The EEGer 4.3 Tutorial

How to Conduct A Neurofeedback Session

1	Introduction	3
	1.1 How To Use This Tutorial	3
	1.2 What You Should Already Know	4
	1.3 Start EEGer	4
	1.4 Main Menu: EEGer4 Top Screen	5
2	Quick Start Guide	6
3	New Client Profile	7
4	Select Client	10
5	Plan the Session	13
	5.1 Set Electrodes	13
	5.2 Change Frequency Bands	15
	5.3 Set Session Length	15
	5.4 Stages $\ldots \ldots \ldots$	17
	5.5 Set Automatic Thresholds: Autogoal	19
6	During The Session	20
	6.1 Begin Session	20
	6.2 Understanding Displays	22
	6.3 Configure EEGer4 Sessions	25
7	Reviewing Sessions	32
	7.1 Graph Review	32
	7.2 Frequency Review	34
	7.3 Review Option Buttons	34
	7.4 Advanced Options	38

8 Spectral Displays

8.1	Settings
8.2	Graph
8.3	Spectral Display Options

9 Advanced Configuration

9.1	Presets
9.2	Changing Colors
9.3	Remote Use

Appendix A Installation of EEGer 4.3

Appendix B Demonstration Only

Appendix C About EEGer 4.3

C.1	Notes Concerning Client Privacy and Safety
C.2	Advantages of Using EEGer
C.3	Licenses

Appendix D Becoming An Affiliate

Appendix E Resources

E.1	Neurofeedback Concepts
E.2	Training Courses in Neurofeedback
E.3	Credits

																		40
															•			40
																		41
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	43
																		45
•																		45
•												•		•				49
•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	49
																		49
																		51
																		52
•																		53
																		59
•		•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	63
																		65
																		65
																		66
																		70
																		71

Introduction 1

Welcome to the EEGer 4.3 Tutorial

Welcome. This tutorial is intended to introduce you to the EEGer 4.3 neurofeedback software and session interface. The software is extremely powerful, so our goal here is to offer some general guidance on beginning the process of learning how to use it. For more information, therapists are strongly encouraged to read the available manuals, to contact technical support, and to take an advanced course in neurofeedback. We hope these pages will inspire you on your journey with EEG biofeedback!

- Skip to the Quick Start Guide
- Read these pages in order.
- Get answers to Installation or General Questions

1.1 How To Use This Tutorial

Two Ways to Use this Tutorial

In this tutorial, clickable links are in blue. For example, this is a link to the table of contents. Key information is in maroon.

And helpful notes look like this.

To use this tutorial, you can:

- 1. Keep it open on a second computer or other device while you install and practice with EEGer4 on the therapist computer.
- 2. Read through it on the therapist computer, using ALT+TAB to switch between this document and EEGer4. Note that some functions may not always work as designed. The first option is usually preferable.

NOTE: You can experience all the features of EEGer4 using the Demo mode with the sample client data. You can replay "raw data samples" which are viewed by the computer as a live EEG. You cannot run live feedback sessions in demo mode – that requires the EEGer security key, or "dongle," plugged into the computer's USB port. You do not need to become an affiliate to use EEGer4, although affiliates do enjoy numerous benefits, such as free technical support.

If the images on these pages appear too small, you may be able to zoom in by using the + button on your pdf viewer, or by holding down the CTRL key and scrolling up.

What You Should Already Know 1.2

Back to the Table of Contents

- This tutorial assumes you understand the basics of frequency and amplitude. For a very basic introduction, see the resources appendix
- Neurofeedback, or EEG biofeedback, can be a powerful experience. It is important that it be used under careful supervision by a qualified practitioner. This tutorial also assumes you've had adequate training in administering neurofeedback. For information about how to become qualified, and for more information about training courses offered by the EEGer community, please see the appendix on training.
- To use this instrument, you must be a licensed health professional, or under the supervision of a licensed health professional. Please read the disclaimer and the software license carefully.

Links to further reading can be found in the resources appendix. This tutorial is focused on how to set up and run the therapist computer. Instructions about specific games are not included in this tutorial. Game directions are available in the EEGer4 Operator's Manual. Email info@eegsales.com if you'd like more information about purchasing additional games.

Start EEGer 1.3



EEGer Icon

After installation, start EEGer4 by double-clicking the EEGer icon on your desktop.

Double-click = 2 quick left mouse button clicks.

If you need help installing EEGer4, see the Appendix section on Installing EEGer4, look at the available support documentation, or consult technical support.

To get started quickly, consult the Quick Start Guide

1.4 Main Menu: EEGer4 Top Screen

When EEGer4 starts up, this screen will display.



Figure 1: EEGer4 Main Menu on the Top Screen

Quick Start Guide 2

Back to the Table of Contents

Quick Start Guide

These are the basic steps to run a neurofeedback session on EEGer4 (not including equipment preparation such as applying electrodes):

- 1. Create New Profile: Create a client profile (if necessary).
- 2. Select Client: After selection, other buttons become active. You will be prompted to choose a default traces layout. This can be changed before each session.
- 3. Plan Session: Set electrode placement and runtime (the length of each stage). Client class and default traces layout are displayed on the main therapist top screen below the client ID. You may use presets to speed session planning.
- 4. Begin Session
- 5. Choose Game: After selecting a game (the display shown to the client), on the therapist monitor will show session waveform traces. At this point, the game will be in a paused state. The therapist may use Ctrl+F7 to check the electrode impedance, if supported by the amplifier/encoder.
- 6. Set AutoThresholds: Once the client is sitting still, traces displayed on the session waveform screen will be less chaotic. In order to facilitate learning, the therapist sets thresholds. Setting thresholds quickly can be done using the 'autogoal' feature, once the client is settled, by pressing F11.
- 7. Start: Begin the game runtime by clicking F5.
- 8. Configure The Session: Configuration options & tools are available during the neurofeedback session.

New Client Profile 3

Back to the Table of Contents

Creating a client profile will only be necessary for new clients

Steps To Create A New Client Profile

Create New Client Profile

To ensure that session data is stored, EEGer requires a client profile. Create this easily in these steps:

- 1. Click Client, click "Create New Client ID." See Figure 3.
- 2. Enter a code name for the client: Enter Client ID
- 3. Enter the full name of the client. This entry may contain spaces.
- 4. Enter the date of birth of the client, using forward slashes. For example, the following would be the entry for a client born February 14, 1961: 02/14/1961
- 5. Select a gender identifier.
- 6. Select an initial Protocol Class(it can be changed later).

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Figure 2: Create New Client ID

Return to the section menu for New Client Profile

Enter A New Client ID

When you click Client on the menu bar, then Create New Client ID, a screen entitled Creating a new client... will appear. In the pink space, type in an invented client ID (initials, code, partname, etc: see below). See Figure 3.

Client ID must begin with a letter, and may contain no spaces or punctuation. Each therapist or clinic may find a system that works for them. For information on obscuring client ID and other details for HIPAA compliance, please see the Appendix.



Figure 3: Enter A New Client ID

Example: A practitioner accepting a new client named Jesse Carpenter on March 26, 2013, might use a client ID code of C_20130326. Note: If the entry has been used before (for another profile), or contains an illegal character the background will be pink. The background will turn from pink to white when entered correctly. Typically, a practioner uses a client ID that allows an identifier that can be easily recalled and found. EEGer4 displays the client date of birth to help ensure the correct client is selected.

Return to the section menu for New Client Profile

Choose Initial Protocol Class

After entering a Client ID of some kind (see above), the client's full name (which can optionally be obscured), DOB, and gender, you will be asked to choose a **protocol class**. This is the default, easily changed (by clicking **Client** and then **Add Protocol Class to Existing Client**).

- Clicking BetaSMR creates a default session plan for running beta SMR sessions. It then returns to the main screen. (Default session plan is explained next.)
- Clicking Alpha-Theta creates a default session plan for running Alpha-Theta sessions.
- Clicking Experimental creates a default session plan for capturing baseline EEG data. Or, you can use it in any way you'd like.

rsmncp



Figure 4: Choose protocol class

You may see one of the following messages:

- Demonstration Only. You have no dongle, or it isn't plugged in properly.
- Demonstration License. You have no license or "keyblock" file, or the keyblock file is not being read by EEGer.

If you see one of these messages, you can experience all the features of EEGer using the Demo mode with the sample client data. You can replay "raw data samples" which are viewed by the computer as a live EEG. For more details on this message, see the appendix on Demonstration-Only Mode. If you are seeing these messages in error, please see the Resources Appendix, look at the available support documentation, or consult technical support.

To edit client information, click "Client" and "Edit Client Information"

4 Select Client

Back to the Table of Contents

Select Client

Before the client is selected, six of the 7 large buttons on the top screen – all but the left-most **Select Client** one – will be greyed-out and inactive. When the client is selected, all seven will be active. Figure 5 below shows the top screen before selection. To see what it looks like after a client has been selected, see figure 8. Notice that the client ID selected (though obscured) is displayed, along with default traces layout and default protocol.

Important: EEGer4 will install with client names shown in plain text. If, for HIPAA compliance, for example, you wish to change the way the name/client ID is displayed on this screen, select **Options** from the menu on the top screen, then select **EEGer Configuration Options** and click the HIPAA tab to change the display settings. For more about HIPAA compliance, see the relevant section of the Appendix.

You are now ready to Begin the Session. However in most cases, after you select the client, you will check the default electrode, runtime and other session configurations, by opening the Plan Session screen.



Figure 5: Screenshot Before Client Is Selected

EEG Demo

Back to the Table of Contents

EEG Demo

If this is your first time, select the client: SMR eegdemo We recommend going through this demo client first. After that, if you are ready to run a live session, go back and run a client name you've set up.

To select, double-click the left mouse button on the name, OR click once and then click on OK at the bottom of the screen.

In front of the Client name or ID, notice the indicator for default client protocol, e.g. SMR, AT or EXP. For more information about this, see Client Class

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	EXP	eegdemo		EEG Demonstration	า
	SMR	ET_data		ET data	





Figure 7: Choose Layout of Traces (for the SMR Protocol Class)

Next, select the default screen layout for this client profile. It can be changed later, or altered on a session-by-session basis. See Figure 7.

Client ID

Back to the Table of Contents

After the therapist has selected a client, the screen shows the Client Class and the default layout for this client profile. In this case (Figure 8) the client profile has been set up with a default layout of 10-trace, SMR Protocol. Notice the client's DOB. For more on obscuring client details for HIPAA compliance see that appendix.

Notice also that all seven buttons are now active and that the Select Client button on the left is now a Change Client Selection button.



Figure 8: EEGer4 Top Screen After Client Selected

5 Plan the Session

Back to the Table of Contents

Plan Session Guide

To begin you **must** select a client profile. If a client does not have a profile, then see New Client Profile Clicking on Plan Session will allow you to set up the session, such as the placement of the electrodes, length of the session, and so on. This screen is used to set up sites, configure inhibit and reward frequencies, and access autogoal settings for the session plan. For information about setting up multiple electrode layouts or sequences of sessions, see stages.

- Specify Electrode Layout
- Display Bands
- Length of Session
- Stages
- F9 AutoThreshold

5.1 Set Electrodes

The Plan Session screen shows a head from above with placed electrodes labeled by colored circles. The initial placement is based on the client profile. It can be configured easily.

Don't forget to click OK at the bottom of each screen to save your settings. In some cases you cannot go to the next screen without either clicking OK or Cancel.



Figure 9: Plan Session



Figure 10: Electrode placement and stages configuration in Plan Session

There are several ways to change how EEGer4 electrodes are placed. You may choose to click 'Clear' at the top of the screen, and then click on the site where the electrode will be placed. By default EEGer4 assumes the reference electrode will be placed on the same side of the client's head as the signal electrode. Another option is to use the text box: separate the locations of electrodes, labeled alphanumerically, by a dash, as you see.

Return to the menu for Plan Session

Change Frequency Bands 5.2

- 1. Changing 1st Inhibit Frequency: To change this inhibit from 4-7 Hz to 1-6 Hz type in the new values. Double-click in both the low and high field and type in the new values. Or click the up and down arrow buttons next to each field to increase or decrease the value. You can assign any values from 0 to 40. Or, you can set a system preference to allow up to 50 Hz.
- 2. Changing 2nd Inhibit Frequency: Change this inhibit by typing in the new values. Double-click in both the low and high field and type in the new values. Or click the up and down arrow buttons next to each field to increase or decrease the value. You can assign any values from 0 to 40. Or, you can set a system preference to allow up to 50 Hz.
- 3. Changing the Reward Frequency: To change this reward from 15-18 Hz to 14-17 Hz type in the new values. Double-click in both the low and high field and type in the new values. Or click the up and down arrow buttons next to each field to increase or decrease the value. You can assign any values from 0 to 40. Or, you can set a system preference to allow up to 50 Hz

Example In Figure 11, a detail from the Plan Session screen is pictured on top the waveform output that is shown on the therapist monitor during a session. The first two waves are raw data (in which the second, Channel B has no signal). Third, fourth and fifth bands are low inhibit, reward and high inhibit bands, respectively. The blue lines show the threshold settings. To read more about this wave display see the Session section.

Note that the client in Figure 11 has their frequencies set at the defaults:

- Low Inhibit: 4 to 7 Herz
- **Reward:** 15 to 18 Herz
- High Inhibit: 22 to 36 Herz

Return to the menu for Plan Session

Set Session Length 5.3

To set the length of the session, click 'Run' button on left side of the 'plan session' screen. The first Run button is now highlighted, and the Run screen is displayed. The default is three minutes. This means the protocol for the previous Setup will pause 3 minutes after the game is started. It is then ready to switch to the next protocol.



Figure 11: Change Inhibit & Reward Frequency Bands



Figure 12: Run Time (with detail)

You can override this automatic (default) time function during a session before it pauses. To change from 3 minutes, double-click the time, and type in the new time or click the up and down arrow buttons next to the field to increase or decrease the value. If you enter 0 in the RUN section, EEGer will ignore the Run stage and you must manually stop the session.

Additional information: Run time will only end a period if there is more than 30 seconds left in the run stage. If there are 30 or fewer seconds, the period will continue to the end and then the stage will end. To learn how to turn off the run time option during a session, or how to set the time manually, see stages.

Return to the section menu for Plan Session

5.4 Stages

For the basic neurofeedback session, it is sufficient to set up a single stage. For more advanced configurations, the clinician may choose to set up additional protocols.

Session plans in the lower left allow you to define, insert, or delete setup and run stages. Use these to set up sequences of sessions or to pause between or switch games. You can have up to 64 setup stages. The default creates two setup stages with a run stage for each. When you select a button, the rectangle turns white, which indicates that it is the active stage.

Run:

After Clicking the run stage button, set the amount of time to run the protocol. The game automatically pauses when this time is completed and the **pause** at end of setup is checked. You can turn off the automatic time function in session (Ctrl-F5). You can also delete the run stage(s) if you prefer to run session times manually.

The **Plan Sessions** interface will enable the following setups.

- Multiple electrode configurations. By default the screen is allows for two. Notice that there are two buttons labeled 'Setup' on the left side. Each can be stored with its own distinct electrode layout, colors, autogoal settings, and so on.
- Multiple runtime sequences. Also by default the screen shows two. Notice the two buttons labeled 'Run' on the left. When you click on each you can set the amount of time a session will run, whether it will play an alert, and whether it will pause after that session is done.
- You have the option of adding additional stages, in the lower left corner of the plan session screen. Note: The addition of new stages may require you to enter a value, and save it, before you can add another one. This is to help the therapist configure the sessions as they are being created.
- You can rearrange stages with the move up and move down buttons. For information about other settings, see the operator's manual or the relevant sections in this tutorial on setting the electrodes and game time settings.

Note that the electrodes have been cleared in figure 13.

Additional Note: If you don't want to use a second protocol, you can of course delete it (as noted, it's trivial to add back later), or simply leave it to be used in the future. It won't be in the way, since the application by default will PAUSE at the end the first run stage.

Return to the menu for Plan Session



Figure 13: Stages

5.5 Set Automatic Thresholds: Autogoal

Once the client is connected via electrodes to the neurofeedback system, a therapist generally does not have time to delve into the settings of the application. For this reason, EEGer4 makes use of an autogoal or autothreshold (the terms are used interchangeably) feature.

F11 during the session applies an autogoal, that is, it adjusts the feedback reward and inhibit thresholds according to the incoming real-time signal the application is receiving from the client. The system defaults to 20%, 65%, 15%, unless you have changed these defaults. You can change autogoal defaults for any client in the **Plan Session** screens. In general, a therapist will adjust the autogoal settings as an on-going part of a treatment plan. For more information about how percentages, thresholds, and feedback, please see the general concepts portion of the appendix.

By clicking the button labeled 'Autogoal Settings,' located in the upper center of the Plan Session screen, you can configure the autogoal feature. See figure 14. To see what the button that opens the settings screen looks like, see figure 10

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Figure 14: Autogoal Settings (with detail)

Note that the autogoal settings can be made according to percentage over threshold, as well as limited by microvoltage. Return to the menu for Plan Session

During The Session 6

Back to the Table of Contents

The Neurofeedback Session

The next few pages will introduce you to the steps and options that are part of running the EEGer4 session. You Can Read about:

- How to Begin A Session
- Session Display
- EEGer4 Configuration During A Session

Running an EEGer4 session requires:

- 1. Proper connection of electrodes, from client to amplifier to computer.
- 2. Client profile is created and selected.

The Begin Session button will remain greyed-out until a client is selected. If necessary, client selected (as displayed on top screen) can be reset by clicking "Change Client Selection."

Minimum Steps

- 1. Select Client.
- 2. Choose Layout, or use the one already associated with this client profile. The layout will be displayed in the middle of the screen below the client name and protocol class.
- 3. Plan Session, if necessary to check electrode layout and set run time.
- 4. Begin Session. Then choose the game.
- 5. You will see the therapist screen display the waveform screen. It will be in a PAUSE state. Use F11 to set autogoal
- 6. Start the game by clicking F5.

See also the Quick Start Guide

6.1 Begin Session

Begin Session

Once the session is planned, click Begin Session. Then:

- Choose the Game
- F5 Start the Game
- Monitor Therapist Screen Waveform Display
- Configure Session During Gameplay

Choose Game

Choose the game your client will play. Click the game name and the Select button. Or, double-click the game name. See Figure 15.

Select game (SMR) Single computer mode
Edit Long Term
Edit 4mation
Edit Space Race
Edit Spectral Mirror
Edit Theta-down highway
Edit Boxlights
Edit Mazes
Edit vmazes
Edit Island
Edit Highway

Figure 15: Select Game Screen

Note: If you edit the game options from this screen, the choices will only be used for the current session. To edit game options for all sessions, go to the Tools menu and select Tailor Installed Games.

Return to the section menu for During the Session

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Figure 16: Session Waveform Display

# 6.2 Understanding Displays

#### Back to the Table of Contents

# This EEG waveform screen displays 5 bands:

- Band 1: Channel A raw EEG (0-40 or 50 Hz).
- Band 2: Channel B raw EEG (0-40 or 50 Hz).
- Band 3: 1st inhibit band. (example; 2-8 Hz)
- Band 4: Reward band. (example; 15-18 Hz)
- Band 5: 2nd inhibit band(example; 22-40 Hz)

If you are replaying an EEG, the frequency shown is what was recorded during the actual session. This can be changed during the review. If this was a live EEG biofeedback session, the frequencies set would come from the protocols configured in Plan Session for this client.

Return to the section menu for During the Session

# Single Channel Trace Display

# Single channel trace

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Figure 17: Waveform Display

Here's the EEG screen with a full single channel EEG displayed.

Notice the red line that sweeps across the screen. The EEG right just left of (that is, behind) this moving red line is the current EEG information. The red line takes about 7 seconds to move from left to right if your screen resolution is 1024x768 (if it is larger it will take a bit longer). That means the last 7 seconds of the EEG are displayed on the screen.

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Figure 18: Single Channel Trace

In figure 18, the low inhibit band was set (in Plan Session) between 2-6 Hz. A faint red line can be seen on this band on the right side of the screen, where the brainwaves for that frequency have exceeded the threshold set by the clinician. For better visibility, see the detail of this in figure 19.



Figure 19: Detail of Trace: Inhibit Band

Press F12 to see the in-session waveform. Usually, it has 3 lines – two inhibits, one reward.

# Realtime Spectral Display

1 Hz Spectral: These spectral display bars are a measure of the energy contained in each 1 Hz frequency from 1 to 45 Hz. They are computed as FFTs (fast Fourier transforms) every 1/2 second. Any artifacts are included in the spectral display – none are clipped out. 1 Hz spectral bars are displayed for all displayed EEG channels. (Only 1 channel is hooked up in figure 20.) For information about the spectral display of past sessions, please see that section.



Figure 20: Spectral Bars

Combined with the full visual EEG bands, the spectral bars provide a therapist with visual tools for observing changes in EEG behavior. To inrease the display of the spectral bars, press F10 (use Shift+F10 to decrease) while at the session waveform screen.

A magnified view of the 1 Hz spectral display. This display is constantly moving. How do you identify which frequency is which? Notice the small lines below the spectral. Each one is 5 Hz from the next so you can easily spot the 5 Hz, 10 Hz, 15 Hz mark (etc.)

The lines are color coded. Each color is slightly different, going up the spectrum. The software allows you to customize colors – assigning a specific color to each frequency band. So if you want 8-12 Hz (alpha) bars all green, you can do that. Return to the section menu for During the Session

#### Start

#### Back to the Table of Contents

Starting The Session Game

To start the game, press F5.

# 6.3 Configure EEGer4 Sessions

#### Configuration Options During A Neurofeedback Session

This part will describe options and tools for configuring the session.

- Scale
- Thresholds
- Artifact
- Control Options
- Event Markers
- Average
- Help Screen

#### Scale: F9

To change the scale of an individual band, first highlight the band (PageDown (PgDn) or PageUp (PgUp)). Then press F9 to change the scale.

- Press the + or right arrow key. This makes the EEG look smaller.
- Press the or left arrow key. This makes the EEG look bigger.
- Press **ENTER** once, and it keeps the EEG trace highlighted, ready for other adjustments, such as changing the threshold setting.
- Press **ENTER** twice to finish.

Note: Scale doesn't change the EEG. It just changes the view, just like zooming in or out on a map.



#### Thresholds

# Percentage Above Threshold

The feedback process works by rewarding the client when EEG activity stays within limits set by the operator. To be rewarded (to get a beep), the client must meet three separate criteria. These criteria are the same whether an EEGer4 session is configured to the standard 5-trace layout (i.e. with a single low-inhibit, a single reward, and a single high-inhibit band) or something else.

- Reward: When the EEG exceeds all reward thresholds, you get a green line. You get a beep unless you also see a red line at the same time.
- Inhibit: When you exceed any inhibit thresholds, you get a red line you DON'T get a beep. A red line overrides the green line. When both these two criteria are met, the trace is said to be in a reward state.
- A specified amount of time has passed since the last reward. The time can be changed. Please have a look at the available support documentation, or consult technical support.

The percentage above threshold describes the approximate percentage of time the EEG on any band is touching or outside the threshold lines. So when you see 23, it means the EEG is touching or outside the threshold lines about 23% of the time.

# Using AutoThreshold (F11) To Speed Up Threshold Setting

When no bands are highlighted and you press F11 (autogoal) it sets the **Percentage Above Threshold** to your targeted percentage for all but the raw bands. When planning the session for each client, you can specify percentages for that client (for example - 25% for low inhibit, 60% for the reward band, 15% for the high inhibit). When you press F11, it sets the threshold based on the average EEG amplitude over the last 30 seconds.

F11 is designed for rough approximation only. See also autogoal.

# **Threshold Indicators**

**RED** lines which display inside the inhibit bands mean the EEG is being computed to be over the threshold lines. A reward is suppressed whenever you see a red line. These will display whether you are running a period, or in Pause mode. See figure 21

**BLUE** lines which display on each band are the graphical display of where thresholds for each band are set. If you change the thresholds, you will see these move.

GREEN lines which display inside the reward band bands mean the EEG is being computed to be over the threshold lines. The red line on inhibit overrides the reward from the green line.

Return to the section menu for During the Session

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Figure 21: Threshold Detail of Session Waveform Screen

Artifact

# **Reducing Artifact**

The top band is highlighted by pressing the Page Down (PgDn) key once. Page Down (PgDn) or Page Up (PgUp) to highlight other bands. Once highlighted, pressing the plus (+) key makes the 2 blue threshold bands move further apart. The minus (-) key moves the thresholds closer together. Figure 22 shows the reward band highlighted. Note that the threshold setting for this band is also active.

Band A and Band B, the Raw EEG: When part of the EEG is outside the thresholds, it may be considered artifact and will not be used for feedback. This typically occurs if a client moves, speaks, or even just yawns. The feedback signal is unreliable when there is a red line to indicate signal considered artifact. Too much artifact may negatively affect learning. Figure 23 shows an example of artifact.

To reduce artifact, the therapist may use several strategies.

- Encourage client to remain still for the duration of the session. Especially with young children, the therapist will find the kind of bargaining that is effective.
- Set more accurate thresholds. Utilizing the autogoal feature may help.
- Check electrode impedance (Ctl+F7) and the physical connection of the electrodes.

Return to the section menu for During the Session



Figure 22: Highlighted Band



Figure 23: Example of Artifact

#### Controls

Alternative controls are available from the training screen.

- 1. Press the **option select keys** to display/clear the control.
- 2. Use **PgUp** and **PgDn** to select the option to change.
- 3. Use + and to change the given value.

Note: Volume controls only work for EGS games at this time. Tactile controls are not available unless the option is licensed and configured properly in Preferences.

Event Markers: Shift+F8

# Event Markers To Annotate The Client Record

This is a basic introduction to the use of event markers to insert notes during the session. For more information, please look at the available support documentation, or consult technical support.

By pressing Shift+F8, you can mark a part of an EEGer session. This can be useful to insert a note into the client's record. For example, you can note why you changed frequency, or an unusual EEG event or burst you observed. It creates a mark you can observe on the Review graph. It also records it in the summary and detail files.

ADD NOTES: You may want to make more extensive notes about a session or treatment plan. F8 brings up a full-screen text editor. Pressing Shift+F8, a box displays at the bottom of the screen. It allows you to enter a comment, or you can leave it blank. The event is shown in the review graph, or in the session summary information. This point in time can be easily identified and selected while selecting the EEG to review, or when reviewing the spectral. For more information, see Review Sessions and Spectral Display.

Average

# Avg (Average Amplitude)

The average EEG amplitude over 30 seconds for each filter band is based on the client's EEG and influenced by feedback. The Avg is a number you can compare over time, assuming you are at the same electrode site.

Example: If a client's average 1-6 Hz starts typically at around 45.2 microvolts, and over time the client shifts it to 28-34 microvolts, you know there's a significant reduction in amplitude. This number directly correlates with changes in the EEG traces, so larger traces increase the Avg, smaller traces reduces the Avg. Since the EEG constantly fluctuates, this number will also. As this number increases or decreases, you should be able to visually note changes in the EEG's size (larger with increased amplitude, smaller with lower amplitude).

During a training session, the typical goal for inhibit bands (example 1-10 Hz, and 22-37) is for average amplitude to decrease – or at least not to increase. Over time, you look for reduced variability. For reward bands (e.g. 13.50 to 16.50 Hz), average amplitudes should tend to go up or at least not to decrease. (An exception – if avg amplitude of the raw EEG decreases, reward bands may decrease as the EEG "settles down." Once it's settled down, then you still want the reward to trend up or at least not to decrease.)

#### Avg = 30 second average of Amplitude

The average amplitude does not dictate the amount of feedback. Feedback is related to the width of threshold lines (which the therapist sets), and how often the EEG is touching or outside those lines. Though the EEG size is certainly controlled by the client, the width of the lines are not. There is a more advanced option (downtraining with **Shift-F2**) where the client is rewarded when the average amplitude is lowered. This is used when there's a desire to encourage decreased rather than increased amplitude – for example, if there is excessive beta.

Note that EEG averages at the same site can vary from session to session. Just as you don't always feel the same when you go to exercise, your brain may vary from session to session. Remember that Average varies by site, so compare averages by site. Bipolar placements – particularly when the signal and reference electrodes are close together – produces smaller EEGs than when electrodes are farther apart.

Return to the section menu for During the Session

#### Notes About Help

# Help

The Help manual (also known as the EEGer4Operator Manual) contains comprehensive and detailed explanations of every aspect of the EEGer Suite, including a complete listing and discussion of menus, buttons, and options available to the therapist before, during, and after a session. Users are strongly encouraged to consult this indispensable resource before contacting technical support.

You can open the help manual, shown in figure 24, from the top screen either by pressing F1 or by clicking the Help menu button, then choosing 'Help manual.' It can also be downloaded from the EEGer4 support web site: http://support.eeger.com.

There are several manuals for EEGer4 users. The Operator's Manual contains information on all the controls and displays provided by EEGer4. The Technical Manual contains details about the interconnection of data for all the processing, the filter and (supported) device characteristics, and structures of various data outputs

From the session waveform screen, when you click F1 you will get the first keyboard help for the session screen, as shown in figure 25. Pressing F1 again will show the next screen. Press it a third time to return to the waveform traces.

#### Return to the section menu for During the Session



Figure 24: The Help Manual



Figure 25: Session Help Screen

# 7 Reviewing Sessions

#### Back to the Table of Contents

#### Reviewing Sessions & Creating Reports

Information about reviewing the multicolored moving wave display history can be found in Spectral Displays. The next pages introduce some of the options for reviewing data collected by EEGer during a session. In this section, you can read about:

- Graph Review
- Frequency Review
- Review Option Buttons
- Advanced Options



Figure 26: Review Sessions

# 7.1 Graph Review

To note client progress, it has been found helpful to review neurofeedback sessions. The review sessions screen allows a therapist or clinician to quickly analyze the changes in brainwave activity.

To begin, click on the **Review Sessions** button. The screen will show a graphical display of session history, as can be seen in figure 26 A review graph is shown in Figure 27. Notice the gray on the top graph, and the black bars. The black bars indicate a starting or stopping of the game. The gray highlights any pauses between periods that have been run. It records the EEG during pauses, in case what happens to the EEG during the rest period is helpful information.





Figure 27: Review Graphs

# **Changing Scale**

For some EEGs, it may be useful to change the scale, by sliding the scale bar (found on the right side). To do this, hold down the left mouse button and slide the fader up or down. Every graph is initially auto-scaled to fit the client's EEG amplitude.

# 7.2 Frequency Review

If you slide the mouse cursor over the graph, at the top, it will display information about the session (event time, frequency, site, threshold, scale, memo.)

It can be useful to show when and how often frequency changes were made, and to include that in the permanent record. Event markers are blue. Red markers are the ones controlled by the checkboxes (frequency, threshold, scale events). A clinician may record comments (by pressing the F8 key during the session). These comments are displayed above: a text reminder and a mark in the record exactly when the event occurred.

#### Return to the section menu for Review Sessions

# 7.3 Review Option Buttons

#### Back to the Table of Contents

Review Screen Display Options
There are several options in the bottom half of the reviewing sessions screen. These buttons are shown in Figure 28.
• Show Raw Data
• Notes
• Tabular
• Session Summary
• Progress Bars
• Details Log

#### Show Raw

# Show Raw

By default, the raw data streams are not shown. Clicking on the **Show Raw** checkbox gives a graphical display of all the sessions in the bottom half of the Review Sessions screen. When the checkbox is active, raw data is shown with a black color.

# Return to the Options Menu

Notes

Click on Notes to see notes added to this client profile.



Figure 28: Review Screen Buttons (detail)

When you have graph button active above, clicking in different areas of the bottom graph will show you graphically EEG raw traces. Note the date and time stamp displayed above the top graph. The shaded grey portions are rests. The operator may find it convenient to use the tabular listing in the bottom frame (see tabular)

Tabular

Notes

Show Tabular

35

- The date of each session
- The number of periods in that session
- The total duration of session
- First protocol listed in the session setup



Figure 29: Review Sessions: Graph in Top and Tabular in Bottom Frame

Double-clicking on a line causes that session to be displayed in the top area.

# Return to the Options Menu

# Session Summary

When you click on Summary, you get a text summary of session information by period, such as that shown in figure 30 It includes all sites and frequencies used in the session (It shows you when frequencies change).

#### The summary includes the following information:

- Number of periods, time per period, beeps per period (aka Score)
- Average amplitude per frequency band per period Average
- Standard deviation per period per band (may be useful for assessing reduced variability over time)

**Technical Tip:** Clinicians use this report (and specific information) in different ways. Some use it to compare client progress session to session (comparing amplitude or standard deviation, for example). Obviously, these variables are additional information about a client. No variable by itself provides the complete story. Others use it to double check for each session to be sure they spot when average amplitude of inhibits are trending up, rather than down (the direction you want them to go). There are probably many other ways they are used.



Figure 30: Review Sessions: Summary on Top Graph, Show Raw on Bottom Graph

#### Return to the Options Menu

#### **Progress Bars**

# Summary of Progress Bars

These are the bars that show on the game display during game rest periods. It's also the final screen of bars when the game was completed. It's simply a quick visual representation of how much training was done. The red bar indicates the time per period. The other colored bar indicates the number of beeps (score) the client got for each period.

The color of the reward for each period reflects the color of the reward band frequency used at the end of the period. Remember, each frequency has its own color. So any changes in frequency are reflected in the reward band. At a glance, you can tell how much training was done at multiple frequencies. For more information, look at the available support documentation, or consult technical support.

#### Return to the Options Menu

# Details

The details report provides a detailed history log of every change that occurred in running the session. It captures the exact beginning and ending time of each period. It tracks changes in Frequency (and when they occurred), and changes in site. If you click on the Show Threshold Events Option and the Show Scale Events Option, it will show you every time a threshold and/or scale was changed. This could be quite useful in consulting on cases with other clinicians, or when reviewing sessions of a new technician or clinician that is being trained. It's a comprehensive record of how a session was trained.

Return to the Options Menu Return to the section menu for Review Sessions

# 7.4 Advanced Options

Back to the Table of Contents

# Smoothing

The default session graph (see previous slides) is automatically smoothed, showing the amplitude per second based on about a 16 second average, rather than the average amplitude per second. Smoothing makes the graph easier to read, and gives you an quick idea of EEG trend shifts. The smoothing is similar to the average amplitude you see on the EEG training screen.



Figure 31: Proto

## Proto

As in figure 31 an operator can use the **proto** option to print the entirety of a client profile record. Normally one would print single neurofeedback sessions from the detail or summary screens. See other review options.

This data is sorted by session date (Date order), frequency settings (Freq order), or reward frequency (Reward Freq order) as selected by the Option selection. Each group is comprised of like layouts, sites, feedback modes, and eyes open/closed status. Each line has the date of the session, the length (in minutes), and the frequency range/ending value/percent change for each band. The percent value will be 0 or 100 if the beginning value was zero (based on the ending value).

# **Fixed Colors**

In some cases, it is hard to see/print the colors or to determine which stream is which if the frequencies (colors) are similar. The **Fixed Colors** checkbox toggles between frequency-specific colors and a fixed set of colors that is independent of frequency

For more about these options and others not covered here, please consult the EEGer4 Operator's Manual. When in doubt, look at the available support documentation, or consult technical support.

Return to the section menu for Review Sessions

# 8 Spectral Displays

#### Back to the Table of Contents

Spectral Displays
Click <b>Spectral</b> to review the full spectral history display. Spectral can be used with any saved EEG. It is typically used to identify slo more targeted inhibit activity. It can also be a useful graph to show clients. Information about the spectral bars real-time wave display at the bottom of the session screen can be found in During the Session. The Spectral Displays part of this tutorial contains four parts:
1. Settings
2. Graph
3. Options

# 8.1 Settings

# **Spectral History**

First, select the client file to view. For any client, choose any session (all EEGs for each training session are automatically saved.) When you've clicked on the client file, you can choose the entire file (as in figure 32) or partial file. The partial file option, shown in figure 33, allows you to select a specific segment of the EEG to play, rather than play the entire file from beginning to end.



Figure 32: Select the Client File

# ow-frequency activity. This can allow

## **Choose Partial File**

You can select a partial file. Choose which part of the file you want to view. Use the left mouse-click to choose the beginning point of the segment. Use a right mouse-click on the brown line to choose the end of the segment. See figure 33. The information bar below shows a record of each period run during the session. A period starts and ends with a blue bar. There's a black bar at the top showing minutes.

# Example: Here's how it looks

Hint: If you pick several periods, you will be replaying the time the client is in **pause** mode. There could be more artifact between periods. But it may also be useful to watch the spectral when the client relaxes after each period. If there's a particular part of the EEG that you noticed during the session, it can be marked with an event marker.



Figure 33: Select Partial File With Details

Return to the section menu for Spectral Displays

#### 8.2 Graph

There are numerous ways to utilize the spectral display. Use keys to change the speed and output of the waveform. For example, figure 34 shows one, while figure 35 shows how F12 has been used to get a different display.

You can change the width of the display by using F3 and Shift F3. See 36.

#### Return to the section menu for Spectral Displays



Figure 34: Spectral Display



Figure 35: Wide Spectral Display (from using F12)



Figure 36: Reduced Width Spectral Display

# 8.3 Spectral Display Options

# Spectral Scale

Because it is moving, the Spectral Display can be used to analyze wave-form activity over time. To make this more easily visible to the therapist, the display scale can be changed, using the + and - keys. The display in figure 37 has been expanded for greater visibility. Therapists will decide what works best for them.



Figure 37: Increased Spectral Scale

# Common Keys for the Spectral Displays

Spectral Display: Common Keys				
Key	Action			
Pause (or P or C)	starts / stops display			
+ or –	Change scale of the spectral display			
F or S	Speed up or slow down display			
Ι	Go back to beginning			
R	Go back one screen			
F6	Save screen for printing			
F1	Open/Close Help			
Esc	Exit spectral display			



Figure 38: Another Example of Spectral Scale

# Video Card Issues

If you see a kind of "dotted line" effect or a "noisy screen" instead of the EEG, it's a function of the video card on your computer (how it decompresses data.) Laptop video cards are often a problem (they often aren't of high quality).

You also could use a video driver upgrade. You may be able to reduce (scale down) the size of the EEG to improve the image, as in figure 38. If this doesn't work, please look at the available support documentation, or consult technical support.

Return to the section menu for Spectral Displays



# 9 Advanced Configuration

#### Back to the Table of Contents

Advanced Configuration
There are numerous advanced configurations possible in EEGer4. These are covered in detail in the support documents and the help ma few of these advanced options.
1. Presets
2. Changing Colors
3. Remote Use

# 9.1 Presets

Presets allow you to quickly plan the session. You can create, delete, or edit the presets protocols. Therapists are encouraged to set up presets for all standard protocols. From the EEGer4 top screen (shown in figure 1) click Client from the menu bar, then click Custom session plans, then select which of the client protocols you will edit, as shown in figure 39.



Figure 39: Select Presets 1

For the purpose of explanation, we'll assume you want to add a preset to the BetaSMR protocol class. Select Edit BetaSMR filter presets, as shown in figure 40. You will then be prompted to select a trace layout, as in figure 7.

nanual. This section will introduce to



Figure 40: Select Presets 2: BetaSMR

Next, make your selection, usually Edit or New. With this selection box (figure 41, you can also delete a preset you are not using. For the purpose of this explanation, we'll choose New.

The next prompt is to Choose a feedback mode for this setup, as in figure 42. For details about each of these, look at the available support documentation, or consult technical support.

At this time, you can set the placement of the electrodes on a screen like that shown in figure 43. Note that there is no ability to configure stages from this screen: the left-most area of the plan session screen has an active button labeled Preset. Also note the Comment box at the bottom. This can be used to add a short identifier, "Any short comment can go here" has been added in this case. Don't forget to **Click OK** at the bottom of this screen.

Once you have created a new preset, it will appear from the plan session screen, by clicking the **Select Preset** button. For this example (figure 44, we placed electrodes at C3-C4 in a single channel A feedback mode. Notice the comment.

Return to Advanced Configuration Menu



Figure 41: Select Presets 3



Figure 42: Select Presets 4



Figure 43: Select Presets 2



Figure 44: Presets 3

# 9.2 Changing Colors

#### Back to the Table of Contents

You can of course run EEGer4 without ever changing the default colors. If you prefer different colors for EEGer, you can change the colors used to identify frequencies and some colors for the real-time feedback screen by selecting the Change Colors option of the Options menu. As usual, if these directions that follow are insufficient, then please take a look at the available support documentation, or consult technical support.

# Change Colors and Change Background

From the Options menu on the top screen, Select Change Colors. You can also select Change Background. The screen that appears provides the color palette for selecting according to preference, the colors that work best for you.

# Return to Advanced Configuration Menu

# 9.3 Remote Use

Step-by-step instructions for remote use configuration are to be found in the operator's manual. For the most accurate information, look at the available support documentation, or consult technical support.

Remote Use Systems can be helpful to some clients, for example one who:

- Is far from a clinician's office
- Needs far more than 40 sessions
- Needs ongoing training over time

# A Installation of EEGer 4.3

#### Back to the Table of Contents

#### Steps to Install EEGer

The next section describes the basic steps to set up your system to run EEGer neurofeedback sessions.

- 1. Install the softare
- 2. Attach the amplifier
- 3. Insert the key
- 4. Start EEGer
- 5. Consult Support Resources



# **Install Software**

- 1. Insert the EEGer Neurofeedback Installation CD into the CD/DVD drive of the therapist computer.
- 2. Install EEGer Therapist Software Package and respond to the prompts to install the software.
- 3. When the installation is complete, remove the CD and put it aside for safekeeping.

For most clinical uses, the default settings during the installation process will be fine. If you have trouble with utilizing one of the less-common configurations, such as the two-computer setup, please look at the available support documentation, or consult technical support.

# Attach The Amplifier

Insert batteries into the amplifier, if necessary.

Attach the amplifier to the therapist computer with the USB cable provided.

# Insert The Security Key (aka Dongle)

Insert the USB security key (also called a dongle) into a USB port on the therapist machine.

# **Start EEGer**

Connect the client monitor to the secondary port of the therapist computer.

If necessary, restart the therapist computer.

Click on the EEGer Icon. You're ready to run a neurofeedback session!

# **Consult Support Resources**

# Further Technical Help

- Find the answer in the EEGer4 Operator's Manual (An 8MB pdf file, 233 pages). You may also download other help documentation at the support website.
- Check the EEGer4 support website at http://support.eeger.com.

- Email support at support@eeger.com
- Call tech support at (800)789-3456. If you are an affiliate, you enjoy free tech support!

# **B** Demonstration Only

Back to the Table of Contents

Instructions if you see this message:

# Demonstration Only, Dongle Not Found.

You need a hardware security key ("dongle") and a software license key to run live sessions. With the Demonstration Only message, you can see all the features of EEGer4 using EEG demo data but not gather live data. With your purchase of EEGer4, there are installation instructions provided to explain how to install the dongle and the license file that are provided with the purchased software.



Figure 45: Demonstration Only

It appears you have no dongle or it is not attached properly to the computer. The dongle is a green security key that goes in the USB port. A dongle is sent by EEG Store. If you'd like to obtain the security key, contact the store at (888)521-9803

You need both a dongle and a license to see live data. If you have a dongle for EEGer, and you still see this message, the operating system may not be reading the USB port. Pull the dongle out of your USB port and try to reinsert it. This can also occur if you tried to install the dongle before you installed EEGer4 (the install instructions warn you not to do this). You will need to follow special steps to correct the problem if the dongle was inserted too soon. You should then contact technical support. You have a dongle, but no license or keyblock file installed The keyblock file comes on a CD. If you have issues installing the keyblock file, please look at the available support documentation, or consult technical support. EEGER Technical Support

support@eeger.com Phone: (818) 886-2585 or (800)789-3456

# C About EEGer 4.3

#### Back to the Table of Contents

EEGer4 is a software suite designed to provide visual and aural feedback based on electroencephalograph (EEG) brainwave signals. Neurofeedback is used to teach the brain to modulate excitatory and inhibitory patterns of specific neuronal assemblies and pathways based upon the details of the sensor placement and the feedback algorithms used, thereby increasing flexibility and self-regulation of relaxation and activation patterns.

# What's New in EEGer4 4.3

EEGer 4.3 is a highly modified and updated version of the older EEGer 4.2 neurofeedback software. As part of the development process, there has been an extended test process carried out to verify operation of all components of the software.

#### Features To EEGer4

#### Significant changes in EEGer4:

- Titles were restructured to be more explanatory and rearranged into more logical arrangements.
- Optional support for 4 channels of EEG
- Up to 3 displays of peripheral data on client feedback displays
- Major revisions to zscore integration
- Extended controls/feedback modes to support ANI zscore computations
- Correction of known bugs in EEGer 4.2.2p
- A new optional feedback display (Iris) to support multiple reward/zscore values
- Revised documentation (compliant with IEEE Std 2010-2012 IEEE Recommended Practice for Neurofeedback Systems)
- Inclusion of utility programs in base release.
- Multiple customizable session plans and ability to assign to existing clients.
- Updated storage formats for additional data. (Note: EEGer4 can read all earlier EEGer files but older software cannot read EEGer4 files)
- As part of the EEGer4 updates, provision for future modes and capabilities were made.

Support for EEGer4 is provided by EEG Education & Research Inc.

#### Notes Concerning Client Privacy and Safety C.1

#### Back to the Table of Contents

#### Concerning Client Privacy & Safety

This section contains several parts:

- General Disclaimer
- Contraindications & Warnings
- HIPAA & EEGer4

#### **General Disclaimer**

Indications for Use This device is to be used for general relaxation training when used with supported amplifier/encoders.

General Warnings US Federal Law restricts this device to sale by or on the order of health care practitioners. Operators of this device are expected to be health care practitioners trained in neurofeedback or technicians trained in neurofeedback supervised by health care practitioners.

**Precautions to Observe** When using an EEG sensor, the result of the sensor's slight susceptibility to strong Radio Frequency Interference (RFI) could be to artificially increase the microvolt reading and, in almost every case, to obviously corrupt the raw waveform. By paying regular attention to the display on the PC screen of the raw EEG waveform, it should be possible to readily identify whether or not obvious extraneous artifacts are present or to confirm that the signal is **clean**. If you observe random or increased signal readings unrelated to user activity, move the amplifier/encoder and client away from any radiating device.

**Other Notes** You can also test for susceptibility of the active sensors by clipping the three electrodes together and observing the display for non-zero readings or variations. If you are unable to resolve the conditions, contact Technical Support. Do not mix electrode types. Electrode connections using mixed combinations of metals can lead to incorrect reporting of EEG data. Do not forget to clean and sanitize electrodes between use. Follow the electrode manufacturer's recommendations. Ensure that proper connection of the electrodes to the client is made. This is most easily checked by measuring the impedance of the electrodes to the head using some measurement device. Follow all the instructions in the instruction manual for the amplifier/encoder to be used.

#### Return to the Menu For This Section

#### **Contraindications and Warnings**

The material presented in this tutorial includes results obtained in a clinical setting, and as such may not yet be documented by research under controlled conditions. As a precaution, this information must therefore be regarded as preliminary and experimental. Neurofeedback is officially approved for general relaxation. The techniques discussed herein should be employed only by professionals who are appropriately trained, and who are operating within the scope of their present license to practice. The presentation of these results is intended for educational purposes only, and to serve as a quick source of information to provoke the interest of researchers within the mental health community who are involved with these conditions. Other terms for neurofeedback include EEG biofeedback and neurotherapy.

# High Risk Conditions Harold L. Burke, Ph.D.

The following are some of the reasons for listing certain conditions, disorders, or syndromes as either "high-risk" or as "requiring caution" in the course of administering EEG biofeedback (neurofeedback). These are not exhaustive and may be revised as the Board's "High Risk Committee" continues deliberations on these matters. The underlying assumption in all of these is that neurofeedback can be a powerful treatment modality in affecting symptoms associated with these conditions. Accordingly, symptoms may be either decreased, as is most often the case, or they may be increased or exacerbated, particularly in conditions that may be characterized as manifesting paroxysmal behaviors secondary to instabilities in neuromodulatory networks.

Seizures: Perhaps the quintessential example of instability, seizures can be either ideopathic (unknown etiology) or caused by some insult to the CNS. Moreover, they may be occur spontaneously (when it is impossible to determine the trigger), or they be triggered by causes outside the CNS (e.g., stressors, lights of a certain frequency). The list of triggers is quite long and varies greatly among individuals and even within the same individual over time. Even if a neurofeedback protocol does not directly cause a seizure, there is the possibility that it could trigger a cascade of events that could eventuate in a seizure. Furthermore, something besides the neurofeedback protocol per se (e.g., something in the room) could trigger it, or it could occur spontaneously. In any event, a practitioner must be familiar with these conditions, how to recognize seizures, what to do, and when to refer. Untreated seizures often get worse over time, possibly due to such mechanisms as kindling. The sequelae of seizures can vary greatly, ranging from minimal to death

(often due to asphyxia). However, even in cases where no apparent sequelae occur, it is likely that additional neurons are negatively affected, as seizure foci spread throughout the brain. Moreover, hypoxic encephalopathy may occur if extended seizures occur. It has been well established by neuropsychological assessments that many individuals with re-occurring seizures suffer cognitive deficits and often personality changes, particularly with temporal lobe epilepsy.

**Bipolar Disorders:** Because these individuals vacillate between manic and depressive episodes, any treatment modality that can decrease one type of episode could potentially trigger the opposite episode. Therefore, both manic and depressive episodes could be triggered by neurofeedback. Mania could be manifested by psychosis, violence, or behavior that is dangerous to self (e.g., taking dangerous illicit drugs) or to one's well being (spending sprees). Depression could result in a suicidal attempt that could be fatal or that could result in severe brain damage. Of course, even without such dire consequences, a depressive episode should be avoided. It should also be mentioned that correct diagnosis can often be difficult, particularly the differential between substance dependence or abuse, borderline personality disorder, ADHD, and bipolar disorder. Practitioners should be educated and trained in such matters before even attempting neurofeedback.

**Major Depression:** Depressive symptoms could become worse with neurofeedback. Suicidal attempts could occur if the depressive episode becomes sufficiently severe. This must be understood even if the neurofeedback per se does not cause the worsening of the episode. As the depressive episode decreases in severity, the probability of suicide could increase. This can occur for several reasons, including but not limited to (a) an increase in energy, which can take an individual from a state of apathy and vegetative psychomotor retardation to a state of being able to engage in the extreme act of suicide; (b) a decrease in helplessness but an increase in hopelessness, so that one now feels able to do something about a hopeless life, namely end it; (c) a decrease in cognitive deficits (e.g., difficulty concentrating and making decisions) caused by the prior severe level of depression, so that one can now make plans (e.g., finalize one's estate) and make the decision to suicide.

**Current suicidal ideation or behavior or a history of suicidal attempts:** Of course, the above applies to any patient with suicidal ideation or behavior. Note the inclusion of suicidal behavior. That is, an individual with depression may not express such ideation, or the practitioner may not know how to make such assessments. Then it is important that the clinician know some of the typical behaviors of individuals about to suicide. A history of suicidal attempts is important, as the past is one of the best general predictors of the future, and it has been well established that a previous suicidal attempt is a predictor of a future attempt. In addition, it has been established in the literature that depressive episodes tend to worsen over time.

Acquired brain injury (ABI): Individuals with ABI, particularly traumatic brain injury (TBI), may be at risk for seizures; see above concerning seizures. Such individuals are usually quite complex for numerous reasons, including but not limited to (a) their brains have suffered frank damage, which is often difficult to assess even with extensive neurological, neuroimaging, and neuropsychological techniques; (b) cognitive, personality, emotional, and behavioral sequelae usually occur; and (c) psychological, premorbid, and psychosocial factors often interact in complex ways. If a practitioner does not know these variables (e.g., does not have information that could be obtained from a neuropsychological assessessment), he (she) is treating a complex condition with partial information. At best, this would be considered substandard care; at worst, this could lead to protocols that could improve some symptoms but make others worse, especially if the clinician does not even know of these other areas. As an example, a protocol being used for decreasing a headache in a TBI patient could trigger executive disinhibiton or acute anxiety, particularly if that patient has dysfunction in his frontal lobes. In view of the complexity cited under #2, the optimal treatment is very likely to be a combination of several modalities. Since many neurofeedback clinicians appear to be treating ABI individuals with only neurofeedback and usually without much other knowledge from other professionals and often with little knowledge of this population, it is reasonable to list ABI as a high-risk condition.

# Conditions not considered "high-risk" but that justify extra caution:

**Narcolepsy:** Individuals can be dangerous to themselves and others due to sudden losses of consciousness. Because neurofeedback appears to affect sleep so frequently, it seems reasonable to assume that it could make this condition worse in a given case, even though history indicates that sleep usually normalizes with neurofeedback. If neurofeedback has the potential of making such a condition worse, even if only temporarily, real harm could occur.

**Reactive Attachment Disorder (RAD):** There is the potential for triggering a period in individuals with RAD during which they could become violent and antisocial to the point that they could commit homicide or serious harm to property or others. Serious decompensation could also occur with other symptoms becoming worse.

**Dissociative Identity Disorder:** Due to the extreme complexity of this condition and how little is really understood about it, it should be considered a condition that warrants caution, if not "high-risk." This would probably pertain especially to alpha-theta protocols. The primary risk appears to be the further splitting of the personality. Another risk may be that an alpha-theta session could cause a severe abreaction with a clinician present who is not fully qualified to handle such states.

**Borderline Personality Disorder:** This condition is characterized by extensive instability of mood and behavior. An individual with this condition may rapidly cycle between extreme states or poles, often much faster than someone with a bipolar disorder. Such states often result in self-mutilating behavior and can be very harmful to the individual or to others. The differential diagnosis with other conditions can be difficult, even with a well-trained clinician. Again, perhaps this condition may even warrant being in the "high-risk" category, but we do not want too many conditions there.

Panic Disorder: There is the potential that a protocol could trigger a panic attack in someone so disposed. Because these can occur so quickly, caution is in order.

Migraine: This appears to be the result of vessels suddenly dilating after having constricted. Again, this is an example of instability. If neurofeedback can stop a migraine attack during a session, there exists the potential of exacerbating one.

**Sleep apnea:** It may not be absolutely clear that sleep apnea is always a condition that "justifies extra caution", but certainly if sleep apnea gets worse, there is the real possibility of increased cognitive dysfunction, since it has been established that individuals with this condition do in fact suffer cognitive impairments.

Individuals with a history of psychotic episodes: The risks will vary significantly from individual to individual. Even if such an individual is clearly in remission and not currently psychotic, a neurofeedback session could trigger decompensation in someone who is at risk. Return to the Menu For This Section



Figure 46: Select EEGer Configuration Options

# HIPAA & EEGer4

EEGer4 can be easily configured to comply with HIPAA regulations regarding patient privacy. To obscure the patient name from the main screen, click **Options** from the top menu, then **EEGer Configuration Options**, as shown in figure 46 This will open the EEGer4 configuration interface. One of the tabs is labeled **HIPAA**, as shown in figure 47

**HIPAA Options:** You can set the display for several areas, such as the top screen (the main menu screen), the title bar (at the top of each window), printing and so on. The display can be set to completely obscure the client name by substituting a random number code, or to show their initials, or several other possibilities. There is a checkbox to show or hide client birthdate, in case the clinician wishes to use this as an identifier.

Return to the Menu For This Section



Figure 47: HIPAA tab options

#### Advantages of Using EEGer C.2

Back to the Table of Contents

# What makes EEGer useful? by Mike Cohen

A number of therapists have asked questions about the clinical utility of EEGer. Here are some comments, based on one person's experience and from talking with other therapists. As an operator or therapist, you may not use all these features right away. But with really well-designed software, the more you use it, the more you appreciate its subtleties – and it makes you more productive. This is very well designed software – very rock solid and reliable. There's much more about EEGer that makes it nice, but this will give you a good idea what it has to offer.

# Real-Time 1 Hz Spectral And Real-Time EEG

- The real time 1 Hz spectral is very helpful in making clinical judgments on the fly. Many therapists report they change inhibits more quickly now. It also helpful in coaching the client at times (with the client looking at the spectral). The spectral highlights specific amplitude bursts that can be hard to spot in the EEG. Detail of a single channel is shown in figure 48.
- Because of the smooth display, it's easy to watch. The information is also helping identify more downtraining options with clients. By having a) the 1 Hz spectral display AND b) a display of the very precise EEG traces for each band AND c) the 30 second moving average numerical amplitudes, each provides different but useful information about the EEG – and about your client. Therapists report that as they gain experience with watching it, they incorporate all this information in their decision process. Each provides something slightly different.



Figure 48: Spectral Bars Detail

# Trend Graph In Session

The F12 key allows you to cycle to the trend graph, and view it in real time. This graph of actual amplitudes during the session can be very helpful during the session for making decisions or giving feedback. At a recent conference, Ed Jacobs, a psychologist, described how he now uses this trend graph to help determine changes in reward thresholds. He pointed out it gives a much more complete picture than simply watching amplitude changes on the therapist screen. It can be helpful to show clients in session as direct feedback about their trends, as shown in figure 49. There is also a spectral view, shown in figure 50

# The Review Sessions Screen



Figure 49: Trend Graph: F12 key



Figure 50: F12 Spectral Mirror Display

In neurofeedback, you constantly make decisions about sessions and protocols for each client. The review sessions screen (see figure 51 makes that easier.

- 1. It gives you access to all session information without shuffling any papers.
- 2. It lists every protocol you've used for the client.
- 3. It highlights each session a specific protocol was used in, and lets you review the details of it instantly.
- 4. You can check changes in amplitude averages and standard deviation changes for every round, and from session to session.
- 5. You can visually spot any change in frequency, when it was made and why it was made (if you use the record events marker F8 during session).
- 6. Every graph for every session is displayed. Trend graphs help you spot learning trends. Reviewing these can help in reviewing protocols and training strategies.
- 7. Trend graphs can help you spot patterns indicating how clients respond to the training process. This can be a useful adjunct to therapy. The visuals can be helpful in engaging the clients in the process.
- 8. Tracking changes graphically in between training periods helps you spot trends that occur during a client "rest" period.



Figure 51: Review Sessions Screen

# **Replay Segments Of The EEG**

It's incredibly easy to go back and review things you saw in the EEG. (Was it artifact? Was it a burst in the EEG – and if so, are we inhibiting it? Is it isolated or intermittent?) The replay is simple and practical. You mark any spot during the session and add comments. When you review it, you can go to the exact section of the EEG you need. It's so quick and simple, that you actually use this option regularly. The way you can zero in on the highlighted segment and comments is very slick. See figure 51.

# Session Planning

- It's easy to define your own default plan that creates your "standard" client plan. When you add a new client name, the plan is automatically created.
- You can setup one or multiple protocols per session, each with its own sites and frequency bands. Switching (F4) from one to another is a snap.
- Preset Protocols speed up session plans and reduce chances for error. It's simple to set up and name every protocol you use. When you go to change your client plan, you choose from your list of protocols. With one click, all the frequencies and sites are setup. It's fast, and it reduces the chances of setup error. The presets screen is shown in figure 52



Figure 52: Presets

# The Session Timer

Being able to stop the session at precise intervals (including in mid-session) allows a therapist to plan and run sessions more easily - particularly if not in the room every second. As importantly, it will help you focus on the client, rather than on the computer. You may find that using a timer also makes you be more structured in session planning. The screen for selecting timer length is shown in figure 53.

# Audit Trail

For every session, there's a detailed log including the exact time any changes in session occurred – from changing thresholds to setting frequencies and even checking impedance. If you are using a supervisor or consultant, it can be a great tool for them to help review your sessions. If you ever use a technician or associate, it can be very helpful in your review of how they run sessions.

EEGer4 from EEG Software Client: 0BA218FSPV74M73W7FSGH9982Q				
M EEGer Session Planning	las Print Cations Hale			
Sequence of stages for this session	Minutes to run			
Setup	3.0			
Run	No Alert Play alert			
Setup	Pause at end of run			
Run				

Figure 53: Session Timer

# **Other Strengths**

- Tracking variability can help in making decisions. Having the std deviation measure on the review screen and session reports is helpful over time in making clinical decisions. Gary Schummer, a psychologist from Torrance, CA explained that as this measure reduces and stabilizes, as it provides specific clues about when to switch protocols. EEGer provides an option to train reduced or increased variability directly.
- Precision allows more flexible shaping of the training process. Many therapists are reporting how precise the feedback controls on EEGer are. By combining that precision with the flexibility of changing the threshold parameters on the fly, you have a great deal of flexibility in fine-tuning the shaping process – which is the learning process. This means that the amount of feedback you can provide on each band is exquisitely adjustable. Every client learns differently and the brain is extremely sensitive to feedback. For therapists who are good at tuning in to a client's learning style, this ability to finely tune parameters can improve the learning process.
- Access client session data from any computer. If you're networked or if you copy the session files to CD, you can access the review screen from any computer in your office – even those without an EEGer license.

# C.3 Licenses

#### Back to the Table of Contents

There are several licenses associated with the EEGer4 Software.

# **Neurofeedback** Certification and Licensing

Therapists using the software are encouraged to become board-certified practitioners of neurofeedback through the Biofeedback Certification International Alliance (BCIA). This professional association accredits the courses offered through EEG Education & Research. For more information about the BCIA and board-certification, visit them online at http://www.bcia.org.

# **Remote Use License**

In some situations, for example when a client lives too far away to make regular clinical appointments practical, a therapist may help the client to set up EEGer4 in a Remote Use configuration. The clinician can provide a limited license to the client, to use the software for a specified number of neurofeedback sessions under the clinician's supervision,

after which the therapist/clinician can review their progress. For more information about issuing this license look at the available support documentation, or consult technical support.

# Software License

The EEGer4 software itself is approved by the federal government for the intended purpose of general relaxation. Federal law restricts associated devices to sale or use by or on the order of a qualified health care practitioner.

# **Tutorial Licensing**

This tutorial is licensed to you, the qualified health care practitioner, but is protected under copyright of EEG Software LLC, who retains all rights to it. It may not be copied, edited, promoted, distributed or otherwise offered for use, in whole or in part, in altered or unaltered form, without the prior written permission of EEG Software LLC. Clinicians and therapists are of course free to offer it as a reference to technicians in their practice as an aid to learning the use of the EEGer Suite.

#### Becoming An Affiliate D

Back to the Table of Contents

# To Join, Call: (800)789-3456

# Affiliate Program Benefits

After completing a 4-day course, and if you meet the requirements, you now have the opportunity to join the EEGER Affiliate program. Please review the Affiliate guidelines and submit the application at your earliest convenience. The application is available online at http://www.eeger.com or call (800)789-3456 **Benefits of Affiliates:** 

- Listing as a provider on the **EEGER** website: <u>http://www.eeger.com</u>, includes focus page (w/your photo) to showcase your specialty and education .
- Free technical support for your EEGerTM system. More info at http://www.support.eeger.com
- Amplifier Loaner Program for those emergency situations.
- Discounts on supplies from **EEG Store**: https://www.eegstore.com
- Full posting privileges on the on-line clinical discussion forum (http://www.forum.eeger.com).
- Continuing education course discounts (worth APA CE Credit).
- Neurofeedback Interchange Conference(NIC) discount.
- Access to clinical archives (offering 5+ yrs. of clinical discussion) searchable by subject.
- Free quarterly phone forums (interviews and clinical discussions).
- Free help designing affiliate marketing material.

#### Resources E

#### Back to the Table of Contents

#### **Further Reading Sources**

#### Light Reading on Neurofeedback

- http://support.eeger.com: Site also contains an archive of manuals for EEGer4 Suite.
- http://eeger.com: Site for EEG Education & Research. A wealth of resources.
- http://aboutneurofeedback.com: Site of general information about neurofeedback.



# E.1 Neurofeedback Concepts

#### Back to the Table of Contents

This section contains a very brief introduction (and glossary) to some of the ideas used in neurofeedback therapy. Clinicians, therapists, and technicians working in the field of neurofeedback therapy are strongly encouraged to get adequate training and certification as part of learning about neurofeedback and practicing in the field. This tutorial should not be considered any more than a basic introduction to the use of EEGer4. Please look at the available support documentation, or consult technical support. Also, further education is critical.

#### You can read about:

- General concepts: Amplitude, frequency.
- Concepts used in EEGer4: Threshold, channel.

Neurofeedback provides a means for the brain to learn to generate balanced brainwave activity. EEGer4 does this by rewarding the client when the desired shifts to brainwave activity occur. Over a period of sessions, this positive shift has been found to become both deeper and longer-lasting.

#### **General Concepts**

# Waves

To understand how neurofeedback works, we'll start by considering a wave in a pond. The waves that ripple out from where an object – like a heavy rock – dropping into the water do not themselves move across the surface, but are actually the movement of the water up and then down as each water molecule is acted on by its neighbor. This wave action is characteristic of periodic phenomen, meaning that many things that happen in cycles display this kind of wave-like property.

The water is moving in one direction (up and down), while the waves move in another (out from the center). Now let's consider a toy boat floating in the water not far from where our rock dropped into the water. The rock creates waves that rock the toy boat. Now we'll consider some of the ways we can describe the waves in the water.

# Amplitude

We can describe their size. Amplitude is used in many science and engineering fields, in particular to refer to the magnitude of change of a periodic variable. In our everyday toy boat terms, a measure of the amplitude of a wave in a body of water could be its height, which one might measure (at least theoretically) from trough to peak, for example. So the amplitude of the wave will be shown in how much the toyboat rocks as the waves hit it. Since electrical signals are periodic, meaning that they happen in cycles, like waves in water, it makes sense to define the amplitude of an electrical signal such as voltage.

Any measurement is made with respect to a reference point, such as the trough in our boat example. So when we measure electrical voltage, we do so with respect to an arbitrary point, called the ground. Brain waves are periodic, and can be measured using sensitive equipment.

# Frequency

The frequency of a periodic signal is a measure of how rapidly the signal changes. It is always measured per unit of time. For our toy boat floating in the pond, one might measure how many waves rock it per minute. For brainwaves, frequency is given in Herz, which just means cycles per second. The most common frequencies of brainwaves have been given names. We'll list them.

- DC-EEG: j0.1 Hz
- $\bullet\,$  Delta: 0.1 4 Hz
- Theta: 4 8 Hz
- Alpha: 8 13 Hz
- Beta: 13 30 Hz
- Gamma: above 30 Hz

Each of these brain wave frequencies are associated, based on research, with different states of mind. EEGer4 allows an operator to specify which frequencies to reward and which to inhibit. More detail about this is reserved for the training course.

#### Return to the section menu for Neurofeedback Concepts

#### Some Concepts Used in EEGer4

- Average Amplitude
- Thresholds
- Protocol
- Protocol Class
- Game
- Layout
- Artifact
- Channel

# Average Amplitude

Note: This value, denoted AVG on the session waveform screen, cannot be changed by the operator. It is a value computed by the EEGer4, and is displayed for reference.

Since electrical signals – and the brain waves measured by the EEG electrodes – are periodic, EEGer4 takes an average of the measured amplitude being picked up by the electrodes. This average is what is used to compute the values that are displayed on the traces in the session waveform screen.

See also Average in Configuring the Session.

# Thresholds

EEGer4 uses thresholds set by the operator to trigger the reward. As described in the section on configuring thresholds, there are three criteria that must be met for a reward (a beep) to occur:

- Reward: When the EEG exceeds all reward thresholds, you get a green line. You get a beep unless you also see a red line at the same time.
- Inhibit: When you exceed any inhibit thresholds, you get a red line you DON'T get a beep. A red line overrides the green line. When both these two criteria are met, the trace is said to be in a **reward state**.
- A specified amount of time has passed since the last reward. The time can be changed. Please have a look at the available support documentation, or consult technical support.

Pressing the F11 during an EEG session resets the width of the threshold lines for each band. This width determines the approximate percentage of time the EEG is above the threshold line. At the moment the F11 is pressed, the threshold lines for each band are set so the EEG is touching or outside the lines a certain percentage of the time. That percentage comes from the autogoal screen (Plan Session). For example, if the F11 for the first inhibit band is 20%, it sets the thresholds so the EEG is touching or outside the lines about 20% of the time (based on what the EEG did in the last 30 seconds). After F11 is pushed, expect the percentage above goal to vary constantly, because the EEG

changes constantly. What the EEG did the last 30 seconds does not predict even the next 1 second of the EEG.

# Protocol

**Protocol** is the term used to describe the sequence of actions to be used for a neurofeedback session (thresholds, times, site locations, etc.). EEGer provides Session Plans as a way of documenting and preselecting the desired protocol.

# **Protocol Class**

There are three different **protocol classes** provided by EEGer as a method of organizing similar data.

- AT class is for Alpha-Theta training data
- SMR is for Beta-SMR training data
- EXP is a Beta-SMR-like class where screening and baseline data can be separated from actual training data

#### Game

In EEGer4, game is the term used to refer to the feedback display in the circuit which trains the neural system of the client. The term game is imprecise, as it generally connotes a more active pursuit, often done exclusively for entertainment. The term game is widely used in the neurofeedback field, so it is used here. Some of the aspects that neurofeedback **games** share with other games:

- Scoring: EEGer4 keeps track of client progress. See Review Sessions
- Fun. The feedback display is intended to engage the interest of the client. Some experimentation may be helpful; different games appeal to different clients.
- Practice improves performance. Like most games, the user will show progress over numerous sessions, although some variability is to be expected from session to session, depending on their condition, and so on.

# Layout

A Layout defines what data is presented on a session screen. The layout definitions specify how many traces of information are displayed and the order of the display. Different protocol classes can have differing layouts available.

For example, the 5-trace layout has (from top to bottom) two raw/lowpass input data traces, one inhibit trace, one reward trace, and another inhibit trace. The 6-trace, inhibit layout has two raw traces, two inhibit traces, one reward trace, and another inhibit trace. Details of the content possibilities for each layout are detailed in the Technical Manual. For more information, look at the available support documentation, or consult technical support.

# Artifact

Artifact is any distortion of the EEG signal from any physiologic source other than the brain or any non-physiologic source that may interfere with the interpretation of the signal.

# Channel

Each physical input measurement is its own channel. One channel of signal may require two or three inputs (electrodes). One is the signal, one the reference, and there must be at least one ground (if two or more channels are present, they may share a ground). Channel refers also to the physical electrodes(wires), preamplifiers, amplifiers and encoders that make up a measurement path and produce the trace. Return to the section menu for Neurofeedback Concepts

# E.2 Training Courses in Neurofeedback

Back to the Table of Contents

# Neurofeedback in the Clinical Practice

Ed Hamlin, PhD, BCN & Andrea Meckley, MA, BCN

4 Day Course

We offer 32 APA CEs for psychologists

(36 BCIA)

The purpose of this training course is to present a comprehensive approach to the clinical application of the emerging EEG biofeedback (neurofeedback) modality. The course is intended for clinical psychologists, neuropsychologists, educators, educational therapists, clinical social workers, rehabilitation specialists and academic researchers in neurophysiology and biofeedback practitioners who have little or no background or experience with neurofeedback. It is also a good refresher course for current neurofeedback practitioners.

The course includes pre-course reading materials from selected professional texts. It is important that you give adequate time to familiarize yourself with this material. It will help you gain more from the course. The four-day course is a combination of didactic presentations and hands-on training. Multiple practicums are conducted over the four days. Neurofeedback systems are provided for practice by attendees.

Upon completion of the course, attendees will have gained a clear overview of the capabilities of the EEG biofeedback process, how to evaluate clients with respect to its possible use, how to choose an appropriate EEG biofeedback protocol and implement it on computerized instrumentation, and how the process might be used in their individual practices. We recommend additional courses and clinical consultation following this introductory course.

The Institute for Applied Neuroscience and EEG Education & Research are working together to bring you quality education in the field of neuroscience.

For more information call: (800)789-3456

# E.3 Credits

Back to the Table of Contents



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