# Experiment HP-31: Hypothesis Testing using the iTrax Eye Tracker

**This is a Hypothesis Testing lab and is recommended for Senior Research or Capstone projects.**

## Equipment Required

PC or Mac Computer with 2 monitors (preferable)

IXTA, USB cable, IXTA power supply

RPD-320 – Response Pad

iTRAX – Eye Tracking System

optional – EM – Event Marker

## Reponse Pad or Event Marker Setup

1. Locate the Response Pad.
2. Connect the Response Pad into the Digital I/O on the back of the IXTA.


*Figure HP-31-S1: The IXTA with the RPD Response Pad.*

3. Optional - If using the event marker, plug the connector into the EM1 Channel input on the back of the IXTA.


*Figure HP-31-S2: The IXTA with the EM-220 event marker.*

**Eye Tracker Setup**

1. Open "External Devices" on the main menu bar.

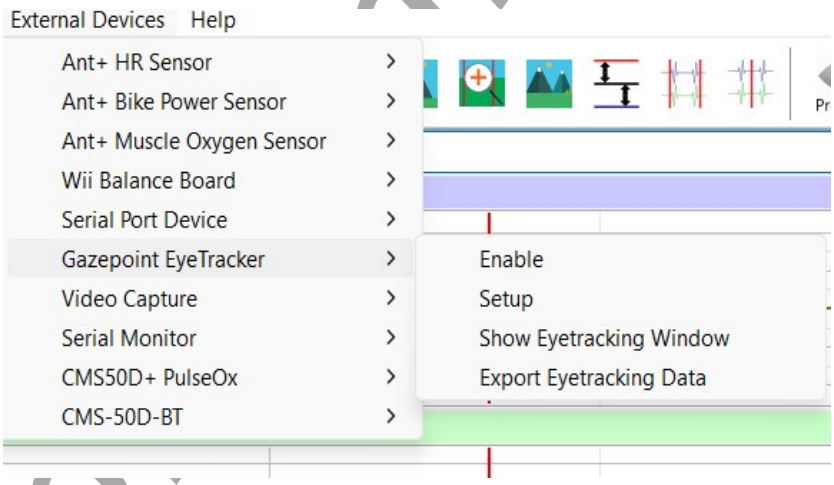


*Figure HP-31-S3: External Devices set up window.*

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.

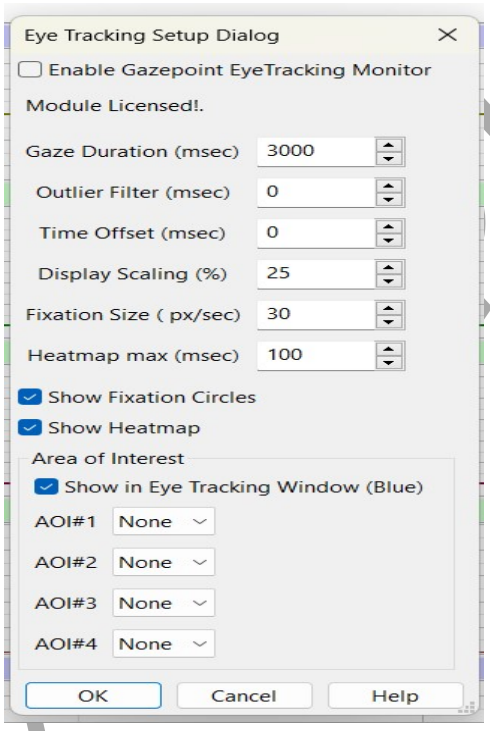


*Figure HP-31-S4: Eye tracking set up dialog window.*

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.

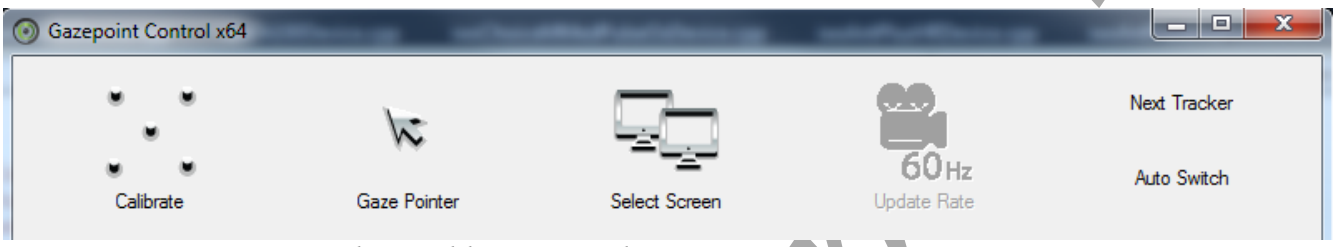


*Figure HP-31-S5: Eye tracking calibration window.*

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.

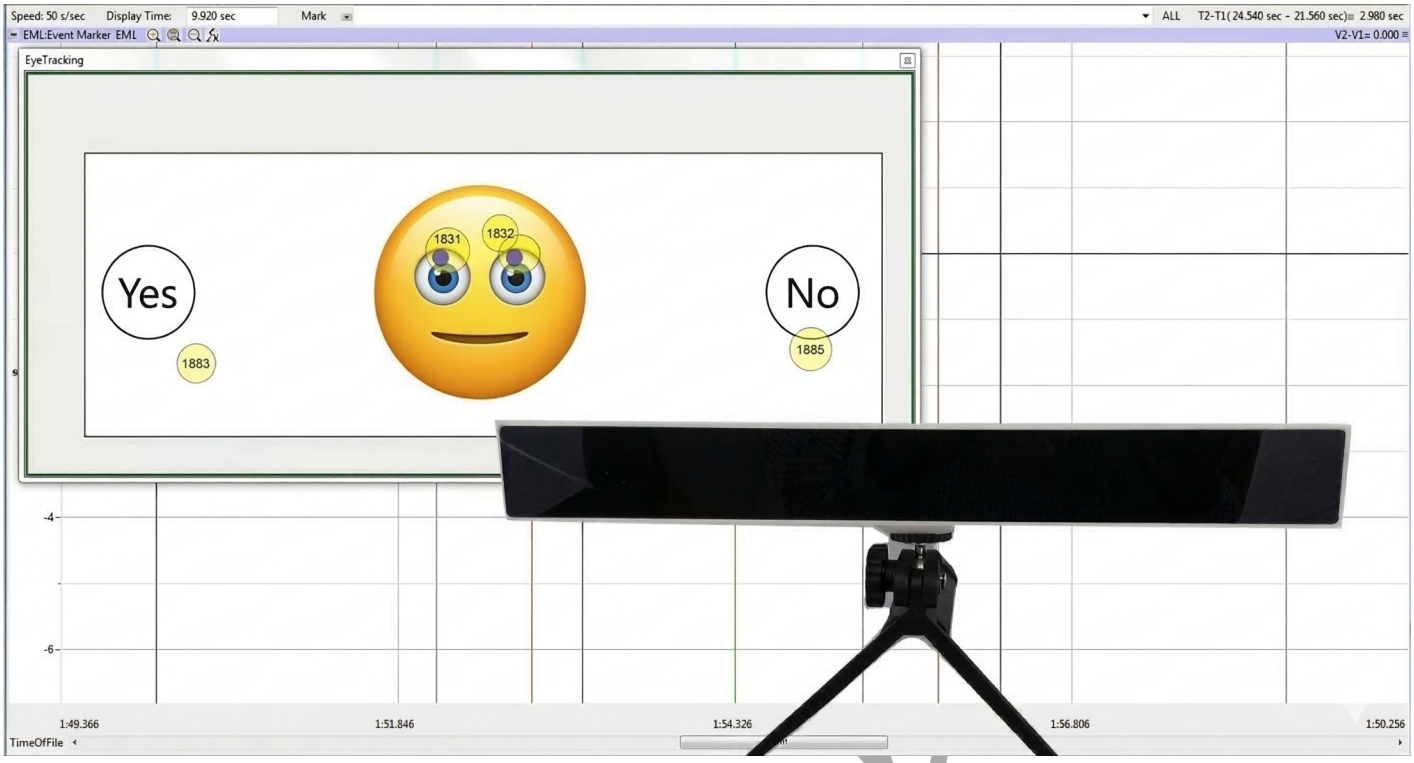


*Figure HP-31-S6: Sample eye tracking window and GazePoint Eye Tracker.*

# Experiment HP-31: Hypothesis Testing using the iTrax Eye Tracker

**This is a Hypothesis Testing lab – directions below are general directions to follow for doing a sample eye tracking experiment. This lab is recommended for Senior Research or Capstone projects.**

## General Information

**NOTE:**

- *The visual cues are made automatically by the macros developed for the hypothesis*
- *The "Response Pad" channel shows when the subject responds to the prompts*
  - *A = Advance to next image or Yes/True*
  - *D = No/False*
- *The "AOI-1", "AOI-2" and "AOI-3" channels will show when the subject "locked" onto the beginning, middle and end of the sentences*
- *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*
- *The F1 key press will allow you to measure the time between when the image was shown (light green line) and when the subject advanced to the question*

## Sample Procedure (50–75 minutes)

### 1. Introduction

- Provide a brief overview of screen-based eye tracking using the Background information
- Present the experimental hypotheses. Examples:
  - "Higher scorers will fixate earlier and longer on diagrams."
  - "Novices will spend more time rereading the text."

### 2. Calibration and Practice

- Calibrate the participant using the calibration routine shown in the SetUp information
- Run 1–2 practice trials so participants understand the task sequence

### 3. Data Collection

- Participants complete the problem set under time constraints and select answers using the response pad or event marker.
- The software records:
  - **Gaze metrics:** time to first fixation per AOI, total dwell time, fixation count
  - **Behavioral data:** accuracy and response time

**4. Quick Analysis and Discussion**

- Export basic metrics for each problem and AOI:
    - Mean time to first fixation
    - Total dwell time – time fixated on the image
    - Number of fixations
- Compare:
    - High- vs low-scoring participants
    - Diagram-heavy vs text-heavy problems
- Display heat maps and discuss what they reveal about attention, strategy, and cognitive load.

**Example Lab**

***Title:*** *Eye Movements in Reading and Comprehension*

***Research Question:*** *How do eye-movement patterns during sentence reading relate to comprehension accuracy and perceived difficulty?*

**Overview of the Task**

- **Participants:** Students enrolled in the course (rotating roles as experimenters and participants).
- **Setup:**
    - Fixed eye tracker
    - Viewing distance ~50–70 cm, minimal head movement
    - Standard keyboard and mouse
- **Stimuli:**
    - 20–30 short sentences or 2–4-line passages
    - Half "easy" (high-frequency words, simple syntax)
    - Half "difficult" (low-frequency words, complex or garden-path structures)
    - One comprehension question after each item (true/false or yes/no)

**Procedure (per participant, ~ 25–30 minutes)**

**1. Consent and Instructions**

- Explain that the study measures **eye movements during reading.**
- Emphasize natural reading pace, minimal head movement, and normal blinking.

**2. Calibration**

- Run a calibration. Repeat if needed.

**3. Practice Trials**

- Present 3–4 practice sentences with comprehension questions.
- Trial flow:
    - Fixation cross → sentence → A on the response pad or the F1 key to advance → question → response pad (A or D) or the event marker action

**4. Experimental Trials**

- Present all sentences in randomized order.
- For each trial:
    - Fixation cross (1.5 sec)
    - Sentence appears; participant reads and presses A on the response pad (F1 key if using the event marker) to advance the screen. If the subject does not press the A or the F1 key within 5 seconds, the screen will advance automatically.
    - Comprehension question appears; participant responds using the response pad or event marker. If the subject does not respond within 5 seconds, the screen will advance automatically.
        - A = Yes or True
        - D = No or False
        - if using the EM = Yes only (there will not be a response for No)
    - These values can be adjusted in the Macros
- Record:
    - Gaze coordinates, fixations, AOI
    - Trial time and accuracy

**Data Analysis**

**1. Global Reading Measures (per sentence)**

- Total reading time
- Number of fixations
- Mean fixation duration

**2. AOI-Level Measures** - Define AOIs (e.g., critical word/phrase vs remainder of sentence):

- First fixation duration on the critical region
- Gaze duration (sum of first-pass fixations before leaving the region)
- Number of regressions into the critical region

**3. Performance Measures**

- Comprehension accuracy – did they answer Yes or No correctly?

**Hypotheses Students Can Test**

Students may preregister hypotheses such as:

- Difficult sentences will produce **longer reading times** and **more fixations**.
- Difficult sentences will elicit **more regressions** and **longer gaze duration** on the critical region.
- Sentences with more regressions and longer gaze duration will show **higher comprehension**, reflecting deeper processing.

**Data Analysis and Write-Up**

In small groups, students will:

- Compute per-participant means for easy vs difficult sentences.
- Conduct paired t-tests or repeated-measures ANOVA on:
    - Total reading time – from the time the image was shown to the press of the A button or the F1 key
    - Fixation count
    - Mean fixation duration, dwell time
    - Gaze duration and regressions
    - Comprehension accuracy – The response pad is pressed using A = Yes/True and D = No/False (or the event marker is pressed only when the answer is Yes/True)
- Create bar graphs with error bars for each measure.
- Include sample heat maps for one easy and one difficult sentence and interpret them relative to their hypotheses