Research

# SIMULTANEOUS VARIATION IN THE HEART AND BRAIN ELECTRICAL FIELDS

**by Colin A. Ross, MD**

## ABSTRACT

The author measured a participant's heart and brain electrical fields simultaneously using EEG electrodes and neurofeedback software while her psychophysiological state was being varied. In the first session, the participant was in an awake-alert state in bright light; in the second she was in a drowsy state in dim light; in both conditions recordings were made with eyes open and eyes closed. Significant differences in EEG amplitude were found in both the brain and heart electrical fields comparing the psychophysiological states of eyes open/eyes closed and alert/drowsy. It is possible to study the participation of peripheral nerve centers such as the cardiac plexus in psychophysiological state change and information processing.

**Keywords:** human energy field, neurofeedback, cardiac plexus

## INTRODUCTION

It is standard practice to measure the electrocardiogram (EKG), or the electroencephalogram (EEG), but there is no literature on measuring the electrical fields of the heart and brain simultaneously using the same electrodes and software. There are no norms available for values in the heart field using standard EEG electrodes and software: in standard practice, the heart field is analyzed to yield the familiar QRST complex, but not the amplitude of delta, theta, alpha, beta and gamma waves. The reason this is so, is that there has been no theoretical reason to make such measurements.

Ross has recently proposed a general theory of human energy fields that makes a range of testable scientific predictions across subject areas including western and alternative medicine, anthropology, psychotherapy, weapons and security systems, and agriculture.[1,2] According to the theory, mind is not located in or associated only with the brain: the peripheral nervous system also participates in the processing of and response to environmental input. Terms like "gut feelings" and "heartache" are not simply metaphors or figures of speech. The theory predicts that there is measurable electromagnetic (EM) information processing in the peripheral nervous system, especially at the major nerve ganglia such as the cardiac, celiac and hypogastric plexes, which correspond to the classical chakras.[3] The body, according to the theory, is a unified energy field that participates as a whole in information processing and interaction with the environment.

For instance, a person with panic disorder or a simple phobia could be exposed to a phobic stimulus under laboratory conditions. The theory predicts that, given sensitive enough electrodes and software, there would be a detectable EM spike in the brain field corresponding to the anxiety reaction of the individual: there would also be a spike in the celiac and hypogastric fields, and there would be signal traffic back and forth between the brain and abdominal nervous system while the information was being processed and the anxiety reaction was ongoing. This reaction would be absent both subjectively and in the EM recordings in a comparison person with no anxiety disorder. The technology could be used to track treatment response to both psychotherapy and psychopharmacology, and the abdominal EM signal could be the target of biofeedback protocols. In DSM-IV-TR, the participation of the abdominal EM field in panic attacks is hinted at with the diagnostic criterion for, "nausea or abdominal distress."[4]

A preliminary test of the theory can be provided by taking simultaneous recordings over the skull and the heart using standard neurofeedback electrodes and software, while varying the psychophysiological state of the participant. If the theory is correct, the brain and heart electrical fields should vary simultaneously with psychophysiological state. If such variation is observed, it will not confirm all elements of the theory: rather, it will provide evidence that the theory can be tested using readily available existing technology. The purpose of the experiment is to provide initial data indicating whether such a line of investigation is worth pursuing. Full confirmation of the theory would require a large set of replicated observations over many experiments, and with manipulation of a variety of state variables of the participants.

## METHODS

The participant was a physically healthy, right-handed, 53-year old, Caucasian woman with no history of seizures, closed head injuries or substance abuse and a full battery of normal blood work within the previous year. In the first session, simultaneous recordings with standard AgCl electrodes were taken at Fp2 and immediately left of the sternum over the fifth intercostal space during the afternoon in bright light with the participant supine and in an awake-alert mental state. Her Glasgow Coma Scale score was 15 in the awake-alert condition, which means she opened her eyes spontaneously, was oriented and conversed normally, and obeyed commands.[5] Ten 3-second recordings were taken with eyes open then ten 3-second recordings with eyes closed. In the second session, the same recordings were taken in the evening in dim light with the participant supine and in a drowsy state. In the drowsy condition her Glasgow Coma Scale score was 14 because she only opened her eyes on command.

The equipment used was a Brainmaster Atlantis II unit with its accompanying software: electrodes and conducting paste were from the same supplier. For Channel 1, the active electrode was at Fp2, and the reference electrode was a clip on the left ear lobe; ground was the right mastoid; and for Channel 2, the active electrode was over the heart and the reference electrode was a clip on the right ear lobe.

Average amplitude values (μV) for the ten recordings were calculated for each electrode location, eye condition, mental state, and frequency band. Average amplitudes for each frequency band were then compared across the different participant conditions using t tests, with significance set at p=.05. For instance, average amplitude at Fp2 with eyes open in the awake-alert state was compared to average amplitude at Fp2 with eyes closed in the awake-alert state; or, average amplitude over the heart in the awake-alert state with eyes open was compared to average amplitude over the heart in the drowsy state with eyes open.

This procedure allowed for observations to be made on the simultaneous variation of amplitude in the brain and heart electrical fields with systematic changes in two physiological conditions of the participant: eyes open versus eyes closed; and awake-alert versus drowsy mental state.

## RESULTS

Results for the comparisons of the eyes open versus eyes closed conditions with the participant in an awake, alert mental state in bright light are shown in Table 1: at Fp2 there were significant differences between eyes open and eyes closed in delta, theta and gamma; and at the heart there were significant differences between eyes open and eyes closed in delta.

Results for the same comparisons with the participant in a drowsy mental state in dim light are shown in Table 2: at Fp2 there were significant differences between eyes open and eyes closed in delta, hibeta and gamma; and at the heart there were no significant differences.

Significant differences between the awake-alert and drowsy conditions for each frequency band, electrode location and eye condition are indicated in Table 1 with a asuperscript. The awake-alert and drowsy conditions differed at Fp2 in hibeta with eyes open and with eyes closed and in gamma with eyes open and with eyes closed; at the heart, the awake-alert and drowsy conditions differed in delta with eyes open and with eyes closed, in theta with eyes open and with eyes closed, and in gamma with eyes open and with eyes closed.

Statistical information for the significant differences between the awake-alert and drowsy conditions are:

Fp2 eyes open, hibeta t(18)=2.1105, p = .05;
Fp2 eyes closed, hibeta, t(18)=2.2061, p =.05;
Fp2 eyes open, gamma, t(18)=4.0404, p=.0008;
Fp2 eyes closed, gamma, t(18)=3.4967, p=.003;
Heart eyes open, delta, t(18)=14.0888, p=.0001;
Heart eyes closed, delta, t(18)=17.0888, p=.0001;
Heart eyes open, theta, t(18)=3.9924, p=.009;
Heart eyes closed, theta, t(18)=4.3488, p=.0004;
Heart eyes open, gamma, t=3.2956, p=.004;
Heart eyes closed, gamma, t(18)=3.3045, p=0.004.

## DISCUSSION

The prediction of the theory of human energy fields was confirmed by the data. The electrical fields of the brain and the heart participate simultaneously in the psychophysiological state of a physically normal human being. This is most evident in the delta frequency band. In delta, the amplitude of the electrical field is greater with eyes open than with eyes closed in both the brain and the heart when the person is in an awake-alert mental state. When the person is in a drowsy mental state, there is still a difference in the brain field but not in the heart field.

*Table 1. Simultaneous Variation in the Heart and Brain Electrical Fields: Bright Light, Awake Mental State*

| Fp2 | | μV | (SD) | t | p | Heart | μV | (SD) | t | p |
|---|---|---|---|---|---|---|---|---|---|---|
| Delta | O | 18.90 | (5.07) | 2.5645 | .02 | O[a] | 85.97 | (4.40) | 2.7148 | .02 |
| | C | 5.49 | (1.28) | | | C[a] | 81.52 | (2.74) | | |
| Theta | O | 7.47 | (4.45) | 2.7326 | .02 | O[a] | 38.38 | (7.47) | 0.3879 | NS |
| | C | 3.58 | (0.68) | | | C[a] | 37.24 | (5.53) | | |
| Alpha | O | 5.13 | (1.33) | 0.9999 | NS | O | 27.44 | (11.00) | 0.0233 | NS |
| | C | 7.83 | (2.35) | | | C | 27.53 | (5.29) | | |
| Lobeta | O | 3.39 | (1.04) | 0.4238 | NS | O | 20.53 | (12.90) | 1.4503 | NS |
| | C | 3.21 | (0.85) | | | C | 13.44 | (8.52) | | |
| Beta | O | 4.50 | (1.61) | 1.5953 | NS | O | 14.27 | (11.18) | 0.7796 | NS |
| | C | 3.49 | (1.19) | | | C | 18.87 | (14.94) | | |
| Hibeta | O[a] | 5.45 | (2.37) | 1.9981 | NS | O | 8.27 | (4.33) | 0.8693 | NS |
| | C[a] | 3.78 | (1.17) | | | C | 10.08 | (4.96) | | |
| Gamma | O[a] | 1.75 | (0.48) | 2.1100 | .05 | O[a] | 2.68 | (1.69) | 1.4409 | NS |
| | C[a] | 1.32 | (0.43) | | | C[a] | 2.05 | (0.72) | | |

O = Eyes open; C = Eyes closed

[a]Bright light, Alert mental state differs from Dim light, Drowsy mental state in this frequency band and this eye condition at p <.05.

*Table 2. Simultaneous Variation in the Heart and Brain Electrical Fields: Dim Light, Drowsy Mental State*

| Fp2 | | μV | (SD) | t | p | Heart | μV | (SD) | t | p |
|---|---|---|---|---|---|---|---|---|---|---|
| Delta | O | 18.61 | (11.88) | 2.4429 | .03 | O | 50.37 | (6.67) | 0.5673 | NS |
| | C | 8.50 | (5.49) | | | C | 51.84 | (4.76) | | |
| Theta | O | 6.78 | (3.18) | 1.8346 | NS | O | 24.98 | (7.54) | 0.2869 | NS |
| | C | 4.53 | (2.22) | | | C | 23.99 | (7.89) | | |
| Alpha | O | 5.10 | (1.10) | 1.5093 | NS | O | 24.70 | (5.32) | 0.5447 | NS |
| | C | 6.67 | (3.10) | | | C | 26.92 | (11.74) | | |
| Lobeta | O | 3.36 | (1.32) | 0.1269 | NS | O | 17.33 | (5.38) | 0.3539 | NS |
| | C | 3.43 | (0.97) | | | C | 18.31 | (6.91) | | |
| Beta | O | 3.49 | (0.82) | 0.5477 | NS | O | 11.58 | (5.34) | 0.1032 | NS |
| | C | 3.27 | (0.54) | | | C | 11.30 | (6.72) | | |
| Hibeta | O | 3.72 | (0.73) | 2.7861 | .02 | O | 12.58 | (6.12) | 0.7341 | NS |
| | C | 2.92 | (0.54) | | | C | 10.39 | (7.18) | | |
| Gamma | O | 1.04 | (0.28) | 2.2746 | .04 | O | 5.53 | (2.15) | 0.5943 | NS |
| | C | 0.77 | (0.25) | | | C | 6.40 | (4.10) | | |

O = Eyes open; C = Eyes closed

There are more differences in the brain field than in the heart field when comparing eyes open to eyes closed. At Fp2, in the awake-alert condition, amplitude is higher with eyes open in delta, theta and gamma; in the drowsy condition it is higher with eyes open in delta, hibeta and gamma. In the heart field, the only difference is in delta; in the awake-alert condition amplitude is higher with eyes open. The fact that these differences occur only in some frequency bands indicates that they are not due to a pervasive, unidirectional artifact. This in turn suggests that they may be valid indicators of a real change in psychophysiological state.

When the awake-alert and drowsy conditions are compared, significant differences are observed in both the brain and heart fields, however the pattern is different. At Fp2, the amplitude is higher in the drowsy state with both eyes open and eyes closed in hibeta and gamma. In the heart field, the amplitude is higher in delta and theta with eyes open and with eyes closed in the awake-alert state; it is higher in gamma in the drowsy state. These findings indicate, again, that no pervasive unidirectional artifact is occurring. They also indicate that the electrical fields of the brain and heart vary simultaneously but differently with psychophysiological state. This is not surprising, given that heart and brain have different functions and different surrounding anatomical structures.

In general, the variability in amplitude of the body's electrical field at different locations should diminish as one proceeds down the Glasgow coma scale, and become zero after death. It therefore makes sense that there was less difference in eyes open versus eyes closed over the heart in the drowsy state than in the awake-alert state.

The findings demonstrate that it is possible to take recordings with standard EEG electrodes at peripheral body sites, and to obtain signals that vary with the psychophysiological state of the organism. Therefore, in principle, it is possible to study any psychophysiological state of interest with EEG electrodes over the body as a whole. Sites of particular interest include major nerve ganglia such as the cardiac, celiac and hypogastric plexes, which correspond to several of the classical chakras. The theory of human energy fields predicts that "I feel it in my heart" and "gut feelings" are not simply metaphors or figures of speech. Instead, they are subjective acknowledgments of the fact that the body's electromagnetic field participates in processing of and response to environmental input, as well as internal information originating within the organism.

Findings from one person at one peripheral location cannot prove that the theory is correct. More data from more individuals across a variety of psychophysiological states are required to reach any final conclusion. The purpose of the present experiment was to gather data demonstrating that such a field of study is technically feasible with readily available technology. Many possible future studies can be envisioned. For instance, the theory predicts that the body electromagnetic field of a person with bipolar mood disorder varies measurably between the manic and depressed states. Similarly, a person with posttraumatic stress disorder exposed to laboratory triggers will exhibit greater abdominal energy field reactivity than a control person without posttraumatic stress disorder.

It follows from this prediction that neurofeedback protocols for the physiological arousal and hyper-reactivity symptoms of posttraumatic stress disorder could be directed at the hypogastric and celiac plexes.[6] They might be particularly useful in individuals who failed to respond to cognitive therapy or brain neurofeedback protocols. The theory further predicts that individuals with posttraumatic stress disorder who respond to medications will exhibit normalization in not just their brain electromagnetic fields but also in their abdominal electrical fields. Additional and related predictions of the theory are available in Ross.[1]

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