Tips for conducting an eye-tracking experiment

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Contents

1 Before the experiment

If recording or playing audio files, make sure that you select the ASIO driver in the Experiment Builder preferences:
Preferences → Experiment → Devices → Audio → Audio driver.

1.1 Monitor

If you decide to keep the current monitor, go to section 1.2. To change the monitor, follow these steps:

1. Position the monitor on the marked spot.
2. Boot the eye-tracking computer to Windows.
3. Choose the appropriate `.ini` file. The files should be on the Desktop. If the relevant file is missing, a complete realignment of the equipment may be necessary (see section 3 and figure 2).
   - `benq.ini` → BenQ (LCD)
   - `belinea.ini` → Belinea (CRT)
4. Make a copy of the desired file and rename it to `physical.ini`
5. Copy the new `physical.ini` file into the following folder: `D:/elcl/EXE`
6. Re-position the chin rest, if necessary. If the chin rest's lower part has been greatly changed, a realignment of the entire equipment may be required. This will require changing values in the monitor's settings files (`physical.ini`). Consult the installation guide or section 3.
7. Reboot the eye-tracking computer to the eye-link software and boot up the experiment computer.
8. On the experiment computer, select the default monitor.
   (a) Turn on both monitors.
   (b) Click Start → Control Panel/Systemsteuerung → (Appearance and Themes →) Display/Anzeige.
   (c) In the Settings/Einstellungen tab, click on the monitor of your choice and select the box "Use this device as the primary monitor". If this check box in not available when you select the monitor, then that monitor is already the primary one.
   (d) Turn off the other monitor.
9. Check that the screen saver is off or turn it off.

Figure 1: Level positioning of the camera with the lens uncovered.

1.2 Camera

1. Remove the lens cover (see figure 1).
2. Ensure that the camera is working. If it isn't, consult the EyeLink manual or installation guide.
3. Confirm that the camera is in the right position. This is either marked on the table or you need to position it directly in front of the monitor (see figure 2c)
4. Align the camera, making sure that it's level (see figure 1).
5. If necessary, clean the lens. This should be done with a soft and lint-free cloth.
6. Check the image on the experimenter's monitor.

2 During the experiment

2.1 Participant

2.1.1 Dominant eye

Determine the participant's dominant eye. To do that, ask the participant to follow these steps:

1. Extend both hands forward of your body and place the hands together making a small triangle (approximately 1.5 to 2 cm per side) between your thumbs and the first knuckle.

2. With both eyes open, look through the triangle and center something further away, such as a doorknob or a red/green circle, in the triangle.

3. Close the left eye. If the object remains in view, you are right eye dominant.

4. Close the right eye (and open the left one). If closing your right eye keeps the object in view, you are left eye dominant.

Instead of looking through the triangle, you can ask participants to cover the fixation point with their thumb and alternate closing the eyes (steps 3-4 above). The dominant eye is the one where the point is still covered by the thumb.

A useful question is also whether the image moves more on one eye and which image is more in focus. Encourage the participant to trust their instinct.

You can inquire which eye has better vision overall (for participants with corrected vision), through which eye would they look when they're looking through a telescope or shooting a gun. However, these methods are less reliable than the one described above.

2.1.2 Chin rest

Seat the participant and have them adjust the chair. The participant's chin should be on the chin rest and the forehead should always be placed against the forehead rest.

If possible, don't adjust the height of the chin rest but the position of the chair. The data in `physical.ini` and the depth of field are set in accordance with the position of the chin rest.

2.2 Calibration

1. Press `ENTER` to display what the camera is recording or look at the experimenter's screen.

2. Adjust the camera so that the dominant eye is in view. Set the camera to the eye that is being tracked by pressing `R` for "right" and `L` for "left" or click the corresponding buttons.

3. Adjust the focus so that you can see the eye clearly. For this part, the participant should be looking at the center of the screen.

4. Make sure that you can see the pupil and the corneal reflection in all corners of the screen. You can set the thresholds for both pupil and corneal reflection automatically by pressing `A` or clicking on "Auto threshold".

5. Calibrate (`C`). Instruct the participant to fixate the point on the screen. You may choose to auto-calibrate (`A`) or do it manually (`M`). Press the `SPACE BAR` or `ENTER` to start the calibration and accept fixations or click the corresponding buttons. Try to make the points resemble a rectangle. To correct a singular value, press `BACKSPACE`.

6. After calibration, press `ENTER` or click on "Accept" to accept the calibration values. Press `ESC` twice or click on "Abort" to discard them.

7. If the calibration was successful, validate it by pressing `V` or clicking on "Validate"). If the validation is poor, you can try re-calibrating or re-validating again. The participant might need more than one trial to calibrate. With time, performance tends to improve. Alternatively, review the pupil and corneal reflection thresholds.

To troubleshoot calibration, follow these steps:

1. To adjust the *corneal reflection*, ask the participant to look at the four corners of the screen, or choose additional intermediate points if you're worried about the quality of the recording. The corneal reflection should be visible and should not flicker or jump around at any of the points. If it isn't, try the following steps.

   (a) manipulate the illuminator power;

   (b) adjust the corneal reflection threshold (`-` and `+` keys);

   (c) turn the light on or off in the cubicle;

   (d) confirm that the participant is keeping their head properly in the chin rest (see section 2.1.2);

   (e) re-position the camera by moving it left or right, if necessary also a bit closer or further away from the participant (but see figure 2c);

   (f) clean or re-adjust the participant's glasses;

   (g) set a search limit box around the eye (`U` key to toggle them on or off, `SHIFT` and `UP, DOWN, LEFT, RIGHT` to move the search limits, `ALT` and `UP, DOWN, LEFT, RIGHT` to re-size the search limits);

   (h) choose the other eye;

   (i) if the participant brought both glasses and contact lenses, try switching those around;

   (j) if the participant is confident they can read the text or view the images clearly without glasses, remove the glasses;

   (k) switch to centroid pupil tracking.

2. To adjust the *pupil*, use the same steps as listed above. In order to adjust the pupil threshold use the `UP` and `DOWN` keys. Additionally, you might ask the participant to remove eye-makeup. In some cases, especially with people with corrected vision, a clear view of the pupil is impossible.

2.3 Black screen when running the experiment

This can have two common reasons: either the screen saver is on or your experiment has too many display screens and the computer's memory is insuficient to handle them. In

both cases your experiment will be aborted. Make sure that the screen saver is turned off. To counter the memory problem, try one of the following solutions (courtesy of Jiye Shen at SR Research):

1. Break up the whole experiment into several smaller ones and run them separately, given different trial types are used.
2. Consider re-designing the experiment if the event flow of some of the recording sequences is repetitive in structure so that the same DISPLAY_SCREEN action is used over and over. For an experiment that has a 'flat design', with many different display screen action resources, the experiment uses more video memory than an experiment that has many iterations of a sequence but with less different actual screens, even if the same number of images are displayed throughout the experiment.
3. Try running your experiment under a lower screen resolution such as 800*600 and a lower bits-per-pixel value.

If you're using very few display screens and the screen saver is off, try the follwing:

1. Check the "Background Color" setting for all of the DISPLAY_SCREEN actions used in the recording sequence as well as the "Transparency Color" setting in the "DISPLAY Device". Make sure the transparency color is set to a color that is close to (but not identical to) the background colors used in the DISPLAY_SCREENS.
2. Go through all of the DISPLAY_SCREEN actions used in the recording sequence, please make sure the "Prepare Next Display Screen Action" box is unchecked for all of them.

3 Adjusting values in `physical.ini`

`physical.ini` is a file located on the eye-tracking computer in the folder `D:/elcl/EXE`. It contains the following parameters that change depending on your system's physical setup:

- `screen_phys_coords` the physical distance of the four edges of the presentation surface to the center of the screen; the order of these measurements is `left, top, right, bottom` and they are specified in millimeters. The `left` and `bottom` values are negative because they are relative to the center of the screen. In figure 2a, these are the values `A, B, C` and `D`, respectively. The absolute values for `left` = `right` and `top` = `bottom`. The default values are:

  ```
  screen_phys_coords = -188.0, 146.0, 188.0, -146.0
  ```

- `screen_pixel_coords` the resolution of the display surface; this should normally automatically adjust but you can input the values manually. The first two values

are the horizontal and vertical point on the screen where the top left corner of the screen should start. The last two values are the resolution of the monitor. The resolution is monitor-dependent. The default values are:

`screen_pixel_coords = 0.0, 0.0, 1024.0, 768.0`

- `screen_distance` the distance to the top and bottom of the display surface from the participant's eye, respectively. In figure 2b, these are the values `E` and `F`, respectively. The default values are:

  `screen_distance = 600 660`

Every time you change the physical setup of the system, you should check and change these values. If you are only moving the chin rest to a different monitor which has not been moved, you don't need to re-measure everything. See section 1.1.

4 Keyboard shortcuts

General shortcuts

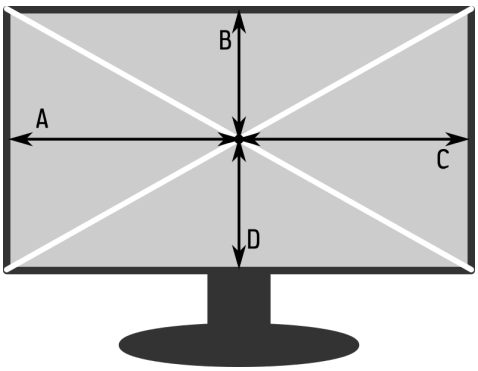
Key	Description
`CNTR + C`	close program

During calibration set-up

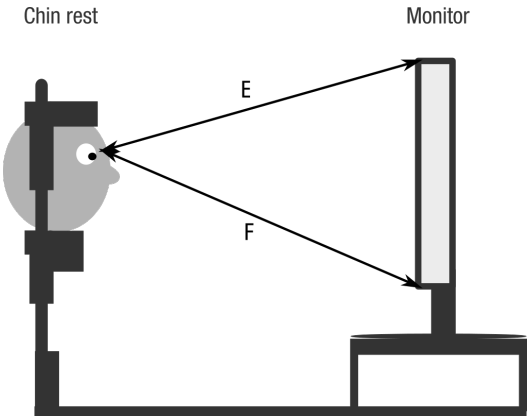
Key	Description
`-, +`	adjust corneal reflection threshold
`A`	auto adjust threshold
`ALT+{UP, DOWN, LEFT, RIGHT}`	re-size the search limits
`C`	start calibration
`ENTER`	transfer image from the experimenter's screen onto the stimulus presentation screen
`ESC`	start experiment, end setup
`R, L`	select right or left eye
`RIGHT`	toggle zoom on face or eye
`SHIFT+{UP, DOWN, LEFT, RIGHT}`	move the search limits
`U`	toggle search limits
`UP, DOWN`	adjust pupil threshold

During calibration

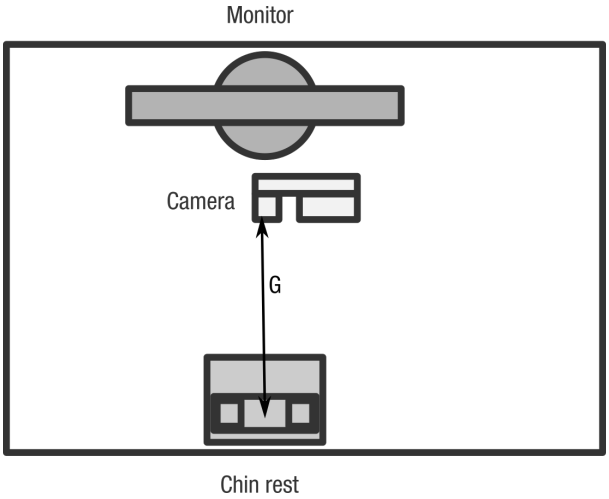
Key	Description
`A`	auto-calibration
`BACKSPACE`	re-calibrate the previous fixation point
`ENTER, SPACE BAR`	accept fixation
`M`	manual calibration
`V`	start validation



(a) Edges of screen to center of screen settings for `screen_phys_coords`.



(b) Eyes to monitor distance values for `screen_distance`.



(c) Distance between the camera and chin rest. Recommended value for `G` is 50–55 cm, but anything between 40 and 70 cm is OK.

Figure 2: Measurements of the equipment in the eye-tracking lab, including the values necessary for the setup in `physical.ini`.