Experiment HP-9: Facial Expression Electromyograms (EMG) and Emotion

Equipment Required

PC or Mac Computer

IXTA, USB cable, IXTA power supply

iWire-B3G ECG cable and electrode lead wires

Disposable electrodes

Optional Equipment:

C-GSR-320 GSR cables (for exercises 3 and 4)

PPG-320 Pulse plethysmograph (only for exercise 4)

Note: *If you choose to add the Optional Equipment as listed above, you will be adding new channels in the Main window. Use the Edit, Preferences dialog window and follow the directions later in the lab.*

Note: Connect the iWire-B3G to the IXTA prior to turning it on.

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.*

EMG Cable Setup

1. Locate the iWire-B3G EMG cable and electrode lead wires.
2. Insert the connector on the end of the EMG cable into the iWire 1channel.
3. 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.
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. Positions the electrodes as follows:
    - 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.

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6. 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.
    - The fifth electrode, used as the ground, is centered on the subject's forehead.

Figure HP-9-S1: The IXTA with the iWire-B3G and electrodes attached to the iWire input of the IXTA.

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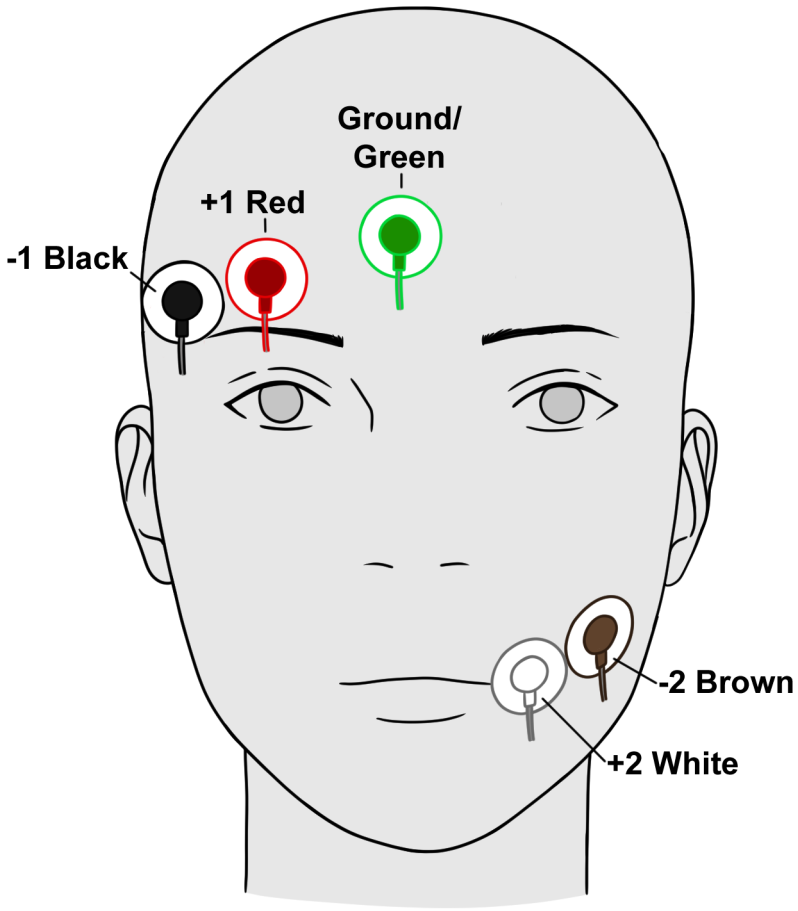

Figure HP-9-S2: The positions of the electrodes on the face for recording Facial EMGs.

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Experiment HP-9: Facial Expression Electromyograms (EMG) and Emotion

Exercises 3 and 4 are optional,
as is using the GSR leads.

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.

Approximate Time: 15 minutes

Procedure

1. Instruct the subject that they 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.
    - Return the mouth to the neutral position for four seconds.
    - Frown and mouth to the neutral position for at least four seconds.
    - Repeat this cycle two more times while recording.

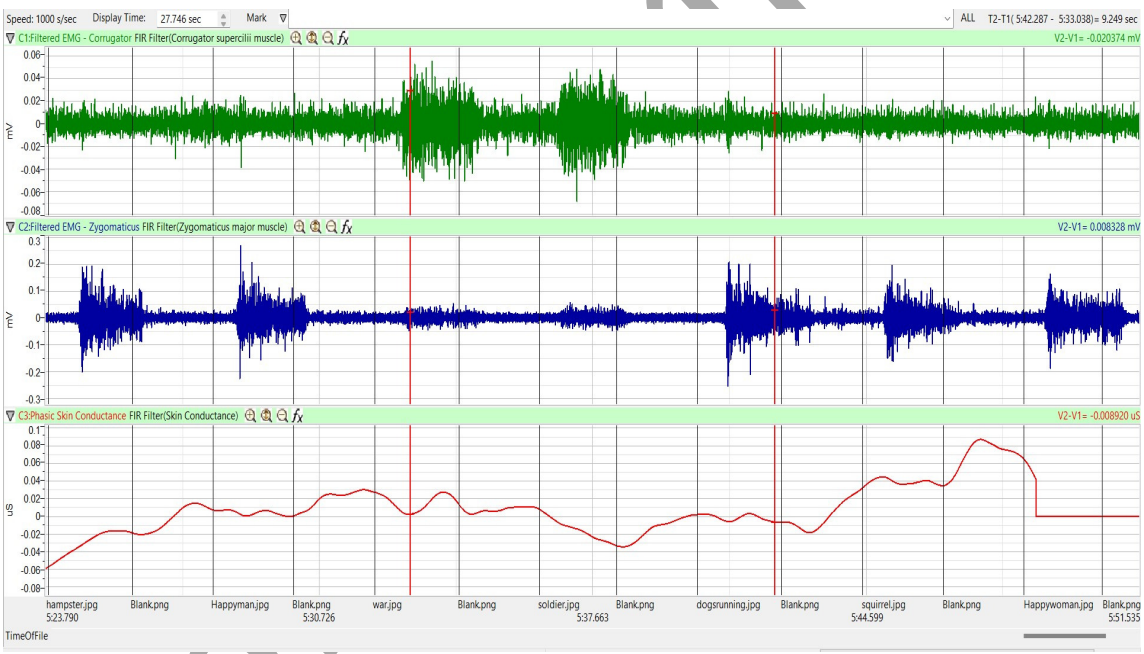

Figure HM-9-L1: Movement performed while recording from muscles of the face responsible smiling. Note that the top channel (Corrugator s.) is only active while the subject is frowning.

2. Before the starting the recording, type **Neutral** in the Mark box. Instruct the subject to place their mouth in the neutral position.

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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.
5. While the subject is smiling, type **Neutral** in the Mark box. When the subject returns their mouth to the neutral position, click on the Mark button.
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.
7. Repeat Steps 2 through 6 two more times.
8. When the last cycle is completed, click the Stop button.
9. Click AutoScale All.

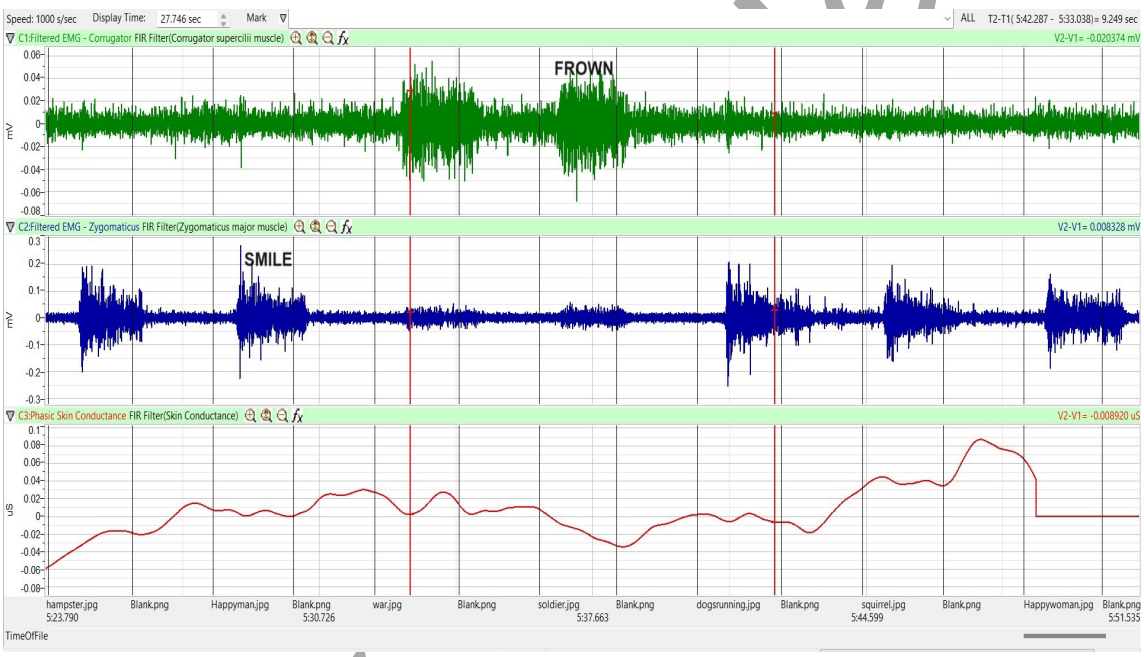

Figure HP-9-L2: Recording showing the movements when the subject is smiling and frowning.

10. Select Save As in the File menu, type a name for the file. 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:

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- 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.

3. Click on the Analysis window icon.

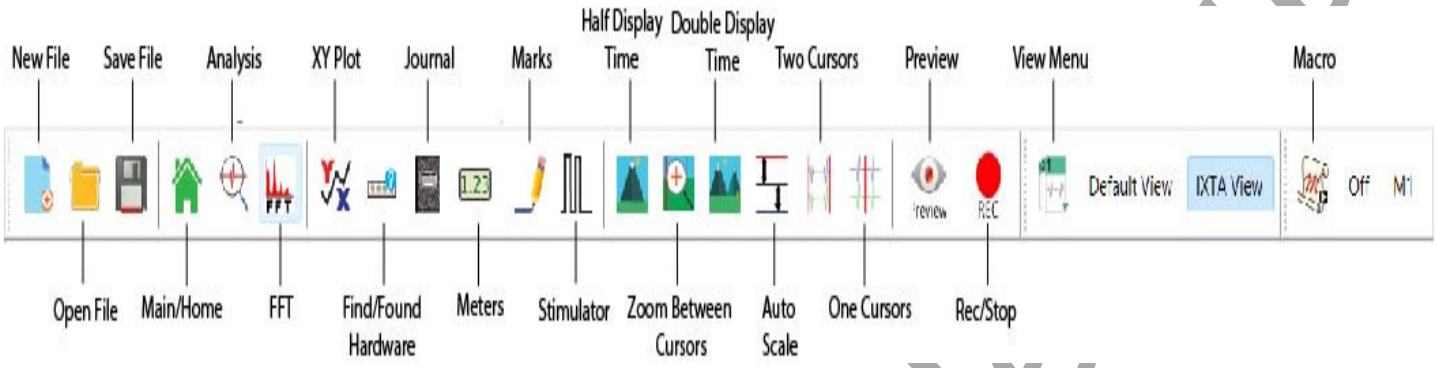

Figure HM-9-L3: The LabScribe toolbar.

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. Use the mouse to click on and drag the cursors to the onset and offset of the first smile. 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.
6. Once the cursors are placed in the correct positions for measuring the parameters of a smile, 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.
    - 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 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.

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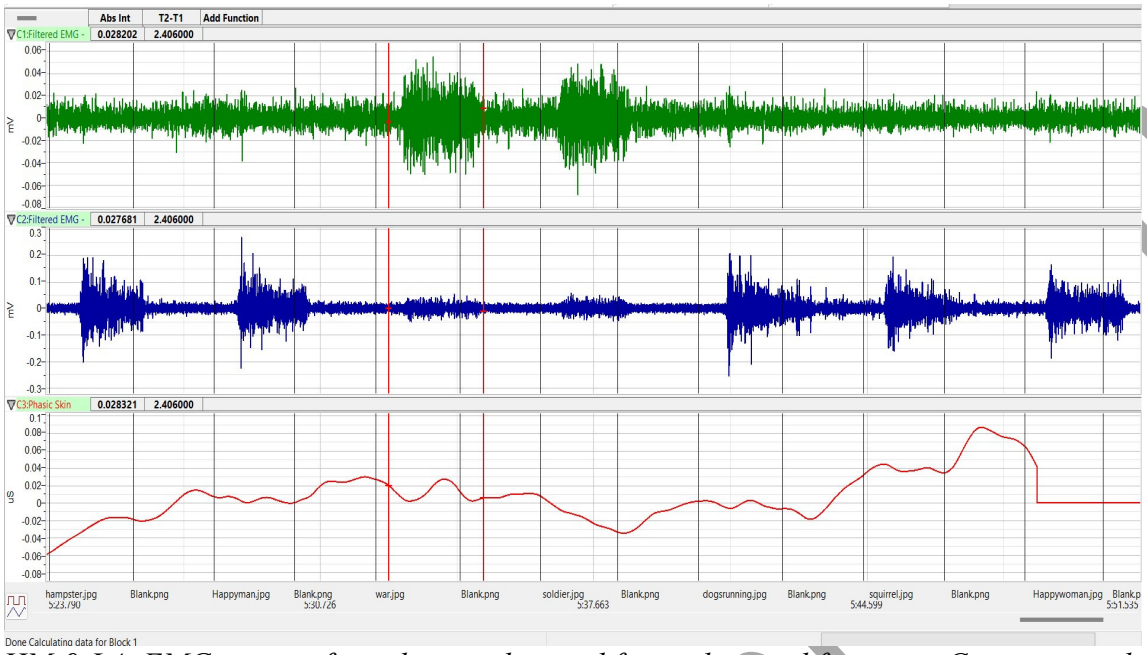

Figure HM-9-L4: EMG activity from the muscles used for smiling and frowning. Cursors are placed to measure the EMG activity taking place during the first "frown" episode.

10. Record the values from each muscle during the first smile frown in the Journal, or on a data table.
11. 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.
12. 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.
13. Repeat steps 10 and 11 for the last smile-frown recording.
14. 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 in Table 1.
15. 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?

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Table HP-9-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.

Approximate Time: 30 minutes

Procedure

1. Instruct the subject that they 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.
2. Click Seq. A – this will run a sequence of 5 images to produce an emotional response.
3. Click the Record button in the upper right corner of the LabScribe Main window.
4. While the subject is sitting quietly, the images will be shown as a slide show on the main screen based on the Sequence chosen.
5. Marks will be made automatically as the images are shown.
6. Click stop after the 5th image is shown and a black square shows up on the screen for more than 2 seconds.
7. Select Save from the File menu.
8. Repeat steps 2 through 6 using Seq. B.
9. Select Save from the File menu.
10. Now choose Seq. C. This sequence will show a series of 15 images that should elicit various emotional responses.
11. Repeat the recording process and click stop at the end when a blank image is shown for more than 2 seconds.
12. Select Save from the File menu.

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Data Analysis

1. Scroll through the recording and find the beginning of the section of data recorded while the subject was looking at the Sequence A images.
2. Click and drag the cursors so they are placed at the onset and offset of the response to the first image. Note that the mark states the name of 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 in Table 2.
6. If there is no response, leave the value columns empty.
7. Scroll through the recording and repeat steps 5 and 6 for all 3 sequences and 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?

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Table HP-9-L2: Recorded Values for Emotional Images

Image Name	Smile Abs Int (mV)	Smile Time (sec)	Frown Abs Int (mV)	Frown Time (sec)
MEAN				

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Additional Transducer Setup for Advanced Data Collection

This lab is fully expandable to record not only EMG activity, but GSR response, and Pulse and heart rate.

To use these additional transducers, follow the directions below.

GSR Setup

1. Attach the C-ISO-GSR electrodes to the iWire-B3G or plug the GSR cables into the GSR channel A7.
2. Click Edit, Preferences to open the Preferences dialog window.
    - Place a check in the box labeled i1 channel or the GSR (A7) channel.
    - Click OK.

Optional Calibration of GSR Amplifier

1. Record data for 1 minute.
2. Click on the Stop button.
3. Set the baseline to zero:
    - Click the down arrow to the left of the GSR channel to open the Channel Menu.
    - Click Units,
    - Click Set Offset
    - Set the offset to 0 and check Apply to all blocks
    - Click OK.

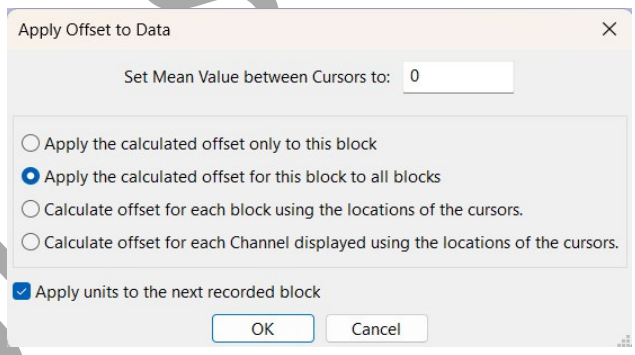

Figure HP-9-L6: Apply Offset window for setting the GSR unit to "0".

Note: *The GSR-200 galvanic skin response amplifier is factory calibrated so that an output of 1 Volt is equal to 5 microSiemens (µS). This calibration factor is programmed into the LabScribe recording software.*

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Exercise 3: Tonic SCL and Habituation

Aim: To measure the subject's tonic skin conductance level and observe possible spontaneous skin responses.

Approximate Time: 30 minutes

Procedure

1. Select one person from your group to be the subject. Ask the subject to go to the sink, wash their hands with soap and water, and dry them thoroughly. Washing the hands insures that surface oils or other substances, which might lower skin conduction, are removed. Do not use alcohol to clean the fingers, alcohol dehydrates the skin.
2. The subject should sit with their back to the computer monitor. Use the subject's hand which is closer to the iWorx equipment.
3. Attach each GSR electrode to the volar surface of the distal finger segment of two non-adjacent fingers; the index and the ring fingers are the ones usually used. Attach the electrodes with the Velcro straps so that the straps are snug, but not overly tight. Make sure the subject's fingers are moistened with either saliva or GSR conductive paste.
4. The subject should rest their hand with the GSR electrodes comfortably. The GSR electrodes should be free from any extraneous pressure and the electrode cable should be hanging freely. Instruct the subject not to move the hand during the recording process; movement will introduce artifacts into the recording.
5. Two measurements are performed in this exercise:
    - **Tonic Skin Conductance Level**: In this measurement, the subject sits quietly for one minute as their tonic skin conductance level (SCL) is recorded. Any movement may cause an artifact in the recording.
    - **Habituation**: In this measurement, the subject's tonic skin conductance level (SCL) is recorded as they sit quietly and without movement. While recording the subject's SCL, ask the subject the question: Is your name, X? (where X is the subject's real name). The subject should respond: Yes. After the subject's SCL changes and then returns to the baseline, ask the subject the same question. Continue to ask this same question until the subject shows no response on three consecutive trials. Lack of a change in the subject's SCL while answering the question is considered habituation.
7. Type **First Tonic SCL** in the Mark box.
8. Click on the Record button. Click the mark button. Record the subject's tonic SCL for one minute.
9. Type **Baseline** in the Mark box and click the mark button.
10. Type **Is Your Name "X"** in the Mark box and click the mark button as the subject is asked the question. Continue recording.
11. Type **IYNX** (Is Your Name, X?) in the Mark box. When the subject's tonic skin conductance level is response to the previous question has returned to the baseline, click the mark button and ask the question again.

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12. Repeat Step 11 until the subject shows no response to the question for three consecutive times. Click Stop to halt the recording.
13. Select Save As in the File menu, type a name for the file. Click on the Save button to save the data file.
14. Repeat this exercise on other subjects in your lab group.

Data Analysis - Tonic Skin Conductance Level

1. Scroll through the data file and locate the recording of the subject's tonic skin conductance level (SCL).
2. Use the Display Time icons to adjust the Display Time of the Main window to display the one minute recording of the subject's tonic SCL on the Main window. This section of data can also be selected by:
    - Placing the cursors on either side of the one minute recording of the subject's SCL, and
    - Clicking the Zoom between Cursors button on the LabScribe toolbar to expand or contract the one minute recording to the width of the Main window.
3. Click on the Analysis window icon.

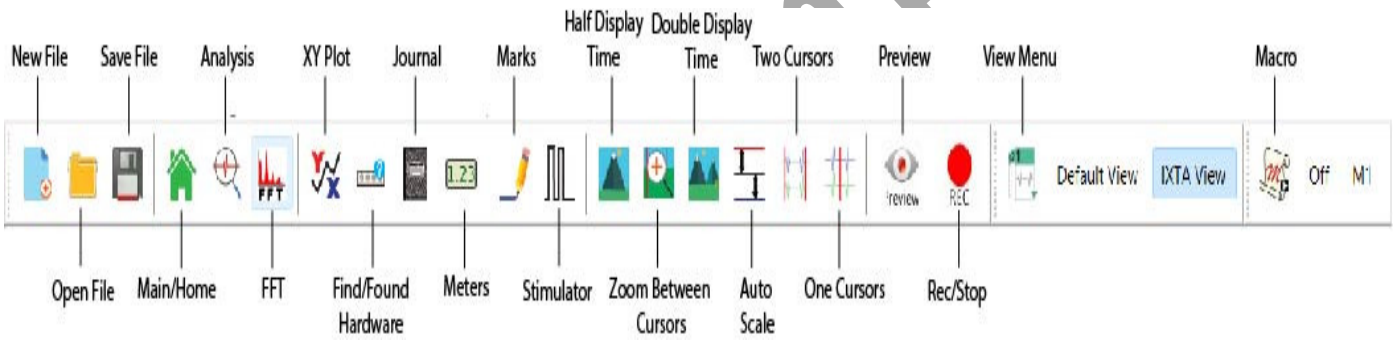

Figure HP-9-L9: The LabScribe toolbar.

4. Look at the Function Table that is above the Skin Conductance Level channel in the Analysis window. The mathematical function, Mean, should appear in this table. The value for mean tonic skin conductance level is displayed in the table across the top margin of the Skin Conductance Level channel.
5. On the Skin Conductance Level channel, use the mouse to click on and drag a cursor to the left margin of the data displayed on the Analysis window. Drag the other cursor to the right margin of the same data.
6. Once the cursors are placed in the correct positions for determining the mean tonic skin conductance level in the one minute recording, the value for the mean tonic skin conductance level can be recorded in the on-line notebook of LabScribe by typing the name and value of the parameter directly into the Journal.

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7. The functions in the channel menu of the Analysis window can also be used to enter the names and values of the parameters from the recording to the Journal. To use these functions:
    - Place the cursors at the locations used to measure the mean tonic skin conductance level.
    - Transfer the name of the parameter to the Journal using the Add Title to Journal function in the Skin Conductance Level channel menu.
    - Transfer the value for the mean to the Journal using the Add Ch. Data to Journal function in the Skin Conductance Level channel menu.
8. Record the values in the Journal using the one of the techniques described in Steps 5 or 6.
9. Enter the value for the mean tonic skin conductance level for the subject in Table 3.

Data Analysis - Spontaneous Skin Conductance Responses

1. On the one minute recording of the subject's tonic skin conductance level displayed in the Analysis window, count the number of spontaneous skin conductance responses that occurred during the one minute recording of the subject's tonic skin conductance.

Note: *Changes in the subject's skin conduction level (SCL) which are upward deflections equal to or greater than 0.05 µS are counted as spontaneous skin conduction responses. The SCL does not need to return to the baseline value before another response takes place.*

2. Enter the number of spontaneous skin conductance responses that occurred in the one minute recording in the Journal by typing the value directly into that window.
3. Enter the number of spontaneous skin conductance responses per minute for the subject in Table 3.

Data Analysis - Habituation

1. Click on the Main window icon to return to viewing the data on the Main window. Scroll through the data file and locate the recording of the habituation SCL for the subject.
2. Use the Display Time icons to adjust the Display Time of the Main window to display the complete habituation period on the Main window.
3. Determine the subject's habituation score by counting the number of times the question, Is your name, <Subject's Name>? was asked before the habituation criterion was reached. Each time the question is asked is considered a trial. The habituation criterion is reached when there is no skin conductance response from the subject for three consecutive trials. For example, if the subject first shows no skin conductance response to the question in the sixth trial, and no responses in the seventh and eighth trials, the subject's habituation score is six. Typical habituation scores are between two and eight.

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Note: *Some spontaneous skin responses may occur during the habituation test. Do not count spontaneous responses in the habituation score. Only count a trial as a skin conductance response to the question when the response begins within three seconds of the question and the skin conductance change is equal to or greater than 0.05 µS.*

4. Enter the subject's habituation score in the Journal by typing the value directly into that window.
5. Enter the subject's habituation score in the table.
6. Enter the value for the tonic skin conductance level, the number of spontaneous skin responses per minute, and the habituation score for all the subjects in your group into the table.

Table HP-9-L3:Tonic SCL, Spontaneous Skin Responses and Habituation

Subject	Mean Tonic SCL (µS)	Spontaneous Skin Responses (Number/Minute)	Habituation Score (Trials before Habituation)

Exercise 4: Skin Conductance Levels While Looking at a Variety of Images

Aim: To determine the change in the skin conductance level and the peak response rise time of a subject responding to a series of images.

Approximate Time: 30 minutes

Note: *This exercise should be completed in conjunction with the EMG exercise where the subject is looking at a variety of images. This will allow you to see the skin conductance change in accordance with a response to these images while the subject is also smiling, frowning or having no reaction.*

Procedure

1. The same subject that performed Exercise 3 should participate in this exercise.

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2. The subject will be shown a series of images with an emotional or neutral content. Instruct the subject to sit quietly and respond to these images normally.
3. Instruct the subject that they 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.
4. Based on the emotion felt while looking at the image - the subject will smile, frown or leave the mouth in the neutral position.
5. Click Seq. A – this will run a sequence of 5 images to produce an emotional response.
6. Click the Record button in the upper right corner of the LabScribe Main window.
7. While the subject is sitting quietly, the images will be shown as a slide show on the main screen based on the Sequence chosen.
8. Marks will be made automatically as the images are shown.
9. Click stop after the 5th image is shown and a black square shows up on the screen for more than 2 seconds.
10. Select Save from the File menu.
11. Repeat steps 2 through 6 using Seq. B.
12. Select Save from the File menu.
13. Now choose Seq. C. This sequence will show a series of 15 images that should elicit various emotional responses.
14. Repeat the recording process and click stop at the end when a blank image is shown for more than 2 seconds.
15. 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 first image. Note that the mark states the name of the image
3. Click on the Analysis window icon.
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 2.
6. If there is no response, leave the value columns empty.

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7. Scroll through the recording and repeat steps 5 and 6 for all 3 sequences and images shown.

Data Analysis

1. Scroll through the data file and locate the recording of the subject's skin conductance response to the first image.
2. Use the Display Time icons to adjust the Display Time of the Main window to display the complete response to the first question on the Main window. This section of data can also be selected by:
    - Placing the cursors on either side of the subject's skin conductance response to the first question, and
    - Clicking the Zoom between Cursors button on the LabScribe toolbar to expand or contract this section of the recording to the width of the Main window.
3. Click on the Analysis window icon.
4. Look at the Function Table that is shown in the Analysis window.
    - Click Add Function, General to add the following functions to the list available: Value1, Value 2, V2-V1. Each function will need to be added individually.
    - Once the functions have been added, Abs Int, T2-T1, Value1, Value 2, and V2-V1 should appear in this table. The values for these functions are displayed in the table across the top margin of the Analysis window.
5. On the Skin Conductance Level channel, use the mouse to click on and drag a cursor to the point in the recording when the image was shown and an EMG response was seen in the top 2 channels. Drag the other cursor to peak of the subject's response to the image. The following parameters of the subject's response are measured by the functions listed in the table:
    - **Baseline Skin Conductance Level**, which is the skin conductance level of the subject at the time the question was asked. The value for the Value1 function on the Skin Conductance Level channel is the baseline skin conductance level.
    - **Peak Response Skin Conductance Level**, which is the maximum skin conductance level of the subject in the period after the question was asked. The value for the Value2 function on the Skin Conductance Level channel is the skin conductance level of the peak response of the subject.
    - **Change (Δ) in Skin Conductance Level**, which is the difference between the baseline and maximum skin conductance levels of the subject in response to the question. The value for the V2-V1 function on the Skin Conductance Level channel is the change in the skin conductance level of the subject.
    - **Peak Response Rise Time**, which is the time between the question being asked and the peak response of the subject to the question. The value for the T2-T1 function on the Skin Conductance Level channel is the rise time of the peak response.
6. Record the values for these functions in the Journal using the one of the techniques described in Exercise 1.

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7. Enter the values for the baseline skin conductance level, peak response SCL, change in SCL, and rise time of the peak response for the first question in Table 4.
8. During data analysis, the addition of a Mean function in the Analysis window will allow you to see the subject's heart rate at the time the image is shown and during the emotional response.
9. Repeat Steps 1 through 7 for the other images.

Questions

1. Did the subject show any changes in skin conductance during the different images shown?
2. How does skin conductance relate to looking at image that produce either a positive (smiling) or negative (frowning) response? Is there a difference in the type of response seen?
3. Does the subject take longer to respond to a negative or positive image? Explain your answer.

Table HP-9-L4: Skin Conductance Changes for a Variety of Images

Images (S, F, or N)	Baseline SCL (µS)	Peak Response SCL (µS)	Δ in SCL (µS)	Peak Response Rise Time (seconds)

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Addition of a Pulse and Heart Rate Channel

Aim: To be able to determine changes in Pulse and Heart Rate while looking at a variety of images.

Approximate Time: This should be done in conjunction with the previous experiment.

Procedure

1. Locate the PT-104 or the PPG-320 pulse sensor and plug it into Channel A5 or the PT port.
2. Click Edit, Preferences to open the Preferences dialog window and place a check in the box labeled Pulse or in the PT box.
3. Click OK.
4. On the Pulse channel now shown on the Main window, click add function:
    - Click Periodic → Rate
    - Click OK - This will add a periodic rate function to calculate heart rate from the Pulse channel.
5. Click the down arrow to the left of the Pulse channel. Click Title and change the name of the channel to Heart Rate, click OK.
6. The addition of this channel will allow you to observe changes in heart rate during the showing of the images. This will allow additional data to be collected to support any changes in the subject's emotions while viewing these images.

Questions – Pulse and Heart Rate – Exercise 4

1. Did the subject show any changes in their heart rate while looking at the different images?
2. How does heart rate relate to looking at images that produce either a positive (smiling) or negative (frowning) response? Is there a difference in the type of response seen?
3. Explain what could be happening physiologically to show changes in heart rate during an emotional response.

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