Experiment HM-3: Electroculogram Activity (EOG)

Equipment Required

PC or Mac Computer

IXTA, USB cable, IXTA power supply

iWire-B3G ECG cable and electrode lead wires

Disposable electrodes

Tennis ball on 5 feet of thin string

Note – You must connect the iWire-B3G to the IXTA prior to turning it on.

EOG Cable Setup

1. Locate the iWire-B3G EOG cable and electrode lead wires in the iWorx kit.
2. Insert the connector on the end of the iWire-B3G cable into the iWire 1 input on the front of the IXTA.

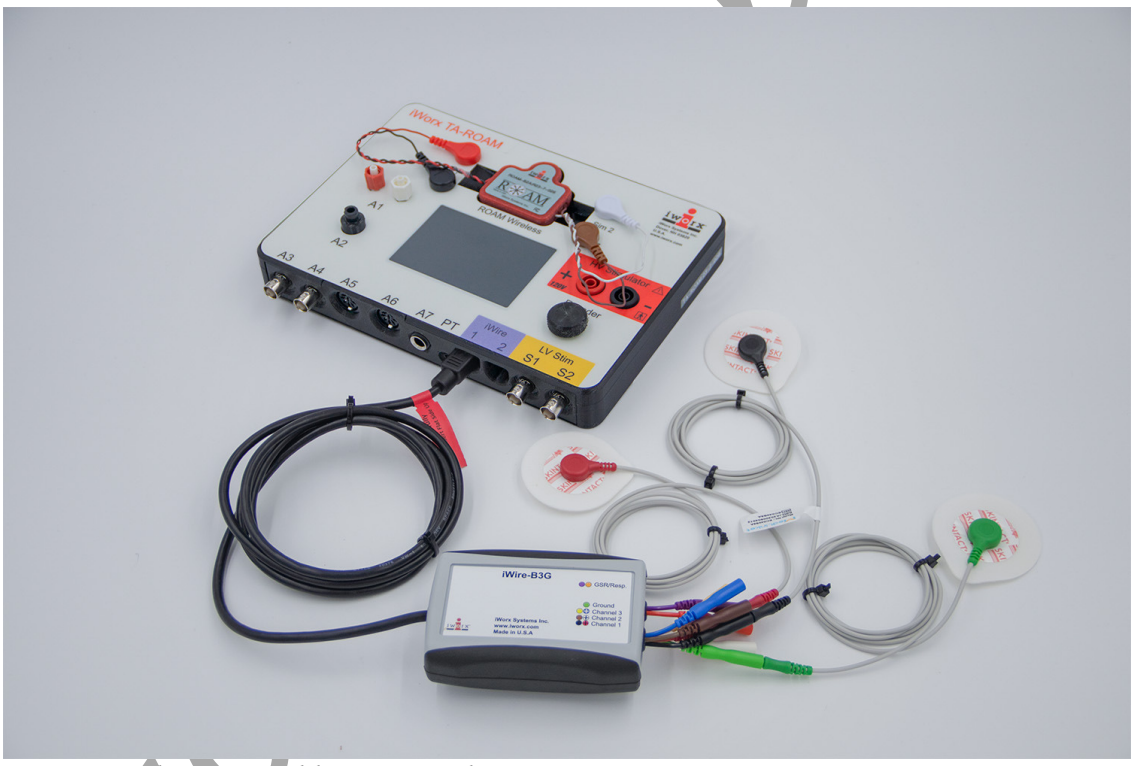

Figure HM-3-S1: The EOG cable connected to an IXTA.

3. Select a person from your group to be the subject in this experiment.

iWorx Sample Lab

4. Trim the electrodes and then remove the plastic disk. Apply the electrodes to one of the scrubbed areas. Attach an electrode to each of the other areas.

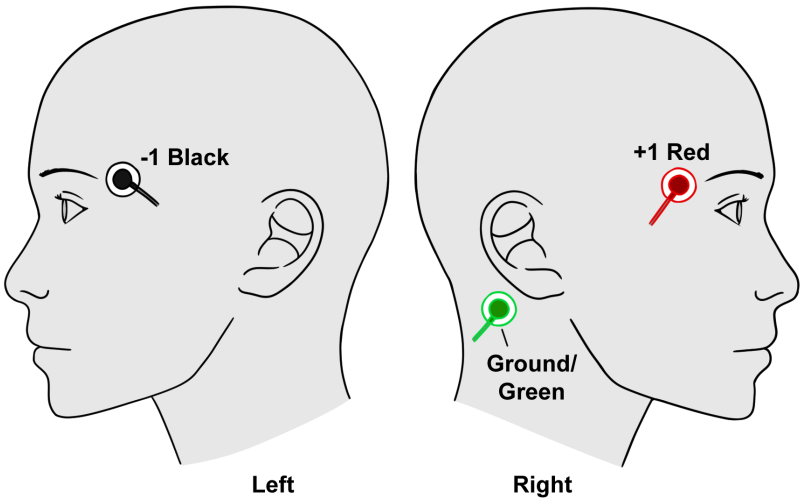

Figure HM-3-S3: Placement of electrodes for recording an electroculogram (EOG).

5. Snap the recording lead wires onto the electrodes, so that:
    - the red (+1) lead is on electrode next to the right eye.
    - The black (-1) lead is on electrode next to the left eye.
    - the green (C) lead (the ground) is on electrode below the right ear.
7. Drape the leads for the electrodes over the subject's shoulders to the lead pedestal which hangs freely down the subject's back and over the chair. There should be no tension on the electrodes.
8. The subject should sit quietly with their hands in their lap.

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Experiment HM-3: Electroculogram Activity (EOG)

Note – for all these experiments it is important to observe your subject's physical eye movements.

THIS LAB IS ALL OBSERVATIONAL – there are no mathematical measurements.

Exercise 1: Saccades

Aim: To demonstrate the type of electrical activity that occurs in the muscles as the subject is reading.

Approximate Time: 30 minutes

Procedure

1. Select a paragraph for the subject to read as their EOG is recorded. The paragraph should be at least 10 lines long with a format and sentence structure that is simple. A simple children's book will work well. As you will find out, the number of words in each line, the length of each line, and the formatting of the paragraph will affect the shape of the EOG recording.
2. The subject should avoid any voluntary movements of their head or body during the recording. **Only the subject's eyes should be moving while they are reading.**
3. Type **Saccades** in the Mark box.
4. As the subject is focusing on the first word in the paragraph, click Record. Instruct the subject to begin reading as you click on the Mark button to mark the recording.
5. After the first cyclic pattern in completed, click on the AutoScale button. Observe the subject's eyes as he or she is reading.

Figure HM-3-L1: Electroculogram (EOG) of a subject reading slowly. Four words are on each line. As the subject moves his eyes to the right to read the next word, the level of the recording rises a step. As the subject moves his eyes back to the beginning of the next line, the amplitude of the EOG drops.

Human Muscle Lab

Note – the trace may be inverted depending on electrode placement.

6. Click Stop to halt recording when the subject has finished reading.
7. Select Save As in the File menu, type a name for the file. Click on the Save button to save the data file.
8. Type **Slow Saccades** in the Mark box.
9. Instruct the same subject to move from word to word in the same paragraph using a slower saccadic movement. It is best if the subject focuses on each word for **two seconds** before moving to the next word.
10. Repeat Steps 4 through 6 while the subject reads slowly.
11. Select Save in the File menu.
12. Type **New Paragraph** in the Mark box.
13. Instruct the same subject to read a paragraph with a more complex format, like a paragraph with multiple columns or more words per line. A newspaper article will work well for this section.
14. Repeat Steps 4 through 6 while the subject reads the new paragraph.
15. Select Save in the File menu.

Questions

1. How does the pattern of the EOG recorded during the *slow saccadic reading* of the first paragraph compare to the *normal reading* of the same paragraph? How does the motion of the subject's eyes differ between these readings?
2. How does the pattern of the EOG recorded during the reading of the first paragraph compare to the pattern during the reading of the second, more complex paragraph? How do the paragraphs differ?

Exercise 2: VOR

Aim: To demonstrate the type of electrical activity that occurs in the muscles as the subject remains focused on an image or word on a page while rotating their head from side to side.

Approximate Time: 15 minutes

Note: Be sure to observe the subject's eye movements as well as the pattern of the recording.

Procedure

1. Select an image on which the subject can focus on as the subject rotates their head from side to side. There should be a single image on the paper.
2. Inform the subject to avoid any voluntary movements of their body during the recording. **Only the subject's head should be moving while they are focusing on the target.**

Worx Sample Lab

3. Type **VOR** in the Mark box.
4. As the subject is focusing on the image and begins rotating their head side to side, click Record. Click on the Mark button to mark the recording. Have the subject do this for 15 seconds.
5. After the first cyclic EOG pattern in completed, click on the AutoScale button. **Observe the subject's eyes as the subject is rotating their head.**
6. Click Stop when the subject has finished the exercise.
7. Select Save in the File menu.
8. Type **Atypical VOR** in the Mark box.
9. Repeat Steps 4 through 6 on the same subject while they increase or decrease the degree or velocity of head rotation.
10. Select Save in the File menu.

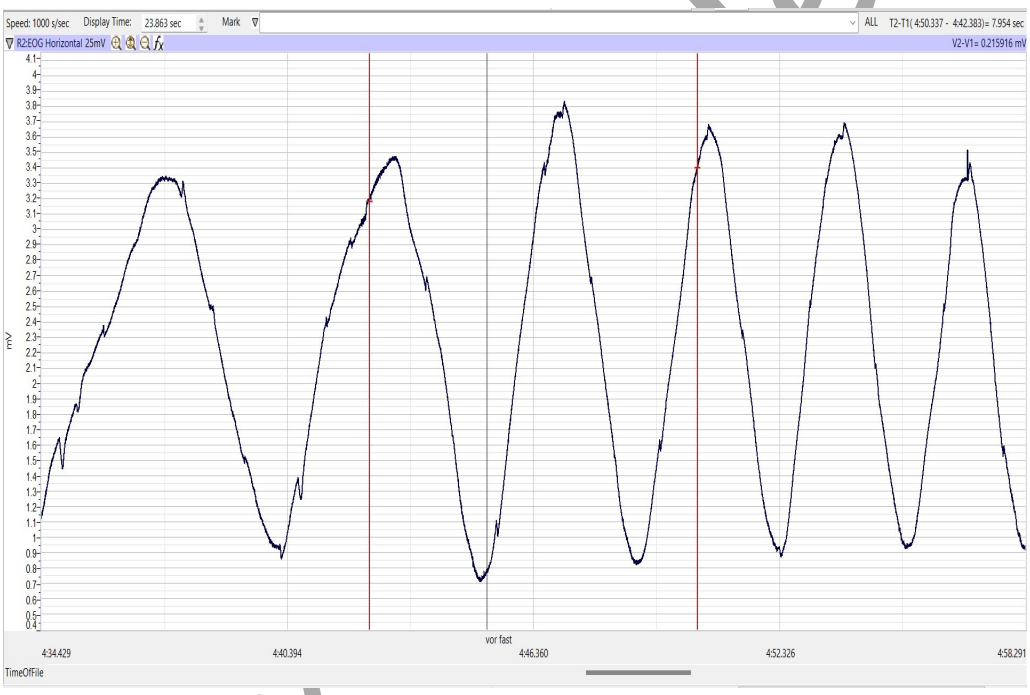

Figure HM-3-L2: Electroculogram (EOG) of a subject rotating his head from side to side as his eyes remain focused on the target.

Questions

1. How does the pattern of the EOG recorded while the subject is rotating their head slowly compare to the pattern during the period when the rotation of the head is to a different degree or with a different velocity?
2. Describe the motion of the subject's eyes during VOR. Is it smooth or saccadic?
3. Does the motion of the subject's eyes differ between VORs of different degrees or velocities?

Work Lab

Exercise 3: Pursuit

Aim: To demonstrate the type of electrical activity that occurs in the muscles as the subject follows a moving target.

Approximate Time: 15 minutes

Note: Be sure to observe the subject's eye movements as well as the pattern of the recording.

Procedure

1. Suspend a target, like a tennis ball on a string, in front of a uniform background of a contrasting color, like a blackboard or a wall. Set the length of the string at about 2 feet. You should be able to swing the target from side to side like a pendulum.

   Only the subject's eyes should be moving while he or she is following the target.
2. Type **Pursuit** in the Mark box.
3. Pull the target to the side in preparation for its swinging like a pendulum; the subject should be focused on the target and ready to follow it when it is released.
4. As the target is released and the subject begins following the target with their eyes, click Record. Click on the Mark button to mark the recording.
5. After the first cyclic EOG pattern in completed, click on the Autoscale button. **Observe the subject's eyes as the subject is following the target.**
6. Click Stop to halt recording when the target has completed about 10 oscillations.
7. Select Save in the File menu.
8. Lengthen the string used suspend the target by a foot or more, so the target will swing more slowly.
9. Type **Slow Pursuit** in the Mark box.
10. Repeat Steps 4 through 7 on the same subject while the target swings slowly.
11. Select Save in the File menu.

Questions

1. How does the pattern of the EOG recorded while the subject is pursuing a fast moving target compare to the pattern during the pursuit of the slower moving target?
2. Describe the motion of the subject's eyes during pursuit. Is it smooth or saccadic?
3. How does the motion of the subject's eyes differ between pursuits of different velocities?

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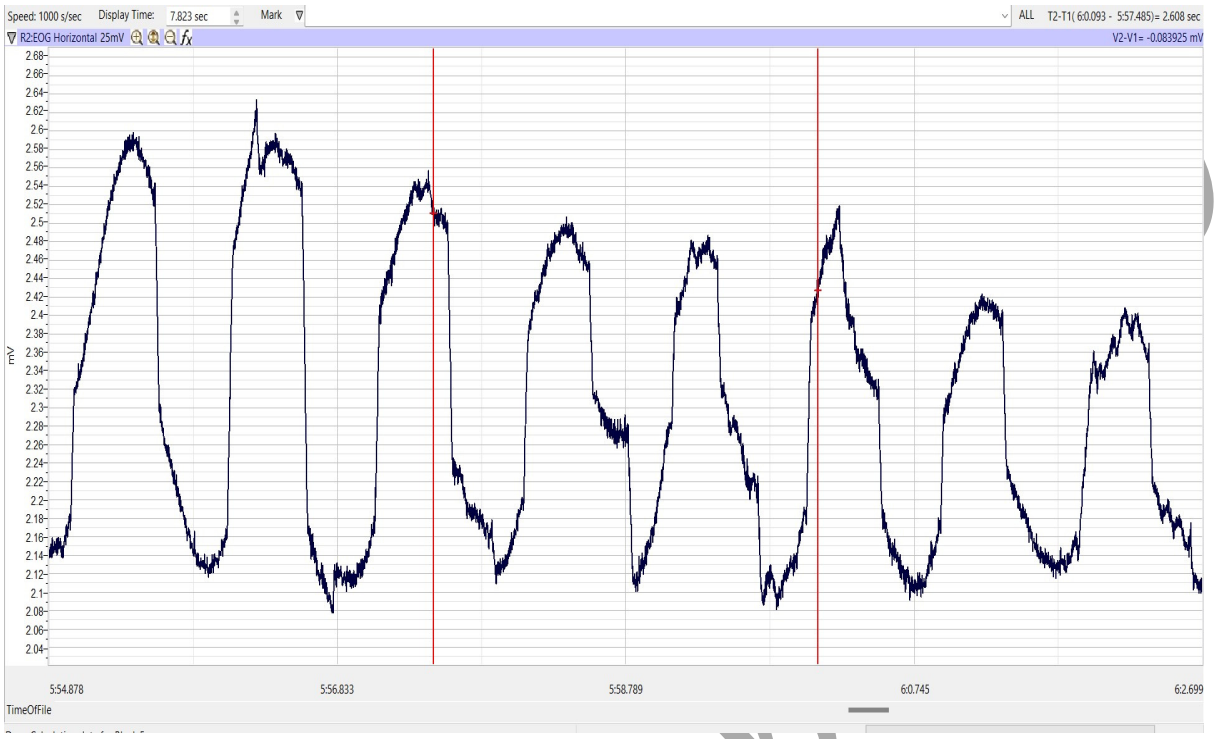

Figure HM-3-L3: Electroculogram (EOG) of a subject following an oscillating target.

Exercise 4: Vergence

Aim: To demonstrate the electrical activity that occurs in the muscles as the subject focuses from a distant to a near target and back.

Approximate Time: 15 minutes

Note: Be sure to observe the subject's eye movements as well as the pattern of the recording.

Procedure

1. Find two targets that are similar in size and shape. Place one target about 10 inches in front of the subject. The second target should be at least 8-10 feet from the subject. The targets should be aligned so the subject can see both targets without moving their head or body.
2. Instruct the subject to:
    - Focus on the distant target for four seconds followed by focusing on the near target for four seconds. Alternate focusing on the distant and near targets for four second periods throughout the recording.
    - Avoid any voluntary movements of their head or body during the recording. Only the subject's eyes should be moving while focusing on the near or distant targets.
3. Type **C**, for convergence, in the Mark box.
4. As the subject is focusing on the distant target, click on the Record button to begin recording.

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5. After the subject has focused on the distant target for four seconds, click on the Mark button to mark the recording as you instruct the subject to move their focus to the near target for four seconds. Aligning both eyes to focus from a distant target to a near target is known as convergence.
6. Type **D**, for divergence, in the Mark box.
7. After the subject has focused on the near target for four seconds, click on the Mark button to mark the recording as you instruct the subject to move their focus to the distant target for four seconds. Aligning both eyes to focus from a near target to a distant target is known as divergence.
8. After the first cyclic EOG pattern in completed, click on the AutoScale button. **Observe the subject's eyes as the subject moves their focus between the two targets.**
9. The subject should continue to alternate focusing on the distant and the near targets about ten times. During the recording, mark the recording with the letter C to indicate convergence or the letter D to indicate divergence.
10. Click Stop to halt recording when the subject has finished the exercise. Select Save in the File menu.
11. Repeat Steps 4 through 10 while the subject is moving their focus from one target to the other more slowly.
12. Select Save in the File menu.

Figure HM-3-L4: Electroculogram (EOG) of a subject focusing on distant and near targets. Note – the trace may be inverted depending on electrode placement.

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Questions

1. How does the pattern for convergence differ from the pattern for divergence?
2. How does the pattern of the EOG from quick movements between targets compare to the pattern from slow movements between targets?
3. Describe the motion of the subject's eyes while focusing from one target to the other and back.
4. How does the motion of the subject's eyes differ between quick and slow vergences?

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