

## **ECG SPECTRA: THE MEASUREMENT OF COHERENT AND INCOHERENT FREQUENCIES AND THEIR RELATIONSHIP TO MENTAL AND EMOTIONAL STATES**

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### **INTRODUCTION**

Research at the Institute of HeartMath has shown that people capable of generating deeply focused love create coherence in the power spectrum of the electrocardiogram (ECG). The normally scattered and incoherent power spectrum of the ECG can become dramatically ordered and coherent when a person experiences deep feelings of love, care, or appreciation. On the other hand, feelings of anger, worry or frustration create incoherent ECG patterns. Changes in the EEG, as well as the ECG, are also seen over time as a person practices mental and emotional self-management to transform negative emotions into positive ones.

Numerous scientific studies have shown that negative mental and emotional states (such as hostility) create hormonal imbalances which weaken the heart (1) and the immune system (2). Feelings of care have been shown to increase the production of salivary IgA (3) which is an integral part of the immune system known to protect against colds and flu. Feelings of anger and frustration are known to cause an overproduction of the hormones norepinephrine, epinephrine, and cortisol, which can increase the risk of suffering from acute coronary events (1). Psychoneuroimmunology (PNI) research continues to confirm the mind-body link. We propose that the heart's electrical system plays a key role not only in physical health but in mental and emotional health as well. We are suggesting a new discipline: Cardioneuroimmunology (CNI).

Since the heart produces the strongest electromagnetic field in the body, the basis of CNI is that the heart is the master oscillator (4). It is well known that the heart's signal is distributed throughout the human system. At an energetic level, all cells in the body exist in this electromagnetic field. This field can be classified as generally either coherent or incoherent. The state of coherence or incoherence of the body's electromagnetic field is shown in the frequency domain of the ECG. Our hypothesis is that the ECG frequencies (spectra) affect hormonal secretions in the body. Our research indicates that individuals who have a higher ratio of coherence in their ECG spectra tend to live happier and less stressful lives (4).

### **METHODOLOGY & EQUIPMENT**

ECG was measured with a Grass ECG Pulse amplifier fed to a BioPak A to D converter, recorded on a Mac II CI computer. The interbeat interval (IBI), respiration and four channels of EEG were simultaneously recorded using Grass wide band EEG amplifiers. Test subjects were seated in a screen room with electrodes placed over the back and front of the heart to minimize muscle artifacts. Electrodes were also placed on the left and right temporal lobes, the top of the head (CZ), and the back of the head (PZ). Additional experiments were conducted where electrical recordings were monitored simultaneously at the top of the head, the heart, and the base of the spine. ECG, EEG and heart rate data were analyzed by Fast Fourier Transform (FFT) analysis to determine the frequency spectra. Spectral analysis has the capacity to reveal characteristics in a signal not apparent in the raw data (5).

## PROCEDURE

All test subjects were first interviewed and given a written test by IHM staff psychologist Dr. Deborah Rozman to determine their overall mental/emotional stress level. Ten individuals trained in mental and emotional self-management and ten control subjects not trained in self-management methods were asked to enter into different states, such as love, appreciation, care and worry. A baseline recording was first obtained. Markers were placed in the computer recordings to indicate the points at which the test subjects were asked to change states. Any significant events were recorded in the computer log as they occurred.

## RESULTS

ECG frequency spectral patterns can be divided into two basic categories, coherent or incoherent (Figure 1). When the data was viewed in 10 second epics, not all epics showed coherence. Rather, what was seen was a ratio of coherent to incoherent patterns. The degree of coherence was defined as a percent of the total coherent to incoherent epics. Feelings of anger, frustration and worry created higher percentages of *incoherence*, while feelings of love, care, or appreciation created higher percentages of *coherence*. These ECG spectral patterns were highly reproducible. Control subjects who were not practiced in mental and emotional self-management often expressed feelings of anxiety or frustration while being tested and could not readily change states to deep feelings of love when asked to do so. Psychological questionnaires revealed that control subjects had more mental and emotional stress in their daily lives than did test subjects. Test subjects who consistently produced coherent ECG frequencies showed more ability to manage their mental and emotional reactions to stressful events in day-to-day life.

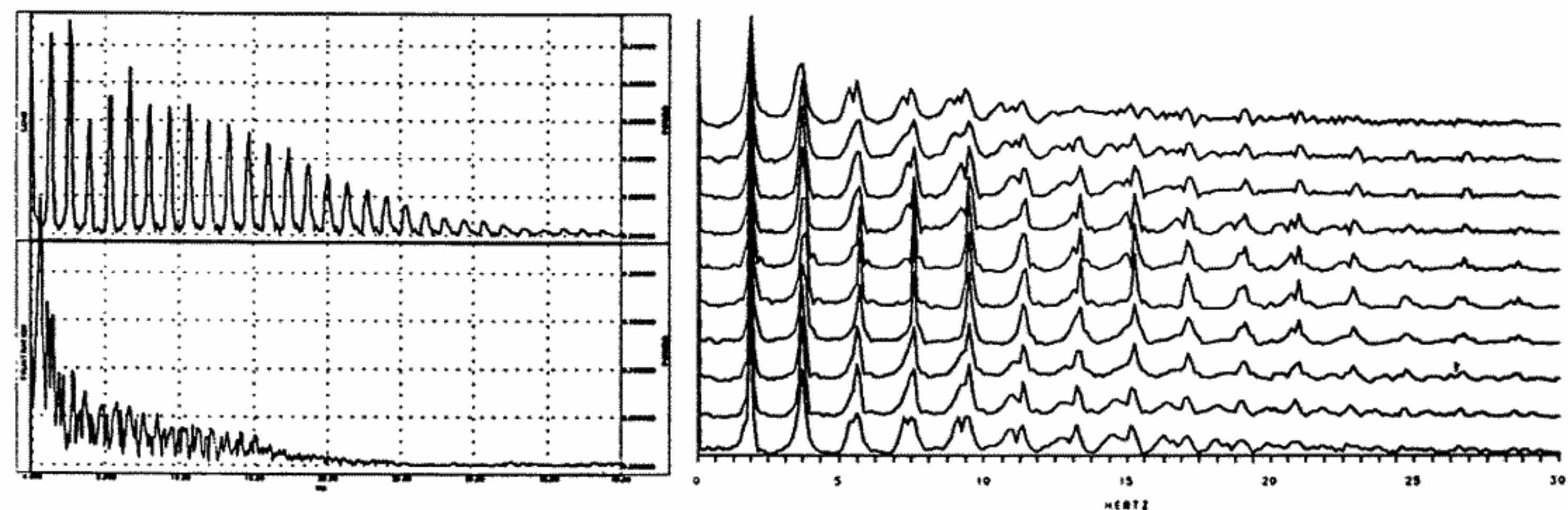


Figure 1. The top left is the ECG frequency spectra when the subject was feeling deep and sincere love (coherent). The lower left spectra is of a subject feeling frustration (incoherent). The chart on the right is ten consecutive 10 second epics of ECG spectra. There are varying degrees of coherence from epic to epic. We consider this chart to have a high degree of coherence (85%), although one subject in particular could maintain a state of focused love and produce 100% coherence at will for long periods of time.

We are not yet able to identify a particular emotional state such as anger with a specific incoherent spectra; nor can we differentiate between love and appreciation in the coherent spectra. However, basic patterns are starting to emerge (Figure 2). In the incoherent spectra, frequencies were constantly changing and did not create a series of standing waves. In the coherent spectra, the frequency distribution is clearly defined as a series of standing waves. One individual was able to create hours of consistently coherent data at will, while others were only able to produce consistent coherence until their focus faded. Control subjects were only able to produce random coherence at low ratios.

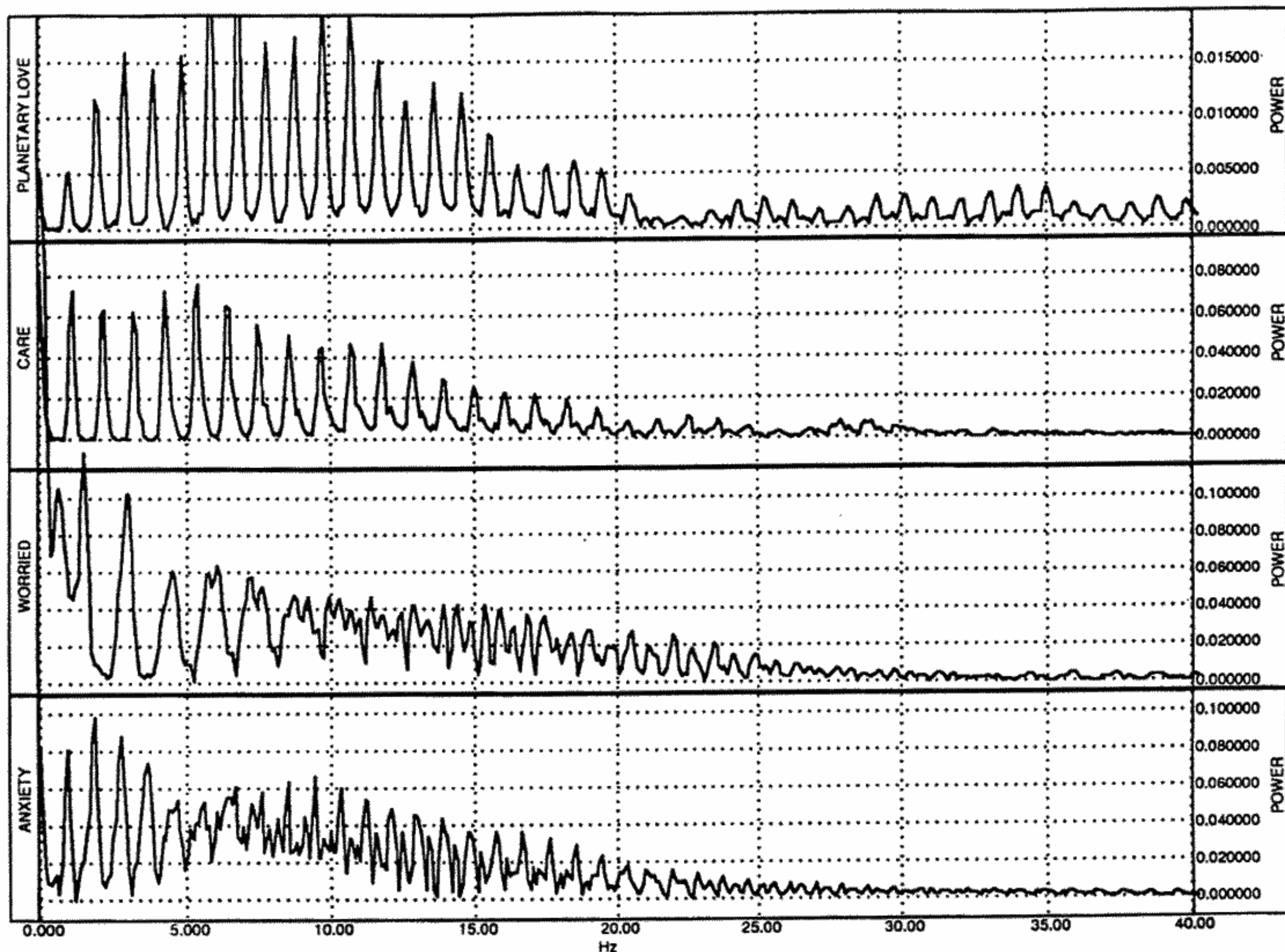
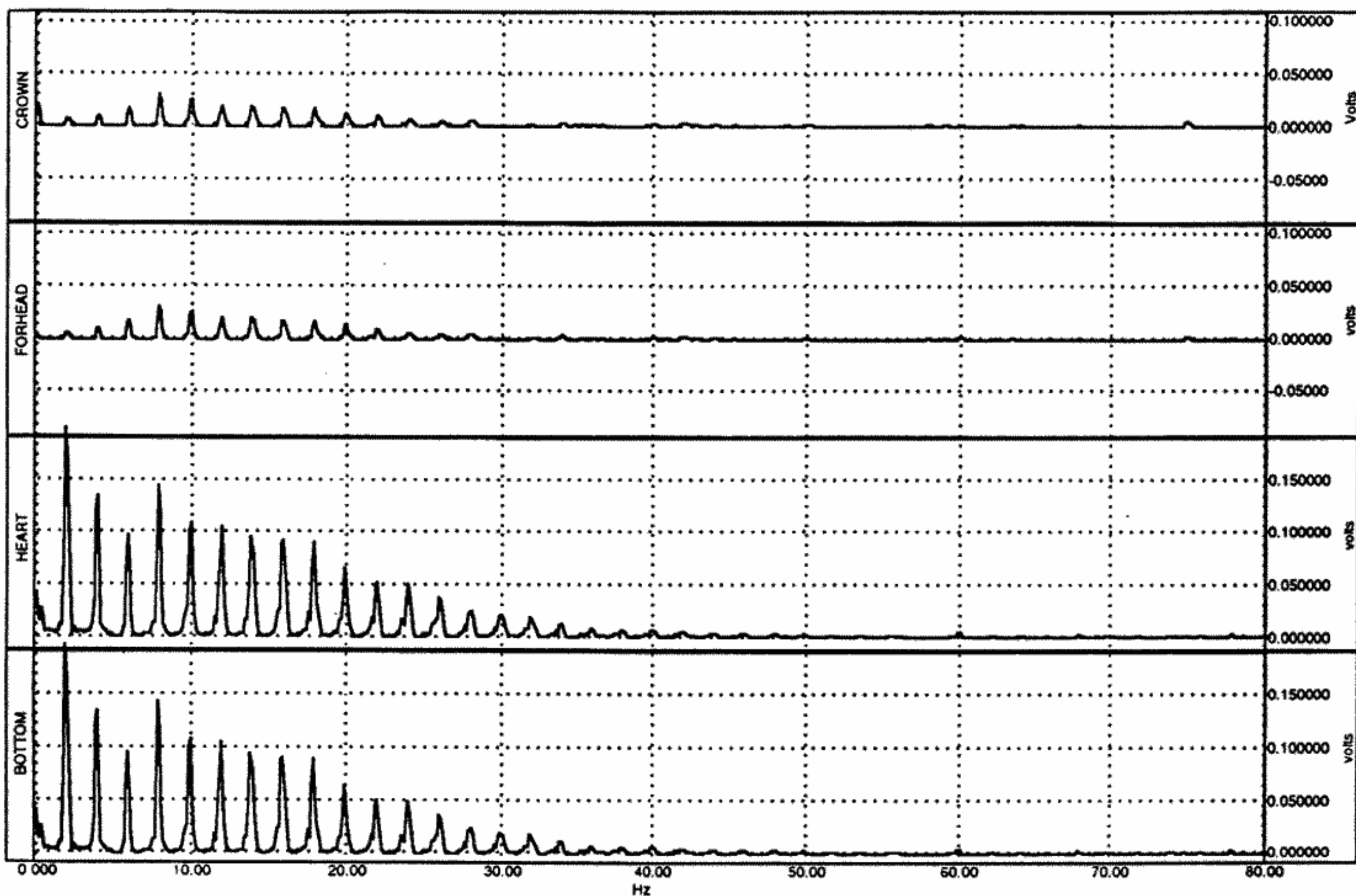


Figure 2. ECG spectra while the subject was in different states. The top two, planetary love and care are coherent. As the subject changed states from love to worry or anxiety, the coherent pattern became increasingly incoherent as shown in the bottom two spectra.

Figure 3 shows the frequency spectra of the electrical activity at different locations on the body. When the heart is radiating coherent frequencies, the rest of the body's sub-systems and cells, including the brain, operate within that coherent electro-magnetic field. The top of the head, the forehead, the heart and the base of the spine were simultaneously monitored. What was consistently demonstrated is that the heart spectra has to be coherent in order for coherence to occur in any other location.

Out of the 20 subjects monitored in this series of tests, a correlation was found between ECG coherence and a predominance of delta and theta EEG frequencies which are normally associated with feelings of deep peace and transcendent states (6). These individuals also showed a remarkable ability to lower the EEG amplitude at will when asked to do so. It is also worth noting that an unusually high amount of very low frequency (sub hertz) high amplitude EEG activity was observed in some.



**Figure 3. ECG FREQUENCY DISTRIBUTION.** Electrodes were placed on the top of the head, forehead, heart, and base of the spine. The heart's electrical energy is distributed throughout the body and can be recorded at any point. In this chart, the spectra are coherent at all the measured locations.

## CONCLUSION

From the results obtained in this research, there is a correlation between the subjects' mental and emotional states and the frequency spectra of the ECG. When the subjects sincerely felt love, care, or appreciation, the spectra changed to a more ordered and coherent frequency distribution. On the other hand, when the subjects were in a state of frustration, worry, or anger, the ECG spectra was disordered and chaotic. Heart frequencies create an electro-magnetic field which is distributed throughout the body. The degree of coherence in the heart is the major determining factor for coherence in the rest of the body, suggesting the possibility that ECG frequencies have profound effects on overall health and well being. Psychological evaluations confirmed that subjects who produced higher percentages of coherent ECG frequencies were better able to manage their mental and emotional natures and their reactions to stressful events in day-to-day life.

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