes.

Professor Ted Carrick of the Carrick Institute for Graduate Studies respected author, and educator has developed training programs for the increased application of clinical neurology for appropriate activation of cerebellar pathways. He has increased awareness and applications for improving the central neurological integrated state of the neurons.

To following quotations will increase the appreciation for the significance of cerebellar input to brain activation and postural control:

The discharge of mechanically sensitive Group III and IV afferents enervating the lumbar spine revealed directional sensitivity to distractive and compressive loads applied across the L5-SI facet joint. Directionally sensitive afferents were found in all tissues of the lumbar spine that we studied, including tissues of the facet joint, connective tissue immediately surrounding the facet joint, and paraspinal muscles and the fascia distant from the facet joint. This network may play an important role in the normal function of the spinal column and may contribute to somatic and autonomic reflexes.[10]

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[9] Allen James, "As a Man Thinketh", (originally published 1904 England.); Deseret Book Company 2002.

9 Pickar JG, DC, PhD, McLain R F, MD. AResponses of Mechanosensitive Afferents to Manipulation of the Lumbar Facet in the Cat," pp. 2379-2386, *SPINE*, vol. 20(22), Lippincott-Raven, 1995.

The results of the current study have shown that mechanical stretching of an important lateral spinal ligament in chickens produced a barrage of sensory feedback from several levels of the spinal cord and responses from the contralateral side of the cord at equivalent levels. Further, the pathway of the sensory input can be traced to include nerve cell bodies in the dorsal root ganglia, the sympathetic ganglia, the intermediate horn of the spinal cord, the cuneatus and gracilis nuclei of the medulla oblongata, the vestibular nuclei, and the thalamus. [11]
The requirement of an intact super spinal system for a goal-directed locomotion indicated the following:

Normal locomotion requires multiple levels of neuro control to support the body against gravity and to propel it forward, the nervous system must coordinate muscle contractions at many joints. This is accomplished by the spinal circuits, which are activated by tonic signals from brain stem nuclei. Other descending systems, including reticulospinal, rubrospinal, and corticospinal pathways, are physically active during locomotion and appear to be important for modulating the strength of the muscle contractions. At the same time, the nervous system must exert active control to maintain balance of the moving body, and it must adapt the locomotor pattern to the environment and to the overall behavioral goals. Although a spinal cat can produce relatively normal stepping patterns, it is not capable of maintaining balance. Adequate balance depends on parallel [our emphasis] descending signals from other brain stem structures, especially from the vestibular system. Adaptation of the locomotor pattern is particularly accomplished by spinal reflex pathways and brain stem structures, but a successful goal-directed locomotion requires the participation of cortical and sub cortical structures, including the motor cortex, basal ganglia, and cerebellum [our emphasis].[12]

The majority of input into the central nervous system comes from the body of mechanoreceptors, largely from that of muscle spindles. In discussing the importance of the discharge of muscle spindle afferents in producing stretch reflexes for input, the following quotation from the literature is of value.

So far, we have considered the muscle spindles and tendon organs as sensory receptors--as transducers of change in muscle length and tension. How is this information used by the nervous system to regulate motor output?. . . .Afferent axons from muscle spindles, tendon organs, and other somatosensory receptors ascend to the brain stem and cerebral cortex through various pathways and relay nuclei. These pathways convey information about the muscles to centers of the brain that participate in planning and controlling motor behavior. In addition, muscle spindles and tendon organs also influence motor neurons directly through spinal reflex circuits. [13]

Wyke (1985), noted some years ago the mechanoreceptor system in the capsules of zygapophyseal joints of the cervical spine and the importance of activation of these mechanoreceptors for efficient spinal function. [14]

Also of significance is the following quotation from the *Annals of Neurology*:

Disturbances of movement with cerebellar lesions could result from poor utilization of feedback from joint proprioceptive, cutaneous, muscle sense, and visual feedback. Thus, muscle responses to protuberation of limbs

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10 Hongxing Jiang MB, PhD, Moreau M, MD, Raso J, MASc, Russell G, MB, ChB, MSc, Bagnall K, PhD, AIdentification of the Location, Extent, and Pathway of Sensory Neurologic Feedback After Mechanical Stimulation of Lateral Spinal Ligament in Chickens,@ pp. 17-25, *SPINE*, vol. 22(1), Lippincott-Raven, 1997.

12 Gordon J, ASpinal Mechanisms of Motor Control,@ p. 593, *Principles of Neuroscience* (3rd ed.), Elsevier Science Publishing Company, Inc., 1991.

13 Gordon J, Ghez C. AMuscle Receptors and Spinal Reflexes; The Stretch Reflex,@ p. 374, *Principles of Neuroscience* (3rd ed.), Elsevier Science Publishing Company, Inc., 1991.

14 Wyke B. AArticular Neurology and Manipulative Therapy,@ pp. 72-77, *Aspects of Manipulative Therapy*, edited by Glasgow, E., Churchill Livingston, New York, 1985.

are abnormal in patients with cerebellar disease, and similar deficits observed in response to protuberations of posture. Evidence has been deduced, also indicating that the cerebellum modulates reflex gain, including long latency reflexes, thereby maintaining effective joint compliance; compensates for inherent mechanical instability; controls movements requiring multiple joints, and calculates transformations between the internal and external geometric plans for predictive coordination. [15]

In a discussion concerning excitability of neurons, the following quotation is useful, considering clinical data:

Although the function of each neuron is determined to a great extent by its position in a specific circuit, its function is also determined by its biophysical properties; these determine the relation between the synaptic input to the cell and the action potential train that it generates. How a neuron responds to synaptic input is determined by the proportions of different types of voltage-gated channels in the cell's integrative and trigger zones. Some cells respond to a constant excitatory input with a decelerating train of action potentials, others respond with accelerating train, others maintain a constant firing frequency. In certain interneurons, small changes in the strength of synaptic input produce a large increase in firing rate, whereas in others the firing rate responds only to large changes in synaptic input. In some neurons a steady hyperpolarizing input reduces the responsiveness of the cell to excitatory input by removing the inactivation of the fast, transient voltage-gated sodium channels; in other neurons, such a steady hyperpolarization makes the cell more excitable because it removes the inactivation of particular class of voltage-gated calcium channels.[16]

The previous quotations illustrate some aspects for breadth and depth associated with postural control mechanisms. Also, of significance is the following study review.

With respect to the relationship of shoulder function and neck involvement it was they noted: “If the coordinated activation of limb and trunk muscles is manifest in the central nervous system the question remains: What is the mechanism? It is already known that antagonistic muscles around the spine co-contract during a neutral spine posture to stabilize the body. Activation of these postural muscles in this coordinated way is thought to involve the cerebellum, although the motor program itself appears to originate elsewhere, possibly in the pre-motor areas and primary motor cortex. This idea would support the implications of our current results suggesting that coordinated activation of the limb and back muscles are generated cortically to maintain a stable body posture. Limb movements are used to change the center of gravity when balancing, i.e., on a narrow ridge. In this case the limb movements help to compensate for unwanted trunk movements rather than to generate instability as a result of voluntary movement.”

The authors concluded in part, “These results support the notion that activation of contralateral trunk muscles during sustained arm abduction is at least partially mediated by central coordination of corticospinal out put to the two muscle groups. This information may be of use when developing and improving spinal stabilization training regimes to help regain control of trunk musculature in patients after a neurological trauma.”

They continue,”Cortical spinal excitability change occurs in both lying and standing postures. These results support the notion that, stabilizing contractions of back muscles produced when the arm is abducted, have a corticospinal origin.@ [17]

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[15] Gilman S, M.D., Department of Neurology, University of Michigan, from *The Annals of Neurology*, vol. 35(1), January 1994, pp. 3-4.

[16] Koester J. AVoltage-Gated Ion Channels and The Generation of the Action Potential,@ p. 111, Principles of Neuroscience (3rd ed.), Elsevier Science Publishing Company, Inc., 1991.

[17] Davey N, PhD., Lisle RM, B.S. AActivation of Back Muscles During Voluntary Abduction of the Contralateral Arm in Humans, *Spine*, vol. 27, No. 12, pp. 1355-1360, 2002.

In discussing the cerebellum and its relationship to basal ganglionic function, it is underscored that the meso-limbic and meso-cortical systems arise from the ventral segmental area (VTA). The authors further went on to indicate, "The cerebellum is connected to the VTA of the midbrain. Therefore, anything that causes decrease muscle tone, or dysfunction of postural anti-gravity muscles, not only will decrease feedback to cerebellum, thalamus, and frontal cortex, but may also result in decrease feedback to the basal ganglia, meso-limbic, and/or meso-cortical system. Each of these components has motor as well as cognitive, emotional, and autonomic effects. The cerebellum can influence the basal ganglia loop through several connections; through direct connections to VTA, through connections to the thalamus, and through its connection to the frontal end prefrontal cortex, each of which have reciprocal connections to the basal ganglia. The basal ganglia can also influence the cerebellum by affecting frontal lobe, thalamus, as well as motor tone, all of which are controlled by the cerebellum." [18]

"Positron emission tomography (PET) studies in patients with dystonia show reduced activation to vibration stimuli. (Hallett, 1998) This may be a result of decrease peripheral large afferent firing, decreased central summation of the dorsal column, or spino-cerebellar pathways, which would alter thalamocortical firing to the somatosensory cortex. This could therefore decrease subsequent frontal striatal firing to the basal ganglia. It is thought that the decreased firing of the basal ganglia pathways may result in metabolic damage to the globus pallidus which then increases its firing rate to a previously decreased area of the frontal cortex. This could result in Dystonia, or even epileptiform activity in the cortex." [19]

In the area of cognition and consciousness, recent research has identified a phenomenon called Gamma-Binding, which involves a 40Hz oscillations. They can be recorded over large areas of the surface, the heads of alert subjects. It has further been noticed that when sensory stimuli are presented, these 40 cycles per second oscillations have been shown to demonstrate a phase locking, which is related cognitive processing and temporal binding of sensory stimuli.[20]

How the brain integrates its perceptions, has been referred to as the binding problem. A group of researchers from France believes that, for the first time, they have been able to measure the binding in a momentary firing in the human brain. "What we are measuring is the integration of the brain," said Francisco J. Varela, who led the research. "We were, for the first time, able to calculate synchrony between emissions of brain cells widely distributed in the brain." He went on to indicate ," Different regions of the brain get active when you do anything, look at a face, move your hand, have a memory, any cognitive act implies that working together are very different neurons in the brain that are widely distributed." They hypothesize t" Gamma oscillations are the medium through which the neurons act together by being synchronous. They time their oscillations together. It is like a transitory glue, a transitory pattern." The research indicated that during their experiment of the gamma oscillations, synchrony would last about .25 seconds, would disappear and then reappear in a different pattern using different parts of the brain." [21]

With respect to a source of the 40Hz, which described as the gamma oscillations, it has been determined that "The rhythmic depolarization observed in thalamic neurons (40Hz oscillations) are not generated intrinsically, but rather represent excitatory post-synaptic potentials of pre-thalamic origin. The neurons of the dorsal column

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[18] Melillo R, Leisman G. ANeuro Behavioral Disorders of Childhood,@ pg. 76, Kluwer Academic-Plenum Publishers, New York 2004.

[19] Melillo R, Leisman G. ANeuro Behavioral Disorders of Childhood,@ pg. 77-78, Kluwer Academic-Plenum Publishers, New York 2004.

[20] Mayevsky, et al. ACortical Spreading Depression Recorded from the Human Brain using a Multi-parametric Monitoring System.@ *Brain Research*, 740, 268-274, 1996.

[21] Rodriguez E, George N, Lachaux JP, Martinerie, FJ, Renault B, Varela. APerceptions Shadow: Long distance synchronization of human brain activity.@ *Nature*, pp. 397, 430-433, 1999.

in deep cerebellar nuclei are capable of encoding their output rhythmically. These potentials are not affected by lesions of the internal capsule or cortex, revealing that they are not of cortical origin. The ventral posterior lateral (VPL) responses were affected by limb position or stimulation by slowly adapting receptors. Slowly adapting receptors are characteristically found in slow twitch muscle fibers, which are most densely populated in postural or anti-gravity muscles, which fire continuously against gravity. In other words, the oscillatory 40 hertz activity, which has been noted in the thalamus, appears not to be intrinsic but appears to rise from the cerebellum and from muscle joint afferents, which fire to the thalamus either directly or through the cerebellum. It is possible that decrease firing with dorsal column fibers can decrease or stop thalamic activity since it appears the thalamus may act as a pacemaker through the regular bursts of 40 hertz oscillations and this is thought to be the source of cognition and possibly consciousness itself, interruptions of this input from the cerebellum or dorsal columns could cause gross deficits in cognition and consciousness." [22]

The above sources of information indicate contemporary neurophysiology and the importance of joint movement and joint position sense in the improvement of overall postural integrity, as well as cortical controls.

The study of Nansel et al, demonstrated the relationship between cervical adjustments and benefits for case management for low back pain."Results indicate that cervical spinal manipulation can have significant effects on the tone of the lumbopelvic musculature, presumably by facilitating tonic neck reflexes involving intersegmental spinal pathways." [23]

Conclusions of a report addressing the issue of spinal manipulation upon low threshold mechanoreceptors in the lumbar paraspinal muscles indicated that, "abrupt changes in neuro-discharge (instantaneous frequency) of low threshold muscle mechanoreceptors of the lumbar spine occur as the duration of a biomechanical load approaches that typically used during spinal manipulation. These changes could comprise part of the mechanism contributing to this intervention's physiological effects."[24]

As individuals with particular learning challenges, at whatever level of involvement, increase their cerebellar activation through complex patterning motions the higher centers of the brain will function more adequately. Individuals will be benefit from the increased input for increased integration and control.

Brain and body health follow from the balanced application of nervous system principles, nutritional concepts, appropriate rest practices, good thinking procedures, and regular exercise that incorporates complex strength training procedures.

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Increase Brain Neuroplasticity

21 Melillo R, Leisman G. ANeuro Behavioral Disorders of Childhood,@ pg. 87, Kluwer Academic-Plenum Publishers, New York 2004.

22 Nansel DD, Waldorf T, Cooperstein R. AEffect of cervical spinal adjustments on lumbar paraspinal muscle tone: evidence for facilitation of intersegmental tonic neck reflexes.@ *J Manipulative Physiol Ther.* Feb: 16(2): 91-5. 1993.

23 Sung, Kang, Pickar JG, PhD. "The effect of spinal manipulation duration on low threshold mechanoreceptors in lumbar paraspinal muscles." *Spine.* Vol. 30 (1). 2005.

For Balance and Fall Prevention

The Brain Back Body DVD Program is a combination of specific Neuro integration exercises combined with traditional strength building protocols. The Brain Back Body DVD Exercise program was designed to increase Brain Neuroplasticity, Core spinal strength, and overall body conditioning. In an article in the March 26, 2009 Wall Street Journal about 'Brain Gyms" and neuroplasticity, the demand for "scientific-based brain-fitness workouts", was evident by the following : " Consumers spent more than 80 million in 2008 on mental fitness." We have been at this for decades but as you will read some call it "new".

"The industry pins its claims for brain exercise on a relatively new scientific discovery: neuroplasticity, the brain's ability to rewire itself throughout life by creating neural connections in response to mental activity."....."...bulking up the brain, what brain scientists refer to as "cognitive reserve". The theory: People engaged in greater degrees of mental stimulation increase their brain mass and neural pathways, protecting them if a brain injury or dementia starts chipping away at brain connections."

The Brain Back Body Exercise Program creates a real "Brain Gym" in the privacy of your home. This program increases brain health by **activating the main pathways into the brain**. Three exercise chapters are divided to focus on specific brain and body areas:

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- FitBALL® Light Exercise & Extra Heavy Exercise Band s

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