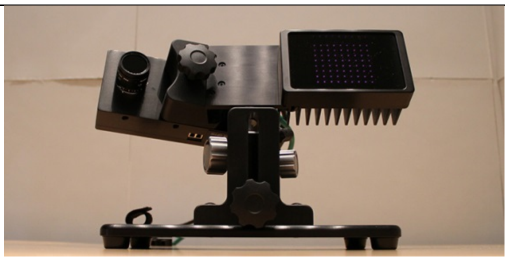
EyeLink 1000 plus eye tracking system

This manual is to provide information to work with the SR Research EyeLink 1000 plus eye tracking system in Aalto Behavioral Laboratory (ABL). Further helpful information can be found from the Eye the EyeLink1000 User manual and from the SR Research Support Sites (you have to register!). There you can also find a forum example experiments and download the documents and software packages. https://www.sr-support.com/

1 System setup

This chapter explains the EyeLink 1000 setup and the basic settings needed to run the experiment.

1.1) Components

Component	Image, details
Eye Link 1000 plus, Core unit, PC. Software version 5.04	 ID: CLG-BBE18
Eye Link 1000 plus camera 50 mm lens IR- illuminator (Shielded room, DC)	 serial # BBE18
Optical Ethernet Eye Link camera (Control room)	 Model: MC200CM S/N: 2149159000996

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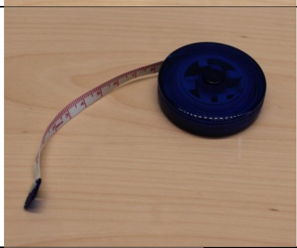
Optical Ethernet Eye Link camera (Shielded room, DC)	 Model: MC200CM S/N: 2146260001456
Sticker markers (AC-Shelf, Control Room)	
Tape measure (AC-Shelf, Control Room)	
Camera lens (35mm) (AC-Shelf, Control Room)	

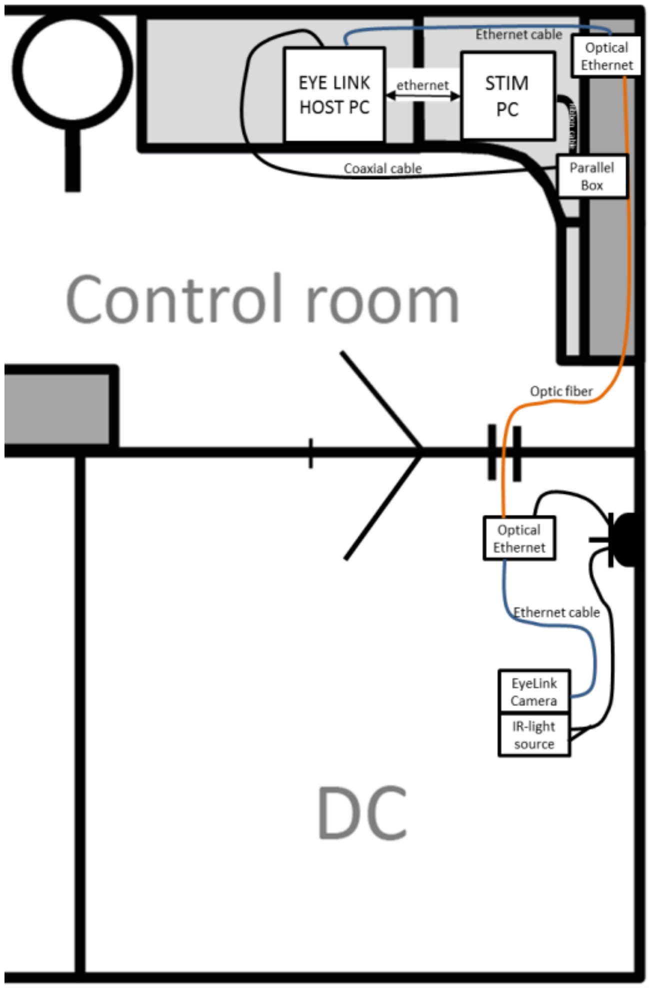
1.2) Wiring of the Eye Link system

The Eye Tracker is installed in the ABL. This means that all eye tracking components are installed and fixed to their place. Still one should make sure before experiment that everything is connected and the proper settings are set.

The following connections are connected when the system is normally set. When in trouble, first check the following:

- Ethernet cable is connected between the “Eye Link host PC” and “Optical Ethernet” (Control room)
- Ethernet cable is connected between the “Optical Ethernet” and Eye Link Camera (Shielded room)
- Optic fiber is connected between the “Optical receiver” and between “the Optical transmitter” (Control and Shielded room)

- All the power cables are plugged in, including:
    - Eye Link PC
    - Eye Link Monitor
    - Optical Ethernet (Control room)
    - Optical Ethernet (Shielded room, DC)
    - Eye Link camera & illuminator
- Blue cross wired Ethernet cable is connected: other end to the Eye Link PC and the other to the PCI-Ethernet card on the Stimulus PC.



1.3) Stimulus PC

The system includes an Ethernet connection between the Stimulus PC and Host PC. Ethernet cable should be connected (blue cross wired cable) between the computers and the following settings set for the Ethernet card of the stimulus PC settings. Name of the connection is “EyeLink 1000 plus”:

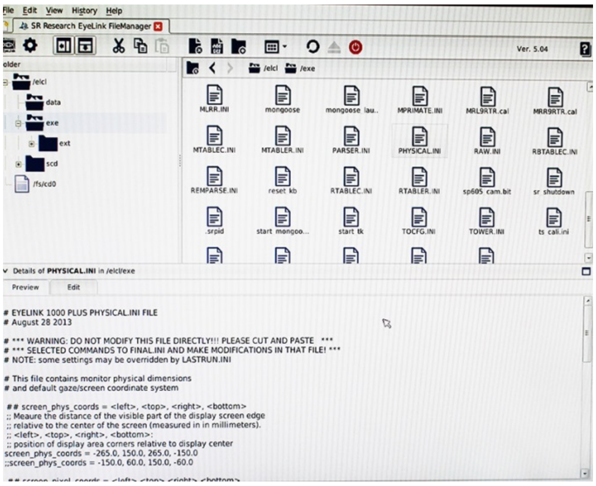
EyeLink 1000 plus IP - 100.1.1.2 Subnet mask 255.255.255.0

1.4) Host PC

Eye Link Host PC controls the eye tracker and includes the Eye Link software.

Check out the system settings before measuring. The detailed system settings are defined the INI-files, which can be found under the c:\elcl\exe directory on Eye Link PC.

You can explore the files from “SR Research EyeLink FileManager” window, by exiting EyeLink software, or by starting the Eye Link Host PC (and choosing “EyeLink”) without eye tracker turned on.



NOTICE: You can also set some parameters of INI-files remotely from presentation software from a stimulus PC. Parameters which are altered remotely won't change the INI-files permanently.

PHYSICAL.INI The file contains the physical characteristics of the setup. Measure the current parameters of your setup and fill the details. The physical measures = the screen sizes of the stimulus monitor.

NOTICE: the measures below are fixed to default settings of stimulus monitor inside the shielded room, so please return the original settings after your measurements.

1.4.1 The default settings:

```
screen_phys_coords = -265.0, 150.0, 265.0, -150.0
 ;;millimeters from the center of the screen(left, top, right, bottom)

 screen_pixel_coords = 0.0, 0.0, 1920.0, 1080.0
 ;;pixel coordinates on the edge of the screen (left, top, right, bottom).
 ;;If you are using a different resolution in your presentation than
 ;;the native resolution of the stimulus PC monitor, you need to change
 ;;these values accordingly.

 screen_distance = 850 800
 ;;distance from the eye to the top and to the bottom of the screen
 ;;in millimeters. These values are calculated from eye to the screen
```

```
;;via mirror. Noticed that the value varies a little bit between persons,
;;depending on the location of the subjects eyes. Still these default
;;values are quite good estimate of the situation in general.
```

It's important that these parameters are properly set, though they'll effect on fixation and saccade detection. For more details, see EL1000_InstallationGuide, 8.4 Customizing Your PHYSICAL.INI

FINAL.INI
Final.ini file overrides the parameters wrote in other ini-files. It's recommended to make the changes to this final.ini files, not to the default one.

Parallel port is set in the host PC on default, so the parallel interface works automatically. If you want to use parallel triggers, check that the following lines are in the final.ini file.

```
write_ioport 0x37A 0x20 ;; enables the bidirectional function for
                        ;; the current parallel port
input_data_ports 0x378 ;; set the input ports to the data register
```

1.5) Mouse stimulation mode

Mouse simulation mode can be used instead of real subject when testing the system. Mouse simulation mode is identical to the camera mode, but instead of eye coordinates, the system records mouse coordinates. Mouse simulation mode can be switched on from the setup window by clicking "mouse simulation" button.

Notice that the camera needs to be on when starting the EyeLink software even though you are planning to use only "mouse simulation" -mode. The reason is that the EyeLink - software won't start unless the camera is connected and powered.

Work around: start the Eye Link software from start menu with command "t -x".

1.6) Data transfer

You can move data files via Ethernet cable with a GetFile.exe -program from Host PC to Stimulus PC.

Also you can use USB memory sticks in "SR Research Eye Link file manager". NOTICE: USB-port on the front side of the Host PC doesn't work when using the file manager, but only in Windows. Again, you don't' have any access to EyeLink data files from Windows.

2 Eye Link Software

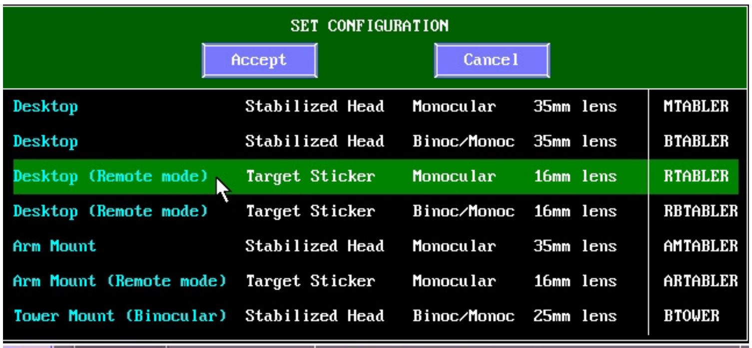
When starting the EyeLink Host PC, a boot manager will appear, where you can choose to launch either Eye Link software or Windows. When choosing the "Eye Link", EyeLink software is automatically launched. Notice that the Eye tracking camera needs to be powered before launching the software.

Software opens in “camera setup screen”. By pressing “Set options” button on the right, you advance to the “Set options screen”. There you can set several settings, including Eye Tracker Mode settings.

2.1.1 Eye Tracker mode

Select correct Eye Tracker Mode configuration by clicking “Select Config..”. You can choose whether you track monocular or binocular. Otherwise there are basically two options to choose, when using the Eye Link 1000 plus in ABL:

a) “Desktop (Remote option) Target Sticker”. Subjects can move relatively freely on front of the camera; it works at 500Hz with the sticker marker attached on the forehead.

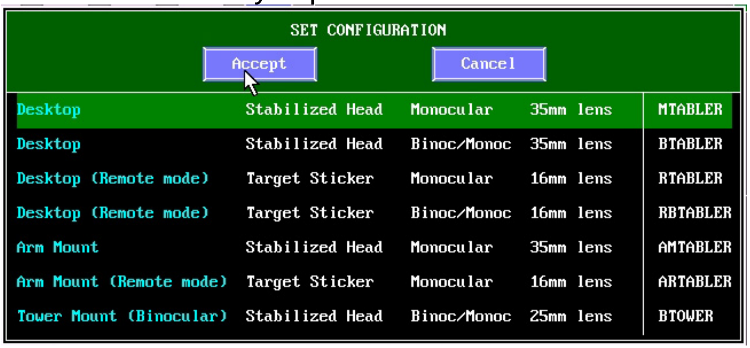


SET CONFIGURATION

Accept Cancel

Desktop	Stabilized Head	Monocular	35mm lens	MTABLER
Desktop	Stabilized Head	Binoc/Monoc	35mm lens	BTABLER
Desktop (Remote mode)	Target Sticker	Monocular	16mm lens	RTABLER
Desktop (Remote mode)	Target Sticker	Binoc/Monoc	16mm lens	RBTABLER
Arm Mount	Stabilized Head	Monocular	35mm lens	AMTABLER
Arm Mount (Remote mode)	Target Sticker	Monocular	16mm lens	ARTABLER
Tower Mount (Binocular)	Stabilized Head	Binoc/Monoc	25mm lens	BTOWER

b) Desktop Stabilized Head. Use this mode with the chinrest (+forehead rest). It's possible to record monocular eye up to 2000Hz



SET CONFIGURATION

Accept Cancel

Desktop	Stabilized Head	Monocular	35mm lens	MTABLER
Desktop	Stabilized Head	Binoc/Monoc	35mm lens	BTABLER
Desktop (Remote mode)	Target Sticker	Monocular	16mm lens	RTABLER
Desktop (Remote mode)	Target Sticker	Binoc/Monoc	16mm lens	RBTABLER
Arm Mount	Stabilized Head	Monocular	35mm lens	AMTABLER
Arm Mount (Remote mode)	Target Sticker	Monocular	16mm lens	ARTABLER
Tower Mount (Binocular)	Stabilized Head	Binoc/Monoc	25mm lens	BTOWER

2.1.2 Sticker marker

To be able to use the remote option, eye tracker needs an extra reference point. Sticker marker is attached to the middle of the forehead, where it's straight and visible for the camera.

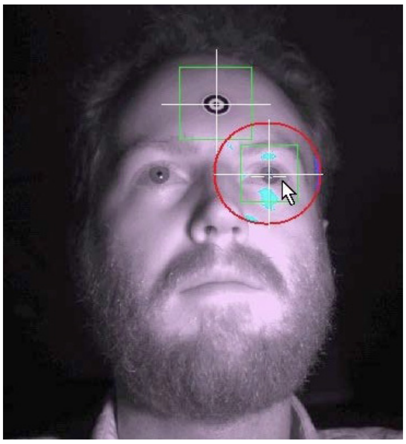


Image from EyeLink User manual, where subject is wearing a target marker in the forehead.

3 Stimulus PC

A separate stimulus PC is needed for the stimulus presentation. The stimulus PC is also used for showing the eye image when adjusting camera.

Stimulus PC is connected to the host PC with a cross wired Ethernet cable (blue).

There are few software which are already installed in the ABL:

3.1) Experiment Builder

The Experiment Builder is a visual experiment creation tool for use with the EyeLink eye tracker made by SR Research. While a primary goal of the Experiment Builder has been to create EyeLink experiments; the Experiment Builder can also be used to create non EyeLink experiments that do not need eye tracking functionality.

3.2) Presentation software

There are two provided ways to communicate with Presentation software with the EyeLink eye tracker in ABL.

- PCL code with (PresLink or Prexel) using Ethernet connection
- TTL- triggers using parallel port

You can combine these two methods to get the benefits from each. If you like to have a flexible remote connection to Host PC and also include TTL triggering, you can use PresLink interface for calibration, start tracking and such. As an addition; use the port_code triggers in PCL for precise TTL synchronization.

3.2.1 PresLink -extension

For controlling the Eye Link Host PC remotely from the Presentation software on Stimulus PC, there exists a Presentation extension called PresLink. PresLink extension enables to use Presentation “eye_tracker” -library, which commands can be used from the PCL-file. The connection works through Ethernet cable.

Presentation Help : Help Guide : References : PCL Reference : Eye Tracking Types
http://www.neurobs.com/presentation/docs/index_html

When using the PresLink commands, all needed procedures are available through the Presentation extension, including calibration, recording, marker sending, data saving, etc.

3.2.2 Presentation-script

In the Presentation, define the trials in the SCE-file and the executive commands in the PCL-file. Also include the eye tracking commands into PCL. In the example code, we create eye_tracker object “tracker”, which is afterwards called with “eye_tracker” library commands. The synchronization is achieved by using the send_messages()-commands before “present()” commands.

Example code: sce/pcl-file:

```
trial {
    picture {
      box { height = 10; width = 10; color = 0,0,0; };
      x = 0; y = 0;
    } pic1;
 }trial1;

 trial {
   picture {
      box { height = 10; width = 10; color = 255,0,0; };
      x = 0; y = 0;
   } pic1;
 }trial2;

 begin_pcl;
 eye_tracker tracker = new eye_tracker( "PresLink" ); # initialize PresLink, use the exact name
```

```
tracker.start_tracking() ;#connect to Eyelink tracker.

#open edf file on the tracker.
string edf_name = "track.edf"; #8 letters maxixum without ".edf"
tracker.set_parameter("open_edf_file",edf_name);
tracker.set_recording(true); #start recording.
main_trials[1].present();  #present the stimulus

tracker.send_message("SYNCTIME");#mark the time we presented the stimulus

main_trials[2];#present the other stimulus

tracker.set_recording(false); #stop recording.
#transfer the edf file. Note Presentation places files specified
#without a path in the user's home directory.
#in this example track.edf will be placed in your home directory.
#(eg. in xp #C:\documents and settings\<username>

string edf_fname = logfile_directory + edf_name;
# string edf_fname = logfile_directory + logfile.subject() + edf_name;
# when using "prompt subject" feature

#gets the edf-file to the stimulus PC, on defined locations
tracker.set_parameter("get_edf_file",edf_fname);
tracker.stop_tracking();
```

3.2.3 Calibration with PresLink

Calibration can be run remotely by using PresLink extension. In this way you also can set your custom settings for the calibration. Example of the sce/pcl code:

```
begin;
picture {
   text { caption = "[C]alibrate"; font_size = 45; transparent_color=128,128,128;}; x = 0; y = 0;
}et_calibration;

begin_pcl;

eye_tracker tracker = new eye_tracker( "PresLink" ); # initialize PresLink.
tracker.start_tracking() ;#connect to Eyelink tracker.

tracker.send_command("screen_pixel_coords = 0, 0, 1920, 1080"); #send resolution to eye tracker host.
tracker.send_command("screen_phys_coords = -265, 150, 265, -150");#send resolution to eye tracker host.

tracker.send_command("screen_distance = 600");       # send screen distance to eye tracker host.
tracker.send_command("calibration_type = HV9");      # enable 9 point calibration
string target_fname  = stimulus_directory +"target.bmp";
tracker.set_parameter("target_file",target_fname);

et_calibration.set_background_color(128,128,128);
```

```
et_calibration.clear();
et_calibration.present();

tracker.calibrate(et_calibrate_default, 1.0, 0.0, 0.0);      # start calibration routine;
```

Calibration uses a picture et_calibration by default. So if you want to use a custom point, name your picture as et_calibration. Notice that you can use bmp-files only.

3.2.4 Usage with Dataviewer

When analyzing data with DataViewer made by SR-Research, to automatize the procedure, you should set certain parameters on the code. The data viewer can then sparse the data, according to those parameters.

Example:

```
# Always send a TRIALID message before starting to record.
 # It should contain trial condition data required for analysis.
 msg= "TRIALID TRIAL ";
 msg.append(string(i)); # i= trial number
 tracker.send_message(msg);
```

3.3) PsychoPy

PsychoPy is open source software, which is based on Python programming language. PsychoPy2 and PsychoPy3 are installed on the Stimulus PC of the ABL. There exist *pylink*-interface between PsychoPy and EyeLink software, which works over Ethernet connection (cross wired cable).

PsychoPy has a “eyetracker” demo, which can be run on Stimulus computer. This eye tracker script connects to EyeLink PC, calibrates, starts recording, stops recording, etc..
https://www.psychopy.org/api/iohub/device/eyetracker_interface/SR_Research_Implementation_Notes.html

Notice that in practice the pylink works only in PsychoPy2. There seems to be some problems in PsychoPy3 with pylink, and this is widely reported in web.

In the below, there are example scripts how to use the pylink:

```
from psychopy.iohub import launchHubServer
from psychopy.core import getTime, wait
#PsychoPy versions:
#ABL: 1.83.04
#MEG: 1.82.01

# Eye tracker defintion, example
iohub_tracker_class_path = 'eyetracker.hw.sr_research.eyelink.EyeTracker'
eyetracker_config = dict()
eyetracker_config['name'] = 'tracker'
eyetracker_config['model_name'] = 'EYELINK 1000 DESKTOP'
```

```
eyetracker_config['simulation_mode'] = False
eyetracker_config['runtime_settings'] = dict(sampling_rate=1000, track_eyes='RIGHT')
eyetracker_config['default_native_data_file_name'] = "fname"     #This will be the name of the .edf
file saved on Host PC

#Starting IO hub
io = launchHubServer(**{iohub_tracker_class_path: eyetracker_config})
tracker = io.devices.tracker

#At the start of an experiment
tracker.setConnectionState(True)
tracker.setRecordingState(True)
#starts recording of eye data and sends eye data to the ioHub Server.

tracker.sendMessage("msg here")
#Send any marker message to the .edf file
#wait(10) # Wait 10 seconds (for recording)

#At the end of an experiment
tracker.setConnectionState(False)
tracker.setRecordingState(False)

#See
#https://www.psychopy.org/api/iohub/device/eyetracker_interface/SR_Research_Implementation_
Notes.html for more details.
```

3.4) Parallel port triggering

The parallel port interface enables of receiving TTL pulses. TTL-pulses from the parallel port are automatically stored into the Eye tracking Data File (EDF) in Host PC (if they are set in ini-file).

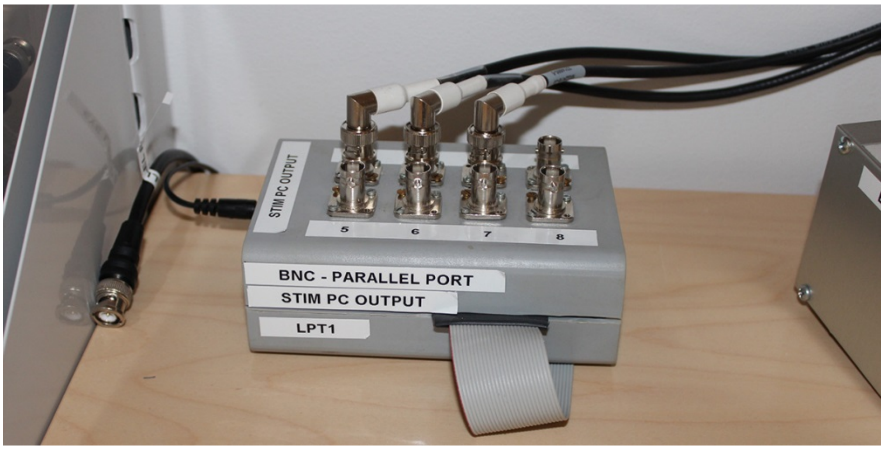
Instead of using the PCL-script, more simple approach is to send only TTL-triggers. In here, TTL triggers are sent from Stimulus PC to the Host PC via parallel ports. These triggers/markers are shown directly in the data file.

This is the simplest way to synchronize your presentation with the eye trackers. The approach alone doesn't allow any other interaction between the computers or sending any other parameters other than plain trigger pulses.

With this approach all eye tracking procedures need to be done separately in the Host PC, including calibration, recording, saving, etc. Only the TTL markers (which show in data) are sent from the Stimulus PC.

3.4.1 Wiring

Parallel port of the Stimulus PC is connected to "Parallel interface box" via ribbon cable.



Parallel port of the Eye Link Host PC is connected to a single coaxial cable (on the left, next to interface box). You can connect this single cable to any "output ports" of the "Parallel interface box".

3.4.2 Presentation settings:

In the Presentation, an output port needs to be defined in the port setting menu (Settings/Port). Add new output port (Output Ports->Add). Set the output port as LPT1-port. You can also choose the length of the pulse.

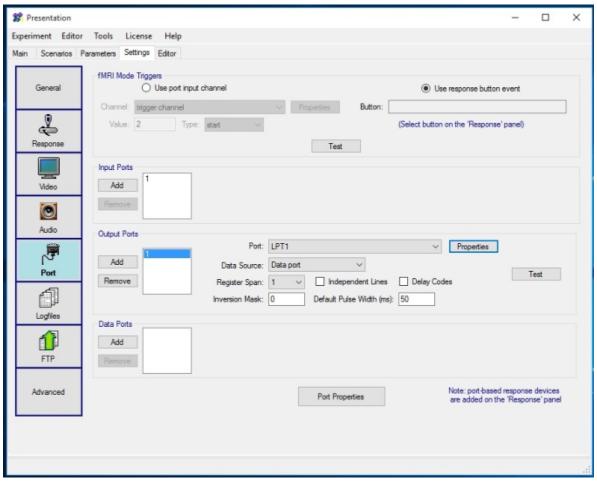


Image 1: Setting output port, LPT1

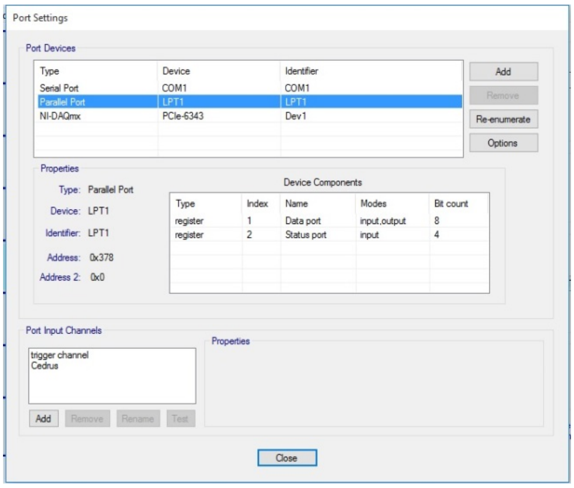


Image 2: Setting the LPT1 port

<u>Presentation script for parallel port triggers:</u>

In the SCE-file, use port-triggers inside the trial as following:

```
port = "1" # if you have defined only one output port, then this is optional.
           # Otherwise you need to define which port to use.

port_code =2; # Defines what is send to the port. You can send numbers
              # between 0-255. Triggers will show in the eye tracking data
              # file as such. In the data file, two events can be seen,
              # the trigger onset and off-set.
```

```
trial {
picture {
    box { height = 10; width = 10; color = 0,0,0; };  # shows a black box
     x = 0; y = 0;
   } pic1;
 port_code = 2; # this code is sent at the time “trial1” is presented
 }trial1;
```

Recorded data file will include the following lines:

```
           (ms)
INPUT    155462    2 ## this is the same number in the “port_code”
INPUT    155472    0 ## indicates the trigger off-set.  Occurs 10ms later
                     ## as the pulse length is set to 10ms
```

3.4.3 Host PC settings:

Parallel port is set in the host PC on default, so the parallel interface works automatically. Check that the following lines are in the final.ini file.

```
write_ioport 0x37A 0x20 ;; enables the bidirectional function for
                        ;; the current parallel port
input_data_ports 0x378 ;; set the input ports to the data register
```

Now, by the default, all the triggers received via parallel port are marked to EDF-file as INPUT-lines.

3.5) E-Prime

There exists an "ELink E-Prime package for Eyelink". "It can be useful for anyone who would like to use E-Prime experiments in combination with the SR Research eyetracker hardware."

Ask personnel for usage of E-Prime in the ABL.

3.6) Using parallel port triggers as buttons

Optionally, the parallel input triggers can be used as buttons. This way, we are able to use additional information to data file besides the INPUT lines. The buttons need to be first defined in button.ini file (see below). In host PC, the different pins (1-8) works as separate triggers and those needs to be defined. This is a little bit complicated approach, because the input parallel port on the Host PC understands the separate pins only and the output from Stimulus PC is sending the decimal numbers in 8bit mode.

NOTICE: You need a special cable for this, which is not installed in ABL by default!

This approach let you have proper messages into the EDF-data file, without using the PresLink interface. Notice that you will only have 8 different buttons available in total.

So we add lines into buttons.ini file, which creates buttons for pins 1-8:

```
create_button 1 0x378 0x01 0;; Button 1
create_button 2 0x378 0x02 0;; Button 2
create_button 3 0x378 0x04 0;; Button 3
create_button 4 0x378 0x08 0;; Button 4
create_button 5 0x378 0x10 0;; Button 5
create_button 6 0x378 0x20 0;; Button 6
create_button 7 0x378 0x40 0;; Button 7
create_button 8 0x378 0x80 0;; Button 8
```

After that, we define the buttons' actions into the same buttons.ini file:

```
## button_function <button_number> <press_command> <release_command>
button_function 1 "data_message 'BUTTON_1_PRESSED'" "data_message 'BUTTON_1_RELEASED'"
button_function 2 "data_message 'BUTTON_2_PRESSED'" "data_message 'BUTTON_2_RELEASED'"
```

When calling these pins from Presentation software, by using decimal numbers in the port_code, you need to keep in mind the following.

port_code	binary	channels
1	0000 0001	1
2	0000 0010	2
4	0000 0100	3
8	0000 1000	4
16	0001 0000	5
32	0010 0000	6
64	0100 0000	7
128	1000 0000	8

When using the single pins, it's rather easy to find the correct port_code, i.e. we want to trigger the channel 5, then port_code = 16 (look at the table above). But when several simultaneous triggers are needed, then it gets more complex. If you want simultaneous triggers on channels 1 and 3, you basically want to send a binary code 0000 0101. This binary code equals to 5, because the 0000 0100 equals to 4 and the 0000 0001 = 1 and the sum of those is 5. So in this case we would send the port_code = 5.

If we send the port_code = 2, in the presentation, it will show on data file as:

```
MSG 52999 BUTTON_2_PRESSED
MSG 52999 BUTTON_2_RELEASED
```

where the “52999” is the time (ms), when the action occurred.

4 Subject preparation

Notice the following things when preparing a subject.

4.1.1 Dominant Eye

When recording a single eye only, the eye movements should be measured from the subject's dominant eye. The dominant eye can be measured, at least with the two following methods:

a) With a simple “two finger” method: Place your both index fingers in line onto front you. Look at the fingers and close your eyes in turns. If the view doesn't change while closing your eye (you still see the fingers in same angle), the current watching eye is the dominant one.

b) With two hands, make a small hole with your thumbs and index fingers and raise them at your eye sight level, while keeping your hands extended. Now focus on certain small target (egde, pin,..) through this hole. Then bring the arms closer to your eyes while still looking at the target through your fingers. Finally your hands should follow to your dominant eye.

4.1.2 Mascara

Eye lashes will get very dark when having mascara, which can effect negatively on the pupil detection.

4.1.3 Eye Glasses

When using glasses with the eye tracker, the lenses may reflect infra-red light, which can disturb the eye tracking. Eye tracker may work with glasses, but it needs to be adjusted very carefully. Notice that the successful rate is lower with the glasses than without.

4.1.4 Contact Lenses

There are basically two types of contact lenses: hard and soft.

4.1.4.1 Soft lenses:

Soft contact lenses works normally quite well. The edge of lens can be seen from the eye image as a pale ring, but it usually doesn't effect on the eye tracking. On the other hand, lenses can create an extra reflection point, which is very close to 1st Purkinje image, but is normally visible only on certain angles.

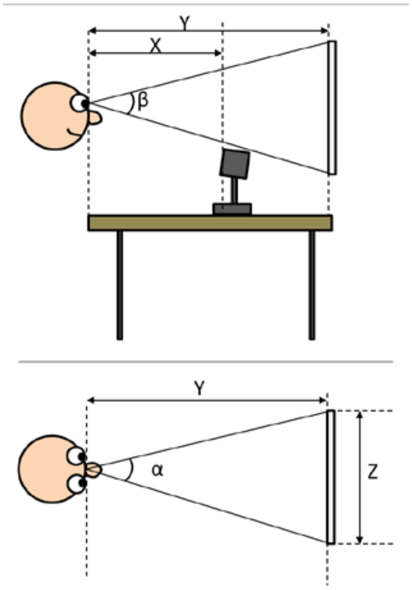
If the lenses don't fit the eye perfectly, they can slide a little bit on top of the eye. This makes the tracking less precise, especially in the corners.

4.1.4.2 Hard lenses:

Hard lenses don't usually work with the eye trackers. They tend to be less stable than soft lenses and can slide partly off the center of the eye. This will produce and eye image, where the pupil is cut off partly.

5 Measuring

5.1) Setup of the experiment



The variables of this paragraph refer to letters mentioned in the Image 3.

Place the subject on front of the eye tracker. The optimal distance is 50-55cm from the eye to the camera (X), though the eye tracker should work with 40-70 cm distances. Eye tracker should be positioned so that the eye tracker is located just below the eye sight when looking at the bottom of the screen.

The viewing angle should not be smaller than 32° in horizontal (α) and 25° in vertical (β) direction. Approximately the distance from the eye to the screen (Y) should be at least 1,75 times the width of the screen (Z). $Y > 1.75Z$

With the current stimulus monitor in ABL, the distance Y should be more than 92cm.

Image 3: Physical dimensions of the setup

5.2) Before experiment

1. Make sure that all equipment are connected and powered
2. Make sure that the physical dimensions are set correctly on physical.ini file.
3. Turn on the Eye Link PC. Choose option “Eye Link” from the startup menu and press enter.
4. Turn on the Stimulus PC.
5. Turn on the stimulus monitor inside the shielded room
6. Set on the eye camera scene on the stimulus monitor (i.e. run the track.exe -file on Stimulus PC)
7. Set the camera into a correct position

5.3) Setting the system with subject

- Turn off “the threshold colors” from Host PC.
- Adjust the camera so that the eye locates in the middle of the camera image. Click the eye with the mouse cursor and switch the camera view for the closer eye image (left and right arrows).
- Focus the camera lens, so that the image is sharp. The easiest way to see this is when the cornea reflection is as small as possible.
- Turn on “the threshold colors” from Host PC.
- Change the pupil and CR threshold levels if needed. See Eye Link 1000 Installation guide, chapter 7.5 Long range mount camera setup
    - **Pupil threshold:** Fill the dark pupil with blue color. If there isn’t enough color inside the pupil, adjust the pupil threshold level up. If there is too much blue color around the pupil, change the threshold level down.
    - **Cornea reflections:** Idea is to have as small CR as possible. If there is a white halo around the turquoise reflections, adjust the CR-threshold level down.
- Check whether the eye tracking works when looking at corners of the screen. For example you can move your finger on top of the screen, and ask the subject to follow the tip of the finger.
- Calibrate the system (see “Calibration”).
- Validate to check if the calibration is good enough.

5.4) Recording

After a successful calibration, one could proceed for data recording. There are two options:

a) Control the session remotely from Stimulus PC, for example use Presentation or Experiment Builder to start and stop recording.
b) Control the session from Host PC. You can manually start and stop recording:

1) In Setup window, click "Recording button"
2) Click "Open file"
3) Write the name of the file. Notice that you can use max 8 letters (+.edf). Press Enter.
4) Start recording
5) Stop Recording
6) Close File

5.5) After experiment

- Make sure you have your edf-file transferred from Host PC to Stim PC. You can either:
  a) Send command "get_edf_file" form the presentation software (see Presentation Script)
  b) Click GetFile Icon on the desktop of StimPC. Choose get file. Write name of the file and press ok. If you left the line empty, the most recent file recorded is then transferred.
- Close Eye Link software on Eye Link PC
- Unplug the EyeLink camera
- Shut down the Eye Link PC and the Stimulus PC.

5.6) Calibration

Calibration can be done:

a) by running track.exe file on a stimulus PC
b) using a "calibration" command in the Presentation
c) calibration command in PsykoPy, etc..

Few things that need to be noticed when doing the calibration:

- In ABL, the eye tracker is set on monocular tracking. If you want, you can also do the binocular tracking.
- Choose the eye to track
- The background's brightness of the calibration shouldn't differ much from the brightness used in the actual experiment. If there are dramatic changes in pupil size, it may effect on the tracking abilities. This is due to the pupil reactions to the brightness. Black background in the calibration enlarges the pupil and if the experiment itself is very bright: the pupil will shrink to small. The different sizes of the pupil may cause inaccuracy to the tracking.
- When calibrating, it's crucial to ask the subject to focus on the center of the calibration ring, not just to the "ring" itself. This way, you get much more accurate calibration, and the "calibration grid" will appear straight.
- Automatic vs. Manual calibration. The guideline is to use manual calibration when possible. In the manual calibration, with training, the operator easily learns to see when then gaze has positioned to its place and when to clarify the point. As opposite, the automatic calibration calculates the first steady state, even though the gaze isn't centered to the calibration point yet. In manual calibration: operator checks the calibration point manually by pressing the space bar when the eye focuses on the point.

5.6.1 Changing the calibration background color in Track.exe

The calibration can be done by running Track.exe file on the Stimulus PC, but notice that the background and foreground colors are set in this file. The file can be modified with the Experiment Builder -software to change the colors (you need to create your own exe-file and this requires a license dongle) or dimensions of the calibration points.

In the Stimulus PC of ABL, there exists CustomCalibration.exe –file, which reads calibration parameters from the txt-file, and uses those in the calibration. The txt-file can be found from: K:\Users\maintenance\CustomCalibration \myfiles\CallInfo.txt. The CallInfo.txt file consists of:

```
# Calibration type - H3, HV3, HV5, HV9, HV13
HV9
# Background color - (0-255,0-255,0-255)
127
127
127
# Foreground color - (0-255,0-255,0-255)
0
0
0
# Calibration_area_proportion 0.88 0.83
0.88
0.83
```

In here you can change "Calibration Type", "Background color", "Foreground color" and "Calibration area".

Open the file with the notepad, change the parameters, save and exit the notepad.

You can run this ExperimentBuilder file from K:\Users\maintenance\CustomCalibration\CustomCalibration.exe.

5.7) Pupil Calibration

EyeLink system records either pupil "diameter" or "area". This can be set in the setup window of EyeLink. The units will vary between different subjects, so the pupil size needs to be calibrated. Otherwise the output unit is "arbitrary".

There exists no pupil calibration procedure in EyeLink, but each user has to calibrate their own. Put "a fake eye" on top of the subject's eye. Now track the fake eye. Change the tracking mode to "pupil" and record few seconds of data. After that, you should change to "pupil-CR" -mode again.

When you know the size of your fake eye, you can calculate the conversion factor between mm:s and eyelink-units, with this distance.

NOTICE: This pupil calibration works only in stabilized head mode.

6 Chin rest

Chinrest can be used to stabilize the head. You can use it with the remote mode to get more precise results, or to enable the high speed modes (1000-2000Hz), which requires of using the stabilized head.

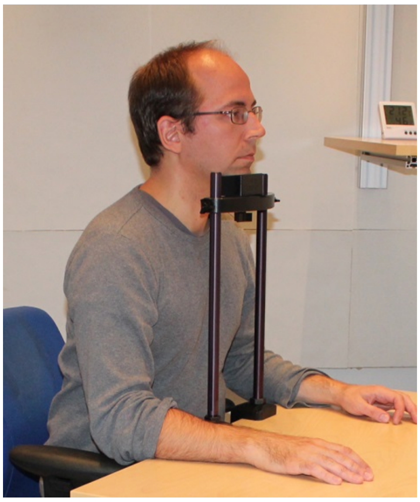


Image 4: Level of the chinrest should be adjusted so that the person is in comfortable position.

7 Data analysis

Eye link system creates an EDF-file which consist the recorded data. To be able to read the file, some converter is needed. The most common options are:

- EDF2ASC – converter
- DataViewer – software
- Matlab - EDF-reader

7.1) EDF2ASC – Converter

EDF-files can be converted to ASCII format with EDF2ASC-converter.
https://www.sr-support.com/forums/showthread.php?t=17

This ASCII file can be then exported to analysis software.

7.2) Data Viewer

The EyeLink Data Viewer is intended for reading, viewing, filtering, and outputting EyeLink 1000 data. The Data Viewer supports EDF files recorded by EyeLink 1000. Detailed information can be found in the Data Viewer manual. Dataviewer software can be downloaded from the forum of SR-research (notice that the dongle is needed)

https://www.sr-support.com/forums/showthread.php?t=10

7.3) Matlab

Edf files can be read directly to Matlab with an EDF_API (can be difficult to get it work).
https://www.sr-support.com/forums/showthread.php?t=255&page=4