HeartTuner
User's Manual (Preliminary v 0.92)

Version 0.9, July 2002. Edited and assembled by Hinze Hogendoorn, with acknowledgements to Dan Winter for the original text, and Jan and Marc and many others who have supported this project.

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A. Introduction and Installation

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1. Background

The new HeartTuner (replacing the earlier HeartLink) is a paradigm changing biofeedback device, primarily offering harmonic and analysis of heart voltages. Like most biofeedback devices, the HeartTuner makes no medical claims, rather, it is an experimental tool intended for research.

The system can also optionally offer brainwave harmonic analysis and display, especially using optional EEG electrodes. The primary and distinguishing feature of the analysis and display is based on Dan Winter's work pioneering the use of a 'second order' power spectra or 'FFT' (Fast Fourier Transform) called 'septrum', which elegantly provides an almost instant measure of ‘harmony’, as well as a dynamic display of the key frequency signatures that are coherent. Furthermore, the raw data are also available for future-release specifically designed biofeedback games and can be used for sharing over the Internet. However, it is not at all necessary to understand the mathematics to enjoy exploring the relationship between coherent emotion and heart coherence, or to see when someone you care about is quite literally ‘on the same wavelength!’

2. Hardware:

Figure 1: Heart Tuner main unit, with paperclip to indicate size

The hardware part of the device consists of a small white box with the size of a cassette tape with a molded one meter connection cord with a 9-pin female serial connector, two EKG wires with electrodes, two sets of wristbands and a head band, and a CD-ROM with the necessary software and a printable manual. Additionally, a serial-to-USB adaptor for connection to a USB port, a 'biological capacitor' probe for life-force measurements, or an inductive ‘electro-smog’ probe are or will be available. The device is shipped in a convenient plastic box.

- 2 data channels variable EKG / EEG gain, 2 HRV channels, Preamplifiers, Analog to Digital Converters, FDA / UL Approved Safe Battery Powered and Opto-Isolated main unit

- Output to Serial Port PC (Win 98 / Millennium) with optional USB adapter - (all PC Operating Systems except Win95 - See Below)

- Standard equipment: 2 sets of convenient wrist strap ECG electrodes with durable conductive coating good for hundreds of uses, with no messy paste

Figure 2: Complete Standard equipment: Main unit, Electrodes, Head band and Wristbands

Optional:

- 1 or 2 channel EEG brainwave electrode set (note: 2 channel Brainwave/EEG Coherence CAN be usefully measured with the standard EKG cables supplied.)
- Callahan Probe Biological Life Force Probe
- Inductive Electro-smog probe

3. Software:

The software includes a data monitor that shows the plain data and the mathematically derived data in clear, automatically scaled graphical plots. The program has the ability to save and retrieve measured data. A simple game environment has been created to display the biofeedback data in a more stimulating manner. This program runs on top of the monitor program. Amongst plans for future releases is a utility to share the biofeedback data over the Internet with many other people connected to a HeartTuner in order to make collective biofeedback experience possible. Updates of the software will be available on the internet website. For developers there is a special software development kit available that can be used to develop games and creative representations of the data.

The manual contains all the necessary instructions for setting up and using the hardware and the basic software. The website www.heartcoherence.com has been set up to promote the HeartTuner and give customers access to the additional services. The website will also host a HeartTuner server for distributing HeartTuner biofeedback data and communications among groups of users on-line. A database of customers will be created as well as a database of people interested in the product and therapy.

4. Configuration notes:

HeartTuner software is compatible with Windows 98, NT, 2000 and XP. It is not compatible with Windows 95. We recommend that you install the software on a computer with a processor speed of 233MHz or higher.

Monitor Display Size: 1024 x 768 pixel strongly recommended.
800 x 600 pixel : requires SCALEABLE version of software – see installed instructions.
640 x 480 pixel: NOT RECOMMENDED – may work with SCALEABLE version.

Our new hardware includes Universal Serial Bus (USB) support with an optional USB adapter for simple Plug-and-Play installation. We designed our USB adaptor to work with standard Windows drivers for maximum compatibility. Depending upon your hardware and which version of Windows you are using, you can continue successfully to use the serial port or you may need to purchase the USB adapter ($100) for seamless installation and compatibility. Please consult the table below to find out whether you need to use a USB adaptor.

Operating System	Serial COM Port	USB Adapter
Windows95	Not recommended	Incompatible

Windows98	Compatible	Compatible
WindowsME	Compatible	Compatible
WindowsNT	Incompatible	Compatible
Windows2000	Incompatible	Compatible
Windows XP	Incompatible	Compatible

Table 1: Heart Tuner compatibility across platforms and interfaces.

(This is due to the way, the newer Windows operating systems do not allow full control access to the serial port - USB is becoming more standard - next generation HeartTuner will be USB only)
Note: Software ships default to read the USB port. If you wish to operate with serial / COM port (without a USB adapter plug), then drag (replace) the special device.ini file into the folder with the program from the folder labeled: SerialDevice.

After installation of HeartTuner software, you should have 3 .dll files in the folder with the software - The files required include Usbrs.dll, Xxdriver.dll, stddriver.dll, and also Device.ini. If you are using the USB adapter (necessary for Windows2000 & XP, optional for 98 & Millennium Edition), your Windows software should automatically find and install the HID -Human Interface Device Driver - when you plug in the USB cable connected to the HeartTuner.

5. Apple Macintosh Users

The HeartTuner has been tested on Apple Mac computers using Virtual PC v.5.0. Be sure to set USB ON in the Virtual PC options - suggest specifying 64 samples second speed on the HeartTuner. While HeartTuner runs in this environment, unless you have a fast Mac - it is likely the sample rate will after a couple minutes get ahead of the display rate - resulting in an undesirable delay of feedback time from actual emotional experience time. You can periodically restart the display as a workaround. We are working to optimize for this environment - meantime we can provide only limited help for Apple Mac users.

B. Basic Operating Instructions

1. Starting to use the HeartTuner
2. Itemized Explanation of Screen Functions
3. Guidelines for using the HeartTuner
4. Troubleshooting

1. Starting to use the Heart Tuner

- **Software and Hardware Installation.** The HeartTuner can be attached to your computer either using the USB or serial port cable. When using the serial port it is recommended to turn off your computer before plugging the unit into your computer’s serial port. Using the USB cable, it is not necessary to turn

off your computer; simply plug the cable into an available USB slot and it should work.

Insert the software CD into your CD-ROM drive and run the file Setup.exe. Alternatively, you can access the directory Files and copy all files in this directory to an empty directory on your hard drive. The program should initialize when run for the first time.

Additional notes about software install: The software is normally supplied to owners Of HeartTuner on CD in a folder called 'privatetuner'. It can also be located on a Confidential web site offered to purchasers – more info contact heartcoherence.com The instructions to install the software are contained in the index.html file in that Folder, which is to be opened with your web browser.

It is better to install the software with the proper setup.exe , rather than unpack it From the offered zipped folder, as this properly registers the dll files. Note the Scaleable 800x600 software version is only needed for those unable to display the Better 1024x768 monitor pixel array.

Note when installing the game software separately, it is best to locate the HeartWaves Valentine game software INSIDE of the HeartTuner01 software folder, as this will Enable the game software to find the necessary Eidata.txt file, coming out of the running HeartTuner without having to edit the options file inside the game software.

II. **Attaching People to the HeartTuner.** Up to two people can be attached to the HeartTuner simultaneously. Plug the cables with the electrodes into the front of the main unit. If using only one person, the other socket can be left empty. The electrodes coming from the socket nearest the red light on the main unit correspond to channel B (the **red** channel) in the HeartTuner program. The electrodes from the other socket correspond to channel A (the **black** channel).

Figure 3: Attaching electrodes to persons

Subjects should fit the athlete's wristbands around their wrists, so that they fit snugly but are not too tight. Subsequently slide one electrode under each wristband, so that one person is attached to one channel. Please see figure 3. It is important **not** to use any conductive paste under the electrodes.

III. **Collecting Data**. Once software and hardware have been installed, and one or two people have been attached to the HeartTuner, then you are ready to start collecting data. Double-click the HeartTuner icon in the directory in which it was installed, or the shortcut that you may have chosen to place on the desktop, to run the program. You will see a screen such as the one shown in Figure 4 in the next section. Using only the default settings, you should be able to collect and display heart-rate information. Press Start in the bottom-left hand corner to start collecting data. It is important that subjects are still while data is collected, because muscle movement can cause a lot of noise in the electrical signal. The graph in the top left of the screen is a representation of your pulse. After a while it should settle down to a relatively stable wave. The rest of the HeartTuner's functions, as discussed in the next section, are all based on the information shown in this wave.

2. Itemized Explanation of Screen Functions

Figure 4: Itemized Display of Screen Functions

- File Menu.
  Open - existing data file for redisplay. Note that the HeartTuner program needs to be closed and reopened before opening, because otherwise the data to be opened will interfere with data from the current session and cause an error message.
  Save and Save As - to store data files from most recent session. This saves the data as log.txt, which contains all the raw and processed data needed to completely review the session.

Additional notes about save and re-open raw data:
The save raw data under file menu, produces a file called "Log.txt"
Which contains all the raw data, of the most recent HeartTuner session
It is recommended that you RENAME this file to a different name
(logA.txt etc…) because HEARTTUNER WILL AUTOMATICALLY
OVERWRITE THIS log.txt file when you start your next data session!
It is also IMPORTANT TO NOTE: that you can only open and replay a raw data session File with hearttuner immediately after re-starting the software – this is because Data stored within hearttuner during an existing session would interfere with The replay of old data. Also note how powerful it can be to open that raw data file In a spreadsheet software environment like Excel, to edit, process and redisplay your data.

Close and Exit – Exit program

- Help Menu: For the time being please refer to this document.

C & D. Raw voltage data display for Channel 1 (Black) and Channel 2 (Red). Note the RED Channel user is ALWAYS the cable plugged into the device next to the small red LED on the front of the hardware device. The bulb lights RED during device initiation, and blinks during shutdown. The raw display of voltage is similar to ECG when connected to the wrist electrodes. Using optional accessories, brainwaves, 'Callahan life-force' and electro-smog voltage measurements are also displayed here, depending on which transducer is plugged into the HeartTuner, and also depending on the GAIN control setting (see U. below).

E. Red Channel Relative Gain. This allows 2 users to balance their relative input raw data for more balanced auto scaled data displays in the harmonic cascade plots (F). A small adjustment is useful here if either the red or black user has a weaker heart voltage input signal. This can be caused by a myriad of variables, including skin conductivity, wrist strap tightness, and of course heart strength - even body fat affects the heart voltage at the skin. Moving this to the right **increases** the gain on the **red** channel.

Note about auto-scaling: All of the plots in the HeartTuner displays are automatically scaled. This means that the relative height or amplitude of all displays automatically adjusts itself to maximum display resolution depending on the averaged input signal size. This is very useful in one important respect, being that even when input signals are very low or very high the display will auto adjust to give you the most visible graph space possible to see the shape of your data wave. However, because of this feature, it is very important the user understand that whenever you get a big noise peak (typically your subject has moved suddenly), the data display jumps to low resolution to display that peak (which is noise). The solution is to be still and wait for the data the re-settle to a stable baseline once again. In some cases, especially on the 'cascade' plot harmonic displays (F & M), this means waiting until the whole series of plots where the noise happened scroll up off the screen (10-15 plots can take a minute or two.) Also remember that even noise you cannot see initially (such as electric interference at a higher frequency from nearby electronic equipment ('electro-smog')), can cause this problem. If you suspect you have some higher frequency noise, try clicking the LIN versus Log plot switch (near K, and to the right of S.) first on then off.

- First Order Power Spectrum, (harmonic, cascade, or waterfall plot). This is a common way to analyze the harmonics present in a biological signal. The bandwidth here from 2-20 hertz is the same frequency window used to study brainwaves (Alpha, Theta, Delta), and the Shumann resonance low-frequency planet magnetic 'heartbeat'.

This plot can be double clicked to expand to a full-screen display (as can the 2nd or Septrum coherence plot bottom left (M)). To close the full screen view, just click close in the standard windows top right 'X' box.

- Scale in Hertz for First Order Power Spectrum. Consecutive measurements are displayed above each other, most recent at the bottom.

- This vertical slider bar controls the AMOUNT of space vertically between graph lines in the vertical waterfall of both Power Spectra, and Coherence displays. We recommend approximately 80% for the initial setting here.

I. Angle Checkbox. When checked causes the vertical waterfall display plots to cascade at an angle - 'walk' gently to the right as they are plotted up the screen.

J. The Pan /Zoom check box. Checking this box allows you to pan - that is click on the scale numbers of the harmonic display (G) and drag the mouse right or left. This allows you to see higher frequencies displayed (up to 100 hertz or so depending on sample rate). This is particularly important when checking for environment electrical noise. (There is a 50 - 60 Hertz filter built into the main unit - nominally set to 50 hertz. If you need 60 hertz filter (U.S.) this can be enabled in the Device.ini file). Unchecking the Pan/Zoom checkbox again allows you to use the mouse to select any area in the rolling graph and zoom in to plot only that area. Additionally, this turns off the auto-scaling function for the plot, effectively fixing the axes. To reset the zoom (i.e. to zoom out), just click the Lin/Log toggle (K) on then off.

K. The Lin/Log toggle check box. This toggle allows you to display the harmonics as a logarithmic plot instead of linearly. In effect this makes higher frequencies visible in one plot, but compresses the right hand side of the plot together with somewhat less viewing resolution. Generally again, this is useful for checking higher frequency environment noise and electro-smog, but is usually OFF when viewing heart and brain harmonics.

L. Horizontal scale for Power Spectrum. It measures frequency in Hz.

M. Second Order Power Spectrum (Septrum) plot. This graph is unique to HeartTuner, and its primary experimental feature. The waveform of the first order Power Spectrum is input to a second order FFT/Power Spectra to yield this Septrum plot. This Septrum time history display presents a measure of coherence in yourself, or any living thing. The amplitude, or height of the first peak (left) of this display is the measure of coherence. If the harmonics of the first order power spectrum (F) are an evenly spaced cascade, such as a musical chord, then this peak grows.

N. O. & P. Blue lines on the Heart Tuner Screen. These lines mark Emotional Index values, which seem to be experimentally correlated with emotional

states. Line N marks the value 0.618, which is the Golden Mean Ratio. Line O marks .79, which is the square root of the Golden Mean Ratio, and line P marks 1.0. Experience with HeartLink and HeartTuner users has shown that a large percentage of people stabilize on or around one of these Emotional Index values. Studying emotional and psychological states and the plots that correspond to them is the primary use of the HeartTuner in research.

Q. Horizontal Scale for Septrum plot. This scale indicates at which Emotional Index value harmonic coherence is evident.

R. Vertical Scale for Septrum plot. This scale indicates the degree of coherence in peaks on the Septrum plot. Because the plot dynamically scales to best fit waveforms, this scale is constantly shifting.

- S. Start / Stop / View Log File Buttons. Click start to begin measuring and displaying data. Click Stop to stop measuring and displaying data and to shut down the hardware. It is important to click 'Stop' to shut down the hardware before quitting the program, because otherwise the hardware may not shut down properly. The light on the main unit blinks white during shutdown. If you try to restart the HeartTuner software without an orderly 'stop' shutdown, you may get an error message (unable to access hardware). If this happens, simply unplug the cable to the computer from the hardware, wait 5 seconds and reconnect - then proceed.

- T. Log File Location. Selects where the data log file will be stored. This log file is called log.txt. This allows to click 'Open' under File, then browse to this raw data file, and then replay and re-analyze full data session files. Note: if you wish to keep the raw data from a session either rename the log.txt file after data 'stop' command, or hit save-as under file after data stop. Otherwise, every time you click the data 'Start' button, your log.txt raw data file is overwritten. This switch also controls where the EIdata.txt file is stored, which contains only the recent Emotional Index and coherence number. This is important to allow import to game (Heart Valentine) software, so it can import interactively. Note that if this address is set to a non-existent drive or folder, you will get an error message on start.
  Your raw data file log.txt contains **all** the input numbers. The EIdata.txt file is only updated interactively with the last EI and coherence number measured (keeping only 1 pair of numbers at any time) to allow game programs easy access. You are invited to examine and learn about both files by opening them in Spreadsheet software (like 'Excel' or 'Lotus' etc).

- U. ECG/EEG Gain Switch. Sets each channel gain from standard (ECG) to High Gain (EEG). EEG / Hi Gain is also used for plant / tree/ life force measures (capacitive). Inductive (coil input) electro-smog measure can use lo gain (ECG). Use Hi-gain only when you are sure you are not over-saturating the pre-amplifier. If the raw data (channel A / B top left) is over 2000 µV total

when using EEG setting then your gain is too high, and you should switch to ECG setting. When comparing ECG to EEG - for example, head / heart link up, we recommend setting the red channel (channel 2) to higher gain (EEG). Important note: because the HeartTuner uses the gain input control in the device initialization parameters, always set the gain before you start collecting data. If you need to change the gain, it is necessary to stop the device, quit the HeartTuner software, and finally restart the software. (Restarting the computer should not be necessary). This does not apply to the relative gain slider (E).

- An additional linear / logarithmic scale display option for Harmonic Power Spectra (without time history waterfall as in F).

- Heart Rate Variability display and selection button. Heart Rate Variability (HRV) is one of the most important measurements of heart health known today. By displaying HRV more dynamically (faster refresh time) the HeartTuner is 'state of the art' in helping users ‘feel’ almost 'real time' how to change it. HeartTuner displays HRV for one channel at a time (2 at once would complicate the display and slow down CPU response). The button at X switches which channel (person A or B – B is the red channel, and so the one plugged nearest to the red 'ON' light) is seeing their HRV. Note here: it takes roughly a full minute for HRV data to appear since it takes relatively long to get low-frequency data input. Since this averaging will carry over when you switch users, expect to wait a few minutes before expecting the HRV display to reflect the new user. We recommend you simply hit Stop and wait 10 seconds for the device to close. Then you can switch the HRV channel input using the selection button and click Start to start measuring data again. The HRV is only used for heart data, (ECG) so ignore the HRV display when you are measuring brainwaves or other 'life force'/'electro-smog' inputs.

- Heart Beat Interval (Interpeak time graph / 'Tachogram'). Like the HRV display, this display shows either channel A or B, depending on switch X. This plot goes up and down to reflect the time in milliseconds between heartbeats. Breathing in usually raises heart rate slightly, and breathing out decreases it. As a result, this graph is essentially a visual representation of your breathing.

3. Guidelines for using the HeartTuner

Batteries
Display Resolution
Gain Control
Noise
Interference
Emotional States
Power Spectrum

Septrum Plot

Batteries: Note that the HeartTuner main module uses a single 9V battery. If your unit stops functioning, it may be up for replacement. The module uses about 6.6 mA during normal functioning, and given an average battery's capacity of about 500 mA-hours, this means one battery should last for approximately 75 hours of use. The module draws a neglible 3 µA when not in function.

Display Resolution: HeartTuner has been designed to run in 1024x768 resolution. If you run in lower resolutions, you may not be able to see the entire screen. In 800x600 resolution, some text annotations may seem out of place, and the graphs will be smaller and have less visible detail. Therefore we recommend

Gain Control: There are two places where gain can me manipulated in the HeartTuner. First of all, there is the relative gain slider under the raw data window. (E). Fine tuning this gain is an important way to optimize results when using the HeartTuner using two channels. By moving the slider bar, you can compensate for different signal strength. Although a strong signal is more resilient to noise, signal strength does not necessarily say anything about the person being measured.
The second place to control gain is using the EEG/ECG switch (U). The EEG setting has a maximum input strength of 2 mV (2000 µV), and the ECG a maximum of 5 mV (5000 µV). Above these levels, the amplifier is saturated. Note that when changing this setting, it is necessary to shut down the program and restart it.

Noise: If you see a noisy screen on the Septrum display when using wrist electrodes, before you try repositioning or replacing the electrodes (usually unnecessary), try simply pressing the plugs on the electrodes firmly into their sockets for a few seconds to improve the connection. This is also sometimes necessary if your subject has moved around, loosening the connection. It is important to move the electrode arrangement as little as possible during actual data taking. If this does happen, there is no damage to the equipment, but there will be noise as a result. You will simply need to wait a minute or so before the HeartTuner will stabilize and produce meaningful measurements once more. Because of this, it is often preferable to have a person not connected to the HeartTuner control it (adjusting gain, changing settings, and taking screenshots).

Interference: Proximity to electronic or magnetic appliances, cables, or sources of any kind can cause interference. Especially desktop computers and Cathode Ray Tubes such as standard monitors and televisions can generate interference in the 50 Hz region. The HeartTuner does have a built-in filter for 50 Hz, which can be set to 60 Hz for the United States, but for most measurements it is still recommended to try to minimize interference from non-biological sources (unless of course you are trying to measure this interference, for example in the form of electro-smog). Avoiding mains electricity sockets, using flat-panel TFT monitors instead of CRT monitors, or better yet, using a laptop running on batteries rather than a desktop

computer running on mains electricity to carry out measurements are all ways to minimize interference.

Emotional States: One of the most interesting applications of the HeartTuner is to investigate whether different emotional or conscious states of mind affect the waveforms in the cascade plot and the Septrum plot. There are many indications that they do. The next step is naturally to study whether and how people can consciously affect the waveform in these two plots. Interesting phenomena to study can include, but are of course in no way limited to:

- Subjects who are in love, and how interaction affects their waveforms
- Subjects meditating, relaxing, or even sleeping
- Subjects working on intense conscious processes such as calculating
- Subjects reading or watching emotional, ethical, or intellectual dilemmas
- Subjects occupied doing something they enjoy or do not enjoy
- Subjects doing routine or varied work
- Subjects successful at a task or frustrated at failure

Power Spectrum: Experimental evidence suggests that a set of regularly spaced peaks with slowly decreasing heights corresponds to high emotional well being, such as relaxation or appreciation. A noisy signal in this window can be the result of noisy data from the sensors, but it does not have to be, and in cases where noise does not seem to be the cause, frustration or some other sort of agitation seem to correlate quite well. Note that a great deal more evidence is desirable to substantiate any claim with respect to this spectrum, and it would be wrong to conclude that any kind of waveform is 'better' or more desirable than any other, either in this plot or in the Septrum plot discussed below.

Septrum plot: This is the primary innovation of the HeartTuner device, and as such there is little in the way of large-scale research into phenomena that become evident using it. Large, distinct peaks seem to correspond to concentration, relaxation, or other relatively stable, calm states of mind, whereas broad, rapidly shifting peaks are more commonly seen with perturbed or uneasy subjects. Furthermore, the location of the peaks along the x-axis (provisionally called Emotional Index) seems to be significant. For this reason, the marker lines (N, O, and P) have been included. For a complete table of Emotional Index values, please see www.HeartCoherence.com. In short, it seems that peaks around 0.618 (N) correspond to emotional emphasis, and peaks around 1.0 (P) seem to correspond to intellectual emphasis. Again, it is emphasized that the observations noted in these guidelines should not be seen as an indication of what is more desirable.

It is Dan Winter's suggestiont that this 'Septrum' plot – a second order Power Spectra – does in fact elegantly measure COHERENCE. (The Amplitude change of the first primary peak.) It is true that by inspect you can observe that when the harmonics in the first order standard power spectra become evenly spaced in phase, that that 'COHERENCE' event DOES correspond with an increase in the amplitude

of the Septrum peak. For more discussion on the implications of this measure of INTERNAL COHERENCE as an indicator of biological sustainability – see: http://www.soulinvitation.com/coherence

4. Troubleshooting

Error: *"USB or Serial Port not found"* or *" C2 (HeartTuner) device not responding.*

Possible Problem: The HeartTuner program is looking for the hardware at the wrong port. To solve this problem, open the **device.ini** file with a text editor such as Notepad. Carefully check the third line, which should say "com=10" (without quotes) if you are using the USB device, and "com=1" if you are using the serial port device. Then click Save. The device.ini file should always be in the same directory as the HeartTuner program.

Possible Problem: The HeartTuner did not shutdown properly and needs to be reset. To accomplish this, unplug the HeartTuner module from your computer, close down the HeartTuner program, plug the module back in and run the HeartTuner program again. To avoid this problem, always shut down the hardware using the Stop command.

Possible Problem: The battery is low and needs to be replaced. Use a good quality 9V 'brick' battery.

Possible problem: Using incompatible operating system with serial/USB device. Windows 2000 and XP cannot access the HeartTuner hardware via the serial port and require the use of the special HeartTuner USB adaptor. Another possibility is that you are using a USB adaptor not intended for use with the HeartTuner. Unfortunately, generic USB adaptors do not work with the HeartTuner.

Error: *"Runtime file path error"*

Possible problem: This error occurs when HeartTuner cannot write to either of its two constantly updated log files, EIdata.txt and log.txt. Right-click on these files and click properties. Ensure that both Archive and Read-Only are unchecked. Another solution is simply to delete the EIdata.txt and log.txt files. Note that you can choose the directory to which HeartTuner saves these two files. (See (S) above).

Error: The HeartTuner is displaying increasingly delayed data, and the number in the lower left hand corner of the screen is increasing to over several hundred.

Possible Problem: The CPU of your computer is not fast enough to keep up with the HeartTuner. Possible solutions include restarting your computer, and closing down unnecessary peripheral programs. Closing down the non-critical HRV display in the

HeartTuner also reduces load on the CPU; one way to do this is to set both channel A and B gain to EEG at (U).

Error: Unable to register file in Windows Registry during install.

Possible Problem: This error occurs in Windows 98 computers that do not have the Windows 98 Update. This is free to download from www.microsoft.com.

C. "Valentine" Game

The game Heart Waves Valentine is a simple graphical representation of the data calculated in the HeartTuner program, and an example of how to integrate the dynamically updated EIdata.txt file into other programs.

The file EIdata.txt is constantly overwritten while HeartTuner is running, so at any given moment it contains only the data from the most recent refresh. Furthermore, rather than containing information about the entire waveform, it records only the height and EI-value of the leftmost peak in the Septrum. Because of this, it is easily used into other programs, for example to represent this information graphically. This is what Heart Waves Valentine does.

Valentine is installed in the HeartTuner directory, in its own subdirectory HeartWaves Valentine. To run the program, first start running HeartTuner, and then, leaving it running in the background, open HeartWaves Valentine. Using the default settings, you should be able to just click Start in the menu bar to start displaying. Since the HeartTuner is running simultaneously, it is preferable that the persons attached to the HeartTuner do not themselves work with the computer, because both muscle movements and electronic interference from being near electronic appliances cause noise in the HeartTuner.

The Valentine program plots a vector representation of the first peak in the Septrum plot from the HeartTuner on a background image. The angle of the vector corresponds to the horizontal coordinate of the peak in the Septrum plot, or the Emotional Index, and the length corresponds to the height of the peak. Characteristic values of the Emotional Index have been marked on the background with the hypothesized emotional states that correspond to them.

For new users, this program offers a simpler, less cluttered representation of their heart's waveform, and for experienced users, this program allows them to practice consciously influencing it.