



EyeLink® 1000 Plus Installation and Training

SR Research Ltd.

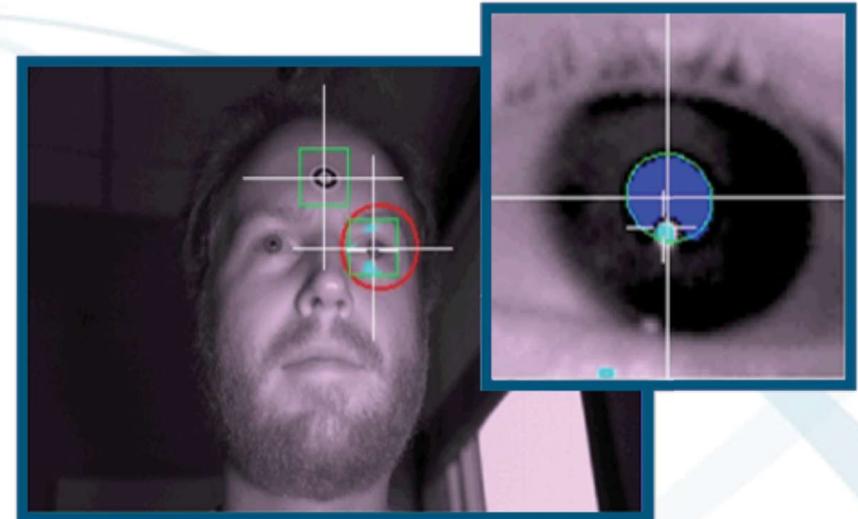
Toronto / Ottawa, Canada

Agenda

- Video-based eye tracking
- The EyeLink Platform
- EyeLink Components
- Terms and Specifications
- System Components
 - Display PC
 - Display API
 - Host PC
- Camera Setup
 - Calibration
 - Validation
- EyeLink Data Structure

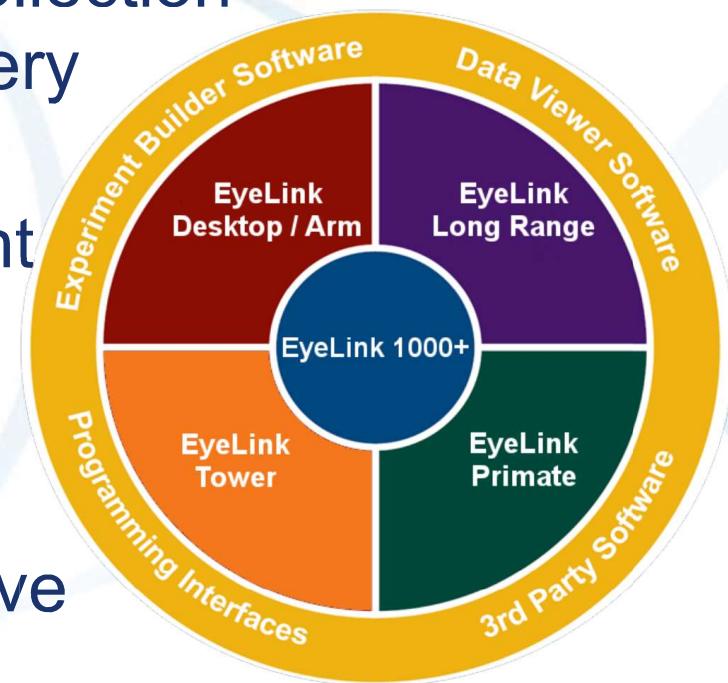
Video-Based Eye Tracking

- IR camera and illuminator
 - Minimal interference with visual stimulus
- High speed video Image analysis
 - Determine centers of dark pupil and corneal reflection
- Calibration yields predictive model
 - Sample camera image while subject fixates several known locations
 - Induce predictive model

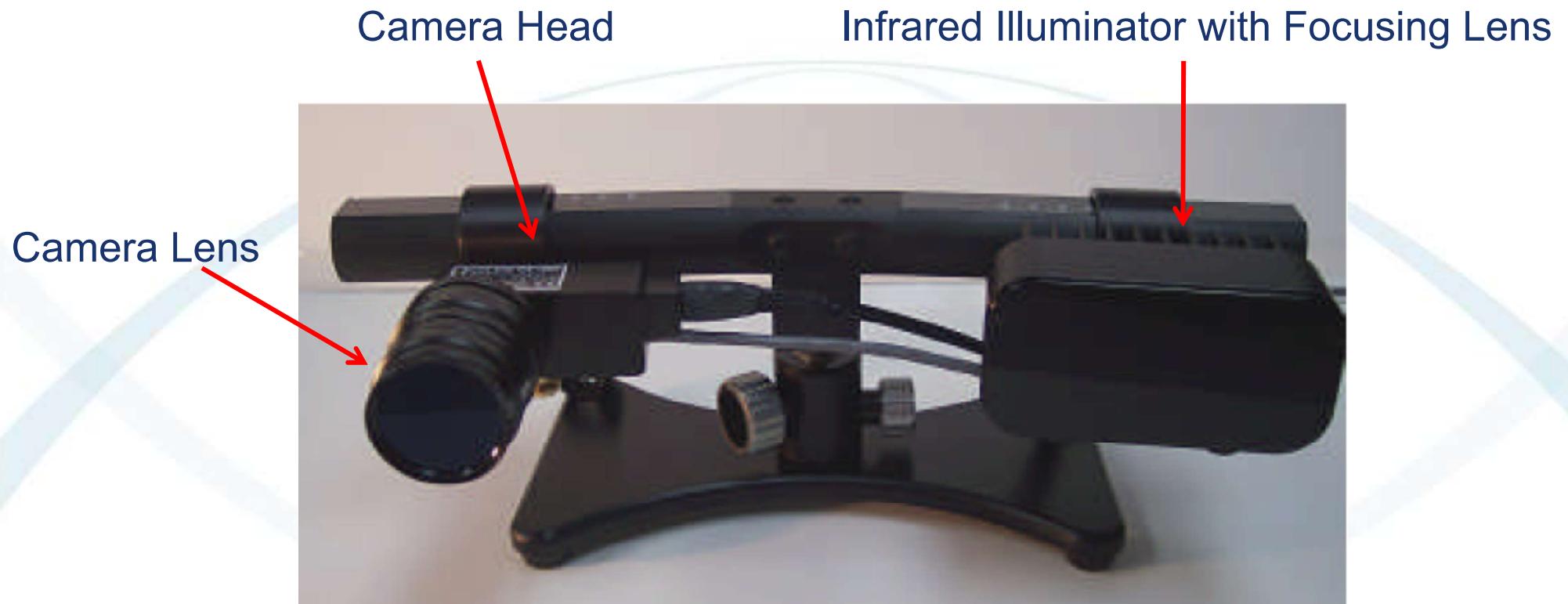


EyeLink Platform

- Focal Imaging Technology (FIT)
 - Point, focus and track camera
 - Real-time host computer for data collection
 - Display computer for stimulus delivery
- One camera, many mounts
 - Desktop, Tower, Primate, Arm Mount
 - Long range variants for MEG/MRI
- Multiple modes of operation
 - High-precision monocular/binocular
 - Remote mode with head free to move
- Unified software
 - Host eye tracker application
 - Application Programming Interface



EyeLink Long Range Mount



Different lenses (75mm, 50mm, 35mm) for
Different distances (overall range: 60-150cm).





Long Range Screen Mount

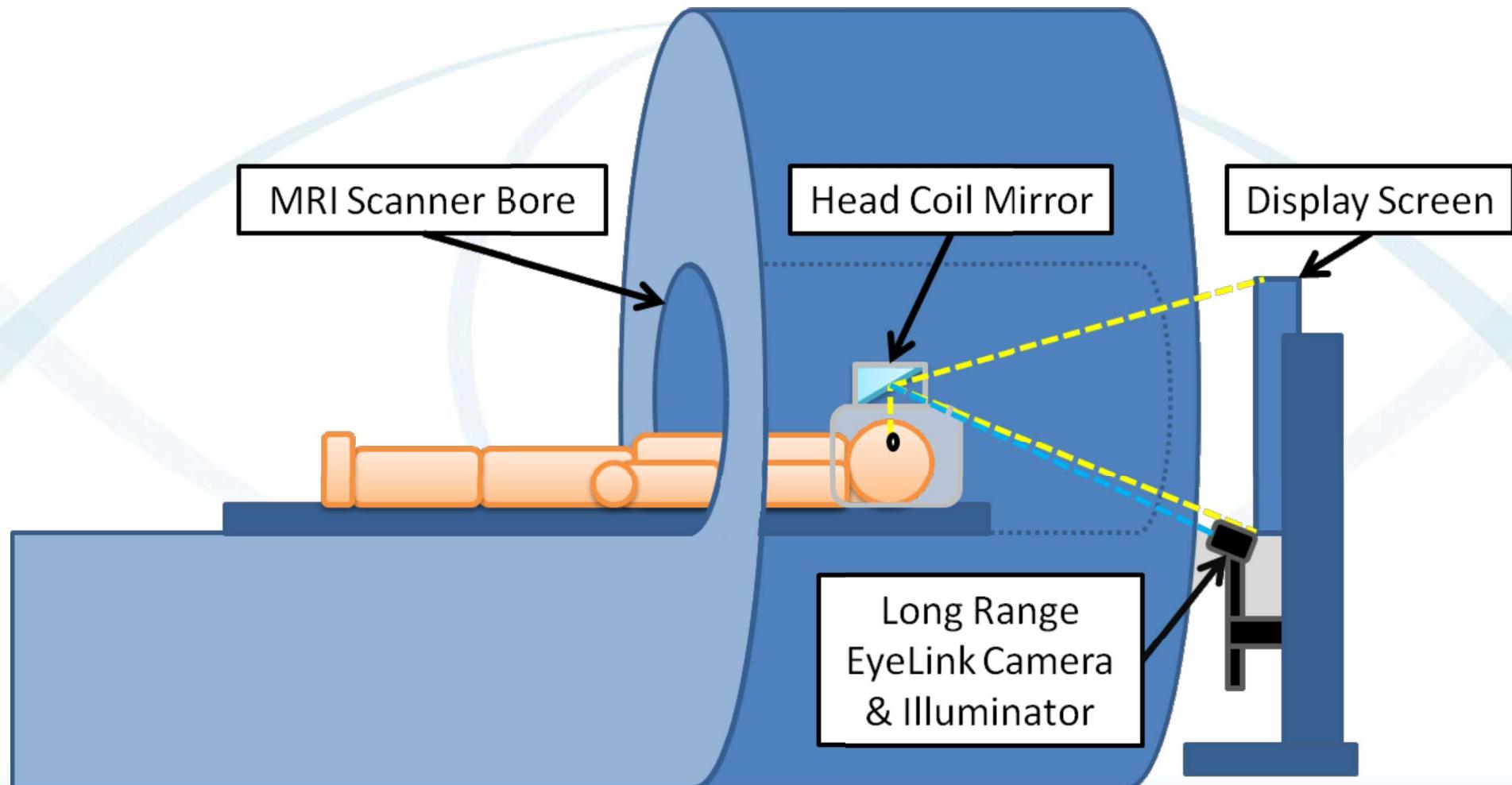


MRI Head Coil Mirror

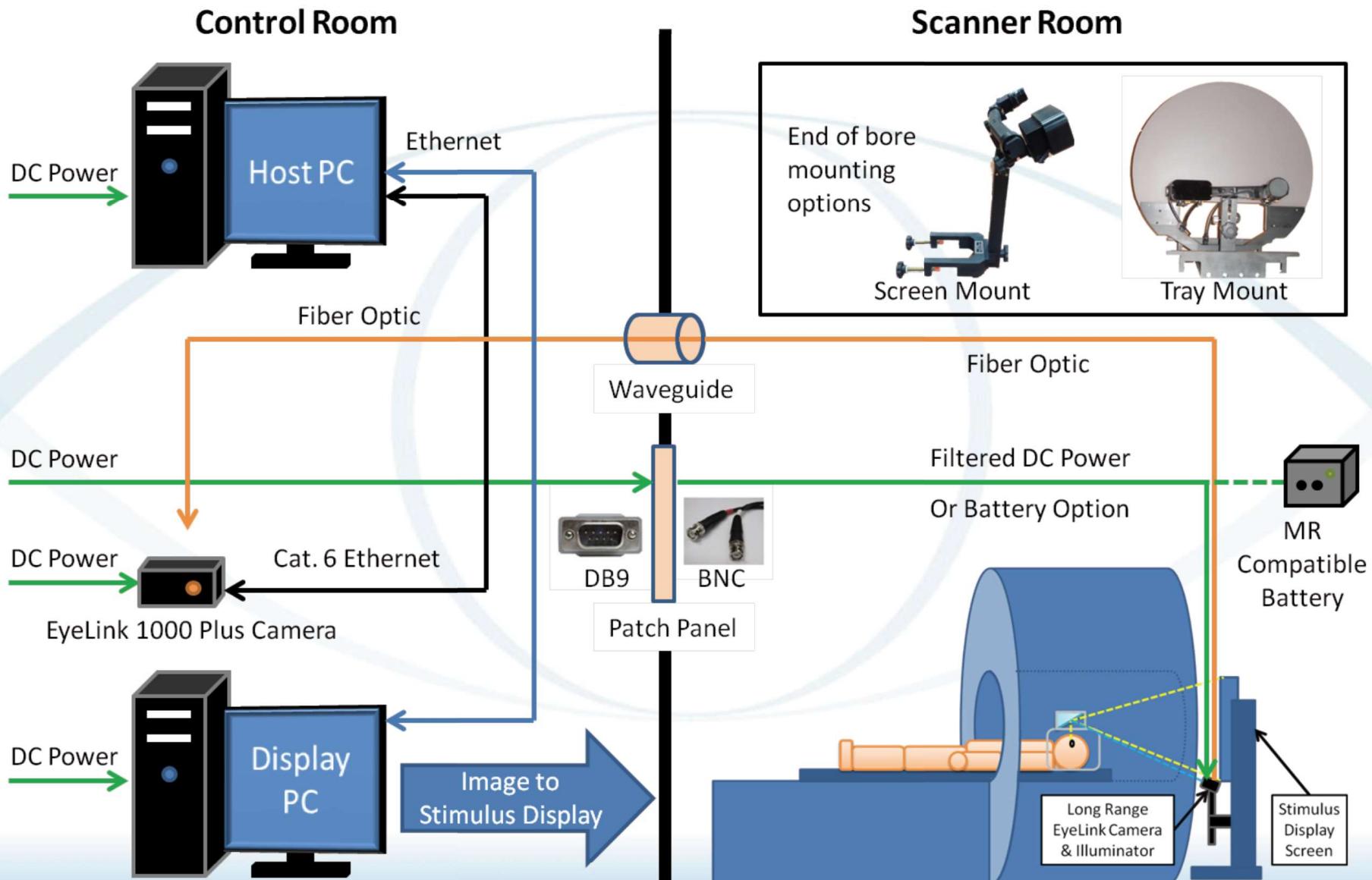


- Make sure you use an approved front surface mirror

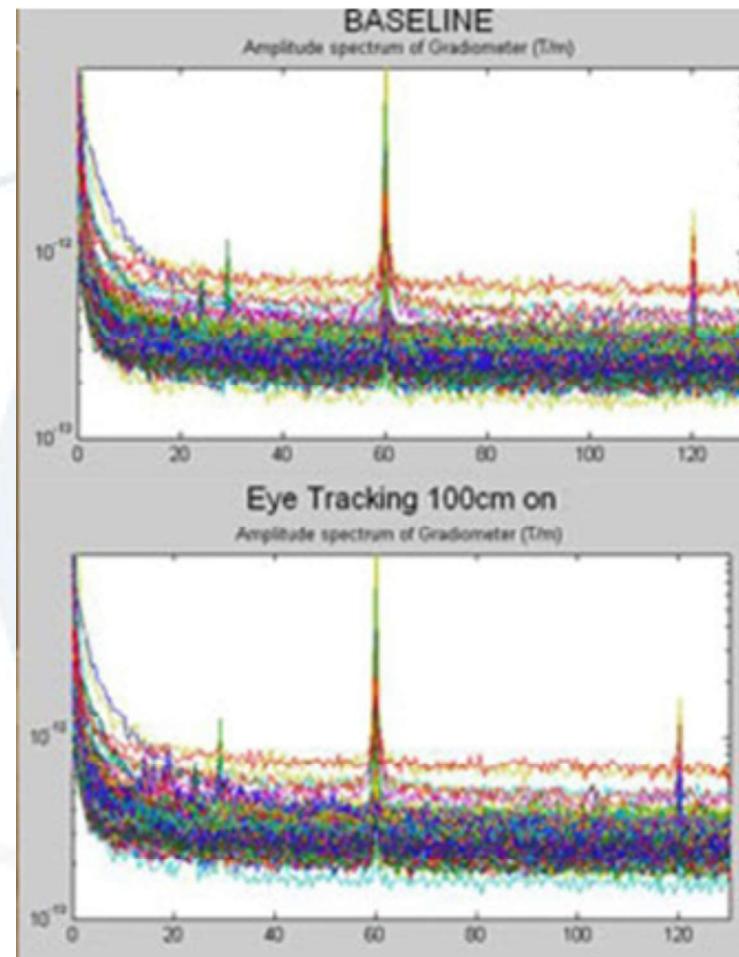
Typical MRI Configuration



Long Range System Cabling



Long Range System Cabling



- No detectable noise with proper cabling
(Graph from use with MEG)

Terms and Specifications

- Accuracy
 - Test-retest discrepancy
 - Measure of absolute spatial location
 - Will be best with dominant eye
 - Drift free, 0.25° - 0.50° typical
- Spatial resolution
 - Smallest measurable movement
 - Measure of relative spatial location
 - $<0.01^\circ$ RMS in pupil-CR 1000 Hz tracking mode
 - Glasses increase error by about 0.01°



Terms and Specifications

- Temporal resolution
 - How many images processed per second
 - Hz = “samples” per second
 - 2000 / 1000 / 500 / 250 Hz recording
- Tracking Range
 - Portion of subject’s field of view (in degrees of visual angle) that can be accurately tracked
 - Desktop mount: 32° horizontal x 25° vertical
 - Tower mount: 55° horizontal x 45° vertical
- Blink Recovery Time
 - Recover of gaze position after missing data
 - Recover position on next sample



Terms and Specifications

- Eye Event Resolution
 - Smallest psychological event that is spatially measurable with the system
 - 0.05° microsaccades
- Head Movement Compensation
 - Tolerable level of head movements
 - Approximately 2 cm of lateral head movement compensation
- Streaming data delay
 - Time to access gaze data on Display PC via Ethernet
 - 1.4 ms delay (SD=0.4 ms) @ 2000 Hz
 - 1.8 ms delay (SD=0.8 ms) @ 1000 Hz



The Display PC

- Performs full experimental control
 - Integrate calibration and data collection into one easy step
 - Sets any tracker preference
 - Sends commands to control tracker
- Time stamps experiment events with messages
- Near real-time access to eye sample and event data structures for gaze-contingent paradigms
- Allows focus on stimulus presentation and data processing
 - Ordinary experiment delivery with calls to the underlying EyeLink libraries to interface with the eye tracker

Display PC API

- Compatible with many stimulus delivery methods
 - Experiment generating packages:
 - Experiment Builder
 - E-Prime
 - Presentation
 - Psychtoolbox (MATLAB)
 - Programming languages:
 - C/C++
 - Python
 - Delphi
 - Any Windows COM language
 - Operating systems:
 - Windows / Mac / Linux



The Host PC

- Host PC application controls the eye tracker
 - Performs image analysis
 - Performs data recording
 - Performs eye event parsing
 - Configures preferences
- Provides real-time feedback
 - Gaze view: gaze cursor on background image
 - Plot view: eye traces over time
- Send and receive TTL via Parallel Port
 - TTLs received logged directly to EDF

Gaze View

Call me Ishmael. Some years ago -- never mind how long precisely -- having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen, and regulating the circulation. Whenever I find myself growing grim about the mouth; whenever it is a damp, drizzling November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet, I account it high time to get to sea as soon as I can. This is my substitute for pistol and ball. With a philosophical flourish Cato throws himself upon his sword; I quietly take to the ship.

Record

TCP/IP Link Open

Stop Recording

Stop
Recording

Abort Trial

PUPIL

OK	OK
SIZE	SIZE
MISSING	MISSING
CORNEAL	OK
OK	MISSING

Plot View

Duration (sec):

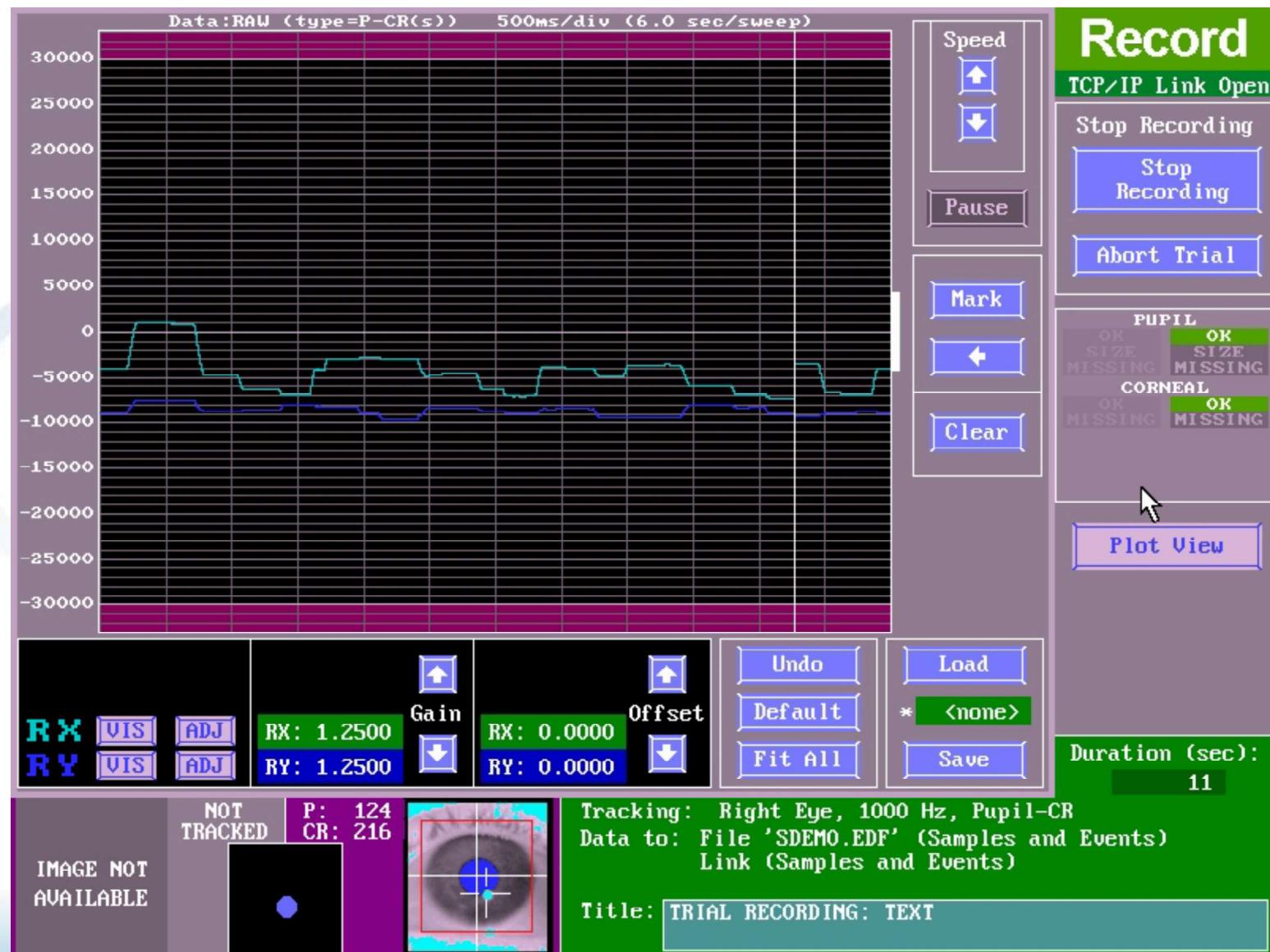
21



Tracking: Right Eye, 1000 Hz, Pupil-CR
Data to: File 'SDEMO.EDF' (Samples and Events)
Link (Samples and Events)

Title: TRIAL RECORDING: TEXT

Plot View



Camera Setup

- Position camera image
 - Center subject's eyes in global camera image
- Focus camera lens on surface of the eye
- Adjust Pupil and Corneal Reflection thresholds
 - Let the system know which part of the camera image should be considered as pupil and corneal reflection
- Perform Calibration and Validation
 - Calibration induces predictive model
 - Validation tests accuracy of calibrated model

Camera Setup

EXP:101% Image Thresholds

Pupil

Corneal

Tracking Mode

Sample Rate

Pupil Tracking

Image Display

Illuminator Power

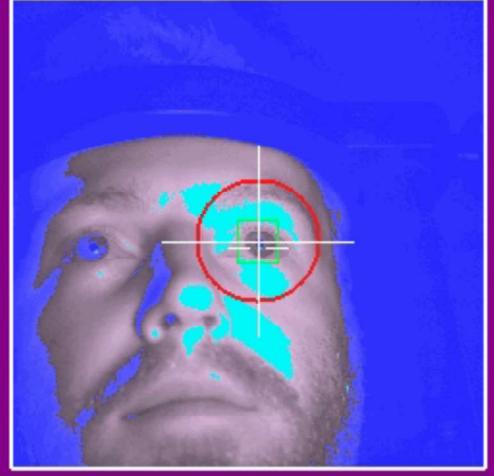
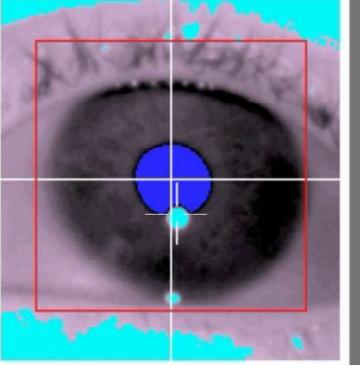


IMAGE NOT AVAILABLE



EYE NOT AVAILABLE

Camera Setup

Desktop Monocular

Screens

Desktop Monocular

Screens

Exit Setup

Offline

Output/Record

Set Options

Help (F1)

Calibrate

Validate

Drift Correct

Left

Right

EyeLink Remote Mode

Image Thresholds

Pupil

Corneal

Tracking Mode

Pupil-CR

Sample Rate

250 500

Pupil Tracking

Ellipse

Image Display

Crosshairs

Threshold Coloring

Image->Display PC

Align Eye Window

Illuminator Power

100% 75%

Target Thr: 149
Distance: 578.1 mm
TARGET OK
DIST OK

Pupil: 107 AUTO x1.00
CR : 223 AUTO x1.00
PUPIL OK
CR OK

Eye Tracked: **Left** **Right**

Camera Setup

Desktop Remote

Screens

Exit Setup

Offline

Output/Record

Set Options

Help (F1)

Calibrate

Validate

Drift Correct

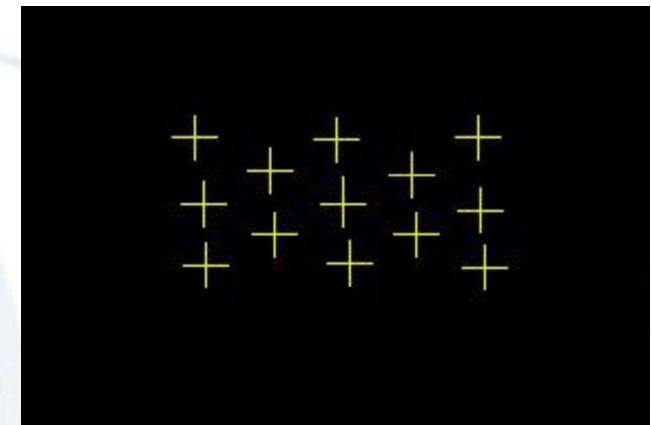
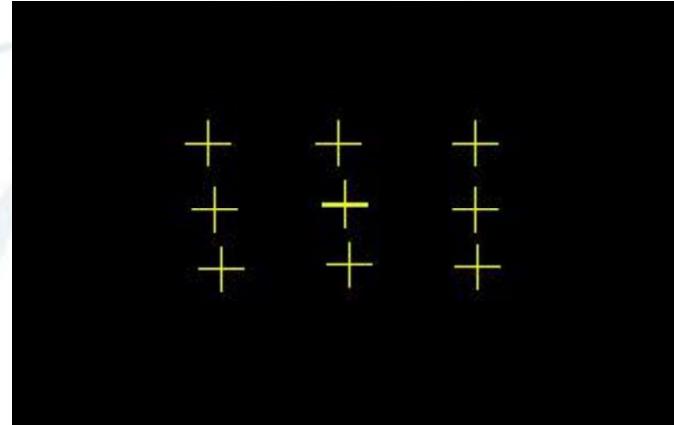
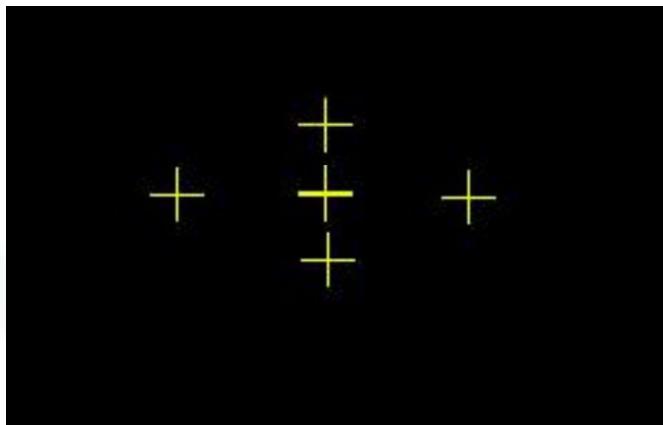
Calibration

Mapping raw eye data / camera image data to predict gaze position

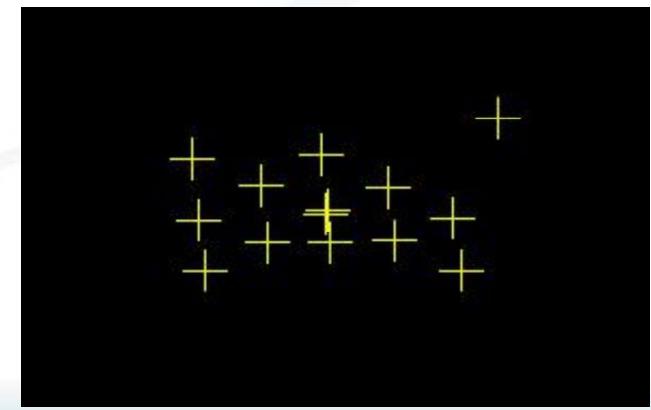
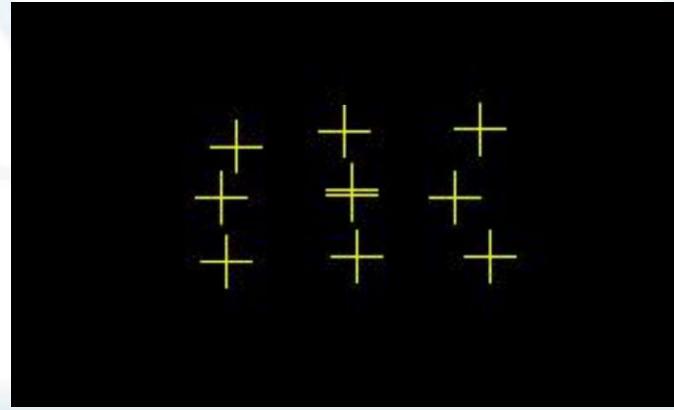
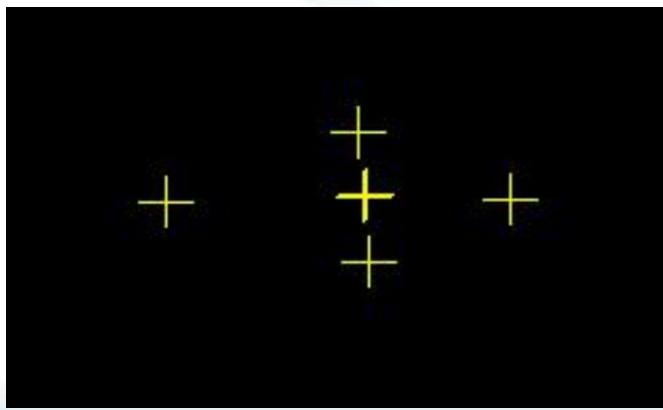


Calibration

Good Calibration models (symmetrical)



Poor Calibration models (asymmetrical)

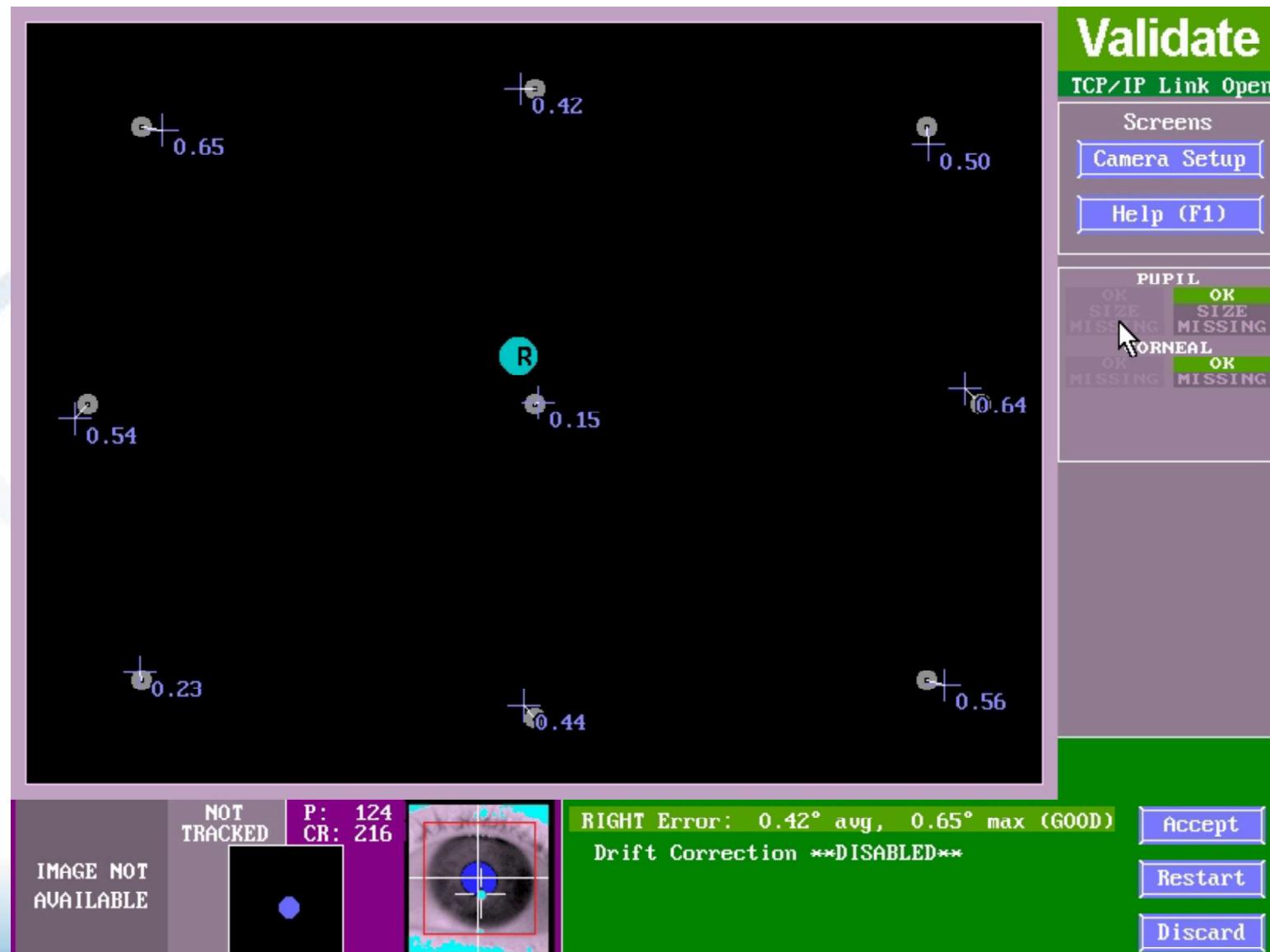


Validation

- Evaluate predictive model's test-retest accuracy
- Subject re-fixates known locations
 - Difference between predicted gaze position and validation sample is “accuracy”
- Summarizes calibration accuracy
 - Reveals which spatial positions fit least accurately in degrees of visual angle

Validation

Checking accuracy level of the calibration



EyeLink Data

- EDF file
 - Use EDF2ASC/VisualASC converter to get ASC files
 - Use EyeLink Data Viewer for direct analysis
- What is recorded:
 - Samples
 - Events
 - Saccades, fixations, blinks, messages, buttons

(Please read Chapter 4 of the EyeLink 1000 Plus User Manual)

EyeLink Recording Data

- Samples
 - System time, x, y, and pupil size
 - Optional velocity, resolution, and CR status

6079861	503.7	680.3	972.0
6079862	503.7	680.1	972.0
6079863	503.8	680.1	972.0
6079864	503.8	680.2	972.0
6079865	503.9	680.2	971.0
6079866	503.7	680.1	971.0
6079867	503.7	680.1	971.0
6079868	503.6	680.0	970.0
6079869	503.6	680.1	970.0
6079870	503.7	680.2	970.0

(Please read Chapter 4 of the EyeLink 1000 Plus User Manual)



EyeLink Recording Data

- Saccades
 - SSACC: eye, start time
 - ESACC: eye, start time, end time, duration, start x/y, end x/y, amplitude, peak velocity

SSACC L 6079955

ESACC L 6079955 6079962 8 507.5 682.5 511.9 682.0 0.20 38

...

SSACC L 6080723

ESACC L 6080723 6080763 41 513.8 679.7 633.5 550.5 7.94 285

(Please read Chapter 4 of the EyeLink 1000 Plus User Manual)



EyeLink Recording Data

- Fixations
 - SFIX: eye, start time
 - EFIX: eye, start time, end time, duration, average x/y, pupil size, resolution

SFIX L 1454748

EFIX L 1454748 1454907 160 510.3 4.1 1187 28.45 27.50

...

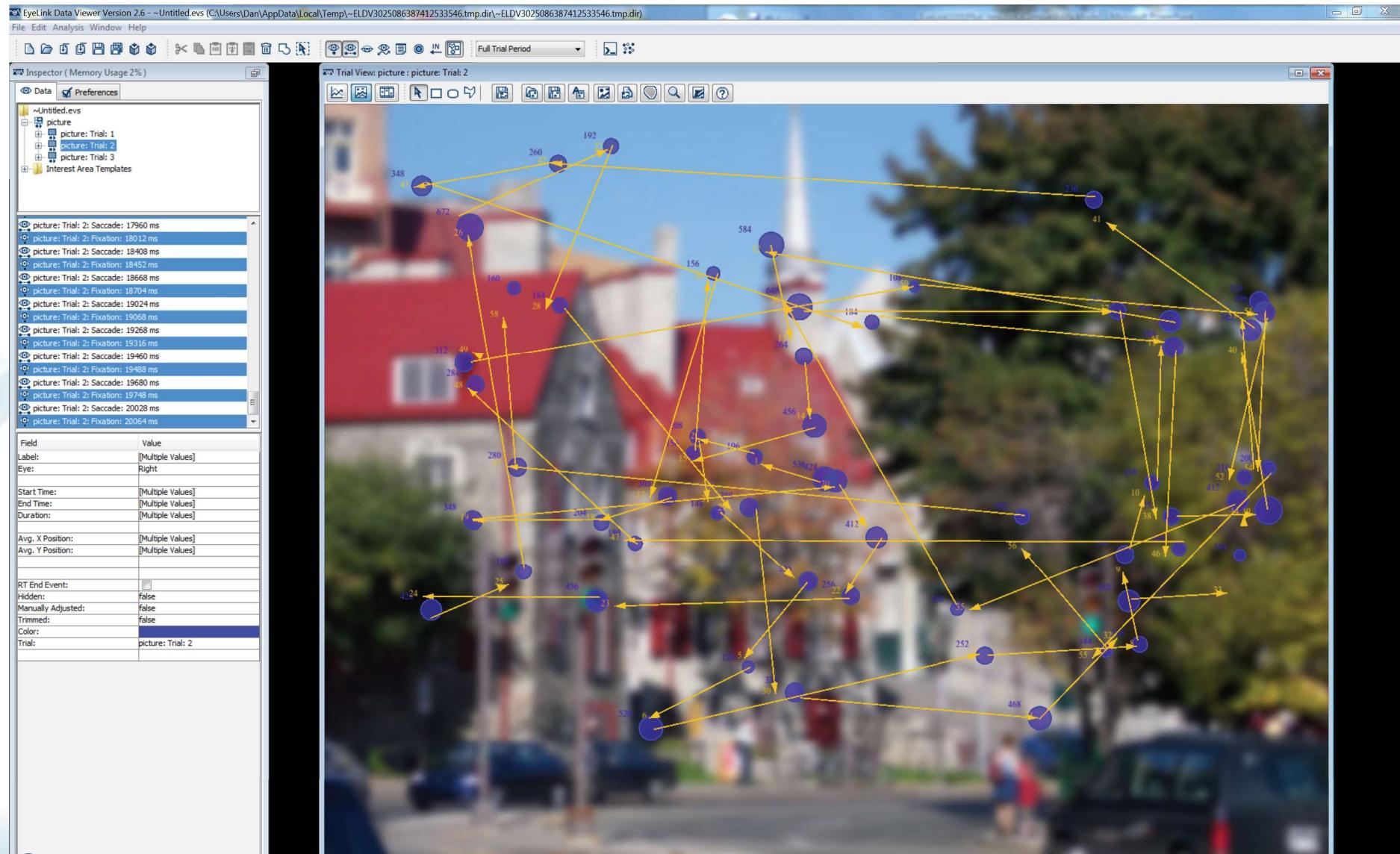
SFIX L 1454919

EFIX L 1454919 1455873 955 514.0 0.3 1361 28.40 27.50

(Please read Chapter 4 of the EyeLink 1000 Plus User Manual)



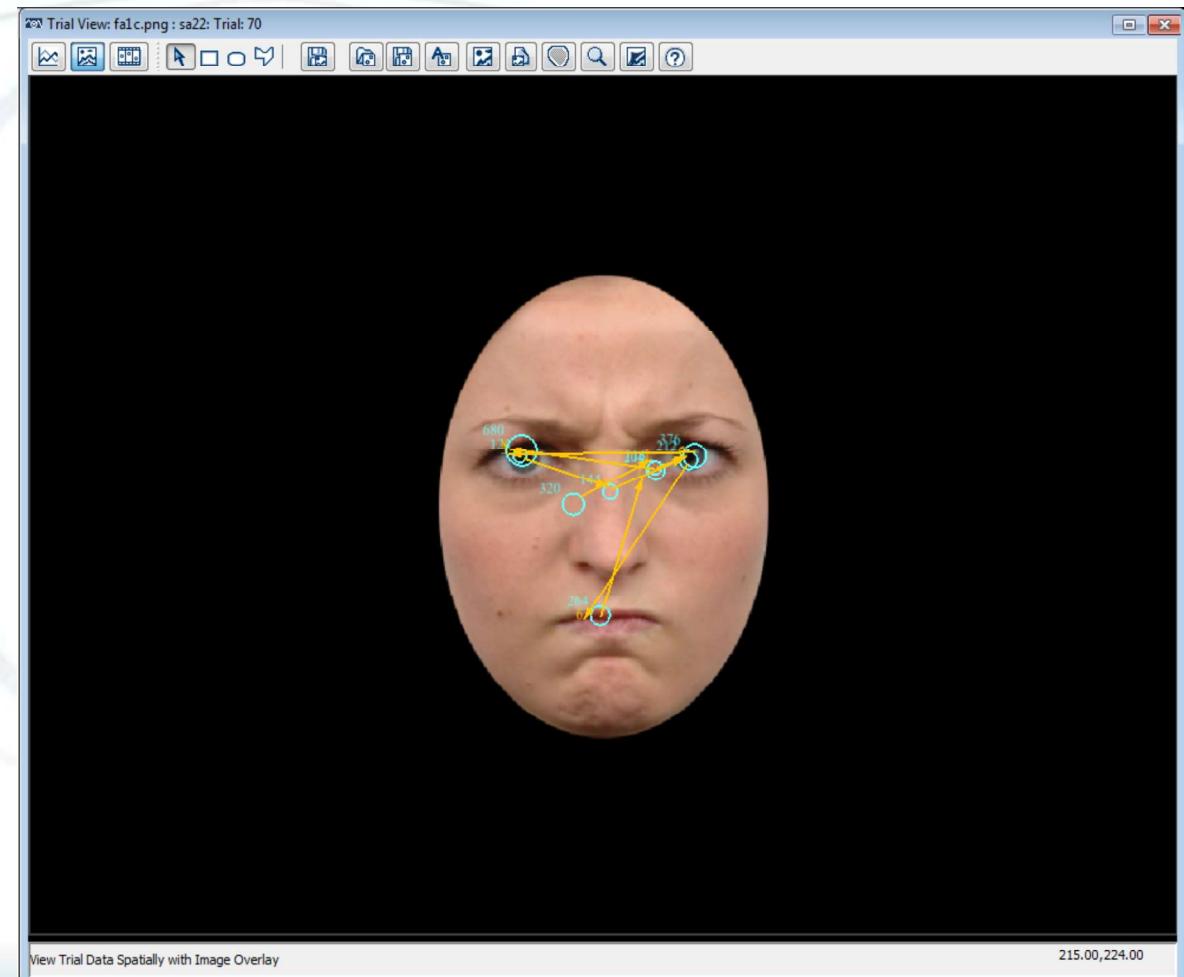
EyeLink Data Viewer



EyeLink Data Viewer

Data visualization:

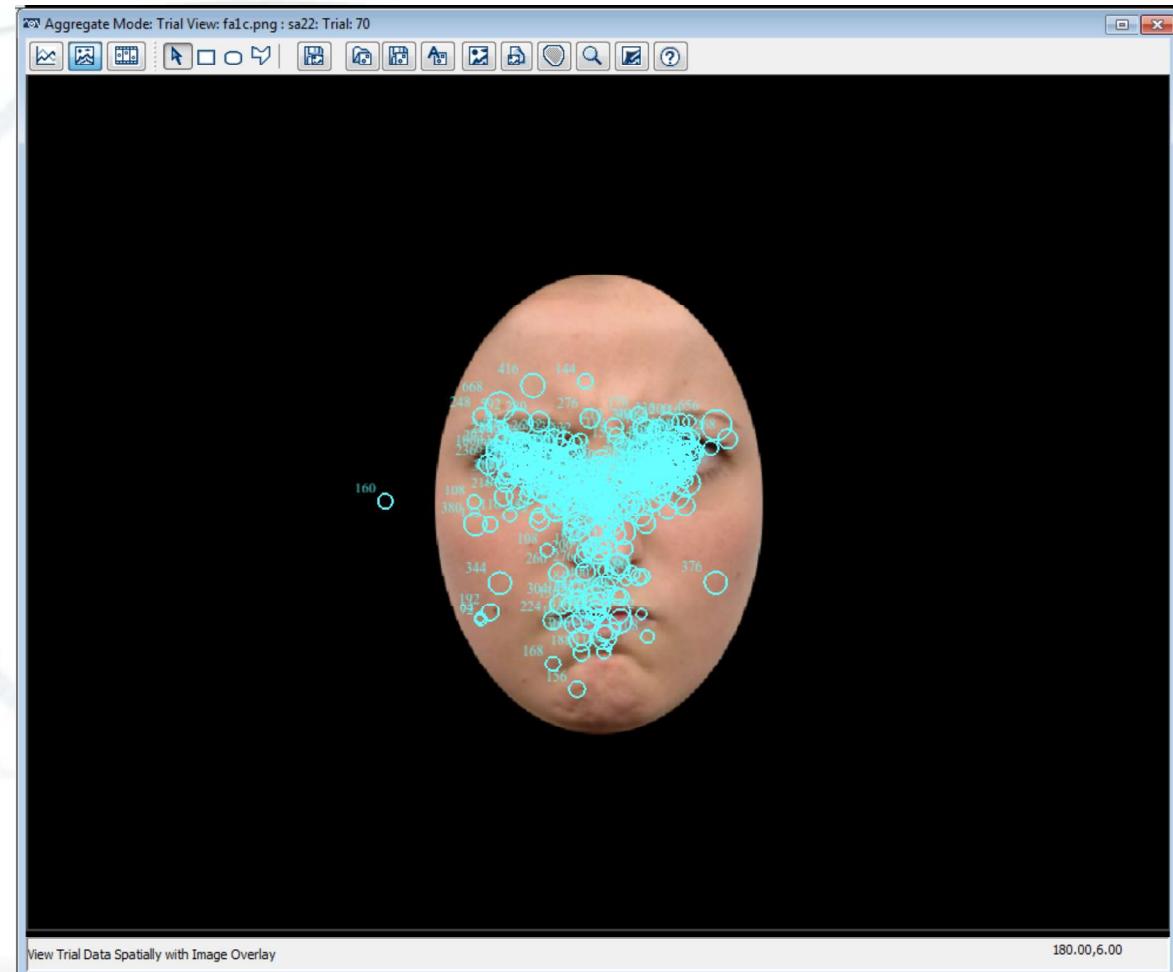
Spatial Overlay View
superimposes
saccade and fixation
scan-path information
over an image



EyeLink Data Viewer

Data visualization:

Aggregate Mode
superimposes data
from multiple trials /
participants

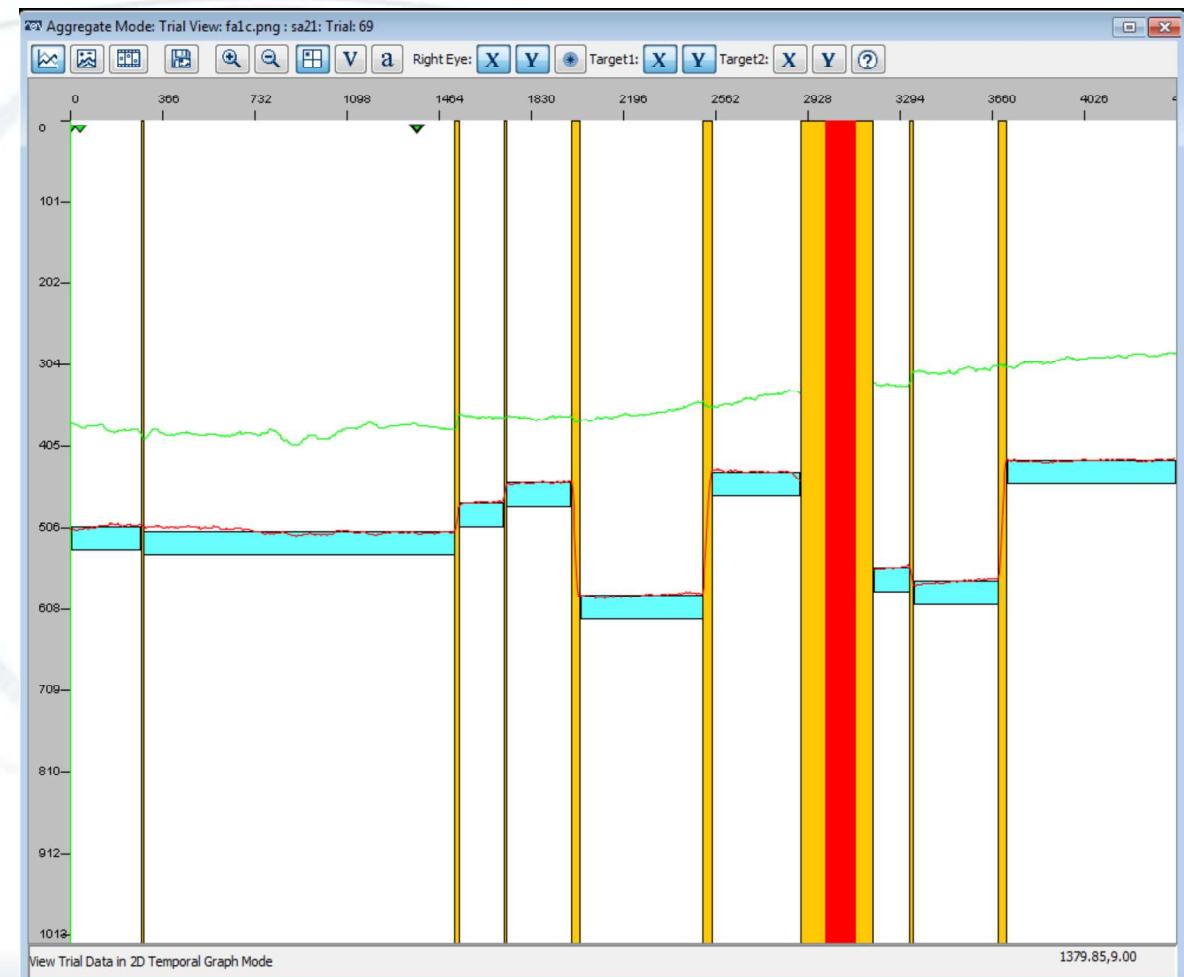


EyeLink Data Viewer

Data visualization:

Temporal Graph View
supports visualization
of eye data over time

Useful for seeing
when messages
appear and setting
Interest Periods

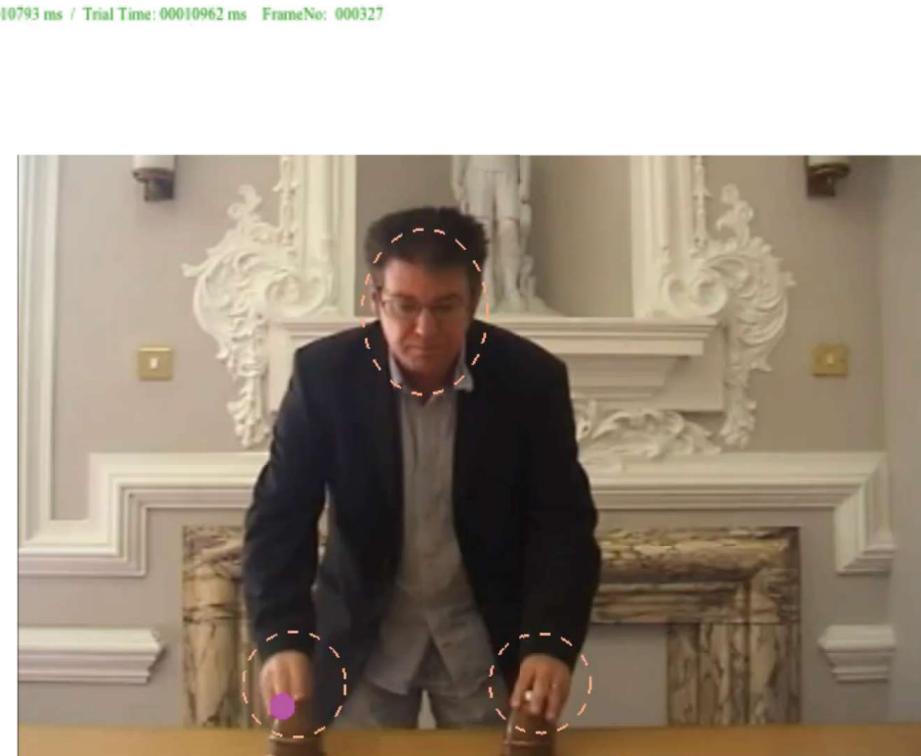


EyeLink Data Viewer

Data visualization:

Animation Playback
View shows a movie of the trial with eye movements overlaid.

Playback speed can be adjusted – helpful for the creation of dynamic interest areas using the Mouse Record technique.



EyeLink Data Viewer

In Aggregate Mode,
Animation Playback
view can show bee-
swarm and dynamic
heat maps.



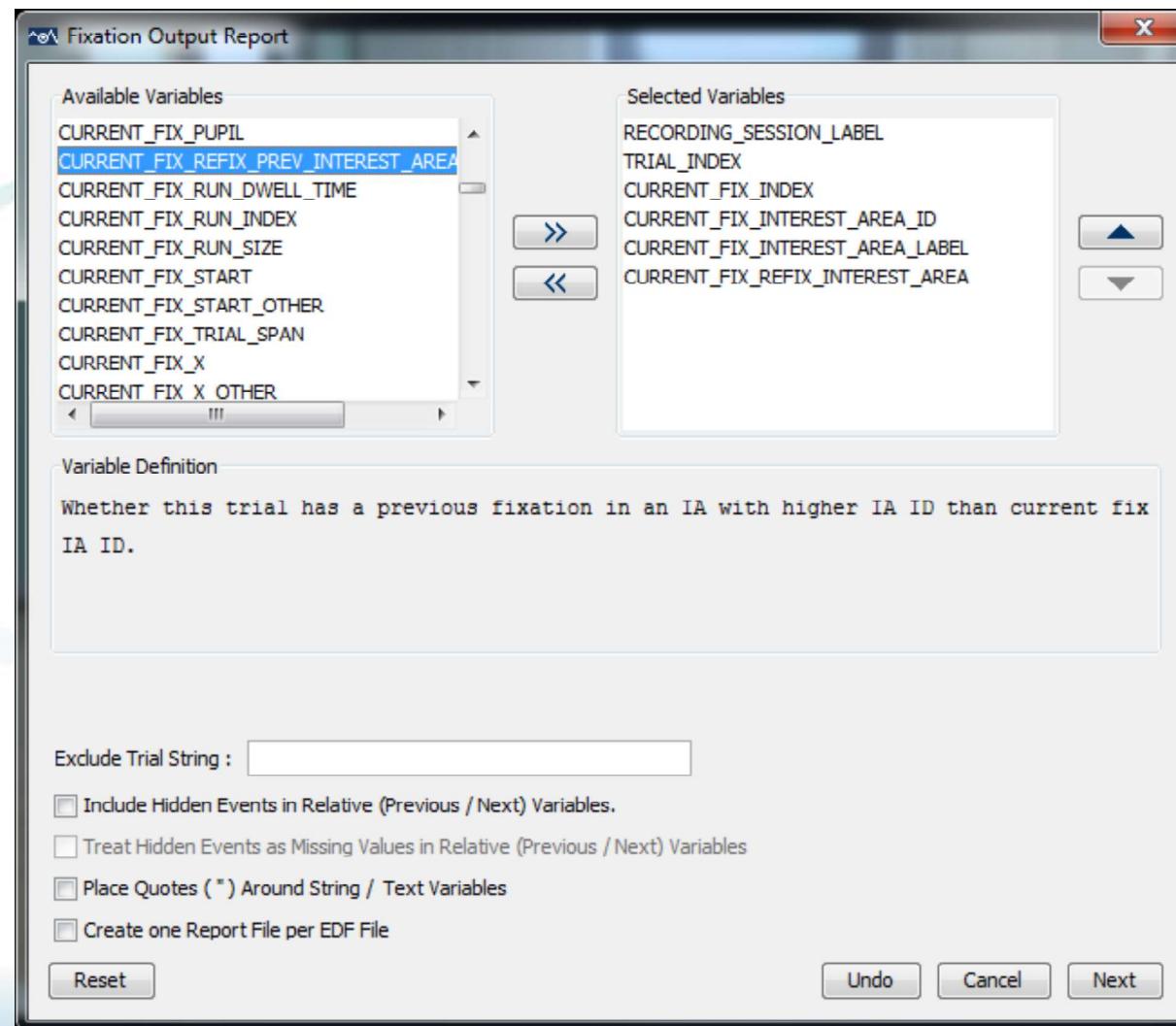


EyeLink Data Viewer

- Supports both static and dynamic interest areas (rectangular, elliptical, or freeform polygons)
- Create interest periods for temporal data filtering
- Group data using existing or new variables
- Generate heat maps / dynamic heat maps for selected trials
- Output eye sample, fixation, saccade, interest area, or trial-based reports for statistical analysis
- Output binned data for time-series analysis (Visual World Tasks / Dynamic Stimuli)
- Calculate hundreds of dependent measures including most common reading measures
- Highly integrated with SR Research Experiment Builder, E-Prime, Presentation, and any custom stimulus display solution
- Available on Windows, Mac OS X, and Linux

EyeLink Data Viewer

Generates detailed Fixation, Saccade, Interest Area, Sample and Trial reports





EyeLink Support

- Documents
 - EyeLink 1000 Plus User Manual
 - EyeLink 1000 Plus Installation Guide
 - EyeLink 1000 Plus Quick Start Guide
 - SR Research Experiment Builder User Manual
 - EyeLink Programmer's Guide
 - EyeLink Data Viewer User Manual
- Contact Information
 - Email: support@sr-research.com
 - Phone: 1-613-826-2958 / 1-866-821-0731
 - Support Forum: www.sr-support.com



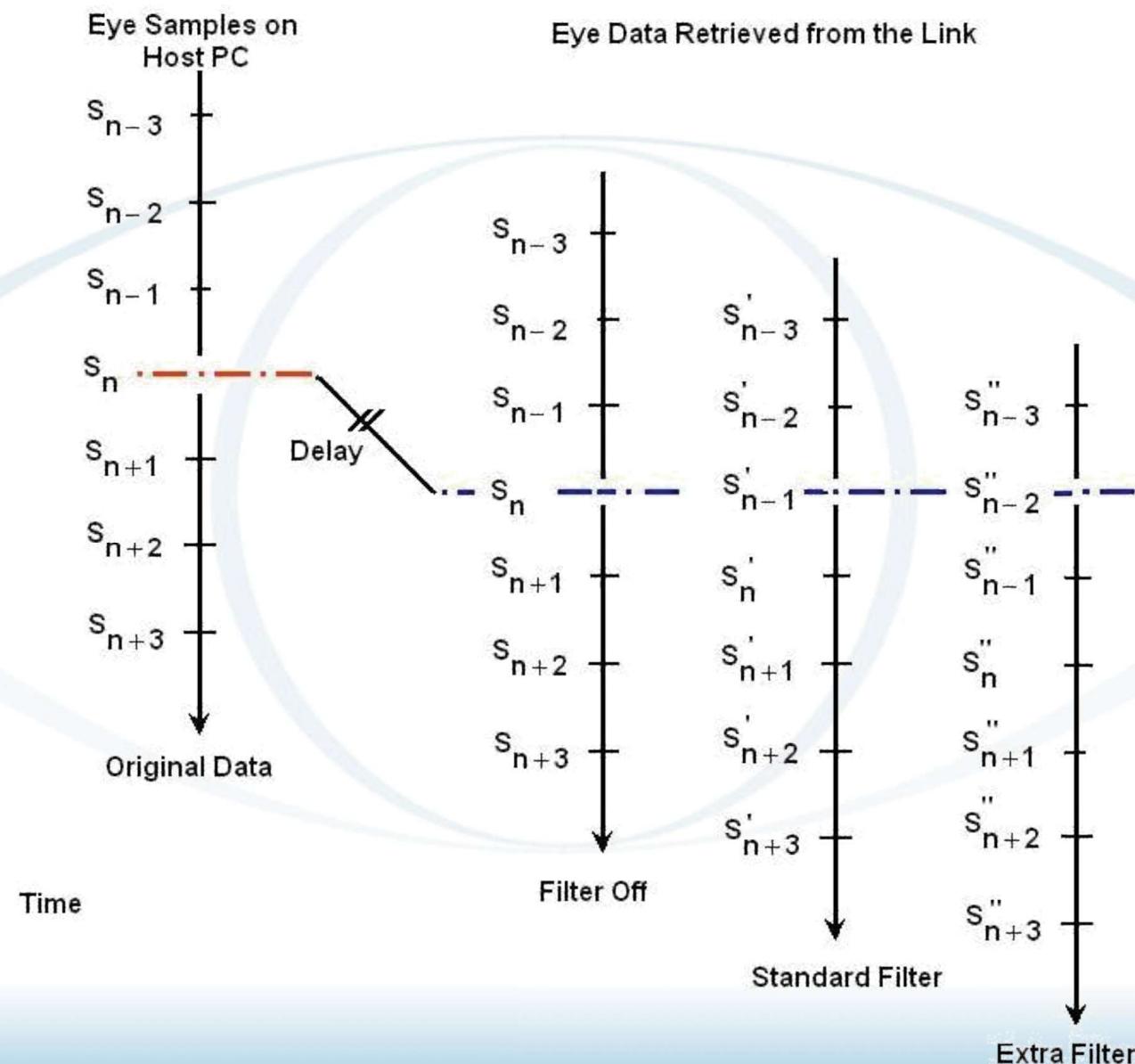
EyeLink Support Forums

SR Research Support

Welcome, WDM Notifications ▾ My Profile Settings Log Out

Forum	New Posts	Private Messages	Forum Actions ▾	Quick Links	Advanced Search
SR Research is pleased to announce the newest addition to our EyeLink series of eye trackers, the EyeLink Portable Duo ! The EyeLink Portable Duo brings the fast, accurate, reliable eye tracking you've come to expect from SR Research into a compact system that's easy to set up for eye tracking in daycares, schools, homes, or hospitals. Check out sr-research.com for more info!					
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Frequently Asked Questions Frequently Asked Questions about EyeLink Usage, Programming, and Data Analysis					
* Experiment Builder FAQ					
* Data Viewer FAQ					
* EyeLink Host PC and Hardware FAQ					
EyeLink Discussions related to EyeLink system usage					
Eyelink Usage Discussions on using the EyeLink systems and options, including set-up, calibration, etc.					
Programming Discussions related to programming the EyeLink systems					
Data Viewer Discussions regarding the EyeLink Data Viewer application					
General General Discussions not covered in other EyeLink forums					
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EyeLink Display Software Download the latest Display Software for the EyeLink System					
Data Analysis Download the latest EyeLink data analysis software					

Smart Data Filter



Host Application

- Camera Setup screen
 - Adjust camera image
 - Calibration
 - Validation
 - Drift Check
- Set Options screen
 - Select preferences / options
 - Set method of recording
- Record screen
 - Real-time gaze cursor / Plot View

Camera Setup screen

EXP: 101%

Image Thresholds

Auto Threshold

Pupil

Corneal

Tracking Mode

Pupil-CR

Sample Rate

250 **500** **1K** **2K**

Pupil Tracking

Centroid **Ellipse**

Image Display

Crosshairs

Threshold Coloring

Image->Display PC

Use Search Limits

Mouse Autothresh.

Illuminator Power

100% **75%** **50%**

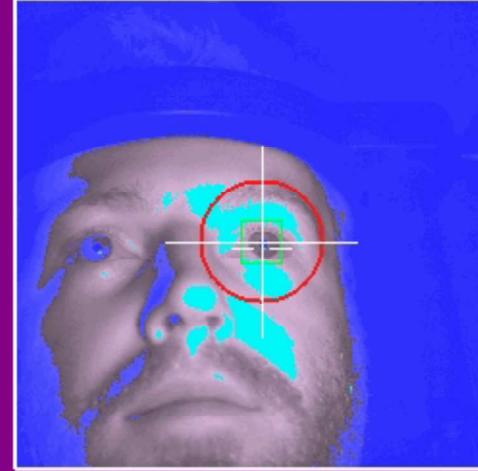


IMAGE NOT AVAILABLE

EYE NOT AVAILABLE

Pupil: 124
CR : 216

PUPIL OK
CR OK

Eye Tracked: **Left** **Right**

Camera Setup

Desktop Monocular

Screens

Exit Setup

Offline

Output/Record

Set Options

Help (F1)

Calibrate

Validate

Drift Correct

Set Options screen

Calibration and Validation

Calibration Type:

Pacing Interval: OFF

Tracking

Pupil Size Data:

Events and Data Processing

Eye Event Data:

Saccade Sensitivity:

File Sample Filter: OFF

Link/Analog Filter: OFF

Configuration

Desktop (Level)
Monocular
35mm lens
Stabilized Head
Camera Level
CAM-ILLUM

File Data Contents:

File Sample Contents:

Recording Data View

Record View:

Plot:

Set Options

TCP/IP Link Open

Screens

Settings

Video Overlay

Set Configuration menu

Calibration and Validation				Configuration		Set Options	
SET CONFIGURATION							
				Accept	Cancel		
C	P	D	E	F	G	H	I
Desktop (Level)	Monocular	35mm lens	Stabilized Head	Camera Level	CAM--	M	TABLER
Desktop (Level)	Binoc/Monoc	35mm lens	Stabilized Head	Camera Level	CAM--I	B	TABLER
Desktop (Remote)	Monocular	16mm lens	Target Sticker	Camera Level	CAM--	R	TABLER
Arm Mount (Remote)	Monocular	16mm lens	Target Sticker			A	RTABLER
Arm Mount (Level)	Monocular	35mm lens	Stabilized Head			A	AMTABLER
				File Data Contents:			
				Samples			
				Events			
				File Sample Contents:			
				Raw Eye Position			
				HREF Position			
				Gaze Position			
				Button Flags			
				Input Port Data			
				Settings			
				Revert to Last			
				Load Defaults			
				Video Overlay			
				Enable Overlay			
Events and Data Processing							
Eye Event Data				Gaze	HREF		
Saccade Sensitivity				NORMAL	HIGH		
File Sample Filter				OFF	STD	EXTRA	
Link/Analog Filter				OFF	STD	EXTRA	
Recording Data View							
Record View				Gaze Cursor	Plotting		
Plot				Gaze	Angle	HREF	Raw

Record screen

Call me Ishmael. Some years ago -- never mind how long precisely -- having little or no money in my purse, and nothing particular to interest me on shore, I thought I would sail about a little and see the watery part of the world. It is a way I have of driving off the spleen, and regulating the circulation. Whenever I find myself growing grim about the mouth; whenever it is a damp, drizzling November in my soul; whenever I find myself involuntarily pausing before coffin warehouses, and bringing up the rear of every funeral I meet, I account it high time to get to sea as soon as I can. This is my substitute for pistol and ball. With a philosophical flourish Cato throws himself upon his sword; I quietly take to the ship.

Record

TCP/IP Link Open

Stop Recording

Stop
Recording

Abort Trial

PUPIL

OK	OK
SIZE	SIZE
MISSING	MISSING
OK	OK
CORNEAL	CORNEAL
OK	OK
MISSING	MISSING

Plot View

Duration (sec):

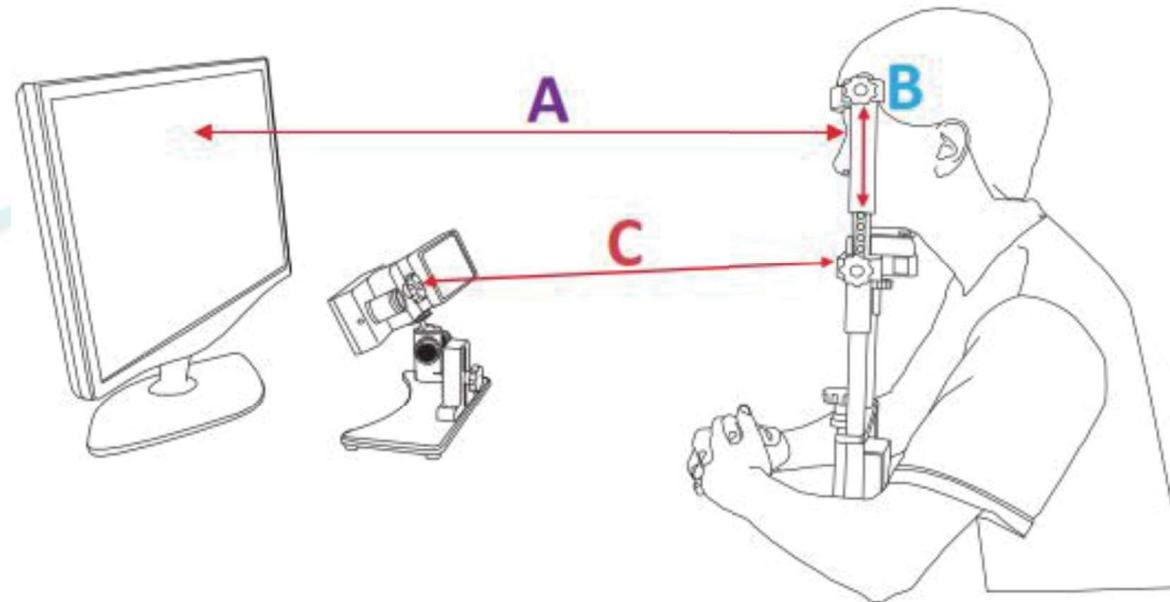
21



Tracking: Right Eye, 1000 Hz, Pupil-CR
Data to: File 'SDEMO.EDF' (Samples and Events)
Link (Samples and Events)

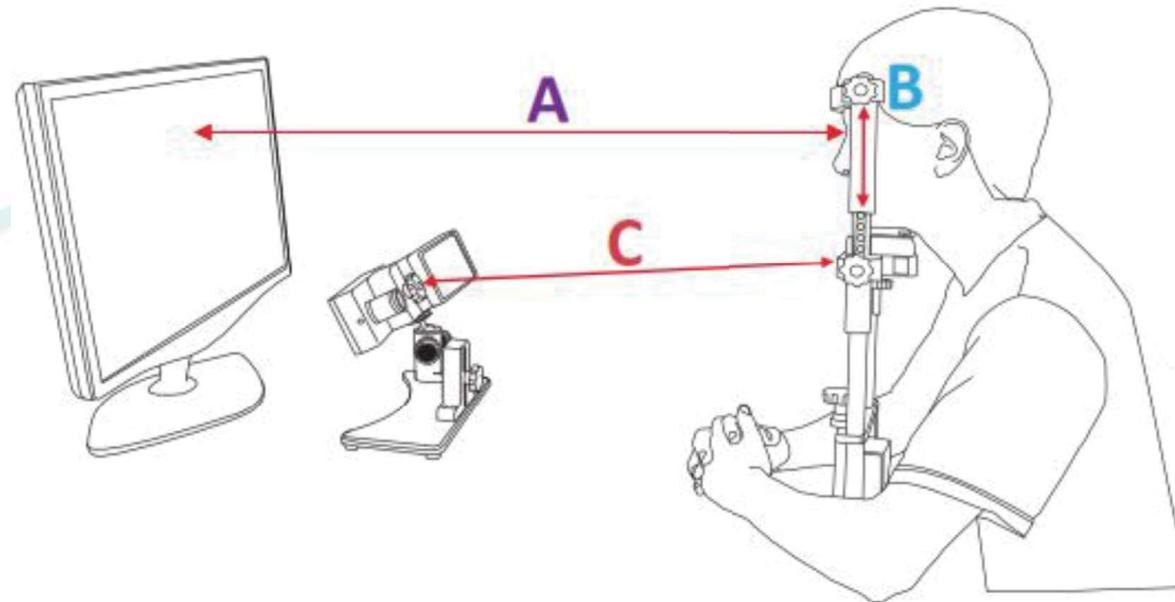
Title: TRIAL RECORDING: TEXT

Physical Setup



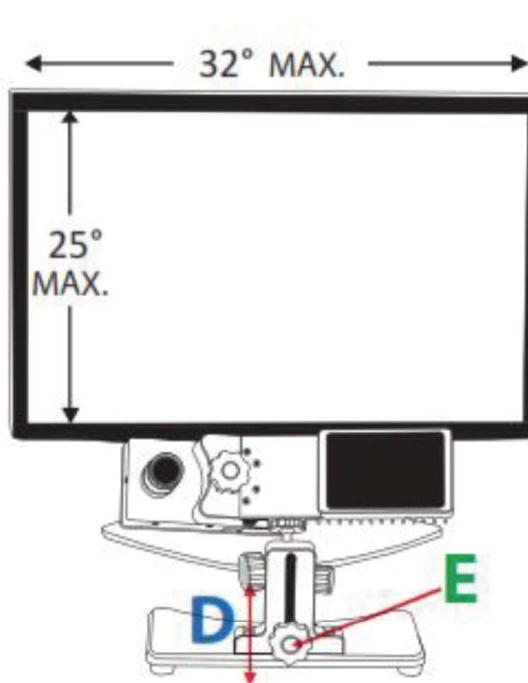
- A) Position the monitor so that it subtends no more than 32 degrees of visual angle horizontally and 25 degrees of visual angle vertically for the participant.
- The eye-to-screen distance should be at least 1.75 times the width of the display to ensure that it falls within the trackable range

Physical Setup



- B) Position the participant so that the eyes align with the top quarter of the monitor – adjust the chair and/or the head support to ensure this alignment
- C) Position the eye tracker so that the distance from the top knob on the front of the Desktop Mount to the front of the chinrest is 50-55 cm. If using remote mode make sure that the reported target distance on the Host PC is around 60cm (55-60 is ideal for calibration)

Physical Setup



- D) Adjust the height of the eye tracker so that it is as high as possible without blocking the participant's view of the display
- E) Position the eye tracker so that its bottom knob is centered horizontally with the front of the display

File Manager

- For the Host software press CTL+ALT+Q to exit back to the File Manager interface
- To access configuration setting select gear icon in top left corner

Screen Setting

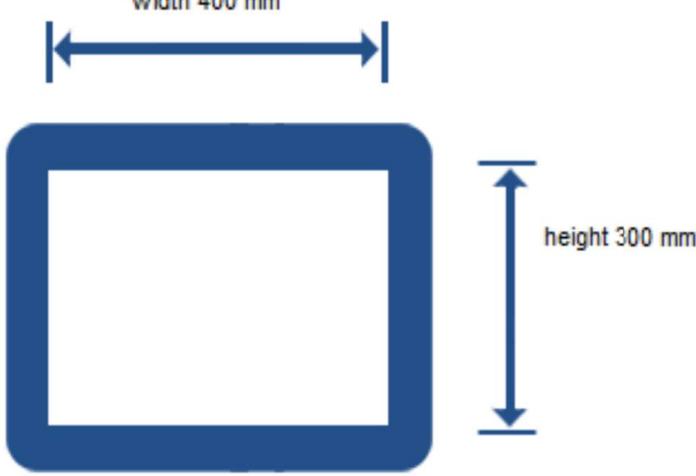
Screen Dimensions

Display Resolution

Eye-to-Screen Distance

Camera-to-Screen Distance

Optimal Target-to-Camera Distance



The diagram shows a blue-bordered rectangle representing a monitor screen. A horizontal double-headed arrow at the top indicates the width is 400 mm. A vertical double-headed arrow on the right indicates the height is 300 mm.

width 400 mm

height 300 mm

Width of the viewable portion of the Display PC monitor (in millimeters) :

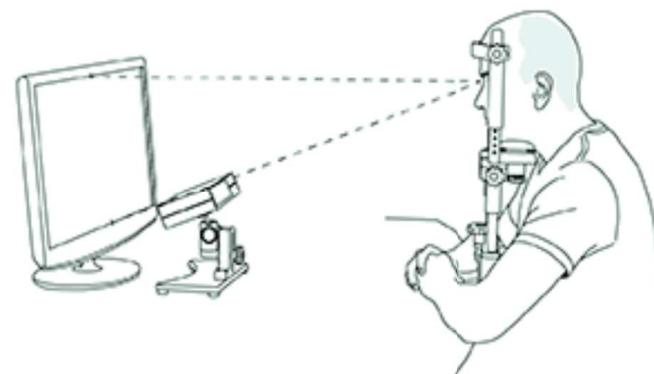
Height of the viewable portion of the Display PC monitor (in millimeters) :

- Enter the physical dimensions of the stimulus display into the screen settings wizard.

Screen Setting

Screen Dimensions
Display Resolution
Eye-to-Screen Distance
Camera-to-Screen Distance
Optimal Target-to-Camera Distance

distance to top 700 mm



distance to bottom 760 mm

Distance from eye to the top of the viewable portion of the Display PC monitor (in millimeters) :

Distance from eye to the bottom of the viewable portion of the Display PC monitor (in millimeters) :

Save

Back

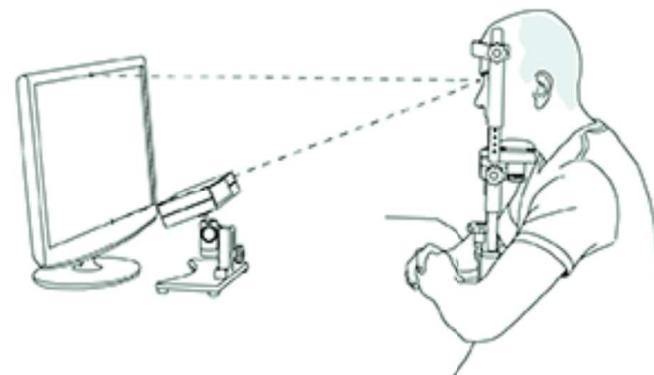
Next

- Enter in the distance from the participant's eye to the top of the display image and the bottom of the display image.

Screen Setting

Screen Dimensions
Display Resolution
Eye-to-Screen Distance
Camera-to-Screen Distance
Optimal Target-to-Camera Distance

distance to top 700 mm



distance to bottom 760 mm

Distance from eye to the top of the viewable portion of the Display PC monitor (in millimeters) :

Distance from eye to the bottom of the viewable portion of the Display PC monitor (in millimeters) :

Save

Back

Next

- Enter in the distance from the participant's eye to the top of the display image and the bottom of the display image.

Participant Setup

EXP:101%

thresholds

Auto Threshold

Pupil **Corneal**

Tracking Mode

Pupil-CR

Sample Rate

250 **500** **1K** **2K**

Pupil Tracking

Centroid **Ellipse**

Image Display

Crosshairs

Threshold Coloring

Image->Display PC

Use Search Limits

Mouse Autothresh.

Illuminator Power

100% **75%** **50%**

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EYE NOT AVAILABLE

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CR OK

Eye Tracked: **Left** **Right**

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Desktop Monocular

Screens

Exit Setup

Offline

Output/Record

Set Options

Help (F1)

Calibrate

Validate

Drift Correct



Participant Setup - Desktop

- 1) Adjust camera angle and position to get a good view of the eye(s)
- 2) Click pupil in the global view to autothreshold
(Host or Display PC)
- 3) Focus the camera - minimize size of teal CR circle
- 4) Autothreshold and adjust pupil and CR thresholds
 - If cautious or troubleshooting, check the setup by asking the subject to look at four corners
 - If the CR is smeared move the Desktop Mount toward the problematic corner until CR is tracked
- 5) Calibration
- 6) Validation
- 7) Recording

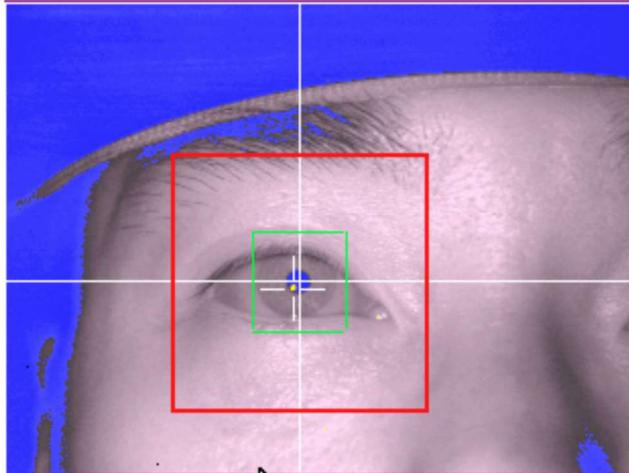
Participant Setup - Tower

Never adjust the Tower Mount with subject's head in place

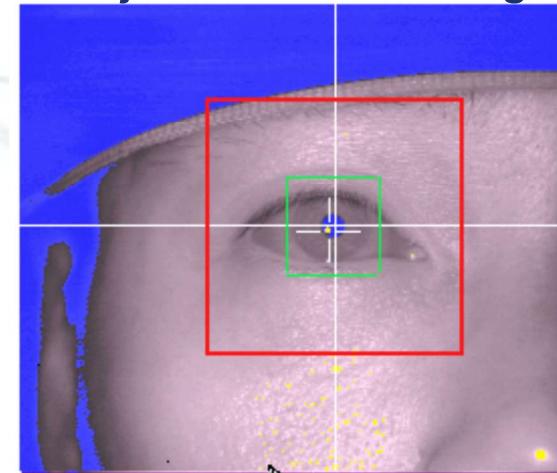
- 1) Set the eye-selection knob to track the dominant eye
- 2) Adjust the mirror angle to get a good view of the eye, or to avoid glasses reflections; adjusting chin position may help too
- 3) Click pupil in the global view to autothreshold (Host Display PC)
- 4) Focus the camera - minimize size of teal CR circle
- 5) Autothreshold and if necessary, adjust pupil and CR thresholds
 - If cautious or troubleshooting, check the setup by asking the subject to look at four corners while monitoring threshold quality at all positions
- 6) Calibration
- 7) Validation
- 8) Recording

Participant Setup

Optimal Eye Position

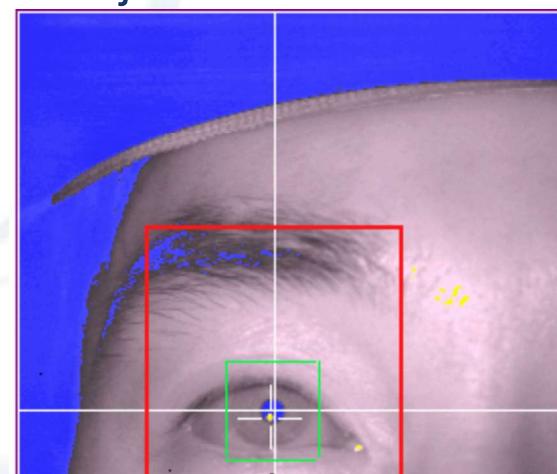


Subject seated too high



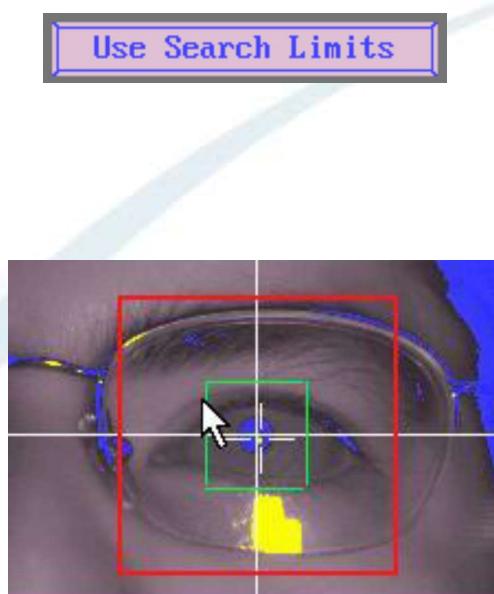
- Adjust chair height so the subject is comfortable and has line of sight to upper part of monitor
- Forehead rest should be just above the eyebrow.

Subject seated too low



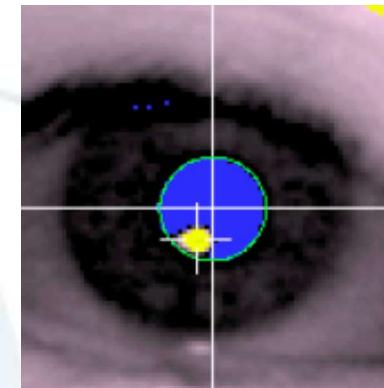
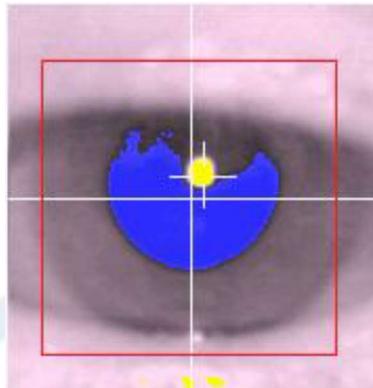
Participant Setup

- Search Limits (red box) can be used to reduce the area of the image that is searched to find the eye.
- Prevents system from switching to opposite eye.
- You can hold ALT + arrow keys to adjust the size and shape of the search limits.
- Use SHIFT + arrow keys to adjust the position of the search limits



Participant Setup

Centroid vs. Ellipse pupil tracking modes



Centroid model fitting:

- Tracks center of a circle fit to thresholded pupil
- Advantages:
 - Highly stable
 - Low noise
- Disadvantage:
 - Position drift if pupil is occluded by eyelid

Ellipse model fitting:

- Tracks center of an ellipse fit to thresholded pupil.
- Advantages:
 - Decreased drift
 - Overcomes pupil occlusion
- Disadvantage:
 - Slightly higher noise level

Participant Setup

Setting Pupil Threshold

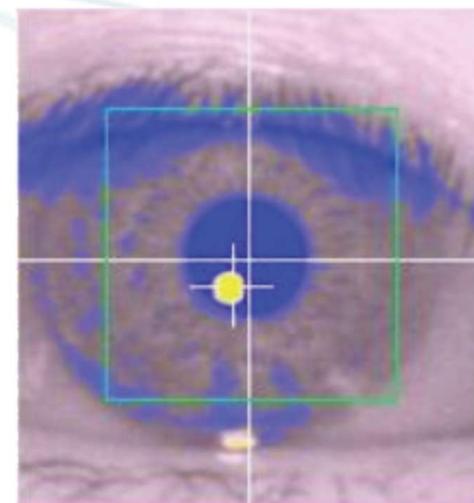
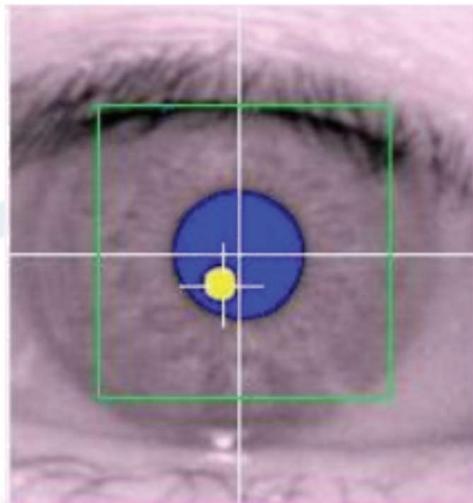


Fig. 1

Pupil threshold can be adjusted automatically, through the Auto-Threshold command, or manually, through the up and down arrows. A threshold too high will result in shadows (Fig. 1), while a threshold too low will result in a noisy signal (Fig. 2).

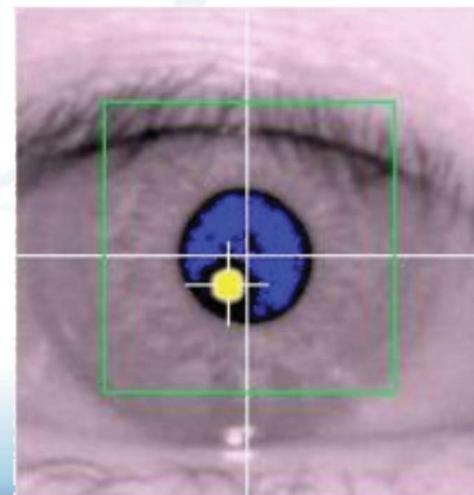
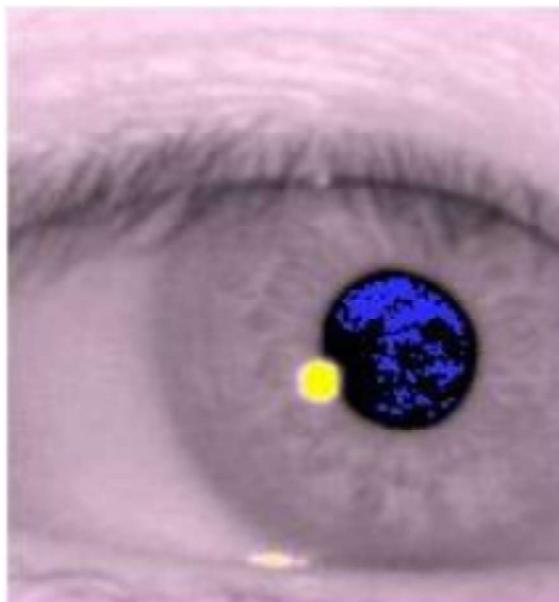


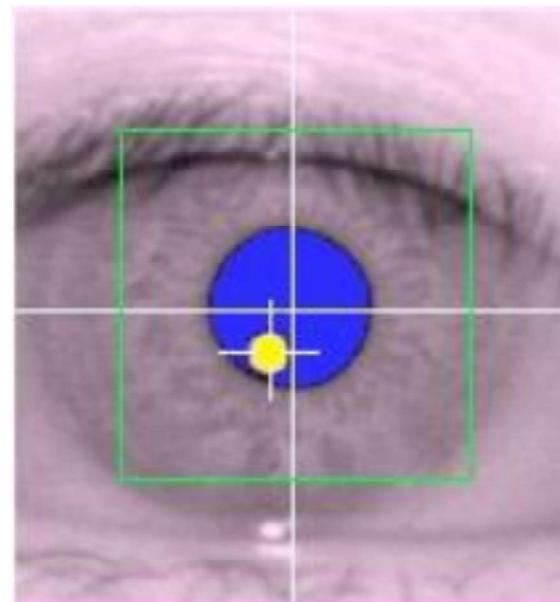
Fig. 2

Participant Setup

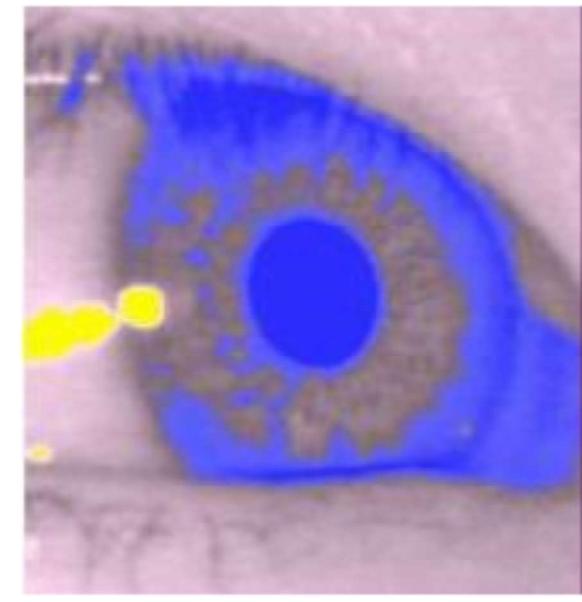
Symptoms of Poor Pupil Threshold



Pupil clipped and lost



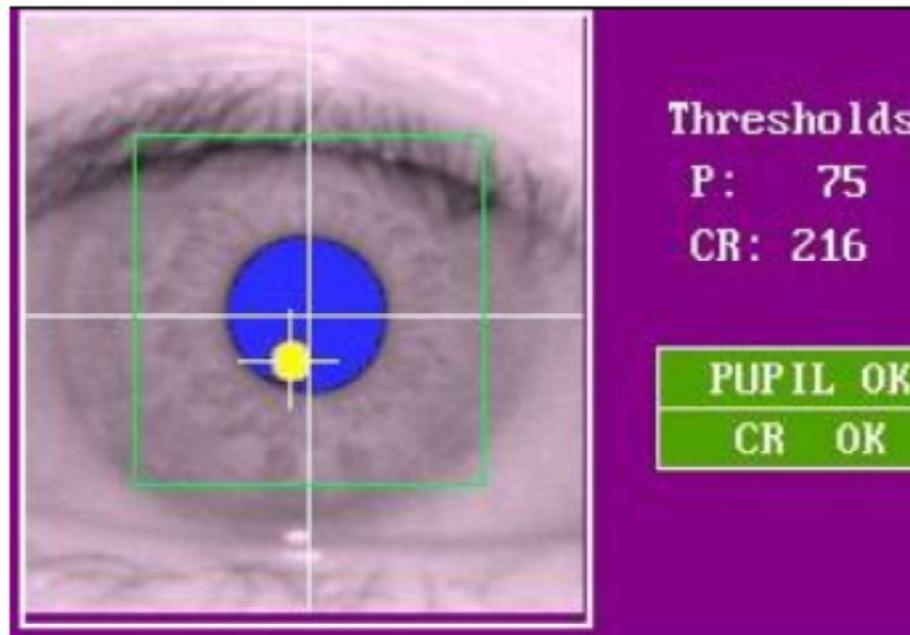
Good



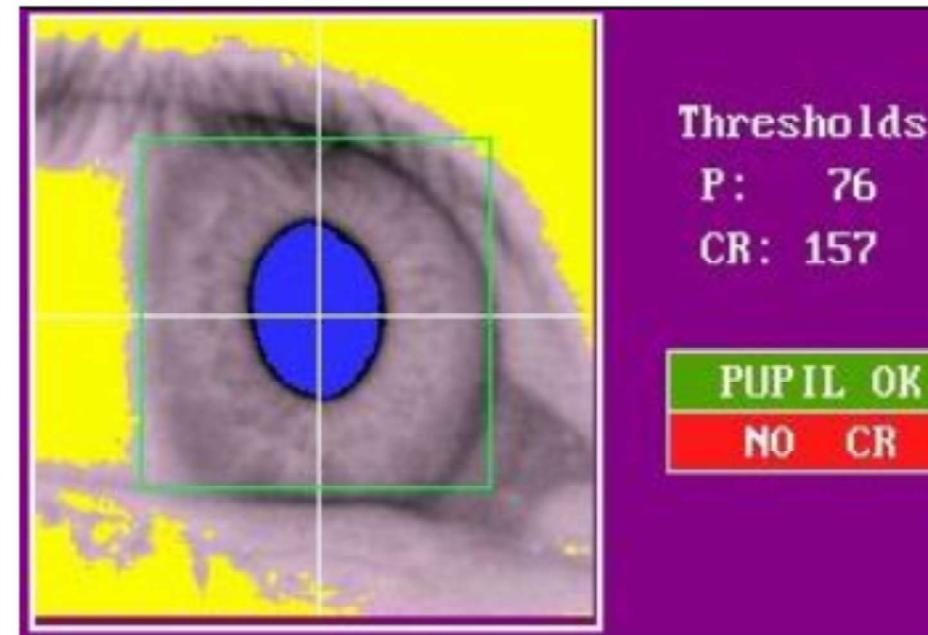
Corner shadow
captures pupil

Participant Setup

Setting Corneal Reflection (CR)



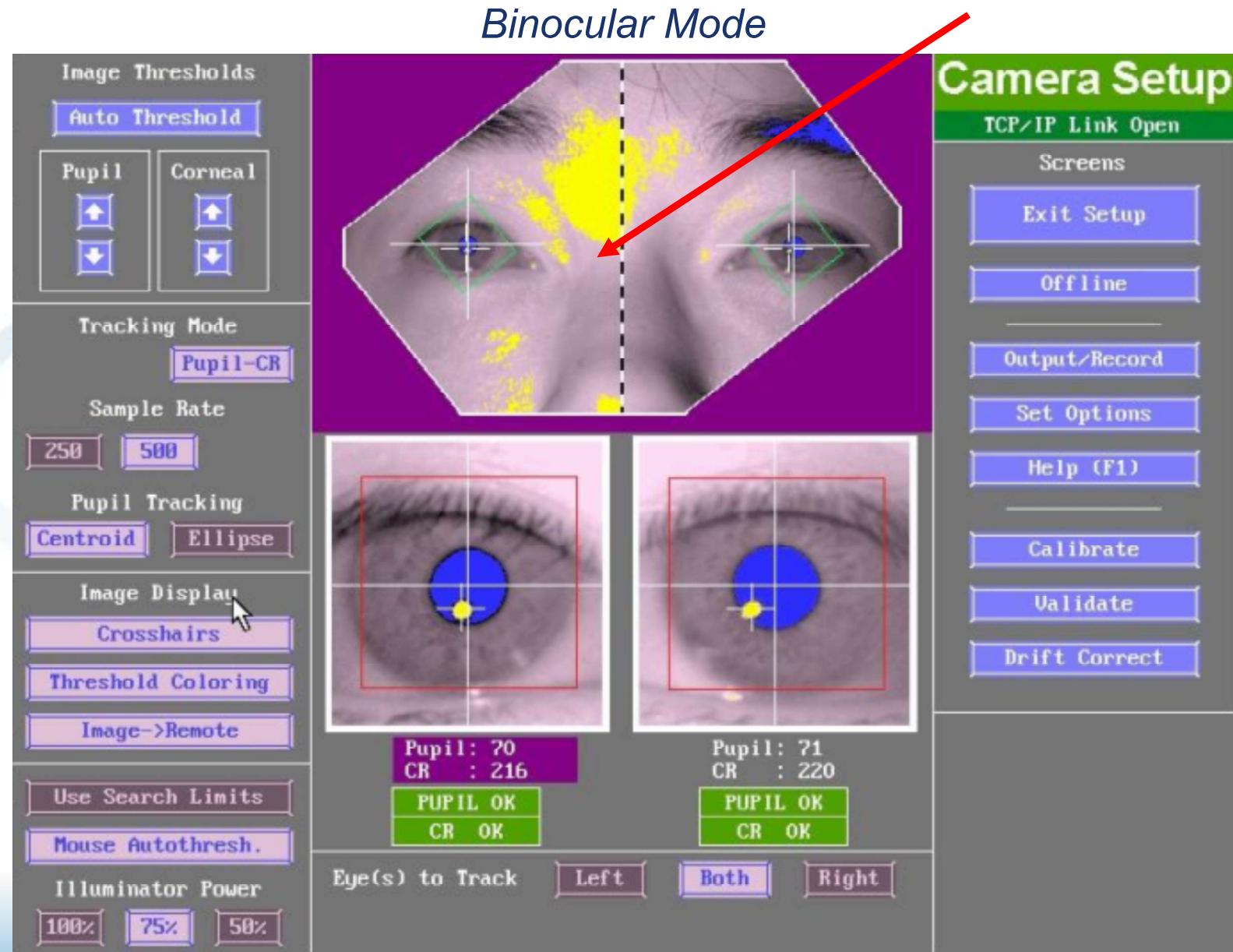
Good corneal reflection



Poor corneal reflection

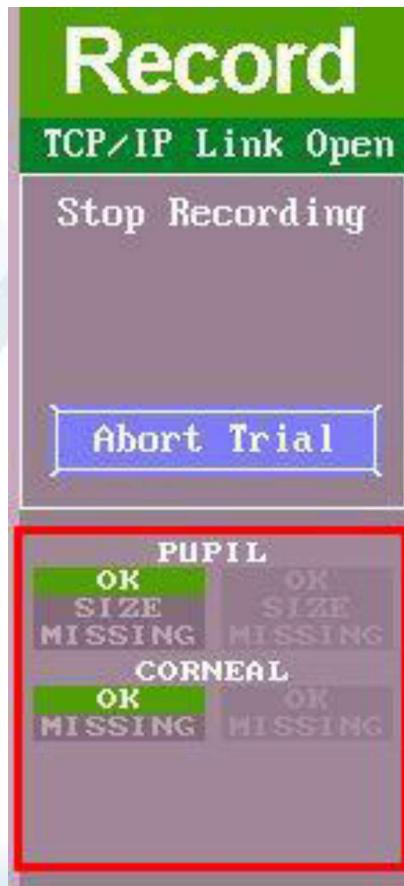
Adjust corneal reflection using + and – keys. Note that the – key increases the thresholded area.

Participant Setup



Status Panel

Monitor the status of camera image of the tracked eye throughout setup, calibration, validation and recording phases.



Pupil:

OK: Pupil present and can be tracked at selected sample rate

SIZE: Occurs when pupil size is larger than the maximum allowed pupil size

MISSING: Pupil not present

Corneal reflection:

OK: CR present and can be tracked

MISSING: CR is not present

Participant Setup - Remote

- 1) Place the target on the subject's forehead
- 2) Adjust camera angle and position to get a good view of the eye and sticker; capture as wide a range of subject movement as possible
- 3) Click pupil in the global view to autothreshold (Host Display PC)
- 4) Focus the camera - minimize size of teal CR circle
- 5) Adjust thresholding bias for pupil and CR
 - If cautious or troubleshooting, check the setup by asking the subject to look at four corners
 - If the CR is smeared move the Desktop Mount toward the problematic corner until CR is tracked
- 6) Calibration
- 7) Validation
- 8) Recording



Participant Setup - Remote

Image Thresholds

Pupil	Corneal

Tracking Mode

Pupil-CR

Sample Rate

250 500

Pupil Tracking

Ellipse

Image Display

Crosshairs

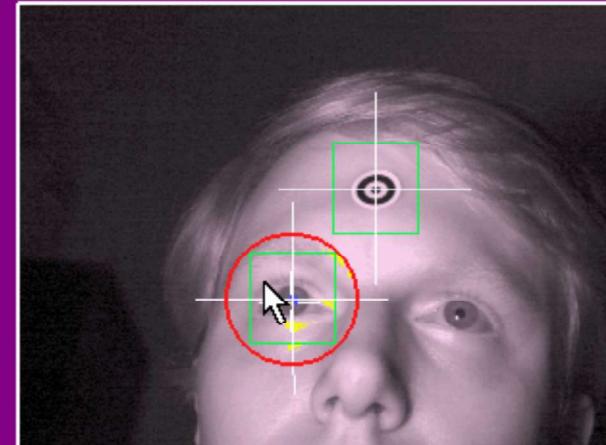
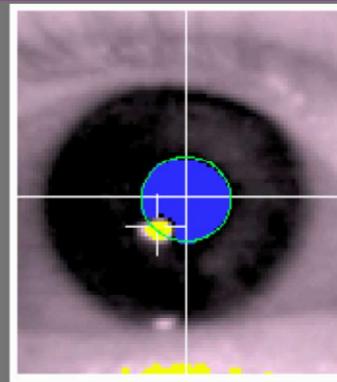
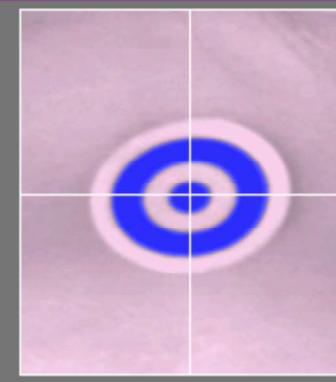
Threshold Coloring

Image->Remote

Align Eye Window

Illuminator Power

100% 75%

Pupil: 86 AUTO x1.05
CR : 203 AUTO x1.00

TARGET OK
DIST OK

Target Thr: 142
Distance: 594.6 mm

PUPIL OK
CR OK

Eye Tracked: Left Right

Camera Setup

TCP/IP Link Open

Screens

Exit Setup

Offline

Output/Record

Set Options

Help (F1)

Calibrate

Validate

Drift Correct

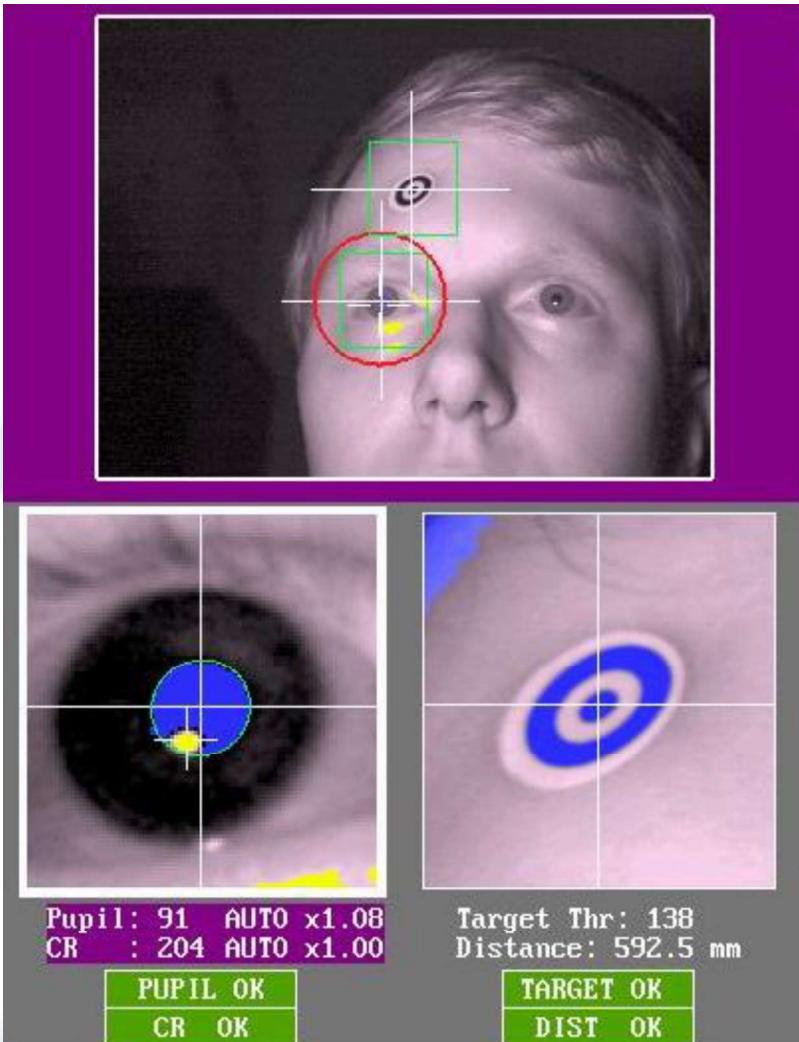


Participant Setup - Remote

Participant setup becomes a smooth and fast procedure with practice. Follow these steps:

- 1) Use proper lens and set ELCL configuration to “Desktop (Remote)”
- 2) Set the height of the monitor; eye-to-screen distance of about 70 cm
- 3) Place camera right in front of the monitor
- 4) Raise desktop mount to maximize tracking range
- 5) Seat the subject and place the target sticker
- 6) Find the pupil by clicking on the eye image
- 7) Adjust the thresholding bias for pupil and CR
- 8) Check setup by asking subject to look at four corners
- 9) Calibration, validation and recording

Participant Setup - Remote

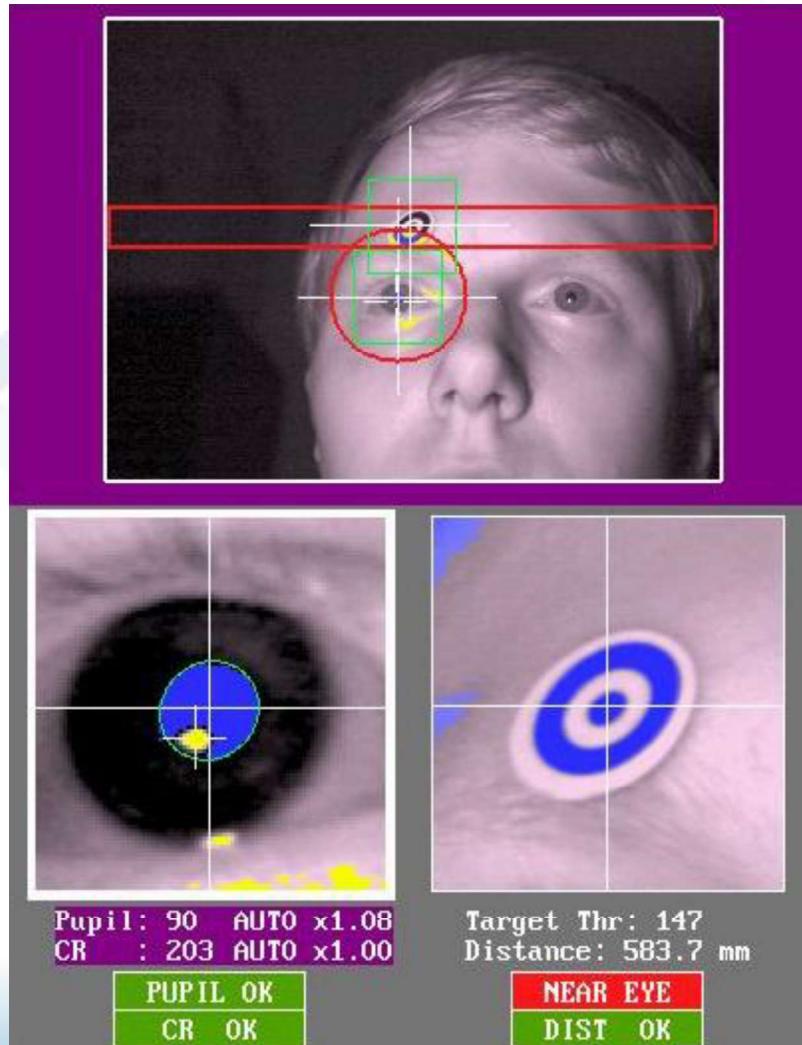


- Place target sticker on the subject's forehead
- The eye and sticker should stay within the camera image when the subject moves
- Ideal target-to-camera distance is 550mm to 600mm for calibration
- For highest accuracy use 13-point calibration

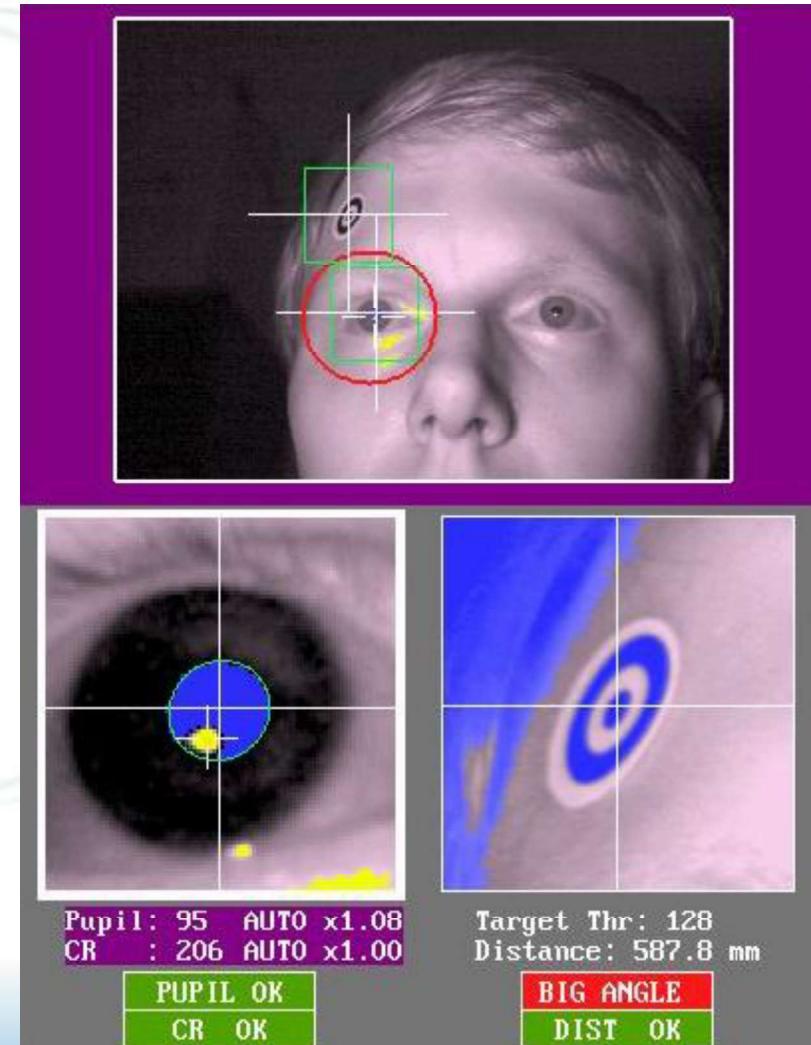


Participant Setup - Remote

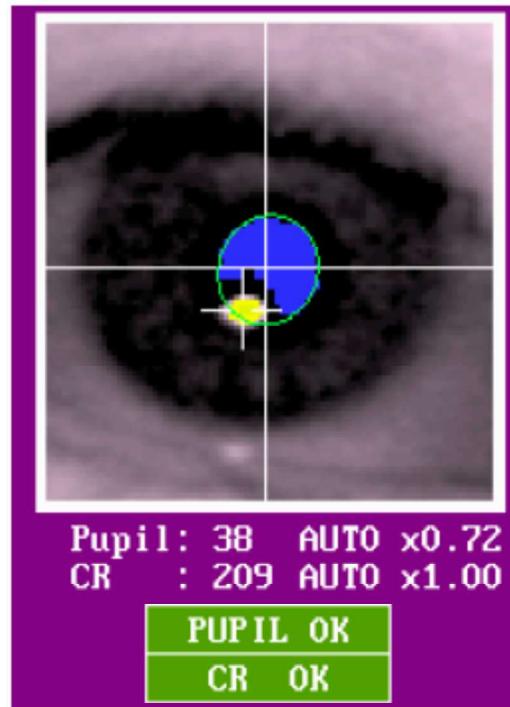
Target too close to the eye vertically



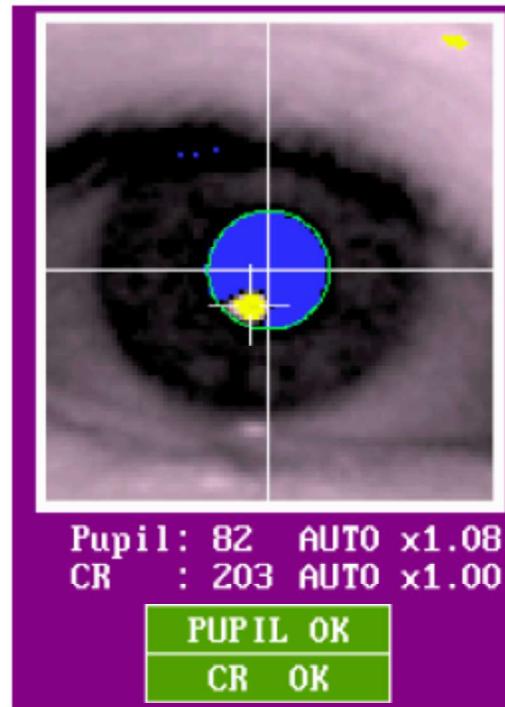
Target has a large angle



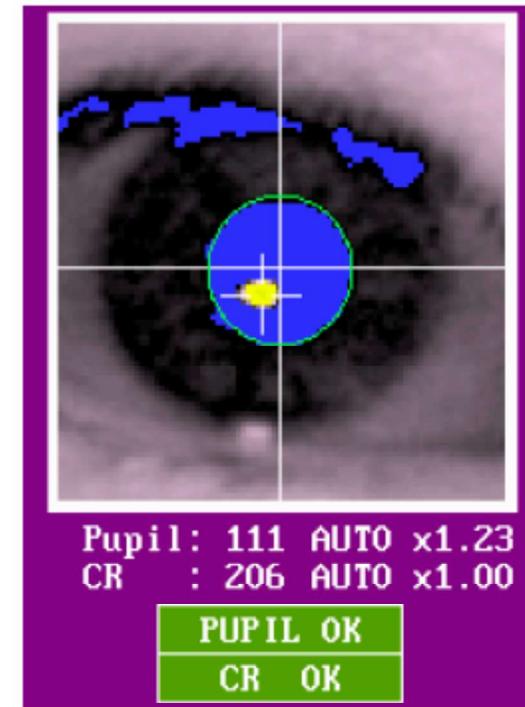
Participant Setup - Remote



Threshold bias too low



Properly thresholded



Threshold bias too high

Pupil threshold bias adjusted by up and down arrow keys
(1.08 typical)

CR threshold adjusted by + and – keys (1.00 typical)

Participant Setup - Remote



- Monitor the thumbnail camera images at the lower left corner of the tracker screen.
- The two dots in the middle panel reflect the target dot and eye position in the camera image
- For reliable tracking, both dots should stay within the red box

Participant Setup - Remote

Pupil

OK: Pupil present and can be tracked at selected sample rate

SIZE: Occurs when the pupil size is larger than the maximum allowed

MISSING: Pupil not present

Corneal

OK: Corneal reflection is present and can be tracked

MISSING: Corneal reflection is not present

Target

OK: Target is present and can be tracked

MISSING: Target is not present

NEAR EYE: Target is placed too close to the eye on the vertical dimension

ANGLE: Target has too low an angle to be recognized properly

Status Panel

PUPIL		CORNEAL	
OK	OK	SIZE	SIZE
SIZE	MISSING	MISSING	MISSING
MISSING	CORNEAL	OK	OK
CORNEAL	OK	MISSING	MISSING
OK	MISSING	MISSING	MISSING
TARGET		ANGLE	
OK	MISSING	OK	ANGLE

Calibration

Calibrate

TCP/IP Link Open

Screens

Camera Setup

Help (F1)

PUPIL

OK	OK
SIZE	SIZE
MISSING	MISSING
MORNEAL	
OK	OK
MISSING	MISSING

Sequencing

Restart

Auto Trigger

Accept Fixation

STABLE

Point 7 of 10

The interface shows a black calibration screen with a 9-point grid and a small image of an eye with a blue dot. Below the screen, there are two input fields for thresholds: P: 101 and CR: 221. To the right, status information indicates tracking of the left eye and pupil-CR, and a 9-point calibration is in progress.

Thresholds:

P: 101

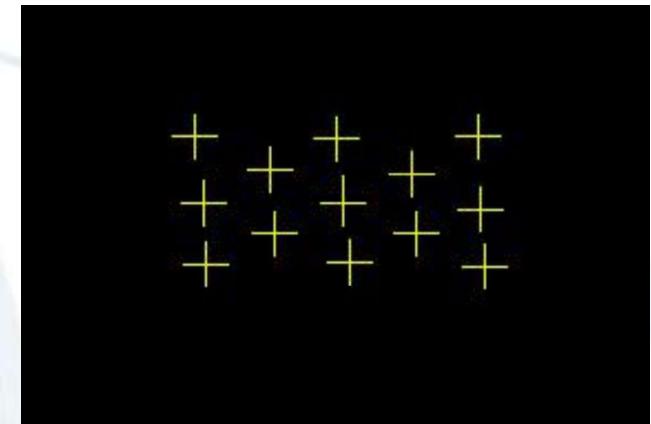
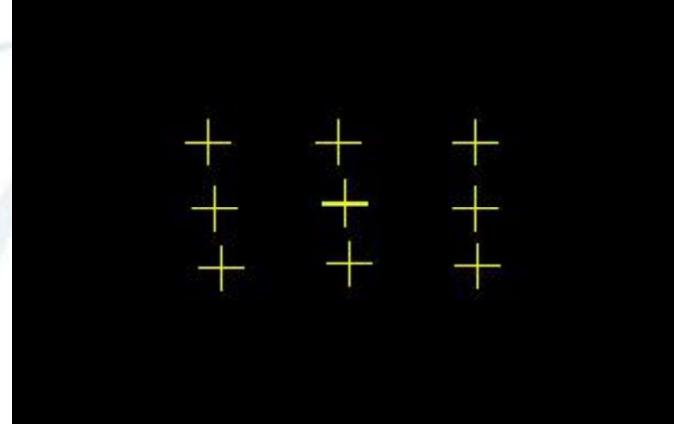
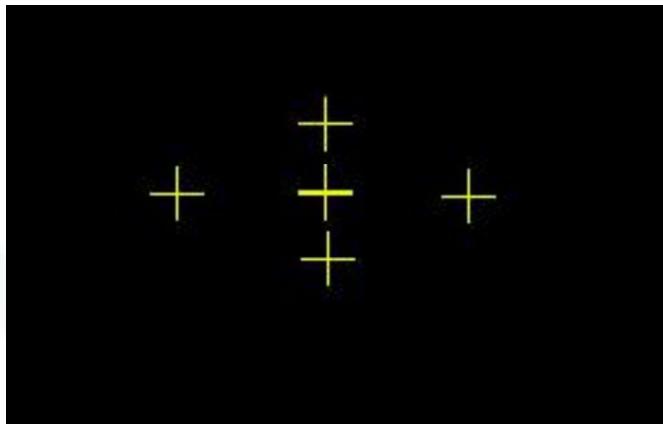
CR: 221

Tracking: Left Eye, Pupil-CR

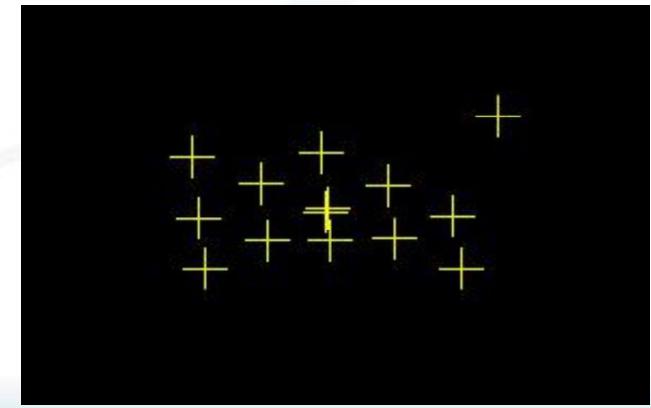
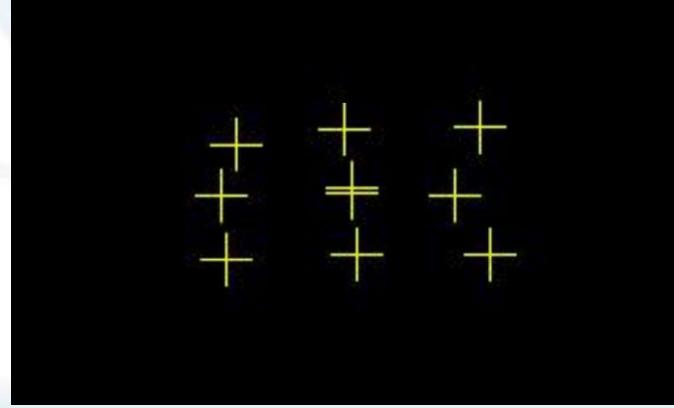
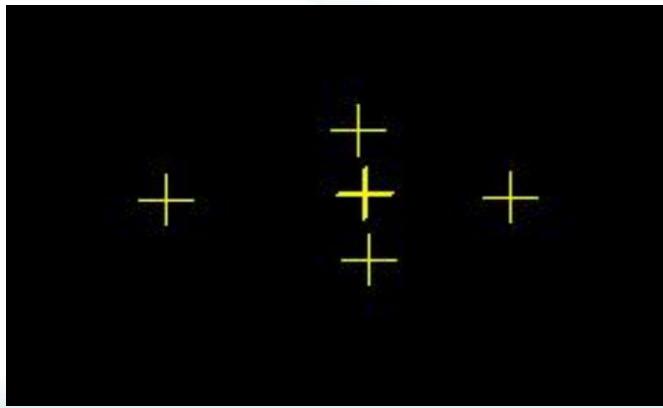
Calibration: 9 point grid

Calibration

Good Calibration models (symmetrical)



Poor Calibration models (asymmetrical)



Calibration

- To improve calibration accuracy:
 - Check pupil and CR as the subject looks at all four corners of the display. They should always be visible, well-thresholded, and tracked.
 - Encourage subject to sit still—no head turning!
 - Redo targets by pressing the backspace key
 - Turn on manual accept mode by pressing the SPACE key twice to ensure subject is fixating calibration target
 - Match background color of calibration/validation screen to test displays—change in pupil size due to large brightness differences can cause drift

Validation

Checking gaze accuracy of the calibration



Validation Results

Validation Results

- GOOD (green background): Level of error is acceptable
- FAIR (grey background): Error is moderate; calibration should be improved
- POOR (red background): Error is too high for useful eye tracking

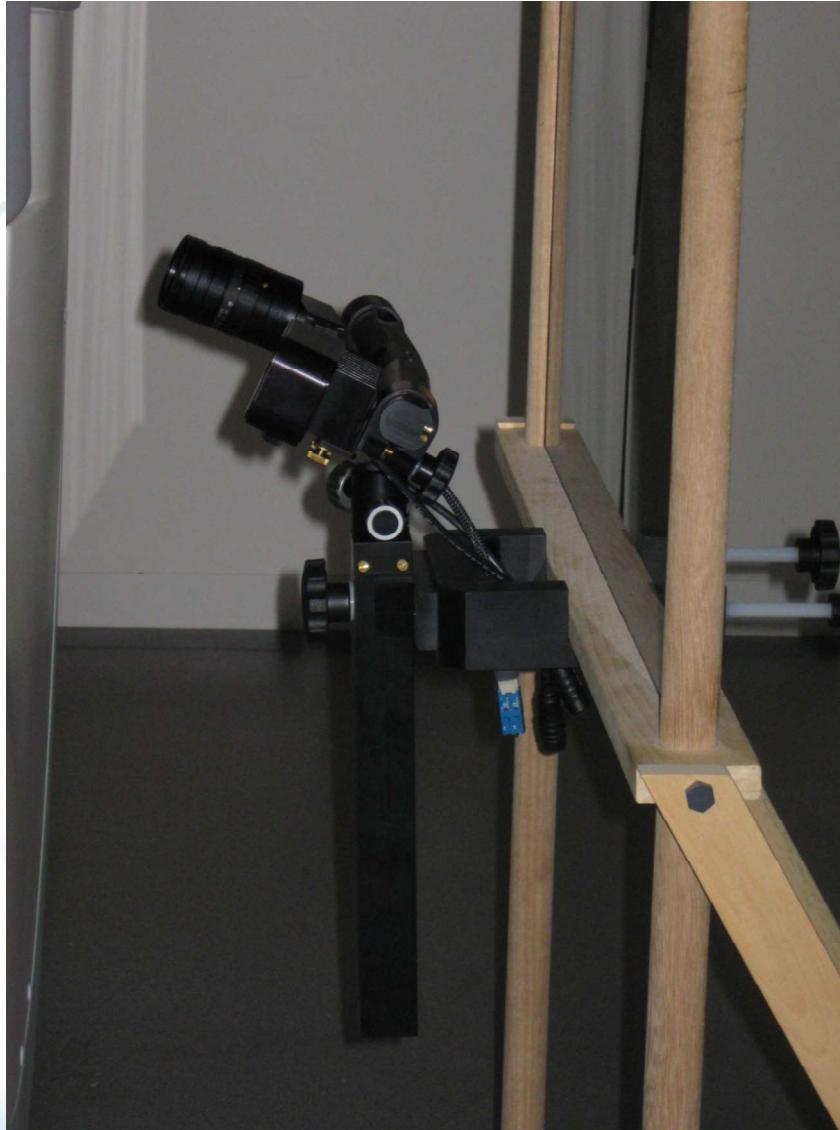
In general, ensure that the average gaze error is within 0.5° and maximum error is within 1.0°

Validation Results

- Optional card for Host PC – usually used for devices like EEG
- Converts Digital Data to Analog Voltages
- Output Gaze X, Y, and Pupil size as voltages over BNC connectors
- Voltage range configurable
- Three Channels per eye being tracked
 - Horizontal Position
 - Vertical Position
 - Pupil Size
- Also allows for extra Digital In/Out (in addition to Parallel Port)
- Quick –
 - Data can be inserted into empty EEG channels
 - Allows for easy alignment with EEG data
- Dirty –
 - Noise is added by D/A and A/D conversion
 - Saccade/Fixation information is lost



Long Range Screen Mount



Long Range Tray Mount



Long Range Tripod Mount



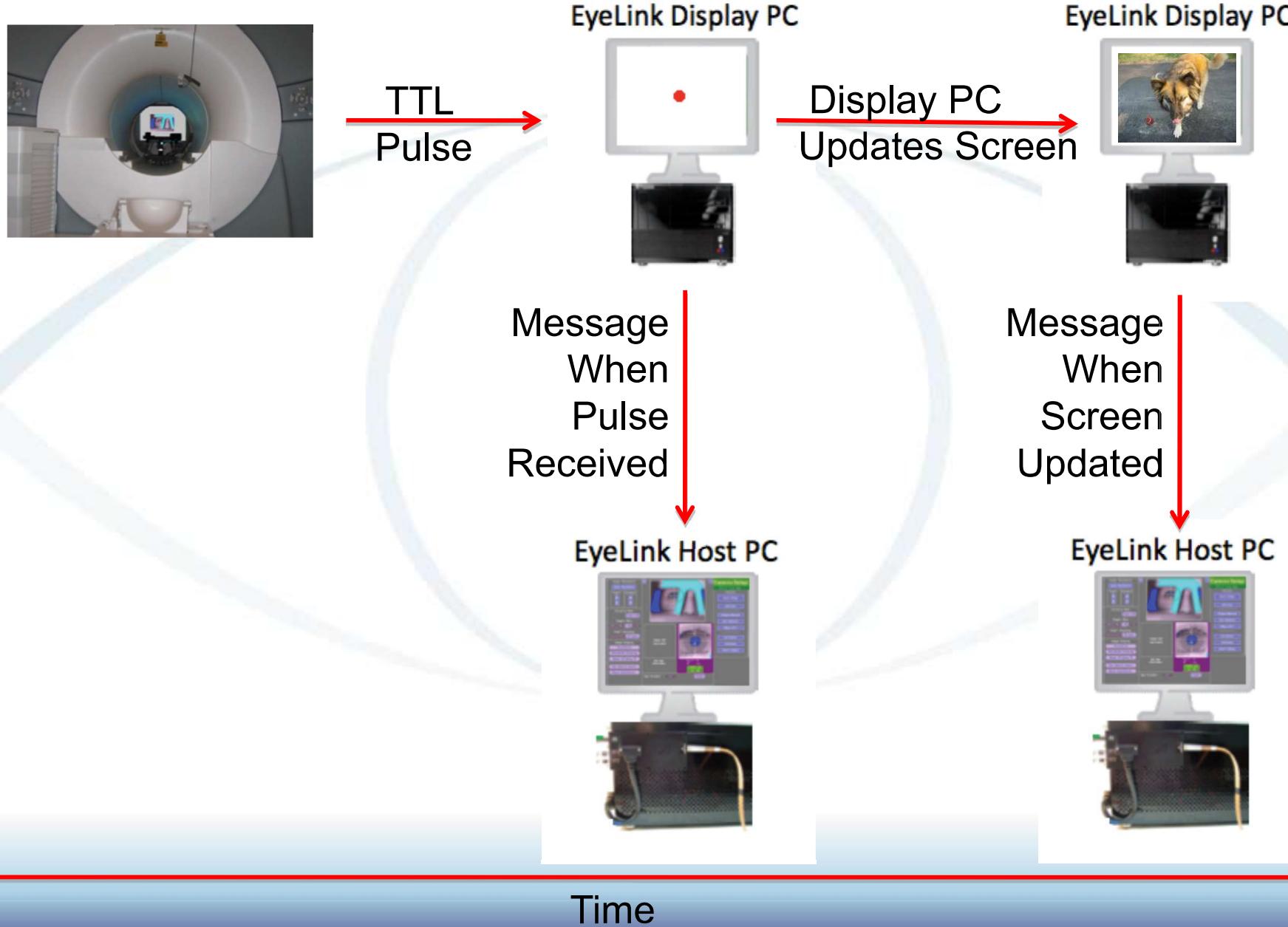
Long Range Illuminator



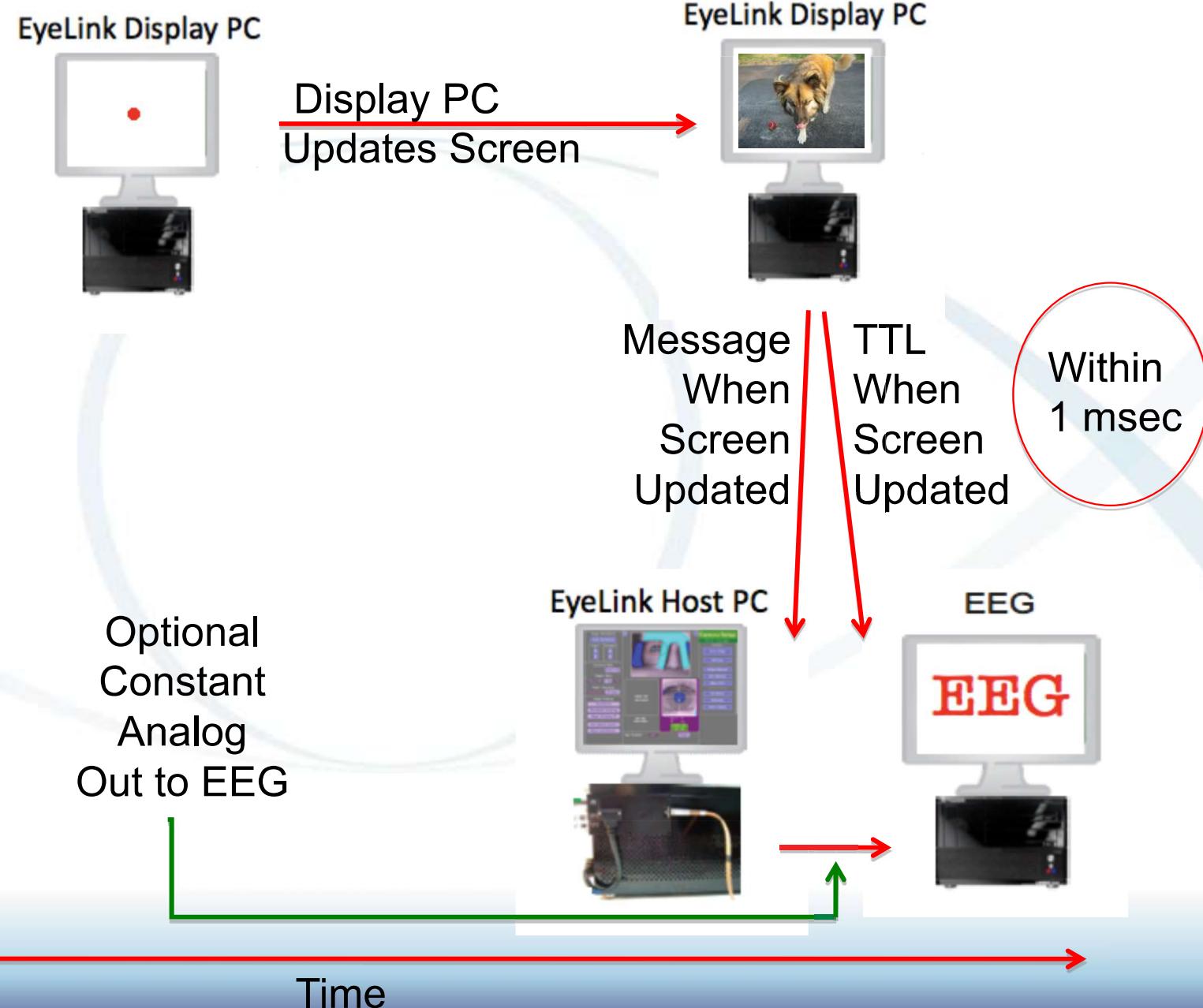
- Adjust illuminator sleeve to furthest position.
- Adjust horizontal position.
- Adjust vertical position.
- Adjust illuminator sleeve to prescribed distance.



MRI / Eye Tracker Setup



EEG / Eye Tracker Setup



EEG / Eye Tracker Setup

OR

