

University of Bristol Tobacco and Alcohol Research Group
Standard Operating Procedures

SOP – 26
Using the EyeLink 1000 Plus

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WRITTEN/REVIEWED BY	Print Name	Olivia Maynard										
	Position	Research Associate										
	Signature											
	Date (dd/mm/yyyy)	1	0	/	1	2	/	2	0	1	5	

APPROVED BY	Print Name	Angela Attwood										
	Position	Research Fellow										
	Signature											
	Date (dd/mm/yyyy)	1	0	/	1	2	/	2	0	1	5	

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REVIEWED BY	Print Name	Olivia Maynard										
	Position	Lecturer										
	Signature											
	Date (dd/mm/yyyy)	1	3	/	0	2	/	2	0	2	0	

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1. PURPOSE

To provide guidance on using the EyeLink 1000 Plus.

2. PERSONNEL REQUIRED AND LEVEL OF EXPERTISE

- Investigator who has already received training on how to use the Eyelink system.

3. MATERIALS AND EQUIPMENT REQUIRED

- Note that these are the instructions on running the EyeLink 1000 Plus located in test room 5 on the 5th floor of the Experimental Psychology building. Other machines vary and the operating procedure will be different.
- This SOP assumes that you have a script in MATLAB with the necessary code to run an eye tracking experiment, (although note that you can also use the Eyelink software to run your experiment).
- Run using MATLAB.

4. PROCEDURE

4.1. Before eye tracking

- Ask the owner of the lab and eye-tracker (Marcus Munafò, Olivia Maynard) if the equipment and lab space can be used for the duration of your experiment
- Use the lab's calendar to book the lab space prior to use
- Obtain written consent from participants
- Explain the task to participants

4.2. Turn on computers and prepare for eye tracking.

- Turn on the stimulus computer (desktop computer) and eye tracker computer (desktop computer). The logon information for the stimulus desktop is as follows: Username: 'eyelink', please contact Olivia Maynard for password. To access the other desktop computer (eye tracker computer), turn it on, there is no password or login information required.
- The Eyelink system on the Eyelink computer should run for 5 minutes after switching on power to the desktop (stimulus) computer before starting eye tracking.
- Load MATLAB on the desktop computer (stimulus computer) and load directory with your script, run script including necessary parameters for eye tracking.

4.3. Setting up the eye tracker

- Ensure the participant is sitting comfortably at the correct distance from the screen (57cm). The swivel chair can be moved, but the chin rest cannot. Place a piece of tape on the chin rest before the participant rests on it.
- Line up the EyeLink 1000 Plus with the 4 dots on the desk and ensure the desk is pushed into the corner with other desks. Place the chin rest onto the edge of the desk (in front of the keyboard), ensuring it is correctly aligned with the 2 dots, then screw into place. Ask the participant to put their head into the chin rest with their forehead at the front most part of the forehead support. Tell the participant they may move the swivel chair up or down if necessary. Ensure the participant is comfortable.

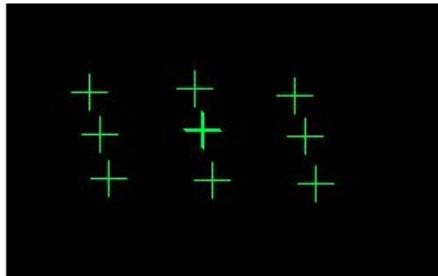
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- Turn the light off in the room and allow the participant time to adapt to the light. Ensure that the light is off for at least one minute before starting the calibration.
- Select the eye you wish to track (usually the participant's left eye, unless this cannot be tracked) by clicking the left eye button near the bottom of the screen.
- Click on the participant's eye on the main image (the one showing whole head). If it is not focused, the camera's focus can be altered by rotating the lens focusing ring. Turn the lens by placing your thumb on the bottom of the lens and turning the focusing ring by sliding your index finger along the top of the focusing ring.
- Press the 'Auto threshold' button on the Eyelink computer screen. The participant's pupil should be coloured in blue on the image on the Eyelink computer screen and as little as possible of the remainder of the eye or eyelid/lash should be blue. If participants are wearing eye makeup this can make the eyelashes show up as blue, which would degrade the signal. Ask participants to remove eye makeup in this case. The threshold (amount of blue) can be altered manually by pressing the up and down arrows on screen in the 'Pupil' box. Aim for the entire pupil to be blue, but nothing else.
- At this point, there are two modes of tracking that can be used: Pupil only and Pupil-CR (corneal reflection). If present, this reflection will appear as a yellow dot towards the top of the pupil surrounded by a white crosshair. The threshold for the CR can be automatically set and altered manually by pressing the up and down arrows on screen.
- Ask the participant to look along the edges of the computer screen. This will show if the threshold has been set correctly, if it is too high, more blue will appear (e.g. in corner of eye or on eyelashes), and the threshold will need to be decreased as above. If the threshold is set too low, the pupil will not be entirely filled with blue as it moves around, and the threshold will need to be increased. Ensure that whilst the participant is looking around the screen, the message underneath the small image of the eye you are tracking is green and says 'PUPIL OK' at all times. Rearrange camera if not. If in Pupil-CR mode, ensure the yellow dot and crosshairs are visible at all times. Note that corneal reflection will not be stable with all participants, in which case Pupil only mode should be used.

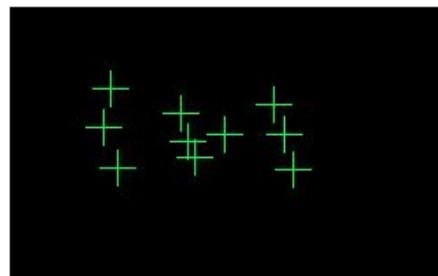
4.4. Running the calibration

- When happy with the position of the camera, run the calibration (ensure that you have informed the participant of what this will involve). This can be run on both eyes which allows the program to automatically select which eye to track based on which had the best calibration. Alternatively, one eye can be chosen to track by locking the other out. These options can be chosen in the Eye to Track section of the camera setup screen.
- To begin the calibration, press either the 'Calibration' button on the laptop screen, or press 'c' on the keyboard.
- A 9 point calibration is usually run, but this can be changed by pressing the 'Set Options' button and changing to the desired size calibration.
- When the participant is fixating on the cross on their computer screen, the box in the bottom right corner of the laptop screen will turn green and will say 'Stable'. Press the spacebar (quietly) when you are sure they are looking at the cross, cross-validate the box in the bottom right hand corner and the position of their pupil as compared with the position of the cross as shown on the laptop screen. Repeat for all 9 fixation points.
- If this is a good calibration (the 9 points will be in a relatively evenly spaced 3x3 rectangle, run the validation by pressing either the 'Validation' button or 'v' on the keyboard. If it is a poor calibration, press the 'Abort' button and re-run the calibration. For the validation, again, press the spacebar when participants are fixating the crosses.

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Good Calibration



Poor Calibration

- Once this is complete, the Eyelink computer screen will display the error scores for each of these points. The mean error score, as reported in the light green box at the bottom of the screen (this box will be red if it is a particularly bad calibration) should be less than 0.4. This is measured in degrees of visual angle, and, if the participant is sat 57cm from the computer screen, means that you can assess where they are looking with an accuracy of 4 mm.
- If the error score is 0.4 or below, press 'Accept'. This will return you to the 'Camera Setup' screen. When ready to start the task, press 'Esc' on the eyelink computer keyboard.
- If the error score is above 0.4, press 'Restart'. This will take you to the Validation screen; if only the validation was poor, then only re-run this. If the calibration was also poor, press 'Abort', and press 'Calibrate' again.
- The calibration can sometimes take a long time, be patient and allow the participant a break if it is taking a very long time. If it takes over 10 minutes, it is unlikely that it will work and the participant will not be able to participate. You should have a procedure to deal with this scenario regarding compensation. It is a good idea to write in the information sheet that it is difficult to track the eyes of some participants and if it does not work for a participant, then they will be reimbursed with £X amount (or whatever the procedure is).
- Tips for a good calibration:
 - Remind participants that they should fixate directly in the centre of the fixation cross and not anticipate the next cross appearing.
 - During the calibration, pressing the backspace button will erase the previous point collected and re-run it if it is bad. This is especially useful for participants for whom it is difficult to calibrate.
 - Participant must keep as still as possible and not move after the calibration/validation is complete.

4.5. Drift correct during the task

- If your code has drift correction between trials (a good idea if it is a long experiment, or if you want to make sure the participant is looking at the centre of the screen at the beginning of each trial) you will need to watch their eye movements on the Eyelink computer screen when the drift correct cross appears between trials and press the spacebar when they are fixating this point.
- It is important to ensure that the participant is looking at the cross when you press the spacebar. Once you've pressed the spacebar, for a second afterwards, an image of the location of the participant's fixation alongside the location of the fixation cross will appear on the Eyelink computer screen. If the centre of the participant's fixation does not overlap with any of the fixation cross, then you should consider rerunning the calibration. This should be avoided if possible and can be, by ensuring a good calibration to start with. To rerun the calibration during the task, press the 'Setup camera' button on the Eyelink computer screen and run the calibration and validation routines as previously. The experiment will then recommence where it left off.

4.6. Finishing eye tracking

- Tell the participant that they can remove their head from the chin rest, then turn the lights on and unscrew the chin rest from the table to allow for the next section of your study (if there is other sections)

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- Shut down the Eyelink computer by pressing the 'shutdown host' button, if this does not appear press the 'exit Eyelink' button first
- Remove the tape from the chin rest.
- There is no virus software on the computer. Ensure that any USB sticks put into the computer are 'clean' and have been checked using a computer with virus checking software.
- The data needs to be backed up after every participant.
- The amount of space on the Eyelink computer needs to be regularly checked.

4.7. General eye tracking tips

- Participants should remove dark eye makeup. It is good practice to keep eye makeup remover pads (and ideally a mirror) in the lab.
- Eye tracking participants with glasses is difficult and sometimes impossible. Wearing glasses can be an exclusion criterion for an eye tracking study. Participants may wear contact lenses.
- Eye tracking should be conducted in a dark lab. Participants can also get drowsy doing eye tracking. If necessary, use a fan during the experiment and leave the window open before and after the experiment, although close it during eye-tracking. During testing, put the sign saying 'Testing in Progress' on the outside of the door.
- The participant should be reminded not to move (or talk) throughout the experiment, including during the calibration.
- As the experimenter, although you will be operating the eye tracking computer during the task (if doing drift correct), do not distract the participant. Do not make loud noises, do not tap the keyboard too loudly, do not drum your fingers, do not do anything which might elicit the participant to speak unnecessarily etc., as this can move their eye position.
- More information on the EyeLink 1000 Plus can be found in the manual located in Test room 7, 5th floor in the School of Experimental Psychology.

4.8. Eye tracking analysis

- Eye tracking data will be saved as an .edf file in MATLAB. You will need to convert these files to .asc files before analysing the data. You will need to download an edf2asc converter file to do this.
- Dr Casimir Ludwig has created a wiki page which describes how to extract this data
<http://casiwiki.pbworks.com/w/page/15355613/Analysing%20data>

5. TROUBLE SHOOTING

Problem	Solution
Any problems	TARG Laboratory phone: 07957334265 Olivia Maynard (0117) 92 89943 internal 89943 Olivia.Maynard@bristol.ac.uk