Experiment HP-8: The Galvanic Skin Response (GSR) and Investigation into 'Cheating'

This iWorx lab experiment was graciously provided by Dr. Paul Wagner and Dr. Tracy Wagner, Asst. Professors, Washburn University, Topeka, KS.

Note: *These exercises are best performed in groups of 4 or 6 individuals. Plan accordingly so that each group has enough members so that some are investigators and some are suspects.*

OPEN THE APPENDIX FOR PERTINENT INSTRUCTIONS FOR THIS EXPERIMENT.

Equipment Required

PC or Mac Computer

IXTA, USB cable, IXTA power supply

PPG-320 Pulse plethysmograph

C-GSR-320 – GSR cables

Folder of 10 Photographs - include neutral and emotional photos

Directions for the Investigators and Subjects

GSR and PPG-320 Setup

1. Locate the PPG-320 pulse sensor and plug it into the PT port. Place it on the fingerprint side of the middle finger.
2. Locate the GSR cable and plug the connector into the GSR port (channel A7).
3. Put GSR Conductive Paste on the electrodes..
4. Attach the GSR electrodes to the pointer and ring finger of the subject's hand where the fingerprints are. Make sure the fingers are not too cold or too dry.

Note: The GSR unit is precalibrated. No other calibration is needed.

5. 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.
6. The subject should sit with their back to the computer monitor. Use the subject's hand which is closer to the iWorx equipment.
7. 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.

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Figure HP-8-S1: PPG-320 pulse plethysmograph.

Figure HP-8-S2: The equipment needed to record GSR and pulse.

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Exercise 1: Tonic SCL and Habituation

Aim: To measure the subject's tonic skin conductance level, observe possible spontaneous skin responses, and habituate the subject to the questioning paradigm used in this experiment.

Approximate Time: 30 minutes

Procedure

1. 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.
2. Type First Tonic SCL <Subject's Name> in the Mark box that is to the right of the Mark button.
3. Click on the Record button. Click the mark button. The value displayed on the Skin Conductance Level channel is the tonic skin conductance level (SCL) of the subject. Record the subject's tonic SCL for one minute.

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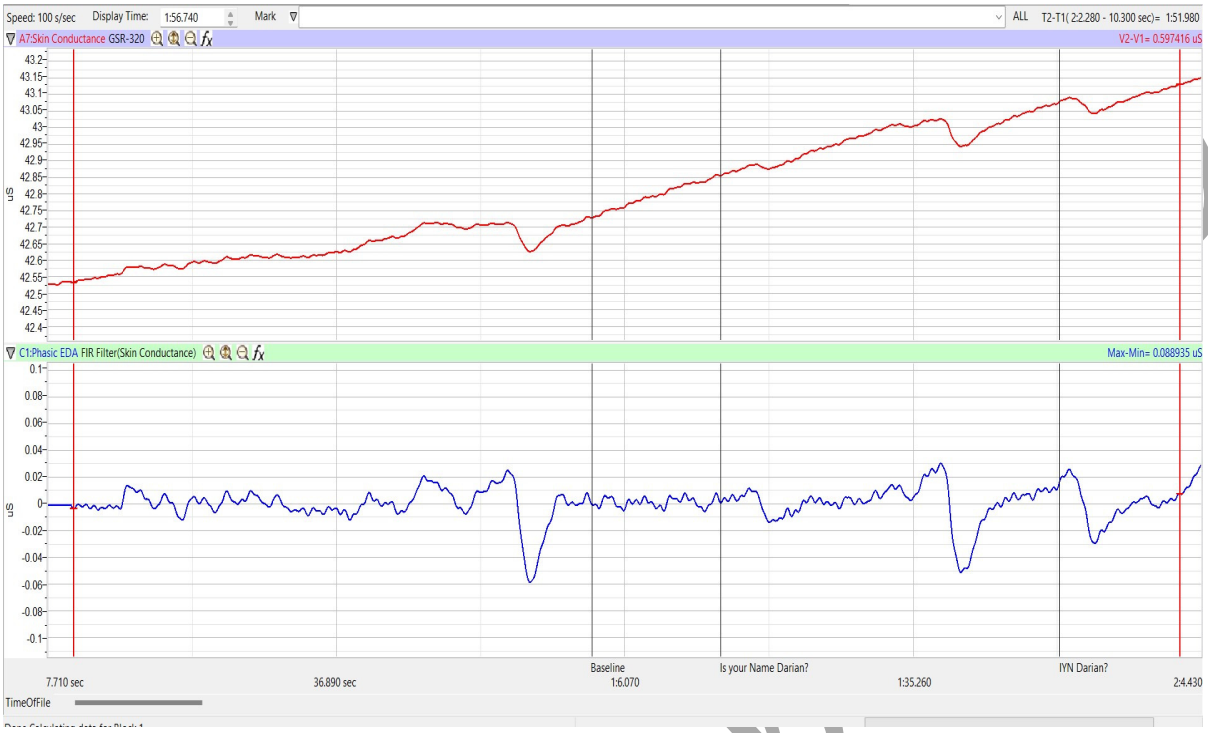

Figure HP-8-L1: The output of the GSR amplifier before and after the GSR electrodes, which are already on the fingers of the subject, were connected to the amplifier. The difference between the output of the amplifier before and after the connection of the electrodes is the tonic skin conductance level of the subject, which is 0.394 microSiemens (µS). The other channels are not shown here.

9. Type **Baseline <Subject's Name>** in the Mark box and click the mark button.
10. Type **Is Your Name**, <Subject's Name>? in the Mark box. 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.
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 all the 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.

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3. Data can be collected from the Main window or the Analysis window. If you choose to use the Analysis window, click on the Analysis window icon in the toolbar.
4. The mathematical function Mean should appear on screen. Value Mean is located on the right margin of the Skin Conductance graph in the Main window and in the upper left of the Analysis window.

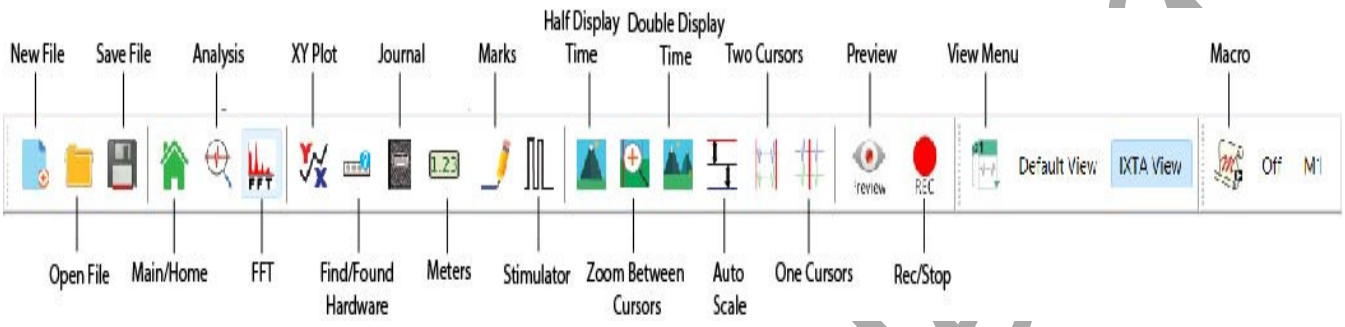

Figure HP-8-L2: The LabScribe toolbar.

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 by typing the name and value of the parameter directly into the Journal.
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 6 or 7.
9. Enter the value for the mean tonic skin conductance level for the subject in Table 1.
10. On the Heart Rate channel, use the mouse to click on and drag the cursors to the beginning and end of the subject's responses. The value for the Mean function on the Heart Rate channel will be the subject's mean heart rate during the responses to INYX.

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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 1.

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.

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 Table 1.
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.

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Table HP-8-L1: Tonic SCL, Spontaneous Skin Responses, and Habituation

Subject's Name	Mean Tonic SCL (µS)	Spontaneous Skin Responses (Number/Minute)	Habituation Score (Trials before Habituation)	Heart Rate

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Exercise 2: Orienting Response - Photographs

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

Approximate Time: 30 minutes

Procedure

Note: *All group members will perform this activity as well. Try to make sure only the subject being tested is seeing the photographs. It is important to keep the photos hidden from others so that they do not know what to expect.*

1. Start with the same subject who performed Exercise 1 first.
2. Have the subject being tested turn away from the computer and carefully look at each photo as they are shown.
3. Show your subject one of the photos and click the mark button to mark the recording with the number of the image being shown to the subject.
4. At a **SLOW PACE** continue to show the pictures in the order they were in the envelope, one picture at a time and clicking the mark button each time.
    - Remember to show the photos only to the subject being tested. Try not to show anyone else in your group and do not look at the photos yourself.

Note: *The photographs MUST stay in the same order for each of the group members. Do not get them out of order or the data will be skewed.*

5. After all the pictures have been viewed, analyze which ones elicited a change in skin conductance and/or heart rate?. Match each computer recording with the corresponding picture and record the results in Table 2.
6. Repeat this test with all group members.
7. Discuss with your lab partner what caused the changes in skin conductance and heart rate for a particular photograph.

Data Analysis

1. Scroll through the data file and locate the recording of the first subject's skin conductance response to the photographs.
2. Use the Display Time icons to adjust the Display Time of the Main window to display the complete response to the 10 photographs on the Main window.
3. Click on the Analysis window icon.
4. Look at the Function Table that is above the Skin Conductance Level channel in the Analysis window. The functions V2-V1, T2-T1,and Mean should appear in this table. The values for these functions are 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 point in the recording when a photo was looked at. Drag the other cursor to peak of the subject's response to the photo. The following parameters of the subject's response are measured by the functions listed in the table:
    - **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 photo. 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 photo being shown and the peak response of the subject to the photo. 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
7. Enter the values for the change in SCL, and rise time of the peak response for the first photograph in Table 2.
8. Repeat Steps 1 through 7 for the other nine photographs.
9. On the Heart Rate channel, use the mouse to click on and drag the cursors to the start and end of the exercise with all subjects. The value for the Mean function on the Heart Rate channel will be the subject's mean heart rate during the responses to the photographs

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Table HP-8-L2:Skin Conductance Changes while viewing Photographs

Photographs	Δ in SCL (μS)	Peak Response Rise Time (seconds)	Mean Heart Rate
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Exercise 3 - Guilty Knowledge Test

Aim: To determine which of the subjects has been cheating on the Physiology quizzes.

Approximate Time: 60 minutes

Note: *In our Investigative Polygraph Test you will examine only two variables: the change skin conductance and the change in heart rate, as indicators of emotions (i.e. truthfulness).*

Procedure

Each group will receive a set of 3 envelopes. The envelopes will be labeled Principal Investigators, Suspect I and Suspect II.

1. For this task select two students from your group who will act as the suspects. These two students should be the ones with the best responses when looking at the photographs.
    - They should each receive corresponding letter.
    - The two Suspects should then leave the room, read their letter and not discuss the contents of the letters with each other.
2. The remaining member (or members) of the group are the Principal Investigators. They should read their letter and then follow the instructions.
3. Make a random list of questions like the ones suggested below. There will be 10 questions in total: seven neutral questions and three emotional questions.

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Examples of "neutral questions" (pick seven, or make your own)

- Do you live in an apartment?
- Do you like pizza?
- Do you have a cat?
- Are you a senior?
- Have you ever gone ice skating?
- Have you ever been to Alaska?
- Do you have a sister?
- Where you born?
- Are you a Biology major?
- Is the year 2001?
- Is this the month of April?
- Did you watch TV last night?
- Do you like to go to the movies?
- Are you taking a PE class?

Examples of "emotional questions" (pick three, or make your own)

- Are you in love?
- Do you love this laboratory course?
- Are you getting an A?
- Does nudity embarrass you?
- Have you ever heard about a date rape?
- Are you in favor of abortion?
- Do you ever hide your feelings?
- Have you ever driven while intoxicated?
- Do you like snakes?
- Have you ever been in or witnessed a tragic accident?

4. Next, on Table 4, write down critical questions that will allow you to identify the possible suspect. This takes some thought. Remember you will be rewarded if you identify the culprit.
    - Examples:
        - Have you been involved in any inappropriate behavior?
        - Did you ever lie?

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- Have you ever been accused of a crime?
- Have you ever been arrested?
- etc.

Note: *Before you begin this phase of the experiment ask the first subject to wash their hands with soap. (Washing the hands has the purpose to remove oils or other substances that might lower the skin conduction). Attach the GSR electrodes to the first and third finger. Rest the hand comfortably palm up. Connect the GSR to channel 4 on the iWorx input box as stated in the set up.*

5. The investigators should call in one of the suspects.
6. Instruct the subject to sit quietly and answer "YES" or "NO" to each of your ten questions. It is important that they do not elaborate on any answer. Ask the questions in slow sequence. Pause between the questions and click "Enter" before the next question in order to mark it on the recording.
    - Spend a few minutes habituating the person to the questioning paradigm by asking a few neutral questions from your list of neutral questions until the responses appear to stabilize at some common low level.
    - Mix in a few emotional questions. If there is a change in the response, wait until the response returns to baseline before asking the next question.
    - It is important no one elaborates on any answer.
    - Save your recordings frequently!
7. Once this is completed - Start the actual lie detecting test.
8. Ask the participant to relax for a few minutes especially if there was a change in conductance in the responses response. Instruct the participant to answer NO to every question from now on. Ask a few more neutral questions before starting your investigation.
9. At a slow pace, ask the participant your critical questions list in Table 4, to which they should only respond with "NO". Don't forget to click the mark button between each question.

Data Analysis

1. Match the question with the computer recording and place the corresponding values in Table 3 for the Neutral/Emotional questions or in Table 4 for the Critical Content questions.
2. Follow this same procedure with the second suspect.
3. **So...Who was the cheater? They will tell you the answers to the quiz. Good luck!**

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Table HP-8-L3: Comparison of Skin Conductance Changes for Neutral and Emotional Content Questions.

Questions	Neutral (N) Emotional (E)	Δ in SCL (µS) SUBJECT 1	Peak Response Rise Time (seconds) SUBJECT 1	Δ in SCL (µS) SUBJECT 2	Peak Response Rise Time (seconds) SUBJECT 2
1.	N				
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
Means for 7 Neutral Questions	N				
Means for 3 Emotional Questions	E				
Mean Heart Rate					

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Table HP-8-L4: Comparison of Skin Conductance Changes for Critical Content Questions.

Questions	Neutral (N) Critical (C)	Δ in SCL (µS) SUBJECT 1	Peak Response Rise Time (seconds) SUBJECT 1	Δ in SCL (µS) SUBJECT 2	Peak Response Rise Time (seconds) SUBJECT 2
1.	N				
2.	N				
3.	N				
4.	C				
5.	C				
6.	C				
7.	C				
8.	C				
9.	C				
10.	N				
11.	C				
12.	C				
13.	C				
14.	N				

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15.	C				
Means for 5 Neutral Questions	N				
Means for 10 Critical Questions	C				
Mean Heart Rate					

Questions

1. Does the recording show a difference in skin conduction in response to neutral or emotional questions?
2. Does the recording show a difference in skin conduction between the two subjects, the one that knows the whole story and the one that does not have a clue in the cheating case?
3. Is there any correlation between the change in skin conduction and the change in heart rate?

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