Basic and Advanced fEMG & EDA: Data Collection Methods and Data Analysis Workshop

With guest speaker Dr. Gary Berntson, Ohio State University

April 27- 29th, 2016

Schedule

Day 1 **VNR5075**

10:00-10:30 | Lab tour / Coffee social

10:30-12:00 | EMG

- Pre-testing electrode prep
- Participant prep
- Electrode placement
- Good signal check

12:00-1:00 | Lunch

1:00-2:00 | EDA

- Electrode placement
- Good signal check

Day 2 (EMG) **VNR 5075**

9:00-9:30 | Coffee social

9:30-10:45 | Theory

10:45-11:00 | Break

11:00-12:00 | Theory

12:00-1:00 | Lunch

1:00-3:30 Data analysis, discussion

Day 3 (EDA) **VNR 2075**

9:00-10:30 | Theory

10:30-10:45 | Break

10:45-12:00 | Theory

12:00-1:00 | Lunch

1:00-3:30 Data analysis, discussion

3:30-5:30 | Social

Welcome to INSPIRE

Integrated Neurocognitive & Social Psychophysiology Interdisciplinary Research Environment

Available Acquisition and Analysis Software

Data acquisition:
BioLab

Data cleaning and extraction:
Mindware Apps (EDA, HRV, BPV, BSA, EEG, EMG, IMP)

More details:
http://www.mindwaretech.com/

Experiment programming:
E-Prime
Experiment Builder
Matlab

Available Psychophysiological Measures

- Electrocardiography
- Impedance cardiography
- Electromyography
- Electrodermal activity
- Respiratory belt
- Pulse
- Blood pressure
- Eye tracking
- Body temperature

Goals of the Basic Acquisition Training

- Learn how to use the Experimenter's Display (ED)
- Learn how to place the electrodes for :
  - Electromyography
  - Electrodermal activity
- Learn more about:
  - BioLab
  - Mindware Technologies
- Learn how to analyse the data from:
  - Electromyography
  - Electrodermal activity

- The INSPIRE laboratory is a shared core facility of multidisciplinary research designed to study the relationships between people's thoughts, behaviours, and physiological reactions.
- These cutting-edge facilities allow for a wide range of sophisticated research projects. Using touchscreens, researchers can monitor and control multiple top-of-the-line workstations that simultaneously capture behavioural, physiological, and cognitive data.
- The capture of these psychophysiological data can be synchronized with a large variety of individual or group experimental tasks in which our research assess, for example, participants' perceptions, opinions, thought processes and emotions, in response to various stimuli.

Facial Electromyography (fEMG)

Facial electromyography (**fEMG**) is an electromyography (EMG) technique that measures muscle activity or "biopotentials" by detecting and amplifying the tiny electrical impulses that are generated by muscle fibers when they contract.

fEMG Equipment includes:

1. 1-3 alcohol prep pads
2. 1 tube of lemon prep
3. 1 cotton tip applicator
4. Several gauze wipes
5. The "checktrode" (to check impedance)
6. 1 EMG lead for the ground, 2 for the corrugator supercilii and 2 for the zygomaticus major
    a. You may label the leads with stickers to indicate to which face area the electrodes are destined.
7. 1 bag of adhesive collars
8. 1 blunt needle/syringe
9. 1 tube of Signa Gel
10. 1 roll of surgical tape

Checking the integrity of all electrode leads:

1. Connect plug end to red electrode input jack
2. Press power switch until it clicks on, then set function switch to contact (kΩ)
3. Connect electrode end of lead to snap connector on bottom panel of Checktrode®. Display should read 00.0 and not change
4. A reading that changes with lead motion indicates an intermittent open circuit in lead

Programs required:

1. Open Mindware (Bio PC on right) – click BioLab 3.0.13 in the researcher room to open the program.
2. Open E-prime (Stim PC on left). You can enter the participant ID, and the session number, but do not press on "ok" (i.e. do not start the experiment per se).

Tips:

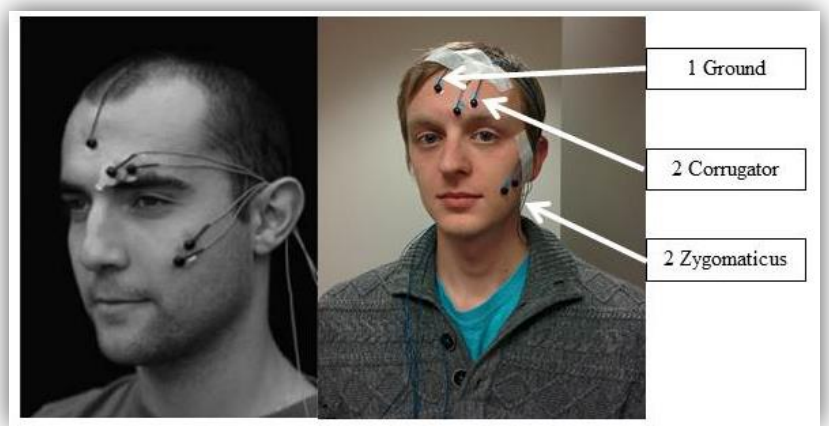
1. Always ask the participant if they are allergic to anything, especially lemon, and if they have ever had negative skin reactions to anything before, or a pre-existing skin condition. Test a blob of the lemon prep on the inner wrist beforehand to see how it reacts.

2. When putting the adhesive collar on the electrode and injecting the gel in the electrodes, avoid making air bubbles in the gel. While the gel should be in contact with the skin, avoid putting too much gel as it will reduce the adhesiveness of the collars. Repeat for each electrode.

3. Preparing the participant's face for electrode placement:
   A. Clean all the relevant areas (i.e. over the left eyebrow, over the left cheek) with an alcohol prep pad and dry with gauze.

   B. Proceeding from the area of one EMG electrode to the next:

      a. Clean the skin with a cotton tip applicator and the lemon prep (the required movement is similar to drilling). The area should be pink, however be mindful that darker skin may not show such a "pinkish" colour, and some people with very sensitive skin may present with pink skin quickly. When in doubt, it's better to test the electrode impedance, as drawing blood poses serious hygienic concerns when using reusable electrodes.
      b. Place the electrode on the cleaned area with the lead hanging over the head. Tape the lead on the skin. Repeat these steps for each electrode.



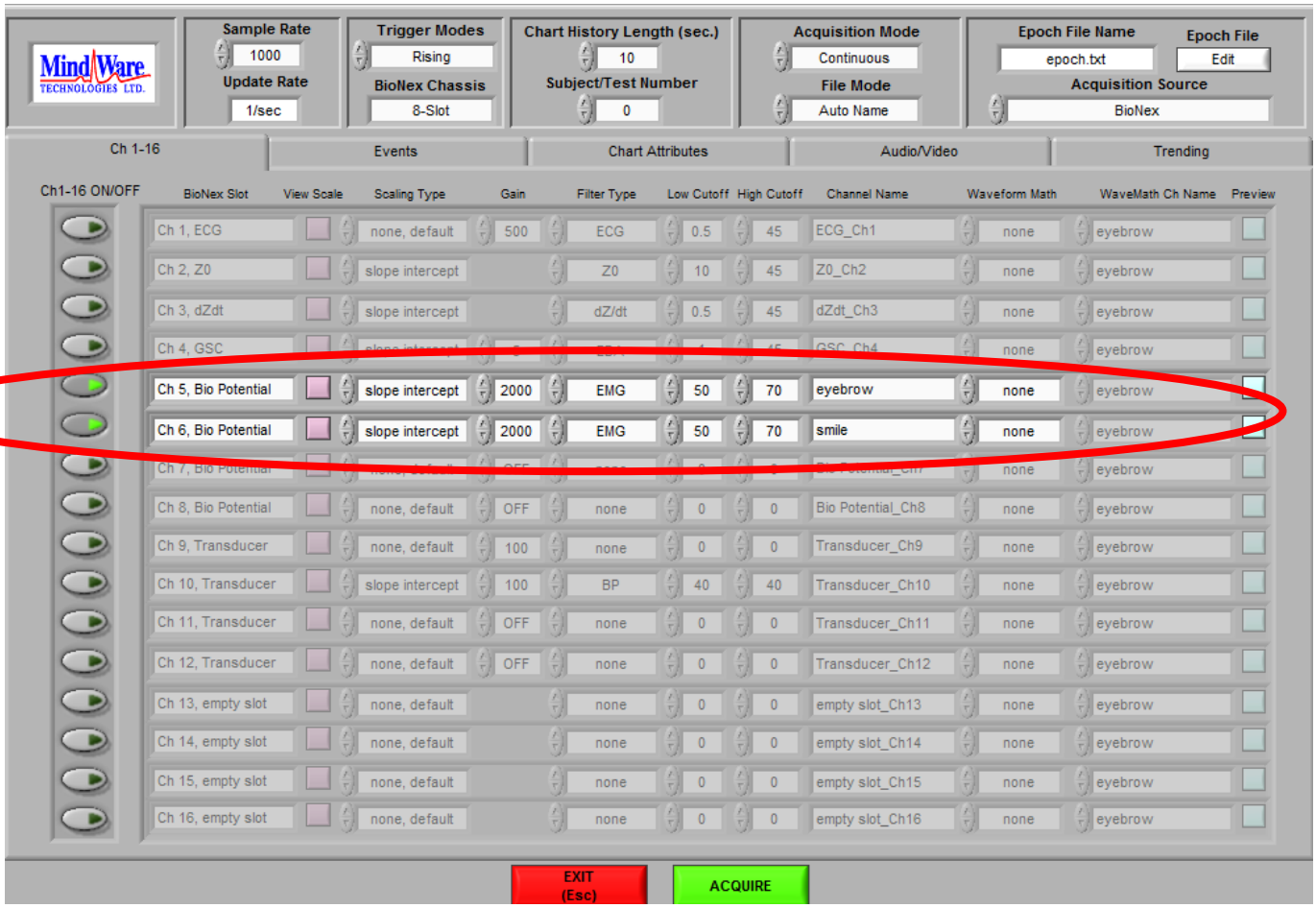
   C. Checking the "electrode contact integrity":
      a. Connect the attached electrode leads to Checktrode® input jacks (red and black jacks). Check ground with the other electrodes and two electrodes together for each area.
      b. Press power switch until it clicks on, then set function switch to 50 (kΩ).Test.
      c. Display reads 49.5 to 50.5 (kΩ) if Checktrode ® is working properly.
      d. Set function switch to contact (kΩ). Display indicates electrode-skin contact impedance. High impedance correlates with inadequate skin preparation. Recordings often will be marred by noise from electrode lead motions.
      e. *Various readings indicate the following:*
         i. **5 kΩ or less** – *excellent skin prep: proceed with recording and expect good results.*
         ii. **5-10 kΩ** – *good skin prep, but expect some noise in the recording.*
         iii. **10-30 kΩ** – *fair skin prep. Contact impedance may decrease with time, but for best recording quality, electrodes should be removed and skin re-prepped.*
         iv. **Above 30 kΩ** – *bad skin prep. Even slight patient motion will cause noise. Electrodes must be removed and skin re-prepped."(Checktrode ® manual)*

   D. Plug the electrodes in the Mindware electrode box on the **left** of the participant.

   E. Don't forget to remind the participant to avoid large body movements and make sure they are comfortable.

Preparing Biolab:

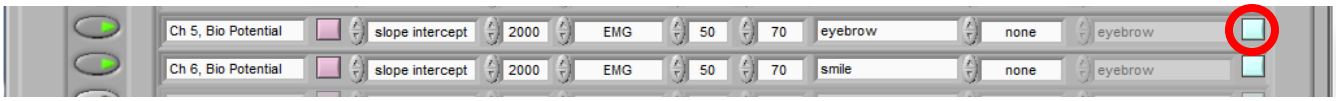
1. Look at the Biolab software to ensure that all settings are correct (as seen below). Keep in mind multiple researchers are using the research space and Biolab will display the most recently used settings. Ensure that channel 5 and 6 are active with all other channels off.



Check the following:

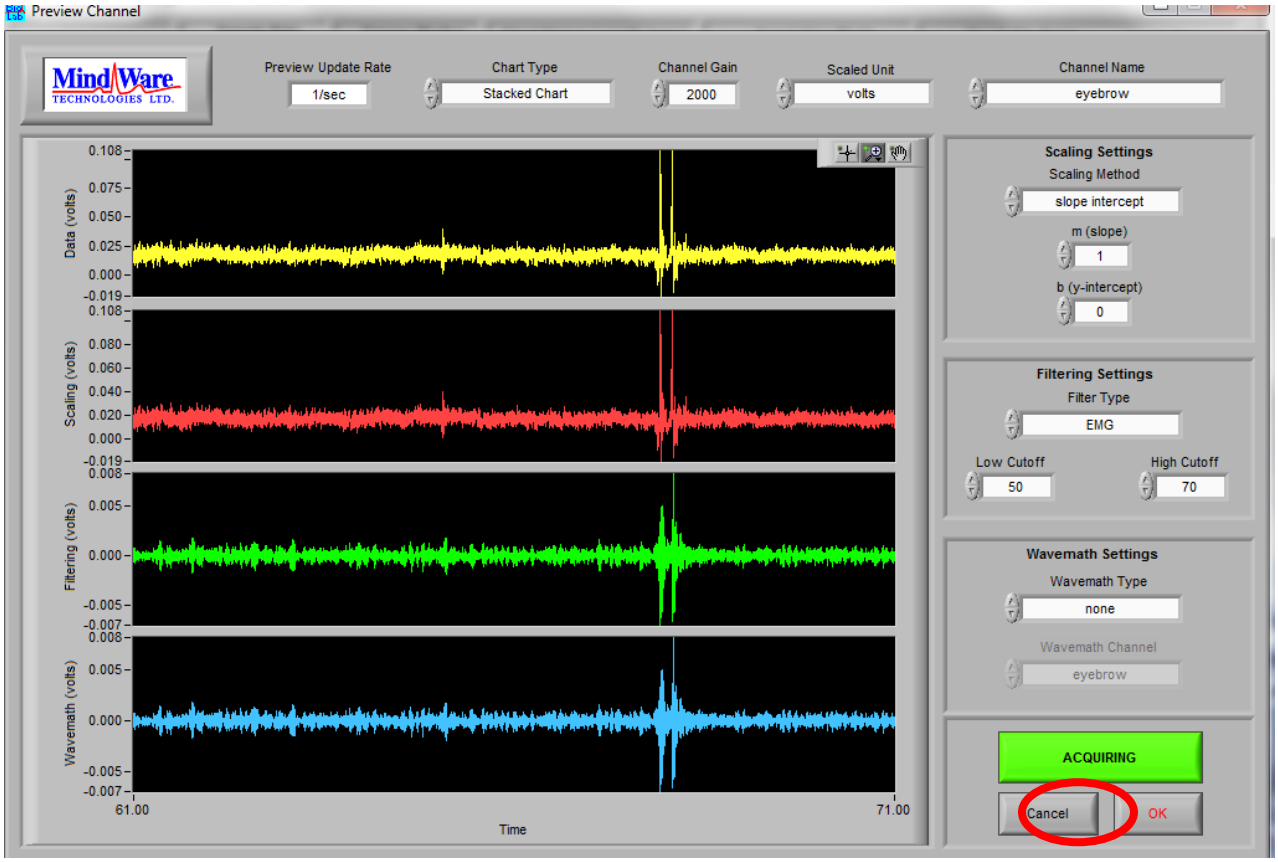
- Sample rate: 1000
- Trigger: Rising (to start the recording automatically with E-Prime. E-Prime needs to be programmed accordingly)
- Acquisition mode: Continuous
- Acquisition source: Bionex
- Subject Test Number: Optional.
- Chart History Length (sec.): Preference of the researcher
- Update rate: 1/sec
- Ensure that channel 5 and channel 6 are on, with the labels for the corr. (eyebrow) and the zyg. (smile). This will be helpful when analyzing the data.

2. Check signal of each of the electrodes by clicking on the blue square beside each of the channels.



3. Ask participant *to move eyes up, down & side to side, pull eyebrows together* and *show teeth* to test the signal.

4. Check to make sure that the signal is not too noisy by asking the participant to create their maximal flexion of each muscle. Pay attention to the change of scale to see if the noise is too large (as observed by the ratio of maximum flexion to resting level). Look for changes in the signal during flexion and no changes in signal when in resting state. Also be sure to check if the signal is picking up the heart beat (an obvious pulsing during resting state, indicating the electrodes are too far apart).



5. If the signal is good → click OK.

6. Click 

→ Save as.

7. Check to ensure EMG signal is still good.

8. Start your task. Monitor the recordings throughout the experiment. Select the F12 button to add comments for participant's reaction to unwanted stimuli (e.g. confused look, cough etc.) or pre-program keys for each of those events (in BioLab).

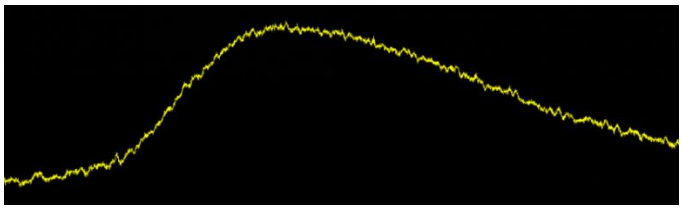
After data collection:

9. Remove the electrodes and wipe the area with gauze. Encourage the participant to go to the bathroom and wash the area with soap and water.

10. Clean electrodes with water (preferably distilled) and let them air dry. Return remaining study materials to their proper places. Blunt needles should be washed and re-used. When discarding the blunt needles, please put them in the green container in 5074 or in a closable sturdy opaque container.

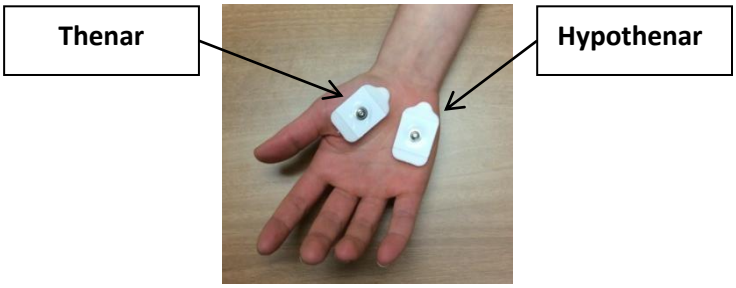
Electrodermal Activity (EDA)

- **Electrodermal activity** (EDA), also called galvanic skin conductance (GSC), is measured in micro-siemens. This measure is sensitive to changes in electrical conductance caused by sweating. EDA is recorded mostly to observe subtle changes in emotion, arousal, and stress.

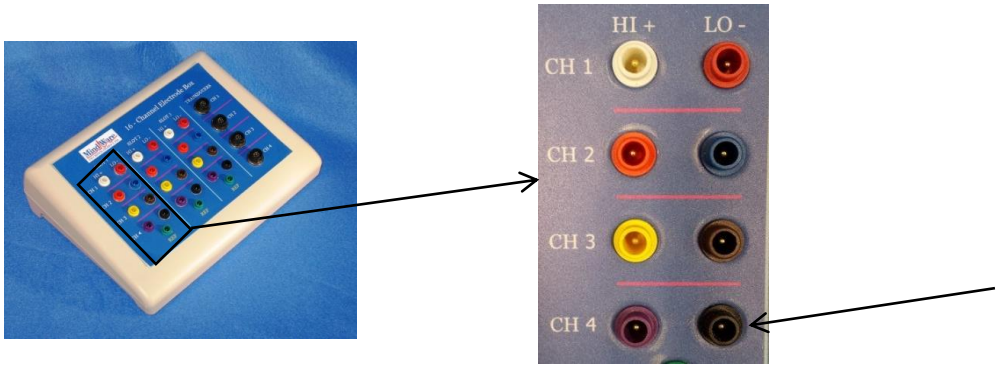


For electrodermal activity, you have to put the rectangular sensors with **the green** leads on the left hand (or the hand that's not used during the task).

We apply the Ag/AgCl sensors typically on the thenar and hypothenar. We do not clean the hands with alcohol wipes, but rather use water or soft soap. Some researchers choose not to clean the skin.



After that, you will have to put the leads in the head box in the drawer next to the computer. Place them in the CH 4; no need to identify their positive or negative charge. Next, check the signals.



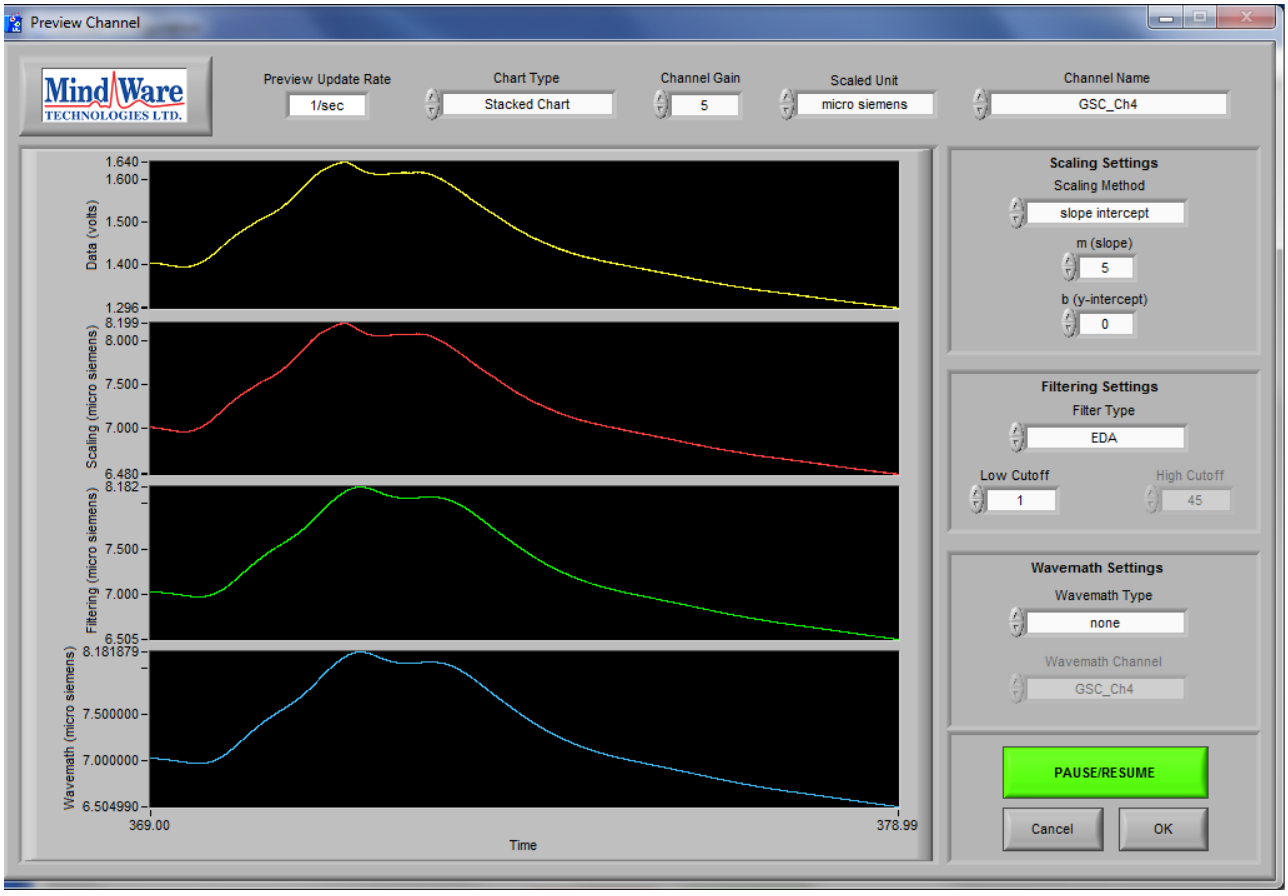
Channel	Slot 1: **HI+/LO-**
1	ECG
2	Z0
3	Dz/Dt
4	GSC/EDA

Note: Remind your participants to avoid any movements throughout the session. Make sure they are relaxed and comfortable.

Tips:

- Temperature of the room should be between 20-25 degrees. You may take of note of the temperature.
- Participants should wear loose clothes to facilitate placing the electrodes, and they should avoid wearing a dress.
- Participants should avoid drinking coffee and alcohol, and smoking or eating before the experiment. Drink lukewarm water.
- Never re-use the same electrodes.
- If you have problems with your EDA signal, change the electrodes and ensure they are properly placed.

In Biolab, the EDA should look like this. Notice how the yellow data line is clean with very little noise.

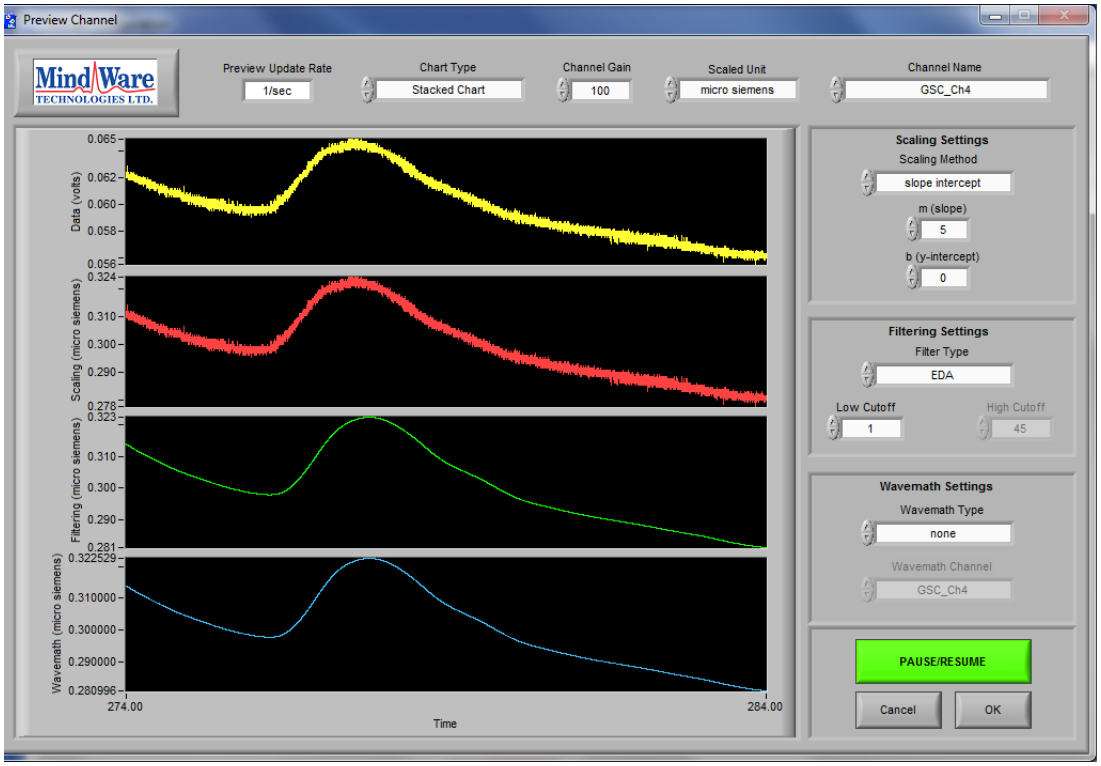


In Biolab, the correct settings should be as follows:

Measure/Filter Type	Channel gain	Unit	Scaling Methods
EDA	5*	Micro-siemens	slope intercept (m slope = 5; b y-intercept = 0)

Next, make sure that channel gain is optimal. Look at the scale on the left of the red signal. The signal should be between 2 and 20 micro-siemens. Ask participants to take a deep breath by inhaling and exhaling quickly. If participants reach 20 micro-siemens when doing this sniff test, change the gain to the next higher number (to reduce the gain). Repeat as necessary.

Avoid signals as shown below:



The yellow data line is thick and shows a lot of noise. Check the connections and reduce the channel gain if it set too high. If the signal is still too noisy, replaces the electrodes.

<u>After data collection</u>:

- Take off the sensors and the leads.
- Give the participant alcohol wipes to take off the glue on their skin. Red spots may appear but they should be gone half an hour later.
- Clean the work place and have the material ready for the next participant.

For more information

National Instruments. (2006). Data Acquisition in the Life Sciences. *Retrieved from* (PDF document) http://www.ni.com/white-paper/4057/en/

MindWare technologies LTD. (2009). Our products. *Retrieved from* https://www.mindwaretech.com/Systems/