

The Heartmath System Improves Cognitive Efficiency and Behaviour:

A New Treatment for ADHD

2007 (*In Press*)

A. Lloyd, MA MEd, D. Brett BSc, Professor K. Wesnes PhD, (Northampton University)
Dr P. Mullins PhD. (Liverpool John Moores University.)

SUMMARY

Research subject to peer review for the British Journal of Research in Special Educational Needs / Journal of Special Education– Blackwell Publishing. 2007/8)

ADHD is the most prevalent behavioural condition in childhood affecting between 3% and 5% of all school children. The National Institute for Clinical Excellence and ADDISS, the leading ADHD Charity in the UK state that approximately 500,000 school children suffer with this condition and that the number appears to be growing. Recent research by Froehlich (2007) suggests an exponential prevalence running at 9% in the USA. According to a report by the National Institute for Clinical Excellence, prescriptions for psychostimulant medication to treat ADHD in the UK have grown from 2,606 in 1992 to 456,909 in 2006. NICE is due to publish a report in 2008 detailing accurate numbers and a national service framework. The international consensus statement on ADHD published by the Journal of American Child & Adolescent Psychiatry (2002) states that many sufferers continue to experience some symptoms throughout their adult life. ADHD children experience multiple disadvantages, resulting in a 'Physiology of exclusion'. Lynch (2000) Untreated, ADHD can lead to academic underachievement, poor interpersonal relationships, anxiety and depression and increased risk of involvement in crime. Barkley et al (1997) Green & Chee (1997) Of particular concern is the increased risk of mental health problems for adolescents with ADHD. Kalttialala-Heino et al (2003) Laitinen-krispijin (1999)

The randomized controlled study undertaken by Lloyd et al (in press) to measure the potential benefits of Heartmath training on children with ADHD derived from pilot studies in 2004. The findings were so promising that a further scientifically robust study was undertaken. The results of the Heartmath ADHD study in England were significantly beyond what was expected. Findings indicate a 24% increase in immediate word recall; a 45% improvement in delayed word recall, a 28% improvement in word recognition and 9.5% improvement in digital vigilance suggesting that improvements in scores for cognitive functioning were not at the expense of speed. Moreover, questionnaire data from teachers indicated a 32% reduction in difficult behaviours after only six weeks. This was achieved in a sample of 38 children who have a DSM IV clinical diagnosis of ADHD. The findings offer a very strong case for funding research into the impact of the Heartmath technique on a large sample of children who do not experience this learning difficulty in order to establish the potential efficacy of Heartmath on cognitive functioning for the normal school population.

There is growing evidence to suggest ADHD has a hereditary link. Kytja & Voeller (2004), however even this most researched childhood condition eludes a unique genetic marker or neuropsychological test that is pathognomic. Diagnosis relies therefore on the subjective

observations of teachers, parents and GP's with endorsement from overstretched paediatric and psychological services. Inevitably, symptom overlap with other co-morbid conditions such as anxiety and depression resulting from adverse life events such as family breakdown, bereavement and bullying etc are mistaken for ADHD.

Very recent research conducted by Berman and Glover (*In press*) at Imperial College London in partnership with the University of Rochester Medical Centre in New York, offers compelling evidence that high levels of the stress hormone 'Cortisol' in amniotic fluid during pregnancy can impact on cognitive development, suggesting that stress reduction programmes for working / pregnant mothers could be one way of reducing cognitive impairment associated with ADHD? Research by Chevrin (2006), has suggested that sleep and breathing disorders are also causative factors in the onset of ADHD symptoms. More recent studies on the impact of television suggest that watching television has a negative impact on cognitive development. Zimmerman (2005) Nutrition is also considered a causative factor; a recent UK Government sponsored study by Professor Jim Stevenson on behalf of the UK Food Standards Agency due to be published later in 2007, raises concerns about food additives and their impact on behaviour. Leading ADHD researcher Dr Stephen Farrarone (1999) argues that ultimately, genetic potential must be evident for environmental factors to trigger the onset of symptoms.

Recent claims by the General Teaching Council in the UK that repeated testing of schoolchildren is a pathogenic influence creating high levels of stress in children perhaps oversimplify the argument that modern lifestyle factors such as poor nutrition, food additives, working or absent parents, and adverse life events all contribute to what can result in 'sustained chronic levels of stress hormones' that may impact negatively on brain development. Environmental causative factors undoubtedly influence age of onset and severity of symptoms. Some experts in this field go as far as to suggest that ADHD is the result of cultural transmission – an adaptive biological and evolutionary response to modern lifestyle? Farrarone (2006)

A biological signature for ADHD is evident in the research that identifies abnormalities in levels of neurotransmitters such as dopamine and norepinephrine. Swanson et al (2000) Volkow et al (1998) Furman (2005) argues that this does not in itself prove the case for a medical model of intervention. Furman offers sound arguments for a multi modal treatment regimen that includes counselling, nutrition, parental support and behavioural interventions that promote pro-social behaviours, offering a more holistic level of support for children with ADHD like symptoms. There is an overwhelming amount of research that proves stimulant medication certainly alleviates symptoms, moderating impulsive and inattentive behaviours resulting in improved school performance. Beiderman (2006) However, there is growing concern among some researchers and clinicians that medicating children with psychostimulants is not the neurological Eldorado that pharmaceutical companies claim; ADHD is an umbrella term for a variety of symptoms with no unique etiology and the long term side effects of psychostimulants on the Ritalin generation are still unknown.

A growing body of research on brain plasticity and neurogenesis – particularly in early infancy and adolescence, suggests that emotional regulation can be learned. Neville et al

(2000) Davidson (2004) Begley (2007). This poses the challenging question for educationalists and all those concerned with the healthy biological and psychological development of children as to what exactly we should be teaching children to prepare them for adult life? In his recent book 'Five Minds for the Future', Harvard's leading educationalist, Howard Gardner(2006), offers a strong argument for assessing 'abilities' that include a social and moral dynamic. Sue Gerhardt (2004) in her book 'Why Love Matters', analyses a wealth of research and explores the necessity of healthy nurturing of children and the implications for psychosocial development if these needs are not met. Michael Lynch in his book 'The Medical Consequences of Loneliness' (2000) cites numerous studies that link school failure to criminal behaviour (already well established) but more alarmingly, he cites robust evidence of links between school failure and cardio vascular disease and premature death. The advent of inter agency working in the UK and the implementation of the 'Every Child Matters' agenda will inevitably lead to a multi diagnostic and multi modal approach to all aspects of child development that recognises the centrality of physiological well being in ensuring all children realise their academic and psychological potential.

The prevailing paradigm for behaviour management in schools is a combination of rewards and sanctions and efforts to facilitate self awareness (appropriate to stages in child development – which vary from child to child). Facilitating self awareness enables the child to learn how their behaviours impact on learning in the classroom, promoting pro social modelling and psychosocial development. This is time consuming and it must be acknowledged that some teachers are better than others at facilitating the type of learning we now define as emotional intelligence or emotional regulation. It must also be acknowledged that managing multiple relationships with children is challenging for even the most gifted teacher (especially in secondary schools where contact may be limited to only a couple of hours per week).

Emotional regulation (emotional intelligence) underpins intellectual development and academic attainment, it is also crucial if children are to achieve the fifth objective of the 'Every Child Matters' agenda; achieving economic independence. A truly inclusive education must be inclusive of learning for psychological development and not be driven by transient employment trends. The rapidly changing employment culture in the UK reflects a knowledge based and service driven economy that places high value on interpersonal skills and executive functions such as problem solving, creativity and innovation. The school leaver who chooses a vocational pathway such as plumbing or hairdressing, must know how to interface with customers and self market in the same way as a graduate executive. We live in a 'relationship; economy. This has been recognised in the OFSTED report of 2007 that emphasises the need for the social and emotional aspects of learning to be inculcated into the national curriculum.

The Heartmath System offers an alternative model for facilitating learning states and pro-social behaviours that starts with changing physiology. Training children to breathe rhythmically while focussing on positive emotions for 15 to 20 minutes per day has been scientifically proven to reduce the levels of stress hormones and improve cognitive functioning. This in turn moderates impulsive behaviours and offers the potential to raise levels of academic attainment. The investigation undertaken in Wirral Local Authority

employed externally validated scientific measures to assess the impact of rhythmic breathing, positive emotions and easy to use non invasive biofeedback computer games to test whether this intervention resulted in improved cognitive functioning. Several researchers have highlighted the benefits of biofeedback training. Hill & Castro (2002) A recent study employing the use of biofeedback computer games by Strehl (2006) demonstrated improved IQ scores in children with ADHD.

A multi modal approach to treatment is now recommended by physicians, educationalists, ADDISS and the British Psychological Society, to support parents in providing the most effective interventions, so their children can thrive, achieve and enjoy childhood. Multimodal approaches include access to counselling, advice on nutrition and parenting as well as specific approaches to teaching and learning for children who experience impulsive behaviours and inattention. Research evidence suggests that multi modal provision is patchy and more research on multimodal provision needs to be undertaken in the UK. A recent study for Birmingham CAMHS by Moosa & Lohawala (2007) indicated that psychostimulants were invariably the only treatment offered.

Research by Allan Schore (2003) and Le Doux (2002) suggest that adolescents are 'opportunity ready' to learn emotional regulation as a result of brain growth and brain plasticity peculiar to this stage in child development. This offers the potential to rewire the brain with significant implications for psychological development and academic attainment at a time when the teenager's house of intelligence is ready for full occupation. Schore's research is being corroborated in very recent studies employing magnetic resonance image scanning which prove the brain can be trained to activate positive emotions and thoughts. Sharon Begley in a recently published book, 'Train your mind to change your brain' (2007) cites numerous studies that prove emotional regulation impacts on the brain and the endocrine system that drives behavioural impulse. A growing body of research highlights the system wide dynamics of the body in the optimum functioning of health and learning Thelen & Smith (1994) and McCraty et al (2006).

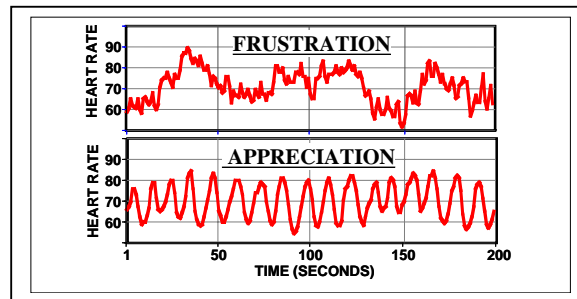
What is the Heartmath System?

The Heartmath system postulates that health is controlled by three interdependent realms incorporating biochemical, structural and psychosocial elements that interact in a complex and highly intelligent manner. The concept of system wide coherence across bodily systems derives from the laws of physics that implies an integrated and organised distribution of energy through signal processing, usually measured in wave form, like those found in an ECG or EEG. The more stable the sine wave or frequency and amplitude, the greater the level of coherence. The Human body contains numerous biological oscillators that control breathing, digestion, homeostasis and oscillations that occur even at cellular level all over the body, including the brain. (Satinover 2001). The most powerful of these biological oscillators is the human heart which also functions as a hormone secreting gland. Cantin & Genest (1986) This most powerful of bodily oscillators can entrain other systems so they become 'frequency locked' creating a cross phase coherence across the nervous system. The eidetic human heart acts as a global conductor of that synchronises the entire human

organism. It follows therefore that the brain is not the only nodal point of access for learning, memory and impulse control; so too is the mind body interface.

Learning and memory are based on our ability to formulate coherent patterns of information which are coded in neural nets throughout the entire nervous system and in greater density in the heart, brain and spinal cord. The laws of physics define coherence as ordered, harmonious and consistent. Oscillating frequencies in the human brain and between other systems in the human body operate at varying frequencies that can be altered cognitively – measurable through biofeedback. McCraty et al (2006)

It is Heartmath's thesis that emotional coherence – a state of sustained, self modulated positive emotion, improves performance and well being. Coherence building interventions have indicated that cardiac coherence evident in heart rate variability leads to improvements in autonomic nervous system balance, Tiller et al (1996), immune system function Davidson et al (2003), and the DHEA / cortisol ratio. McCraty(1998) and Cognitive Functioning. Wesnes et al (2004) In the Heartmath system, the coherence of the human heart is central to system wide coherence and is influenced by emotion.



A mounting body of influence across a number of scientific disciplines also suggests there is potential value in research that explores applications such as the Heartmath system that introduce a psychophysiological dynamic to educational pedagogy.

Design & Methodology

Employing a rigorous positivist research paradigm, this blind placebo controlled study evaluated the impact of a daily 15 minute 'Heartmath Lock in', for 38 children aged 9 to 13 years, with a diagnosis of ADHD. The primary hypothesis was that 'Heartmath improves cognitive function post training'. Results were measured using the sophisticated 'CDR' electronic test for cognitive functioning. Results from the test were independently analysed and validated by Cognitive Drug Research Ltd (UK). Secondary measures included the Revised Connors Teachers Rating Scale Questionnaires and Strengths and Difficulties Questionnaires completed by both children and teachers. The results of the questionnaires were analysed and validated by Liverpool John Moores University in England.

The placebo control consisted of daily twenty minutes 1 to 1 sessions with a Learning Assistant for a period of six weeks, Each child was free to build a model of choice from Lego building bricks. Lego was chosen as the placebo due to evidence of its efficacy as therapeutic medium. 7

The children were trained to use the Heartmath Freeze Framer biofeedback software 'Rainbow Game'. This was utilised to measure and train the children to increase their levels of physiological coherence. The Heartmath 'Quiet Joy' music was used during the training to reinforce the learning.

Of the children who participated, 37 stated they enjoyed the sessions and 32 children said they continued to practise the 'Heartmath Lock in' technique three months after the training was completed. Anecdotal feedback indicated that 31 children reported improved sleep patterns.

Results.

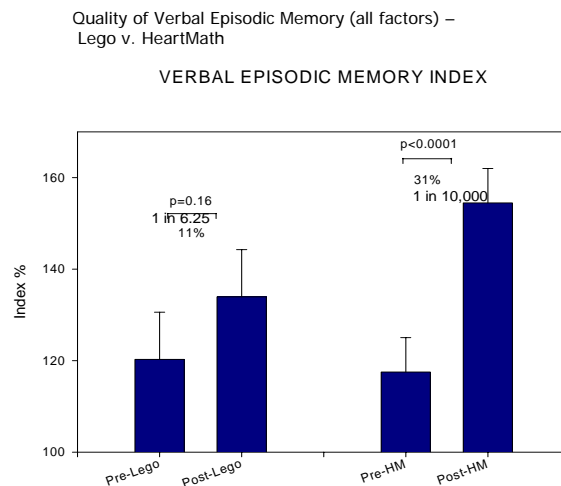
The results were beyond the researchers expectations. There was a statistically significant increase in the Quality of Verbal Episodic of the Heartmath Group and a less than significant increase in the Control Group. Speed of Recall and Accuracy of Recall increased significantly in the Heartmath Group but no statistically significant improvement was measured in the Placebo Group.

Immediate Word Recall improved by 24%

Delayed Word Recall improved by 45%

Word recognition improved by 28%

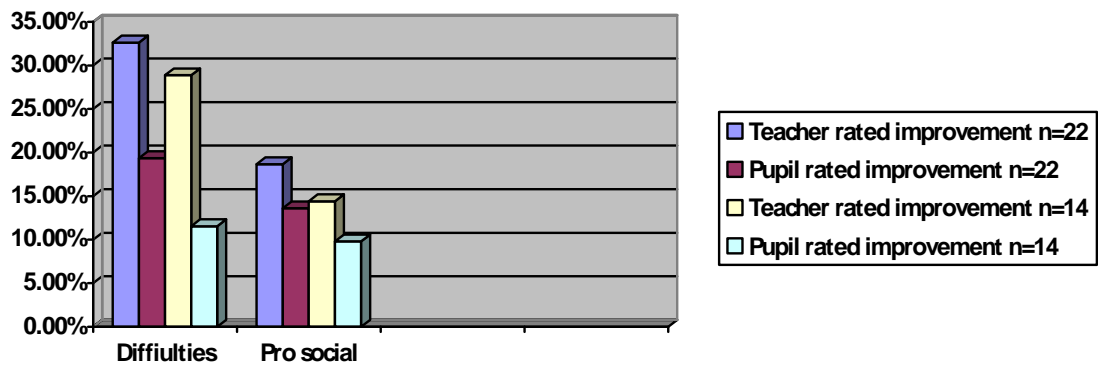
Digital vigilance improved by 9.5%



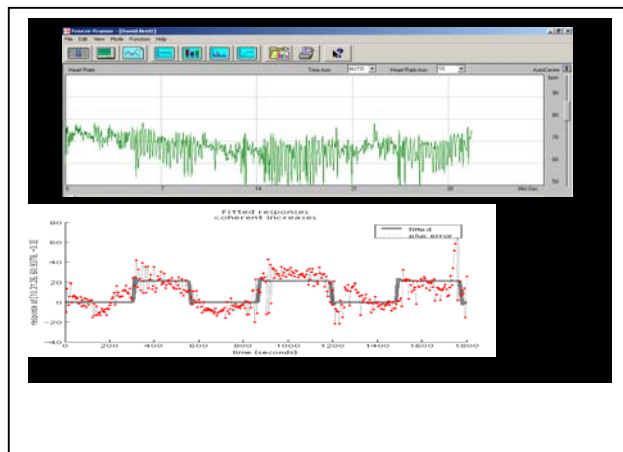
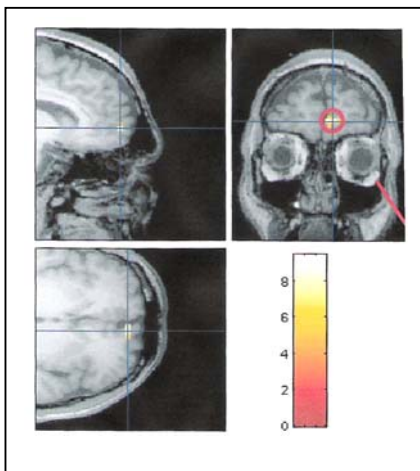
Behaviour

The results indicated statistically significant improvement in certain behaviours measured by teachers across a range of indices. It must be noted however, that the subjectivity of the self reporting questionnaires completed by child participants are subject to demand characteristics and multiple uncontrollable variables such as the culture of the individual

school or adverse life events for the children participating in the study. Also the extent to which teachers in a secondary school context can claim to truly know a child when they have very limited contact with the child, inevitably undermine the validity of the questionnaires with such a small sample. However, a reduction in behavioural difficulties scores of 12% employing Strengths and Difficulties Questionnaires after a period of only six weeks was beyond the expectations of this study. This represents a 33% improvement in Teacher observed behaviour post Heartmath training, in the group that received the placebo for six weeks prior to the Heartmath training. (n=22) The group who received Heartmath only (n=14) also demonstrated a reduction of 12% in their teacher reported Difficulties scores equivalent to a 29% improvement. Pupil self reported reductions in difficulties were equivalent to 19% for the group who received the placebo followed by the Heartmath training and 12% for those who received Heartmath only. Improvements in pro social scores were also significant.



One fMRI scan was employed in an adult volunteer who regularly practised the Heartmath Lock in technique. The subject was asked to activate a positive emotion correlating with a coherent heart rate variability measured by the Heartmath FreezeFramer software for intermittent periods of 5 minutes, three times over a thirty minute period while the fMRI scan was taken. This demonstrated activity in the right orbito frontal cortex of the brain. An exact correlation between this brain activity and coherent heart rate variability suggests that positive emotion generates a coherent heart rate variability. HRV is associated with well being and optimum psychophysiological function.



Discussion of results.

The results clearly illustrate the correlation between physiological coherence and improved cognitive functioning. Evidence that cognition is the product of system wide dynamics emphasises the centrality of physiology in facilitating learning states and appropriate behaviours in school. Working with physiology as the primary conduit for learning in the classroom is a more efficient change agent than working with a child's limited self awareness. There is therefore sufficient evidence to suggest a further, larger study to explore the value of the Heartmath system in education.

Conclusion.

This investigation proves that the Heartmath System has a scientifically proven statistically significant impact on learning. Heartmath training can facilitate learning states and improve cognitive functioning with the potential to increase levels of academic attainment, reduce difficult behaviour and promote pro social behaviour in schoolchildren with ADHD.