Experimental

INTERPERSONAL HEART-BRAIN REGISTRATION AND THE PERCEPTION OF PARENTAL LOVE: A 42 YEAR FOLLOW-UP OF THE HARVARD MASTERY OF STRESS STUDY[1]

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ABSTRACT

A dynamical energy systems approach to cardiac energy predicts that the registration of cardiac energy can occur between individuals, and that the degree of registration may be greater in persons who are more open to interpersonal information. As part of a 42 year follow-up to the Harvard Mastery of Stress study, 19 channels of EEG and the ECG were recorded during a 2 minute eyes closed resting baseline from 20 Harvard graduates currently in their 60's and from an experimenter who sat 3 feet in front of the subjects. Cardiac synchronized energy patterns were calculated in the subjects' EEGs separately triggered by the subjects' ECG and the experimenter's ECG. When the subjects' own ECG was used as the trigger, significant evidence of the subjects' ECG in the subjects' EEG was found, primarily in the posterior regions. When the experimenter's ECG was used as the trigger, significant evidence of the experimenter's ECG in the subjects' EEG was found, primarily in anterior regions, in subjects who rated themselves in college as having been raised by loving parents. These subjects were also significantly healthier in late adulthood than subjects who rated their parents "low in loving." Implications for theory and research in energy medicine are considered.

KEYWORDS: Dynamical energy systems, cardiology, heart, caring, love, transpersonal, health, alternative medicine, energy medicine

INTRODUCTION

A fundamental premise in energy medicine is that subtle information can be transmitted between individuals, especially between loving individuals,[2] in a manner that is dynamic and wholistic.[3] The idea that collections of individuals can interact in a dynamic and wholistic manner is also a key premise of general systems theory,[4] and, in particular, living systems theory.[5]

Russek and Schwartz have extended modern systems theory to include dynamic energetic interactions.[6] Using a definition of living systems as being "dynamic organizations of intelligent information that are expressed in energy and matter," Russek and Schwartz have derived five dynamical energy systems hypotheses using the heart, the largest generator of electromagnetic energy in the body, as a model system.[6] Energy cardiology is defined as an interdisciplinary approach that applies the concept of organized energy to the cardiovascular system in health and illness using a dynamical energy systems framework.

Table I summarizes five dynamical energy systems hypotheses and their applications to energy cardiology. Hypothesis 4 (cardiac energy patterns may have interactive effects interpersonally and environmentally as well as intrapersonally), combined with Hypothesis 5 (levels of consciousness may modulate cardiac energy patterns in health and illness, and conversely, cardiac energy patterns may modulate levels of consciousness) predict that cardiac energy from one person can be registered by another person in a dynamic, interactive fashion. It follows that people who have the capacity to experience interpersonal relationships as safe and comfortable, which should more likely be the case in people who were raised with loving parents, should be more receptive to, and therefore more readily register, the cardiac energies of other individuals in their immediate environment.

In a 35 year follow-up of the Harvard Mastery of Stress study,[7] Russek and Schwartz found that ratings of perceptions of parental caring obtained in college predicted physical health in mid-life.[8] Harvard students rated their mothers and fathers on items associated with positive perceptions of parental caring ("loving," "just," "fair," "clever," "hardworking," "strong"). Their medical records were examined 35 years later. Russek and Schwartz were able to locate parental caring

Table I

Five Dynamical Energy Systems Hypotheses
and Their Expression in Energy Cardiology
(From Russek and Schwartz)[6]

	Dynamical Energy Systems Hypotheses		Energy Cardiology Hypotheses
1.	Systems are expressions of organized energy and emit energy.	1.	The heart is a dynamic energy generating system.
2.	Energy activates and regulates systems interactively.	2.	Energy from the heart may regulate organs and cells throughout the body interactively.
3.	Energies (types and frequencies) are emitted simultaneously, including at the quantum level.	3.	The heart generates patterns of energy. The cardiac energy pattern includes electrical, magnetic, sound, pressure, and thermal energies.
4.	Energy is transmitted between systems dynamically and interactively.	4.	Cardiac energy patterns may have interactive effects interpersonally and environmentally as well as intrapersonally.
5.	Levels of consciousness may modulate patterns of energy in health and illness, and conversely, patterns of energy may modulate levels of consciousness.	5.	Levels of consciousness may modulate cardiac energy patterns in health and illness, and conversely, cardiac energy patterns may modulate levels of consciousness.

data on 87 of the 116 subjects (of the 126 original subjects) interviewed in the 35 year follow-up.

Whereas only 25% of subjects (7 of 21) who rated both their mothers and fathers high in parental caring were sick in mid-life (cardiovascular disease, ulcers, alcoholism, and miscellaneous), 87% (20 of 23) who rated both their mothers and fathers low in parental caring were sick in mid-life. The remaining subjects who rated one parent high and the other parent low in parental caring had rates of sickness in mid-life that fell midway between the high-high and low-low groups. These effects were independent of family history of disease, death and/or divorce of parents, smoking history of the men at follow-up, and divorce history of the men at follow-up. These findings provide strong support for the hypothesis that love may have salutary effects on physical health.[2]

In a subsequent 42 year follow-up to the Harvard Mastery of Stress study, we collected electroencephalographic (EEG) and electrocardiographic (ECG) data from a subset of these men and simultaneously from the interviewer (the senior author) during a structured, biopsychosocial-spiritual interview, and during 2 minute eyes closed resting baselines. The initial eyes-closed resting baseline provided a context to examine whether cardiac energy from the experimenter (triggered from the experimenter's ECG) could be registered in the subjects' brains (from synchronized averages in the subjects' EEGs), and to determine whether the degree of registration was greater in subjects' who perceived their parents to be loving (and therefore ended up being healthier in later adulthood).

METHOD

SUBJECTS

The subjects, all men, ranged in age from 60 to 66 at the time of testing (the 42 year follow-up). Thirty subjects were tested in sound and temperature controlled rooms (professional recording studios) in New York City and Boston in the summer of 1994.

Ratings of parental caring were obtained on 20 of the subjects while in college. The ratings were based on the average of 6 positive perception items ("loving," "just," "fair," "clever," "hardworking," "strong") rated separately for mothers and fathers. Eleven subjects rated their mothers and fathers high in parental caring (averaged scores), whereas nine subjects rated their mothers and fathers low in parental caring.[6]

Physiological Measures

An initial 2 minute eyes-closed resting baseline EEG was recorded from the subjects, and ECG was simultaneously recorded from both the subjects and the experimenter, before the formal interview began, using a Lexicor Neurosearch 24 system (Lexicor, Boulder, Colorado). EEG was recorded with an electrode cap (Electrocap International, Eaton, Ohio) from 19 channels, referenced to linked ears, and digitized on-line at 128 Hz. The sites are displayed in Table II. Bilateral impedances were generally below 10 Kohm. ECG was recorded arm to arm using silver/silver chloride disk electrodes and also digitized at 128 Hz. The subjects and experimenter sat facing each other in comfortable chairs, approximately 3 feet from each other measured knee to knee.

Table II
EEG Sites (Topographic Pattern)*

	FP1		FP2	
F7	F3	FZ	F4	F8
T3	C3	CZ	C4	T4
T5	P3	PZ	P4	T6
	01		02	

*Nineteen EEG sites from the 10-20 system were recorded per subject. The top two sites (FP1 and FP2) are located in the front of the head (anterior), the bottom two sites (01 and 02) are located in the back of the head (posterior). Tables II-IV and Figures 1-3 display the EEG findings using this topographic pattern.

Calculation of Cardiac Synchronized Energy Patterns

The cardiac synchronized energy patterns (CSEP) methodology (outlined below) was implemented using special purpose software written to calculate averaged waveforms per trial per site per subject.[6] Using raw ECG and EEG units (values), the program calculates averaged ECG and EEG waveforms synchronized either with the subjects' own ECG (*intra*personal CSEPs) or the experimenter's ECG (*inter*personal CSEPs). The program:

1. Detects the peak of each R-spike (the largest peak that accompanies each ventricular depolarization),

2. Selects 30 samples preceding each R-spike and 90 samples following each R-spike, and

3. Calculates averaged waveforms over the 120 samples for the 2 minute baseline.

The window of time directly surrounding the R-spike was selected for statistical analysis (4 samples before the peak of the R-spike and 6 samples after the peak of the R-spike). At 128 Hz, this represented an 85.94 millisecond window of time. One microvolt equals 13.21 units (displayed in Figures 2-4). Statistical analyses and graphics were performed using Statistica for Windows.

RESULTS

The mean rating of the Harvard Parental Caring Scale obtained while the subjects were in college for the total sample (n = 20) was 7.1 (sd = 0.8). The high (n = 11) and low (n = 9) perceptions of parental caring groups had mean scores of 7.7 (sd = 0.6) and 6.4 (sd = 0.4) respectively (t = 5.24, df = 18, $p < .00006$).

Figure 1 displays the percentage of subjects who had diagnosed diseases 42 years later in the follow-up in the high and low perception of parental caring groups. Whereas 4 of the 11 high perception of parental caring subjects (36%) had diagnosed diseases at follow-up (heart disease, ulcers, and alcoholism), 8 of the 9 low perception of parental caring subjects (89%) had diagnosed diseases at follow-up (Yates corrected Chi Square = 3.71, df = 1, $p < .05$). This 42 year

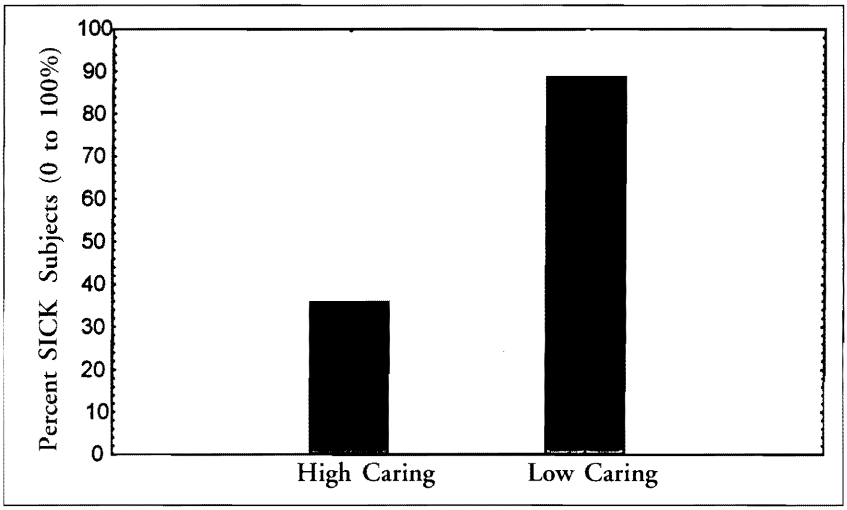

Figure 1. Percent Subjects Sick at 42 Year Follow-Up in High and Low Perceptions of Parental Caring Groups.

prospective finding paralleled the results for the larger sample (n = 87) reported for the 35 year follow-up study.[8]

The average number of heart beats in the 2 minute baseline for the total sample was 122.7 (sd = 21.2) for the subject-triggered CSEPs, and was 129.30 (sd = 9.8) for the experimenter-triggered CSEPs. The average number of heart beats for the subject-triggered CSEPS was non-significantly lower (t = 1.46, df = 18, $p < .16$) in the low perception of parental caring subjects (Mean = 115.2; sd = 25.8) compared to the high perception of parental caring subjects (Mean = 128.7; sd = 15.2). The average number of heartbeats for the experimenter-triggered CSEPS was virtually the same in the low perception of parental caring subjects (Mean = 130.7; sd = 12.5) and the high perception of parental caring subjects (Mean = 128.1; sd = 7.4).

Figure 2 displays the mean CSEPs in the 19 EEG channels and the ECG channel for the total sample for the subject-triggered CSEPs. Separate analysis of variance for each scalp site revealed reliable evidence of R-spike synchronized EEG changes in the middle and posterior sites. Table III displays the p values for the main effects of time for each site for the total sample.

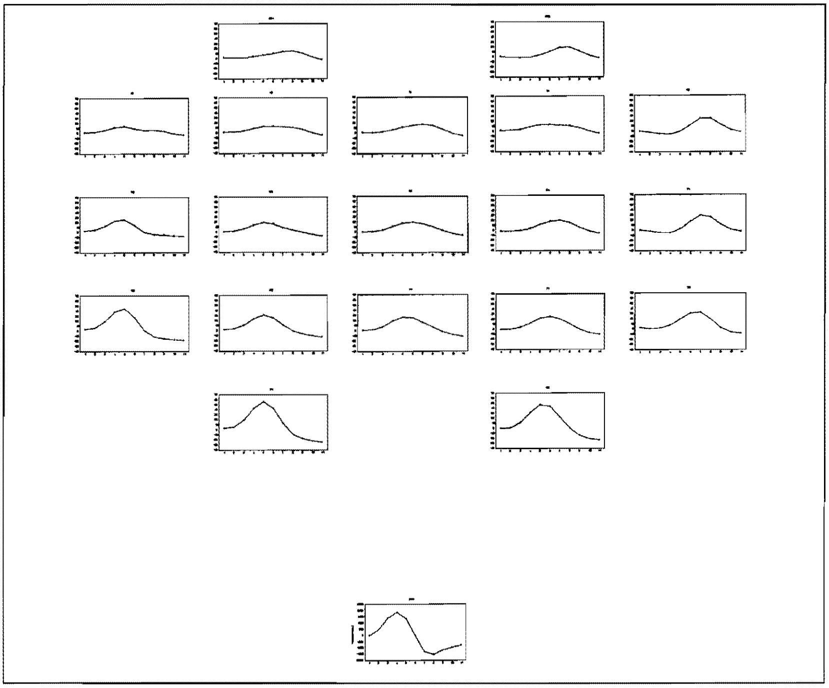

Figure 2. Averaged EEG and ECG waveforms synchronized with the Subject's ECG R spikes (n = 20). The top two waveforms are FP1 and FP2, the next to the bottom two waveforms are 01 and 02, the bottom waveform is the Subject's averaged ECG. The scale for the EEG waveforms is +70 to -40, the ECG waveform is +2500 to -2000. One microvolt equals 13.21 units.

It can be seen that there was a positive wave synchronized with the ECG in the posterior regions, especially in the T5 - P3 - PZ - P4 - T6 regions, and the 01 - 02 regions (p's $<$. 001 to .000001) of the brain. The right frontal (F8) region also reached significance ($p < .005$), though the time to peak was delayed in the anterior regions compared to the posterior regions. This topographic pattern of subject-triggered CSEPs could reflect cardiac vector differences (*i.e.*, the heart vector in three dimensional space may generate larger signals toward the back of the head) and/or neurocardiovascular differences (*e.g.* possible increased conductivity and/or resonance of the brain in posterior regions).

There were no group (high versus low perceptions of parental caring) by time interactions for any site. Hence, perceptions of parental caring did not significantly influence the patterns of subject-triggered ECG registration in the EEG.

Table III

P values for main effects of time for subject ECG triggered changes in the subject's EEG. 19 Sites in the 10-20 System are displayed. The top two *p* values are for FP1 and FP2, the bottom two *p* values are for 01 and 02.

	.74		.22	
.77	.61	.28	.13	.005
.001	.05	.07	.05	.001
.00001	.00001	.0003	.001 .	.0002
	.000001		.000001	

Figures 3 and 4 display the mean CSEPs in the 19 EEG channels and the ECG channel separately for the high and low perception of parental caring groups for the experimenter-triggered CSEPs. Separate analysis of variance for each scalp site revealed that the anterior and posterior sites showed significant differential R-spike synchronized EEG changes in the high verses low perception of parental caring groups. None of the main effects for time reached significance.

Table IV displays the *p* values for the group by time interactions for each site.

It can be seen that the topographic pattern was generally reversed for the *experimenter-triggered* CSEPs compared to the *subject-triggered* CSEPs, *especially for the high perception of parental caring subjects.* The largest R-spike synchronized positive waves in the EEG were found in the frontal FP1 and FP2 sites (*p*'s $<.001$ and .0003), and the times to peak were generally delayed in the posterior regions compared to the anterior regions. The group by time interactions suggested that the high perception of parental caring subjects registered the experimenter's cardiac signals more strongly, and somewhat more quickly, that the low perception of parental caring subjects.

DISCUSSION

When subjects (in the present study, males) sat quietly with their eyes-closed facing an experimenter (in the present study, a female) who was also sitting quietly with her eyes-closed, the EEG of subjects was found to register cardiac

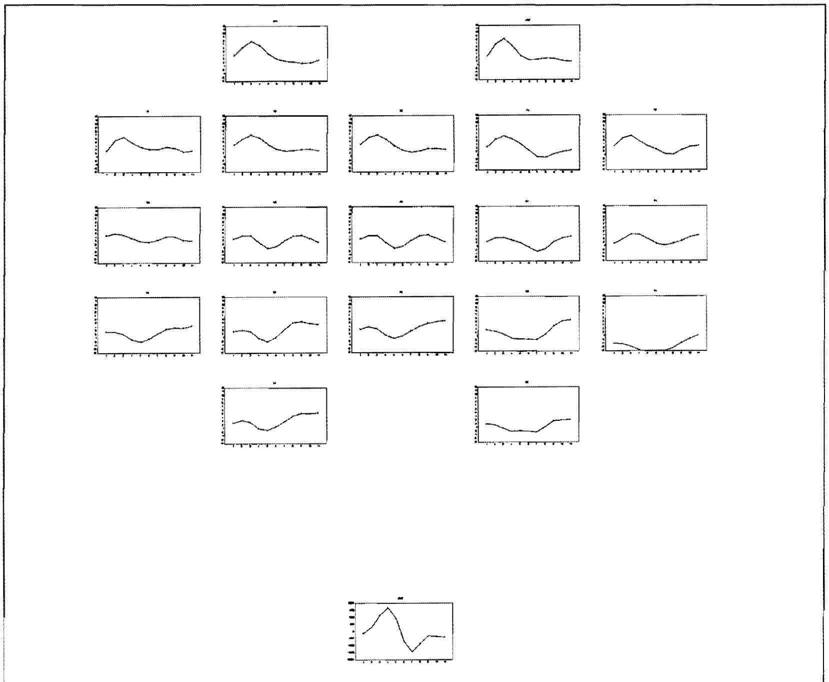

Figure 3. Averaged EEG and ECG waveforms synchronized with the Experimenter's ECG R spikes in High perception of parental caring subjects (n = 11). The top two waveforms are FP1 and FP2, the next to the bottom two waveforms are 01 and 02, the bottom waveform is the Experimenter's averaged ECG. The scale for the EEG waveforms is +12 to -3, the ECG waveform is +2500 to -2000. One microvolt equals 13.21 units.

activity synchronized with the beating heart of the experimenter. The topographic pattern of the subject's EEG registration of the experimenter's ECG was opposite to the topographic pattern of the subjects' EEG registration of their own ECG. The cardiac synchronized energy pattern was largest in the back of the head for the *intra*personal ECG and was largest in the front of the head for the *inter*personal ECG. This finding is consistent with predictions from vector cardiography concerning the complex directionality of cardiac energy patterns. It would be hypothesized that if the experimenter had been sitting behind the subjects rather than facing the subjects, the experimenter's ECG registered in the subject's EEG would have been largest in the back of the head rather than in the front of the head.

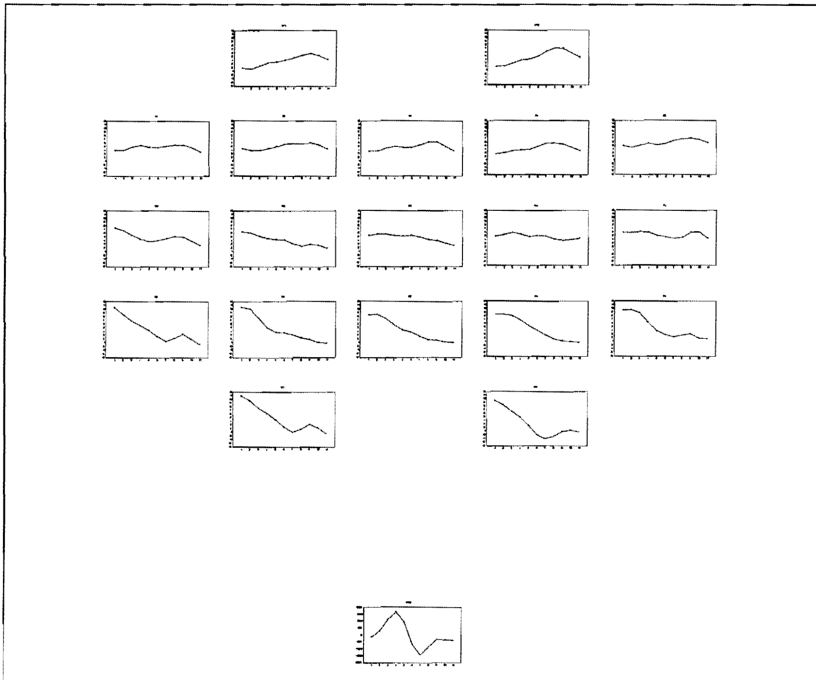

Figure 4. Averaged EEG and ECG waveforms synchronized with the Experimenter's ECG R spikes in Low perception of parental caring subjects (n = 9). The top two waveforms are FP1 and FP2, the next to the bottom two waveforms are 01 and 02, the bottom waveform is the Experimenter's averaged ECG. The scale for the EEG waveforms is +12 to -3, the ECG waveform is +2500 to -2000. One microvolt equals 13.21 units.

The interpersonal effect was significantly influenced by the history of perceived love and caring in the subjects lives. The interpersonal heart—brain registration was greatest in subjects who perceived their parents to be caring and loving when they were in college. Since these subjects were generally healthier at the time of testing than the subjects who perceived their parents to be low in caring and love, it is not possible to determine whether the group differences in interpersonal cardiac registration were a result of psychological information processing differences and/or were a result of physiological registration differences. However, the data are consistent with a dynamical energy systems approach which views living systems as being dynamic organizations of intelligent information that can interact in complex ways.[6] The findings are also

Table IV

P values for group by time interactions for experimenter ECG triggered changes in the subject's EEG. 19 Sites in the 10-20 System are displayed. The top two *p* values are for FP1 and FP2, the bottom two *p* values are for 01 and 02.

	.001		.0003	
.85	.42	.35	.03	.06
.97	.57	.93	.94	.90
.0004	.002	.07	.02	.05
	.01		.03	

consistent with theory and research on cardiac coherence and love,[9] extended to cardiac interpersonal interactions.

The findings cannot be explained by possible differences in the heart rate of the experimenter *per se* (her heart rate was similar for both high and low perception of parental caring subjects). However, it is interesting that the experimenter's heart rate turned out to be moderately correlated with the subject's heart rate ($r = .523$, $n = 20$, $p < .018$). Since the subjects and experimenter engaged in conversation while the second author connected the electrodes and calibrated the equipment, it is possible that individual differences in style of interaction and content from person to person resulted in psychophysiological empathy between the experimenter and the subject. However, there were very few actual beat to beat synchronies between the subjects' and experimenter's heart contractions during the eyes-closed baseline. Moreover, if the experimenter-triggered EEG registration had been an "artifact"of subject synchronized heartbeats with the experimenter, the topographic pattern observed for experimenter-triggered EEG waveforms would have looked the same as the subject-triggered EEG waveforms (largest in the back of the head) rather than what was observed (largest in the front of the head).

A dynamical energy systems approach using the heart as a model system provides a paradigm for addressing important questions in energy medicine. Is it possible that the degree of interpersonal communication between mother and child, friends, spouses, people and their pets, or healer and receiver, will be correlated with degree of interpersonal cardiac energy registration? Is it possible that individual differences in psi communication will be correlated with, if not mediated by, cardiac energy/information communication? Does the cardiac energy registration vary as a function of distance, and will it occur even in the presence of electrical shielding? Preliminary evidence suggests that evoked potential EEG registration between people may take place in the presence of electrical shielding.[10]

Is it possible that certain alternative medicine therapeutic modalities involving interpersonal interactions such as non-contact therapeutic touch[11] may be correlated with, if not mediated by, cardiac energy/information communication? Preliminary evidence reported by Sugano, Uchida and Kuramoto suggests that synchronous changes in the EEG of healers and receivers during healing may occur, especially in the frontal regions.[12]

Future research measuring cardiac synchronized energy patterns from a dynamical energy systems approach may help elucidate these challenging questions.

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