Experiment HP-13A: The Gaze Cue Paradigm with Eye Tracking

Equipment Required

PC or Mac Computer with 2 monitors (preferable)

IXTA, USB cable, IXTA power supply

EM-220 Event marker

iTRAX – Eye Tracking System

Event Marker Setup

1. Locate the EM-220 event marker.
2. Plug the connector to the EM-220 event marker into the EM1 Channel input on the back of the IXTA.

Figure HP-13A-S1: The IXTA with the EM-220 event marker.

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Eye Tracker Setup

1. Open “External Devices” on the main menu bar.

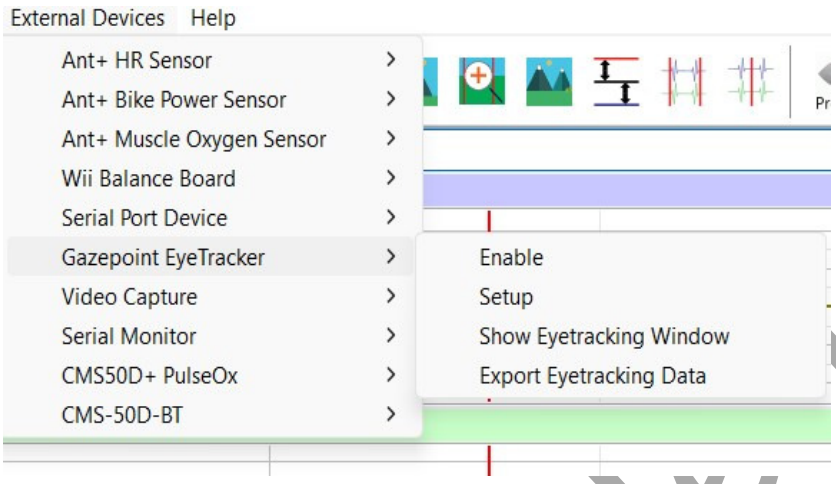

Figure HP-13A-S2: External Devices set up window.

2. Enter the license information provided and set up the parameters for eye tracking and click Setup.
   - **Gaze Duration (msec)**: The amount of time, in msec, before the current time that fixation information will be displayed in the Eye Tracking window.
   - **Outlier Filter (msec)**: The amount of time, in msec, that the eye has to be fixated at a single spot. If the fixation duration is less than the Outlier Filter value, then the fixation will not be displayed in the Eye Tracking window.
   - **Time Offset (msec)**: This can be used to take care of any time offset between the eye tracking data and LabScribe data.
   - **Display Scaling (%)**: The Eye Tracker tracks the complete screen. We want to analyze LabScribe data as well as eye tracking data. Display scaling allows for the eye tracking window to show a scaled version of the screen.
   - **Fixation Size**: The “fixation” data is shown as a circle whose radius is proportional to the fixation duration. The circle size is the radius of the circle in pixels corresponding to a 1 second fixation duration.

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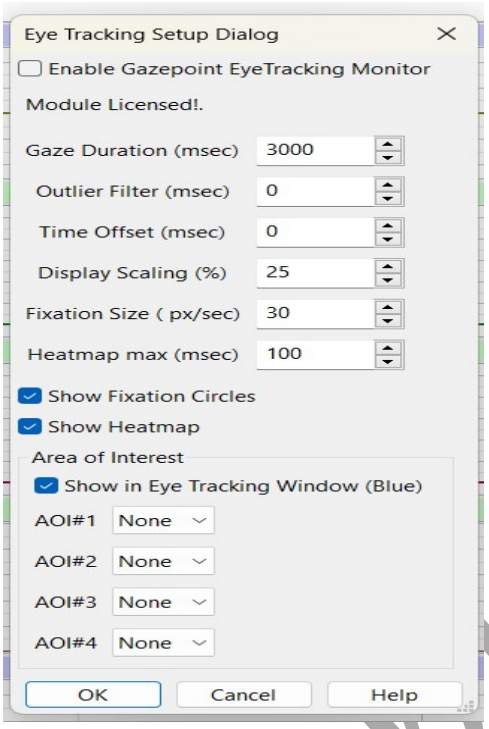

Figure HP-13A-S3: Eye tracking set up dialog window.

3. Set up the Area of Interest (AOI) if there is a specific location on the image you wish the subject to focus on. Note that some experiments will just want to see where the subject is focusing rather than knowing when the subject focuses on the "designated" area.
   - Choose AOI#, click the drop down to have the AOI shown as a circle or rectangle
   - Open the image that the subjects will be looking at in an image editing program such as Paint, Photoshop, Lightroom
   - Hover over the AOI, note the X and Y pixel coordinates – and enter these in the boxes to the right of AOI#
   - When you choose to "Show the EyeTracking Window" - the image the subject is looking at will be shown on one monitor with the AOI in blue. The actual image the subject will be looking at on the second monitor will not show the AOI.

NOTE: If you want to know when the subject looks at a specific location, you must set the AOI.

4. To acquire eye tracking data, the GazePoint module has to be enabled in LabScribe and the GazePoint application has to be running.
5. Calibrate the GazePoint Eye Tracking sensor.

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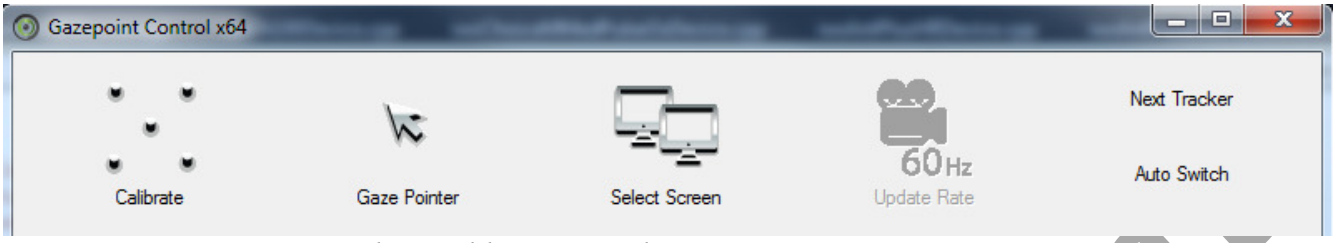

Figure HP-13A-S4: Eye tracking calibration window.

6. Choose the screen that the subject will be using. Then calibrate the Eye Tracker.
7. Refer to the GazePoint manual for more instructions to calibrate the system.
8. The image window in LabScribe should be moved over to a second monitor if using multiple monitors. Note that 2 monitors is preferable in this experiment especially when looking at AOI data.
9. Enable the Eye Tracking window by choosing External Devices → GazePoint Eye Tracker → Show Eye Tracking Window.

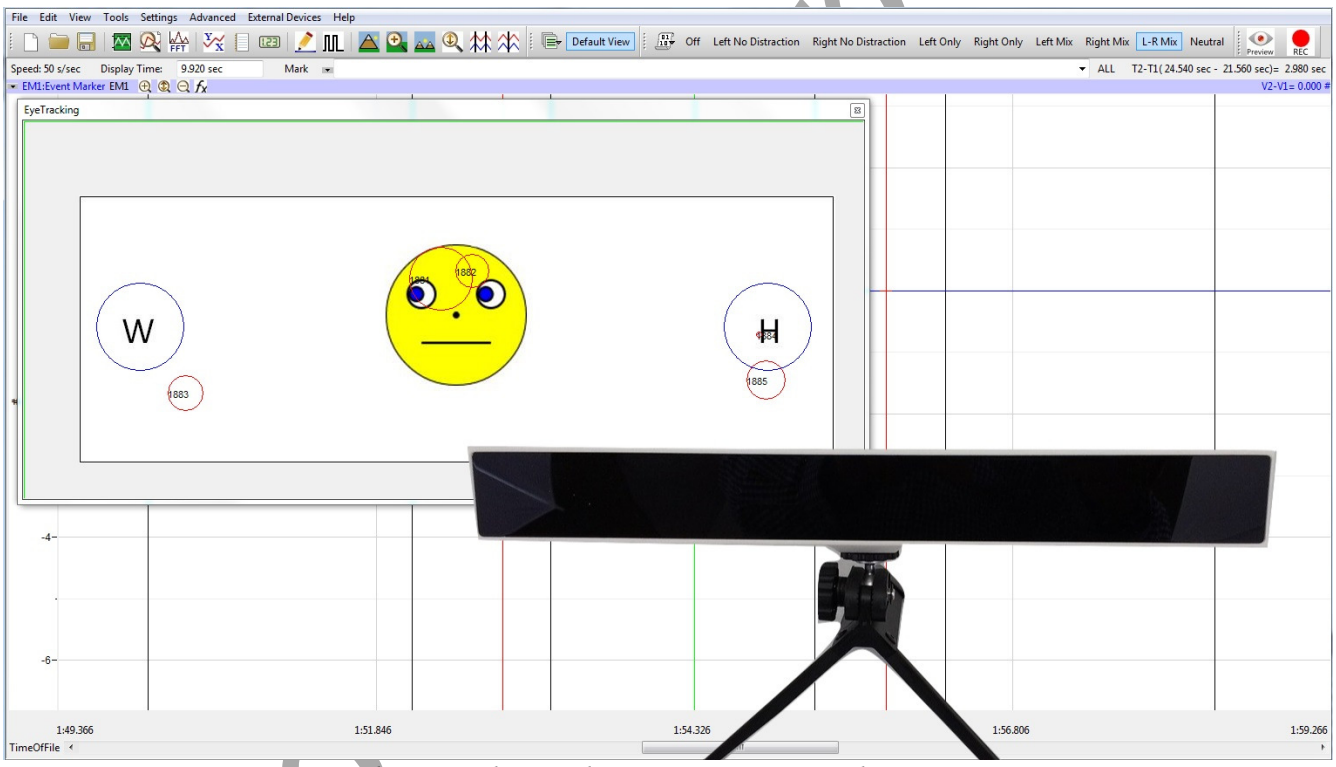

Figure HP-13A-S5: Eye tracking window and GazePoint Eye Tracker.

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Experiment HP-13A: The Gaze Cue Paradigm with Eye Tracking

NOTES:

1. The target letter is always "**H**".
2. The distractor letter is always "**W**".
3. The images will show a simplistic face with the eyes either facing to the:
    - left,
    - center, or
    - right
4. The subject will react ONLY after finding the target letter "**H**", which will either be on the left or the right side of the face.
5. The subject has 2 seconds in which to respond to finding the target letter "**H**". If the target has not been found within that time period, there should be no reaction recorded.
6. The last image will always be blank.

Warning: In this exercise, it is important to press and release the button of the event marker as soon as the target letter "H" is located. Do NOT click the marker if you do not see the letter "H".

Exercise 1: Reaction Time and Predictable Gaze Cues

Aim: To measure the reaction time of a subject to a predictable gaze cue.

Approximate Time: 15 minutes

Procedure

1. Read all instructions carefully before beginning to record.
2. Information for the subject:
    - Instruct the subject to sit in a chair and face the computer screen.
    - Watch the computer screen and look at the center of the image when it pops up.
    - Then quickly press the event marker when the image appears on the screen and the subject has located the target letter **"H**".
3. Type **Left** in the Mark box.
4. Click on the Record button. Click the mark button to mark the recording.
5. Choose ***Left Only*** from the Macros list.

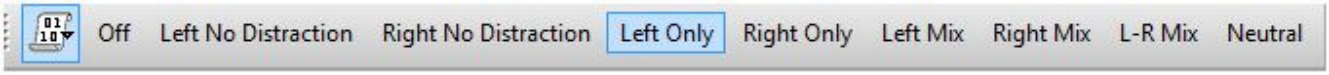

Figure HP-13A-L1: Macros.

6. Instruct the subject to press the event marker as soon as (and only if) he or she locates the letter "H" on the image that appears.
7. Ten images will appear for the subject.

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8. After the tenth image, a blank will image will appear. Click Stop to halt recording.
9. Select Save As in the File menu, type a name for the file. Click on the Save button to save the data file.
10. Repeat the same procedures above, choosing ***Right Only*** from the Sequences list.
11. Click Save to save your data.

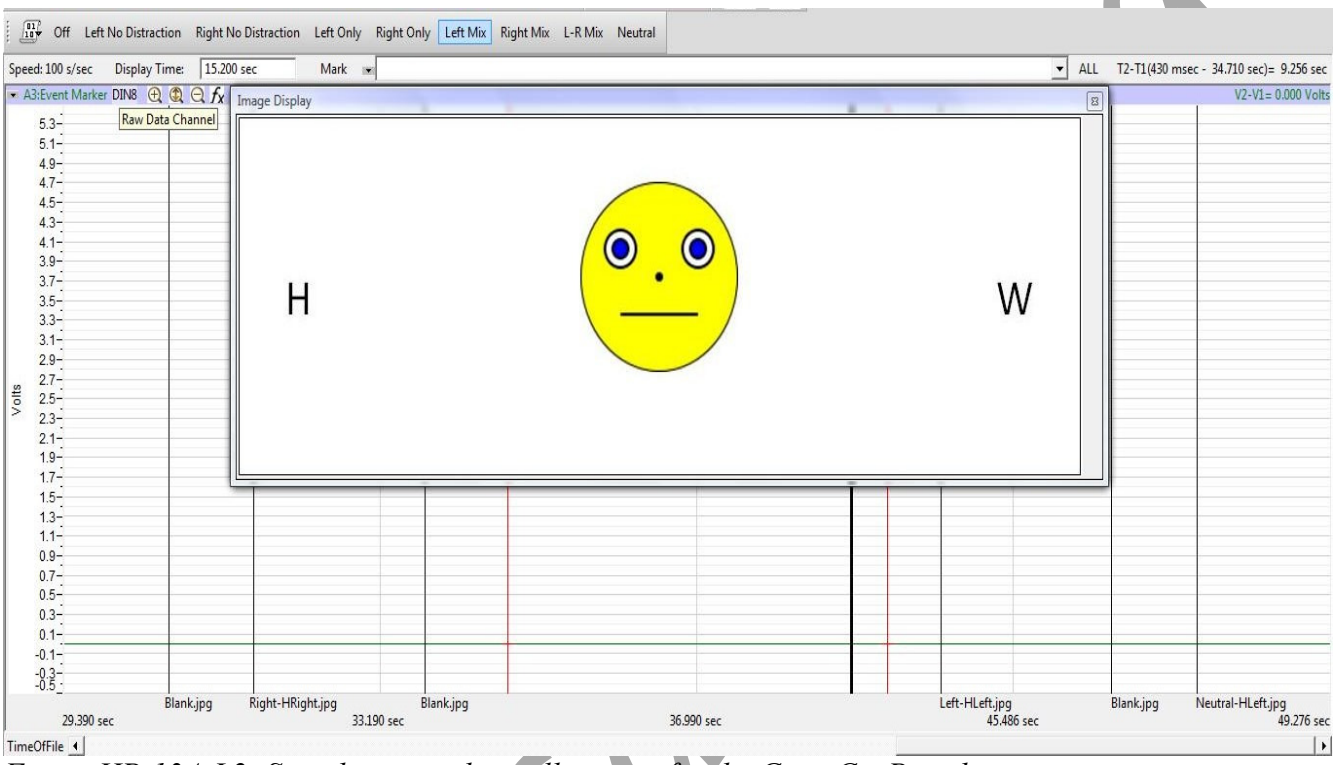

Figure HP-13A-L2: Sample image that will appear for the Gaze-CueParadigm testing.

- *The visual cues are made automatically by the sequences*
- *The "Event Marker" channel shows when the subject clicks the event marker*
- *The "AOI-Left" and "AOI-Right" channels will show when the subject "locked" onto the target letter 'H' on the right or left side of the face*
- *The Velocity channel shows the eye movement velocity as the eye moves to and focuses on the target*
- *The light green line on the screen shows exactly when the specific image was shown.*

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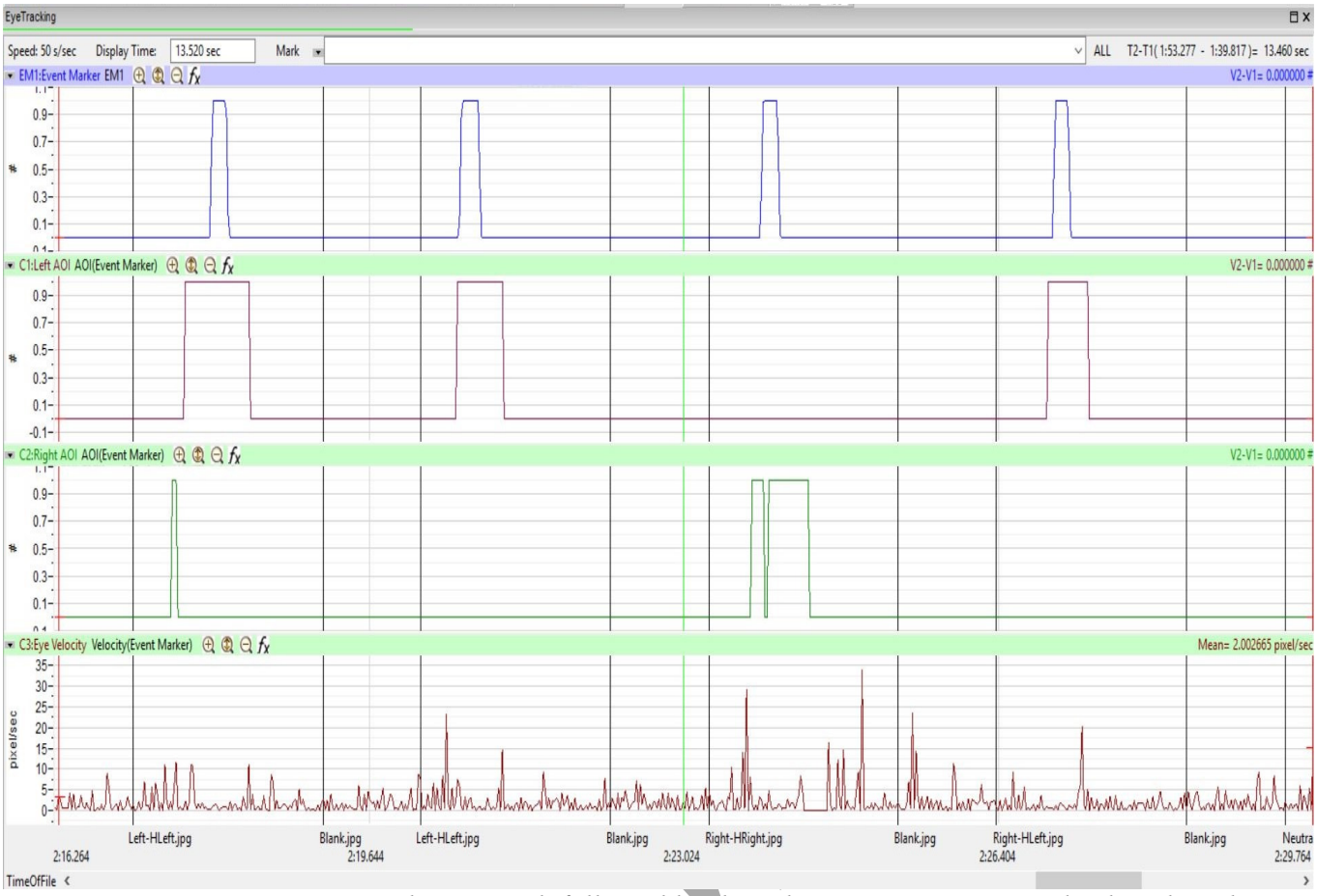

Figure HP-13A-L3: Four visual cues, each followed by the subject's responses, are displayed on the Main window.

Data Analysis

NOTE: Make sure to "Show the Eye-Tracking Window" before starting data analysis.

1. Scroll to the beginning of the data recorded for Exercise 1 to display the first trial on the Main window.
2. Use the Display Time icons to adjust the Display Time of the Main window to show 4 or 5 responses for when the ***Left Only*** macro was running. This data can also be selected by:
    - Placing one cursor before the beginning of the first image cue and the second cursor after the mark made by the 4th or 5th Blank image (mark will state: Blank); and
    - Clicking the Zoom between Cursors button on the LabScribe toolbar to expand the trials to the width of the Main window.

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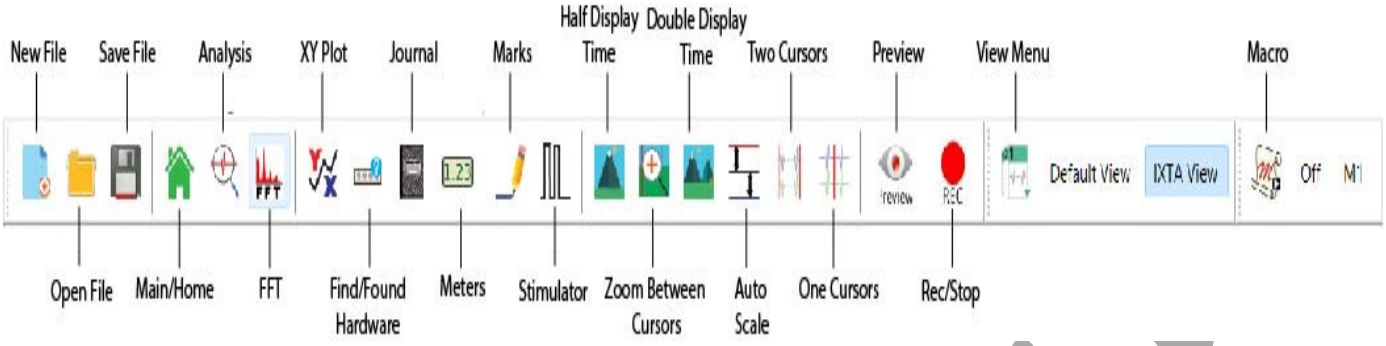

Figure HP-13A-L4: The LabScribe toolbar.

3. Check to see if there is an offset time between the "mark" for the image and the time the actual image was shown.
    - Place one cursor on the mark for any image.
    - Hold the Ctrl key and slowly drag the actual recording window until that image shows up in the Eye-Tracking window. Stop scrolling.
    - Keep the first cursor on the mark and place the second cursor on the green line that shows up when the image is actually displayed.
    - Look at T2-T1 in the upper right corner of the screen – this is your offset time.
        - Click External Devices → Setup
        - Enter the Offset Time. If the green line is to the right of the mark – the offset time is negative. If the green line is to the left of the mark – the time is positive.
        - Click OK
4. Data should be collected from the Main window.
5. The mathematical function T2-T1 should appear on screen. Value T2-T1 is located in the upper right corner of the Main window.
6. Use the mouse to click on and drag a cursor to the onset of the image shown, this will be represented by the vertical green line with an annotation at the bottom. Place the 2nd cursor so that it is on the beginning of the mark generated by the subject using the event marker as a response to factually finding the target letter. The value for T2-T1 is the reaction time.
7. Leave the first cursor on the green line and move the other cursor over to the beginning of the square wave when the AOI was reached. The value for T2-T1 is the time it took the subject to locate the actual image.
8. Leave the one cursor on the beginning of the AOI and move the second cursor to the beginning of the mark generated by the subject using the event marker. The value for T2-T1 is the delay between actually focusing on the target and the reaction by the subject.
9. Once these values for the first trial are measured and recorded, continue to fine the times of the subject for the rest of the specific macro being looked at.

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10. Once the reaction times in all ten trials have been measured and recorded, determine the mean values subject for reaction time, focusing time, and delay. Discard the longest and shortest times from the data set, and determine the average of the remaining reaction times. Record the times for this exercise in Table 1.
11. Repeat these steps on the data for the Right Only macro.

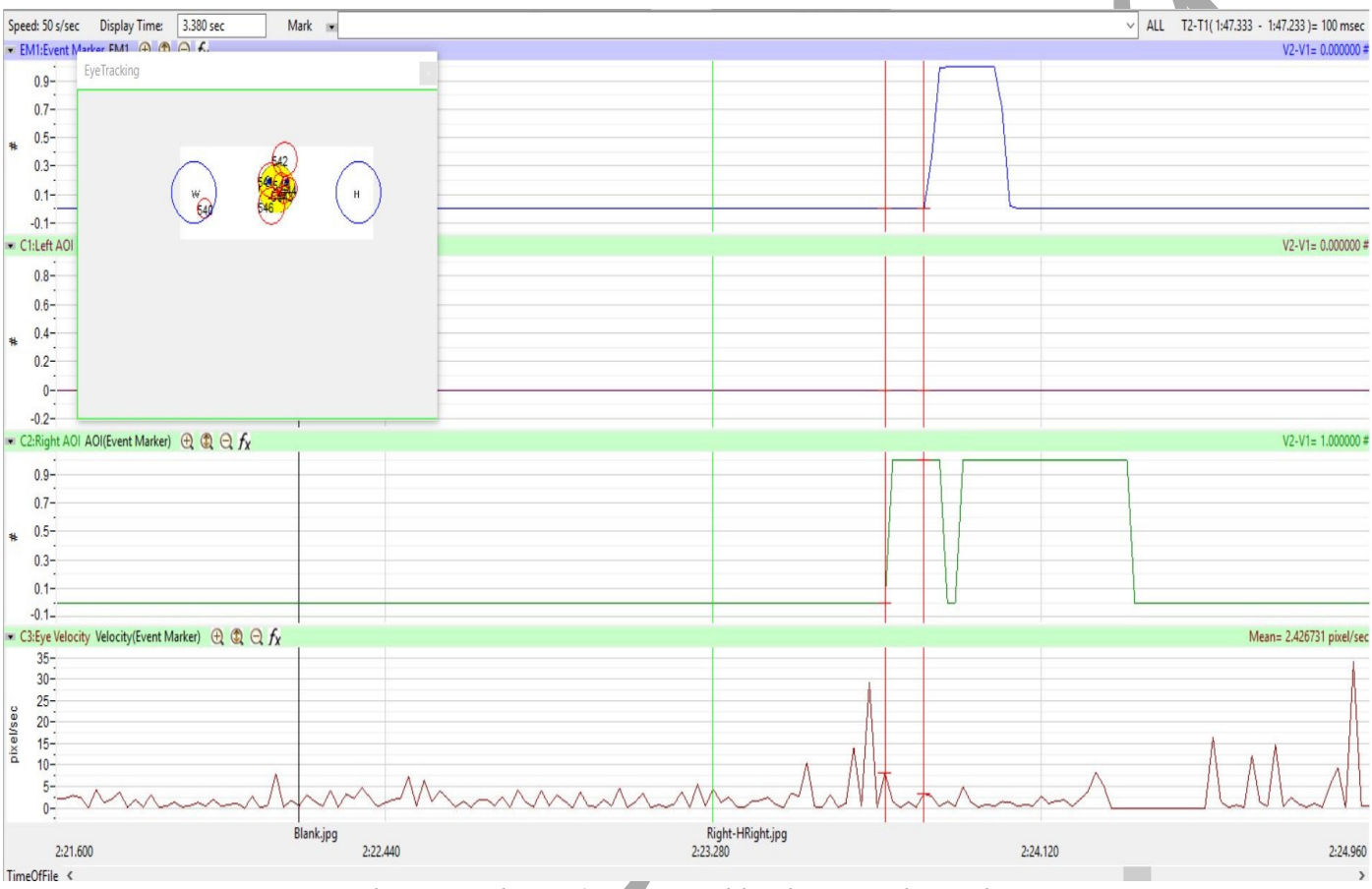

Figure HP-13A-L5: A single image shown (represented by the green line. The two cursors are positioned at the beginning of the AOI and on the mark for when the subject reacted to the image. T2-T1 of 100msec is the delay time for this reaction.

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Table HP-13A-L1: Reaction Times for *Left Only* and *Right Only* Sequences

Eyes Left – H Left Time (msec)			Eyes Right – H Right Time (msec)		
Reaction Time (msec)	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**
MEAN			MEAN		

Exercise 2: Reaction Time and Gaze Cues with No Distractor

Aim: To measure the reaction time of a subject to an image cue that does not contain a distractor letter. Ten images will appear for the subject.

Approximate Time: 15 minutes

Procedure& Data Analysis

1. Follow the directions from Exercise 1, running the ***Left No Distraction*** macro.
2. Click Save to save your data.
3. Repeat this experiment, running the ***Right No Distraction*** macro.
4. Save your data.
5. Use the same technique explained in Exercise 1 to measure and record the times for the subject presented with Gaze Cue images with no distractor letter.
6. Enter the times for this exercise in Table 2.

NOTE: Always check to make sure your subject reacted to the correct target "H". If not, the timing does not count.

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Tables HP-13A-L2: Reaction Times for *Left No Distraction* and *Right No Distraction* Sequences

Left No Distractor								
Eyes Left H Left (msec)			Eyes Neutral H Left (msec)			Eyes Left H Right (msec)		
Reaction Time (msec)	Focus Time (msec)	Delay Time (mec)	Reaction Time (msec)	Focus Time (msec)	Delay Time (mec)	Reaction Time (msec)	Focus Time (msec)	Delay Time (mec)
MEAN			MEAN			MEAN		

Right No Distractor								
Eyes Right H Right (msec)			Eyes Neutral H Right (msec)			Eyes Right H Left (msec)		
Reaction Time (msec)	Focus Time (msec)	Delay Time (mec)	Reaction Time (msec)	Focus Time (msec)	Delay Time (mec)	Reaction Time (msec)	Focus Time (msec)	Delay Time (mec)

Iworx Sample Lab

Right No Distractor							
MEAN			MEAN			MEAN	

Questions

1. How does the subject's mean reaction time to gaze cues when the eyes face left compare to his or her mean reaction time to gaze cues when the eyes face right?
2. What is the mean reaction time when the eyes are in the neutral position? Is there any difference between the neutral position with the "H" on the left or right? If so, which gives a faster reaction time?
3. What would cause a longer reaction time to one type of gaze cue as compared to another?

Exercise 3: Reaction Time and Gaze Cues with Distractors Present

Aim: To measure the reaction time of a subject to a gaze cue where a distractor letter "W" is present. Fifteen images will appear for the subject.

Approximate Time: 15 minutes

Procedure& Data Analysis

1. Follow the directions from Exercises 1 and 2, running the ***Left Mix*** macro.
2. Click Save to save your data.
3. Repeat this experiment, running the ***Neutral*** macro.
4. Save your data.
5. Repeat this experiment, running the ***Right Mix*** macro.
6. Save your data.
7. Use the same technique explained in Exercise 1 to measure and record the times for the subject presented with Gaze Cue images with a distractor letter.
8. Enter the times for this exercise in Table 3.

Questions

1. To what set of gaze cues did your subject respond fastest? Slowest? Why?
2. Did the "Eyes Right-H Left" have a different reaction time than "Eyes Left – H Left"? Why?
3. Did the same hold true for "Eyes Right – H Right" and "Eyes Right – H Left"?
4. What does the position of the image's eyes have to do with reaction time?

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Tables HP-13A-L3: Reaction Times to *Gaze Cues with Distractors Present*

Left Mix								
Eyes Left - H Left (msec)			**Eyes Neutral - H Left (msec)**			**Eyes Right - H Left (msec)**		
Reaction Time (msec)	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**
MEAN			MEAN			MEAN		

Neutral Mix					
Eyes Neutral - H Left (msec)			**Eyes Neutral - H Right (msec)**		
Reaction Time (msec)	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**
MEAN			MEAN		

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Right Mix								
Eyes Right - H Right (msec)			**Eyes Neutral - H Right (msec)**			**Eyes Left - H Right (msec)**		
Reaction Time (msec)	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**
MEAN			MEAN			MEAN		

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Tables HP-13A-L4: Reaction Times to *Left-Right Mix* of Complex Gaze Cues

Left-Right Mix of Gaze Cues with Distractors								
Eyes Left -H Left (msec)			**Eyes Neutral - H Left (msec)**			**Eyes Right - H Right (msec)**		
Reaction Time (msec)	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**
MEAN			MEAN			MEAN		
Eyes Left - H Right (msec)			**Eyes Neutral - H Right (msec)**			**Eyes Right - H Left (msec)**		
Reaction Time (msec)	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**	**Reaction Time (msec)**	**Focus Time (msec)**	**Delay Time (mec)**
MEAN			MEAN			MEAN		

Iworx Sample Lab

Exercise 4: Reaction Time and Complex Mixed Gaze Cues

Aim: To measure the reaction time of a subject to a mix of gaze cues with no predictability. Twenty-five images will appear for the subject.

Approximate Time: 15 minutes

Procedure& Data Analysis

1. Follow the directions from Exercises 1 and 2, running the ***L-R Mix*** macro.
2. Click Save to save your data.
3. Use the same technique explained in Exercise 1 to measure and record the times for the subject presented with Gaze Cue images with a distractor letter.
4. Enter the times for this exercise in Table 4.

Questions

1. To which gaze cue did your subject respond most quickly?
2. To which gaze cue did your subject respond to most slowly? For what reasons?
3. Why do you think one gaze cue is generates a faster response than others?
4. Explain congruency and incongruency with respect to gaze cueing.
5. Did your subject respond more quickly or more slowly to same gaze cue as the other members of the class?

Exercise 5: Hypothesis Testing

Create your own sequences using the images provided or import your own images.

Testing Possibilities: handedness (using 2 event markers); realistic vs. cartoon images; target seeking in complex images (like Finding Waldo); or create your own hypothesis.

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