



Mind Body Connect

## **Something has changed.**

Experienced teachers have seen troubling changes in the classroom over the past few decades. *More and more children in school develop learning disorders every year.* Students have difficulty paying attention and following instructions, and they have a hard time reading and sitting still. More and more have developed severe behavioral and language problems. (US Dept of Health and Human Services, 1997).

The scientific community agrees – the incidence of neurobehavioral developmental disabilities is increasing. (Case-Smith and Miller, 1999). There is an epidemic rise in reported problems during the past ten years; shorter attention span, more impulsive behavior, and decreasing scores in reading and language skills. (Chakrabarti and Fombonne, 2001). Up to 10 percent of the school-aged population in the United States is classified as learning disabled. Attention Deficit Disorder (ADD), attention deficit hyperactive disorder (ADHD), pervasive developmental disorder (PDD), obsessive compulsive disorder (OCD), Asperger's Syndrome, Autism, and developmental coordination disorder (DCD) are more and more common among our children. There has been an 800% increase in the use of Ritalin in the last 10 years, 90% of which is used in the United States. (Connor 2002).

## **Why?**

There has been significant societal change in this country over the past 20 years. Although the symptoms themselves are not new – many of them were identified more than 100 years ago – their rapid growth is. Various researchers have identified several major causes of developmental neurobehavioral disorders that delay development and result in deprivation of intellectual stimulation and arousal. (Melillo and Leisman, 2004).

*The first is the voluntary reduction in physical activity (a sedentary lifestyle) caused by an increase in the development and availability of technology (television, video games); the second, parents' fears about their childrens' safety; and finally, economic factors that force both parents to work outside the home. Kids are encouraged more and more to spend their time inside, and parents can afford increasingly*

entertaining luxuries to occupy them without encouraging movement. Kids themselves are drawn to the immediate, easy, and compelling satisfaction that these forms of inside-entertainment offer, completing the cycle in which the television or computer becomes a sort of babysitter.

### **Children aren't moving enough.**

*Today's children are the most sedentary generation that has ever existed.* The percentage of overweight Americans has increased by 30% in the past 20 years. More than 25% of the children in this country are overweight or obese (Astrup et al 2001). American children have the highest obesity levels in the world (Troiano and Flegel, 1998). The dramatic increase in both sedentary activity and obesity levels has mirrored the increase in learning disabilities and behavioral problems. (Melillo and Leisman, 2004).

It was difficult to imagine children deprived of rhythm and movement skills before the age of television. Now, many decades after the advent of TV and digital entertainment, the lack of fundamental movement and rhythmic movement skills in children and adolescents is wildly apparent to parents, educators and researchers. Over the past few decades physical activity in urban American children between the ages of 3 and 17 has decreased by 70% (Hannaford). Children are moving less and watching television more. When they play, they frequently remain seated. Even when they travel they are seated and belted in a car, bus, train or plane. More active methods of local travel (biking, skateboarding, or rollerblading) are often unsafe and sometimes even illegal for many children who live in urban or suburban neighborhoods. Movement and music programs have been systematically reduced and eliminated in our schools, which are now full of more and more bright children who are unable to learn.

Young people (aged 8-18) spend an average of four hours a day watching TV, just over one hour a day on the computer outside of schoolwork, and just under 50 minutes a day playing video games. About a quarter of the time that young people are using media, they're using more than one medium at a time. In a sense, they are actually exposed to the equivalent of 10 3/4 hours a day of media content (including listening to the radio, CDs, tapes, or MP3 players), even though they pack that into less than 7½ hours of time. (Kaiser Family Foundation Study, 2010)

The leisure activities of the average parent are more sedentary as well, with television watching, video games, and personal computing the most popular activities. Adults of all ages living in industrialized countries are expending less energy in their daily activities and at work (Prentice and Jebb, 1995; US Dept of Health and Human Services, 1996).

In 1960, 85% of British children walked or rode a bicycle to school. Now that number is only 6%. (Prentice and Jebb, 1995). The National Center for Health Statistics shows that the percentage of overweight children ages 6-17 has almost doubled since 1980. A 1997 survey by the National Association for Sports and Physical Education found that only Illinois mandates daily physical education for K-12 students, even though federal guidelines call for such regular activity. Inactivity leads to overeating and a long list of related health problems, but it's the effect of inactivity on the brain that is the real problem for children.

Children need to move every day. Inactivity and overeating are primarily responsible for a decrease in the production of dopamine (DA). DA decrease has been associated with a number of cognitive and emotional problems in children. (Volkow 1992). Several studies suggest that an active lifestyle during childhood and adolescence can play an important role in optimizing growth and development. (US Dept of Health and Human Services 1996)

### **And they can't keep time -**

Learning is difficult without basic rhythmic skills. (Weikart) Rhythm underlies patterns of breathing and movement and helps to organize incoming sensory information into coherent new patterns of learning. All learning is based on pattern acquisition, and the first patterns infants feel and know come from the rhythmic beating of a mother's heart. (Hannaford)

The ability to keep time to a steady beat is a natural competency, which is normally in place by the time a child is two years old. "Steady beat" is an important precursor to language acquisition, and it helps us to detect patterns in incoming sensory information. Human perception and learning are based on finding coherent patterns in our world – without them, there is no cause and effect. "Steady beat" underlies our ability to first pick up patterns of language as an infant, express the pattern as verbal language, and finally, to read that pattern.

There is a strong link between academic achievement and steady beat competence, particularly in math and reading achievement scores. (Scheuer and Mitchell 1994, Kuhlman and Schweinhart 1999) Today, less than 50% of American teenagers can demonstrate rhythmic competence (Weikart, 1989) and in many parts of the US only 10% of elementary students demonstrate steady beat competence. Girls are twice as likely as boys to show beat competence, and there are 6 boys for every girl in special ed programs that focus on reading. (Weikart)

Rhythmic movement competence *can* be learned, and it is strongly correlated with significant improvements in academic achievement and related abilities at both the elementary and high school levels. (Taub and McGrew 2004). Steady beat can be

learned, and when learned is linked to academic success. The best way to acquire rhythmic competence is by moving parts of the body in enjoyable and interesting ways, which start simply and become progressively more challenging and compelling. (Weikart)

### **MEMOVES: Just Listen**

Music anthropologists list “eliciting physical response” as one of the ten basic functions of music in human culture. Music has been used for thousands of years – informally and as part of very specific serious healing rituals in many cultures – to elicit motor response and enhance motor behavior. Neuroscientists studying the impact of music on motor processes have concluded that auditory rhythmic stimuli can enhance or promote motor responses and elicit movement, and there is clinical evidence that other components of music also have an arousing effect on the motor system.

There is an interesting dynamic parallel between the temporal nature of auditory information and movement performance – simply put, there is a strong connection between rhythmicity and brain function.

New research continues to highlight the significant impact music has on emotional and physical well-being – sound waves actually orchestrate patterns in the brain that facilitate learning.

Music therapy is a powerful tool “because of its unique capacity to reorganize cerebral function where it has been damaged.” (Sacks) There is an overlap in brain mechanisms in the neurons used to process music, language, mathematics, and abstract reasoning. (Tramo et al, 2001, 2002) Sound and music can affect dysfunction in the brain and nervous system and have been used successfully in treatment programs to reduce stress or lower blood pressure, alleviate pain, overcome various learning disabilities, improve movement and balance, and promote endurance and strength.

### **And Move**

If there are any ‘magic bullets’ that are proven to work against most human disorders, **the most powerful is movement**. Movement strengthens the cardiovascular system, the endocrine system, the immune system, and the central nervous system. The brain is activated primarily through the motor system.

*Movement prepares the brain for optimal learning.* The human brain is fueled by glucose, as a car is fueled by gasoline – brain activity is measured in terms of glucose utilization. Movement forces blood to travel through the body at greater rates,

feeding the brain greater amounts of oxygen and glucose, its essential nutrients. A person exchanges about 10% of oxygen capacity with each normal breath, which leaves 90% of the oxygen dormant until the subject accesses it through deep breathing or exercise. A lack of oxygen to the brain results in disorientation, confusion, fatigue, sluggishness, inability to concentrate, and memory problems.

In early studies in 1991, William Greenough discovered that rats that exercised had a greater number of synaptic connections than their sedentary counterparts. Later studies showed that rats in exercise-enriched environments had twice the number of brain cells as sedentary mice, greater cortical density and were better problem solvers (Gage).

Movement raises levels of endorphins in the brain. The three major neurotransmitters - norepinephrine, dopamine and serotonin - concerned with mood, cognition, behaviour and personality are all increased by movement and are strongly implicated in mood-elevating effects. Movement increases the amounts of neurotransmitters that help with mood regulation, anxiety control, the ability to handle stress and aggression, and the ability to become more attentive and social.

Movement increases levels of brain-derived neurotrophic factor (BDNF) that stimulates the growth of new cells, increases resistance to brain insult, and improves learning and mental performance. Movement also mobilizes gene expression profiles that benefit brain plasticity processes. Movement provides a simple way to maintain brain function and promote brain plasticity (Cotman and Berchtold, 2002)

Motor function is critical for all the other brain functions. The innumerable connections being discovered between motor and cognitive functions suggest that any sort of physical activity can improve both motor function and cognition. Learning complex movements increases the growth of connections between neurons, sharpening memory and increasing the capacity to master new information.

The greatest benefits come from a combination of physical activity and mental focus or “purposeful activity” at the same time.

## References

- Armstrong, T. (2000). Multiple intelligences in the classroom. Alexandria, Va.: *Assoc. for Supervision and Curriculum Development*, 1-11.
- Astrup, A., Hill, J.O, and Saris, W.H. (2001). Dietary fat: At the heart of the matter. *Science*, 293, 801-804.
- Bringoux, L., Marin, L., Nougier, V., Barraud, P., and Raphel, C. (2000). Effects of gymnastics expertise on the perception of body orientation in the pitch dimension. *Journal of Vestibular Research: Equilibrium & Orientation*, 10(6), 251-258.
- Brualdi, Amy (1996). Multiple Intelligences: Gardner's Theory. (*ERIC/AE Digest Series EDO-TM-96-01*).
- Burton, A.W., and Miller, D.E. (1998). Movement skill assessment. Champaign, IL: *Human Kinetics*.
- Case-Smith, J. and Miller, H. (1999). Occupational therapy with children with pervasive developmental disorders. *American Journal of Occupational Therapy*, 53, 506-513.
- Chakrabarti, S. and Fombonne, E. (2001). Pervasive developmental disorders in preschool children. *The Journal of the American Medical Association*, 285, 3093-3099.
- Clark, A., (2001). Adaptive Music. *Gamasutra.com*, May 15
- Cocke, A. (2002). Brain May Also Pump up from Workout. *Society for Neuroscience Annual Meeting Web Site*:  
<http://www.neurosurgery.medsch.ucla.edu/whastnew/societyforneuroscience.htm>
- Connor, D.F. (2002). Preschool attention deficit hyper-activity disorder: A review of prevalence, diagnosis, neurobiology, and stimulant treatment. *Journal of Developmental and Behavioral Pediatrics*, 23 (Suppl.), S1-S9.
- Cooper, D., (2003). Very Nervous System. *Wired*. i3.03. 1-4.
- Cotman, C.W. and Berchtold, N.C. (2002). Exercise: A behavioral intervention to enhance brain health and plasticity. *Trends in Neurosciences*, 25, 295-301.
- Duke, R.A., Geringer, J.M., and Madsden, C.K. (1991). Performance of perceived beat in relation to age and music training. *Journal of Research in Music Education*, 39(1), 35-45.

Dwyer, T., Coonan, W., Leitch, D., Hetzel, B., and Baghurst, R. (1983). An investigation of the effects of daily physical activity on the health of primary school students in South Australia. *International Journal of Epidemiologists*, 12(3), 308-313.

Dwyer, T., Sallis, J. F., Blizzard, L., Lazarus, R., and Dean, K. (2001). Relation of Academic Performance to Physical Activity and Fitness in Children. *Pediatric Exercise Science*, 13, 225- 238.

Fitzpatrick, P., Schmidt, R.C., and Lockman, J.L. (1996). Dynamical patterns in the development of clapping. *Child Development*, 67(6), 2691-2708.

Flohr, J.W., and Meeuwssen, H.J. (2001). Validity of rhythm timing software with college age adults. *Technological Directions in Music Education: Institute for Music Research, University of Texas at San Antonio*, 1-4.

Gabbard, C.P. (2004). *Lifelong motor development*. San Francisco: Benjamin Cummings.

Gage, F.H. (2002). Neurogenesis in the adult brain. *Journal of Neuroscience*, 22, 612-613.

Gauchard, G., Jeandel, C., and Perrin, P. (2001). Physical and sporting activities improve vestibular afferent usage and balance in elderly human subjects. *Gerontology*, 47, 263-270.

Geron, E. (1996). Intelligence of Child and Adolescent Participants in Sports. *The Child and Adolescent Athlete 6*. Oxford, England: Blackwell Science Ltd.

Goodway, J. D., Crowe, H., and Ward, P. (2003). Effects of motor skill instruction of fundamental motor skill development. *Adapted Physical Activity Quarterly*, 20(3), 298-315.

Goodwin, D. L., Krohn, J., and Kuhnle, A. (2004). Beyond the wheelchair: The experience of dance. *Adapted Physical Activity Quarterly*, 21, 229-247.

Goodwin, D. L., and Thurmeier, R. (2004). Inadequate bodies or inadequate contexts: Reactions to the metaphors of disability. *Adapted Physical Activity Quarterly*, 21, 379-398.

Graziano, A., Peterson, M. and Shaw, G. (1999). Enhanced learning of proportional math through music training and spatial-temporal training. *Neurological Research*, 21(2), 139-152.

Greenough, W.T., Black, J.E., and Wallace, C.S., (1987). Experience and brain

development. *Child Development*, 58, 539-559.

Haskell, L. (1993). Rehabilitation therapists tap into new rhythms for life. *Advance for Physical Therapists*, 4(5), 24-26.

Haywood, K.M., and Getchell, N. (2001). *Life span motor development*. Champaign, IL: Human Kinetics.

Jensen, E. (2001). *Arts with the brain in mind*. Alexandria, VA: Association for Supervision and Curriculum Development.

Jeong, Y.J., Hong, S.C., Lee, M.S., Park, M.C., Kim, Y.K. and Suh, C.M.. (2005). Dance movement therapy improves emotional responses and modulates neurohormones in adolescents with mild depression. *International Journal of NeuroScience*. v115 i12. 1711-1720.

Kaiser Family Foundation (2010). *Generation M2: Media in the Lives of 8 to 18 Year Olds*.

Keogh, Jr., & Sugden, D.. (1985). *Movement skill development*. New York: McMillan Publishing Company.

Kuhlman, K and Schweinhart, L.J. (1999). *Timing in Child Development*. High/Scope Educational Research Foundation.  
<http://www.highscope.org/Research/TimingPaper/timingstudy.htm>

Lejeune, L. Anderson, D., Leroy, D., Thouwarecq, R., and Jouen, F. (2004). Kinesthetic perception of the vertical as a function of sport experience. *Research Quarterly for Exercise and Sport*, 75(4), 440-445.

Levitan, Daniel J. (2006). *This is Your Brain on Music: The Science of a Human Obsession*, Dutton Adult.

Linder, K. J. (1999). Sport Participation and Perceived Academic Performance of School Children and Youth. *Pediatric Exercise Science*, 11, 129-144.

Linder, K. J. (2002). The Physical Activity Participation--Academic Performance Relationship Revisited: Perceived and Actual Performance and the Effect of Banding (Academic Tracking). *Pediatric Exercise Science*, 14, 155-170.

Melillo, Robert and Leisman, Gerry (2004). *Neurobehavioral Disorders of Childhood: An Evolutionary Perspective*. Springer Science Media, NY.

Meeuwssen, H., Flohr, J.W., and Fink, R. (1998). Computerized assessment of the skills of synchronization and the imitation and timing of rhythm patterns. *Technological Directions in Music Education: Institute for Music Research, University of Texas at San Antonio*, 93-95.

Meyer, R.K., and Palmer, C. (2003). Temporal and motor transfer in music performance. *Music Perception*, 21, 81-104.

Mitchell, D. L. (1994). The relationship between rhythmic competency and academic performance in first grade children. Doctoral Dissertation. Orlando, FL: *University of Central Florida Department of Exceptional and Physical Education*.

Mittelstaedt, H. (1998). Origin and processing of postural information. *Neuroscience and Biobehavioral Reviews*, 22(4), 473-478.

Mjaavatn, E. (1999). Modern lifestyle: a threat to young people's life. *Norwegian University of Science and Technology*,

National Association of Sport and Physical Education (NASPE). (2002). Active start: A statement of physical activity guidelines for children birth to five years. Reston, VA: *National Association of Sport and Physical Education*.

Palmer, C., and Meyer, R.K. (2000). Conceptual and motor learning in music performance. *Psychological Science*, 11, 63-68.

Perret, P., and Fox, J. (2006). *A Well-Tempered Mind: Using Music To Help Children Listen and Learn*, New York, NY, Dana Press, The Dana Foundation.

Pica, R. (1999). Music and the movement program. *Teaching Elementary Physical Education*, 10, 32-33.

Prentice, A.M. and Jebb, S.A. (1995). Obesity in Britain: Gluttony or sloth? *British Medical Journal*, 11, 437-439.

Troiano, R.P, and Flegel, K.M. (2001). Overweight children and adolescents: Description, epidemiology, and demographics. *Pediatrics*, 101, 497-504.

Roberts, D.F., Foehr, M.A, and Rideout, V., (2005). Generation M: Media in the Lives of 8-18 Year-olds. *A Kaiser Family Foundation Study*.

Sacks, O. (1973). *Awakenings*, London, UK: Duckworth.

Sacks, O. (1995). *An anthropologist on Mars: Seven paradoxical tales*. New York, NY: Knopf.

Sacks, O. (2007). *Musicophilia: Tales of Music and the Brain*, New York, NY. Knopf.

Shaffer, R.J., Jacokes, L.E., Cassily, J.F., Greenspan, S.I., Tuchman, R.F., and Stemmer, P.J. (2001). Effect of Interactive Metronome® training on children with ADHD. *The American Journal of Occupational Therapy*, 55(2), 155-161.

Shephard R.J. (1997). Curricular physical activity and academic performance. *Pediatric Exercise Science*, 9, 113-125.

Sievers, C.H. (1932). The measurement of musical development: Part II. A study of rhythmical performance with special consideration of the factors involved in the formation of a scale for measuring rhythmic ability. *University of Iowa Studies in Child Welfare*, 7, 111-172.

Smoll, F.L. (1974a). Development of rhythmic ability in response to selected tempos. *Perceptual and Motor Skills*, 39, 767-772.

Smoll, F.L. (1974b). Development of spatial and temporal elements of rhythmic ability. *Journal of Motor Behavior*, 6, 53-58.

Smoll, F.L. (1975). Variability in development of spatial and temporal elements of rhythmic ability. *Perceptual and Motor Skills*, 40, 439-442.

Storr, A (1992). *Music and the Mind*, Random House Publishing Group.

Taub, G., McGrew, K., and Keith, T., (2007). Improvements in Interval Time Tracking and Effects on Reading Achievement. *Psychology in the School*, 44 (8), 849-863.

Temple, I.G., Williams, H.G., and Bateman, N.J. (1979). A test battery to assess intrasensory and intersensory development of young children. *Perceptual and Motor Skills*, 48, 643-659.

Thomas, J., and Moon, D. (1976). Joy in learning through music and movement improvisations. New York: Macmillan. Townsend and Gurvitch (2002). Integrating technology into physical education: Enhancing multiple intelligences. *Teaching Elementary Physical Education*, 13, 35-40.

Tramo, M.J. (2001). Biology and music. Music of the hemispheres. *Science*, 291, 54-56.

Tramo, M.J., Shah, G.D., and Braida, L.D. (2002). Functional role of auditory cortex in frequency processing and pitch perception. *Journal of Neurophysiology*, 87, 122-139.

Tremblay, M. S., Inman, J. W., and Williams, J. D. (2000). The Relationship Between Physical Activity, Self-Esteem, and Academic Achievement in 12-Year-Old Children. *Pediatric Exercise Science*, 12, 312-324.

Troiano, R.P., Flegel, K.M. (2001). Overweight children and adolescents: Description, epidemiology and demographics. *Pediatrics*, 101, 497-504.

Troiano, R.P., Flegel, K.M., Kuczmarski, R.J., Campbell, S.M., and Johnson, C.L. (1995). Overweight prevalence and trends for children and adolescents: The National Health and Nutrition Examination Surveys, 1963 to 1991. *Archives of Pediatric Adolescent Medicine*, 149, 1085-1091.

U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the surgeon general*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

U.S. Department of Health and Human Services, Administration for Children and Families. (1997). *The first progress report on head start program performance measures*. [http://www.acf.hhs.gov/programs/core/ongoing\\_research/face/faces\\_pubs\\_reports.html](http://www.acf.hhs.gov/programs/core/ongoing_research/face/faces_pubs_reports.html)

Volkow, N.D., Levy, A., Brodie, J.D., Wolf, A.P., Cancro, R., van Gelder, P., and Henn, F. (1992). Low cerebellar metabolism in medicated patients with chronic schizophrenia. *American Journal of Psychiatry*, 149, 686-688.

Volman, M.J.M., and Geuze, R.H. (1998). Temporal stability of rhythmic tapping "on" and "off the beat": A developmental study. *Psychological Research*, 63, 62-69.

Wall, R.B. (2005). Tai Chi and mindfulness-based stress reduction in a Boston Public Middle School. *Journal of Pediatric Health Care*, 19(4), 230-237.

Weikart, P.S. (1989). *Theory: A Sequential Approach to Rhythmic Movement*. Ypsilanti, MI: High/Scope Press.

Weikart, P. (1992). *Pedagogy/Theory: Movement in Steady Beat*. Ypsilanti, MI: High/Scope Press.

Weikart, P. (1998) *Teaching Movement and Dance: A Sequential Approach to Rhythmic Movement*. Ypsilanti, MI: High Scope Press.

Williams, H.M. (1993). A study in the prediction of motor rhythmic performance of school children. *Journal of Genetic Psychology*, 43, 165-172.

Zachopoulou, E, Derri, V., Chatzpoulou, D., and Ellinoudis, T. (2003). Application of Orff and Dalcroze activities in preschool children: Do they effect levels of rhythmic ability? *Physical Educator*, 60(2), 51-58.

Zion, Leela (1996). Making sense: Kinesthesia. *ETC: A Review of General Semantics*, 53, 300- 315.

