



Institute of HeartMath Research & Case Studies

Macquarie Institute (Aust) Pty Ltd

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Introduction

The Macquarie Institute (Aust) Pty Ltd makes available in Australia and New Zealand programs and technology for lowering stress and improving health and performance. These programs incorporate the results of research undertaken, and methodologies developed, by the Institute of HeartMath (IHM) USA. Macquarie Institute is part of a worldwide network making this work available, in conjunction with HeartMath LLC in the USA, and Hunter Kane Ltd in the UK and Europe, and other organisations.

The Institute of HeartMath, founded in 1991, established HeartMath LLC in 1996 as a separate commercial company to provide the information and training systems developed by the Institute to workplaces, hospitals and healthcare professionals. HeartMath LLC also produces and distributes learning materials and learning support software, and supports the development of the global network of organisations providing IHM programs.

This document provides an overview of the published research and related work of the Institute of HeartMath, and results of application in corporate, health, education and government sectors. It includes published research, references to case study data, brief biographical details of independent researchers who constitute the Institute of HeartMath Advisory Boards, and references to current research into Heart Rate Variability.

Neurocardiology

Independent biomedical research in the field of neurocardiology in the last fifteen years has revealed that the heart is more than a simple pump, and includes a highly complex, functional nervous system. The heart includes an intricate network of several types of neurons, neurotransmitters, proteins and support cells similar to those found in the brain. The recently published book *Neurocardiology* (Oxford University Press 1994), edited by Dr. J. Andrew Armour and Dr. Jeffrey Ardell, provides a comprehensive overview of the heart's intrinsic nervous system and the role of central and peripheral autonomic neurons in the regulation of cardiac function. The heart's intrinsic nervous system is vital for the maintenance of cardiovascular stability and efficiency.

Neurocardiology work has led to new discoveries related to heart-function and autonomic system function. Heart Rate Variability (HRV), derived from the electrocardiogram (ECG), is a measurement of the beat-to-beat changes in heart rate. Heart Rate Variability is today widely recognised as a window into the health of the nervous system and a correlate of all-cause mortality.

The appendices includes an overview of selected third-party scientific research being conducted internationally into the field of HRV and its many sub fields.

Overview of the work of the Institute of HeartMath (IHM)

For over a decade, the Institute of HeartMath, a United States non-profit public educational research institution, has conducted research into the physiology of **Heart Rate Variability** and the associated signalling between the heart and brain, and the complex inter-relationships that exist between HRV and human physical, mental, and emotional function. "HeartMath" the term was coined originally to imply a scientific and applied study of the function of the heart.

The IHM Research Center regularly participates in collaborative studies with other U.S. and international scientific, medical, and educational institutions. IHM research is published in numerous peer-reviewed journals and regularly presented at psychological and biomedical research conferences both nationally and internationally. References to this published research follows.

IHM research has demonstrated that the heart-brain signalling system not only affects physiological regulation, but can also deeply influence perception, emotions, behaviours, performance, and health. IHM's research has found that heart rhythm patterns can provide a useful and objective measure of *physiological coherence*, a high performance state characterised by a high degree of functioning in the body's diverse oscillatory systems. It includes high heart rhythm coherence (a sine wave-like rhythmic pattern), increased parasympathetic activity in the autonomic nervous system, increased entrainment and synchronization between physiologic systems, and efficient and harmonious functioning of the body's cardiovascular, nervous, hormonal and immune systems.

The Institute of HeartMath has found that heart rate variability patterns are extremely responsive to emotions, and heart rhythms tend to become more ordered or coherent during positive emotional states. IHM has developed techniques to enable individuals to self-generate and sustain positive emotion to drive physiological coherence. This state of *psychophysiological coherence* is characterised by a high degree of mental and emotional stability and constructive integration of cognitive and emotional systems. Outcomes observed include: reduced stress, anxiety and depression; decreased fatigue; enhanced immunity and hormonal balance; improved cognitive performance and learning; health improvements in a number of clinical populations.

Clinical and applied applications of the work of the Institute of HeartMath have been substantiated by numerous research studies conducted across diverse populations--ranging from people with clinical conditions such as hypertension, diabetes and congestive heart failure, to students of all ages, corporate executives and healthcare workers. Applied research and field trials in organisations and education have also been undertaken internationally over the last 5-10 years, and further trials are currently being undertaken in the United Kingdom, Europe, Asia and Australia.

IHM has recently been awarded grants of US\$1.75M by the U.S. Federal Department of Education to further develop and implement practical applications into both primary and secondary schools. The IHM has also received State of California funding.

Further detailed information on IHM research is available in publications of the Institute of Heartmath, including *Science of the Heart*, which provides a detailed overview of IHM's research and case studies up to 2001. References to published research and case studies follow. Abstracts are included where available. Copies of articles are available through the Macquarie Institute.

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Institute of HeartMath Research Papers - Basic and Clinical Research

Assessment of Autonomic Function and Balance in Chronic Fatigue Patients Using 24-Hour Heart Rate Variability Analysis

R. McCraty, S. Lanson, M. Atkinson

Clinical Autonomic Research 1997;7(5):237.

Chronic fatigue syndrome (CFS) is a medically unexplained disorder characterized by chronic, disabling fatigue, muscle pain, impaired concentration and a variety of neurobiological symptoms that make everyday activities extremely difficult. While it has been suggested that patients with CFS may have impaired autonomic nervous system function, there have been few studies that have examined this question directly. The purpose of this study was to determine if there were differences in autonomic function, as assessed by 24-hour heart rate variability (HRV) analysis, in 22 CFS patients (age range 31-69, mean age 45.5) as compared to healthy age and sex-matched controls. Holter monitoring was performed on all subjects, and HRV data was subjected to time domain, frequency domain and circadian rhythm analysis. In CFS patients, the SDNN index (mostly sympathetic) and RMS-SD (parasympathetic) measures were significantly lower than in controls. In the frequency domain, 5-minute total power, very low frequency (VLF) (mostly sympathetic), low frequency (LF) and high frequency (HF) (parasympathetic) power were all significantly lower in CFS patients. Circadian rhythm analysis revealed that differences in time and frequency domain measures were significant primarily during the daytime hours; 5-minute total power, LF power and HF power were also significantly lower in CFS patients during the latter part of the sleep cycle. There were no significant differences in mean heart rate or in the LF/HF ratio. Our results indicate that autonomic function is indeed impaired in CFS patients, as both sympathetic and parasympathetic activity are significantly depressed with respect to healthy age and sex-matched controls.

Analysis of Twenty-Four Hour Heart Rate Variability in Patients with Panic Disorder

R. McCraty, M. Atkinson, D. Tomasino, W. P. Stuppy

Biological Psychology 2001; 56(2-3):131-150.

Growing evidence suggests that alterations in autonomic function contribute to the pathophysiology of panic disorder (PD). This retrospective study employed 24-hour heart rate variability (HRV) analysis of Holter records to compare autonomic function in PD patients (n = 38) with healthy, age- and gender-matched controls. Both time and frequency domain measures were calculated, and a circadian rhythm analysis was performed. The SDNN index, 5-minute total power, very low frequency and low frequency power were significantly lower in panic patients relative to controls over the 24-hour period; differences were significant primarily during the waking hours. In contrast, the mean RR interval, RMSSD and high frequency power were comparable in patients and controls. Results suggest that sympathetic activity is depressed and vagal tone predominant in PD patients under usual life conditions. Findings of low HRV in PD patients are consistent with the high rate of cardiovascular morbidity and mortality in this population, as well as with the emerging view of panic as a disorder involving reduced flexibility and adaptability across biological, affective and behavioural dimensions.

Cardiac Coherence: A New Noninvasive Measure of Autonomic System Order

R. McCraty, W. A. Tiller, M. Atkinson

Alternative Therapies in Health and Medicine 1996;2(1):52-65.

Although cardiac sympathovagal regulation has been studied during stress using power spectral density analysis of heart rate variability, little is known about its regulation during emotional states. Using heart rate variability measurements we studied autonomic balance in 20 subjects trained in a mental and emotional self-management technique called Freeze-Frame. The study was conducted in two environments; under controlled laboratory conditions, and at work under real-life stressful conditions in the workplace. Power spectral density plots of R-R intervals obtained from electrocardiogram recordings were divided into three regions: low frequency, (predominantly sympathetic activity), mid-frequency, and high frequency, (parasympathetic activity). Measurements were taken for a 5-minute baseline period followed by a 5-minute period of positive emotional expression.

Three unique conditions of autonomic nervous system order can be clearly discriminated in the data, (1) normal heart function mode, 2) entrainment mode and 3) internal coherence mode. The internal coherence mode is new to the electrophysiology literature. We provide supporting data for modes 2 and 3 and show that a group of 20 subjects trained in this technique can enter and maintain these states at will. We found that, when one is in

the entrainment mode, other physiological systems lock to the entrainment frequency which is approximately 0.1 Hz.

The results suggest that emotional experiences play a role in determining sympathovagal balance independent of heart rate and respiration and further suggest that positive emotions lead to alterations in heart rate variability that may be beneficial in the treatment of hypertension and reduce the likelihood of sudden death in patients with congestive heart failure and coronary artery disease.

A Controlled Pilot Study of Stress Management Training of Elderly Patients With Congestive Heart Failure

F. Luskin, M. Reitz, K. Newell, T. G. Quinn, W. Haskell
Preventive Cardiology 2002;5(4):168-172, 176.

Cycle Length Dependency of Heart Rate Variability in Elderly with Ischemic Heart Disease

K. Umetani, D. H. Singer, R. McCraty, M. Atkinson
Circulation (suppl 1) 1996;94(8):I-498.

Low heart rate variability (HRV) is considered as a marker of coronary disease (CD). However, HRV also decreases with normal aging, reaching levels as low as those seen with CD. This limits the predictive utility of HRV. Cycle length dependency (CLD) of HRV has been proposed as an additional discriminator. To test the possibility that differences in CLD could help distinguish low HRV due to normal aging from that due to disease, we computed HRV for different CLs in 24 hr Holter records from 65 subjects (\bar{O} 65 yrs): 1) 37 healthy subjects (mean = 75 yrs); 2) 17 single vessel CD patients (mean = 74 yrs) and 11 multi-vessel CD patients (mean = 74 years). Mean RR interval, Standard Deviation Index (SDI), root mean square of successive differences (rMSSD) and % difference in successive RR intervals > 50 msec (pRR50), were computed for consecutive 5 min periods. Periods with comparable mean RR interval were grouped in 100 msec bins. Mean SDI, rMSSD and PRR50 were calculated for each bin for each subject. Mean values for each CL were determined for each group. Inter- and intra-group HRV differences at CL 500-1100 msec were evaluated using ANOVA and paired t-test. The results show: 1) SDI of group 1 (45 msec) differed significantly from that of group 3 (31 msec). However, SDI of groups 1 (45 msec) and 2 (39 msec) did not differ; 2) rMSSD and pRR50 did not differ significantly among the 3 groups; 3) In group 1, CLD of SDI persisted at 500-700 msec; rMSSD at 900-1100 msec; and pRR50 at 800-1100 msec. In contrast, CD patients (groups 2 and 3) did not exhibit CLD irrespective of the measures used. In conclusion: 1) Both low HRV and absent CLD distinguish healthy elderly from elderly multi-vessel CD patients; 2) Diminished and absent CLD, but not low HRV, also appear to distinguish healthy elderly from 1 vessel CD patients.

The Effects of Emotions on Short-Term Power Spectrum Analysis of Heart Rate Variability

R. McCraty, M. Atkinson, W. A. Tiller, G. Rein, A.D. Watkins
American Journal of Cardiology 1995;76(14):1089-1093.

Objectives. This study sought to define the effects of age and gender effects on the normal range of time domain heart rate variability (HRV) over nine decades in healthy subjects.

Background. Low HRV is considered an independent marker of mortality risk. However, the age-related decline in HRV may limit its predictive value, particularly in the elderly. Delineation of the range of HRV in healthy subjects over the life span is needed. Gender-related differences in HRV also need clarification.

Methods. We determined, according to decade, 24-h heart rate (HR) and HRV of 260 healthy subjects (10 to 99 years old; 112 male, 148 female) by means of five standard time domain measures: standard deviation of all normal sinus RR intervals over 24 h (SDNN), standard deviation of the averaged normal sinus RR intervals for all 5-min segments (SDANN), means of the standard deviations of all normal sinus RR intervals for all 5-min segments (SDNN index), root-mean-square of successive normal sinus RR interval difference (rMSSD) and the percentage of successive normal sinus RR intervals >50 ms (pNN50).

Results. 1) HRV decreased with aging, the pattern of change being measure dependent. HRV (SDNN and SDANN) decreased only very gradually, reaching 60% of baseline (second-decade values) by the tenth decade. With the SDNN index, HRV decreased linearly with aging, reaching 46% of baseline by the tenth decade. Using pNN50 and rMSSD, HRV decreased most rapidly, reaching 24% and 47% of baseline, respectively, by the sixth decade and then stabilized. 2) Using the SDNN index, rMSSD and pNN50, HRV of subjects >65 years old fell below published cutpoints for increased risk of mortality in 25%, 12% and 4%, respectively. 3) At age <30 years, HRV for all measures was lower in female than male subjects. Gender

differences decreased at age >30 years and disappeared at age >50 years. 4) HR also declined with aging but much more slowly. HR at age <50 years was faster in female than in male subjects. Gender differences disappeared thereafter.

Conclusions. 1) Using all measures, HRV of healthy subjects declines with aging, with measure-dependent patterns. 2) Using the SDNN index, rMSSD and pNN50, HRV of healthy subjects, particularly those >65 years old, may decrease to below levels associated with increased risk of mortality. 3) Gender influences HRV. Gender differences in HRV are age and measure dependent. 4) Age and gender also affect heart rate.

Emotional Self-Regulation Program Enhances Psychological Health and Quality of Life in Patients with Diabetes.

R. McCraty, M. Atkinson, L. Lipsenthal.

Submitted to *Diabetic Medicine*.

Aims: This pilot study was designed to assess changes in psychological status, quality of life and hematologic measures predictive of long-term health and well-being in patients with diabetes following a stress reduction and emotional self-regulation program.

Methods: Twenty-two patients with Type 1 or Type 2 diabetes mellitus participated in a 2-day HeartMath workshop, a research-based program developed to reduce stress and negative affect, increase positive affect and reduce inappropriate autonomic nervous system activation. Self-report measures of stress, psychological status and quality of life were administered before and six months following the intervention. Hemoglobin A1c, cholesterol and triglycerides, and blood pressure were also assessed.

Results: Participants experienced significant reductions in psychological symptomatology and negative emotions, including anxiety, depression, anger and distress, following the intervention. Significant increases in peacefulness, social support and vitality were also measured, as well as reductions in somatization, sleeplessness and fatigue. Participants showed reduced sensitivity to daily life stressors after the intervention, and quality of life significantly improved. Regression analysis revealed a significant relationship between self-reported practice of the techniques learned in the program and the change in HbA1c levels in patients with Type 2 diabetes. Increased practice was associated with reductions in HbA1c.

Conclusions: Results suggest that the HeartMath emotional self-regulation intervention reduces stress, improves psychological health, enhances quality of life and improves glycemic control in individuals with diabetes. Replication of this study with a non-treatment control group is necessary to confirm these findings.

The Heart Reinnervates After Transplantation

D. A. Murphy, G. W. Thompson, J. L. Ardell, R. McCraty, R. S. Stevenson, V. E. Sangalang, R. Cardinal, M. Wilkinson, S. Craig, F. M. Smith, J. G. Kingma, J. A. Armour
Annals of Thoracic Surgery 2000;69(6):1769-1781.

Heart Rhythm Coherence - An Emerging Area of Biofeedback

R. McCraty

Biofeedback 2002;30(1):23-25.

The Impact of a New Emotional Self-Management Program on Stress, Emotions, Heart Rate Variability, DHEA and Cortisol

R. McCraty, B. Barrios-Choplin, D. Rozman, M. Atkinson, A. D. Watkins
Integrative Physiological and Behavioural Science 1998;33(2):151-170.

This study examined the effects on healthy adults of a new emotional self-management program, consisting of two key techniques, "Cut-Thru" and the "Heart Lock-In." These techniques are designed to eliminate negative thought loops and promote sustained positive emotional states. The hypotheses were that training and practice in these techniques would yield lowered levels of stress and negative emotion and cortisol, while resulting in increased positive emotion and DHEA levels over a one-month period. In addition, we hypothesized that increased coherence in heart rate variability patterns would be observed during the practice of the techniques. Forty-five healthy adults participated in the study, fifteen of whom acted as a comparison group for the psychological measures. Salivary DHEA/DHEAS and cortisol levels were measured, autonomic nervous system function was assessed by heart rate variability analysis, and emotions were measured using a psychological questionnaire. Individuals in the experimental group were assessed before and four weeks after receiving training in the self-management techniques.

The experimental group experienced significant increases in the positive affect scales of Caring and Vigor and significant decreases in the negative affect scales of Guilt, Hostility, Burnout, Anxiety and Stress Effects, while

no significant changes were seen in the comparison group. There was a mean 23 percent reduction in cortisol and a 100 percent increases in DHEA/DHEAS in the experimental group. DHEA was significantly and positively related to the affective state Warmheartedness, whereas cortisol was significantly and positively related to Stress Effects. Increased coherence in heart rate variability patterns was measured in 80 percent of the experimental group during the use of the techniques.

The results suggest that techniques designed to eliminate negative thought loops can have important positive effects on stress, emotions and key physiological systems. The implications are that relatively inexpensive interventions may dramatically and positively impact individuals' health and well-being. Thus, individuals may have greater control over their minds, bodies and health than previously suspected.

Impact of a Workplace Stress Reduction Program on Blood Pressure and Emotional Health in Hypertensive Employees

R. McCraty, M. Atkinson, D. Tomasino

Journal of Alternative and Complementary Medicine 2003;9(3):355-369.

Influence of Cardiac Afferent Input on Heart-Brain Synchronization and Cognitive Performance

R. McCraty

International Journal of Psychophysiology 2002;45(1-2):72-73.

An Inner Quality Approach to Reducing Stress and Improving Physical and Emotional Wellbeing at Work

B. Barrios-Choplin, R. McCraty, B. Cryer

Stress Medicine 1997;13(13):193-201.

This exploratory field study examined the impact of an Inner Quality Management program (IQM) on a group of Motorola employees. IQM is a training program designed to help people increase productivity through improved health, communication, goal clarity, positive mood and job satisfaction, and through the reduction of tension, burnout, physical symptoms of stress and negative mood. Both psychological and physiological measures were assessed in the 6-month study. The study involved three groups: managers, engineers and factory workers. Results showed that contentment, job satisfaction and communication significantly increased after the training, while tension, anxiety, nervousness and physical symptoms of stress significantly decreased. Blood pressure in hypertensive individuals decreased, and there was reduction in sympathetic nervous activity. Implications for workplace wellbeing are discussed.

Pilot study of a group stress management training on elderly patients with congestive heart failure.

Luskin, F., Reitz, M. and Newell, K. *Journal of Cardiopulmonary Rehabilitation*. 2000; 20(5):303.

A study conducted by the Stanford Center for Research in Disease Prevention, using the HeartMath techniques with elderly congestive heart failure patients. Treatment group participants learned Freeze-Frame and the Heart Lock-In as the core techniques in an 8-week psychosocial intervention program. Participants were asked to do a 15-minute Heart Lock-In twice daily and to use Freeze-Frame as needed for the duration of the study. The patients were extremely receptive to the techniques, which resulted in excellent compliance.

As compared to a control group that did not attend the program, the treatment group showed a significant reduction in perceived stress and depression, significant gains in mental health and vitality, and a significant improvement in functional capacity as measured by performance on a six-minute walk. (Congestive heart failure patients are typically characterized by severely limited physical activity and exercise intolerance).

Results suggest that by using the HeartMath tools, patients were able to improve both their psychological health and physical status in a relatively brief period of time. The results of this study were also presented at the Association for Cardiovascular and Pulmonary Rehabilitation Annual Conference 2000.

The Physiological and Psychological Effects of Compassion and Anger

G. Rein, R. McCraty, M. Atkinson.

Journal of Advancement in Medicine 1995;8(2):87-105.

Salivary IgA, heart rate and mood were measured in thirty individuals before and after experiencing care or anger. Two methods of inducing the emotional states were compared: self-induction and external induction via video tapes. Anger produced a significant increase in total mood disturbance and heart rate, but not in S-IgA levels. Positive emotions, on the other hand, produced a significant increase in S-IgA levels. Examining the effects over a six hour period we observed that anger, in contrast to care, produced a significant inhibition of S-

IgA from one to five hours after the emotional experience. Results indicate that self-induction of positive emotional states is more effective at stimulating S-IgA levels than previously used external methods. Self-induction techniques may therefore be useful in minimizing the immunosuppressive effects of negative emotions.

24 Hour Time Domain Heart Rate Variability and Heart Rate: Relationships to Age and Gender over Nine Decades

K. Umetani, D. H. Singer, R. McCraty, M. Atkinson

Journal of the American College of Cardiology 1998;31(3):593-601.

Objectives. This study sought to define the effects of age and gender effects on the normal range of time domain heart rate variability (HRV) over nine decades in healthy subjects.

Background. Low HRV is considered an independent marker of mortality risk. However, the age-related decline in HRV may limit its predictive value, particularly in the elderly. Delineation of the range of HRV in healthy subjects over the life span is needed. Gender-related differences in HRV also need clarification.

Methods. We determined, according to decade, 24-h heart rate (HR) and HRV of 260 healthy subjects (10 to 99 years old; 112 male, 148 female) by means of five standard time domain measures: standard deviation of all normal sinus RR intervals over 24 h (SDNN), standard deviation of the averaged normal sinus RR intervals for all 5-min segments (SDANN), means of the standard deviations of all normal sinus RR intervals for all 5-min segments (SDNN index), root-mean-square of successive normal sinus RR interval difference (rMSSD) and the percentage of successive normal sinus RR intervals >50 ms (pNN50).

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Conclusions. 1) Using all measures, HRV of healthy subjects declines with aging, with measure-dependent patterns. 2) Using the SDNN index, rMSSD and pNN50, HRV of healthy subjects, particularly those >65 years old, may decrease to below levels associated with increased risk of mortality. 3) Gender influences HRV. Gender differences in HRV are age and measure dependent. 4) Age and gender also affect heart rate.

Institute of HeartMath Conference Papers

The Autonomic Assessment Report: A New Noninvasive Measure of Autonomic Function and Balance

R. McCraty

In: *Proceedings of the Fifteenth Annual International Symposium on Man and His Environment in Health and Disease*, Dallas TX, 1997.

The HeartMath Research Center, based at the Institute of HeartMath (IHM) in Boulder Creek, CA, has developed a sophisticated tool for quantifying autonomic function called the Autonomic Assessment Report (AAR). The aims of the AAR are: (1) to provide physicians with a new, powerful, noninvasive test which quantifies autonomic function and balance and aids in risk stratification; (2) to offer researchers a test that can validate the effects of their interventions on autonomic function, and (3) to generate data that will allow the autonomic profiles in a number of pathological conditions to be more fully characterized. The AAR is derived from 24-hour ambulatory ECG (Holter) recordings, and is based on analysis of heart rate variability (HRV), which provides a unique window into the interactions of sympathetic and parasympathetic control of the heart. The report includes time domain, frequency domain and circadian rhythm analysis, which together constitute a comprehensive analysis of autonomic activity, balance and rhythms. Time domain measures include the mean normal-to-normal (NN) intervals during a 24-hour recording and statistical measures of the variance between NN intervals. Power spectral density analysis is used to assess how power is distributed as a function of frequency, providing a means to quantify autonomic balance at any given point in the 24-hour period, as well as to chart the circadian rhythms of the different branches of the autonomic nervous system.

Autonomic imbalances have been implicated in a wide variety of pathologies, including depression, fatigue, premenstrual syndrome, hypertension, diabetes mellitus, ischemic heart disease, coronary heart disease and environmental sensitivity. Stress and emotional states have been shown to dramatically affect autonomic function. Self-management techniques, which enable individuals to gain greater control of their mental and emotional stress and improve their sympathovagal balance, can significantly impact a wide variety of disorders in which autonomic imbalance plays a role. Clinical examples of HRV measures from patients with various symptoms are presented. Several examples of patients who were able to significantly improve their autonomic balance, symptomatology and psychological well-being through training and practice in emotional management interventions are discussed.

The Effects of Different Emotional States and a New Stress Management Intervention on Autonomic Regulation of the Heart

R. McCraty

In: *Cardiovascular Health: Coming Together for the 21st Century, Proceedings*, San Francisco CA, 1998.

An Effective Stress Prevention Training: Research From Four Diverse Organisations

D. Rozman, R. McCraty, B. Barrios-Choplin

In: *Proceedings of the Ninth International Montreux Congress on Stress*, Montreux, Switzerland, 1997.

This presentation summarizes the results of four studies on stress prevention training in four diverse organisations. In each case, participating employees attended an Inner Quality Management (IQM) seminar which includes the stress prevention technique "Freeze-Frame." This technique allows individuals to alter their interpretation of potentially stressful events by evoking a sincere feeling of appreciation, then reassessing the events from a more positive perspective. This technique is predicted to reduce tension, anger, burnout and physical symptoms of stress, while increasing positive feelings and perceptions and productive responses. The entire IQM seminar also includes modules on empathic communication, intuitive thinking and holistic goal setting. Therefore, the prediction is for improvements in communication, mental focus, goal clarity and ultimately job satisfaction and productivity.

The first study was conducted in a Fortune 100 consumer electronics firm. Nine managers, nine engineers and 30 factory workers completed a survey, attended the IQM seminar, practiced the techniques for several months, then completed the survey again.

The various groups reported significant reductions in nervousness, tension, anxiety and physical symptoms of stress. Conversely, there were significant increases in contentment, communication, and job satisfaction. This study also measured blood pressure and Heart Rate Variability (HRV) in a sub-sample. There were significant decreases in high blood pressure, as well as improved HRV.

The second study involved a Canadian human resource development consulting firm. In addition to the IQM seminar, this firm had a sub-set of its employees attend a five day seminar to become certified as Freeze-Frame trainers. Fifty-seven employees completed a survey prior to the IQM training, and 31 completed the same survey one year later. There was a significant reduction in tension from time one to time two. Also, the sub-set that had attended the certification training had lower levels of burnout than those who didn't attend. Finally, the more frequently the employees practiced Freeze-Frame, the less frequently they reported feeling angry.

The third study was conducted internally by Canada's second largest bank. The bank had five employees trained to be certified in the Freeze-Frame technique. These trainers subsequently delivered the Freeze-Frame portion of the IQM seminar to 1200 employees. They then surveyed all 1200 employees at several intervals of practice. Seventy-one percent of those surveyed reported ongoing use of the Freeze-Frame technique. Of these, 86% use it at work and 55% use it at home. Of the users, 73% reported their behaviour has changed for the better as a result of using the technique, and 82% stated that it has improved their overall health and well being.

The fourth study involved a unit of a California State government agency. One hundred and thirty-four participants completed surveys prior to the IQM seminar. Six weeks after the seminar 115 participants completed the same survey. There were significant decreases in anger, anxiety, burnout, tension, and physical symptoms of stress. There was also a significant increase in peacefulness. Regression analysis revealed a significant relationship between use of the Freeze-Frame and other IQM techniques and reductions in anxiety, burnout, and physical symptoms of stress.

Taken together, these studies offer a compelling argument for the efficacy of techniques which prevent stress by altering interpretive styles. In the case of Freeze-Frame and IQM, the results go beyond stress symptoms and tension to important physiological changes in blood pressure and HRV. Additionally, emotions and reactions were better managed through using these techniques. Finally, workplace outcomes such as job satisfaction and communication improved, which should eventually affect productivity.

The results discussed were achieved at a relatively low cost, and could save organisations significant expenditures on stress-related inefficiencies and health care costs. Additionally, the techniques are portable and available to individuals in the midst of activity, at the moment they are most needed, unlike most coping behaviours such as exercise, meditation, rest or vacations. The most encouraging implication of these studies is that individuals may have more control over their emotions and perceptions, stress

The Electricity of Touch: Detection and Measurement of Cardiac Energy Exchange Between People

R. McCraty, M. Atkinson, D. Tomasino, W.A. Tiller

In: K. H. Pribram, ed. *Brain and Values: Is a Biological Science of Values Possible. Proceedings of the Fifth Appalachian Conference on Behavioural Neurodynamics*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers, 1998 359-379.

The Freeze-Framer: A Stress Management Training and Heart Rhythm Education System for Increasing Physiological Coherence

R. McCraty

In: *Proceedings of the Tenth International Montreux Congress on Stress*, Montreux, Switzerland, 1999.

This presentation will cover the background, purpose and uses of a new approach to stress management training that has broad-based applications in schools, blood pressure control and other health-related areas, sports performance and workplace stress reduction. It is a computer-based training and heart rhythm education system that teaches the stress and emotional self-management techniques Freeze-Frame and Heart Lock-In, which are particularly effective in increasing heart rhythm coherence and improving autonomic balance.

The Freeze-Framer can also be used to monitor the effects of techniques such as meditation, controlled breathing and other interventions believed to affect autonomic nervous system activity. The Freeze-Framer is a convenient and accurate device that monitors and displays your heart rate variability in real time as you practice the stress management techniques taught in the on-line menus and books included with the system. It plots the speeding and slowing of your heart rate on a beat-to-beat basis and analyzes the heart rhythm patterns for coherence. Coherence reflects autonomic nervous system balance and entrainment of the body's inner systems. The output of the entrainment algorithm is used to control three fun games that are designed to reinforce emotional self-management skills.

A small finger sensor detects each pulse and the time interval between consecutive heartbeats is computed. The changing beat-to-beat heart rate is then displayed on the computer screen. In general, a smoother or more sine-wave-like heart rate variability pattern indicates a more balanced autonomic nervous system and a higher

ratio of physiological entrainment. The ratio of entrainment is calculated and fed back to the user as an accumulated score or success in playing one of three games. The three on-screen games are: 1. The hot air balloon game, in which the degree of heart rhythm coherence controls how high the balloon flies. There are obstacles that must be cleared as you travel through a moving landscape. When the heart rhythm coherence is too low, the balloon returns to the ground and stops the landscape from moving. 2. The rainbow game, in which the heart rhythm coherence controls the development of a rainbow that gradually grows until it reaches a pot of gold, which starts to fill and then overflow with gold coins! At the end of this game a score is calculated telling you how much you have accumulated. 3. The meadow game, in which a dry, black-and-white nature scene gradually transforms into a beautiful landscape filled with color, running water and gentle animals. Several examples of the how the Freeze-Framer has been used in research studies in diverse settings to facilitate the practice of stress management techniques will be discussed.

Functional Magnetic Resonance Imaging and Spectroscopy of Brain Activation During Heart Rhythm Coherence (Abstract)

T. Richards, R. McCraty, M. Atkinson

In: *Toward a Science of Consciousness Conference Proceedings*, Neuroscience section, Abstract #111, Tucson, AZ, 2002.

Head-Heart Entrainment: A Preliminary Survey

R. McCraty, W. A. Tiller, M. Atkinson

Paper presented at the Key West *Brain-Mind, Applied Neurophysiology, EEG Biofeedback 4th Annual Advanced Colloquium*, Key West, FL, 1996.

This preliminary survey deals with experimental observations on the degree of entrainment exhibited between heart rate variability (HRV), respiration and electroencephalograph (EEG) recordings for 5 subjects, trained in the use of a particular inner self-management technique, as they change their mode of heart function through various states of order. As the heart approaches its first major ordered mode of functioning (entrainment), both the sympathetic and parasympathetic branches of the autonomic nervous system shift their power into the mid frequency range (~ 0.1 Hz) in the HRV power spectrum which is associated with the baroreceptor feedback loop between the heart and brain. One then sees frequency pulling of the respiratory system towards this mid frequency range, until frequency-locking of the HRV waveform and respiration rate occurs. Thereafter, the signal amplitude in the ~0.1 Hz range of the brainwaves begins to increase significantly. Strong cross-correlation functions are found to exist between these pairs of biological oscillators. However, the brain wave signals from different areas of the brain don't all frequency-lock with the baroreceptor signal. The auxiliary data indicates that there is much hidden complexity yet to be elucidated. Evoked potential data reinforces some of the major findings.

Heart rate variability, hemoglobin A1c, and psychological health in Type 1 and 2 diabetes following an emotional self-management program.

McCraty R, Atkinson M, Conforti K.

Proceedings of the Society of Behavioural Medicine 20th Annual Scientific Sessions, San Diego, California, 1999

Heart Rhythm Coherence Feedback: A New Tool for Stress, Rehabilitation, and Performance Enhancement

R. McCraty, D. Tomasino

In: *Proceedings of the First Baltic Forum on Neuronal Regulation and Biofeedback*, Riga, Latvia, November 2-5, 2004.

Music and the Immune System

R. McCraty

In: *Proceedings of the Tenth International Montreux Congress on Stress*, Montreux, Switzerland, 1999.

Psychophysiological Coherence: A Link between Positive Emotions, Stress Reduction, Performance and Health

R. McCraty

Proceedings of the Eleventh International Congress on Stress, Mauna Lani Bay, HI, 2000.

Paper also presented at the *American Psychological Association 109th Annual Convention*, Symposium on Gratitude and Positive Emotionality as Links Between Social and Clinical Science, San Francisco, CA, Aug. 2001.

Psychophysiological Coherence: A Proposed Link Among Appreciation, Cognitive Performance, and Health
R. McCraty

In: *Proceedings of the Eleventh International Congress on Stress*, Mauna Lani Bay, HI, 2000.

While much psychological theory and practice has focused on improving health and well being by eradicating negative emotions, relatively little research has explored the impact of positive emotions on physical and psychological functioning. We have found that sustained positive affective states lead to a clear and definable mode of physiological function that appears to facilitate the body's natural regenerative processes. This mode, which we call *physiological coherence*, is associated with a sine wave-like pattern in the heart rhythms, increased heart/brain synchronization and entrainment between diverse physiological systems. Although physiological coherence is a natural human state which can occur spontaneously during positive emotional experiences and sleep, sustained episodes are generally rare. While specific rhythmic breathing methods may induce coherence and entrainment for brief periods, our research indicates that the active generation and maintenance of a positive emotion can produce extended periods of physiological coherence. Using positive emotion to drive the coherent mode allows it to emerge naturally, most likely as a result of changes in the patterns of afferent information flowing from the heart to the respiratory and other brain centers. This makes it easier to sustain the positive emotional state and coherent mode for longer periods, even during work and other activities. When the physiological coherence mode is driven by a positive psychological state, we call it *psychophysiological coherence*.

The capacity to self-generate positive emotional states and quickly shift to a physiologically coherent mode at will can be developed and refined through the use of practical tools and techniques developed by the Institute of HeartMath, such as Freeze-Frame, Heart Lock-In and Cut-Thru. This shift allows people to arrest the physiological stress response and prevent the psychological wear and tear normally associated with various stressors. Studies conducted across diverse populations have associated the use of these techniques with a wide range of beneficial health, performance and quality of life-related outcomes. Observed benefits include: reduced psychological stress and negative affect; decreased anxiety and depression; increased positive affect; improved psychosocial functioning; enhanced cognitive performance; increased emotional intelligence; reduced tension and physical stress symptoms; decreased burnout and fatigue; enhanced physical vitality; increased humoral immunity; reduced cortisol and increased DHEA.

Favorable outcomes associated with the psychophysiological coherence mode have been demonstrated not only in the laboratory but also in numerous organisational and educational settings. Additionally, practice of these techniques has been associated with health improvements in a wide variety of clinical conditions. Several examples include: reduced trait anxiety and pathological symptoms in individuals with HIV; reduced depression and improved functional capacity in elderly patients with congestive heart failure; the restoration of normal blood pressure levels in hypertensive individuals and improved glycemic control and quality of life in patients with diabetes.

The presentation will describe the coherent mode and methods by which physiological coherence can be objectively quantified. In addition, summary results from outcome studies will be presented. In conclusion, psychophysiological coherence is an internal mode of function that has far-reaching implications for human health and effectiveness. Physiological correlates of this mode can be objectively measured using straightforward methods. Practical tools and techniques exist by which individuals of diverse ages and backgrounds can learn to self-orchestrate coherence with increased consistency, thereby reducing stress and enhancing health, emotional stability, performance and quality of life.

The Role of Physiological Coherence in the Detection and Measurement of Cardiac Energy Exchange Between People

R. McCraty, M. Atkinson, W. Tiller

In: *Proceedings of the Tenth International Montreux Congress on Stress*, Montreux, Switzerland, 1999.

Institute of HeartMath Research Publications

The Appreciative Heart. The Psychophysiology of Positive Emotions and Optimal Functioning (e-Book)

R. McCraty, D. Childre, HeartMath Research Center, IHM, Boulder Creek, CA, 2003.

Autonomic Assessment Report. A Comprehensive Heart Rate Variability Analysis–Interpretation Guide and Instructions. HeartMath Research Center, IHM, 2002

Intended primarily for researchers and health care professionals, this guidebook provides an introduction to the use of 24-hour heart rate variability (HRV) analysis in the assessment of the autonomic nervous system. HRV analysis provides a unique window into the dynamics of sympathetic and parasympathetic control of the heart, is useful for assessing autonomic involvement in a number of pathologies, and is also used to enhance health risk stratification. This guidebook was originally written for physicians and researchers who utilize the IHM Research Center's 24-hour Autonomic Assessment Report (AAR) in clinical research and assessment. The guidebook includes clear and detailed descriptions of both time domain and frequency domain measures of HRV and explains how these measures are interpreted in clinical applications to provide a comprehensive, quantitative analysis of autonomic activity and balance. The use of circadian rhythm analysis in the assessment of autonomic function is also discussed. Additional topics covered include the effects of stress, emotions, and emotional management interventions on autonomic function and balance; alterations in autonomic function in various clinical disorders; aging and HRV; and Holter recorder hook-up procedures. Numerous clinical examples, including charts and segments of actual HRV recordings, are provided throughout the booklet to illustrate the concepts discussed.

CalPERS Information Technology Services Division. Inner Quality Management Intervention Report.

R. McCraty, M. Atkinson, J. Sundram

Prepared for the California Public Employees retirement System 1996.

The Effect of Employee Self-Management Training on Personal and Organisational Quality

B. Barrios-Choplin, R. McCraty, J. Sundram, M. Atkinson

HeartMath Research Center, IHM, Publication No. 99-083. Boulder Creek, CA, 1999.

The Energetic Heart: Bioelectromagnetic Interactions Within and Between People (e-Book)

R. McCraty

Even when we're not consciously communicating with others, our physiological systems interact in subtle and surprising ways. Did you know that the electromagnetic signal produced by your heart is registered in the brain waves of people around you? Or that your physio...

Heart–Brain Neurodynamics. The Making of Emotions. (e-Book)

R. McCraty

HeartMath Research Center, IHM, 2002

As pervasive as they are in human experience, emotions have long remained an enigma to science. This comprehensive monograph explores recent scientific advances that clarify central controversies in the study of emotion, including the relationship between intellect and emotion.

Impact of the HeartMath Self-Management Skills Program on Physiological and Psychological Stress in Police Officers

R. McCraty, D. Tomasino, M. Atkinson, J. Sundram

HeartMath Research Center, IHM, Publication No. 99-075. Boulder Creek CA, 1999.

Impact of the Power to Change Performance Program on Stress and Health Risks in Correctional Officers

R. McCraty, M. Atkinson, L. Lipsenthal, L. Arguelles

HeartMath Research Center, IHM, Report No. 03-014. Boulder Creek CA, November 2003.

Emotional Self-Regulation Program Enhances Psychological Health and Quality of Life in Patients with Diabetes

R. McCraty, M. Atkinson, L. Lipsenthal

HeartMath Research Center, IHM, Publication No. 00-006. Boulder Creek, CA, 2000.

Neurocardiology. Anatomical and Functional Principles (e-Book)

J. Andrew Armour (University of Montreal)

HeartMath Research Center, IHM, Report No. 03-011. Boulder Creek CA, 2003.

This 19-page monograph is authored by pioneer neurocardiology researcher Dr. J. Andrew Armour of the University of Montreal, who first introduced the concept of a functional heart 'brain' in 1991. Here Dr. Armour describes the anatomical organisation and function of the cardiac nervous system, which is comprised of a complex hierarchy of nested feedback control loops organized in three regulatory levels. He details the interactions that occur among multiple populations of neurons to maintain cardiovascular stability and maximize cardiac efficiency, and also considers the role of the cardiac nervous system in various forms of heart disease. Armour discusses intriguing data documenting the complex neuronal processing and memory capabilities of the intrinsic cardiac nervous system, indicating that the heart brain can process information and make decisions about its control independent of the central nervous system. By providing an understanding of the elaborate anatomy and physiology of the cardiac nervous system, this monograph contributes to the newly emerging view of the heart as a complex, self-organised system that maintains a continuous two-way dialogue with the brain and the rest of the body. **Note:** *This is a technical monograph written primarily for medical professionals, students, and researchers with a background in neuroanatomy and neurophysiology*

Science of the Heart

This detailed book takes you behind the intricate and compelling science of the HeartMath system. It is a compilation of ten years of innovative research at the Institute of HeartMath, presenting some of the scientific discoveries that have shaped the development of the tools and techniques that comprise the HeartMath system. Charts, diagrams and full explanations are presented in a form that is both easy for the layman and complete for the science professional and researcher alike. Includes abstracts and summaries of clinical and organisational research.

Institute of HeartMath Educational Research

The Heart in Holistic Education

L. Arguelles, R. McCraty, R. A. Rees

Encounter: Education for Meaning and Social Justice 2003;16(3):13-21

The Impact of an Emotional Self-Management Skills Course on Psychosocial Functioning and Autonomic Recovery to Stress in Middle School Children

R. McCraty, M. Atkinson, D. Tomasino, J. Goelitz, H. N. Mayrovitz

Integrative Physiological and Behavioural Science 1999;34(4):246-268.

The Scientific Role of the Heart in Learning and Performance

R. McCraty

HeartMath Research Center, *IHM Publication* No. 02-030. Boulder Creek, CA, 2002.

HeartMath in Education. In *Science of the Heart.*

HeartMath Research Center, 2001

Selected Case studies:

Creighton Elementary School District Summer Academy, Phoenix, Arizona

HeartMath Tools Improve Reading Proficiency in Elementary School Special Education Students

Independent investigation conducted by Edie Fritz, EdD

Key findings: Fourteen days of instruction in the HeartMath techniques allowed a special education class of fifth and sixth graders to significantly improve their reading proficiency.

Dekalb County School System, Georgia

Improving Resiliency and Performance in Educational Administrators

Independent study commissioned by Eugene Walker, PhD.

Key findings: A group of educational administrators trained in the HeartMath techniques found them to be of significant value applied to challenges in the field of education.

Discovery Project

Portsmouth Schools - Benefits of Peak Performance Presentation and Coaching

Evidence in all three schools has reported:

Motivation of students/children to use the techniques

Better atmosphere within the classes

Improved behaviour of those using the techniques noted by staff

Less obvious stress observed during the exam period

The Discovery Project has been granted additional funding to buy equipment to support coaching in the community to mothers and to the unemployed in the area.

See <http://www.hunterkane.com/case-studies/Discovery.pdf>

Improving Test-Taking Skills and Academic Performance in High School Students Using HeartMath Learning Enhancement Tools Case Study: Minneapolis Public School District, Minnesota.

R. McCraty, D. Tomasino, M. Atkinson, P. Aasen, S. J. Thurik Collaborative study.

HeartMath Research Center, *IHM Publication* No. 00-010. Boulder Creek, CA, 2000.

Because of the success of this pilot study, district curriculum specialists have implemented training in the HeartMath interventions for Reading and Math teachers throughout the district, in efforts to provide a greater number of students with access to the techniques. The school district has also acquired over 30 learning program Freeze-Framers instruments for classroom use, and plans to initiate a study with a larger student group to determine district-wide effects of HeartMath programs on test-taking performance.

Palm Springs Middle School, Dade County, Florida

This school has been using the Heart Smarts® training program for 8 years with groups of middle school students, elementary students, and parents. Initially, 35 gifted students, 10 at risk, and 20 ELL students (English Language Learners) participated in a 16-hour training. Many of these students took the Achievement Inventory Measurement (AIM) to measure pre- and post-results. Dramatic gains in areas such as locus of

control, peer empathy, work motivation, and parent compliance, as well as a decrease in the influence of at-risk behaviours, led to a cross-age HeartMath mentoring program with 17 middle school students tutoring 55 second and third graders at nearby DuPois Elementary School. A six-month follow-up assessment was given to the 17 middle school mentors to determine long term improvements and, again, the results were very encouraging with gains in all 19 scales of the AIM assessment. The third phase began in the following fall with two full-year elective courses (called Heart Smarts) involving 62 middle school students. The next spring, these 62 students began "cross-age mentoring" to approximately 150 elementary students from three nearby "feeder" schools. Parents were required to participate in the training process as well. This led to a controlled research study of the program conducted by Miami Heart Research Institute to determine adolescent resiliency in the face of stress. Results were published in *Integrative Physiological and Behavioural Science* in 1999. The HeartSmarts program now extends to three full time elective classes.

Plessington Catholic High School Technical College

Applying The Peak Performance Programme incorporating IHM methodology.

The Peak Performance programme is based on the IHM scientific research and has been shown to impact a wide variety of health and business performance indicators.

Training as well as pre/post surveys were carried out with 30 students and 30 teaching staff. Results clearly show significant improvements in all indicators.

See <http://www.hunterkane.com/case-studies/PlessingtonHighSchool.htm>

Staten Island (New York) School District, New York

In April, 2002, training was provided for twenty-five counselors who work with elementary, middle and high school students suffering from the psychological effects of the terrorist attack on the World Trade Center. The training introduced the counselors to the HeartMath tools and techniques for emotional management, stress reduction, and resilience. Counselors were also trained in how to use the Freeze-Framer to strengthen students' ability to balance their emotions in stressful situations.

Washington D.C. Public Schools

In 2000, the HeartSmarts program was introduced to two elementary schools and two middle schools as part of a court-mandated behaviour management program. The goal was to help students gain greater self-control and to improve the overall classroom learning environment. With district approval, the program was expanded to include approximately 60 additional teachers. The program is still being implemented in classrooms three years later.

Current Education Projects (a selection):

TestEdge National Demonstration Project

The US federal government has awarded HeartMath funds for a national demonstration project on the benefits of the *TestEdge* program. Schools have been selected as *TestEdge* demonstration sites in nine Congressional districts located in California, Delaware, Florida, Maryland, Ohio, Pennsylvania, Texas, and Wisconsin. Selected schools include elementary, middle, and high schools; "high performing" and "low performing" schools; and urban, suburban, and small city schools. The program includes use of the Freeze-Framer® Interactive Learning System which allows kids to view changes in their heart rhythms, which generally become more ordered when they use the HeartMath techniques taught in *TestEdge*.

The demonstration study will provide an opportunity to conduct a truly scientific examination of the effectiveness of the program in a variety of school environments. The primary objective of the study is to investigate the effectiveness of the *TestEdge* curriculum in reducing test anxiety and increasing students' test performance in grades 3 to 12. More broadly, the study will also investigate other qualitative indicators of improvements in student emotional stability and behaviours in classroom dynamics. A secondary objective is to investigate the programmatic aspects of implementing *TestEdge* in school systems with diverse characteristics and student populations. The investigators are Dr. Rollin McCraty, Director of the HeartMath Research Center, Mike Atkinson, Laboratory Manager for the Research Center, and Dr. Raymond T. Bradley, Director of the Institute for Whole Social Science.

Clemson University, Clemson, South Carolina

The Institute of HeartMath and South Carolina's Clemson University have recently entered into a major collaborative relationship. Clemson hopes to integrate HeartMath through its Youth Learning Institute, one of the premiere experiential learning programs in the country, and include HeartMath tools and technology in its youth development, juvenile justice and education programs. In addition to workshops for youth development professionals, immediate plans include a three-day, academic experience and a week-long summer camp, called *The Edge*, beginning summer 2005. Founded in 1889, Clemson was named one of America's top universities by *U.S. News and World Report* this year, and was recognized by *TIME* magazine as *Public College of the Year*.

Claremont Graduate University, Claremont, California

Claremont Graduate University's School of Educational Studies, in collaboration with the Institute of HeartMath, has created a graduate course called "The Heart in Education." This course--which focuses on the role of the heart in world cultures, the science of the heart, and the application of HeartMath technologies in urban school settings--marks the beginning of the institutionalization of teaching and learning about the heart in schools of education in general and teacher education in particular. Funding for lectures by IHM's Jeff Goelitz and Rollin McCraty, and for Raymond T. Bradley of the Institute for Whole Social Science is provided by a grant from the Pitzer in Ontario Program.

The students in the course are teacher interns as well as practicing teachers and administrators pursuing their doctoral degrees. As part of their graduate educational practice, these students are applying the HeartMath tools and technology in their own classes.

Holyoke Public Schools, Holyoke, Massachusetts

Three hundred high school students received a *TestEdge* training in spring 2003 in preparation for the MCAS graduate exit exam. John Keppel of Stoughton High School delivered a training for teachers, and the district outfitted a lab with Freeze-Framer software for 70 students. The high school is continuing an ongoing TestEdge after-school program for their high school students in 2004.

Kentucky

A school district in Kentucky is using TestEdge™ to prepare 8,000 students for mandated state exit and college prep exams.

Pitzer College, Claremont, CA, Freshman Retention Program

In fall 2004, HeartMath will introduce a program at Pitzer College (part of the Claremont Colleges) to increase the retention of first-year students. The program, which will be integrated into a select number of classes in the Freshman Seminar, will include HeartMath stress reduction and emotion-refocusing techniques, use HeartMath concepts in examining issues related to social justice, and will encourage students to apply HeartMath tools and technology within the college environment.

University of Cincinnati at Clermont, Ohio, Math Anxiety Project

In June, 2002, the University of Cincinnati and IHM conducted a research study with high school juniors needing to pass the COMPASS entrance exam for math. Sponsored by the regional Tech Prep, an association of vocational high schools, the study sought to help struggling math students overcome math anxiety, thereby enhancing their performance. Poor performance on the entrance exams delays eligibility for required academic courses, which are an essential part of each student's career track. Initial results showed substantial gains among a small group of students, leading to an expansion of the initiative. The following fall, Dr. Michael Vislocky and Dr. Ron Leslie taught an Algebra/Math Anxiety course to 24 University of Cincinnati students. In 2004, the program will be taught to incoming freshmen students as part of a larger orientation program.

University of Louisiana at Lafayette School of Education, Lafayette, LA

The School of Education received "Gear Up" funding to help socio-economically disadvantaged students from grades 8 through college receive a better education and stay in school. HeartMath trained 50 educator/administrators in TestEdge and is beginning a research study in 2004 with about 150 students to see how the TestEdge program reduces test anxiety and increases academic performance.

Institute of HeartMath General Books & Publications

From Chaos to Coherence: The Power to Change Performance

by D. Childre and B. Cryer. Planetary, HeartMath LLC, 2000

From Chaos to Coherence Multimedia Learning Program CD Rom

The From Chaos to Coherence multimedia learning program introduces Inner Quality Management (IQM) ®, an internationally recognised training program designed to help individuals and organisations become more coherent, productive and successful by combining intellectual, intuitive and emotional intelligence.

The HeartMath Solution

by D. Childre and H. Martin. Harper Collins, 1999.

Contains leading-edge science, practical information and easy-to-use techniques to increase the intuitive, creative, heart-centered aspects of your personality and bring more intelligence into your life.

Overcoming Emotional Chaos: Eliminate anxiety, lift depression and create security in your life

by D. Childre and D. Rozman. Ph.D. Jodere Group, 2002.

This book covers the range of emotional chaos that can and does affect our families, our friends, co-workers, our neighbors and us.

A Practitioners Guide, Applications of Using the Freeze-Framer® Interactive Learning System

An in-depth practitioners guide by Dr. Timothy Culbert with Rollin McCraty, Ph.D. and Howard Martin. This 24-page guide offers new tools for stress reduction and emotional management.

The Inside Story; Understanding the Power of Feelings

(for Health Education, Psychology Classes and Counseling)

The Inside Story is full of vital information tied to the healthy behaviour and physiological and psychological well-being of high school and college students. Drawing on the latest research in neuroscience and emotional physiology.

Transforming Anger: The HeartMath Solution for Letting Go of Rage, Frustration and Irritation.

by D. Childre and D. Rozman, Ph.D. New Harbinger Publications 2003

If you are dealing with anger you can't quite seem to manage, this book can provide hope, and practical tools to successfully handle this emotion.

Transforming Stress: The HeartMath Solution For Relieving Worry, Fatigue, And Tension

by D. Childre and D. Rozman, Ph.D. New Harbinger Publications 2005 ISBN: 157224397X

This book offers scientifically-proven techniques that alter the body's physical response to stress, and shows readers how to attain a peaceful, positive state of being.

IHM Monograph Contributions

The Energetic Heart: Bioelectromagnetic Communication Within and Between People

R. McCraty

Chapter published in: Clinical Applications of Bioelectromagnetic Medicine, edited by P. J. Rosch and M. S. Markov. New York: Marcel Dekker, 2004: 541-562.

The Grateful Heart: The Psychophysiology of Appreciation

R. McCraty, D. Childre

Chapter published in: The Psychology of Gratitude, edited by R. A. Emmons and M. E. McCullough. New York: Oxford University Press, 2004: 230-255.

Institute of HeartMath Organisational Research and Case Studies

The results of the Institute of HeartMath applied programs are recognised internationally through a series of research-validated case studies. Extracts appear below. The organisational interventions below have been provided by the for-profit partner organisations in the USA, UK and Australia.

US Case Studies

Scientific Validation. Practical Application in the Workplace.

Numerous research studies have demonstrated that business performance, is critically dependent upon individuals' abilities to manage themselves, their behaviour and their relationships with others successfully. The HeartMath Inner Quality Management (IQM) programs show dramatic, sustained and quantifiable improvements in leadership health and performance, sales, customer satisfaction, employee satisfaction and engagement. **A sampling of the business case studies are listed below.**

Leadership Group – Fortune 50 High Tech

This high performing geographically diverse leadership team needed communication tools to help them strengthen teamwork and form more effective working relationships.

http://www.heartmath.com/corporate/case_study_cisco.html

Boeing 767 Leadership Productivity

Senior managers and senior engineers from the Boeing Commercial Airplane Group were brought together to develop the 767-400 ERX, with a tight deadline and operating budget. With assistance from new consulting solutions they came in on time and under budget.

http://www.heartmath.com/corporate/case_study_boeing.html

Bay Area Rapid Transit – Leadership Team

After September 11, this metro rapid transit organisation was faced with heightened pressure and financial concerns. Read how BART equipped their leaders with the tools to deal with more complex and amplified concerns.

http://www.heartmath.com/corporate/case_study_bart.html

Sales Case Study--IT services firm

The downturn in the economy, particularly in the technology sector, hit many firms hard. See how one program assists in a new way.

http://www.heartmath.com/corporate/case_study_sales.html

Customer Service Case Study--Fortune 50 technology company

Call centers are some of the most stressful workplaces, plagued by high turnover, low skills, tough working conditions, and challenging processes. One company decided their front-line people needed extra attention, both to help them reduce stress on the job, and to help the company retain their best customers.

http://www.heartmath.com/corporate/case_study_roi.html

Executive Health Case Study

Cost savings in protecting executive health can be substantial. Hypertension is just one of many risk factors faced by top executives, affecting their health, performance, and value to the firm.

http://www.heartmath.com/corporate/case_study_blood_pressure.html

Health Care Organisation Case Study

A Midwest Hospital was at a turning point in its history, with challenges in staff retention, patient satisfaction and employee satisfaction. Read how they energized their culture, saved a drain on their HR expenses, and were recognized nationally for their efforts.

http://www.heartmath.com/corporate/case_study_health_care.html

Achieving Peak Performance--Data from Global Organisations

HeartMath has worked with Fortune 100 organisations since 1994, providing programs to tens of thousands of leaders, managers and associates. Read a summary of the key case study data.

http://www.heartmath.com/corporate/case_study_peak_performance.html

Boosting Performance & Reducing Stress at Motorola

Long known for its innovative technologies and strong people culture, Motorola recognized its people needed new tools to deal with mounting pressure from competition and economic factors. Three diverse groups tested the HeartMath tools and saw dramatic results.

http://www.heartmath.com/corporate/case_study_motorola.html

Leadership Team-Building at Mandarin Oriental Hotel

Maintaining reputation as one of the premier hotel brands in the world, while catering to a very demanding clientele, can be quite stressful.

http://www.heartmath.com/corporate/case_study_mandarin.html

“Results that Count”

A Summary of results from a multinational electronics company, a US Healthcare organisation, an IT sector organisation, and biomedical tests in trials in 3 global companies. Results clearly show that users of the IQM programs improve their physiology significantly while non-users results actually showed visible deterioration. Article available from Macquarie institute.

Health Sector

Staff Retention and Development Program. (for hospitals)

Please contact info@macquarieinstitute.com.au for further information.

Public Sector

Seven Police agencies boost health and resilience.

Please contact info@macquarieinstitute.com.au for further information.

Additional US Case Studies available:

Intensive Study with Global Oil Company

Optimising Performance Across Major Organisations

Sustaining Performance over 6 months

Please contact info@macquarieinstitute.com.au for further information.

UK Case Studies

Achieving Peak Performance

Working in close collaboration with the scientific and business professionals within our client companies, we have addressed the limitations of conventional behavioural training. Our programmes deliver the fundamental drivers of performance, enabling demonstrable benefit to be measured simultaneously in health, well-being and cognitive and business performance. These programmes can be run as a stand-alone or integrated into a company's ongoing training processes. As industry now has to operate in a more complex and demanding environment, solutions are available to enable individuals and teams to perform at a much higher level, whilst maintaining a balanced lifestyle.

<http://www.hunterkane.com/case-studies/achieving/achieving-performance.html>

Fortune 100 Performance and Health improvements Study

A leading FMCG Global business looking to improve employee performance and health conducted a study with the help of their in-house medical research team. Results included significant improvements in stress, productivity and mental clarity as well as measured improvement in blood pressure, Cortisol/DHEA ratio, and reduced body fat...

http://www.heartmath.com/corporate/case_study_sales.html

Advances in Safety Performance

Results from 2 North Sea Oil Platforms

Presents evidence indicating that safety performance in critical environments like manufacturing and public service is linearly related to stress levels. Also reports on the link to personal health, as well as safety-related parameters such as reaction times and clarity of communication.

Please contact info@macquarieInstitute.com.au for further information.

Australian Case Study

In Australia the work of IHM, HeartMath LLC and Hunter Kane Ltd the UK HeartMath organisation has been reproduced and extended for local conditions. The staff of Macquarie Institute (Aust) Pty Ltd have been active in the following areas: providing stress management and resilience training for corporate and government organisations, hospitals and schools; and providing training and education to specialist health professionals, psychologists, teachers, counsellors, medical practitioners and others.

Australian data derived from interventions in five Australian corporate and government organisations, with more than 250 participants, appears below. This case study is currently in publication. The results show highly statistically significant data that correlate important improvements in health and wellness for participants. These correlates include reported measures of fatigue, anxiety, depression, anger management, communication effectiveness, goal clarity and confidence in the organisation. The results are consistent with data from the international research and trials.

Personal and Organisational Quality Assessment – Revised (POQA-R)

The POQA-R is a self-report inventory used in HeartMath interventions to measure the key psychological and workplace elements that contribute to the overall quality of an organisation. The instrument provides a concentrated yet comprehensive assessment. Time 1 is pre-workshop. Time 2 is 6-8 weeks post workshop.

Raw Score Means Table

	Time 1	Time 2	% Change	p <
Positive Outlook	4.02	4.23	5%	ns
Gratitude	3.82	4.13	8%	0.01
Motivation	3.89	4.12	6%	ns
Calmness	3.39	3.88	14%	0.001
Fatigue	3.69	3.13	-15%	0.001
Anxiety	3.22	2.63	-18%	0.001
Depression	2.46	2.05	-17%	0.001
Anger Management	2.45	2.10	-14%	0.001
Resentfulness	3.01	2.53	-16%	0.001
Stress Symptoms	2.79	2.39	-14%	0.001
Work Attitude	5.01	5.15	3%	ns
Strategic Understanding	4.95	5.09	3%	ns
Confidence in the Organisation	3.94	4.35	10%	0.001
Manager Support	4.83	5.07	5%	ns
Goal Clarity	4.43	4.82	9%	0.001
Job Challenge	5.00	5.30	6%	0.05
Value of Contribution	4.91	5.10	4%	ns
Freedom of Expression	4.77	4.98	4%	ns
Communication Effectiveness	4.13	4.62	12%	0.001
Productivity	4.94	5.07	3%	ns
Work Intensity	5.12	5.08	-1%	ns
Time Pressure	4.79	4.34	-9%	0.001
Morale Issues	4.43	4.01	-9%	0.01
Intention to Quit	3.20	3.02	-6%	ns
Analogue Stress	8.92	7.13	-20%	0.001

The Raw Score Means Table (above) contains the group average raw scores for each of the scales in the POQA-R survey. Raw scores are derived by first summing the values (i.e., 1-7) for the items in each of the survey scales. (It should be noted that the additional items do not form a unified construct and are not included in the table.)

The sum for each survey scale is then divided by the number of endorsed items in that dimension. (For example, Positive Outlook has four items. If the client responded to only three items, the sum should be divided by three, not four.)

Finally, the individual scale scores (average of endorsed items) are averaged across all participants in the group and reported in the table above.

Please contact info@macquarieinstitute.com.au for further information.

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Appendix 1 IHM Research: Questions and Answers

Question:

Have IHM techniques been shown to help people with atrial fibrillation?

Answer:

Yes, many people with atrial fibrillation have benefited substantially from the IHM techniques.

A large hospital in Orange County, California, conducted an internal study with a random sampling of 75 patients with atrial fibrillation. Many of these patients had severe conditions and were on aggressive antiarrhythmic and antihypertensive medication regimens; a large number were on "last resort" medications with extremely toxic side effects.

The patients learned IHM's Freeze-Frame and Heart Lock-In techniques through coaching and home learning materials and were asked to practice the tools over a period of three months. At the end of the three-month period, 71 of the 75 patients reported substantial improvements in their physical and emotional health. Fifty-six patients had significantly fewer symptomatic episodes of atrial fibrillation and were able to reduce their antiarrhythmic and antihypertensive medications under their physician's guidance. Fourteen were able to discontinue their antiarrhythmic medications altogether. The reduction in pharmacy costs to the HMO as a result of these improvements in patients' health was in thousands of dollars per month. The hospital study coordinator concluded: "The overall benefits to the patients were significant, life-changing, and priceless."

In addition to this study, numerous patient case histories have documented dramatic improvements in people suffering from atrial fibrillation and other cardiac arrhythmias after learning IHM tools and techniques.

Question:

Is there any research related to congestive heart failure?

Answer:

Yes, a study was conducted by Stanford University investigating the effects of the IHM program in patients with congestive heart failure. Patients demonstrated significant improvements in functional capacity and significant reductions in stress and depression, among other improvements.

For example 1. McCraty, R, et al., The effects of emotions on short-term power spectrum analysis of heart rate variability. Am J Cardiol, 1995. 76: p. 1089-93.

In summary, this work extends previous findings by demonstrating that anger produces a sympathetically dominated power spectrum, whereas appreciation produces a power spectral shift toward MF and HF activity. Results suggest that positive emotions lead to alterations in HRV, which may be beneficial in the treatment of hypertension and in reducing the likelihood of sudden death in patients with congestive heart failure and coronary artery disease.

Question:

Are there any studies on the IHM techniques that were not conducted by the IHM, And has there been confirmation of IHM findings by independent groups?

Answer:

There are a number of studies using IHM interventions that have been done by other institutions and health care professionals. For example, a study with congestive heart failure patients was conducted by a research group at Stanford University, this Heart failure study was completely independent.

The DHEA/Cortisol findings have been replicated by an independent group in the UK.

The educational study of student test score was independent, this study involved middle school children and was done by the Miami Heart Research Institute.

An investigation on test-taking in high school students was conducted by the Minneapolis Public School District and an independent clinical psychologist.

The cognitive performance data has been recently replicated (not yet published).

A study on employee retention was independently conducted by Delnor Hospital (Geneva, Illinois).

A review of the Science of the Heart booklet will reveal that many of the studies were conducted by researchers that are not associated with IHM. In addition, many other listed results IHM have reported have either been replicated or are in the process of being replicated by other researchers.

Question:

Who defined the terms and concepts "Cardiac coherence" & "power spectral density analysis"?

The concept of Physiological Coherence was introduced by the IHM and is gaining rapid acceptance into the psychophysiology community. The term power spectral density is a physics term that has broad scale use in many disciplines.

Question:

What is the difference between "coherence" and "entrainment"?

Answer:

IHM introduced the term physiological coherence to describe a physiological mode that encompasses entrainment, resonance, and synchronisation, which are all distinct but related physiological phenomena that are frequently associated with more ordered and harmonious interactions among the body's systems.

The coherence mode is associated with a sine wave-like pattern in the heart rhythms (reflecting increased synchronisation between the two branches of the autonomic nervous system), a shift in autonomic balance toward increased parasympathetic activity, increased heart-brain synchronisation, increased vascular resonance, and entrainment between diverse physiological oscillatory systems.

In physics "coherence" is used in two different ways, both of which apply to IHM use of the term. It is used to describe the ordered or constructive distribution of power within a single waveform. The more stable the frequency and shape of the waveform, the higher the coherence. The term autocohereance is used to denote this kind of coherence. An example of a coherent wave is the sine wave. In physiological systems, this type of coherence describes the degree of order and stability in the rhythmic activity generated by a single oscillatory system. For example, in the physiological coherence mode, the heart rhythms become more coherent, shifting toward a sine wave-like pattern.

Coherence is also used to describe two or more waves (or systems) that are either phase- or frequency-locked. This is also called entrainment. In the coherent mode, respiration, heart rhythms, and blood pressure rhythms become entrained and oscillate at the same frequency. The term cross-coherence is used to specify this type of coherence.

In terms of physiological functioning, coherence confers a number of benefits to the system. For example, there is increased cardiac output in conjunction with increased efficiency in fluid exchange, filtration, and absorption between the capillaries and tissues; increased ability of the cardiovascular system to adapt to circulatory requirements; and increased temporal synchronisation of cells throughout the body. This results in increased system-wide energy efficiency and metabolic energy savings.

Question:

Why the word HeartMath?

Answer:

Although the words "Heart" and "Math" are rarely used together, IHM founders felt that this combination reflected the two most essential aspects of the IHM work.

Heart—The word heart, of course, has meaning to almost everyone. When we think of heart, we think of the physical heart as well as qualities such as wisdom, love, compassion, courage and strength, the higher aspects of all human beings.

Math—In the context of HeartMath, the word 'math' refers to the stepping stones or the nuts and bolts of unfolding the qualities of the heart in a systematic way. It also refers to physiological and psychological equations for developing an understanding of the heart and the human nervous system.

The term HeartMath represents the importance of both aspects in an exploration of the heart.

Appendix 2 Institute of HeartMath Research Overview

The Institute of HeartMath undertakes research into various fields related to the heart, including:

Heart rate variability and autonomic function: Heart rate variability--a measure of the naturally occurring beat-to-beat changes in heart rate--is a powerful, noninvasive measure of autonomic nervous system function and an indicator of neurocardiac fitness. A portion of the IHM's research efforts is devoted to basic research on heart rate variability (HRV) and autonomic nervous system function. The IHM Research Center has established and maintains an extensive HRV normals database, which provides data on the variations in measures of HRV among normal, healthy individuals. IHM have published research demonstrating how HRV varies with age and gender, and using HRV analysis to assess alterations in autonomic function in conditions such as panic disorder and chronic fatigue. IHM also provide analysis services to other laboratories interested in using HRV in their research.

Incoherent patterns in HRV are correlated with increased sympathetic activity in the ANS, emotional stress and impaired cortical function. Coherent rhythms are correlated with improved ANS balance, increased emotional wellbeing and cortical facilitation. Heart rhythm is immediately affected by emotional change, and in turn, profoundly affects the autonomic nervous system & cognitive function. With each beat, the heart continuously communicates with the brain and body via the nervous system, hormonal system, bioelectromagnetic interactions, and other pathways.

Heart-brain signalling and interactions: The heart and brain maintain a continuous two-way dialogue, with each influencing the other's functioning. It is now known that the signals the heart sends the brain can influence perception, emotional processing, and higher cognitive functions. IHM research is exploring the influence of the heart's input on brain activity, emotional perception and experience, and cognitive performance. IHM have shown that emotion-related changes in the heart's rhythmic activity are correlated with distinct changes in these variables. IHM findings also point to a link between positive emotions and improved cognitive functioning.

Applied Research: IHM research has resulted in therapeutic and personal development concepts resulting in improved health, increased emotional balance, improved cognitive function and performance. The concepts have been developed into a system of scientifically-validated tools and technology to help people become more aware of stress, reduce stress and improve health, learning, performance, and thereby the quality of life.

The efficacy of the IHM system is substantiated by numerous research studies conducted across diverse populations--ranging from students of all ages, to corporate executives, to people with clinical conditions such as hypertension, diabetes and congestive heart failure.

Treatment outcome studies in clinical populations: Treatment outcome studies assess the effects of IHM positive emotion-focused tools and techniques in helping people with health challenges. Research studies have demonstrated significant improvements in health-related measures, psychological well-being, and quality of life in people with hypertension, diabetes, congestive heart failure, and AIDS. In addition to conducting clinical research studies, IHM maintains a database of case history data contributed by numerous patients and health care professionals. These case histories of patients using the IHM interventions document substantial improvements in health and psychological status in individuals with such conditions as cardiac arrhythmias, chronic fatigue, anxiety, depression, panic disorder, post-traumatic stress disorder, environmental sensitivity, fibromyalgia, and chronic pain.

Emotional physiology: How do our emotions affect our physiology? In what ways do patterns of physiological activity change when we experience heartfelt positive emotions? Are there specific physiological patterns that are markers of different emotional states? Elucidating the physiological correlates of emotions, with particular emphasis on positive emotional states, is a major area of focus at the IHM Research Center. Studies have revealed clear changes in the patterns of activity of the autonomic nervous system, immune system, hormonal system, brain, and heart when we experience emotions such as appreciation, love, care, and compassion. Such physiological changes may help explain the observed connection between positive emotions, improved health, and increased longevity. IHM research also provides evidence that the heart plays a particularly important role in the generation and perception of emotion, and has contributed to the development of a new, systems-oriented model of emotion that includes the heart, together with the brain, nervous, and hormonal systems, as fundamental components of a dynamic, interactive network from which emotional experience emerges.

Development and testing of positive emotion-focused tools and techniques: IHM research in emotional physiology has identified a distinct and beneficial physiological mode of functioning, which IHM term *physiological coherence*, that is associated with the experience of genuine positive emotions. The physiological coherence mode is characterised by increased efficiency, order, and harmony in the functioning of the body's systems, and is also associated with improved emotional stability and cognitive performance. Practical techniques and technologies that enable people to sustain positive emotions and physiological coherence with greater consistency, have been tested for efficacy in laboratory studies as well as in intervention studies conducted in educational, organisational, and clinical settings.

Educational intervention studies: IHM's positive emotion-focused tools and techniques that foster physiological coherence have been shown to significantly improve key aspects of health, emotional well-being, and performance. Educational intervention studies examine the effects of IHM programs in school settings. Programs and curricula incorporating IHM tools and techniques introduced at the elementary, middle school, high school, and college levels have been demonstrated to reduce general psychological distress, test anxiety, and risky behaviours, and to improve test scores, classroom behaviours, stress resiliency, learning, and academic performance. IHM programs are used in schools in the US, Holland, UK and Australia. Studies are also underway to investigate the impact of IHM interventions for children with specific learning challenges, including attention-deficit hyperactivity disorder (ADHD).

Workplace intervention studies: As mentioned IHM is a public education organisation and a registered non-profit research organisation. Intervention studies investigating the impact of IHM programs in the workplace have documented a range of organisationally relevant outcomes, including increases in productivity, goal clarity, job satisfaction, communication effectiveness, improvements in employee health and well-being, and reductions in employee turnover.

Appendix 3 Stress Management Strategies Compared

HeartMath Techniques versus Other Stress Management Strategies

There are many systems of stress and emotional management, each with distinct advantages and benefits. HeartMath interventions incorporate features commonly employed by other behavioural techniques, and therefore in some respects are similar in methodology and/or in physiological effect to other widely practiced stress management tools. However, HeartMath interventions also differ in important theoretical and methodological ways. As such, they can serve as additions or augmentations to other empirically validated interventions and facilitate further gains. An understanding of the key ways in which the HeartMath interventions differ from other common approaches to stress management may be useful for the health care practitioner interested in using the techniques with clients.

Cognitive-Behavioural Therapies

The cognitive-behavioural model operates from the theory that maladaptive thoughts spawn negative emotional reactions and should therefore be the point of intervention. HeartMath interventions and research argue that while negative, maladaptive thoughts do play a role in emotional dysregulation, it is the mismanaged *emotional system* itself that wreaks havoc on psycho-physiological balance, and drives the biochemical changes that alter neural connections within the brain. Similarly, positive thoughts have little regenerative effect on the body and psyche if not accompanied by sincere positive feelings.

Current research in neuroscience is confirming that emotion and cognition can best be thought of as separate but interacting functions and systems. These systems communicate via bidirectional neural connections between the neocortex and amygdala that permit emotion-related input from the amygdala to modulate cortical activity and cognitive input from the cortex to modulate the amygdala's emotional information processing. Cognitive-behavioural therapy is based upon the assumption that a person's cognitive system can override and therefore bring about sustainable change in the emotional system. However, research indicates that within the brain, communication pathways from the emotional system to the cognitive system well overshadow those flowing from the cognitive to the emotional system.¹ This provides a physiological basis for most people's experience that emotional arousal can readily dominate and control thinking. Although thoughts can easily trigger emotions, it is usually far more difficult to willfully "turn off" strong emotions through thought alone. At times, emotional reactions may bypass the mind's reasoning process entirely. Likewise, it is generally one's emotional experience, rather than solely cognitive activity, that is the strongest motivator of attitudes and behaviour. These facts have significant implications for emotion regulation interventions and suggest that intervening at the level of the emotional system itself is a more direct, efficient, and powerful way to self-regulate patterns underlying maladaptive psychological, behavioural and physiological responses.

This primary focus on the emotional system distinguishes HeartMath from other techniques derived from cognitive-behavioural psychotherapy. While cognitive methods attempt to change maladaptive thoughts, believed to be directly responsible for negative emotions, HeartMath techniques aim first to facilitate emotional transformation, which, in turn, modifies maladaptive thoughts. A positive change in emotional state is often accompanied by new, wider perspectives, which lead to notable changes in thought patterns and can positively affect physiology.

Relaxation and Meditation Techniques

Relaxation training is a behavioural intervention with many variations, associated with physiological changes.² The main effect of these interventions is to lower arousal levels (decrease sympathetic activity and increase parasympathetic activity), which facilitates physical regeneration of the body, similar to that which occurs during sleep. Such methods, which focus primarily on the mind, resemble

distraction techniques designed to provide respite by redirecting attention to other stimuli and away from the distressing emotion.

In contrast, HeartMath techniques seek to address the emotion directly, and thus have greater potential to alter the underlying problem that is the *source* of excessive or inappropriate arousal. Additionally, by generating a positive feeling while simultaneously focusing attention on the heart, the HeartMath interventions alter the pattern of cardiac afferent input to the brain and produce physiological effects distinct from those associated with the relaxation response. While many relaxation and meditation techniques are beneficial in that they decrease sympathetic activation and increase parasympathetic activity, these methods rarely lead to increased psycho-physiological coherence. HeartMath technology, to our knowledge, is exceptional in its capacity to generate characteristic, sustained patterns of increased coherence in the ANS, as reflected in coherent heart rhythms and entrainment of oscillatory systems, resulting in body-wide ramifications. This is a key feature of the techniques, which we believe is central to their ability to initiate sustained perceptual and emotional shifts, as well as long-term hormonal changes (e.g. an increased DHEA/ cortisol ratio), outcomes not necessarily seen with the practice of relaxation or cognitive methods.

By facilitating increased coherence throughout the physiological, mental and emotional systems, HeartMath techniques also tend to increase one's access to intuition. Although intuitive insights may also be gained through meditation practices, because these techniques attempt to use the mind to quiet the mind, they can often be very difficult to master and require extensive focused practice to be used effectively. Even those meditation techniques which involve focus in the heart still generally use the mind to direct the attention, rather than engaging a core heart feeling to induce a shift to increased systemic coherence. Most experienced meditators who have learned the HeartMath techniques report that the interventions can quickly and easily lead one to an internal state that would commonly require years of meditative practice to achieve, if ever.

Visualization and Guided Imagery

Another common form of relaxation training aimed at eliciting the relaxation response is guided imagery and/ or visualization.^{3,4} These exercises focus on generating a mental image and are successful and similar in their physiological consequences to relaxation training since their aim is to decrease overall ANS arousal and increase distraction from the stressor. In addition, they aim to program the brain with a new, more healthful or prosperous "image of achievement," which the subconscious then works to fulfill. These techniques are widely used, and there are some research data suggesting they are helpful.^{5,6} The use of imagery is included in some of the steps of the HeartMath interventions as well; however, the primary emphasis is on genuinely experiencing a positive feeling rather than only calling up a pleasant mental memory or image and visualizing it in the mind's eye. The addition of the emotional shift is critical to the reprogramming of the neural circuitry and establishment of a new baseline pattern, which, in turn, determines helps determine one's response to future stressors.

Biofeedback

Biofeedback techniques are effective and often used as part of relaxation training protocols to help individuals self-regulate or modify various bodily functions such as heart rate, blood pressure and blood flow? These methods essentially enable people to exercise control over aspects of their internal functioning previously perceived to be beyond their control. This can be empowering to clients, thus encouraging them to take charge of other areas in their life that need attention. However, because these interventions are mental, not emotional techniques, again, they work on one level only. While they may be successful in overriding aspects of the physiological stress response by decreasing sympathetic arousal, biofeedback methods generally do not attempt to directly alter the disturbing feelings and perceptions causing stress. Further, altering physiological activity through mental control imparts quite a different feeling experience from the physiological shifts that naturally arise through generating a positive emotional state.

Advantages of the HeartMath Interventions

Address the Source of Stress

In summary, a primary distinguishing feature of HeartMath interventions is that these techniques operate in the emotional domain and focus on directly transforming the negative emotions that are the source of most stress.

Many common stress management approaches, such as those mentioned in the previous section, are intended to draw attention away from the stressful issue or situation. For most, this distraction is difficult to maintain, and even though attention is drawn elsewhere, the distressing emotion often returns once individuals have shifted away from the "focusing device." HeartMath technology helps people to actively address the problematic issue, situation or feeling. Although focus is initially drawn away from stressful perceptions and feelings, once the focal shift from head to heart and from a negative to a positive emotion has been achieved, the interventions guide individuals in returning to address the original stressor from a different perspective. This process is effective in that the interventions tend to induce not merely a conceptual shift, but a repatterning that extends throughout the emotional, physiological and mental systems. The shift from a negative to positive emotional state and increased psycho-physiological coherence often facilitates mental and intuitive processes that allow greater clarity and a wider perspective on the stressful situation to emerge. In this state of greater systemic coherence, individuals can more easily experience perceptions and discern practical solutions that were previously inaccessible while in a disordered mental and emotional state. Therefore, upon returning to address the stressor from a more balanced and coherent inner point of reference, stress can be dissipated rather than simply suppressed or postponed.

Easily Used in the Midst of Stress

HeartMath techniques also differ from many other stress management strategies in their brevity and adaptability for application during typical life situations. Many meditation and relaxation procedures, as well as exercise, fitness and nutritional education programs, while beneficial for a healthful lifestyle, require extended blocks of time and/or a separate space and cannot be utilized when relief from stress is most needed. The simplicity and practicality of HeartMath techniques lends them to easy application in virtually any context - in the car, at the dinner table, in the meeting room or workplace - environments where one might have an immediate need for a stress management technique. In actuality, the Freeze-Frame technique was designed specifically to help individuals transform inefficient mental and emotional reactions *in the midst of day-to-day stressful situations*, thereby offsetting the need to recuperate from stress" after the fact." Thus, this technology helps people intercept stressful responses as they occur, and with practice, prevent these responses altogether. These interventions are designed to meet the needs of contemporary life, and because they can be used in the "heat of battle" are ideal for transforming stress as it arises.

Highly Generalise-able, Readily Learned and Quickly Effective

Perhaps one of the most attractive aspects of HeartMath interventions is their generalise-ability and applicability to people of all walks of life, as well as to a wide variety of physical and psychological disorders. The interventions affect virtually all aspects of physiology and provide a viable method of reducing the cumulative emotional energy drains that contribute to the development and progression of many illnesses. Another attractive feature is the simplicity and ease with which they can be taught, learned and implemented; this benefits both time-pressed clients and health-care professionals. Similarly, this technology has been found to initiate immediate physiological and psychological changes, as well as overall life satisfaction and quality of life changes in very short periods of time. This rapid positive feedback is highly encouraging to clients and often establishes immediate confidence in their ability to use the tools to create tangible improvements in their health and well being.

Positive Focus

A further advantage of the HeartMath interventions is that to a large extent they circumvent the laborious and emotionally painful process of "working through" past issues in order to gain emotional relief. The process of re-living painful memories, as often prescribed in some behavioural treatment protocols, can reopen old emotional wounds and actually can reinforce these unproductive emotional patterns and memories. HeartMath techniques, in contrast, infuse the system with pleasurable, positive emotional experiences which, over time, create new baseline patterns represented in the neural circuitry. The interventions instill empowerment and choice, giving each person more control over his or her own destiny.

High Compliance

The practicality and ease of application of the techniques, together with the often immediate positive feedback gained from their practice gives these interventions a notably high rate of compliance, which is an enormous advantage in itself. Poor compliance with treatment protocols is a particularly problematic area in both mental health and medical care. Even the best of interventions, of course, can only be effective to the extent that it is used, and many patients refuse to comply with treatment protocols that are difficult to engage in, time-consuming, that cause them physical or emotional discomfort, produce negative side effects or that do not yield positive outcomes in a timely manner. HeartMath techniques allow patients to *feel better* in a way that is tangible to most people; this change can be immediately and objectively validated through heart rhythm monitoring, and the interventions produce no negative side effects. Further, the nature of the interventions enables individuals to continue to use them post-recovery to maintain and enhance health, wellness and performance. The overall positive experience of using the techniques makes them truly self-motivating practices to promote health and personal effectiveness.

Supportive of Other Therapies

Finally, the HeartMath interventions can easily be utilized in conjunction with other treatment modalities whether pharmaceutical, psychological or behavioural. Rather than interfere with other therapies, the techniques often enhance the effectiveness of these protocols, by several means. First, in reducing inappropriate emotional arousal, the interventions naturally create a more balanced and regenerative physiological environment, as evidenced by direct effects on the immune, nervous, hormonal and cardiovascular systems. This, in turn, increases the system's receptivity to concurrent therapies. Further, the techniques help instill positive attitudes that may encourage greater adherence to self-care behaviours, thereby supporting other treatment regimens. Thus, the integration of the HeartMath interventions in virtually any therapeutic protocol is likely to speed recovery time and facilitate desired outcomes.

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Source: "The HeartMath@ Odyssey Program. An Emotional Management Curriculum for the Treatment of Substance Abuse"

Appendix 4 Heart Rate Variability

A select list of General Research Papers by Third Parties, indexed for Medline by PubMed. These pages contain selected search results from the National Center for Biotechnology Information (NCBI) at the U.S. National Library of Medicine (NLM) as at June 2005.

Stress + HRV + emotions

Sakuragi S, Sugiyama Y. Related Articles, Links

Interactive effects of task difficulty and personality on mood and heart rate variability.

J Physiol Anthropol Appl Human Sci. 2004 May;23(3):81-91.

PMID: 15187380 [PubMed - indexed for MEDLINE]

Schwarz AM, Schachinger H, Adler RH, Goetz SM. Related Articles, Links

Hopelessness is associated with decreased heart rate variability during championship chess games.

Psychosom Med. 2003 Jul-Aug;65(4):658-61.

PMID: 12883118 [PubMed - indexed for MEDLINE]

Cohen H, Neumann L, Alhoshle A, Kotler M, Abu-Shakra M, Buskila D. Related Articles, Links

Abnormal sympathovagal balance in men with fibromyalgia.

J Rheumatol. 2001 Mar;28(3):581-9.

PMID: 11296963 [PubMed - indexed for MEDLINE]

Hanson EK, Godaert GL, Maas CJ, Meijman TF. Related Articles, Links

Vagal cardiac control throughout the day: the relative importance of effort-reward imbalance and within-day measurements of mood, demand and satisfaction.

Biol Psychol. 2001 Mar;56(1):23-44.

PMID: 11240313 [PubMed - indexed for MEDLINE]

Dishman RK, Nakamura Y, Garcia ME, Thompson RW, Dunn AL, Blair SN. Related Articles, Links

Heart rate variability, trait anxiety, and perceived stress among physically fit men and women.

Int J Psychophysiol. 2000 Aug;37(2):121-33.

PMID: 10831999 [PubMed - indexed for MEDLINE]

HRV and Fitness

1: Faulkner MS, Quinn L, Rimmer JH, Rich BH. Related Articles, Links

Cardiovascular endurance and heart rate variability in adolescents with type 1 or type 2 diabetes.

Biol Res Nurs. 2005 Jul;7(1):16-29.

PMID: 15920000 [PubMed - in process]

2: Middleton N, De Vito G. Related Articles, Links

Cardiovascular autonomic control in endurance-trained and sedentary young women.

Clin Physiol Funct Imaging. 2005 Mar;25(2):83-9.

PMID: 15725306 [PubMed - indexed for MEDLINE]

3: Brunetto AF, Roseguini BT, Silva BM, Hirai DM, Guedes DP. Related Articles, Links

Effects of Gender and Aerobic Fitness on Cardiac Autonomic Responses to Head-Up Tilt in Healthy Adolescents.

Pediatr Cardiol. 2005 Jan 27; [Epub ahead of print]

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