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II. EXPERIMENTAL OBJECTIVES

1) Record EOG and compare eye movements during real and simulated tracking of a pendulum.
2) Record EOG and compare eye movements during real and during simulated tracking of an object in the vertical plane.
3) Record and compare the "saccadic" eye movements when reading three different ways; silently (easy,) silently (challenging) and aloud (challenging).

III. MATERIALS

- 2 x BIOPAC Electrode Lead Set (SS2L)
- BIOPAC Disposable Electrodes (EL503,) 6 electrodes per subject
- BIOPAC Electrode Gel (GEL1) and Abrasive Pad (ELPAD)
- *Optional*: BIOPAC Adhesive Tape (TAPE 2)—use to tape wires to reduce cable strain
- Pendulum: Can be made by attaching any object (i.e. 50 gm force calibration weight) to approx. 61 cm (24 inches) of string.
- Pen or other real object for vertical tracking
- Passages for reading: Passage 1 – easily understandable (i.e., entertainment article)
  Passage 2 – challenging material (i.e., scientific article)

Note *A sample reading passage in printable PDF format is available in the lesson Help menu.*

- Biopac Student Lab System: BSL 4 software, MP36, MP35 or MP45 hardware
- Computer System (Windows 8, 7, Vista, XP, Mac OS X 10.5 – 10.8)

IV. EXPERIMENTAL METHODS

A. SETUP

FAST TRACK Setup

1. Turn the computer ON.
   - If using an MP36/35 unit, turn it **OFF**.
   - If using an MP45, make sure USB cable is connected and "Ready" light is **ON**.
2. **Plug the Electrode Lead Sets** (SS2L**)** in as follows:
   Horizontal lead — CH 1
   Vertical lead — CH 2
3. Turn **ON** the MP36/35 unit.

Setup continues…

Detailed Explanation of Setup Steps

Fig. 10.6 MP3X (top) and MP45 (bottom) equipment connections

4. Gently clean and abrade skin.
5. Attach six electrodes to **Subject**'s face as shown in Fig. 10.7.

IMPORTANT
For accurate recordings, attach the electrodes so they are horizontally and vertically aligned.

Fig. 10.7 Proper electrode placement

- If the skin is oily, clean electrode sites with soap and water or alcohol before abrading.
- If electrode is dry, apply a drop of gel.
- Attach one electrode above the right eye and one below, such that they are aligned vertically.
- Attach one electrode to the right of the right eye and one to the left of the left eye, so they align horizontally.
- The other two electrodes are for ground, and alignment is not critical.

For optimal electrode contact, place electrodes on skin at least five minutes before start of Calibration.

6. Clip CH 1 Electrode Lead Set (SS2L) in the horizontal placement, following the color code (Fig. 10.8).

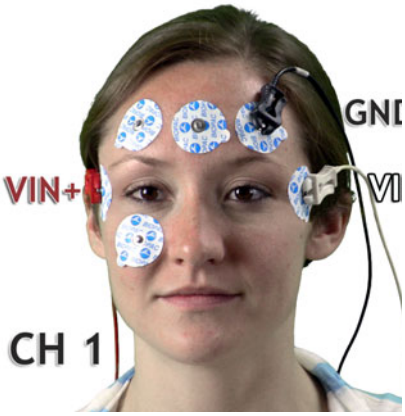

Fig. 10.8 Horizontal (CH 1) Lead Placement

- Drape the electrode lead cables behind the ears, as shown, to give proper cable strain relief.
- Connect the electrode cable clip to a convenient location to help relieve cable strain.
- Electrodes must lay flat on skin.

7. Clip CH 2 Electrode Lead Set (SS2L) in the vertical placement, following the color code (Fig. 10.9).

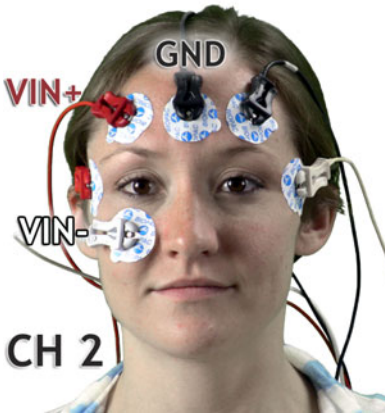

Fig. 10.9 Vertical (CH 2) Lead Placement

Setup continues…

8. **Start** the Biopac Student Lab Program.

Start Biopac Student Lab by double-clicking the Desktop shortcut.

9. Choose lesson "**L10 – Electrooculogram (EOG) I"** and click **OK**.
10. Type in a unique **filename** and click **OK**.

No two people can have the same filename, so use a unique identifier, such as **Subject's** nickname or student ID#.

A folder will be created using the filename. This same filename can be used in other lessons to place the **Subject's** data in a common folder.

11. *Optional*: Set Preferences.
    - Choose File > **Lesson Preferences**.
    - Select an option.
    - Select an option and click **OK**.

This lesson has optional Preferences for data and display while recording. Per your Lab Instructor's guidelines, you may set:

Grids: Show or hide gridlines

Lesson Recordings: Specific recordings may be omitted based on instructor's preferences.

END OF SETUP

B. CALIBRATION

The Calibration procedure establishes the hardware's internal parameters (such as gain, offset, and scaling) and is critical for optimal performance. **Pay close attention to Calibration.**

FAST TRACK Calibration

1. **Subject** is seated, relaxed, breathing normally, and facing away from monitor.
   - **Carefully review** upcoming steps.
2. Click **Calibrate**.
3. **Subject** must:
   - Complete four horizontal eye movement cycles (extreme left-extreme right-return to center) and four vertical eye movement cycles (extreme up-extreme down-return to center).
   - Wait for Calibration to stop.
4. Verify recording resembles example data.
   - If <u>similar</u>, click **Continue** and proceed to Data Recording.
   - If necessary, click **Redo Calibration**.

END OF CALIBRATION

Detailed Explanation of Calibration Steps

- **Subject** should sit with arms relaxed at side of body, legs flexed at knee and feet supported.
- **Subject** prepares to move eyes horizontally and vertically for Calibration procedure.
- **Subject** must try to keep head still and avoid blinking.
- Calibration lasts 20 seconds.

Fig. 10.10 Proper head positioning

The four cycles of horizontal and vertical eye movement should be clearly visible in the appropriate data channel.

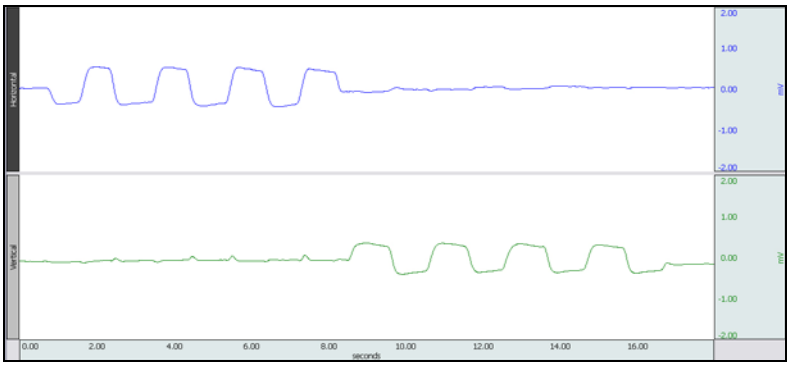

Fig. 10.11 Example Calibration data

<u>If recording does not resemble Example Data…</u>

- If data is flatline, check all connections to MP unit.
- If there is excessive noise or baseline drift, check that electrodes are making good contact with the skin (lying flat) and that leads are not pulling on the electrodes.
- If **Subject** blinked, resulting in a large data spike, redo the calibration.

C. DATA RECORDING

FAST TRACK Recording

1. Prepare for the recordings.

Pendulum

2. **Prepare** for the recording.
   - **Director** holds pendulum in front of **Subject**, ready to release (Fig. 10.12).
   - **Subject** must focus on pendulum.
   - **Review** recording steps.

Recording continues…

Detailed Explanation of Recording Steps

Seven data recordings will be acquired*:

Recording 1 – 2: real and simulated pendulum
Recording 3 – 4: real and simulated vertical tracking
Recording 5 – 6: read silently (easy and challenging)
Recording 7: read aloud (challenging)

***IMPORTANT**
This procedure assumes that all lesson recordings are enabled in lesson Preferences, which may not be the case for your lab. Always match the recording title to the recording reference in the journal and disregard any references to excluded recordings.

For all recordings, the **Subject** is seated and relaxed, facing away from the monitor.

Hints for obtaining optimal data:

- Review recording steps in advance.
- Make sure all electrodes are making good contact with skin (lying flat) and that leads are not pulling on the electrodes.
- **Subject** must remain in a seated, relaxed state for all recordings.
- **Subject** must keep head still, move only eyes and try to avoid blinking.
- In order to record sufficient amplitude variation, eye movements should be as large as possible. When tracking a moving object, eye movements should cover a significant portion of the visual range along at least one axis. When reading, the reading material must be held as close to the **Subject** as possible, while maintaining focus.

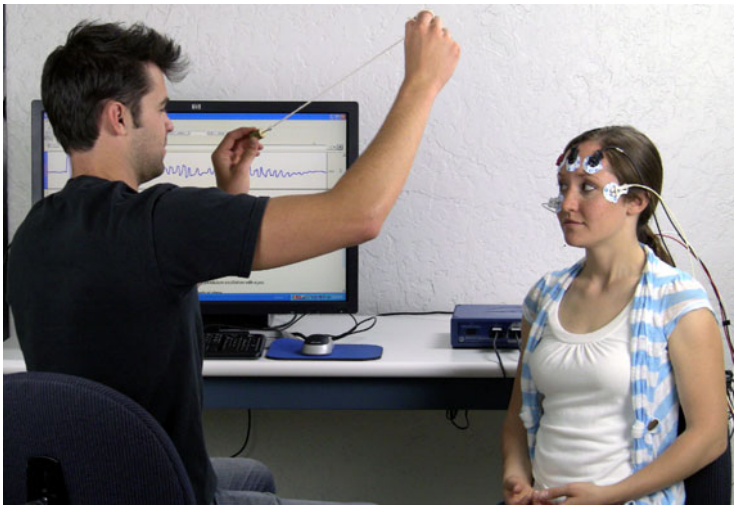

Fig. 10.12 Pendulum positioning

Details...

- **Subject** should be seated about 25 cm (10 inches) from pendulum—adjust as necessary to maintain focus.
- Bottom of pendulum swing should align with bottom of **Subject's** nose.
- Pendulum should be lifted approximately 45 degrees to **Subject's** right while maintaining a taut string, ready to release when recording starts.
- **Director** must hold pendulum string at a constant position.

3. Click **Record**.
   - **Director** releases pendulum.
4. **Subject** tracks pendulum with eyes only.
5. Wait for pendulum to stop swinging.
6. Click **Suspend**.

7. Verify recording resembles the example data.
   - If similar, click **Continue** and proceed to the next recording.

There should be cyclical variation in the data and the amplitude should progressively decrease. The Horizontal data should display greater amplitude variation than the Vertical data.

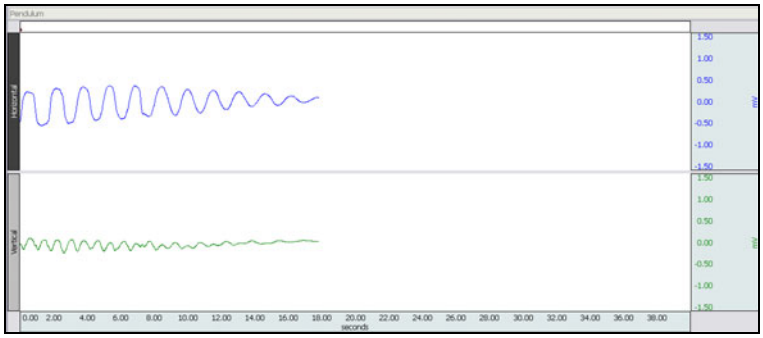

Fig. 10.13 Example Pendulum data

If recording does not resemble Example Data...

- If data is flatline, check all connections to MP unit.
- If there is excessive noise or baseline drift, check that electrodes are making good contact (lying flat) and that leads are not pulling on the electrodes.
- If there is not sufficient amplitude variation, make sure that the horizontal range of the pendulum swing covers a large portion of the **Subject's** visual range.
- If **Subject** blinked, resulting in a large data spike, redo the recording.

   - If necessary, click **Redo**.
   - If all required recordings have been completed, click **Done**.

Click **Redo** and repeat Steps 2 – 7 if necessary.

Note that once **Redo** is clicked, the most recent recording will be erased.

Simulate Pendulum

8. **Prepare** for the recording.
   - **Subject** prepares to simulate eye-tracking an imaginary pendulum.
   - **Subject** places eyes at the 2 o'clock position
   - **Review** recording steps.

This simulates the starting position of the pendulum.

9. Click **Record**.
10. **Subject** tracks an imaginary pendulum with decreasing swing cycles.
11. **Director** observes horizontal channel until there is little or no eye movement.
12. Click **Suspend**.

Subject must try to visualize the pendulum movement of the previous recording and track the imaginary pendulum with the eyes only. The initial swing should take up a large portion of the **Subject's** visual range along the horizontal axis and each successive swing should be reduced in amplitude until the eyes are still.

Recording continues…

13. Verify recording resembles the example data.
    - If similar, click Continue and proceed to the next recording.

There should be cyclical variation in the Horizontal data and the amplitude should progressively decrease.

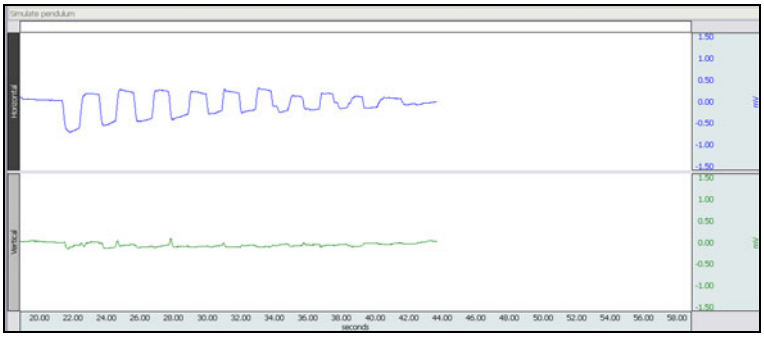

Fig. 10.14 Example Simulated Pendulum data

    - If necessary, click **Redo**.

Data would be different for reasons detailed in Step 7.

Click **Redo** and repeat Steps 8 – 13 if necessary.

Note that when **Redo** is clicked, the most recent recording will be erased.

Vertical Tracking

14. **Prepare** for the recording
    - **Director** positions a pen about 25 cm (10 inches) from **Subject**.
    - **Subject** tracks pen.
    - **Director** moves pen vertically up and down to determine the limits of the **Subject's** visual range.
    - **Review** recording steps.

Director holds pen centered with the eyes - adjust as necessary to maintain focus (Fig. 10.15). **Subject** must pick a focal point on the pen and track its movement WITHOUT moving head.

Director determines (and mentally notes) the upper and lower edges of the **Subject's** visual field by moving the pen up and down until **Subject** indicates it is out of view.

Director returns pen to a center position (eyes looking straight ahead) and the recording is ready to begin.

Fig. 10.15 Vertical tracking positioning

Recording continues…

15. Click **Record**.

16. **Subject** tracks pen while **Director** moves it from center to upper and lower edges of visual field.
    - Repeat for a total of five cycles.
17. Click **Suspend**.

18. Verify recording resembles the example data.
    - If similar, click **Continue** and proceed to the next recording.

Subject must track pen movement with the eyes only, trying not to move head or blink.

Director moves the pen through five vertical tracking cycles as follows:

- From center to upper then lower edges of visual field and then back to center.

The five cycles should be clearly visible in the Vertical channel data.

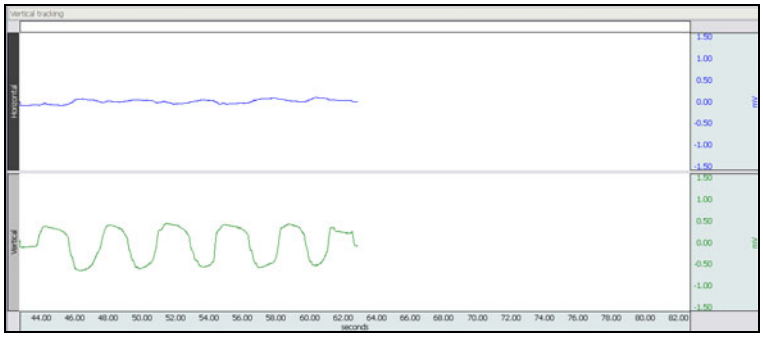

Fig. 10.16 Example Vertical Tracking data

If recording does not resemble Example Data...

- If data is flatline, check all connections to MP unit.
- If there is excessive noise or baseline drift, check that electrodes are making good contact (lying flat) and that leads are not pulling on the electrodes.
- If there is not sufficient amplitude variation, make sure that the vertical range of the pen covers the **Subject's** visual range.
- If **Subject** blinked, resulting in a large data spike, redo the recording.

- If necessary, click **Redo**.
- If all required recordings have been completed, click **Done**.

Click **Redo** and repeat Steps 14 – 18 if necessary.

Note that once **Redo** is clicked, the most recent recording will be erased.

Simulate Vertical Tracking

19. **Prepare** for the recording.
    - **Subject** centers eyes and prepares to simulate vertical eye-tracking.
    - **Review** recording steps.
20. Click **Record**.

21. **Subject** tracks an imaginary pen moving vertically through visual field for five cycles.
22. **Director** observes vertical channel until there is little or no eye movement.
23. Click **Suspend**.

Subject tracks the imaginary pen with eyes only, imagining the pen moving to the upper then lower edges of visual field, then returning to center. This upper/lower cycle should be repeated five times.

Recording continues…

24. Verify recording resembles the example data.
    - If similar, click **Continue** and proceed to the next recording.

The five cycles should be clearly visible in the Vertical channel data.

Fig. 10.17 Example Simulated Vertical Tracking data

- If necessary, click **Redo**.

Data would be different for reasons detailed in Step 18.

Click **Redo** and repeat Steps 19 – 24 if necessary.

Note that when **Redo** is clicked, the most recent recording will be erased.

Read Silently (Easy)

25. **Prepare** for the recording
    - **Director** holds reading material centered in front of **Subject** as close as possible, while maintaining focus (Fig. 10.18).
    - **Review** recording steps.

This passage should be easy to read. The upper passage will be used for this recording. You may hide the lower passage by folding the paper in half.

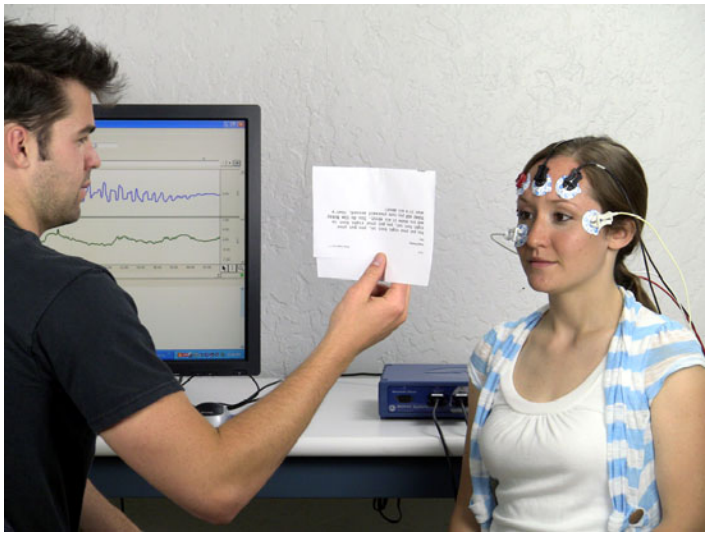

Fig. 10.18 Reading material positioning

Details...

- **Subject** must be able to read entire passage without moving head.
- **Subject** must keep head still, move only eyes, and try to avoid blinking.
- **Director** must hold the reading material as still as possible.

26. Click **Record**.
27. **Subject** reads material silently and announces when finished.
28. Click **Suspend**.

Recording continues…

29. Verify recording resembles the example data.
    - If similar, click **Continue** and proceed to the next recording.

There should be a visible "saw tooth" pattern in the Horizontal data.

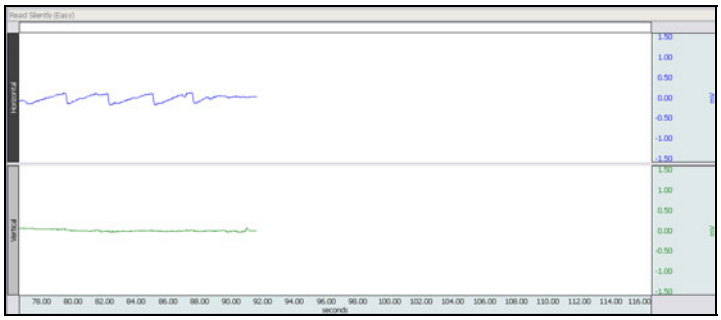

Fig. 10.19 Example Read Silently (Easy) data

If recording does not resemble Example Data...

- If data is flatline, check all connections to MP unit.
- If there is excessive noise or baseline drift, check that electrodes are making good contact (lying flat) and that leads are not pulling on the electrodes.
- If there is not sufficient amplitude variation, make sure that the reading material was held as close as possible to the **Subject's** face while maintaining focus.
- Make sure the **Director** held the reading material as still as possible.
- If **Subject** blinked, resulting in a large data spike, redo the recording.

- If necessary, click **Redo**.
- If all required recordings have been completed, click **Done**.

Click **Redo** and repeat Steps 25 – 29 if necessary.

Note that once **Redo** is clicked, the most recent recording will be erased.

Read Silently (Challenging)

30. **Prepare** for the recording.
    - **Director** holds reading material centered in front of **Subject** as close as possible, while maintaining focus.
    - **Review** recording steps.
31. Click **Record**.
32. **Subject** reads material silently and announces when finished.
33. Click **Suspend**.
34. Verify recording resembles the example data.
    - If similar, click **Continue** and proceed to the next recording.

This passage should be more challenging then that from "**Read Silently (Easy).**" You may hide the upper passage by folding the paper in half.

Review the "Details" listed in Step 25.

There should be a visible "saw tooth" pattern in the Horizontal data.

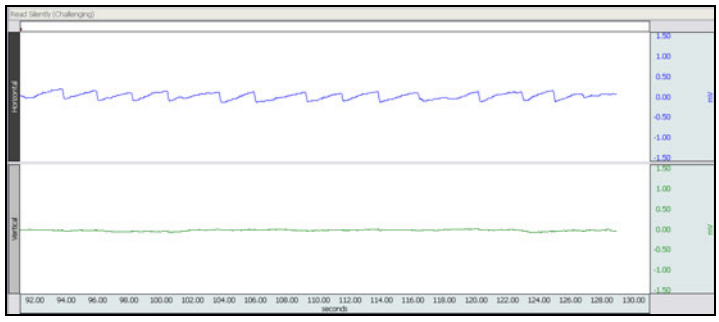

Fig. 10.20 Example Read Silently (Challenging) data

- If necessary, click **Redo**.
- If all required recordings have been completed, click **Done**.

Recording continues…

Data would be different for the reasons detailed in Step 29.

Click **Redo** and repeat Steps 30 – 34 if necessary.

Note that when **Redo** is clicked, the most recent recording will be erased.

Read Aloud (Challenging)

35. **Prepare** for the recording
    - **Director** holds reading material centered in front of **Subject** as close as possible, while maintaining focus.
    - **Review** recording steps.

This passage should be the same as that used in "**Read Silently (Challenging).**"
Review the "Details" listed in Step 25.

36. Click **Record.**
37. **Subject** reads passage aloud.
38. Click **Suspend.**

Subject reads passage aloud until material is complete. **Subject** should try to minimize mouth and jaw movement as this can add signal artifact to the EOG.

39. Verify recording resembles example data.
    - If similar, click **Continue** to proceed to optional recording section, or **Done** to finish the lesson.

The Horizontal data will most likely show less of a consistent pattern than in the Read silently recordings.

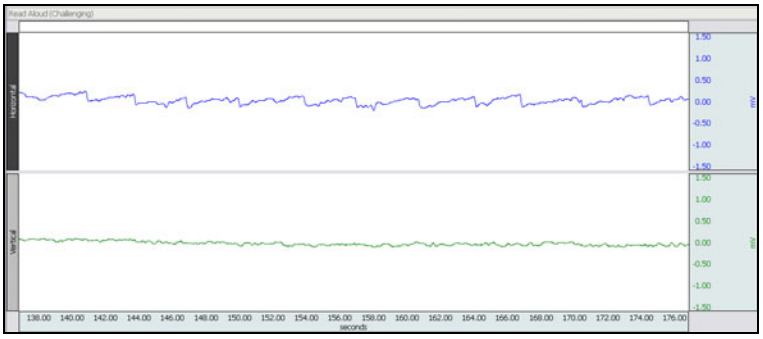

Fig. 10.21 Example Read Aloud (Challenging) data

- If necessary, click **Redo**.

Data might be different for the reasons detailed in Step 29.

If the signal is too difficult to interpret, redo and have the **Subject** use less mouth and jaw movement.

Click **Redo** and repeat Steps 35 – 39 if necessary. Note that when **Redo** is clicked, the most recent recording will be erased.

Recording continues…

OPTIONAL ACTIVE LEARNING PORTION

With this lesson you may record additional data by clicking **Continue** following the last recording. Design an experiment to test or verify a scientific principle(s) related to topics covered in this lesson.

Design Your Experiment

Use a separate sheet to detail your experiment design, and be sure to address these main points:

A. ***Hypothesis***

Describe the scientific principle to be tested or verified.

B. ***Materials***

List the materials you will use to complete your investigation.

C. ***Method***

Describe the experimental procedure—be sure to number each step to make it easy to follow during recording.

Run Your Experiment

D. ***Set Up***

Set up the equipment and prepare the subject for your experiment.

E. ***Record***

Use the **Continue**, **Record** and **Suspend** buttons to record as much data as necessary for your experiment.

Click **Done** when you have completed all of the recordings required for your experiment.

Analyze Your Experiment

F. Set measurements relevant to your experiment and record the results in a Data Report.

40. After clicking **Done**, choose an option and click **OK**.

If choosing the **Record from another Subject** option:

- Repeat Setup Steps 4 – 7, and then proceed to Calibration.

41. Remove the electrodes.

Remove the electrode cable pinch connectors and peel off all electrodes. Discard the electrodes. (BIOPAC electrodes are not reusable.) Wash the electrode gel residue from the skin, using soap and water. The electrodes may leave a slight ring on the skin for a few hours which is quite normal.

END OF RECORDING

V. DATA ANALYSIS

FAST TRACK Data Analysis

1. Enter the **Review Saved Data** mode.

   - Note Channel Number (CH) designations:

Channel	*Displays*
CH40	**Horizontal**
CH 41	**Vertical**

   - Note measurement box settings:

Channel	*Measurement*
SC	**Delta T**
CH 40	**P-P**
CH 41	**P-P**

2. Set up your display window for optimal viewing of the "**Pendulum tracking**" data.

Data Analysis continues…

Detailed Explanation of Data Analysis Steps

If entering **Review Saved Data** mode from the Startup dialog or Lessons menu, make sure to choose the correct file.

Example data:

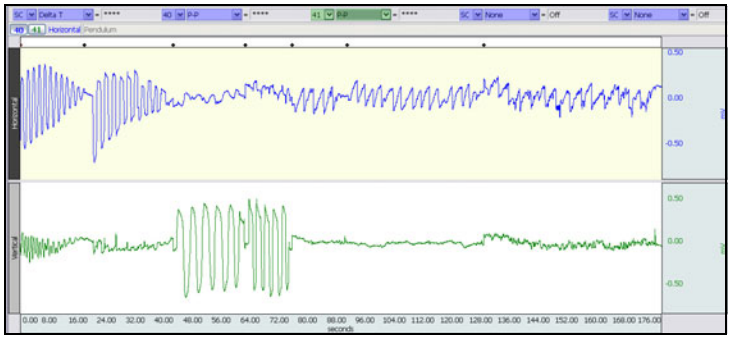

Fig. 10.22 Example data

The measurement boxes are above the marker region in the data window. Each measurement has three sections: channel number, measurement type, and result. The first two sections are pull-down menus that are activated when you click them.

SC is the Selected Channel; the one with the darkened channel label. Channels are selected clicking on the channel selection box or by clicking within the channel display region.

Brief definition of measurements:

Delta T: Displays the amount of time in the selected area (the difference in time between the endpoints of the selected area).

P-P (Peak-to-Peak): Subtracts the minimum value from the maximum value found in the selected area.

The "selected area" is the area selected by the I-beam tool (including endpoints).

Note: The append event markers mark the beginning of each recording. Click on (activate) the event marker to display its label.

Useful tools for changing view:

Display menu: Autoscale Horizontal, Autoscale Waveforms, Zoom Back, Zoom Forward

Scroll Bars: Time (Horizontal); Amplitude (Vertical)

Cursor Tools: Zoom Tool

Buttons: Overlap, Split, Show Grid, Hide Grid, -, +

Hide/Show Channel: "Alt + click" (Windows) or "Option + click" (Mac) the channel number box to toggle channel display.

3. Referencing the Horizontal data, select the area of the first tracking cycle. Record the Delta T (period) and P-P measurements. Repeat for each successive tracking cycle.

   A (Table 10.1)

At the start of the tracking cycle, the eyes were looking straight ahead and the data was approximately centered between minimum and maximum values.

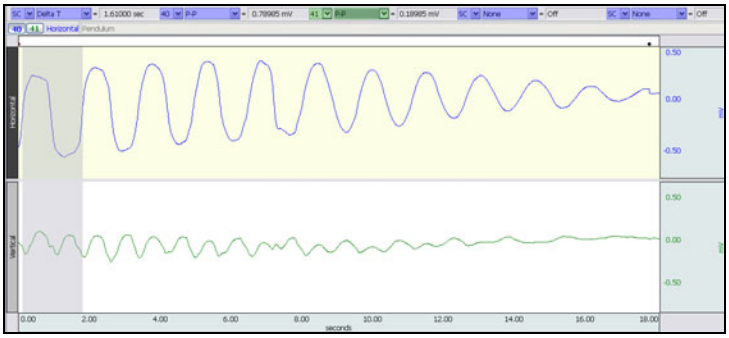

Fig. 10.23—Selection of first Horizontal tracking cycle.

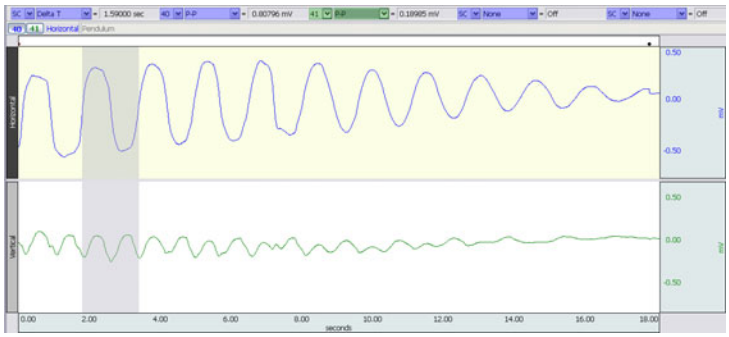

Fig. 10.24—Selection of second Horizontal tracking cycle.

4. Scroll to "**Simulate pendulum**" data and record the measurements for each successive cycle as in Step 3.

   A

5. Scroll to "**Vertical tracking"** data.

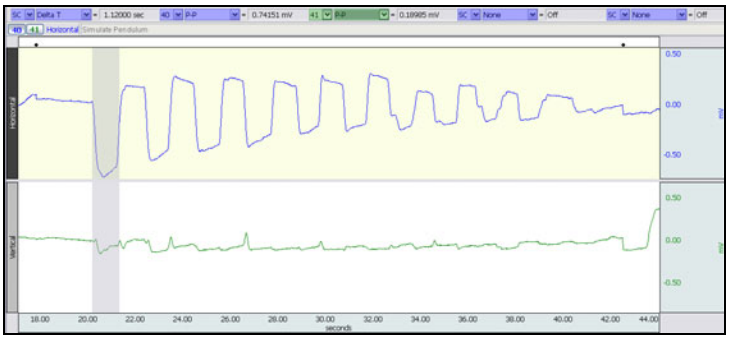

Fig. 10.25—Selection of first Horizontal cycle.

6. Referencing the Vertical data, select the area of the first tracking cycle. Record the Delta T (period) and P-P measurements. Repeat for each successive tracking cycle.

   B (Table 10.2)

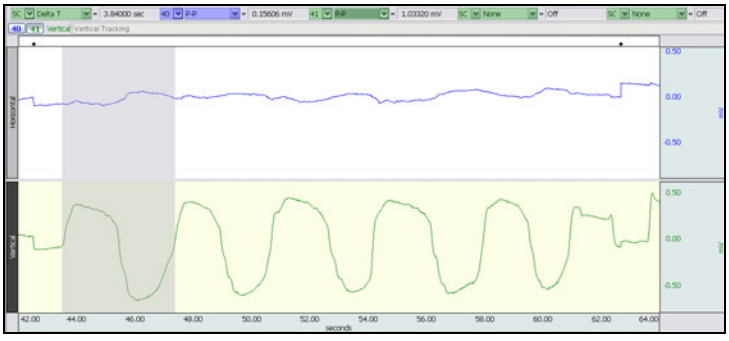

Fig. 10.26—Selection of first Vertical tracking cycle.

Data Analysis continues…

7. Scroll to "**Simulate vertical tracking**" data and record the measurements for each successive cycle as in Step 6.

   B

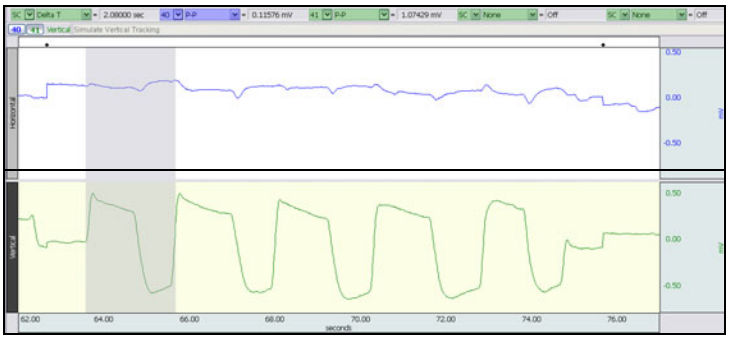

Fig. 10.27—Selection of first Vertical tracking cycle.

8. Set up your display window for optimal viewing of the "**Read silently 1**" data.

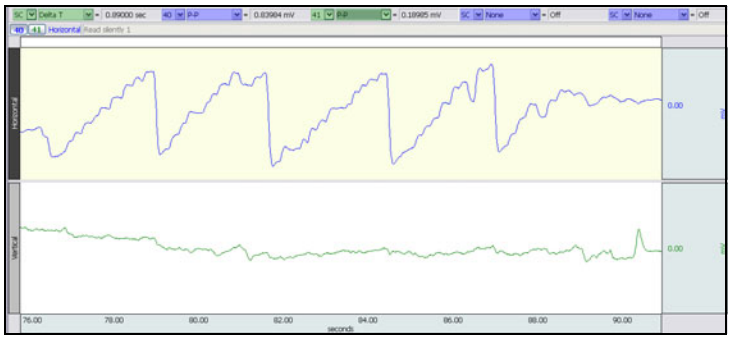

Fig. 10.28—Example Read Silently 1 data.

9. Record the number of words in line 1 and line 2 of each passage.

   C (Table 10.3)

10. Zoom in on the data recorded during the reading the first line.
11. Count and record the number of saccades that occurred while reading the line.

    C

12. Measure and record each time interval (period) between saccades (Delta T).

    C

13. Scroll to the data recorded during the reading of the second line and repeat Steps 11 and 12.

    C

In the following examples, the Vertical channel is hidden since all measurements are made on the Horizontal data.

The data for the reading of each line should be easy to discern as there is a large, fast transition when the eyes move from the end of one line to the beginning of the next.

Saccades are the fast transitions in the positive trending data. The period between saccades is the time the **Subject** looked at each word.

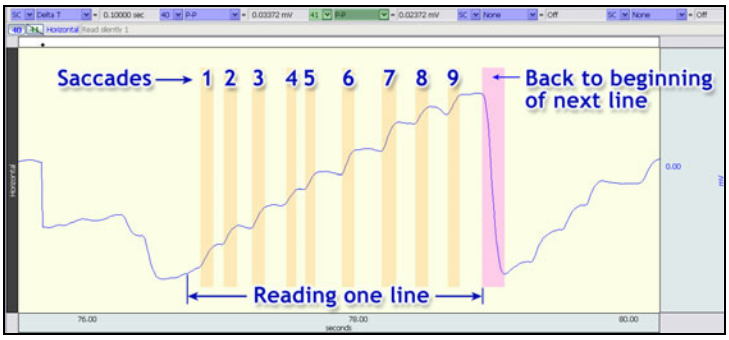

Fig. 10.29—Highlight shows saccade intervals.

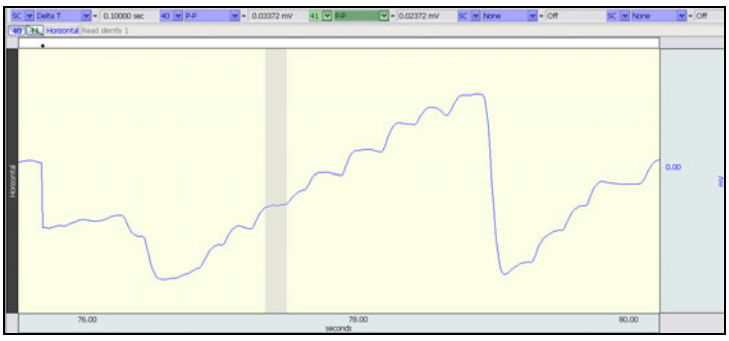

Fig. 10.30—Example of interval between saccades.

Data Analysis continues…

Scroll to "**Read silently 2**" data and repeat Steps 10 through 13.

C

14. Scroll to "**Read Aloud**" data and repeat Steps 10 through 13.

C

It may be more difficult to distinguish the saccades and the interval between saccades because eye movement is more complex when reading aloud. The movement of the facial muscles can also create signal artifact. The following example shows typical data with an interval selected. It is only necessary to measure the intervals between saccades that are clearly distinguished.

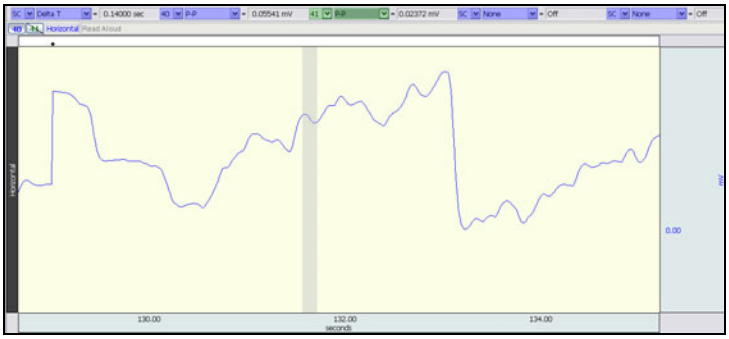

Fig. 10.31—Example of interval between saccades.

15. Answer the questions at the end of the Data Report.
16. **Save** or **Print** the data file.
17. **Quit** the program.

An electronically editable **Data Report** can be found in the journal (following the lesson summary,) or immediately following this Data Analysis section. Your instructor will recommend the preferred format for your lab.

END OF DATA ANALYSIS

END OF LESSON 10

Complete the Lesson 10 Data Report that follows.

ELECTROOCULOGRAM

- *EOG*

DATA REPORT

Student's Name: _____

Lab Section: _____

Date: _____

I. Data and Calculations

Subject Profile

Name:_____ Height:_____

Age:_____ Gender: Male / Female Weight:_____

A. **Pendulum Tracking**—Complete Table 10.1.

Note: Your data may have more or fewer cycles than the 7 allotted in the tables.

Table 10.1 Pendulum Tracking vs. Simulation Tracking (using Horizontal data)

Cycle	Pendulum		Simulation	
	40 Delta T	40 P-P	40 Delta T	40 P-P
1				
2				
3				
4				
5				
6				
7				

B. **Vertical Tracking**—Complete Table 10.2.

Table 10.2 Vertical Tracking vs. Simulation

Cycle	Real Object		Simulation	
	41 Delta T	41 P-P	41 Delta T	41 P-P
1				
2				
3				
4				
5				
6				
7				

C. **Saccades**—Complete Table 10.3.

Table 10.3 Saccades

Measurement	*Read Silently 1*		*Read Silently 2*		*Read Aloud*	
	1st line	*2nd line*	*1st line*	*2nd line*	*1st line*	*2nd line*
Number of words						
Number of saccades						
Time interval between saccades						
#1						
#2						
#3						
#4						
#5						
#6						
#7						
#8						
#9						
Average time interval between saccades (Calculate)						

II. Questions

D. Focusing a camera changes the distance between the lens and the film. Does the eye focus by changing the distance between the lens and the retina? Explain your answer.

E. Define the following terms:

Cone

Rod

Fovea

Visual Field

Visual Fixation

Saccade / Microsaccade

F. Why is vision in darkness more effective when focusing away from the fovea rather than focusing directly on the fovea?

G. Explain the difference between “voluntary fixation” and “involuntary fixation”:

H. Examine the data in Table 10.1 and answer the following questions

a.) Did the amplitude continue to decrease with each successive swing cycle during pendulum tracking? Explain

b.) Did the amplitude continue to decrease with each successive swing cycle during simulated pendulum tracking? Explain

c.) Did the time interval (period) of each successive swing cycle increase, decrease, or remain constant during pendulum movement? Explain

d.) Did the time interval (period) of each successive swing cycle increase, decrease, or remain constant during simulated movement? Explain

e.) Are the waveform shapes different between tracking and simulated tracking data? Explain

I. Examine the data in Table 10.2 and answer the following questions:

a.) Do the cycle amplitudes increase, decrease, or remain constant during vertical tracking? Explain

b.) Do the cycle amplitudes increase, decrease, or remain constant during simulated vertical tracking? Explain

c.) Do the cycle periods increase, decrease, or remain constant during vertical tracking? Explain

d.) Do the cycle periods increase, decrease, or remain constant during simulated vertical tracking? Explain

e.) Are the waveform shapes different between vertical tracking and simulated vertical tracking data? Explain

J. Examine the data in Table 10.3 and answer the following questions:

a.) Did the number of saccades match the number of words for each line? Explain any differences.

b.) Is the average time interval between saccades different when reading an easy passage vs. a challenging passage? Explain

_____

_____

c.) Is the average time interval between saccades different when reading the same passage silently vs. aloud?

_____

_____

d.) Are the waveform shapes different between Read Silently 2 and Read Aloud data? Explain

_____

_____

K. Name the cranial nerves tested and the extraocular muscles tested when the subject is asked to follow the eraser on a pencil when moved in a one foot circle, two feet from face.

Cranial Nerves	Extraocular Muscles
_____	_____
_____	_____
_____	_____
	_____
	_____
	_____

L. Define corneal–retinal potential (CRP) and explain its relation to electrooculography and the electrooculogram.

_____

_____

_____

_____

_____

III. OPTIONAL Active Learning Portion

A. ***Hypothesis***

B. ***Materials***

C. ***Method***

D. ***Set Up***

E. ***Experimental Results***

End of Lesson 10 Data Report

Sample Readings

Easy:

You put your right foot in, you put your right foot out, you put your right foot in and you shake it all about. You do the Hokey Pokey and you turn yourself around, that's what it's all about!

Difficult:

O proud right foot, that ventures quick within, then soon upon a backward journey lithe. Anon, once more the gesture, then begin: Command sinistral pedestal to writhe. Commence thou then the fervid Hokey Poke. A mad gyration, hips in wanton swirl. To spin! A wilde release from heaven's yoke, Blessed dervish! Surely canst go, girl. The Hoke, the Poke – banish now thy doubt. Verily, I say, 'tis what it's all about!