

Group Capnometry Software Application User Guide

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1 Introduction

This guide introduces the Basic Capnometry biofeedback application, part of the Mind-Body Training Tools suite. This set of applications is designed to develop skills in mind-body awareness and self-regulation, particularly in a context of mindfulness and meditation practice.

The guide has two purposes: firstly to give an overview of capnometry biofeedback, and secondly to teach you how to use the software – though it is more of a reference than a tutorial. Other training material is available on the StressResilientMind.co.uk website.

The application is designed to train optimal breathing in a group context. A capnometer measures end-tidal carbon dioxide in exhaled air, which is known to correlate with the level of carbon dioxide in blood. The latter is an important physiological parameter, as it controls vasodilation, most prominently in the brain. Over-breathing or hyperventilation causes depletion of blood carbon dioxide and thus restriction of oxygen delivery to brain cells, while conversely capnometry biofeedback is a means of training optimal oxygen delivery to brain cells.

The application is designed to work with a group of up to eight individual trainees, each connected to their own capnometer device. The software monitors a single physiological parameter from each capnometer: partial pressure of carbon dioxide in inhaled air (PP CO₂). Think of this as the concentration of CO₂. The software calculates the end-tidal CO₂, or the peak in the PP CO₂ signal over the course of a breath – this is the most significant parameter. Additionally the software can calculate breathing rate.

At the end of a session data is stored for each of the (up to) eight users, and you can generate session reports for each individual (see section 5 below).

The guide assumes that you have read the Software Installation and Set-up Guide, and therefore know how to start the application.

The applications in the suite work with a number of different devices. For an up to date list of supported hardware, please see the StressResilientMind.co.uk website.

2 Launching the Application

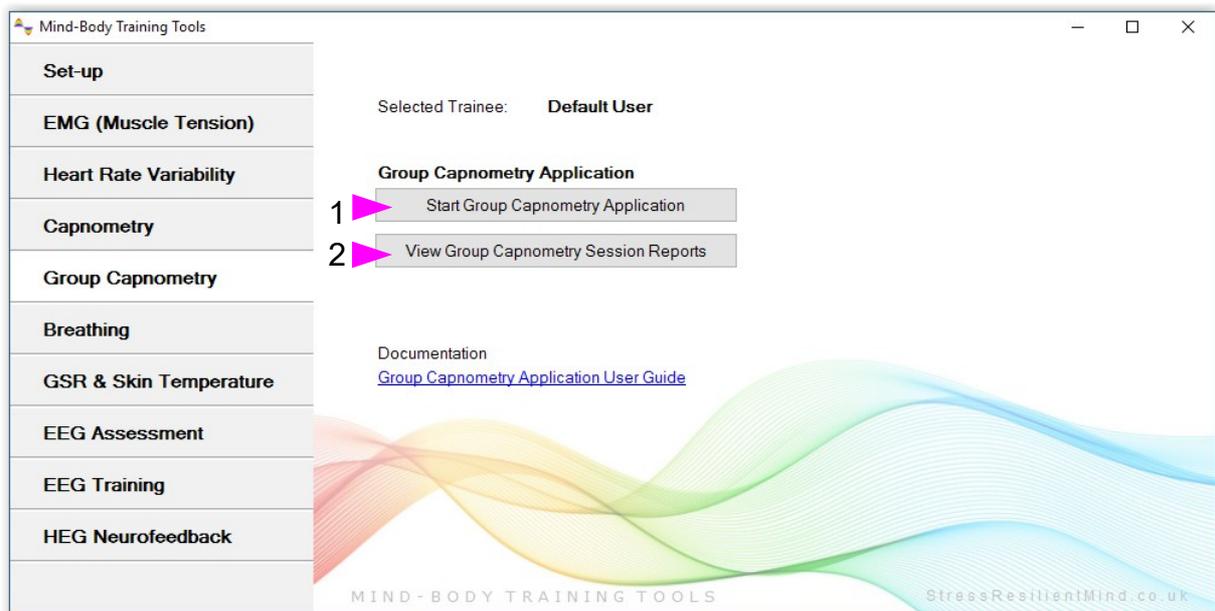


Figure 1 – Capnometry tab of the Platform application

Figure 1 above shows the Capnometry tab of the Platform application. Press the button labelled 1 to launch the application. Make sure you have your BioEra licence key (dongle) inserted into a USB socket. After a few seconds a window will appear on your screen.

2.1 Hardware Set-up

The physical aspects of hardware set-up (how to connect and use your sensors, etc.) are dependent upon the type of device you are using, and are covered in a separate document (Hardware Set-up Guide).

Before you start the application you configure the device set-up options, accessible by clicking a button in the Set-up tab of the Platform. In the dialog, select the type of amplifier (biofeedback device) you are using in the **capnometer source control**. Note, all the source settings are remembered the next time you start the Platform.

One of the device options is 'Simulator'. In simulator mode, you can learn how to use the software without the encumbrance of actually sampling the breath. (The application simply uses recorded data as a source.)

It is important to correctly set the configuration of each device, not least so you know which chart in the application refers to which trainee. This topic is covered in section 4.3 below ('Support Window').

It will be useful to read the hardware set-up guide for your device type, if available.

3 About Capnometry

As stated in the introduction, a capnometer measures carbon dioxide in exhaled air.

For a discussion of the meaning and significance of this parameter, plus data that can be calculated from it, please see section 3 of the Basic Capnometry Application User Guide.

4 User Interface

When you first start the application from the Platform, you will see two windows. The main window is shown in figure 2 below, while the support window is shown later (figure 3, in section 4.2). The support window is geared towards configuring the set of capnometers.

4.1 Main Window

Figure 2 below shows the main window of the Group Capnometry application.

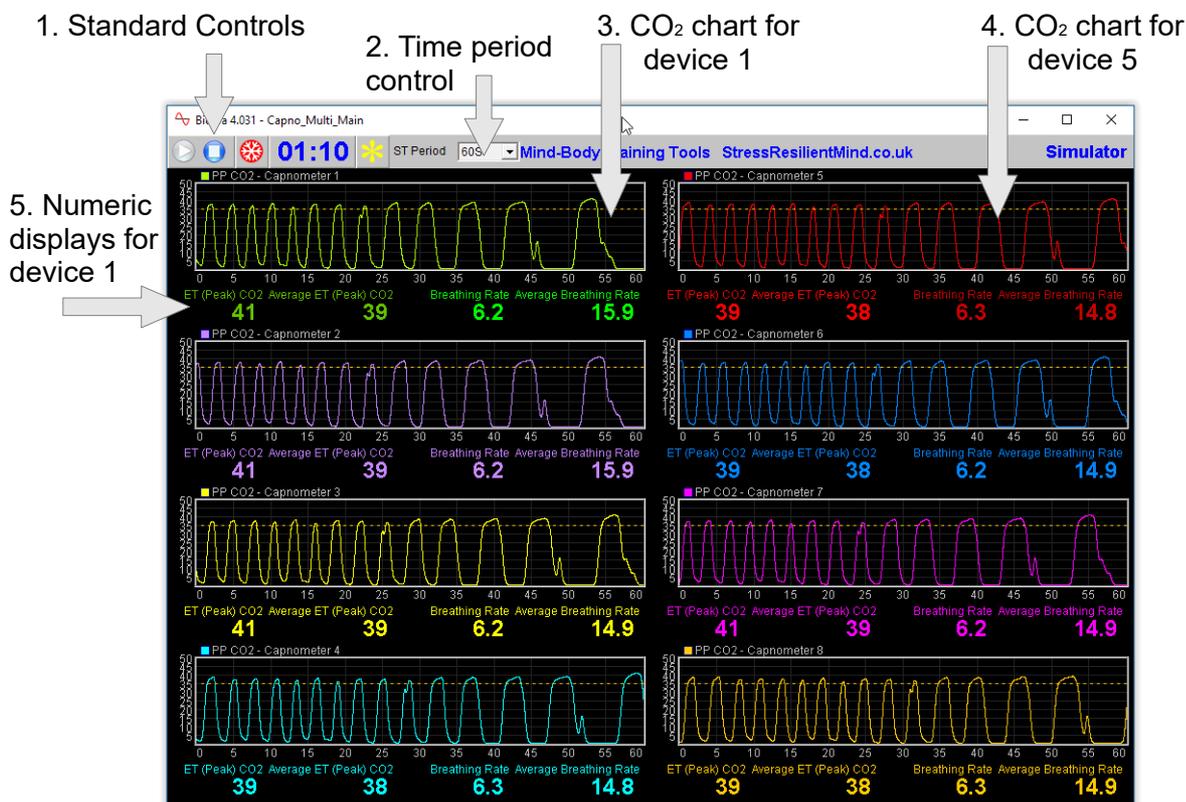


Figure 2 – Main window

4.1.1 Standard Controls (Start / Stop, etc.)

A set of buttons – Play, Stop and Pause – are the same in all the applications in the suite. They should be self-explanatory.

The button marked with a red asterisk is a simple event marker. As in other applications, you can use it to mark adventitious happenings and changes in session conditions (e.g. you turn on or off breath pacing). Please note that the individual charts do not show events – however the events are recorded in the data and are used to generate reports (see section 5 below).

Note that pressing the escape key during a session has the same effect as pressing the red asterisk with your mouse (i.e. it is an alternative).

4.1.2 Individual Capnometer Displays

The main window is divided into eight sectors, each of which pertains to one particular capnometer / user, and each having the same set of displays, and each being equivalent to displays available in the Basic Capnometry application.

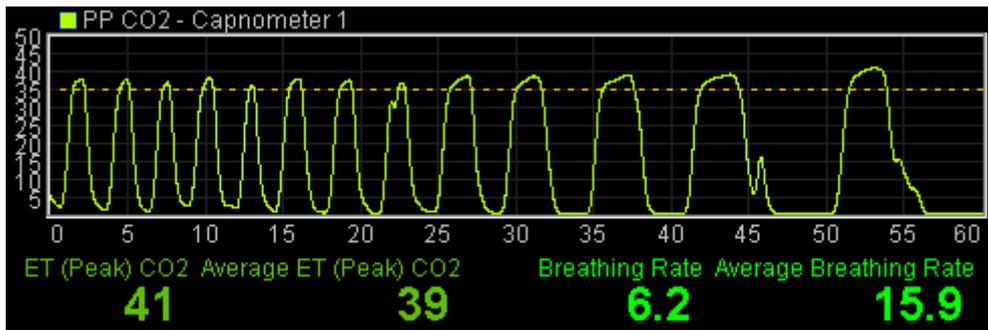


Figure 3 – Individual capnometer displays

Figure 3 above shows one such sector. You see that there is a short-term chart of the carbon dioxide signal, and below it are numeric displays showing end-tidal carbon dioxide, breathing rate, and their averages over the previous one minute.

A drop-down list control at the top of the main window (labelled 2 in figure 2) sets the time period (horizontal range) for all eight of the individual displays.

4.2 Support Window

Figure 4 below shows support window, as you see it when the device type selection is “Respirionics-compatible” - at the time of writing this is the only device this application supports.

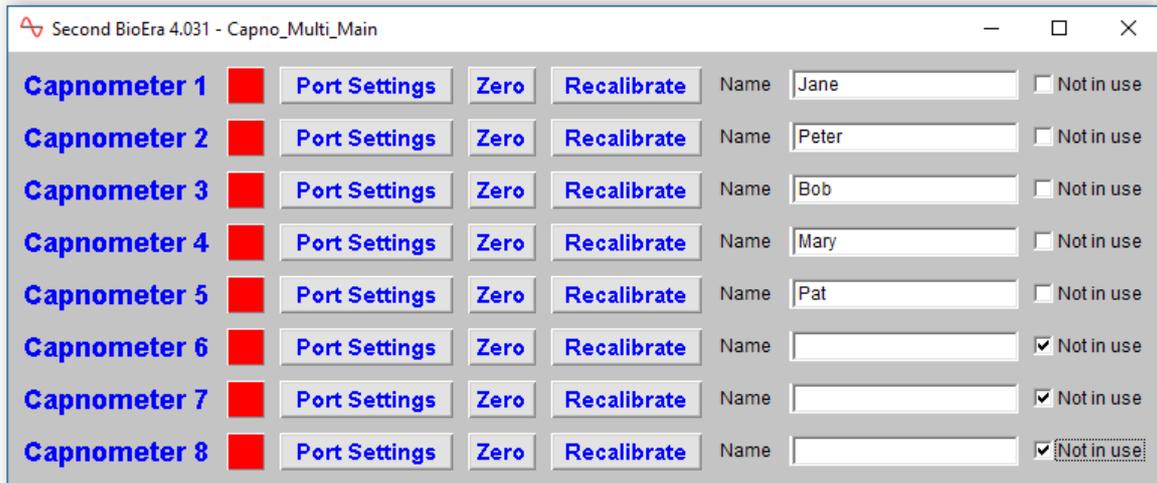


Figure 4 – Support Window

The main purpose of the support window is to configure the devices and make sure that each session record is linked to the right user.

The eight devices are listed with their associated controls, one per row.

A text box control allows you to name the particular user of each device.

You will almost certainly want to label your physical devices. My suggestion is that you add the name of the device on your physical label after the user's name, e.g. “Fred Blogs CAP-0001”.

When you connect each respirionics-compatible device, a virtual COM port is set up for that device (this topic is covered in the hardware guide). You need to make sure that each of the application devices is paired to the right COM port.

I suggest following this procedure:

1. Configure the devices in the support window BEFORE pressing the play button.
2. Connect each capnometer one at a time.
3. Watch the Windows device manager, to see that each one appears as a COM port, and note it's number, e.g. the first one you connect might be “COM3”.
4. Click the “Port Settings” button in the support window and make sure that the serial port is set to the one you just observed, e.g. “COM3”.
5. Enter the name of the user who will be training with the device you just connected, in the text box control.
6. Repeat the steps for the next device.

If you have less than eight users, you can check the check-box controls at the right-hand side of the support window, “Not in use”. Doing so will mean no data is written for the device. You should check the boxes before pressing “play”, for this to have an effect. If you forget, it doesn't really matter – the software will create extra reports containing junk data.

4.2.1 Zeroing Capnometers

Each device row in the support window has a button to zero its corresponding capnometer. These buttons work in just the same way as for the Basic Capnometry application. The following is a description of the purpose of zeroing your capnometers.

When there is no exhaled air flowing into the capnometer, the signal (PP CO₂) should go to zero. You can see this happens in figure 3 below, at least for the first few breaths (later the breathing is so rapid it doesn't have time). Sometimes this doesn't happen, and if you see that the trace hovers a few points above zero, you need to take steps to re-zero your device. In fact it's a good idea to do this every so often anyway, because if the signal drifts the other way, i.e. below zero, you won't see it.

In summary, zeroing a capnometer is in effect re-calibrating its signal.

In the application, depending on your device, there may be a button that allows you to do this from within the software. For example, in figure 2 above you can see a “Zero” button.

At the time of writing this is only implemented for the “Respironics-compatible” device. For it to work properly, the device must be disconnected from the breath for a period of several seconds before clicking. When you click, you should see the trace disappear and the lamp turn red for a period of a few seconds. If this doesn't happen, wait longer.

4.2.2 Breathing Calibration

The software calculates breathing rate and end-tidal carbon dioxide for each device. To do so, it needs to accurately and consistently detect the turning points of the breath (beginnings of inhalation and exhalation). This calibration should happen automatically during the first minute or so of the session. It's possible that sudden changes in breathing can cause the software to lose its calibration so that it no longer detects the breath turning points. You can tell this has happened because the breathing rate and ET PP CO₂ no longer update for each breath – but it should be a very rare event. In such cases you can recalibrate the breathing by pressing a button, in the bottom left of the application's window, labelled 4 in figure 4 below.

In the group capnometry application there is a button to recalibrate breathing for each user, one per row in the support window. Each works just the same as in the other capnometry applications.

5 Session Reports

The application records data from each user so that you can generate individual session reports, one per trainee. Each of these session reports is equivalent to that generated for the Basic Capnometry application. The trainee name that you entered in the support window is saved and used for the report.

The report contains summary data and graphs showing the progression of the feedback parameters over the whole session (excepting the first minute or so, during which time data is not written to allow for warming of the device).

To generate and open all the users session reports, click the button labelled 2 in figure 1. A dialog window opens in which you can select various options (see figure 5).

The software creates the report in html format. It will be opened using your computer's default web browser, e.g. Google Chrome. (Note that a live internet connection is not needed.) The html file is saved, so you can for example email it to the trainee. See the Installation and Set-up Guide for details of file storage. (Note also that trainee names are not incorporated into file names.)

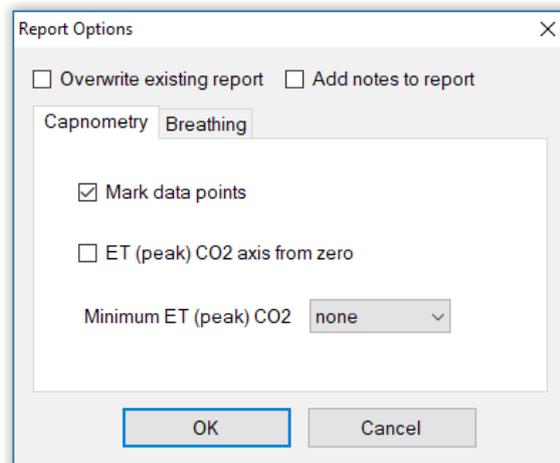


Figure 5 – Report options

5.1 Report Options

Most of the options should be self-explanatory.

If you change your mind about options on seeing your report, you can regenerate the report by clicking the report button (2 in figure 1), then checking 'Overwrite existing report'.

Options relating to either CO₂ data or breathing data are found under separate tabs.

Drop-down list controls allow you to set maximum or minimum values for several of the parameters. Setting these limits is a basic way of excluding “artefacts”, for example if you spoke to someone during the session this is likely to affect the calculations.

5.2 Adding Notes to a Report

You can choose to write some notes for your session report. Checking 'Add notes to report' (top right of the dialog) allows you to do this.

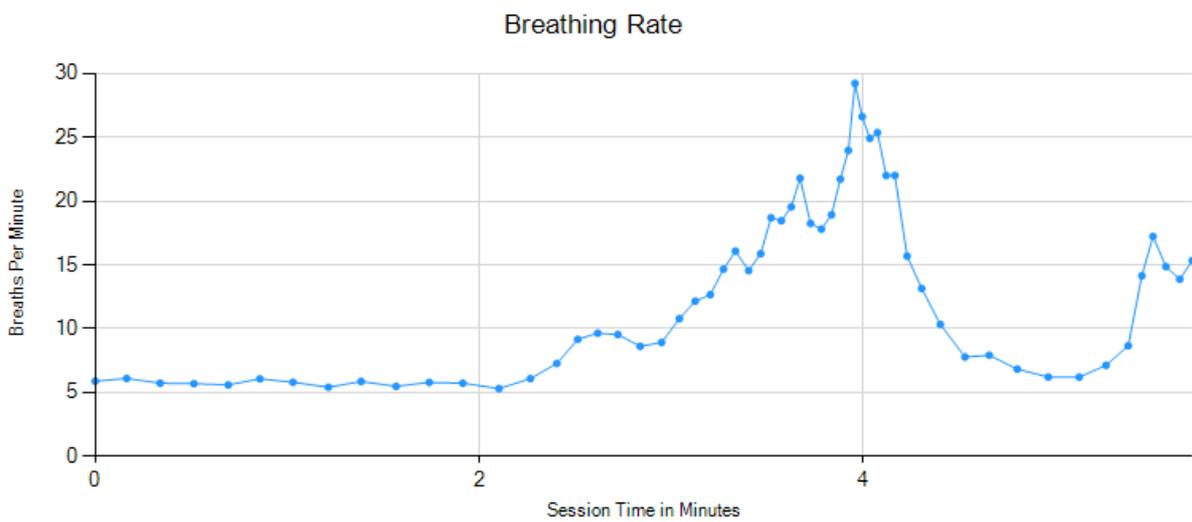
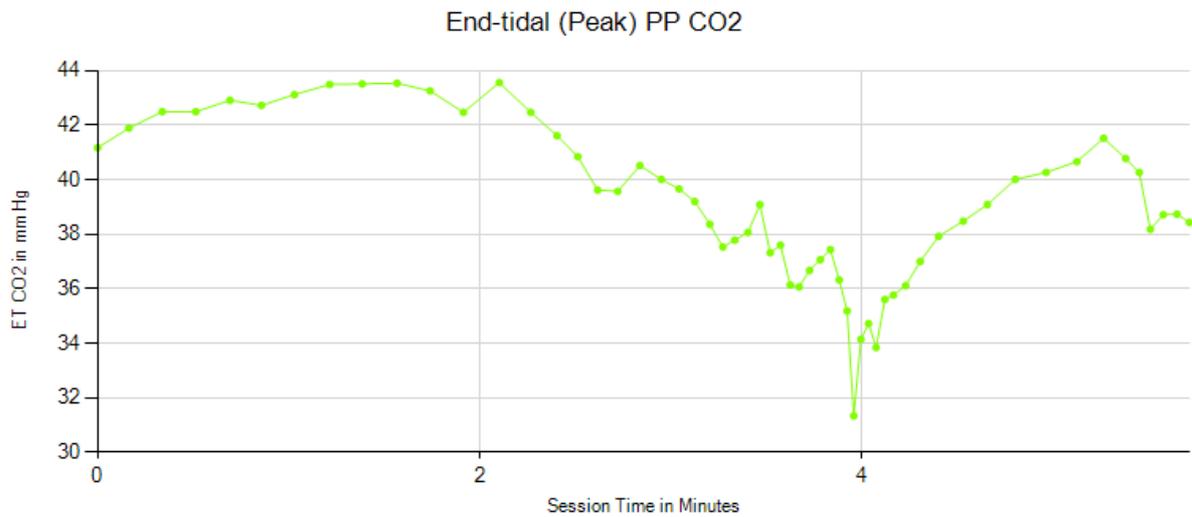
You may wish to add notes after having first seen the report. In this case, simply click the button (2 in figure 1) again, and check the Add notes option. This will regenerate the report with your added notes.

5.3 Sample Session Report

Please note, the formatting of the report has been changed slightly to fit this document.

Training Session Report

Training Application	Group Capnometry
Trainee Name	Fred Blogs
Session Date	23/03/12 08:24



Breathing Summary Data

Parameter	Mean	Max	Min	S.D.
Peak CO ₂	39.2 mm Hg	43.6 mm Hg	31.3 mm Hg	2.8 mm Hg
Breathing Rate	12.7 bpm	29.2 bpm	5.3 bpm	6.6 bpm