

II. EXPERIMENTAL OBJECTIVES

1. Observe the effect of learning and the effect of anticipating the stimulus delivery on reaction time.
2. Compare reaction times in four stimulus-response situations:
 - a) Fixed interval stimulus presentation using the dominant hand for the response.
 - b) Random interval stimulus presentation using the dominant hand for the response.
 - c) Fixed interval stimulus presentation using the nondominant hand for the response.
 - d) Random interval stimulus presentation using the nondominant hand for the response.
3. Compare the reaction times for groups of subjects by calculating the statistics of group mean, variance, and standard deviation in each of the four stimulus-response situations.

III. MATERIALS

- BIOPAC Hand Switch (SS10L)
- BIOPAC Headphones (OUT1 or OUT1A*)
- Biopac Student Lab System: BSL 4 software, MP36 or MP35 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 your computer **ON**.
2. Turn OFF MP36/35 unit.
3. **Plug the equipment in** as follows:
Hand Switch (SS10L) — CH 1
Headphones (OUT1 or OUT1A*) — back of unit
**OUT1A is compatible with MP36 only.*
4. Turn **ON** the MP36/35 unit.
5. **Start** the BIOPAC Student Lab Program.
6. Choose lesson “**L11 – Reaction Time I**” and click **OK**.
7. Type in a unique **filename** and click **OK**.

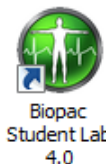
Setup continues...

Detailed Explanation of Setup Steps



Fig. 11.3 Equipment Connections

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



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

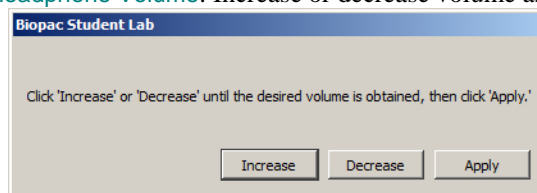
A folder will be created using the filename. This same filename can be used in other lessons to place the **Subject's** data in a common folder.

8. **Optional:** Set Preferences.
- Choose File > **Lesson Preferences**.
 - Select **Headphone Volume**.
 - Set the desired volume and click **Apply**.

END OF SETUP

This lesson has an optional Preferences setting for headphone volume:

Headphone Volume: Increase or decrease volume as desired.



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

B. CALIBRATION

This calibration procedure will check that the headphones and SS10L are properly connected. **Pay close attention to Calibration.**

FAST TRACK Calibration

1. Prepare the **Subject** for the calibration recording.
 - Put headphones on.
 - Get in a seated and relaxed position, with eyes closed.
 - Hold hand switch in **dominant** hand, with thumb is ready to press the button.
2. Click **Calibrate**.
3. **Subject** must press hand switch button after click is heard, and then release.
4. Wait for Calibration to stop.
5. Verify recording resembles example data.
 - If similar, click **Continue** and proceed to Data Recording.
 - If necessary, click **Redo Calibration**.

END OF CALIBRATION

Detailed Explanation of Calibration Steps

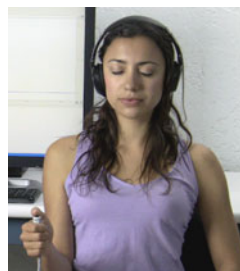


Fig. 11.4

The click will be heard approximately four seconds into the recording.

Calibration lasts eight seconds.

The switch response should be clearly seen near the middle of the screen.

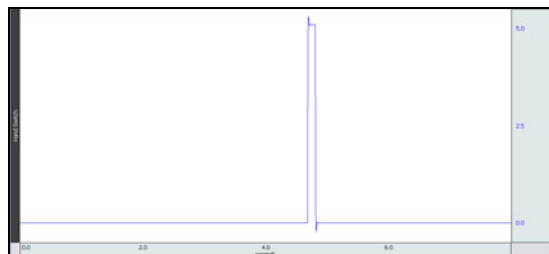


Fig. 11.5 Example Calibration data

If recording does not resemble Example Data...

- If no switch response is detected, check all connections.
- If the baseline signal is excessively noisy (greater than 5 mV peak-to-peak,) there may be a computer grounding problem. Make sure the computer power cord and outlet uses all 3 prongs. If using a laptop, try disconnecting the power supply.
- If no click was heard, check headphone connections and volume level.
- If the Calibrate button reappears in the window, the switch response was not detected. Check connections and repeat the calibration procedure, making sure to press the button firmly.
- If multiple responses are present, redo and be sure to press hand switch button only once during Calibration.

C. DATA RECORDING

FAST TRACK Recording

1. Prepare for the recordings.
 - **Subject** is seated with eyes closed.
 - **Subject** holds switch in dominant hand, with thumb ready to press the button.

Detailed Explanation of Recording Steps

Four data recordings will be acquired*, each requiring **Subject** to press the button (response) as soon as possible after hearing a click (stimulus):

- a. Recordings 1 and 3 present the stimuli at random (1 – 10 second) intervals, alternating between dominant and nondominant hand.
- b. Recordings 2 and 4 present the stimuli at fixed intervals (every 4 seconds,) alternating between dominant and nondominant hand.

Notes:

- If the **Subject** is right-handed, the right hand is generally dominant; if the subject is left-handed, the left hand is generally dominant.
- This lesson measures reaction time, so pressing the hand switch immediately after a click is heard is 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.
- The reaction time summaries will be calculated and placed in the journal automatically at the end of the lesson. The software looks for one response per stimulus, and ignores responses that occur before the stimulus or more than one second after the stimulus. The threshold the program uses to calculate reaction time is 1.5 mV.
- DO NOT manually insert event markers during this lesson as this could cause incorrect reaction time calculations.

Random interval - dominant hand

2. Click **Record**.
3. **Subject** must press hand switch button immediately after each click is heard, and then release.
4. Wait for recording to stop.
5. Verify recording resembles example data.
 - If similar, click **Continue** and proceed to the next recording.

The recording will stop after ten clicks.

A pulse should be displayed after each event marker if the switch was pressed correctly. Use the horizontal scroll bar to look back on earlier portions of the recording.

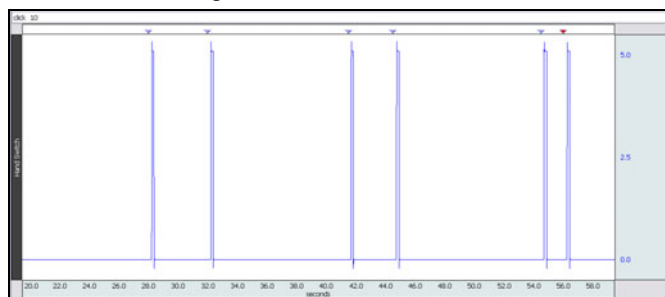


Fig. 11.6 Example Random interval data

Recording continues...

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

The data might be different for the following reasons:

- If data is flatline, check all connection to MP unit.
- The recording did not detect a switch response for each click. Make sure the switch is pressed firmly. You can miss some responses, but if you miss more than two, you should consider redoing the recording.
- The switch response (pulse) occurs before the event marker, indicating the **Subject** responded prematurely.

If necessary, click **Redo** and repeat Steps 2 – 5. Note that once **Redo** is clicked, the most recent recording will be erased.

Fixed interval – dominant hand

6. **Prepare** for the recording.

- **Subject** is seated with eyes closed.
- **Subject** holds switch in dominant hand, with thumb ready to press the button.

7. Click **Record**.

8. Press hand switch button immediately every time a click is heard.

9. Wait for recording to stop.

10. **Review** the data on the screen.

- If similar to Fig. 11.6, click **Continue** and proceed to the next recording.
- If necessary, click **Redo**.
- If all required recordings have been completed, click **Done**.

The recording will stop after ten clicks.

See details in Step 5.

If necessary, click **Redo** and repeat Steps 7 – 10. Note that once **Redo** is clicked, the most recent recording will be erased.

Random interval –nondominant hand

11. Prepare for the recording.

- **Subject** is seated with eyes closed.
- **Subject** holds switch in **nondominant** hand, with thumb ready to press the button.

12. Click **Record**.

13. Press hand switch button immediately every time a click is heard.

14. Wait for recording to stop.

15. **Review** the data on the screen.

- If similar to Fig. 11.6, click **Continue** and proceed to the next recording.
- If necessary, click **Redo**.
- If all required recordings have been completed, click **Done**.

See details in Step 5.

If necessary, click **Redo** and repeat Steps 12 – 15. Note that once **Redo** is clicked, the most recent recording will be erased.

Fixed interval – nondominant hand

16. **Prepare** for the recording.

- **Subject** is seated with eyes closed.
- **Subject** holds switch in **nondominant** hand, with thumb ready to press the button.

17. Click **Record**.

Recording continues...

18. Press hand switch button immediately every time click is heard.
19. Wait for recording to stop.
20. Verify a response follows each event marker.
 - If similar to Fig. 11.6, click **Continue** and proceed to the optional recording section or click **Done** to end the lesson.
 - If necessary, click Redo.

See details in Step 5.

If necessary, click **Redo** and repeat Steps 17 – 20. Note that once Redo is clicked, the most recent recording will be erased.

OPTIONAL ACTIVE LEARNING PORTION

Prepare for Recording

- Prepare Subject and any materials for the recording.
- To use fixed timing, click **Fixed Intervals**.
- To use random timing, click **Random Intervals**.

Click **Record**.

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. Prior to recording additional data, choose the desired audio stimulus interval (random or fixed,) as shown on left.

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

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

When **Done** is clicked, a dialog with options will be generated. Make a selection and click **OK**.

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

- Repeat Calibration Steps 1 – 3, and then proceed to Recording.

21. Click **Done**.

END OF RECORDING

V. DATA ANALYSIS

FAST TRACK Data Analysis

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

- Note channel designation:

Channel *Displays*

CH 1 **Hand Switch**

- Note measurement box settings:

Channel *Measurement*

CH 1 **Delta T**

2. Set up your display window for optimal viewing of the first event marker and pulse of the first data recording (Fig. 11.8).

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.

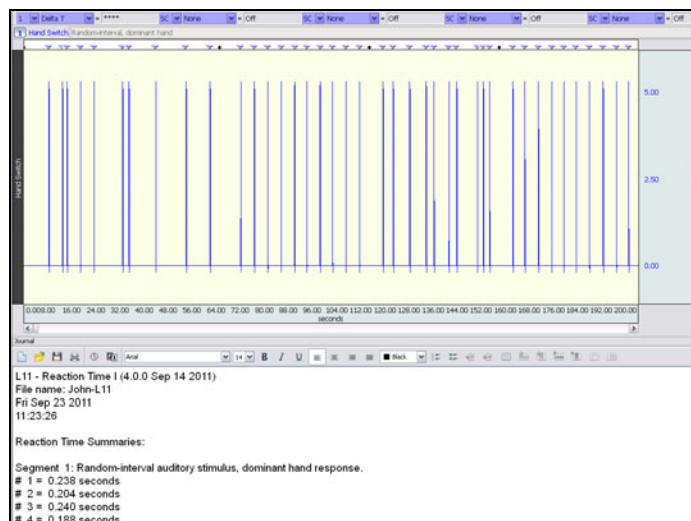


Fig. 11.7 Example Data and journal

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.

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).

The “selected area” is the area selected by the I-Beam tool (including the endpoints).

Note The Journal contains the reaction time summary. Use this to fill in your data report.

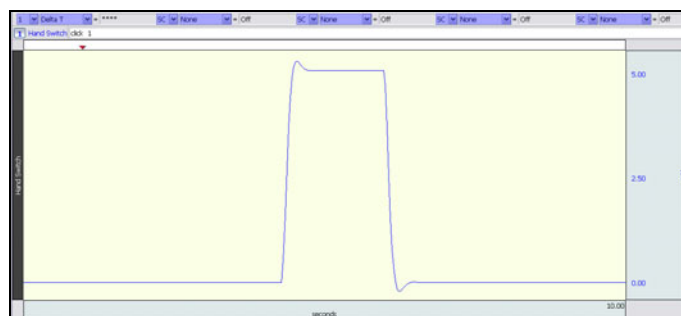



Fig. 11.8 Zoomed in on First event marker and switch pulse

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: Show Grid, Hide Grid, -, +

Data Analysis continues...

3. Select an area from the first event marker to the leading edge of the first pulse (Fig. 11.9) and note the Delta T measurement.



A

4. Look at the first reaction time result in the Journal and compare this to the Delta T measurement found above.
5. Repeat the steps above on other pulses until you are convinced that the Journal readings are accurate.
6. Transfer your data from the Journal to the Data Report.



B

7. Collect data from at least five other students in your class as needed to complete the Data Report.



C, D, E

8. **Save** or **Print** the data file.
9. Quit the program.

END OF DATA ANALYSIS

The first event marker indicates the start of the stimulus click. The leading edge of the pulse indicates when the button was first pressed. The threshold that the program uses to calculate reaction time is 1.5 mV.

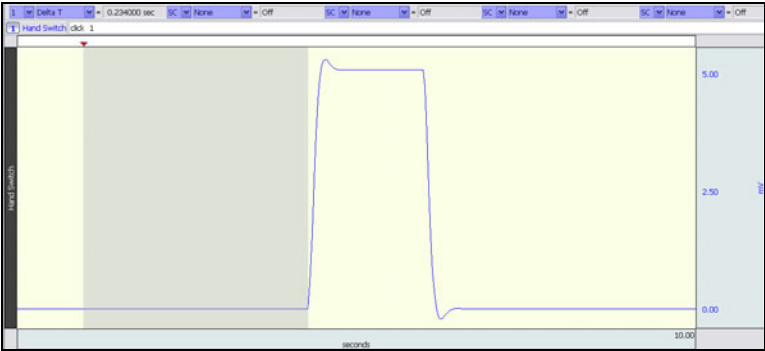


Fig. 11.9 Example reaction time measurement.

The two measurements should be approximately the same.

This step may not be necessary if your Instructor allows you to print out your Journal and staple it to the Data Report.

Hint: Measurements and formulas can be pasted directly into the **Journal Data Report** table cells by right-clicking into the desired table cell and selecting the measurement from the contextual menu. (See below)

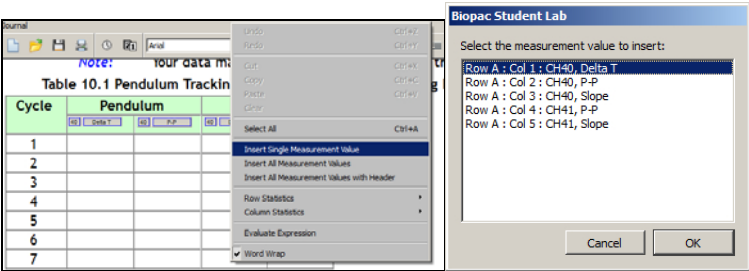


Fig. 11.10 Pasting measurements to Data Report

Note that the Variance and Standard Deviation calculations in table E are optional and depend on the requirements of your instructor.

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 LESSON 11

Complete the Lesson 11 Data Report that follows

REACTION TIME

DATA REPORT

Student's Name: _____

Lab Section: _____

Date: _____

I. Data and Calculations

Subject Profile

Name: _____

Height: _____

Age: _____

Gender: Male / Female

Weight: _____

A. Manual calculation of reaction time

Calculate the reaction time for the first click in initial recording:

Delta T = _____

B. Summary of Subject's Results (copy from the software Journal)

Table 11.1

STIMULUS NUMBER	REACTION TIMES (ms)			
	Dominant Hand		Nondominant Hand	
	(Random)	(Fixed interval)	(Random)	(Fixed interval)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Mean				

C. Comparison of reaction time to number of presentations

Complete Table 11.2 with data from the first “Random Data (Dominant)” and “Fixed Interval Data (Dominant)” trial for 5 students. Calculate the mean for each presentation to determine if reaction times vary as each Subject progresses through the series of stimulus events.

Table 11.2 Comparison of Reaction Times

Student's Name	Random Data (Dominant Hand)			Fixed Interval Data (Dominant Hand)		
	Stimulus 1	Stimulus 5	Stimulus 10	Stimulus 1	Stimulus 5	Stimulus 10
1.						
2.						
3.						
4.						
5.						
Calculate the Means:						

D. Group Summary

Complete Table 11.3 with the mean for 5 students and calculate the group mean.

Table 11.3

Class Data Student Means	Random trials		Fixed-interval trials	
	Dominant Hand	Nondominant Hand	Dominant Hand	Nondominant Hand
1.				
2.				
3.				
4.				
5.				
Calculate the Group Means:				

E. Variance and Standard Deviation (Optional)

$$\text{Variance} = \frac{1}{n-1} \sum_{j=1}^n (x_j - \bar{X})^2$$

$$\text{Standard Deviation} = \sqrt{\text{Variance}}$$

Where

n = number of students

X_j = mean reaction time for each student

\bar{X} = Group mean (constant for all students)

$\sum_{j=1}^n$ = Sum of all student data

Calculate the variance and standard deviation for 5 students with data from **Random Trial 2** (Table 11.4) and from **Fixed Interval Trial 2** (Table 11.5)

Table 11.4: Random Trial 2 Data (Nondominant hand)

	ENTER	ENTER	CALCULATE	CALCULATE
	Mean Reaction time for Student	Group Mean	Deviation	Deviation ²
Student	(X _j)	(\bar{X})	(X _j - \bar{X})	(X _j - \bar{X}) ²
1				
2				
3				
4				
5				

$$\text{Sum the data for all students} = \sum_{j=1}^n (x_j - \bar{x})^2$$

=

Variance (σ^2) =

$$\text{Multiply by 0.25} = \frac{1}{n-1}$$

=

Standard
Deviation =Take the square root of the
variance =

=

Table 11.5: Fixed Interval Trial 2 Data (Nondominant hand)

	ENTER	ENTER	CALCULATE	CALCULATE
	Mean Reaction time for Student	Group Mean	Deviation	Deviation ²
Student	(X _j)	(\bar{X})	(X _j - \bar{X})	(X _j - \bar{X}) ²
1				
2				
3				
4				
5				

$$\text{Sum the data for all students} = \sum_{j=1}^n (x_j - \bar{x})^2$$

=

Variance (σ^2) =

$$\text{Multiply by 0.25} = \frac{1}{n-1}$$

=

Standard
Deviation =Take the square root of the
variance =

=

II. Questions

F. What are the essential elements of a stimulus-response pathway? List them in correct sequence. _____

G. Explain the difference between a voluntary reaction to a stimulus and a reflex response to a stimulus. _____

H. Reaction time using a dominant, voluntary motor pathway is usually shorter than when using an equivalent nondominant pathway. Explain. _____

- I. Reaction times associated with repetitive fixed interval stimuli in a given stimulus-response situation usually decrease over a short time period to some minimal value and then remain stable. Explain. _____

III. OPTIONAL Active Learning Portion

A. *Hypothesis*

B. *Materials*

C. *Method*

D. *Set Up*

E. *Experimental Results*
