

Experiment HP-1: Facial Electromyograms (EMG) and Emotion

Facial Electromyography (fEMG) refers to an EMG technique that measures muscle activity by detecting the electrical impulses that are generated by muscle fibers in the face when they contract. It primarily focuses on two major muscle groups, the corrugator supercilli and zygomaticus major muscle groups.

Facial EMG has been studied to assess its basis as a tool for measuring emotional reactions to various stimuli. Studies have found that contraction of the corrugator muscle, which lowers the eyebrow and is involved in frowning, varies inversely with the activity of the zygomaticus muscle, which controls smiling. It is said these muscle groups are either associated with negative emotional stimuli and negative mood (corrugator) or positive emotional stimuli and positive mood (zygomaticus). Facial Electromyography is emerging as a more precise and sensitive method to measure changes in facial expressions than just using visual observation. Facial EMG measures minute changes in the electrical activity of facial muscles, which reflects minute muscle movements. This technique has been shown to be capable of measuring facial muscle activity to even weakly evocative emotional stimuli. Even when subjects are instructed to inhibit their emotional expression, facial EMG can still register the response.

Facial EMG has been used to distinguish and track positive and negative emotional reactions to a stimulus as it occurs. Many of these experiments have been conducted in laboratory environments using a range of stimuli, such as: still pictures, movie clips and music pieces.

Another aspect of Facial EMG is the different emotional responses shown between males and females. Analysis in a number of experiments has shown that compared to men, women reported higher feelings of pleasantness and generated significantly higher EMG ratios at the zygomatic muscle region while viewing pleasant images and women reported significantly fewer feelings of pleasantness and generated significantly higher EMG ratios at the corrugator muscle region while viewing unpleasant images. These results have demonstrated that gender plays a role in emotion expression and associated EMG responses while viewing emotion provoking photographs.

In this series of lab exercises, students will record and analyze facial EMGs using an iWorx A/D recorder while looking at a variety of images known to produce emotional responses. Students will be viewing still images, but this exercise can be extended to include both video and responses when listening to music. This lab experiment is also fully customizable to add Galvanic Skin Response to the data collection. This will allow students to observe a wider range of parameters to support the idea that facial EMGs are a valid method for determining emotional response.

Experiment HP-1: Facial Electromyograms (EMG) and Emotion

Equipment Required

PC or Mac Computer

USB cable

IX-BIO4 or IX-BIO8 data recorder

Five EMG electrode lead wires

Disposable electrodes

Alcohol swabs

IX-BIO Setup

Use the USB cable to connect the computer to the USB port on the IX-BIO.

Start the Software

1. Click on the LabScribe shortcut on the computer's desktop to open the program. If a shortcut is not available, click on the Windows Start menu, move the cursor to All Programs and then to the listing for iWorx. Select LabScribe from the iWorx submenu. The LabScribe Main window will appear as the program opens.
2. On the Main window, pull down the Settings menu and select Load Group.
3. Locate the folder that contains the settings group, IXBIO.iwxgrp. Select this group and click Open.
4. Pull down the Settings menu again. Select the FacialEMG settings file from Human Psychophysiology.
5. After a short time, LabScribe will appear on the computer screen as configured by the FacialEMG settings.
6. For your information, the settings used to configure the LabScribe software and the IX-BIO unit for this experiment are programmed on the Preferences Dialog window which can be viewed by selecting Preferences from the Edit menu on the LabScribe Main window.
7. Once the settings file has been loaded, click the **Experiment** button on the toolbar to open any of the following documents:
 - Appendix
 - Background
 - Labs
 - Setup (opens automatically)

EMG Cable Setup

1. Locate the red, black, green, brown, and white electrode lead wires and connect them to the color coded sockets on the IX-BIO (Figure HP-1-S1).
2. Locate the muscles of the face over which the recording electrodes will be placed. Muscles can be located by frowning and smiling and noting the areas of the face where the muscles are tense.
3. Use an alcohol swab to clean and scrub the areas where the electrodes will be placed. Let the areas dry before attaching the electrodes.

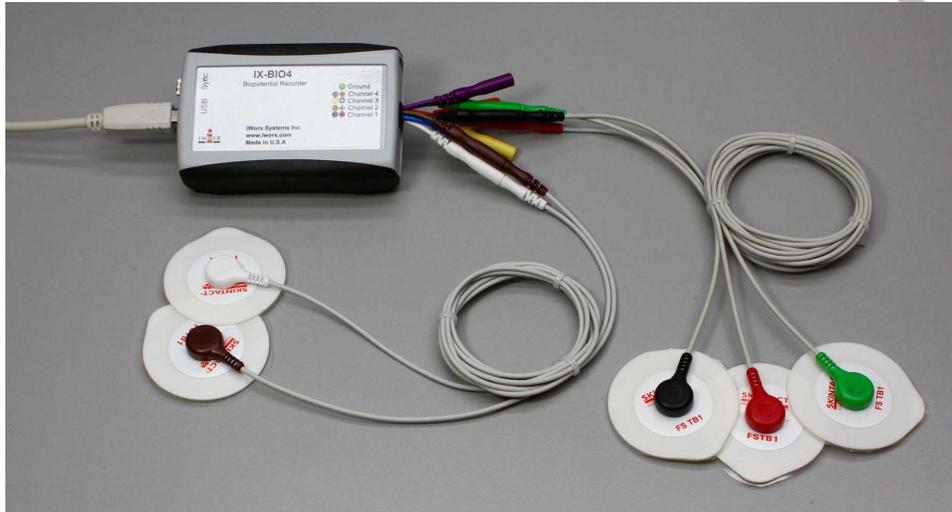


Figure HP-1-S1: The IX-BIO4 with five EMG electrodes.

Note: You will need to trim the snap electrodes carefully so they fit close together in each of the locations. Trim them prior to removing the plastic backing.

4. Remove the plastic disk from a disposable electrode and apply it to one of the scrubbed areas. Attach an electrode to each of the other areas.
5. One pair of recording electrodes will be placed over the Corrugator supercilli muscle just above the left eyebrow.
 - The first electrode is placed above the eyebrow and directly in line with inside corner of the eye. This sensor should be placed as close to the eyebrow as possible.
 - The second sensor is placed directly next to the first sensor and to the outside of the eye.
6. The second pair of recording electrodes will be placed along the Zygomaticus major muscle along the right cheek.
 - Trace an imaginary line between the corner of the mouth and the indentation at the top of the ear. Place the first electrode directly in the center of this imaginary line.
 - Place the second electrode immediately next to the first, closer to mouth along the imaginary line.
7. The fifth electrode, used as the ground, is centered on the subject's forehead.

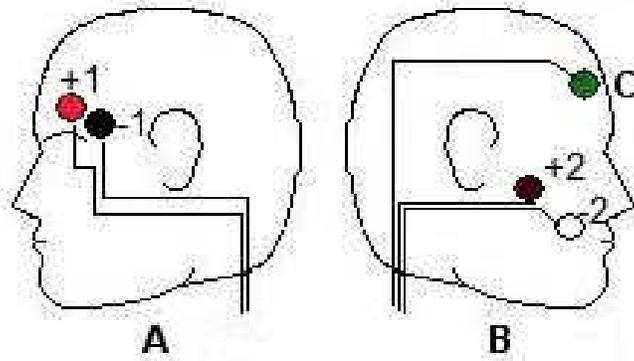


Figure HP-1-S2: The positions of the electrodes on the face for recording Facial EMGs.

8. The positions of the electrodes are as follows (Figure HP-1-S2)

- The red “+1” lead is placed near the center of the left eyebrow.
- The black “-1” lead is placed immediately to the left of the red electrode towards the outside of the eyebrow.
- The brown “+2” lead is placed along the cheek midway between the ear and the mouth.
- The white “-2” lead is placed adjacent to the brown electrode closer to the mouth.
- The green “G” electrode is placed in the center of the forehead.

Note: The electrodes must be placed very close together, trimming them will help keep them positioned correctly.

Experiment HP-1: Facial Electromyograms (EMG) and Emotion

Exercise 1: Muscles in Face used for Smiling and Frowning

Aim: To study the EMG activity in muscles of the face that work to smile or frown.

Procedure

1. Instruct the subject that he or she will be doing the following during this exercise:
 - Before the recording begins, the subject will sit quietly with their mouth neither smiling nor frowning. This position is defined as the neutral position.
 - Smile widely away from the neutral position and hold this position for four seconds ([Figure HP-1-L1](#)).

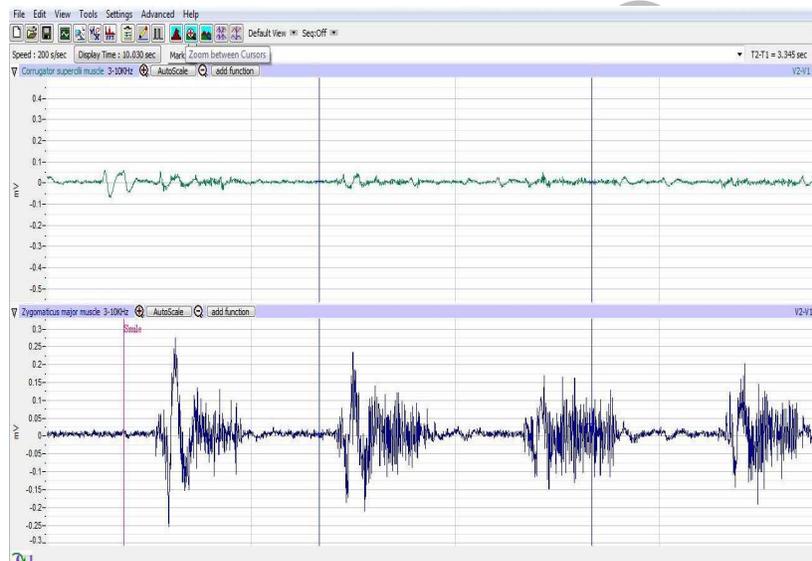


Figure HM-9-L1: Movement performed while recording from muscles of the face responsible smiling. Note that the top channel (Corrugator s.) is not active while the subject is smiling.

- Return the mouth to the neutral position for four seconds.
 - Frown and mouth to the neutral position for at least two seconds.
 - Repeat this cycle two more times while recording.
2. Before the starting the recording, type Neutral in the Mark box to the right of the Mark button. Instruct the subject to place his or her mouth in the neutral position.
 3. Click the Record button in the upper right corner of the LabScribe Main window. Click on the Mark button to label the recording.
 4. While the subject's mouth is in the neutral position, type Smile in the Mark box. When the subject smiles, click on the Mark button to label the recording.

5. While the subject is smiling, type Neutral in the Mark box. When the subject returns his or her mouth to the neutral position, click on the Mark button to label the recording.
6. While the subject's mouth is in the neutral position, type Frown in the Mark box. When the subject frowns, click on the Mark button to label the recording.
7. Repeat Steps 2 through 6 two more times.
8. When the last cycle is completed, click the Stop button.
9. Click AutoScale on all channels to amplify signals. The recording should be similar to [Figure HP-1-L2](#).



Figure HP-1-L2: Recording showing the movements when the subject is smiling and frowning.

10. Select Save As in the File menu, type a name for the file. Choose a destination on the computer in which to save the file, like your lab group folder. Designate the file type as *.iwxdata. Click on the Save button to save the data file.

Data Analysis

1. Scroll through the recording and find the section of data recorded while the subject was smiling and frowning.
2. Use the Display Time icons to adjust the Display Time of the Main window so three smile-frown cycles appear on the Main window. The three cycles can also be selected by:
 - Placing the cursors on either side of the three adjacent cycles; and
 - Clicking the Zoom between Cursors button on the LabScribe toolbar to expand the segment with the three cycles to the width of the Main window.

- Click on the Analysis window icon in the LabScribe toolbar (Figure HP-1-L3) or select Analysis from the Windows menu to transfer the data displayed in the Main window to the Analysis window (Figure HP-1-L4).

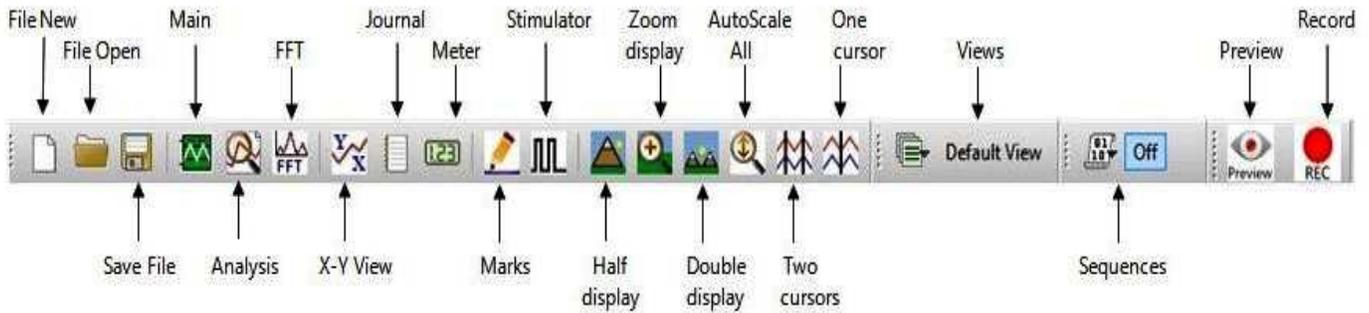


Figure HP-1-L3: The LabScribe toolbar.

- Look at the Function Table that is above the uppermost channel displayed in the Analysis window. The mathematical functions, Abs. Int and T2-T1, should appear in this table. The values for Abs. Int and T2-T1 on each channel are seen in the table across the top margin of each channel.



Figure HP-1-L4: EMG activity from the muscles used for smiling and frowning. Cursors are placed to measure the EMG activity taking place during the first “smile” episode.

5. Once the cursors are placed in the correct positions for measuring the parameters of a smile or frown, the values for the parameters can be recorded in the on-line notebook of LabScribe by typing the names and values directly into the Journal, or on a data table.
6. The functions in the channel pull-down menus of the Analysis window can also be used to enter the names and values of the parameters to the Journal. To use these functions:
 - Place the cursors at the locations used to measure the absolute areas.
 - Transfer the name of the mathematical function used to determine the absolute areas to the Journal using the Add Title to Journal function in the Zygomaticus major m. Channel pull-down menu.
 - Transfer the values for the absolute areas to the Journal using the Add All Data to Journal function in the Zygomaticus major m. Channel pull-down menu.
7. Use the mouse to click on and drag the cursors to the onset and offset of the first smile ([Figure HP-1-L4](#)). The values for Abs. Int and T2-T1 on the Zygomaticus major channel are the relative amounts of the EMG activity and the durations of the zygomaticus muscle during the smile.
8. Use the mouse to click on and drag the cursors to the onset and offset of the first frown. The values for Abs. Int and T2-T1 on the Corrugator supercilli channel are the relative amounts of the EMG activity and the durations of the corrugator muscle during the frown.
 - The values for these parameters, listed in the table above the Corrugator supercilli channel, are the same properties from the corrugator muscle during the frown.
9. Record the values from each muscle during the first smile frown in the Journal, or on a data table.
10. Use the mouse to move the cursors to onset and offset of the next smile. Measure and record the values for Abs. Int and T2-T1.
11. Use the mouse to move the cursors to onset and offset of the next frown. Measure and record the values for Abs. Int and T2-T1.
12. Repeat steps 10 and 11 for the last smile-frown recording.
13. Average the values for each parameter taken from the zygomaticus muscle during smiling. Find the average for each parameter from the corrugator muscle during frowning. Enter the averages for each parameter on [Table HP-1-L1](#).
14. Select Save from the File menu.

Questions

1. Which muscle had the most EMG activity during smiling?
2. Which muscle had the most EMG activity during frowning?
3. Did the subject notice the way the muscles moved during smiling and frowning. If so, what can be commented upon about how these muscles move to accommodate smiling and frowning?

Table HP-1-L1: Average EMG Activity and Duration during Smiling and Frowning

	Smile Abs Int (mV)	Smile Time (sec)	Frown Abs Int (mV)	Frown Time (sec)
1				
2				
3				
Mean				

Exercise 2: Smiling and Frowning While Looking at a Variety of Images

Aim: To study the subject's emotional response while looking at a series of images.

Procedure

1. Instruct the subject that he or she will be doing the following during this exercise:
 - Before the recording begins, the subject will sit quietly with their mouth neither smiling nor frowning. This position is defined as the neutral position.
 - The subject will then be shown an emotional or neutral image for a few seconds.
 - Based on the emotion felt while looking at the image - the subject will smile, frown or leave the mouth in the neutral position.

Note: It is important to have on hand a variety of images that express happiness, sadness, excitement, surprise, agony, etc... for the subject to view during this portion of the experiment. Neutral images, such as a single color or a blank page, will also be used.

2. Click the Record button in the upper right corner of the LabScribe Main window.
3. While the subject is sitting quietly, begin to show the images one at a time. Pause on each image for 3-5 seconds to allow the subject to respond to what he or she is looking at.
4. Mark the recording with either an S, F or N based on the type of image shown. Click on the Mark button to label the recording appropriately.
5. Repeat step 4 using at least 20 images that will elicit some sort of emotional or neutral response.
6. Select Save from the File menu.

Data Analysis

1. Scroll through the recording and find the beginning of the section of data recorded while the subject was looking at the images.
2. Click and drag the cursors so they are placed at the onset and offset of the response to the image.

3. Click on the Analysis window icon in the LabScribe toolbar or select Analysis from the Windows menu to transfer the data displayed in the Main window to the Analysis window.
4. Look at the Function Table that is above the uppermost channel displayed in the Analysis window. The mathematical functions, Abs. Int and T2-T1, should appear in this table. The values for Abs. Int and T2-T1 on each channel are seen in the table across the top margin of each channel.
5. Measure the Abs. Int and T2-T1 value for the response to the image shown and record the values in either the Journal or on [Table HP-1-L2](#).
6. If there is no response, leave the value columns empty.
7. Scroll through the recording and repeat steps 5 and 6 for all 20 images shown.

Questions

1. Did the subject show the expected emotional response to each of the image shown?
2. If the subject did not shown the expected response, what explanation can be given for this?
3. Was there any variation in EMG activity or duration of the response based on the image? Why could this happen?
4. What reasons can you give for a lengthier response?
5. What reasons can you give for a higher or lower EMG response?

