BeGaze Manual

Version 3.7

August 2017

SMI
SensoMotoric Instruments

Table of Contents

Introduction

Chapter

1 Introduction

Congratulations on your purchase of SMI BeGaze™ behavioral and gaze analysis software for eye tracking data. SMI BeGaze™ is designed particularly for researchers working in the fields of reading research, psychology, neurology, cognitive neuroscience, marketing research and usability testing.

Document number: 091222-P-1400-001-000-A

How to Read this Document

Chapter

2 How to Read this Document

This manual is designed to serve both as online help and as printed documentation of BeGaze.

Latest software versions covered in this document: BeGaze – Version 3.7

You can use this manual in one of these ways:

- Read through the chapters pertaining to particular functions to get background information before using the program.
- Consult the manual as a reference document to find out particular information. You can find a topic either by consulting the table of contents (at the front of the manual), or the index (at the end).

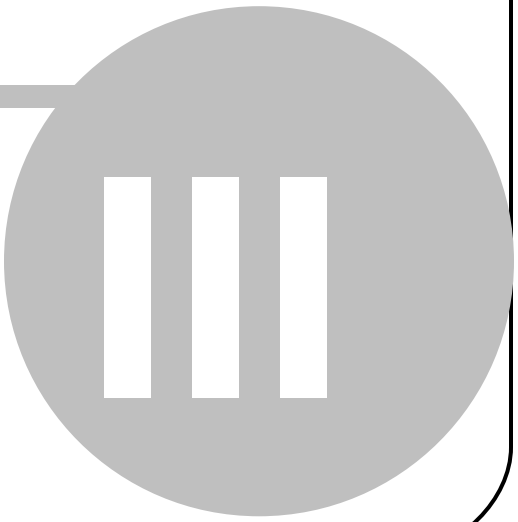
All the information in this manual can also be accessed through the program. Press F1 to get help on the menu-item or the element that has been currently selected.

 If you cannot find what you are looking for try searching the index.

Last updated: August 2017

Important Notice

Chapter



3 Important Notice

Experiment Responsibility

Make sure the presented visual stimuli do not harm or injure your participants.

SensoMotoric Instruments GmbH is in no way responsible for the experiments you develop, execute and analyze.

Do not offend against your participant's cultural background, age, psychological condition, or similar.

Photosensitive Epilepsy

Some people may have epileptic seizures triggered by light flashes or patterns.

This may occur while presented successive pictures or video material, even if they have never had a seizure before.

Supervise your participants during experiments.

Stop immediately and consult a doctor if a participant has the following or similar symptoms:

- Involuntary movements
- Disorientation
- Convulsions
- Loss of awareness
- Altered vision

Overview

Chapter

4 Overview

4.1 Features and Benefits

Meaningful results

The Behavioral and Gaze Analysis (SMI BeGaze™) software simplifies monocular and binocular tracking data analysis by structuring the information on experiments and participants, as well as displaying the results as meaningful graphs – all in one advanced application.

Simultaneous analysis

- Designed to support gaze sampling rates from 50Hz up to 1250Hz
- Processes both eye and head tracking data
- Stores all movement data, participant demographics and graphics in its internal database
- Analyzes several participants or trials simultaneously
- Changes easily the parameters for reanalyzing previous data

Various Stimuli

SMI BeGaze™ displays, analyses and visualizes various kind of stimuli - whether

- text and graphics
- still images
- video clips and screen recordings
- websites
- pdf files

- external video sources, like game consoles

SMI BeGaze™ analysis does not limit the choice of stimulus for experiments.

Multiple Participants

- Designed to handle multiple participants
- Integrated filter functions allow analyzing subgroups of participants within trials based on user assigned parameters (e.g. gender, age, etc.)

Smart Visualizations

SMI BeGaze™ provides the full spectrum of visualizations

- Gaze plots (scan path, bee swarm, gaze replay)
- Attention maps (focus map, heat map)
- Real time statistics (key performance indicators, gridded AOIs)
- Visualization parameters can be modified "on-the-fly"
- Visualizations can be exported as video (AVI) or bitmap for documentation, presentation etc.

Exploit Optimized Workflow and Interaction

SMI BeGaze™ is not only the tool for visualization of gaze interaction with stimuli. It is also a tool to optimize workflow when it comes to quantitative analysis.

- Drill into fixation and saccade event data from scanpath or linegraph
- Find point of regard by time interval of events
- Click on data plot to view detailed information and statistics of selected events
- Customize diagrams and statistical data tables before exporting to file,
- Define your personal visualization standards and apply them across analyses or experiments etc.

AREAS OF INTEREST (AOI) – static and dynamic

- The integrated AOI editor allows definition of zones of interest
- Various geometries can be fitted to the element of interest
- Automatic Move&Morph™ function for dynamic stimuli e.g. video clips ensures the AOI being “on target” even in position and form changing elements of interest
- AOI statistics can be visualized as AOI sequence per participant, or AOI Binning Chart for groups of participants
- The AOIs can be displayed together with gaze plot or attention map visualization
- Geometric definition of AOIs can be saved to, and loaded from file – e.g. for recurring experiments with same stimuli

Statistical Data – Your way to quantitative Analysis

- Powerful statistics module allows configuration and export of statistical data tables of more than 100 statistical variables (e.g. first fixation duration, number of glances, pupils size, blink frequencies etc.)
- Export AOI transition matrix for single or multiple participant analysis
- Export fixation and saccade parameters to file
- Measure saccade latencies and reaction times in Linegraph diagram
- Adjust event detection parameters as needed

Intelligent integration

- SMI BeGaze™ fully integrates with SMI Experiment Center™ 3.7 - the software to make gaze tracking experiments and visual stimuli creation a snap
- Load all experiment data into SMI BeGaze™ by 1-click: Fail-safe, fast, convenient

- SMI BeGaze™ offers an experiment creation wizard to load manually the experiment data, allow to assign attributes to the participants for later grouping and filtering
- Assignment of stimulus and participant‘s gaze data is done manually or automatically

4.2 General Product Information

4.2.1 BeGaze Product Variants

BeGaze is distributed in different versions and bundles that are customized to the variety of research applications.

For screen-based eye tracking studies:

- In professional contexts, BeGaze is delivered together with Experiment Center as Experiment Suite Professional, which is available in two variants
  - Experiment Suite Professional Package provides qualitative analysis tools for professional screen-based eye tracking studies, such as Website Usability evaluations or studies on product placement. Core functionalities are powerful visualizations such as scan paths and heat maps and support for the retrospective think-aloud protocol.
  - Experiment Suite Professional Package Premium Edition adds comprehensive quantitative analytics, with Key Performance Indicators and AOI statistics.

- In scientific contexts BeGaze is delivered together with Experiment Center as part of Experiment Suite Scientific, which is available in three variants. Experiment Suite Scientific provides functionality required in many scientific scenarios, such as stimulus conditions and advanced statistical visualizations. It also provides adjustable event detection parameters in a separate tab when creating and modifying experiments and the Adjust Event Detection 325 menu item is available for the same purpose for an existing experiment.
    - Experiment Suite Scientific Basic allows for recording and analysis on static stimuli such as texts, images and pdfs in addition to Experiment Suite Scientific's fundamental scientific capabilities like questionnaires and Trigger AOIs for gaze contingent paradigms.
    - Experiment Suite Scientific Advanced adds recording and analysis capabilities for dynamic stimuli such as video and web content as well as screen recordings. It also supports the retrospective think aloud protocol in addition to all functionalities of the Basic version.
    - Experiment Suite Scientific Premium provides flexible tools for efficient analysis of specialized paradigms, such as in reading research and linguistics. It allows for analysis of time-series data as well as aggregation on highly interactive content in addition to all functionalities of the Advanced version.

For analysis of mobile eye tracking data (recorded with SMI Eye Tracking Glasses) two BeGaze variants are available:

- ETG 2w Analysis provides qualitative analysis tools for mobile eye tracking studies. Core functionalities are single video analysis using gaze replay and scan paths as well as support for retrospective think aloud protocol, annotation of important events and export options for video and raw data.
- ETG 2w Analysis Pro allows for a quantitative analysis of mobile eye tracking data, including full statistics and AOI-related analyses in addition to all functionalities of the Analysis version. Highly interactive mobile eye tracking data can be aggregated across participants using SMI's Semantic Gaze Mapping tool.

Mobile eye tracking data recorded with the ETG 2 Observation or ETG 2w Observation packages cannot be analyzed in BeGaze.

In addition to these Packages, functional analysis modules are available:

- Advanced Analysis Module (Upgrade for REDn Professional Package Premium Edition only) adds advanced visualization options (Binning Chart, Gridded AOIs, AOI Sequence Chart, Proportion of Looks Graph) and Semantic Gaze Mapping functionalities for efficiently analyzing data from highly interactive studies.
- Multi-User Semantic Gaze Mapping Module allows Semantic Gaze Mapping by several users. This module is available in a single seat license and a network license version.
- Index of Cognitive Activity Module combines SMI eye tracking data with cognitive workload data calculated with the patented Index of Cognitive Activity (ICA).
- Emotiv EEG Module allows display and analysis of data recorded with the emotive headset during a recording with iViewETG or Experiment Center.

Upgrade modules are also available for Experiment Center which allow recording of eye tracking data on specialized stimuli (Frame Grabber Module, External Scene Camera Module) and user actions (Observation Module) that can be analyzed in BeGaze.

4.2.2 Dongle Protection and License Update

BeGaze is dongle-protected and requires a license.

The following license types are available:

Single License

- This type of license allows you to start one instance of Experiment Center and BeGaze on a computer. The license is protected by a dongle connected to the computer where the programs are executed. This can be extended by a network floating license.

Network Floating License

- A network floating license is a license to execute BeGaze and Experiment Center on any computer attached to the local network. This enables a group of users to share the use of a program. Network licenses are counted in terms of concurrent users. If a department owns a single network license then only one user can execute the program. Other users who attempt to execute the program while a copy is currently running will be denied.

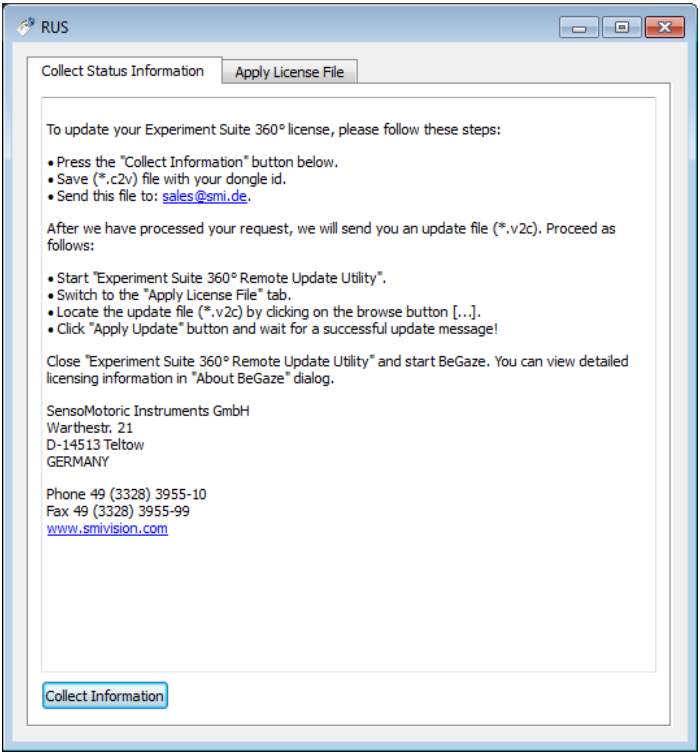
4.2.2.1 License Update

BeGaze is dongle-protected and requires a license. If you want to update your BeGaze version, please contact the SMI sales department 482 to obtain a new license.

Collect license information

The SMI sales department will need your current license information:

1. From the Windows™ start menu, select **Programs: SMI: Experiment Suite Remote Update Utility**.
2. In the **Collect Status Information** tab of the Remote Update Utility, click the **Collect information** button. This will acquire the current license information which is currently stored on the dongle device.



3. You will be prompted to save a file identifying your current BeGaze license ("Save key status"). Please save the file under your last name for easy identification.
4. Send this file to sales@smi.de.

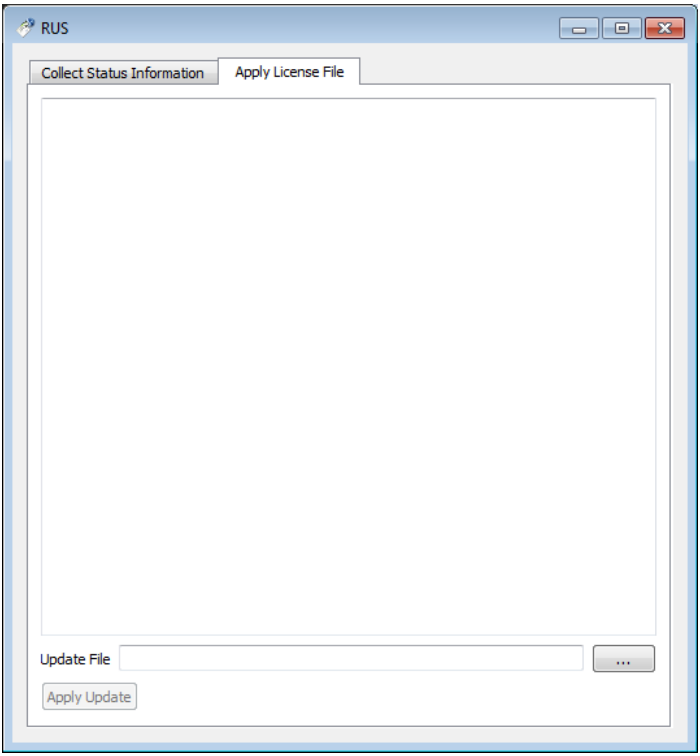
   You will receive a new license key from SMI.

Update license

After you have purchased your new license key (*.v2c file format), update your license as follows:

1. From the Windows™ start menu, select **Programs: SMI: Experiment Suite Remote Update Utility**.

2. Switch to the **Apply License File** tab.



Ensure that only the BeGaze dongle is plugged. Remove all other dongles from the PC.

3. Locate the update file (*.v2c) by clicking on the browse button ... and click **Apply Update**. This will write the updated license information to the dongle device.
4. You will be prompted that a receipt has been produced to confirm the update. Please send this receipt file to sales@smi.de.
5. Close the **Remote Update Utility** and start BeGaze. You can view detailed licensing information in the BeGaze About Box 462.

Type and status of your licenses are stored on the dongle device, not on the PC on which BeGaze is installed. With the license update procedure, the dongle is updated. That means, that you can run BeGaze on any PC when the dongle is plugged in.

4.2.2.2 Time Limited Dongle

Time Limited Dongles

There are dongles that contain time limited licenses for certain features. In such cases the features with time constrains can be checked in the "About" dialog.

A message will also be displayed when a feature's license expires. After the license expires the feature is no longer available for use.

Time limited licenses can be extended. For more details, please read the License Update 15 chapter.

4.2.2.3 Network Dongle

Installation of HASP Network Dongle.

The Hasp Network dongle accepts remote connections from Experiment Center 3.7 and BeGaze over the network using the TCP/IP protocol. It can be set to accept a maximum of 10 users simultaneously, and the features can be time limited or permanent. For security reasons the network dongle must be installed on a computer with private (non-routable) IP address so that the licenses can't be used over the internet by malicious users (see RFC 1918 for additional information).

To use a Hasp Network dongle follow these steps:

- Connect the Hasp Network dongle to the computer where Experiment Suite is installed (we'll call this the Client PC), or to a different computer from the LAN (we'll call this the Host PC).
- If Experiment Suite is not installed on the Host PC, please install the Sentinel HASP Run-time Environment.
- Make sure the Client PC, running Experiment Suite, is connected to the same LAN as the Host PC.
- Start Experiment Center 3.7 or BeGaze on the Client PC.

The connectivity to a HASP dongle (local and remote) can verified using the Sentinel HASP Admin Control Center. Sentinel HASP Admin Control Center is a distributed application running in the Internet browser: http://localhost:1947. The list with all Hasp dongles available for the current computer can be found using the menu Administration Options / HASP Keys.

When the user is logged on remotely to the company's LAN through a VPN connection, in order to use a Hasp network dongle connected to a computer from LAN, a setting has to be made on the Sentinel HASP Admin Control Center running on the client's computer: the IP of the computer hosting the Hasp network dongle must be typed in Administration

Options \ Configuration \ Access to Remote License Managers \ Specify Search Parameters, and then the Submit button must be pressed.

When two HASP dongles are available, one local and one remote (a HASP Network dongle), the local dongle has priority over the remote dongle.

Once the application has started (Experiment Center 3.7 or BeGaze) the chosen dongle is used throughout the whole application's current session. In order to switch to a different dongle, the application has to be restarted after the dongle has been replaced.

Troubleshooting the Hasp Network Dongle

- If the Sentinel HASP Admin Control Center (http://localhost:1947) is not running, there may be two reasons:

  – Neither Experiment Suite nor Sentinel HASP Run-time Environment are not installed;

  – The Sentinel HASP License Manager service is stopped.

- If the Sentinel HASP License Manager service is stopped, one possible reason is because the antivirus software stopped it. In this case the executable file for the HASP License Manager service which is C:\Windows\system32\hasplms.exe must be included in the antivirus Exclusions (or Exceptions) list. Then go to Control Panel \ Administrative Tools \ Services and start the Sentinel HASP License Manager service.

4.2.3 Automatic Updates

BeGaze and Experiment Center can check if a new version of Experiment Suite is available for download. The computer must be connected to the internet and the firewall must allow http connections to access to the update location.

Checking is done:

- Automatically when BeGaze or Experiment Center is started but not more than once a day.

- When „Check for Updates“ is executed from the Help menu.

If an update is available, the user can decide to download and install it.

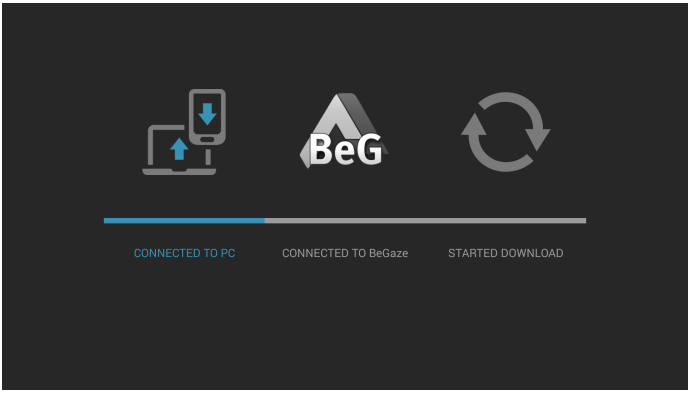
Smart Recorder version 2.0 automatic updates

The software on a Smart Recorder version 2.0 can also be updated automatically when such an update is available for download. To update a Smart Recorder please follow these steps:

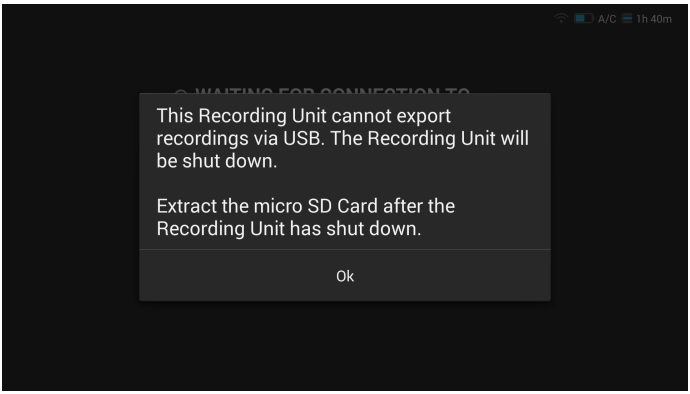
- Start the Smart Recorder and wait until loading the software has finished.

- Connect Smart Recorder to the computer through a USB cable.

  After connecting the USB cable to the computer the Smart Recorder shows this (for a I9505 version of the device):

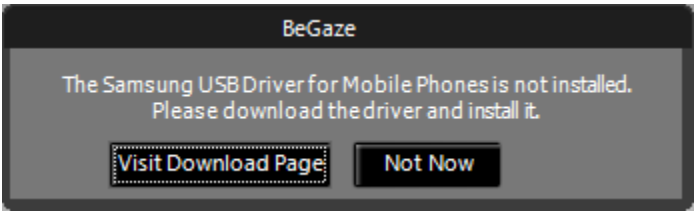


Or this (for a newer I9506 version of the device):

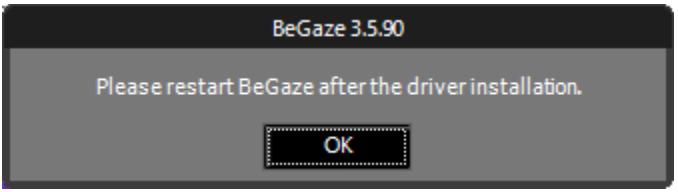


- Start BeGaze when the Smart Recorder has finished connecting to the PC.

The update process needs the Android USB Driver installed in order to work. If a Smart Recorder is connected to that computer for the first time and the drivers are missing then BeGaze will show a notification when started.

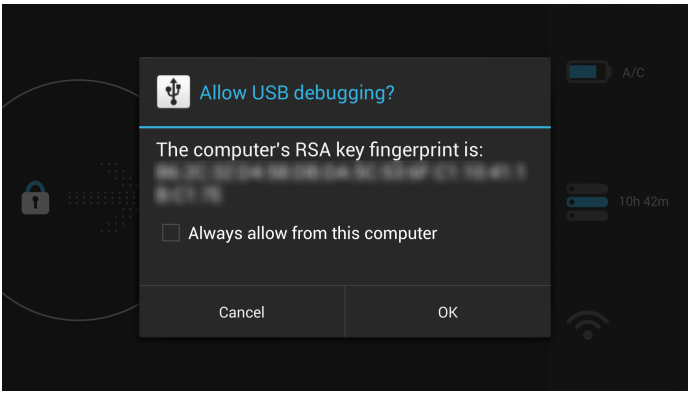


Please go to the download page by pressing the button and download and install the drivers. After running the installer and closing it, wait for the Windows device installation process to complete (you can see the notification in the taskbar). BeGaze will show this message:

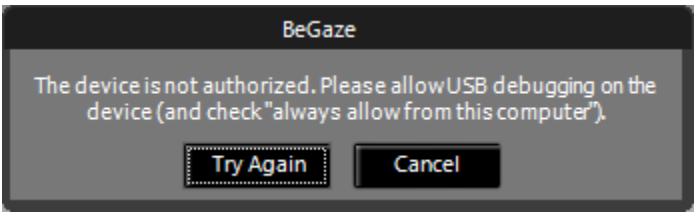


After the process is finished a message will be shown on the Smart Recorder screen asking to allow "USB Debugging". Allowing this is needed for the automatic update process to work. BeGaze notifies you if the USB debugging is not enabled.

On the Smart Recorder:

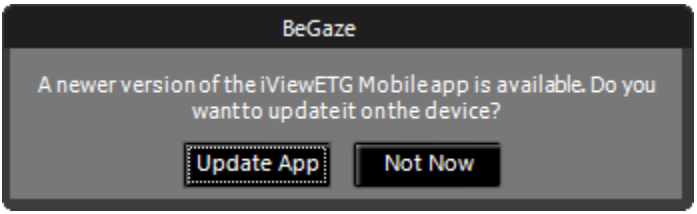


In BeGaze:

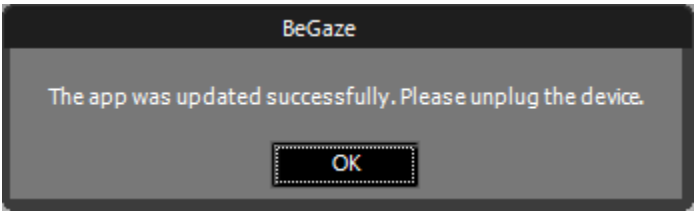


Make sure that the BeGaze PC is connected to Internet. BeGaze will check for any updates being available for the Smart Recorder. If an update is available, you will be prompted with a confirmation dialog to proceed with the update, or cancel it.

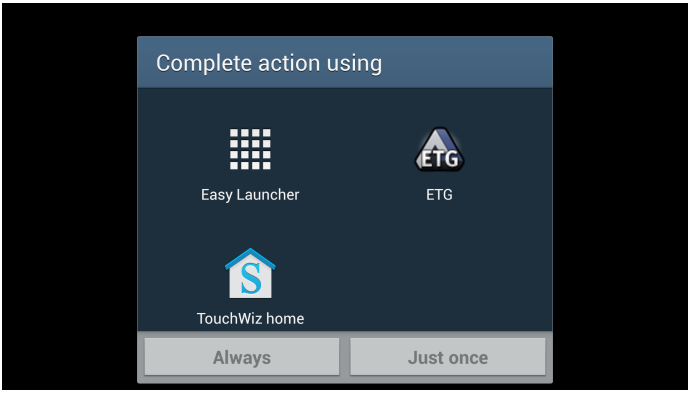
After an update is downloaded BeGaze will check the attached Smart Recorder and offer to install the update if the software on the Smart Recorder is older.



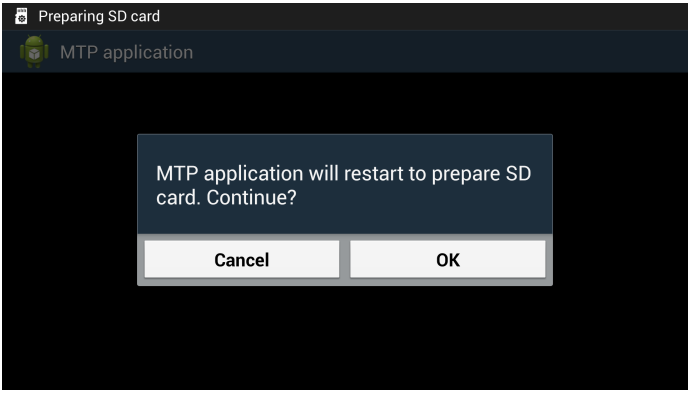
When the update activity is finished a confirmation message is shown in BeGaze.



Meanwhile on the Smart Recorder the following message appears when the update is finished:



Please select the ETG application icon and click "Always" so that the updated ETG application can always run when the Smart Recorder is powered on. After pressing "Always" a new message appears requesting to restart the Smart Recorder:



Please disconnect the USB cable from the computer now, before accepting the above message, otherwise the Smart Recorder will restart again whenever the cable is disconnected. Now press the "OK" button to allow the Smart Recorder to restart and run the updated application.

4.3 How to Operate the Program

4.3.1 Use Cases

BeGaze can be used in a broad range of eye tracking data analyzing contexts but there are typical use cases. To get familiar with the powerful features of the program, it will be helpful to know some standard use cases.

Advertising

This use case includes the evaluation of still images (e.g. print ads) or video material (e.g. television commercials) which are presented to the participants using the SMI Experiment Center. With this use case, you present the same visual stimuli to a larger group of participants.

- Prerequisites:
  – min. versions for still images: 2.0.23 and Experiment Center 2.0
  – min. versions for videos: iView X 2.1.16 and Experiment Center 2.1
- Experiment design: Experiment Center is used to create and record the experiment. The experiment includes various stimuli, such as videos, still images, and text.
  – Typical image presentation: Images (BMP, JPG, PNG) with a typical size of 1680x1050 pixels
  – Typical video presentation: Videos (AVI) with 30 to 300 seconds in length and a typical video size of 320x200, 640x480, 720x576 or 1280x720 pixels
- Experiment recording:
  – Use a proper gaze tracking device (RED, Hi-Speed, or MRI/MEG).
  – During the experiment, the data set is stored in the experiment's results folder. The data set includes the presented stimuli as well as the IDF files (gaze tracking data and user events), the participant

protocols, and the meta data (participant properties, experiment design).

- Typical evaluation: The analysis of this common use case is described step-by-step in the Getting Started 54 topic.

Web Testing

Another use case is to evaluate web page perception and/or user navigation during web browsing sessions. This use case features the presentation of web pages to a group of participants using the SMI Experiment Center. To evaluate the user navigation, Experiment Center provides screen recording of all actions the participants perform during the web browsing session.

- Prerequisites: min. version is iView X 2.5.x and Experiment Center 3.0
- Experiment design: Experiment Center is used to create the experiment and to record the participants' web site perception and/or navigation within the site.

  – the web page is stored as one large picture with automatic scroll compensation

  – Record keystrokes and mouse clicks

  – Optionally, use the background screen recording feature to record the user actions.

- Experiment recording:

  – Use a proper gaze tracking device (RED, Hi-Speed, or MRI/MEG).

  – During the experiment, the data set is stored in the experiment's results folder. The data set includes either as a series of still images representing full web pages and (optional) background screen recordings. In the results folder, the IDF files (gaze tracking data and user events), the participant protocols, and the meta data (participant properties, experiment design) are stored also.

- Typical evaluation: Open the experiment in BeGaze by using the New Experiment from Folder 64 command. Evaluate the experiment together with the recorded mouse clicks and key presses (which BeGaze

indicates as **User Messages**) with the Gaze Replay 198, Bee Swarm 202, Scan Path 209, Focus Map 221, Heat Map 228 and AOI statistics data views (Key Performance Indicators 236, Gridded AOIs 249, AOI Sequence Chart 259 and Binning Chart 264).

Software Usability

A third use case is to monitor participants with the objective to improve software usability. For this, a group of participants is working with a software program while their gaze tracking data and their user actions are recorded to individual videos.

- Prerequisites: min. version: iView X 2.1.16, Experiment Center 2.1
- Experiment design: Experiment Center is used to create the experiment and to record the participants' actions (mouse clicks and key presses). For each participant, an individual video is recorded.
  - Typical video length: 60 to 300 seconds
  - Typical video size: 1280x1024 pixels / 1680x1050 pixels
- Experiment recording:
  - Use a proper gaze tracking device (RED, Hi-Speed, or MRI/MEG).
  - During the experiment, the data set is stored in the experiment's results folder. This includes the recorded videos as well as the IDF files (gaze tracking data and user events), the participant protocols, and the meta data (participant properties, experiment design).
- Typical evaluation: Open the experiment in BeGaze by using the New Experiment from Folder 64 command. Analyze the videos together with the recorded user actions, such as mouse clicks and key presses (which BeGaze indicates as **User Messages**) with the Gaze Replay 198, Bee Swarm 202, Scan Path 209, Focus Map 221, Heat Map 228, and AOI statistics data view (Key Performance Indicators 236, Gridded AOIs 249, AOI Sequence Chart 259 and Binning Chart 264).

HED Videos

Another use case is to record individual in-the-field videos while monitoring the participants gaze position. A single participant is monitored, for example while visiting a supermarket, doing sports, or driving a car.

- Prerequisites: min. iView X 2.1
- Experiment design: For each participant, an individual real-world video is recorded.
- Experiment recording:
  - Use the SMI Head mounted eye tracking device for real-world eye tracking studies.
  - Typical video length: 10 to 60 minutes
  - Typical video size: 752x480 pixels
- Typical evaluation: Use the BeGaze analysis data view (Scan Path 209 and Attention Map 221) and AOI statistics data view (Key Performance Indicators 236, AOI Sequence Chart 259 and Binning Chart 264) to analyze the recorded video data.

Eye Tracking Glasses

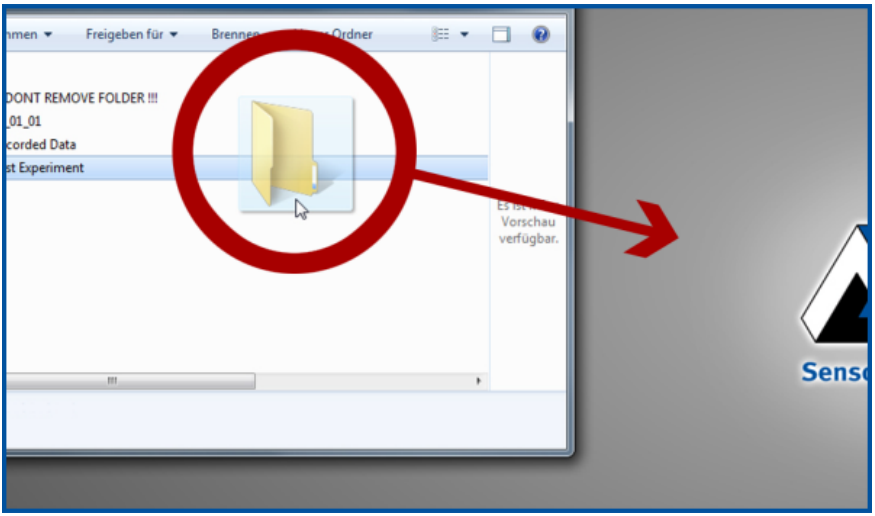
This use case is about recording in-the-field videos and gaze position with the Eye Tracking Glasses. For a detailed description of the use case please see Eye Tracking Glasses Analysis 30.

4.3.2 Eye Tracking Glasses Analysis

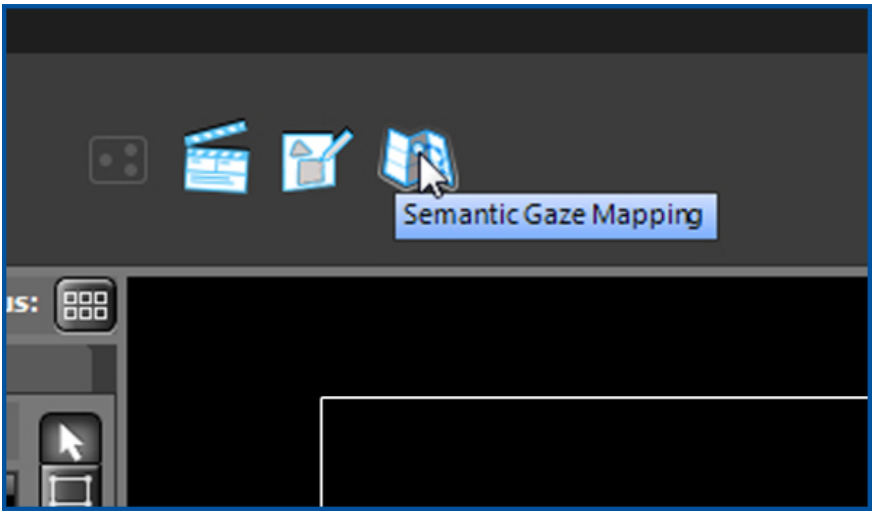
4.3.2.1 Using the Laptop

Following are the recommended steps for analyzing an Eye Tracking Glasses (ETG) experiment.

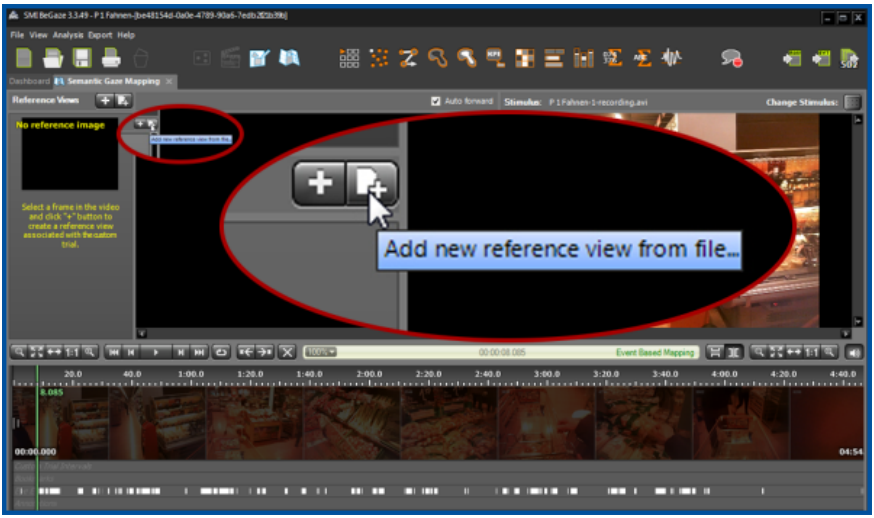
1. **Create Experiment**: Drag and drop data folder from file explorer onto the BeGaze software surface or open an existing experiment. Alternatively **New Experiment From Folder** and **Manual Experiment Creation** can be used.



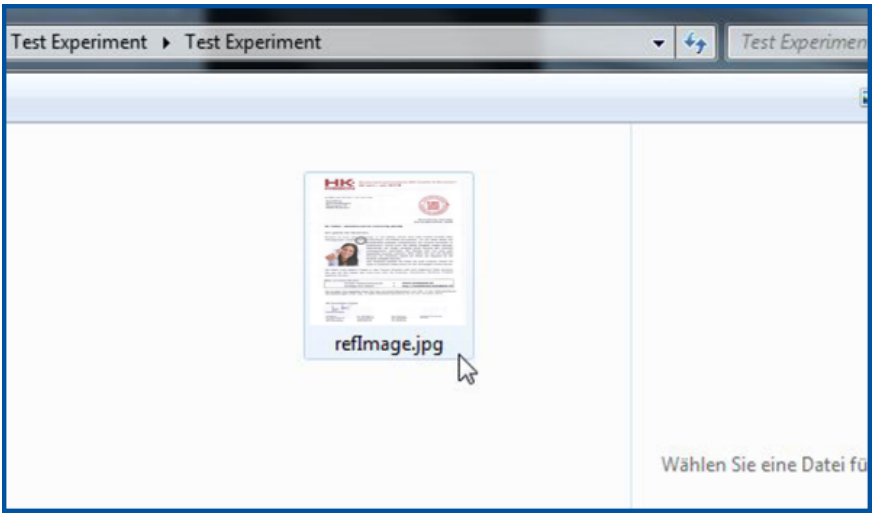
2. **Semantic Gaze Mapping**: Open the Semantic Gaze Mapping by clicking on the icon.



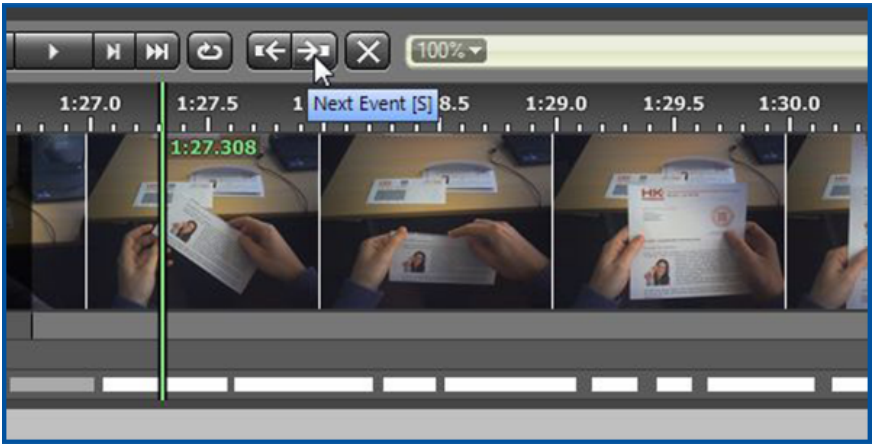
3. **Add Reference Image**: Click the highlighted icon to load a new reference image from an external source.



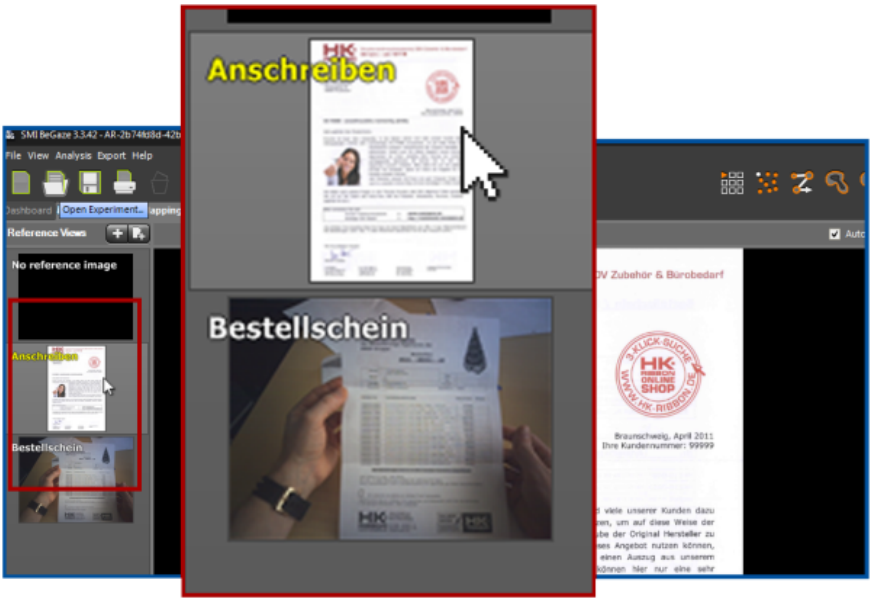
4. **Select Reference Image**: Select an image that illustrates the scene you want to analyze. Optionally rename the reference image, by right clicking on the reference image preview.



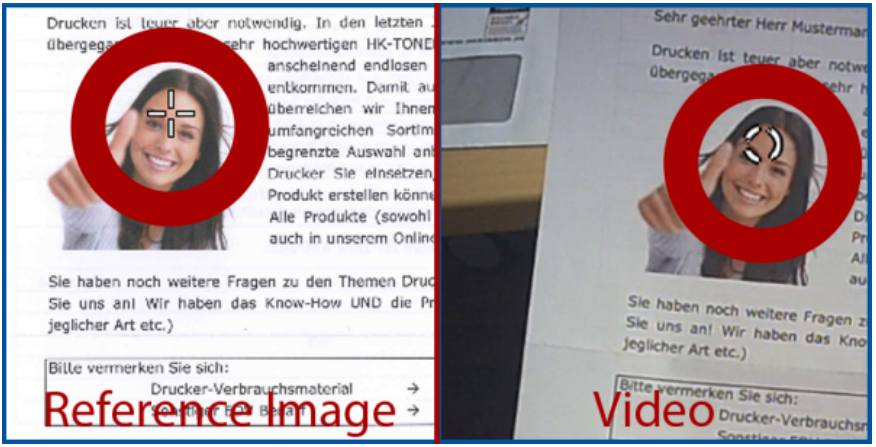
5. **Select Fixations**: Go to the relevant fixations that shall be allocated to a reference image by clicking the arrow buttons or using 'A' or 'S' keys.



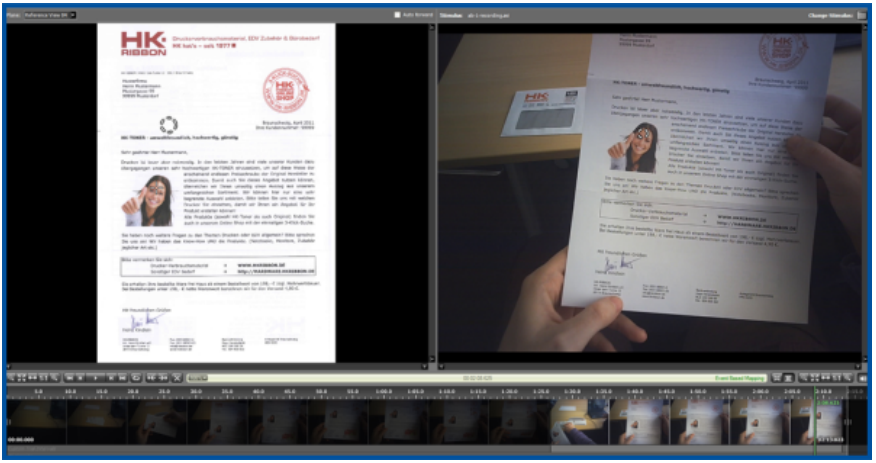
6. **Select Reference Image**: Activate the reference image that matches the present fixation.



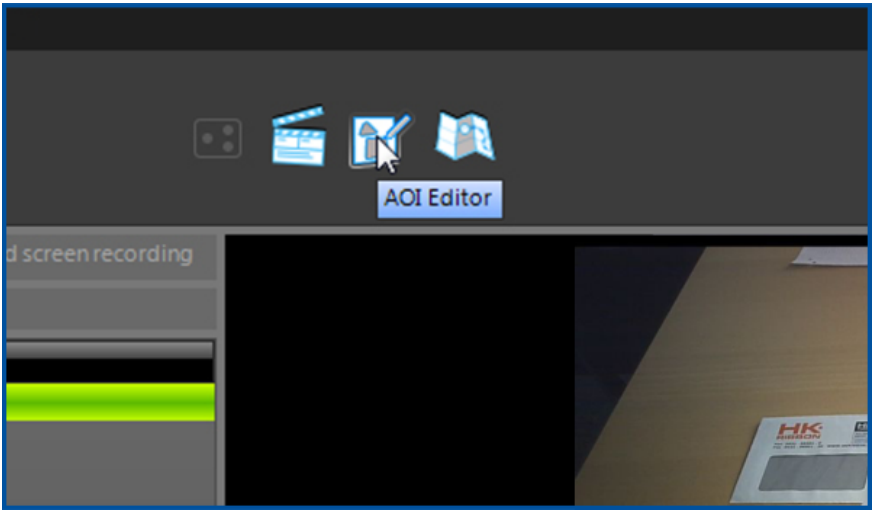
7. **Map the Gaze**: Map the selected fixation from the video, click on the associated position in the Reference Image. Click and hold the mouse button to magnify the underlying part of the stimulus for a better gaze mapping.



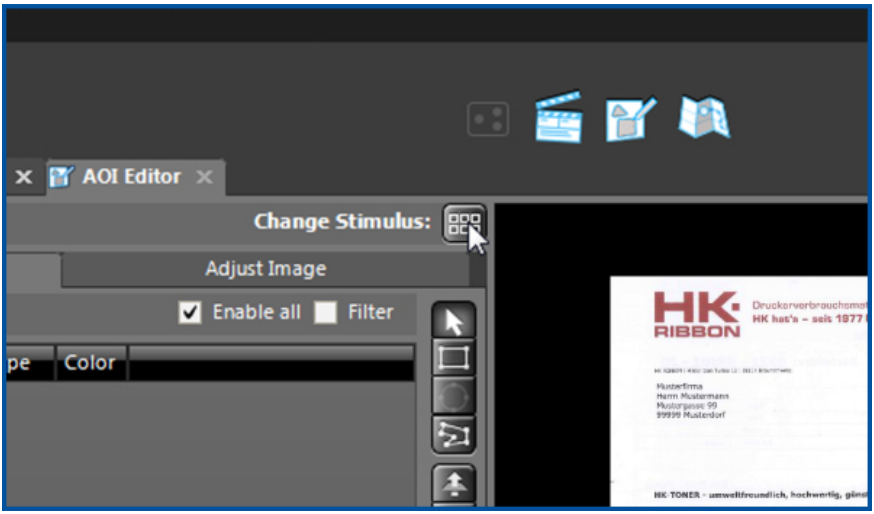
8. **Repeat Mapping**: Repeat step 7 until all relevant fixations are mapped to a reference image. Repeat steps 5 to 8 for all participants.



9. **AOI Editor**: Open the AOI Editor plugin by clicking on the icon.

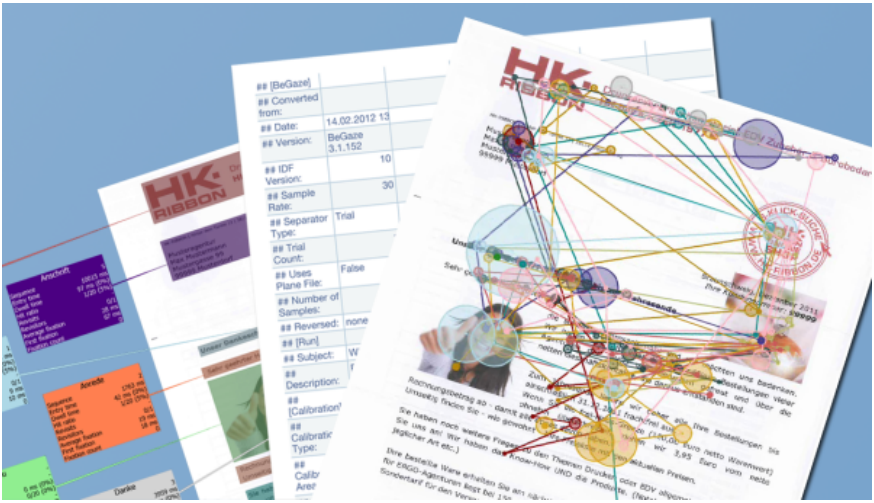


10. **Choose Stimulus**: Select previously created reference image from the stimulus selection button.



11. **Create AOIs**: Create AOIs using the available tools, like the rectangle or freehand tool.

12. **Analysis**: Metrics Export 339 and qualitative/quantitative analyses to display your data.



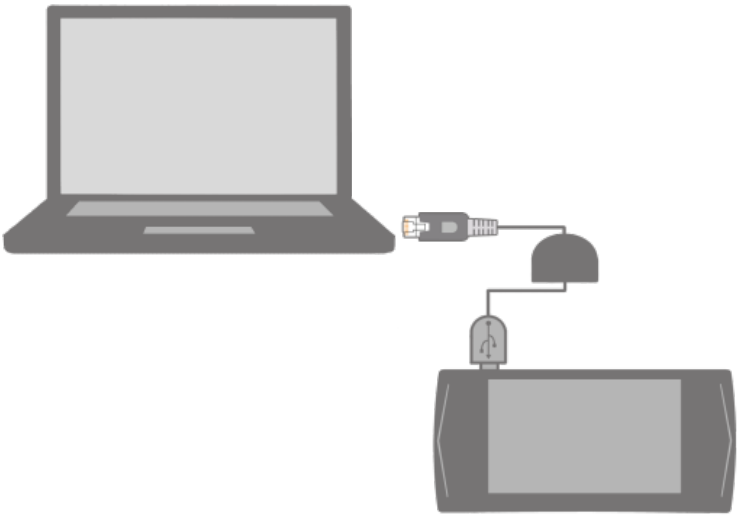
4.3.2.2 Using the Smart Recorder

In order to use data coming from the Smart Recorder there are a number of preliminary steps compared to the regular Eye Tracking Glasses analysis using a laptop 30 that should be completed before continuing with the regular work flow.

Software update procedure for Smart Recorder Version 2.0 is found in the Automatic Updates 20 chapter.

Smart Recorder Version 1.0

Connect the Smart Recorder to the network with a regular network cable or connect it directly to the ETG Laptop using the USB to LAN Adapter. The picture shows the direct connection to the laptop.



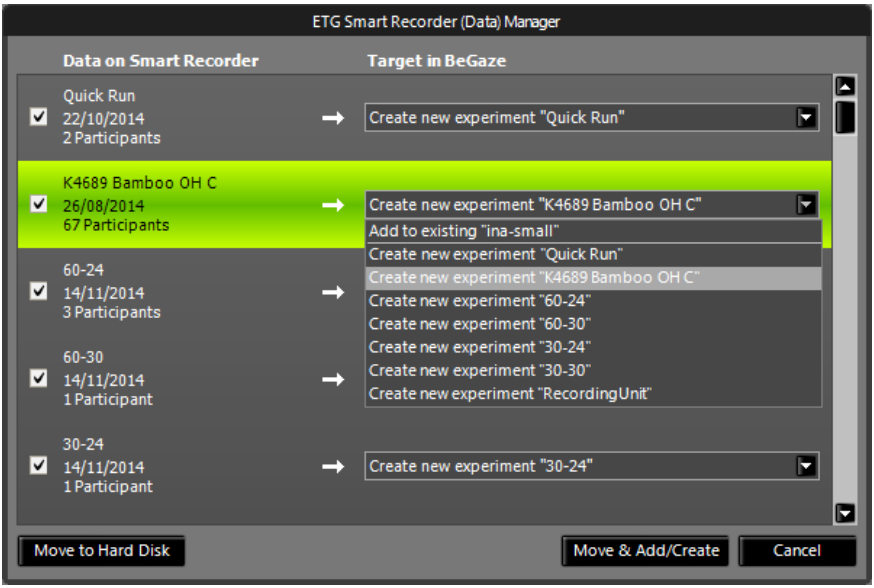
If this is the first time you are connecting the Smart Recorder to your network (or laptop) you need to register the unit with SMI BeGaze™. To do that please follow the instruction from the Global Settings 61 chapter. This registration only needs to be done once (as long as the Smart Recorder name doesn't change).

Smart Recorder Version 2.0

Connect the Smart Recorder to the computer with a USB cable. Wait for the unit to be fully recognized as a USB device in Windows.

Smart Recorder (all versions)

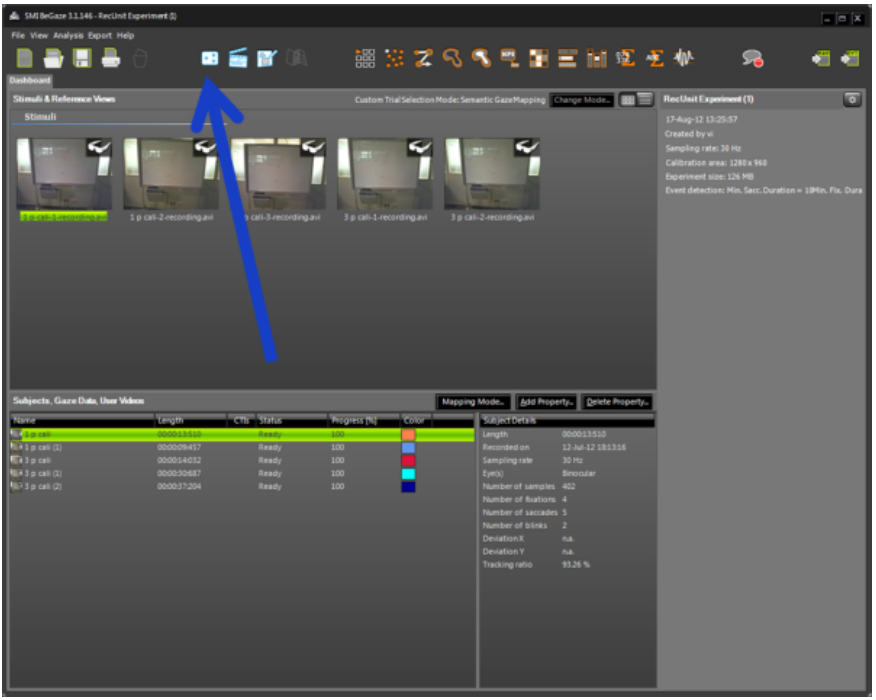
Create experiments using the data from the Smart Recorder. Creating experiments with Smart Recorder data can take a long time for larger experiments. More details about managing the Smart Recorder data are given in the Manage Smart Recorder Data 73 chapter.



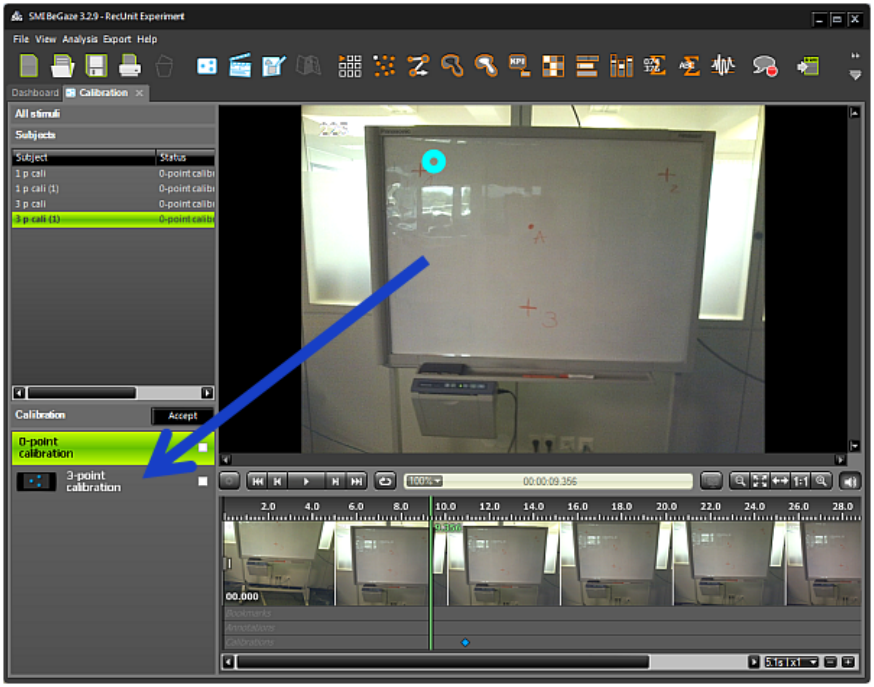
The whole "Calibrate" step is needed only for Smart Recorder Version 1.0. For version 2.0 calibration is not needed and the Calibration plugin is not displayed at all. Go directly to the next step, "Analyse" for version 2.0.

Smart Recorder Version 1.0

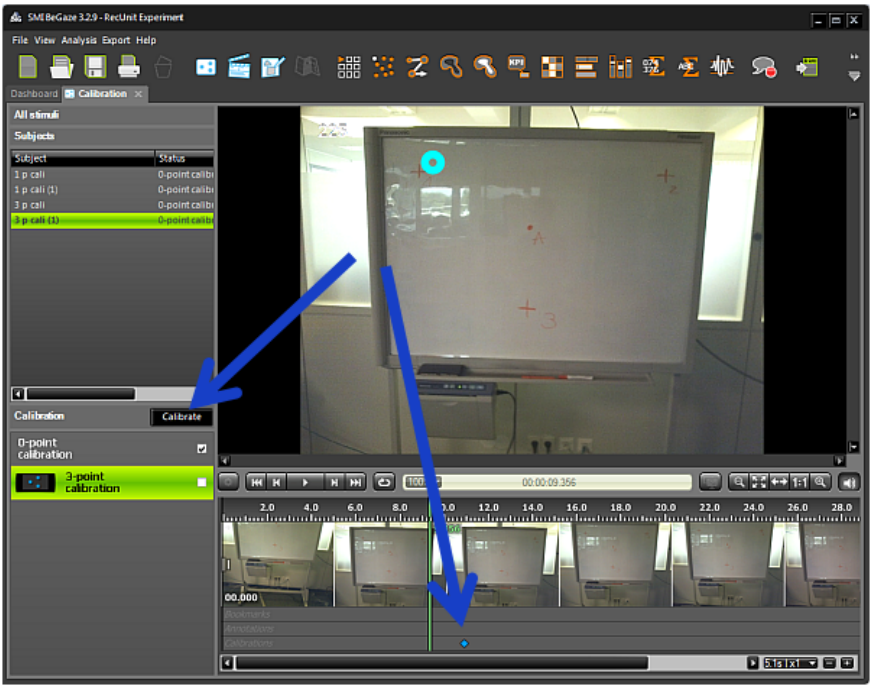
Open the Calibration plugin to calibrate Smart Recorder data offline.



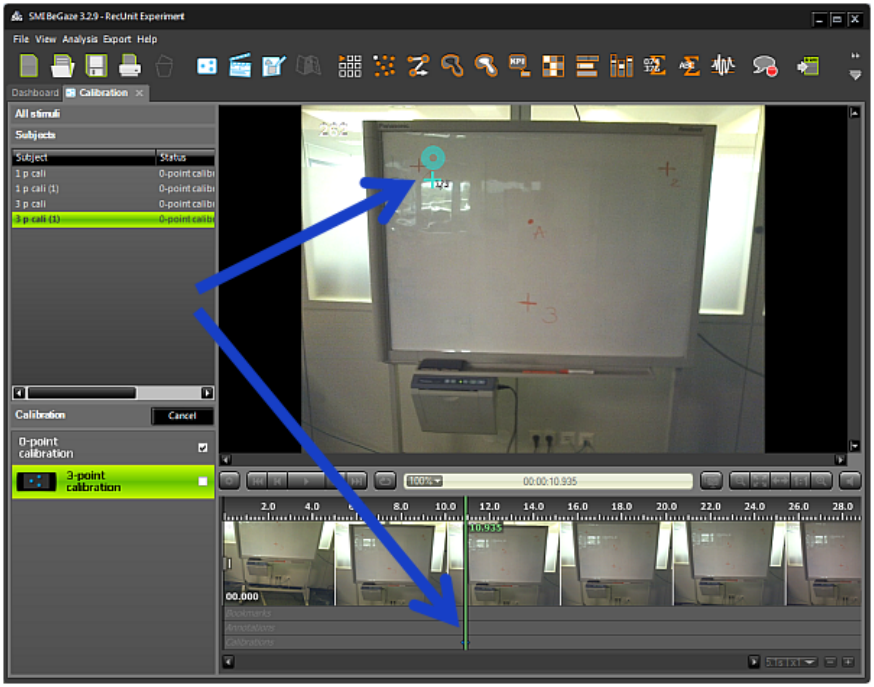
All performed calibrations for this video are displayed. Choose a calibration by clicking on it.



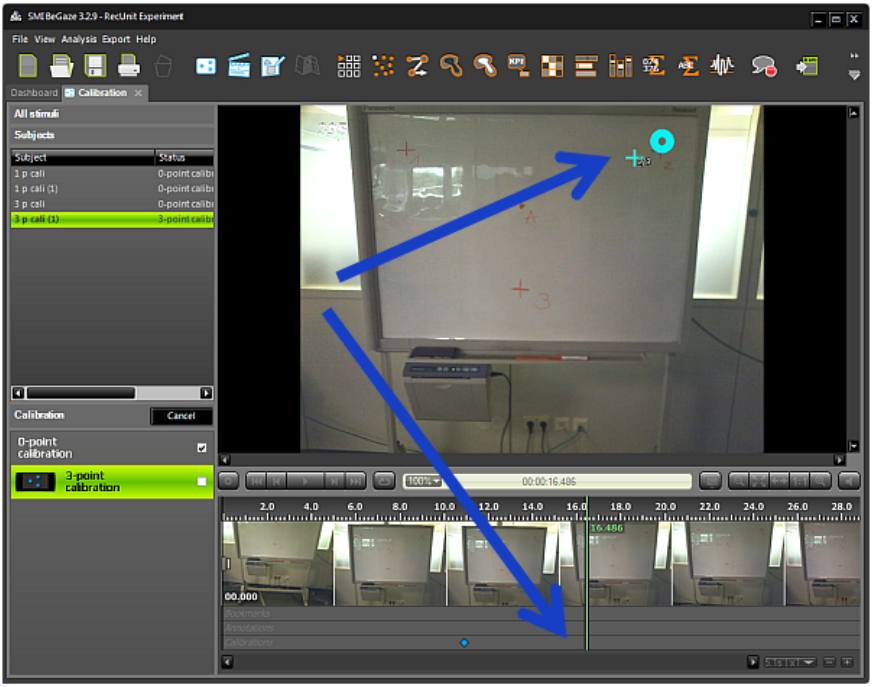
Press the Calibrate button to start the calibration process. Video time will jump to calibration markers that have been used before in the calibration process.



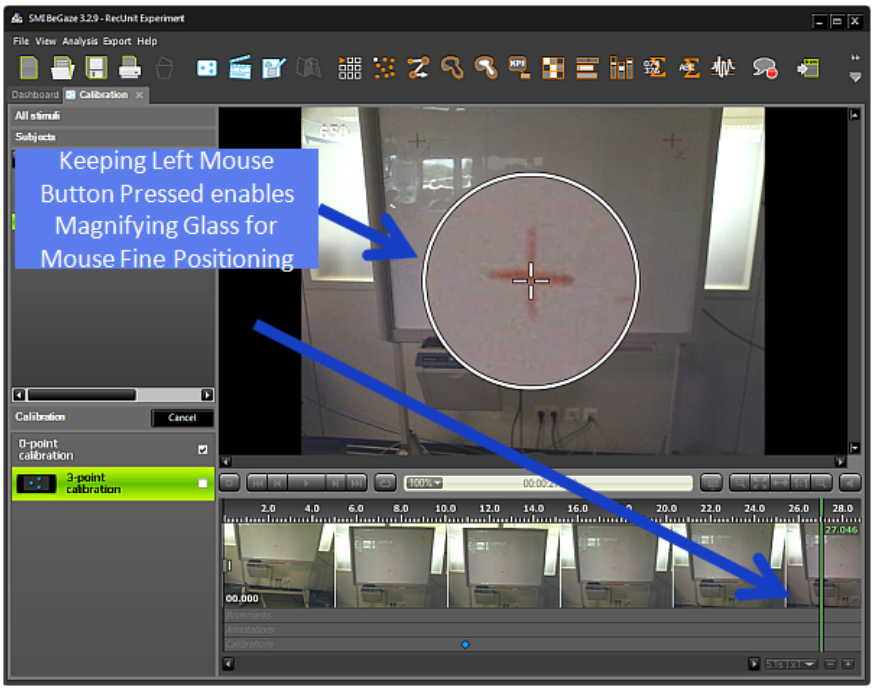
Move mouse over the first calibration point and press left mouse button.



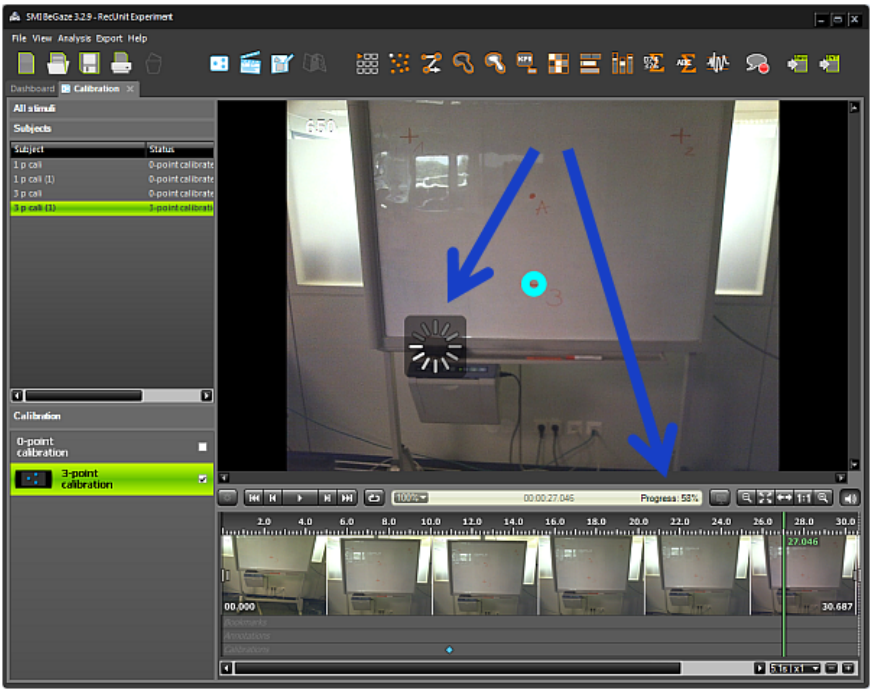
After accepting the first point video time jumps to time where the participant fixated the second calibration point.



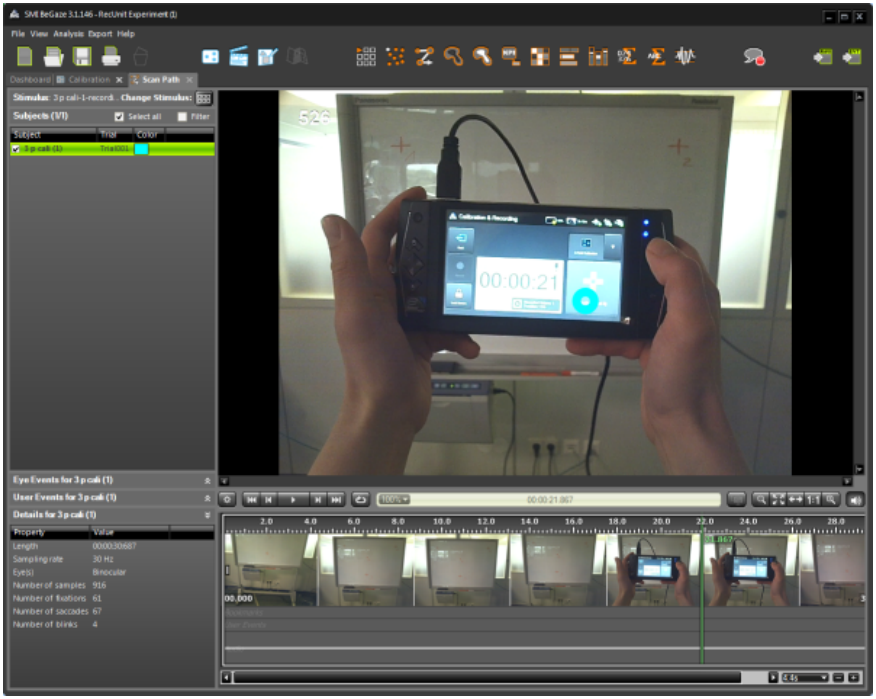
After accepting the second point video time jumps to time where the participant fixated the third calibration point.



When the last calibration point is accepted the gaze data adapts to the new calibration. This might take a while. When done the gaze cursor is displayed.



When the calibration is processed the calibrated eye tracking data can be analyzed. From here you can continue with the Eye Tracking Glasses analysis using a laptop 30.



4.3.2.3 Using mixed devices

An experiment can have calibrations already done on the laptop when it is created, before recording data with the Smart Recorder. The last calibration from the laptop is accepted automatically in BeGaze and the user can go back to 0-point calibration if he wants. See Mixed Device Calibration 153 for details.

4.3.2.4 Multi User Semantic Gaze Mapping

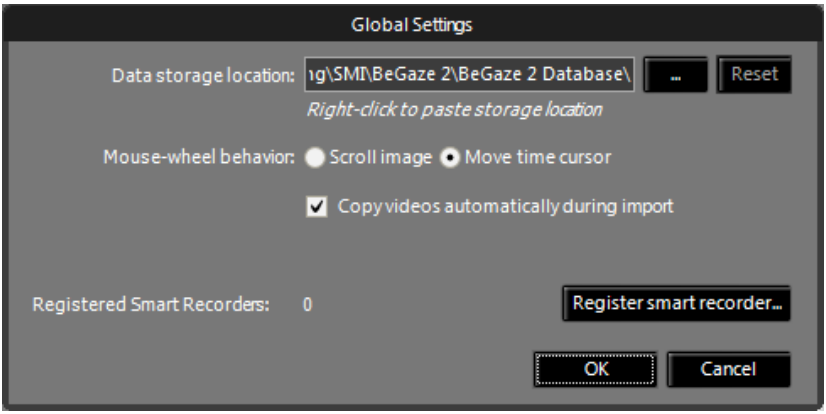
Following is a quick start guide to having multiple users do Semantic Gaze Mapping on a single experiment. There are two ways of doing this, by going to **File -> Multi User Gaze Mapping** and selecting an option:

1. **Central Data Storage** (usually done on several PCs on the same network that use a shared data storage for the experiment)
2. **Single User Data Storage** (doesn't need a network, all activities are done on a single PC, except the actual semantic gaze mapping which can be sent to different coders).

Central Data Storage

I. General Setup

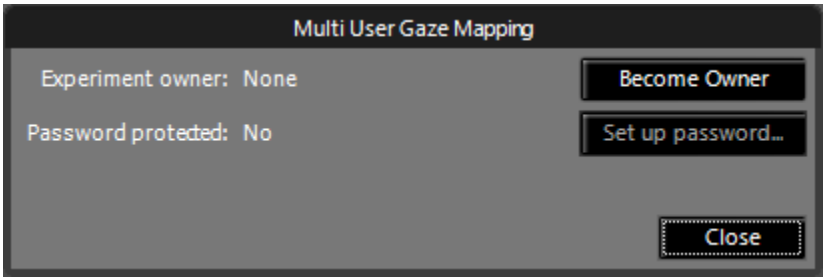
1. **Precondition**: To run Semantic Gaze Mapping with multiple users, all involved PCs need to be connected to the same local area network. The network must provide a folder that is accessible (read and write) for all PCs.
2. **Choose a network database**: Start BeGaze on the experiment manager PC. go to **File** and select **Global Settings**. Choose the network folder form step 1 to be the **Data storage location** and press **OK**.



3. **Create new experiment**: Create a new experiment using a database stored in a network folder.

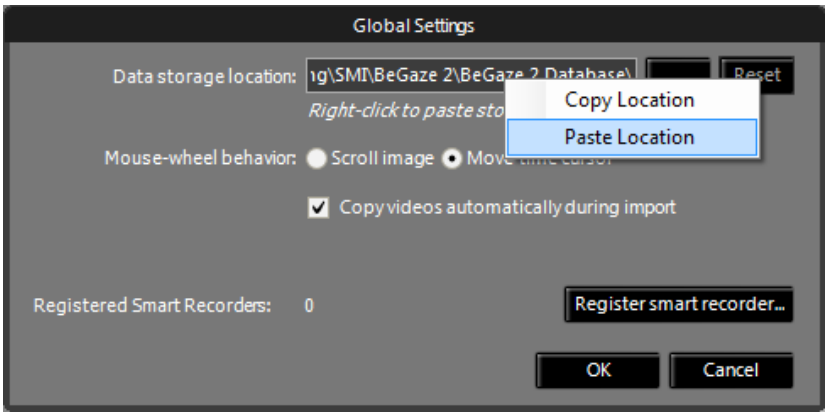
II. Enable Multi User Mapping

1. **Enable multiple users**: To enable multiple Semantic Gaze Mapping users make the experiment manager the "experiment owner". Go to **File -> Multi User Gaze Mapping -> Central Data Storage** and select **Become Owner**.

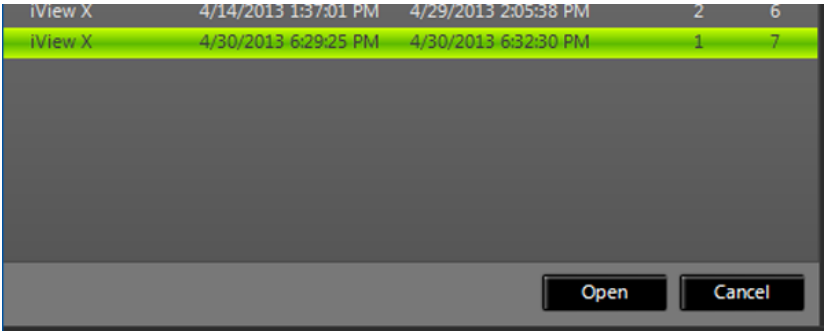


III. Add more Semantic Gaze Mapping Users

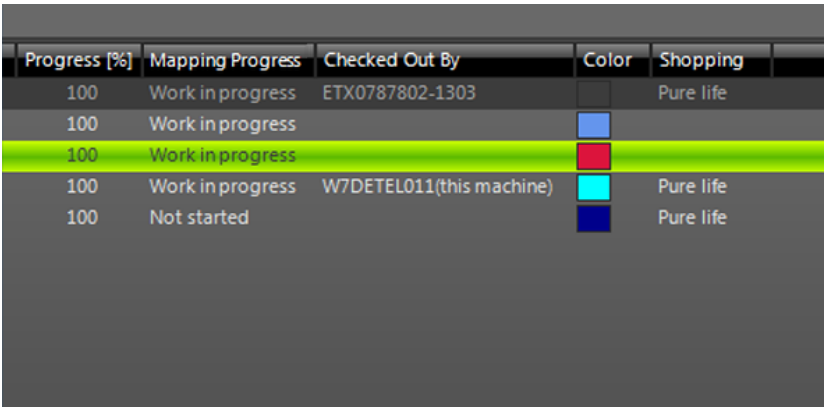
1. **Add more users**: Start BeGaze on the second PC to join as a Semantic Gaze Mapping user. Go to **File -> Global Settings** and add the path of the database folder previously selected. Press **OK**.



2. **Open Experiment on second PC**: Open the experiment. Go to **File** -> **Open Experiment**. Select the experiment and click **Open**.



3. **User Overview**: The BeGaze Dashboard indicates the **Works Status** and the working PCs (**Checked Out By** column).



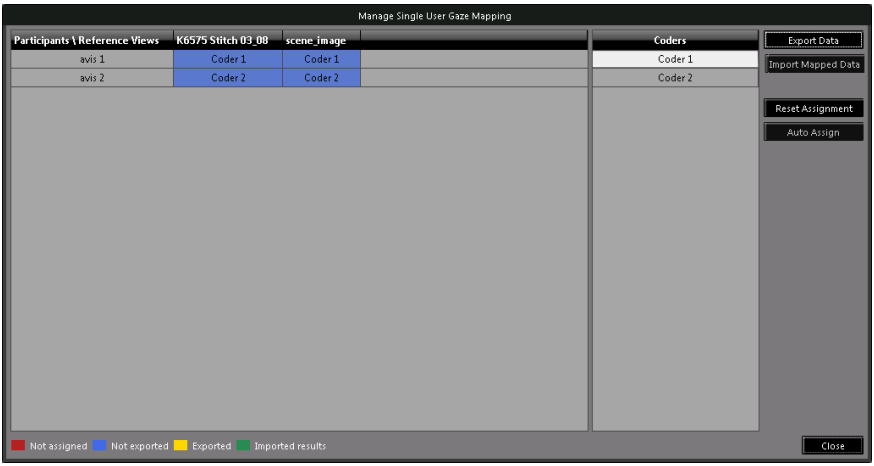
4. **User Rights**: Only the experiment manager can open and use all plugins. Semantic Gaze Mapping users are only allowed to open the Semantic Gaze Mapping plugin and the AOI Editor plugin. Stimuli opened by others users cannot be opened again.

For more details about working with a central data storage you can also check the Multiple Users 92 chapter.

Single User Data Storage

I. General Setup

Create an experiment or open an existing one in the usual way. Go to **File -> Multi User Gaze Mapping** and select the **Single User Data Storage** option. This will open a dialog where one can split the currently defined reference views between several users for gaze mapping purposes.



Here you can see the existing reference images and define several coders that will do the gaze mapping for each one (using the **Add/Delete** buttons on the right). Clicking the **Auto Assign** button will assign a different coder for each participant, if possible.

II. Distributing experiment parts

After coders are created and assigned to reference views you can click the **Export Data** button to export an experiment part that you can give to a coder to map on his computer. This experiment part is identical to a regular experiment backup, but contains only the experiment parts the respective coder needs, not the whole experiment data. The coder will be able to import the experiment part assigned to him like they would an experiment backup, by going to **File -> Restore Experiment from File...**,

and selecting the received part. They can the proceed to do the gaze mapping as usual, with the same restrictions as in the **Central Data Storage** mode (that is the users will only be able to access the Semantic Gaze Mapping and AOI Editor plugins.

III. Merging back experiment parts

After a coder finishes the mapping the can send back their experiment part by going to **File -> Export Multi User Experiment...**. On the initial PC, where the parts where created, the received part can be merged back in the experiment by selecting the **Import Mapped Data** button in the dialog above and selecting the received part. Warning: the part received from the coder is no longer an experiment backup type file, but a special type that can only be used in this dialog.

The status of each part is showed with colors, which are explained on the bottom. After doing step I the color goes from red to blue, after doing step 2 it goes to yellow, after doing step 3 it goes to green. When all parts are green the gaze mapping is complete for the whole experiment.

4.4 Getting Started

The following steps describe how to analyze a typical **Advertising** experiment (see Use Cases 26) recorded using SMI Experiment Center. If you start BeGaze for the first time, you may proceed as described below. Alternatively, you can open one of the provided sample experiments (see Open Experiment 79).

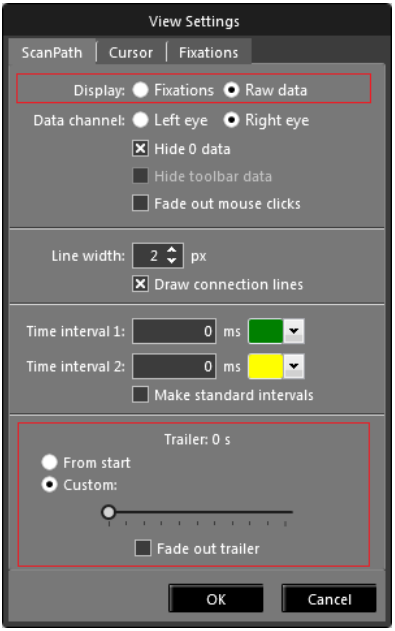
1. Create a BeGaze experiment directly from the Experiment Center's results folder (see New Experiment from Folder 64).
2. Open the **Scan Path** plug-in (see Scan Path Overview 209).

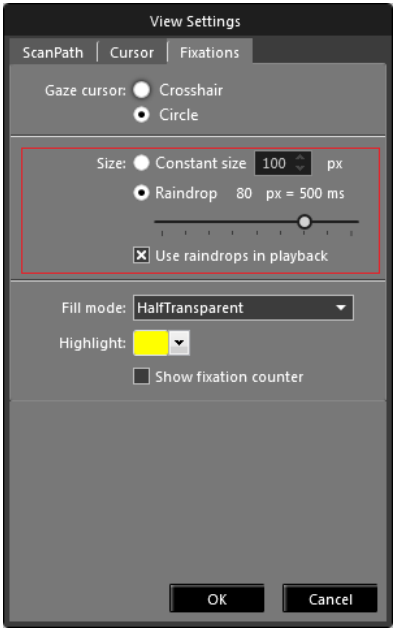
   – Select a stimulus (see Stimulus Selection 104).

   – Select participants, either manual or based on a participant property filter (see Participants Selection 109).

   – Modify the **Scan Path** settings (see View Settings Dialog 214). For video stimuli, you may configure the "bee swarm" mode. Therefore,

change the **Display** setting to **Raw Data** with the **Trailer** switched to **Custom** and the length slider set to zero (left image). For still image stimuli, you may change the **Display** setting to **Fixations** with the **Trailer** switched to **From Start**. When displaying **Fixations**, you should open the **Fixations** tab and change the **Size** of fixation circles (right picture).





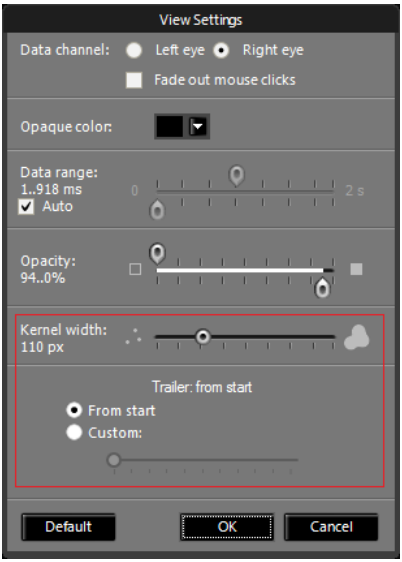
– Use the Player Control [120] to play the scan path presentation. To move to a specific event, use the **Events** view (see Events Selection [115]).

– Export the data – either to a picture or to a video (see Export Overview [339]).

3. Now open the **Focus Map** data view (see Focus Map Overview [221]).

   – The **Focus Map** data view inherits the settings of the previously opened **Scan Path** data view. If appropriate, change the stimulus selection and the participants selection (see above).

– Modify the **View Settings** (see Focus Map Settings 225). Change the visible area with the **Kernel Width** slider. Change the **Trailer** setting to **From Start** to see how the AOIs have evolved over time.



– Use the Player Control 120 to play the attention map presentation. To move to a specific event, use the **Events** view (see Events Selection 115).

– Export the data – either to a picture or to a video (see Export Overview 339).

4. Open the **AOI Editor** data view (see AOI Editor Overview 161). This data view allows you to define **A**reas **O**f **I**nterest (AOIs). An AOI defines an image area you are interested in. AOIs are painted on top of an object in a video or image. If the participant's gaze position hits the defined area, this is evaluated as an "AOI hit". You need to define AOIs in order to use the subsequent data views (**AOI Sequence Chart** or **Binning Chart**).

   – Select a stimulus (see Stimulus Selection 104).

– If you have selected a video stimulus, move forward to the position in the video where you want to start with an AOI (see Player Control 120).

– Select an AOI type: rectangle, polygon, or circle and paint it on the object (see AOI Editor Toolbar 163). To toggle the visibility of an AOI, press the [V] key. For a video stimulus, use the left and right arrow keys to move within the video. Use the mouse to change the position of the AOI. Note, that AOI key frames are generated when size, position or visibility changes, while the interpolation between key frames is done automatically (tweening). For still image stimuli, AOIs are always fixed and valid for the whole selected time period.

– Rename the AOI if necessary (see Rename AOI 167).

– Add more AOIs as required.

5. Open the **Key Performance Indicators** data view (see Key Performance Indicators Overview 236). This data view shows relevant statistical indicators for the defined AOIs.

   – Modify the **View Settings** (see Key Performance Indicators Settings 241) to select the desired indicators and the font size used for the display.

   – Select the desired participants, either manual or based on a participant property filter (see Participants Selection 109).

   – Select the **Save Image...** command from the **Export** menu to export the current visualization as a picture.

6. Open the **AOI Sequence Chart** data view (see AOI Sequence Chart Overview 259). This data view shows the correlation between participant and AOI hits.

   – Modify the settings available in the bottom view. It is recommended to select **Raw data** for video stimuli and **Fixations** for still image stimuli.

   – Select the desired participants, either manual or based on a participant property filter (see Participants Selection 109).

   – Select the **Save Image...** command from the **Export** menu to export the current visualization as a picture.

7. Open the **Binning Chart** data view (see Binning Chart Overview 264). This data view shows a statistical overview of AOI hits for separated time slices (bins).

   – Select a stimulus (see Stimulus Selection 104).

   – Select the desired participants, either manual or based on a participant property filter (see Participants Selection 109).

   – Modify the settings available in the bottom view. It is recommended to select **Raw data** for video stimuli and **Fixations** for still image stimuli. Modify the **Bins integration time** to your needs.

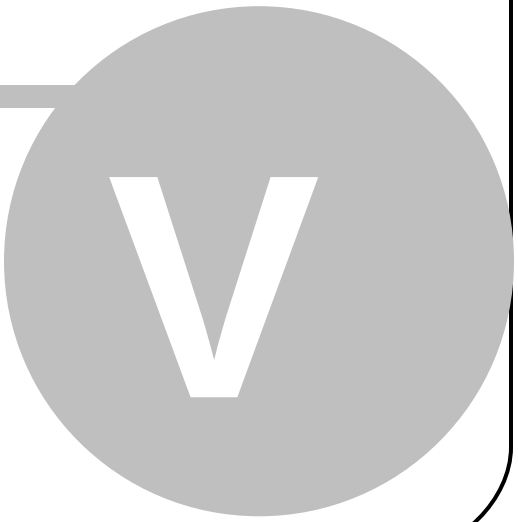
   – Select the **Save Image...** command from the **Export** menu to export the current visualization as a picture.

Further steps depend on your requirements. For example, you may

- use other data views (see Overview of Analysis data views 100),
- export data to CSV files (see Export data to files 339),
- print or save images of the currently opened diagram (see Export menu commands 451), or
- backup your experiment (see Backup 80).

Experiment Setup

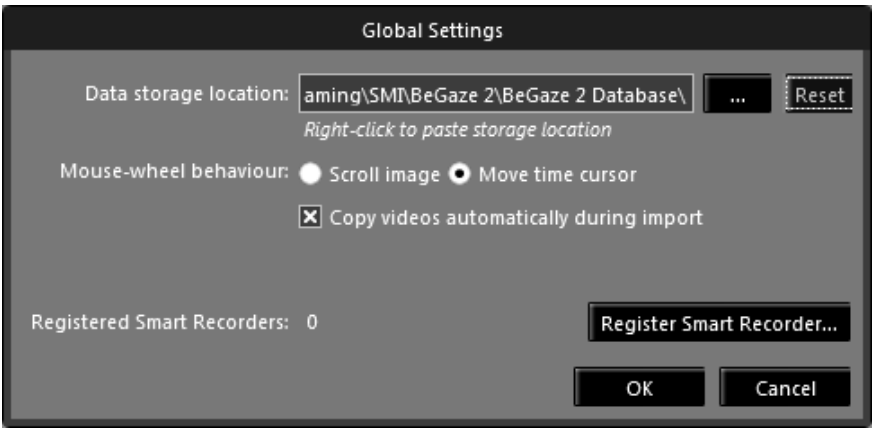
Chapter



5 Experiment Setup

5.1 Global Settings

In order to select another location for the database 465, change default behavior or register Smart Recorders (version 1.0) there is the **Global Settings** dialog in the **File** menu.



Data storage location

This setting changes the database storage to a different folder. Clicking the "..." button allows choosing a different folder while the "Reset" button changes this to the default database location for your Windows user.

Mouse wheel behavior

This option allow toggling between different behaviors for the mouse wheel:

- Scroll image: use the mouse wheel to scroll the stimulus when it is taller than the stimulus window.
- Move time cursor: use the mouse wheel to move the time cursor in the player control 120 backward and forward in time.

Copy videos automatically during import

If this option is checked then the video stimuli associated with the eye data are copied automatically to the database, otherwise you are being the option whether to copy them from their original location to the database or not during experiment creation.

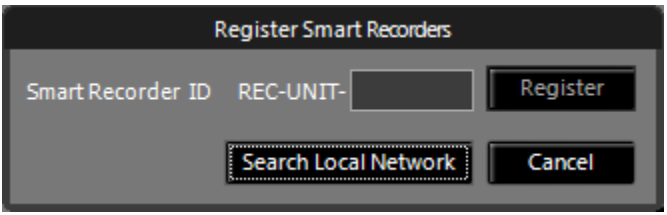
Registered Smart Recorders

Smart Recorder version 2.0

There is no need to register a version 2.0 Smart Recorder, it is detected automatically when connected to the USB port of the computer. You can start collecting the Smart Recorder data as soon as the device is mounted as USB storage. It does however need to have the Android USB Driver installed in order for the Smart Recorder software to be updated.

Smart Recorder version 1.0

The text shows the number of Smart Recorders that SMI BeGaze™ knows about already. In order to register new Smart Recorders added to the network you need to click the **Register more units...** button.



After clicking the button there are two possibilities available for adding new Smart Recorders: either add the Smart Recorder manually using its name (printed on the device) and clicking the **Register** button or click the **Search Local Network** button that scans you network and registers any Smart Recorders it finds. Scanning the local network can take a while depending on your network size.

After the Smart Recorders are registered you can manage the data recorded on them from the **Collect Smart Recorder Data...** 73 dialog.

This registration step only needs to be done once (as long as the Smart Recorder name doesn't change).

When the Smart Recorder is directly connected with the network cable to a computer then the network connection TCP/IP settings on that computer must be set to default. That means that when going to the network connection "Properties" -> "General" tab -> "Internet Protocol (TCP/IP)" the "Obtain an IP address automatically" option must be selected. This allows automatic setting of IP addresses so that the Smart Recorder and the computer can communicate.

5.2 Create Experiment Wizard

5.2.1 Overview

With the **Create Experiment** wizard you assemble all data to be analyzed to a BeGaze experiment. There are two ways to do so.

New experiment from folder

You can load a results folder which has been stored by SMI Experiment Center or SMI iViewETG to BeGaze and thus easily create your experiment (see New Experiment from Folder 64).

Create experiment step-by-step

Alternatively, you can create a new experiment step-by-step.

1. Go to the **File** menu and select **Manual Experiment Creation**.

   The **Create experiment** dialog opens with several tabs.

2. You can proceed through the tabs step by step using the **< Back** and **Next >** buttons. You can also immediately jump to a specific tab by clicking on the tab title.

3. Fill in the experiment data in the following tabs:

   Experiment Name 65: Experiment name and additional experiment information can be entered here.

   Gaze Data 66: Here you select the eye tracker data files to be analyzed, if needed the plane file is selected in this tab.

   Stimulus Images 67: All images for one experiment need to be selected in this tab.

   Stimulus Association 69: Based on the experiment type the selected stimuli need to be associated with the trials or planes of the experiment.

   Event Detection 325: The parameters for the fixation/saccade detection can be changed in this tab.

Note that the Create experiment button is enabled only if the experiment contains sufficient data to perform the analysis.

5.2.2 New Experiment from Folder

You can easily create an experiment based on the data generated with SMI Experiment Center or other tools. The stored gaze tracking data will be processed to BeGaze. During this process the stored meta data such as participant properties and the properties of the presented stimuli will be parsed and the experiment will then be created automatically in BeGaze.

New experiment from folder

1. Click on the  icon in the toolbar 455 or select **New Experiment from Folder** from the **File** menu.

   A file selection dialog opens where you can browse to the folder containing the experiment you want to load.

2. Select the appropriate folder from the directories list.

3. The Create Experiment dialog opens and the experiment is created automatically.

   A progress bar indicates the creation of the experiment. After completion the new experiment is already loaded in the interface.

New experiment from folder with drag and drop

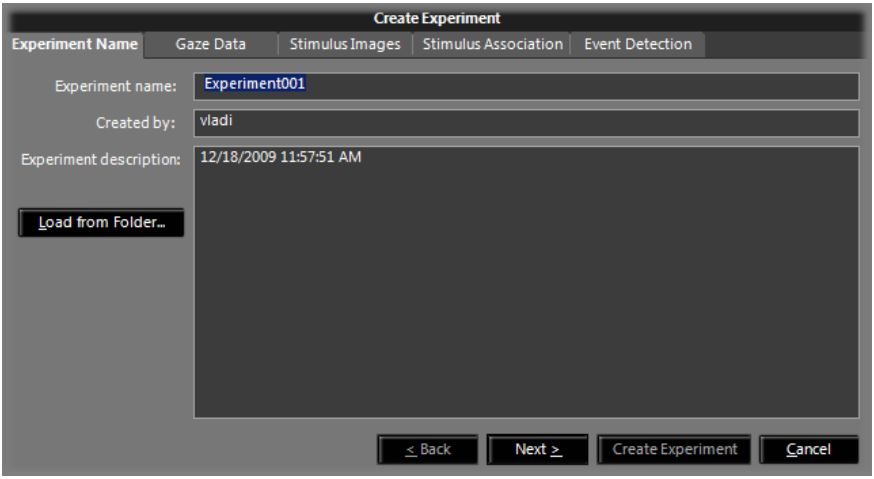
Another way to achieve the same as the above is to simply drag the experiment folder from any file browser and drop it in the main BeGaze window. Creating the experiment then proceeds as explained above.

To load an experiment from folder, you can alternatively use the Load from Folder command which is located in the Experiment Name tab of the Create Experiment 63 dialog which appears when selecting **Manual Experiment Creation** from the **File** menu. With this method the experiment will not be created automatically and you will be able to adjust the settings in all tabs (as explained in the following chapters) before pushing the **Create Experiment** button.

5.2.3 Experiment Name Tab

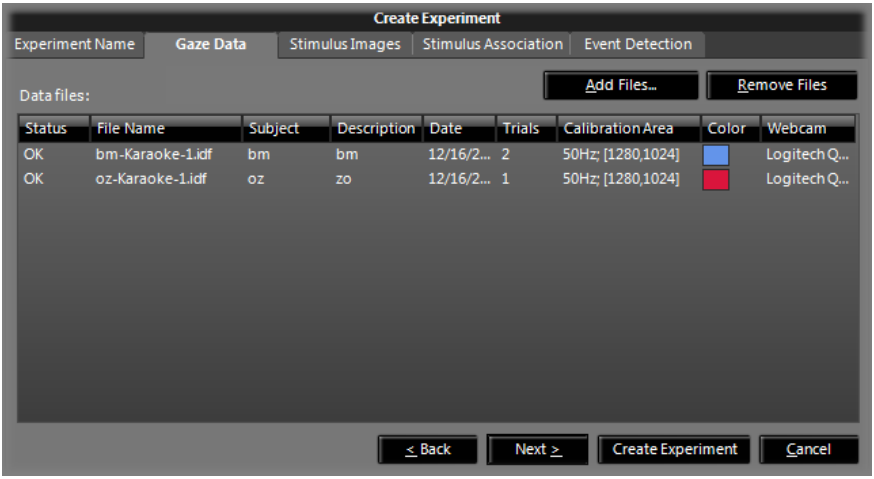
In this tab you can enter general information for the experiment. The experiment will be saved in the database 465 with the chosen name and description.

The **Load from Folder** command allows you to automatically fill the data and to create the experiment (see New Experiment from Folder 64).



5.2.4 Gaze Data Tab

In this tab you select which eye tracker data files should be analyzed.



Select files

BeGaze currently supports the iView X data files (*.idf) .

a) If you click on **Add Files...**, a file selection dialog opens. Select one or more files for the experiment.

b) To remove a file from the list, select the file and click on **Remove Files**.

Multi-Frequency support: IDF files recorded with different sampling rates are allowed in the same experiment.

Information on file entries in the data files table

- **Status**: In order to be analyzed together, all files must be recorded under the same conditions. The file to be first in the list serves as reference. All other files must fit to the reference file. If a file in the list

fits the criteria, its status is ok. If a file is rejected, the status will inform of the reason of rejection and the color of the row will be red.

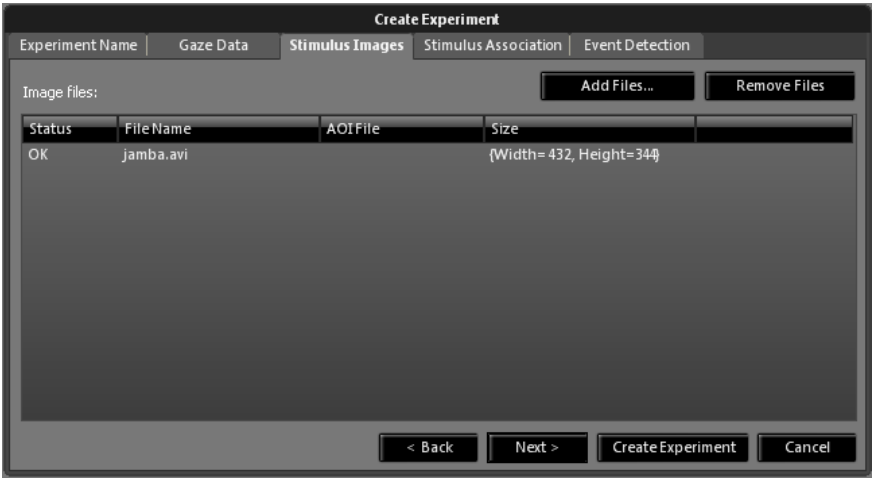
- **File Name** and **Date**: In these columns the file name and date are displayed.
- **Participant** and **Description**: If the files contain participant and description information they will be listed here.
- **Trials**: The number of trials in the file are computed and shown in this column.
- **Calibration Area**: Sample rate and calibration area size are presented in this column.
- **Plane file**: If the data files used require a plane stimulus file, then a **Select Plane File** button will be shown on the tab.

The planes description file comes from the Surveyor. The measurement scenario 75 is determined by the number of planes in the selected file.

- **Color**: A different color is automatically assigned to each participant.

5.2.5 Stimulus Images Tab

All required stimulus images for an experiment need to be selected in this tab.



Select files

a) If you click on **Add Files...**, a file selection dialog will open. Select one or more files for the experiment.

b) To remove a file from the list, select the file and click on **Remove Files**.

Information on file entries in the image files table

- **Status**: To be analyzed together, each stimulus has to meet the following criteria:

  – The format of an image file must be of type: bmp, jpg, jpeg, png.

  – The format of a video file must be of type avi and optimized with the XMP4 encoder provided in the installer (incompatible videos can be optimized with the Video Optimizer tool provided in the package)

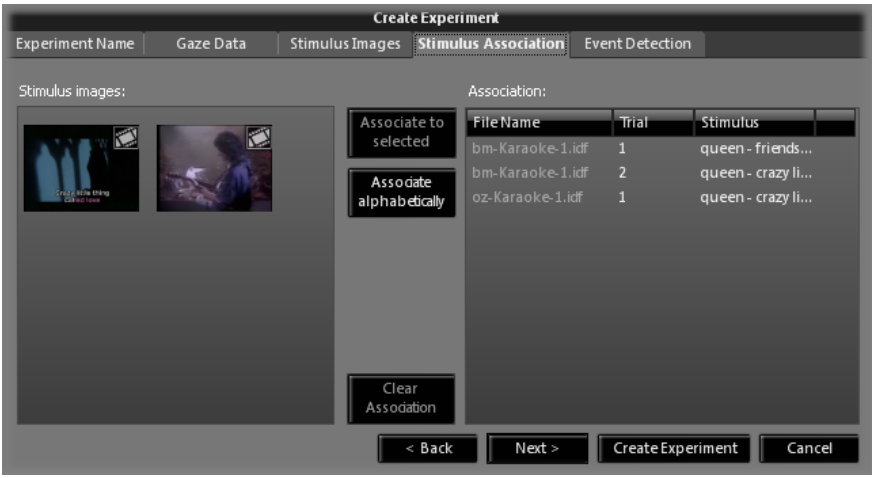
  – The image size must be at least as large as the calibration area of the reference data, which is the first data file in the gaze data file list 66.

If the stimulus fits the criteria, the status is ok. If the stimulus fails, the status will give a clue about the reason of failure and the color of the row will be red.

- **AOI File**: Images and Videos can be associated with AOI files. The AOI files should have the .xml extension (see also AOI Format Description 182) and be located in the same folder as the images. If an AOI file has the same name as an image file, except for the extension, it will be automatically added to the experiment and listed in the **AOI Files** column next to the respective image file.

5.2.6 Stimulus Association Tab

In this tab you can associate each trial (or plane in the case of a multiple plane Measurement Scenario 75) with a stimulus image, that will be used as background for the single views. It is recommended to set suitable associations between stimulus images and trials at an early stage of the analysis process, as it will allow an easy handling with the experiment data later on.



It's not required to make the associations. Items that have no stimulus associated will get a default gray image as background.

In the left part of the window all stimulus images of the experiment are displayed in an image pool. In the right part all trials (or planes) are listed in the **Association** list. If the trials are separated by trial separator messages 76, every trial should already be associated with the appropriate stimulus image. Otherwise, the stimulus images will be sorted and associated with the trials in alphanumerical order.

Associate a stimulus image

1. Click the image you want to associate.
2. Click the trial (or plane) you want to associate.
3. Click the **Associate to selected** button.

You can also associate stimulus images with the following actions:

a) If a trial is selected then you can simply double-clink the image you want associated with it.

b) To clear an association, select a trial and use the **Clear Association** button.

c) All actions that can be done on one trial, can be done on multiple trials by selecting multiple trials in the trials list.

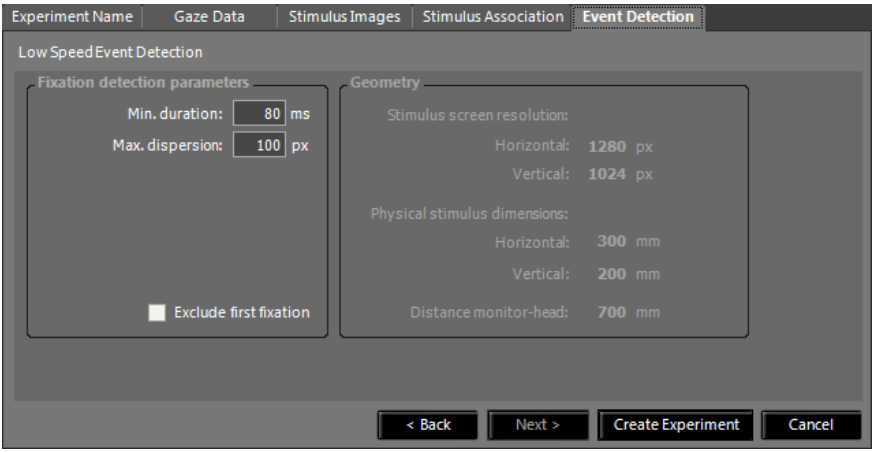
d) With the **Associate alphabetically** button, all associations are redone by associating images to all trials in alphabetical order.

5.2.7 Event Detection Tab

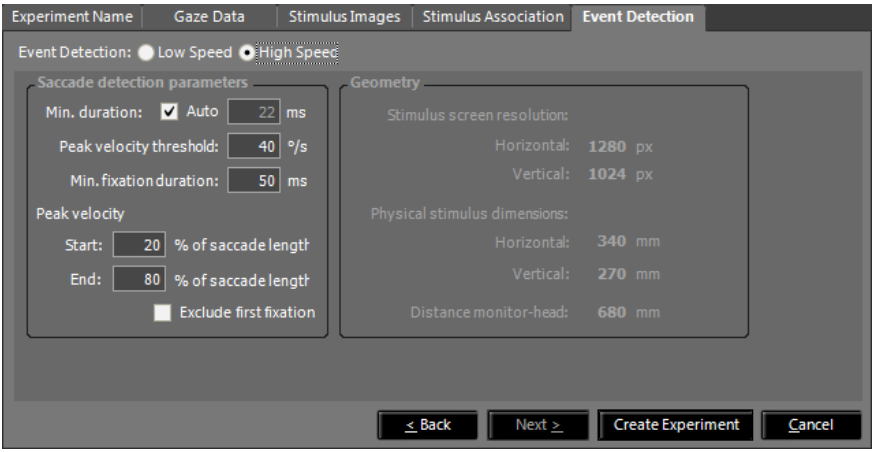
In this tab you can adjust the event detection parameters for the trials loaded within the experiment. You can also adjust these settings during analysis. For information on the event detection parameters, see Adjust Event Detection 325.


For event detection adjustment availability please check the BeGaze Product Variants 12 chapter.

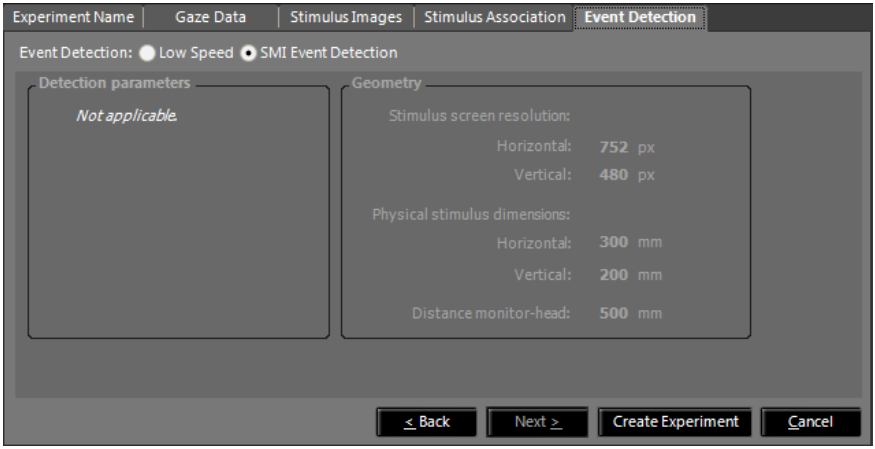
Low - Speed data (<200Hz):



High- Speed data (>=200Hz) with selectable event detection algorithms, either low speed or hi-speed algorithm:

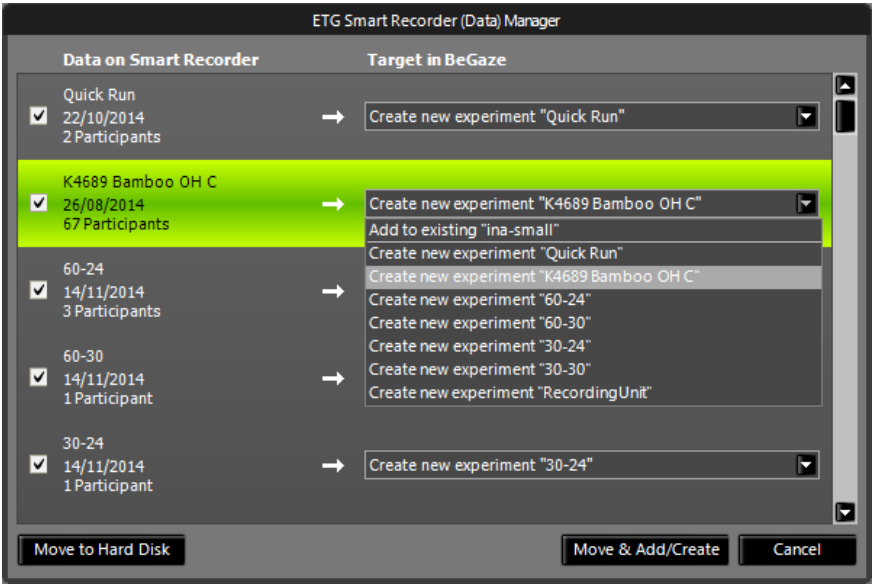


HED and ETG experiments have an additional option to select "SMI Event Detection" which is specifically designed for these experiment types (this option is also selected by default when available).



5.3 Manage Smart Recorder Data

Smart Recorder data can be handled from the **Collect Smart Recorder Data...** option in the **File** menu. Selecting this option shows a list of recorded data from all the Smart Recorders that SMI BeGaze™ knows about. Before using this dialog to handle data the first step is to register the Smart Recorders on the network with SMI BeGaze™, if a version 1.0 Smart Recorder is used. This step is detailed in the Global Settings 61 chapter. Version 2.0 Smart Recorders do not need any registration.



The dialog shows a list of recorded experiments present on all of the registered Smart Recorders. For each experiment there is a drop down list on the right that selects how to add the Smart Recorder data to SMI BeGaze™. The options are:

- **Create new experiment "..."**: add the Smart Recorder data to a new experiment with a given name. The default is to create a new experiment with the same name as the Smart Recorder experiment.
- **Add to existing "..."**: add the Smart Recorder data to a previously created experiment. The default is to use the existing SMI BeGaze™ experiment with the same name (if one exists). This is usually what you want when there are some new recordings done on the Smart Recorder for the same experiment.

The drop down options presented above are the same for all the Smart Recorder experiments so you can chose any other combination of options. The defaults are usually the expected behavior but you can choose, for example, to add all the Smart Recorder data to a single new experiment or

to add data from one Smart Recorder experiment to a different SMI BeGaze™ experiment.

Each experiment on the Smart Recorders has a checkbox in front. When clicking the **Move & Add/Create** button all the checked experiments are imported in SMI BeGaze™ either as a new experiment or as new data for an existing experiment (using the options explained above).

In case you just want to download the recorded data to the computer there is the **Move to Hard Disk** button. Pressing this button moves all the checked experiments from the Smart Recorder to a selected folder on the computer.

 Moving data off the Smart Recorder deletes the original data from the Smart Recorder. In order to create experiments using the moved data you need to create the experiment using regular means (like drag and drop and others) as explained in the Create Experiment Wizard 64 chapter.

To delete experiment data from the Smart Recorder without any further processing you can right click on the experiment and select **Delete** from the context menu. This deletes the selected experiment's data from the Smart Recorder storage.

5.4 Measurement Scenario

There are three scenarios that BeGaze can handle:

Non Head Tracking survey:

No head tracking system was used and the raw data is mapped directly on the selected stimulus.

Single Plane survey:

Only one plane is surveyed. All measurements are performed on one single plane. The raw data is mapped on the surveyed plane. The contents of the plane may change during the experiment. Possible use case: participant reads a newspaper.

Multiple Plane survey:

Several planes are surveyed. Each plane has a fixed content, that does not change during the experiment. The raw data is mapped to it's associated plane. Possible use case: participant sits in a cockpit and watches the various panels.

5.5 Signal

Data Trial Separator

For a better overview each BeGaze experiment run is separated into *Trials*. The separation is performed automatically by ”Trial Number” or by ”Trial Separator Message”, according to the recorded data.

The trial number and/or trial separator message was recorded by the eye tracker together with the data. Note, that iView X allows both trial number and trial separator message recording. If trial separator messages are present, BeGaze automatically performs the separation by trial separator message. Otherwise, the trial number separation is used.

Separation by trial number: If you use a trial number you have to set associations 69 between stimulus image and trials manually.

Separation by trial separator message: If you use an trial separator message it must have a specific format:

<Timestamp>MSG# Message: <image name>

Example:

28437864110MSG# Message: image01.bmp

This allows an automatic association 69 between stimulus images and trials. The following image and video formats are supported: bmp, jpg, jpeg, png, avi.

The separator message can be inserted in the IDF file during recording by sending the remote command ET_REM to iViewX. The format has to be:

ET_REM "filename.suffix"

Example:

ET_REM "image01.bmp"

Auxiliary Events

You can choose if *Trigger Events* should be created by *Trigger Message*. If so, the trigger message must have a specific format:

<Timestamp>MSG# Message: TRG: <trigger message>

Example:

28437864110MSG# Message: TRG: left Button up

The trigger message can be inserted in the IDF file during recording by sending the remote command ET_REM to iViewX. The format has to be:

ET_REM "TRG:<trigger message>"

Example:

ET_REM "TRG: left Button up"

5.6 Manage Experiments

5.6.1 Modify Experiment

With the **Modify Experiment** wizard you modify the data to be analyzed in the current experiment.

1. From the **File** menu, select the **Modify Experiment** command.

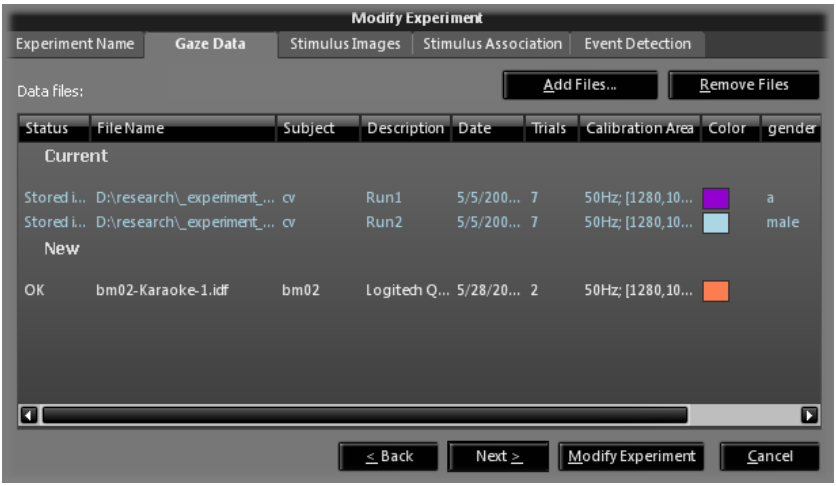
   A dialog opens with several tabs.

2. You can proceed through the tabs step by step using the **< Back** and **Next >** buttons. You can also immediately jump to a specific tab by clicking on the tab title.

3. Fill in the experiment data in the following tabs:

   Experiment Name 65: Experiment name and additional experiment information can be entered here.

   Gaze Data 66: Here you can select the new eye tracker data files to be analyzed, and also remove from the data base the existing data. The existing data will be removed permanently.



Stimulus Images 67: Here you can add new stimuli and also remove existing stimuli from the data base. The existing stimuli will be removed permanently.

Stimulus Association 69: Based on the experiment type the selected stimuli need to be (re)associated with the trials or planes of the Experiment.

Event Detection 325: The parameters for the fixation/saccade detection can be changed in this tab.

Note that the Modify Experiment button is enabled only if the experiment contains sufficient data to perform the analysis.

5.6.2 Save Experiment

To save an experiment proceed as follows:

1. Click on the  icon in the toolbar 455 or go to the File menu and select **Save Experiment**.
2. To save the experiment to a new name, click **Save Experiment As**. Enter a new name and click **Save**.

   The experiment will be saved with it's current settings, for example the opened data views, in the database 465 directory.

5.6.3 Open Experiment

To open an experiment proceed as follows:

1. Click on the  icon in the toolbar 455 or go to the **File** menu and select **Open Experiment**.
2. The **Open Experiment** dialog opens.

3. Select the experiment you want to open.
4. Click **Ok**.

5.6.4 Close Experiment

You can interrupt the creation and analysis of an experiment by closing it. To close an experiment proceed as follows:

1. From the **File** menu, select the **Close Experiment** command.
2. Click **Save** if you want to save the experiment with it's current settings, for example the opened data views. Otherwise click **Don't Save**.
3. To continue the experiment, simply open 79 it again.

5.6.5 Experiment Backup

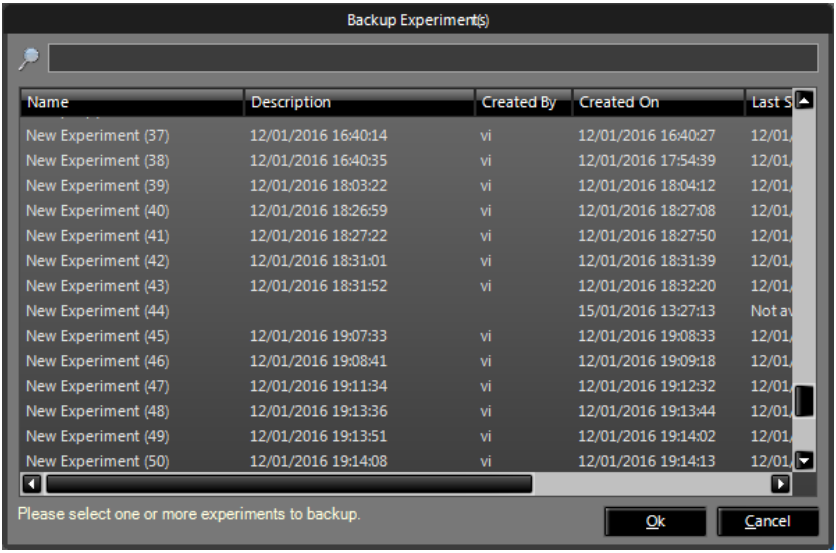
You can backup a saved experiment to a file. To backup an experiment proceed as follows:

1. Close 80 all experiments.
2. From the **File** menu, select the **Backup Experiment to File** command.

The Backup Experiment to File command can be performed only if all experiments are closed.

The **Select Experiment** dialog opens.

3. Select the experiment you want to backup.



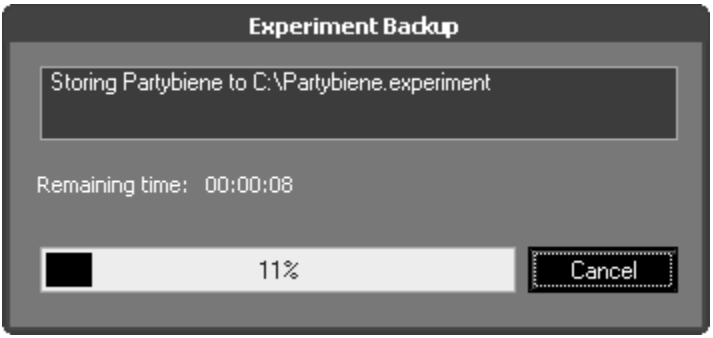
4. Enter the desired experiment file name. Browse for the folder or create a new folder where the backup will be stored.

   The **Experiment Backup** dialog will be presented, showing the following information:

   – path of the file

   – remaining time

   – progress bar



5.6.6 Experiment Restore

To restore an experiment proceed as follows:

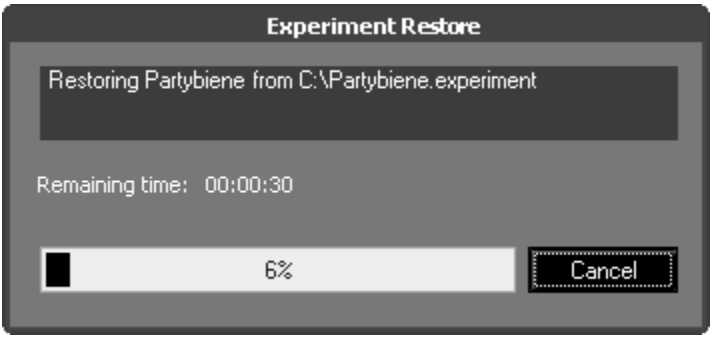
1. From the **File** menu, select the **Restore Experiment from File** command. No experiment must be loaded for the option to be available.
2. In the file selection dialog, browse for the file corresponding to the experiment you want to restore.
3. Select the experiment you want to restore.

   The **Experiment Restore** dialog will be presented, showing the following information:

   – path of the file

   – remaining time

   – progress bar



4. At the end of the process you'll be asked if you want to open the experiment.

Alternatively you can drag a backed-up experiment from a file browser and drop it in the main BeGaze window. Restoring the experiment starts automatically.

Note that the "BeGaze2\SampleExperiments" folder from the Installation CD contains sample experiments that can be restored and used in BeGaze.

5.6.7 Delete Experiment

To delete a saved 79 experiment from the database proceed as follows:

1. Click on the  icon in the toolbar 455 or go to the **File** menu and select the **Delete Experiment from Database** command.

   The **Delete Experiment** dialog opens.
2. Select one or more experiments you want to delete.
3. Click **Delete Experiment**.

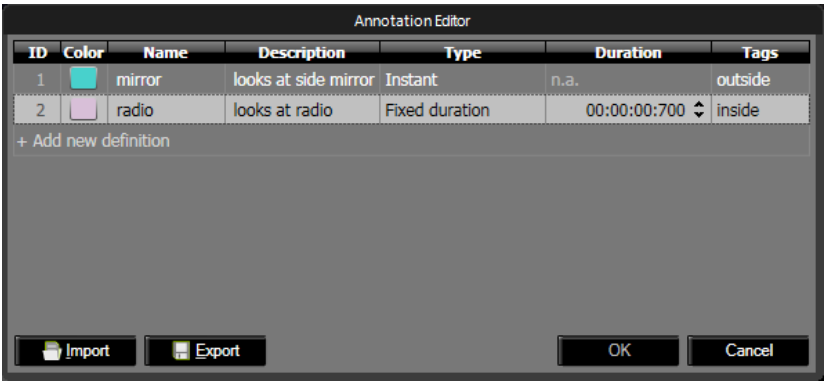
The experiment will be removed from the database. This process is irreversible.

5.7 Annotations

Annotations are user defined notes associated with a certain moment of time and duration in a data recording. They can either be previously defined and added during gaze recording in Experiment Center or they can be defined offline during analysis and added in any of the Data Views that offer a Player Control 120.

Define Annotations

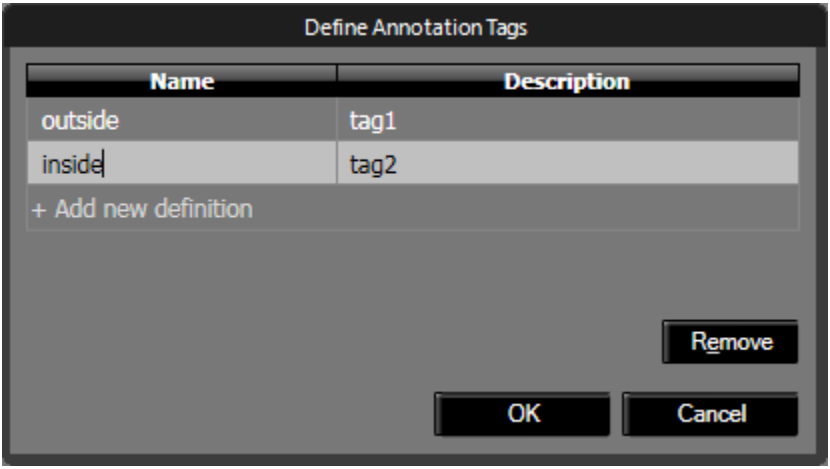
Annotations can be defined in the **Annotation Editor...** that can be found under the **File** menu.



A set of annotation definitions is stored together with the currently opened experiment.

Add Annotation Definition

- Click **+ Add new definition** in the top area to create a new line in the list.
- Type a **Name** for the annotation definition (this is a mandatory field).
- An **ID** and **Color** are assigned automatically. You can modify the color.
- Optionally type a **Description** for the definition.
- Select the annotation **Type**: either **Instant** where the annotation is added at a specific point in time or several interval types where the annotation also has a duration. **Fixed duration** adds annotations of fixed duration. Note that because there is no live recording happening, **Manual On/Off** and **Until same tag** can't work as in Experiment Center, they will just create fixed duration annotations with a preset duration.
- **Duration**: shows when interval annotations end respective to their onset and allows setting the interval duration when **Fixed duration** is selected for the type.
- **Tags**: edit and associate a number of text tags to the annotation definitions which can be used to filter the definitions later. Clicking **+Edit** in the Tags field show an editor for tags, similar to the one for definitions, where they can be added and removed and a **Name** and optional **Description** can be set.



Delete Annotation Definition

- Right click an entry in the list and click **Remove**.
- Or select an entry and press the **Del** key.

Save Annotation definitions

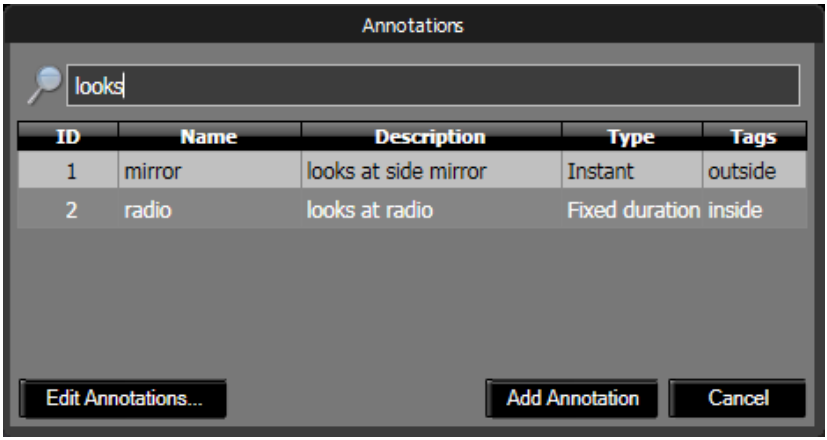
Definitions are saved automatically when pressing the **OK** button. By pressing the **Export** button, the current set of definitions can be saved (exported) as a xml file in order to use them later on in other experiments as well.

Load Annotation definitions

Press the **Import** button to load a previously exported set of definitions. The current list will be overwritten.

Creating and editing annotations

When adding a new annotation by pressing the "**0**" key on the keyboard or from the context menu of the *Annotations* line in the Player Control 120 the following window appears:



The list of annotation definitions will show up and you can either select one from the list using the mouse or the arrow keys or filter the list first by doing a free text search in the search bar above the list. This search will show definitions that contain all the typed words in any of the **ID**, **Name**, **Description** or **Tags** fields.

If you type something in the search field that doesn't match any existing definition you can still add what you typed by pressing **Enter** and a new definition will be added using the typed text as its **Name**.

Select the definition from the list using the mouse or the arrow keys and press **Enter** or click **Add Annotation**. An annotation with the selected definition will be added to the participant recording at the current time shown in the player control.

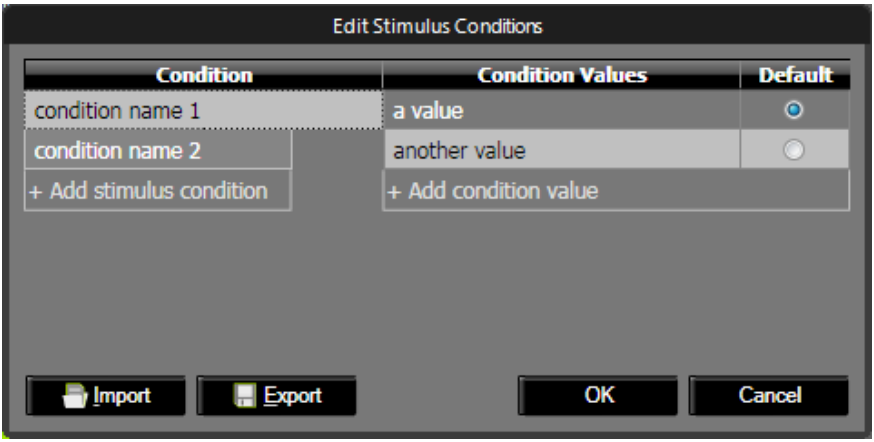
You can go to the definitions editor directly from here by pressing the **Edit Annotations...** button.

Annotations are shown in their separate timeline underneath the Player Control 120 thumbnails in the color set for their definition.

5.8 Stimulus Conditions

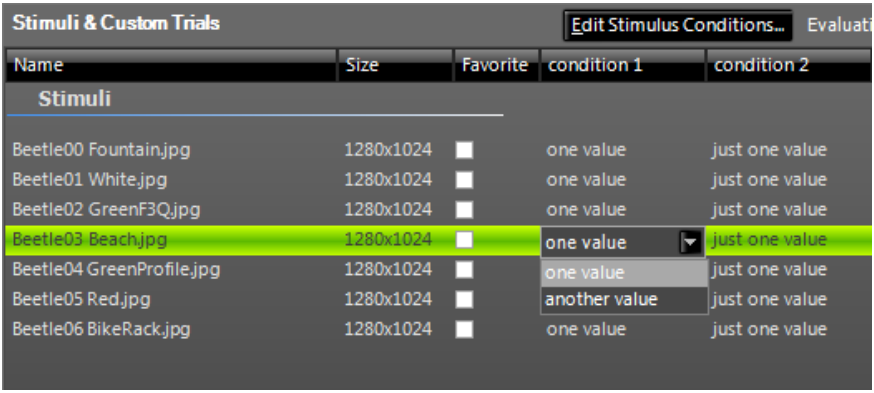
Stimulus conditions can be defined and associated to the stimuli in the experiment (similar to adding participant properties 66 to participants).

You can edit the stimulus condition names and values in the Dashboard 142 by clicking the **Edit Stimulus Conditions...** button in the upper part.



In the left column you can define stimulus conditions and in the right column you can define several values for each condition and also select the default value for that condition. This default value will be used for all the stimuli that don't have a specific value set in the Dashboard.

Editing the stimulus condition values is done in the Dashboard 142 by switching to the list view for the stimulus panel in the upper part (toggling to the right button). You then get the stimulus list with columns for each defined stimulus condition. By clicking over the stimulus condition values a drop down list shows up allowing you to change the value for that stimulus.



You can also export the currently defined conditions by pressing **Export** or load back previously saved conditions with the **Import** button.

5.9 Export Queue

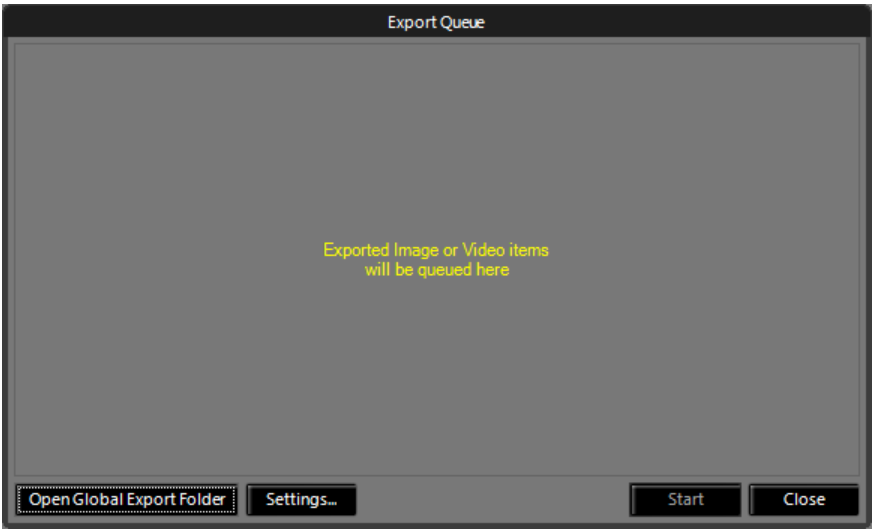
The export queue contains items(video, image and others) selected for export from the various available data views. There is only one export queue for all experiments in the database so all exports requested from all experiments are presented here. The queue helps when several exports (especially ones that take a lot of time, like long video exports) are needed and it would be time consuming to wait for each one to finish before requesting the next one. By using the export queue all the exported items are added here one after the other without being started and can then be executed as a batch at a later time.

When exporting an item (for example, by using the **Export Video...** 443 or **Save Image...** items in the **Export** menu) there is an additional **Add to Queue** button that allows adding the item to the export queue for later processing, instead of starting the export immediately.

Exporting images is actually added to the export queue and processed immediately, unlike other item types, because exporting

images is fast. So when you add an image to queue and open the export queue dialog you'll see it shown as "done".

You can see the current export queue and start processing it by either going to the **Export** menu and selecting**Show Export Queue...** or by clicking the  toolbar button. You can also click the "Export queue: [n] items" link in the dashboard right panel.



The items added to the export queue are visible in the opened dialog together with their progress status, type and length (for videos). The export queue allows editing the file names for the queued items. Clearing an item's file name will switch back to the default file name of that item (generated according to the selected file naming scheme - see Export Queue Settings).

Clicking the **Start** button will start the batch export of all items. The currently exported item is highlighted and the percent processed is shown. When done items are grayed out. The items are exported in the order they appear in the list. The batch export can also be started by double clicking a

"queued" item and this will start exporting the clicked item first and then the other in order.

Starting the batch export will close the currently opened experiment so that no experiments is changed during export. After the export is finished or paused the experiment is opened again.

While the export is running the **Start** button becomes a **Pause** button that when pressed cancels the progress of the currently exported item and stops the batch export.

Pressing the **Open Global Export Folder** button opens the folder where all the exported files are placed. Note that the exported files are placed in separate subfolders for each experiment. Going to the **Export** menu and selecting **Open Experiment Export Folder** opens the export subfolder for the currently opened experiment. Double clicking a finished item in the list (status "done") opens that item in the appropriate viewer (media player, image viewer, etc.).

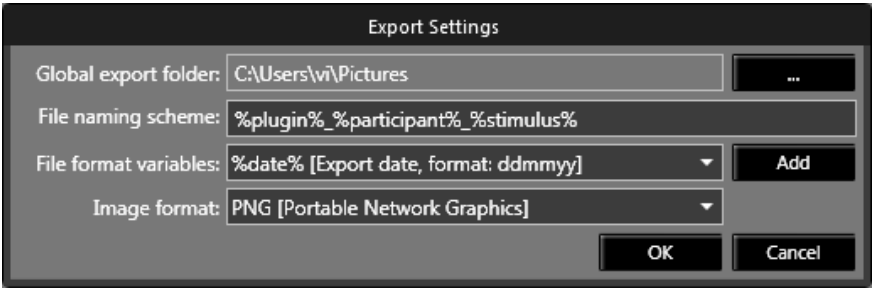
Selecting and item and right clicking shows a menu with the following options:

- **Move to Top**: moves the selected item to the top of the export queue so it is processed first when starting the export (equivalent to double clicking an item but without starting the export)
- **Export selected**: starts exporting the selected item only, not the whole list
- **Remove from Queue**: removes the item from the queue (can also be done by pressing the Del key on the keyboard).

Multiple items can be selected with the mouse or keyboard so the right click context menu options can be applied for several items at once.

Export queue settings

Clicking the **Settings** button opens the export queue settings.



- **Global export folder** button on the right allows changing the export folder where all the exported items are placed. By default it points to the TEMP folder defined in Windows.
- **File naming scheme** allows writing a custom naming scheme for the file names of the exported items. The scheme can be edited here or special variables can be added using the next option.
- **File format variables** allows adding special fields in the file name of the exported items (from options like date, time, experiment name, stimulus name, etc.). Clicking the Add button adds the special field to the file naming scheme above.
- **Image format** allows selecting the graphics file format (BMP, PNG, JPG).

5.10 Multiple Users

Multiple users can safely work on the same experiment (on the Semantic Gaze Mapping 187 and AOI Editor 161 data views in particular). The users must access the same database containing the shared experiment.

For a description of all the available options for working with multiple users please read the Multi User Semantic Gaze Mapping 50 chapter. The explanations below will refer to the **Central Data Storage** option.

Multiple Users with a Central Data Storage Scenarios

One usage scenario, applicable to ETG experiments for example, can be the following:

- A project owner creates an experiment.
- The owner defines reference views.
- The owner sets up the experiment for multiple users.
- Semantic gaze mapping is performed and AOIs are defined on multiple worker PCs. The worker PCs access a shared database (for example in a shared network folder).
- The project owner can see the progress of each working station in his Dashboard 142.
- Analysis is performed on the owner PC .

Another usage scenario can be this one:

- Start the same as in the previous scenario (owner creates experiment, defines reference views and sets up the experiment for multiple users)
- "Workers only" case: data is shared with a storage device containing the database being shipped back and forth between owner and workers that do the gaze mapping.

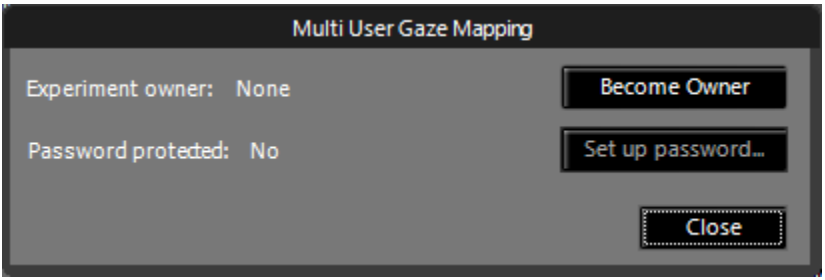
Setting Up An Experiment for Multiple Users

There are two ways of setting up an experiment for use with multiple users with a central data storage, depending on whether you already have the experiment created and opened or not.

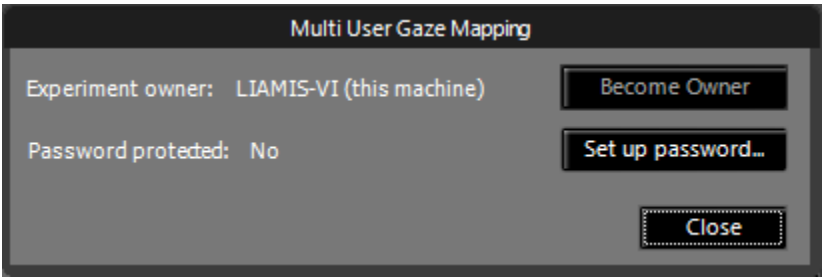
An experiment is already opened

To setup an experiment for multiple user access, a user has to become "Experiment Owner" by going to the **File** menu and selecting **Multi User Gaze Mapping -> Central Data Storage**. This opens a dialog where one can become experiment owner and setup a password to protect the owner

selection from then on. When dialog is first opened after creating an experiment, there is no owner and the **Become Owner** button is available.



After clicking it, the user becomes owner, the **Set up password...** button becomes available.

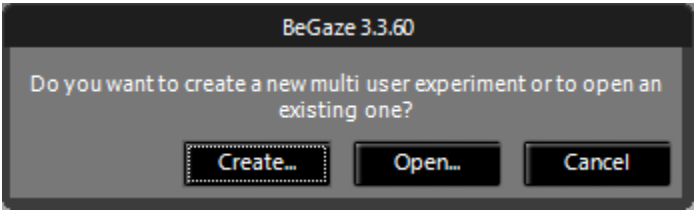


The owner can now set up a password so that other users can't become owners without knowing the password (the password should have at least 4 letters).

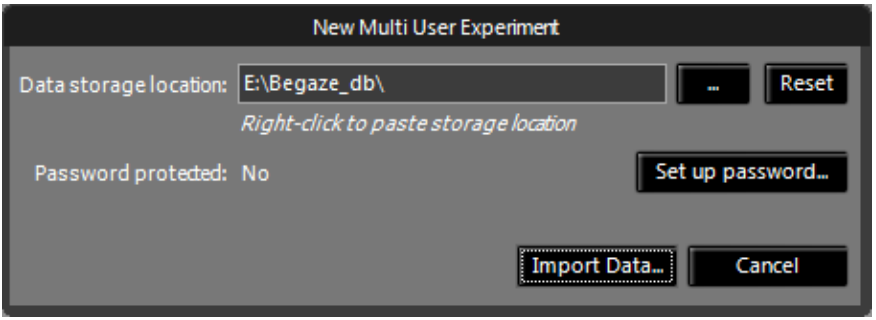
After an experiment owner has been set up, the experiment can be opened simultaneously from multiple computers accessing the same database. Any other computer apart from the experiment owner will open the experiment in worker mode.

An experiment is not yet created and opened

Going to the **File** menu and selecting **Multi User Gaze Mapping -> Central Data Storage** with no opened experiment will show a dialog where one can create an experiment or open an existing experiment that was already setup for multiple users.

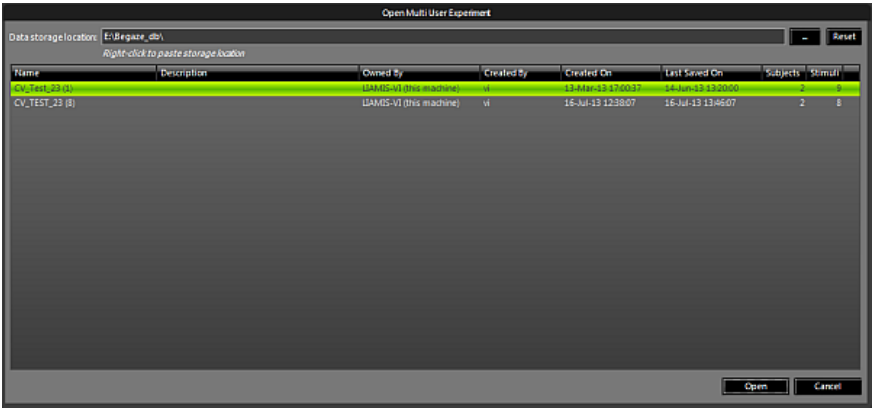


1. Selecting **Create...** shows a dialog for setting up the multiple users and then allows selecting the experiment data for creating the new experiment.



Here it is possible to select a certain database like in the Global Settings 60 and to setup a password for the experiment so that other users can't become owners without knowing the password. Then clicking the **Import Data...** button starts the usual process of creating an experiment 64 from a given folder. The Experiment Owner will be automatically set to the user creating the experiment.

2. Selecting **Open...** in the **Central Data Storage** dialog shows a list of existing experiments that were set up for multiple users and also allows switching the active database to a different location.



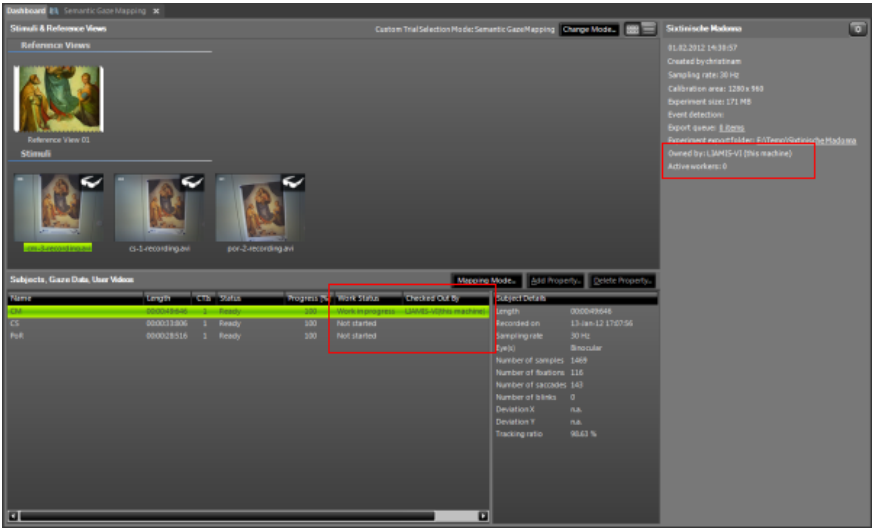
Owner Mode

The experiment owner may access all Begaze plugins and options.

However, there are some restrictions. While the experiment is open on worker PCs, the owner **may not**:

- Modify the experiment by deleting participants or changing event detection parameters;
- Change "Custom Trial Selection Mode" or "Mapping Mode";
- Modify or delete reference views;

The information about which data is currently being mapped by which users and which data is finished is displayed in the dashboard, in the lower **Gaze Data** panel. Information about the current owner and workers is available in the right panel.



Worker Mode

A worker opening the experiment has access to a limited set of options. The worker may:

- Open the AOI Editor 161 and define AOIs;
- Open Semantic Gaze Mapping 187 and perform gaze mapping (defining reference views is not allowed).

Experiment Analysis

Chapter

6 Experiment Analysis

6.1 Data View Selection

Select data view

1. Select a data view by clicking on the respective icon of the toolbar 455. Alternatively, you can choose the respective entry from the Analysis 451 menu.

   The appropriate data view will open in a new tab.

2. If required, you can repeat step 1 to open another data view.

Operating the data views

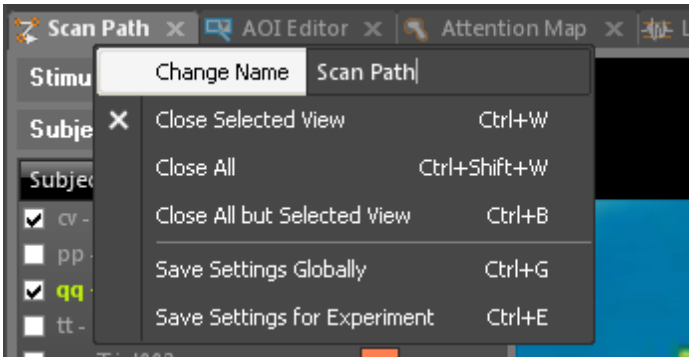
Each plug-in will open in a separate tab. Note that a plug-in can be opened several times within one experiment, e.g. to examine the scan path for several participants/trials.

The AOI Editor, Custom Trial Selector, Semantic Gaze Mapping and Gaze Replay can be opened only once in an experiment.

1. You can switch between the data views by clicking on the tab titles. You can also use the [CTRL] + [Tab] keyboard command to switch between the tabs.

   If multiple tabs of a data view are opened, it may be useful to rename them for differentiation.

2. Right click the tab title.
3. Enter a new name in the **Change name** field.



4. Press [ENTER] to confirm your entry.

6.2 Overview of Analysis Data View

BeGaze provides various data views to analyze gaze data. Here is a brief overview of the data views and what they are for:

Toolbar button	Data view description
	The Calibration 151 plugin allows the offline calibration of a given participant's eye data (available for Smart Recorder Version 1.0 only).
	In the Custom Trial Selector 154, you can define the custom trials and their associated reference views.
	In the AOI Editor 161, you define the AOIs (**A**reas **O**f **I**nterest) that should be evaluated for the stimulus.
	In the Semantic Gaze Mapping 187, you can map the gaze data points from scene videos to a corresponding reference view.
	The Gaze Replay 198 displays a quick overview of all stimuli associated to a participant, with a visualisation similar to the scan path one.

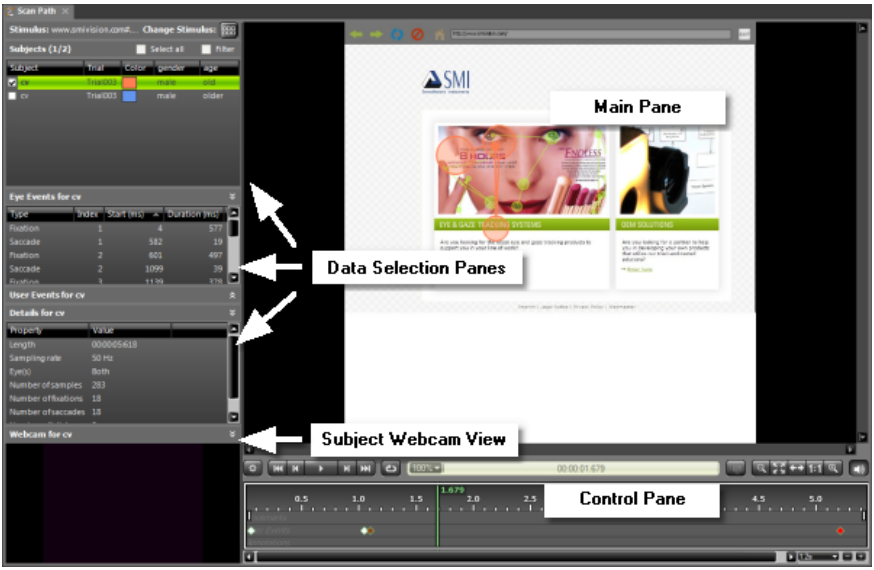
	The Bee Swarm 202 displays a raw gaze data overlay over the stimulus image/stimulus video.
	The Scan Path 209 displays a gaze data (raw or eye events) overlay over the stimulus image/stimulus video.
	The Focus Map 221 shows gaze patterns over the stimulus image visualized as a transparent map.
	The Heat Map 228 shows gaze patterns over the stimulus image visualized as a colored map.
	The Key Performance Indicators 236 displays relevant statistical data for each defined AOI over the stimulus image
	The Gridded AOIs 249 displays relevant statistical data for an automatically defined grid of rectangular AOIs over the stimulus image
	The AOI Sequence Chart 259 displays the AOI hit order over time.
	The Binning Chart 264 gives a statistical overview of AOI hits per binning frame.
	The Proportion of Looks 271 plugin gives an graph overview of the gaze behavior over time aggregated over multiple trials.
	The Line Graph 306 displays x and y directions of gaze data plotted as graphs over time and events displayed in a timeline.
	The Reading Statistics 279 computes statistics for reading experiments based on automatic generated AOIs.
	The Metrics Export 339 computes diverse statistics based on events and AOI hits.

Note on monocular and binocular data: The Line Graph data view shows binocular data. All other data views (except the **AOI Editor**) show monocular data.

6.3 Data Views

6.3.1 Overview

Each visualization consists of several data views. The views contents vary but there is a standard layout:



- **Data selection view**: On the left side of the screen, you find the views to select and restrict the data to evaluate. In the AOI Editor 161, the left view serve to create and edit AOIs.
- **Participant Usercam and Audio**: If user videos (recorded with a webcam in Experiment Center 3.7) are available, the video

corresponding to the selected participant is shown here. This view can be minimized to ignore the user video and audio completely. When the view is visible, the recorded audio is played back as well.

Usercam and Audio playback requires the observation package license.

- **Main view**: On the upper right, the main view displays the corresponding diagram, the AOI preview or the statistics.
- **Control view**: On the lower right, a control view offers individual commands for operating the display in the main view. When the webcam view is present and its panel is not minimized the participant video is played in sync with the main stimulus and the participant audio is played instead of any sound the stimulus might have.

6.3.2 Operating the Data Views

You can adapt the display of the views to your needs.

Resize views

1. To resize a view, position the mouse on it's border.

   The mouse cursor changes to ↔.

2. Resize the view by dragging the mouse into the desired direction.

Hide and show views

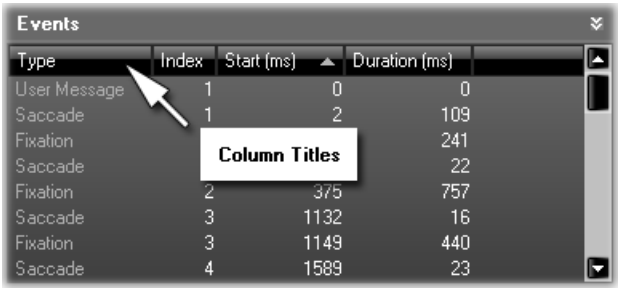
a) To hide a view, click on it's ⊻ button.

b) To display the view again, click on it's ⊼ button.

Sort and modify order of columns

You can sort the lists displayed in the data selection view (see Data Views Overview 102).

1. To sort columns, click on one of the column titles. An arrow indicates if the order is ascending or descending. To change that, click on the column header again.
2. To modify the order of the columns, click on one of the headers and move the column with the mouse to a new position (Drag & Drop).



6.3.3 Stimulus Selection

The **Stimulus** selection view allows you to change the stimulus and thus the trials associated with it.

The stimulus selection is available in the following data views:

- AOI Editor 161
- Semantic Gaze Mapping 187
- Bee Swarm 202
- Scan Path 209
- Focus Map 221
- Heat Map 228
- Key Performance Indicators 236
- Gridded AOIs 249

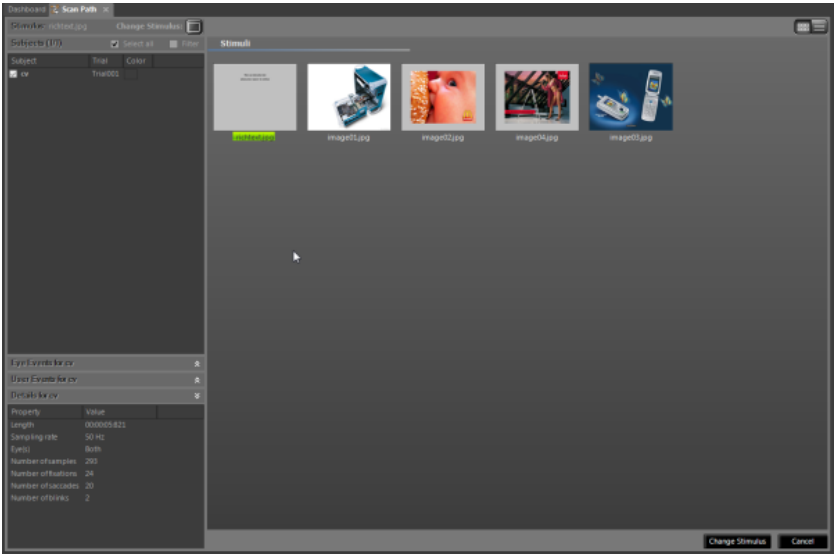
- AOI Sequence Chart 259
- Binning Chart 264

Select stimulus

To select a stimulus proceed as follows:

1. Click on the select stimulus button to open a view with all available stimuli.

   The file name of the currently selected stimulus is highlighted.



   You can select between thumbnail view and list view modes by toggling between the buttons at the top of the stimulus list.

2. Double click on the appropriate stimulus thumbnail or click on the select stimulus button again.

   The selected stimulus will immediately be displayed in the data view's main view.

You can also use the [CTRL] + [X] keyboard command to open and close the stimulus selection and you can use the left and right arrow keys to move within the stimulus selection.

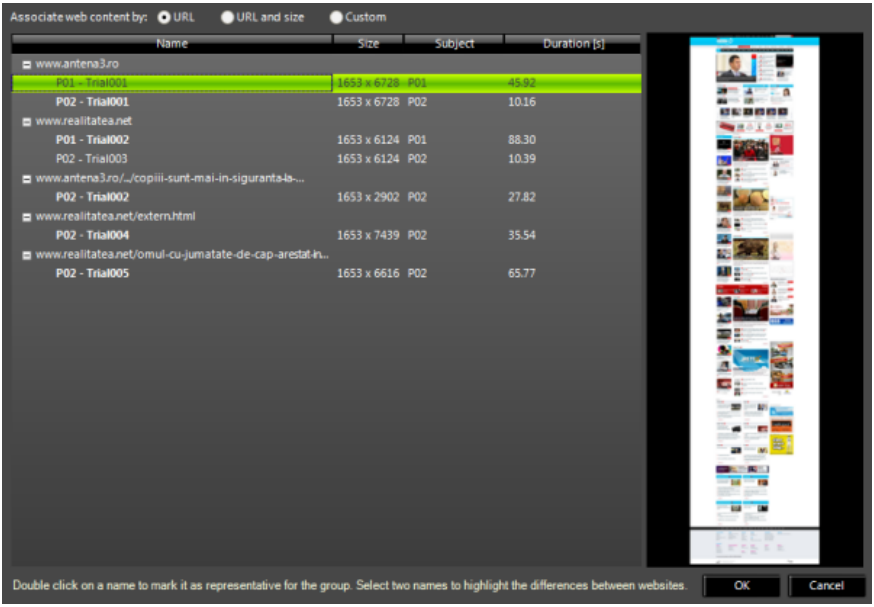
You can also use the [CTRL] + [T] keyboard command to switch between a list view and a thumbnail view in the stimulus selection.

6.3.4 Associating Web content

In the case of web experiments the recordings will usually contain users browsing around several web pages. Due to the dynamic content of the pages (page content updates, banners, ads, user specific customizations) the webpages will not always look the same for different users although the page address is the same. To alleviate this problem each trial that was recorded also contains its own screenshot of the webpage as it was presented to that user.

For several trials there will be several screenshots of the same webpage. You can sort through these similar screenshots and pick the one to be shown as representing all the related trials during analysis. The web content association dialog is accessed by first going to the Dashboard 142 tab and then clicking on the 

button at the top of the stimulus list. When clicking the button the following dialog appears:

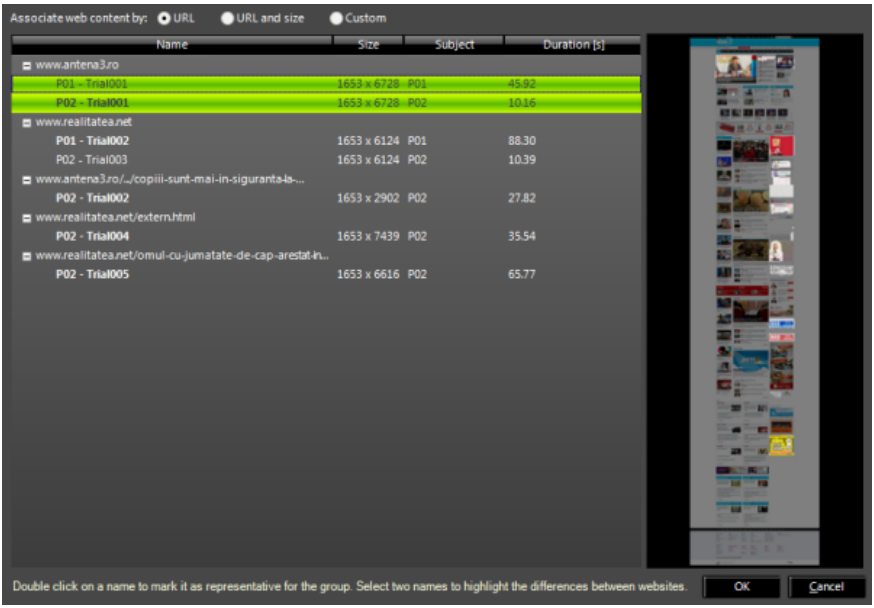


The main panel contains the available web pages screenshots grouped by one of the criteria selected at the top of the dialog:

- **URL**: all screenshots done for the same page address (URL) are shown as a group (as seen above)
- **URL and size**: all screenshots done for the same page address that also have the same physical size (height x width) are shown as a group
- **Text content**: all screenshots done for pages with the same text content are shown as a group
- **Custom**: for more complex scenarios the grouping can be done manually

Selecting a trial shows on the right side a screenshot of the page taken during that trial. Selecting two trials (by dragging with the mouse or holding the CTRL key and clicking with the mouse to select a second trial) highlights the differences between the pages while dimming the areas with

identical content. This is useful in order to decide how similar the pages were so you can customize the groups properly in the custom mode.



In "URL" and "URL and size" modes you can decide which of the screenshots in a group to use by double clicking on its corresponding trial in the list. This will become the representative screenshot for that set of trials and will be shown accordingly in the data view as the stimulus image. The selected screenshot is shown in bold font in the list.

In "Custom" mode additional actions are available apart from selecting the representative screenshot. You can move images between groups and create additional custom groups and drag images there if the URL-based groups don't actually match the webpage contents. Moving the images is done by clicking on the corresponding trial in the list and dragging it over another group.

6.3.5 Participants

6.3.5.1 Participant Selection and Filtering

In the **Participants** view all participants together with their associated trials are listed. The list entries are related to the selected stimulus (see Stimulus Selection 104).

The participants selection is available in the following data views:

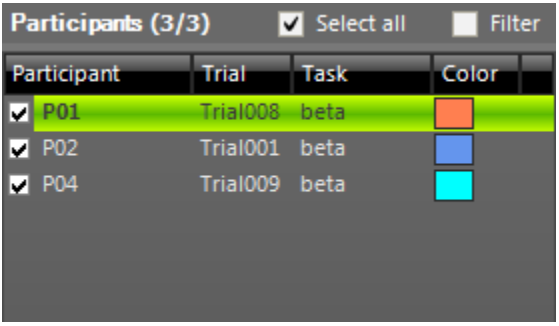
- Gaze Replay 198
- Bee Swarm 202
- Scan Path 209
- Focus Map 221
- Heat Map 228
- Key Performance Indicators 236
- Gridded AOIs 249
- AOI Sequence Chart 259
- Binning Chart 264
- Reading Statistics 279
- Line Graph 306

Select participants

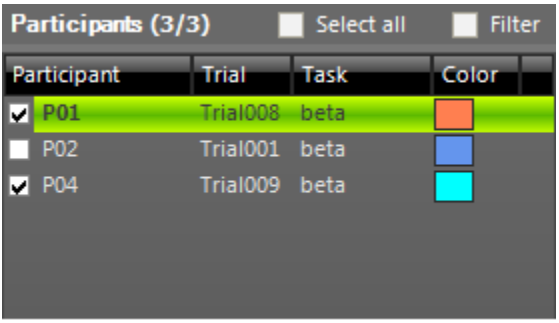
You can decide whether you want to use all participants gaze data for your analysis or if you want to restrict the analysis to a subset of them by using filters. Filters are based on the participant group properties which were defined in Experiment Center or afterward in BeGaze in the Dashboard 147.

You can select one or more participants/trials with the following procedures:

a) Click the **Select all** check box to check/uncheck all items presented in the list at once.

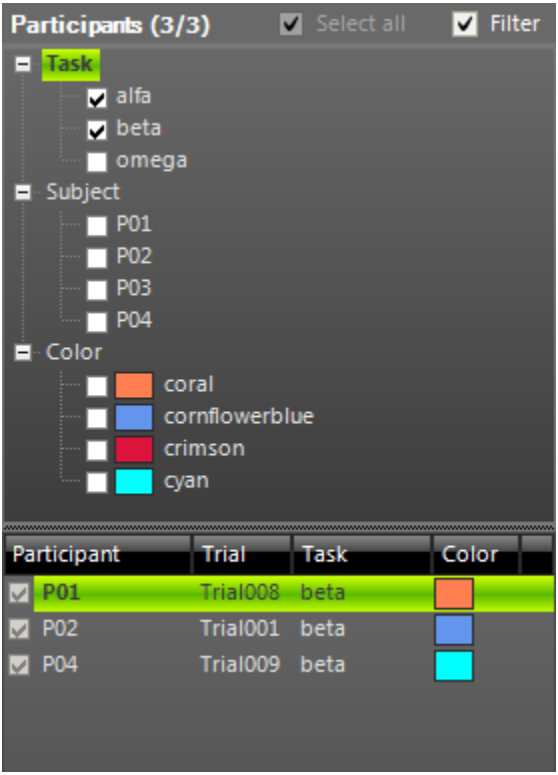


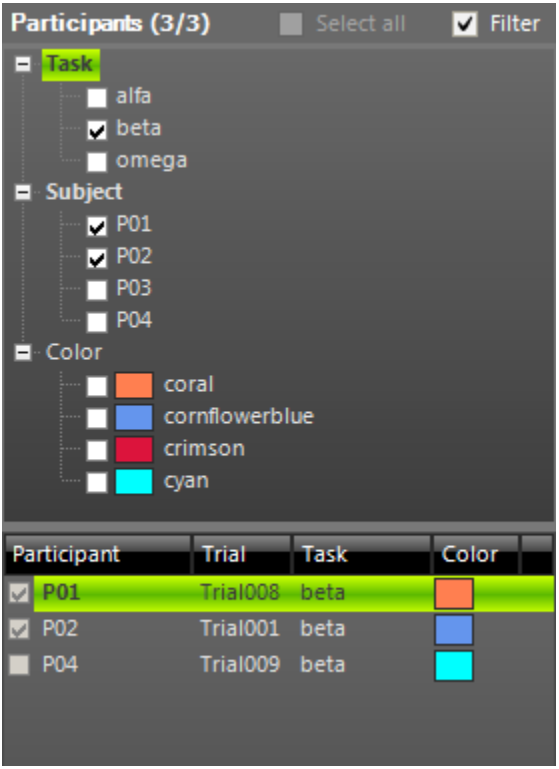
b) To select single items, click the appropriate check box next to an item.



c) Click the **Filter** check box to enable the filter setting. The participants list displays the group properties, e.g. age. Click on ⊞ to open the list of given filters for this property. Select the desired filter(s). The related items will automatically be checked.

There are two built-in filter groups: **Participant** and **Task**. The **Participant** group contains all the participant names from the current experiment so you can filter by participant, selecting only trials associated to the checked participants in the filter. The **Task** group contains the tasks defined for the current experiment. If tasks were defined during experiment recording, a Task property column also appears in the participantselection list, before the **Color** column.


Participants (3/3)
Select all
Filter
Task
alfa
beta
omega
Subject
P01
P02
P03
P04
Color
coral
cornflowerblue
crimson
cyan
Participant
Trial
Task
Color
P01
Trial008
beta
P02
Trial001
beta
P04
Trial009
beta



The checked items will represent the participants trials used in the current analysis.

If you select an item (the selected item is highlighted), it becomes the selected trial and will be used to fill:

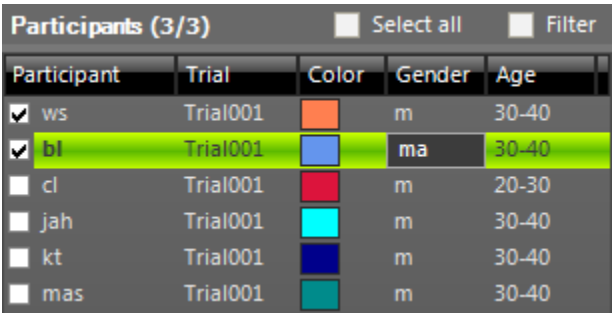
- and the Trial Details 113
- the Events List 115

Sorting is possible by clicking on the column titles.

Modify properties

While you are operating the scan path 209, attention map 221, key performance indicators 236, aoi sequence chart 259 or binning chart 264 data view, you can change the properties of a participant if required. To do so:

1. Click on the corresponding property in the **Participants** view.
2. Overwrite the property value.



If you have the filter settings dialog open, you can neither select single participants nor edit properties.

You can edit the **Color** property for several participants at once by selecting them and clicking any color property of the selected items.

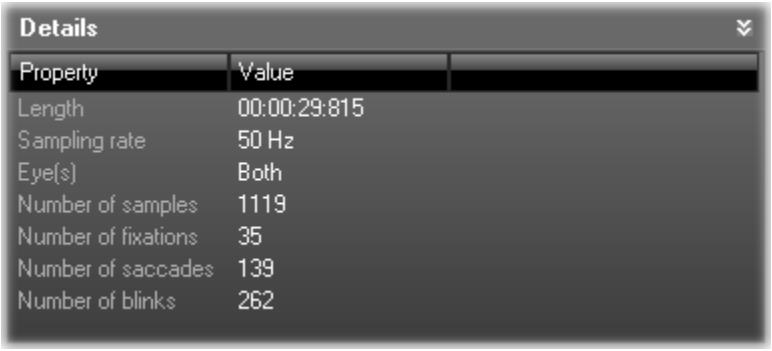
6.3.5.2 Participant-Trial Details

The **Details** view shows detailed information of the currently selected participants trial.

The trial details view is available in the following data views:

- Gaze Replay 198
- Bee Swarm 202
- Scan Path 209

- Focus Map 221
- Heat Map 228
- Key Performance Indicators 236
- Gridded AOIs 249
- AOI Sequence Chart 259
- Binning Chart 264
- Line Graph 306



If a participant trial is selected (see Participants Selection 109), information will be given about

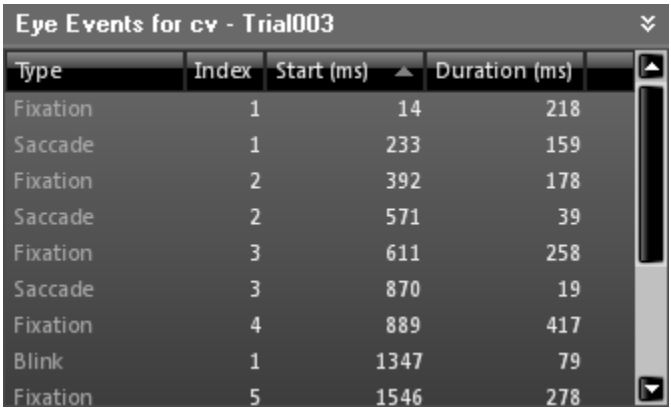
- duration of the trial,
- sampling rate in [Hz],
- available data channels (left/right/both),
- number of samples,
- number of fixations,
- number of saccades,
- number of blinks.

6.3.6 Events

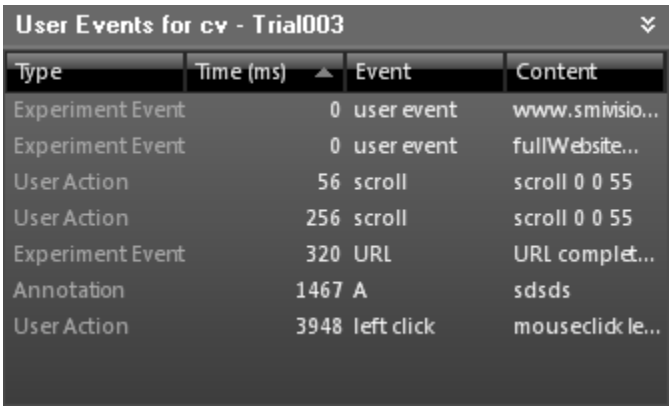
6.3.6.1 Events Selection

The **Events** views contain the summary of events of the currently selected participants trial (see Participants Selection 109). There are two views available:

- Eye Events



- User Events



The events are listed in chronological order. For detailed information on the various eye events see Event Details 117. For the user events the relevant data is shown directly in the user events view:

- Type: experiment event, user action, annotation
- Event: keyboard presses, mouse clicks, page scrolls, annotation types, etc.
- Content: the relevant content for the specific event

The user events are generated based on the following messages from the IDF files:

Message Type	Format	Comments
Image message	"# Message: stimulus.jpg"	Recognized extensions: ".bmp", ".jpg", ".jpeg", ".png", ".avi", ".wmv', ".mkv', ".h264"
Mouse click	"# Message: UE-mouseclick left x=552 y=443"	Currently supports "left" or "right"
Key press	"# Message: UE-keypress shift-G"	
Recording Note	"Recording Note: Hello World"	

The events views are available in the following data views:

- Gaze Replay 198
- Bee Swarm 202
- Scan Path 209
- Focus Map 221
- Heat Map 228
- Key Performance Indicators 236

- Gridded AOIs 249
- Line Graph 306

Select event

1. Mark an item by clicking on it with the left mouse button.

   Now more information about the event will be given in the Event Details 117 field.

2. Depending on the selected data view, the main view is being updated as well. For example, when you click on a fixation in the scan path, the corresponding fixation is shown and selected also in the main view.

6.3.6.2 Event Details

In the **Details** view more detailed information of the currently selected event is displayed (see Events Selection 115).

The events details view is available in the following data views:

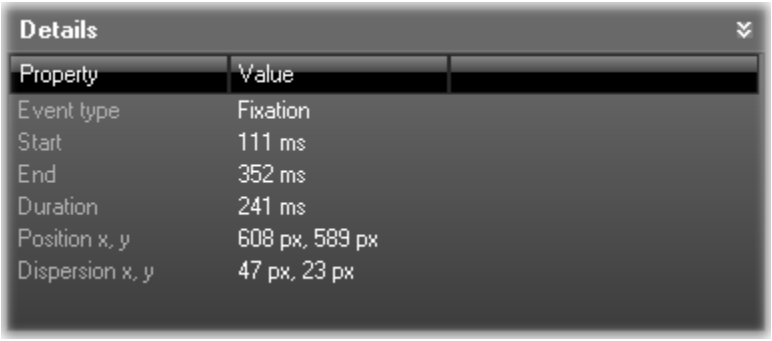
- Gaze Replay 198
- Bee Swarm 202
- Scan Path 209
- Focus Map 221
- Heat Map 228
- Key Performance Indicators 236
- Gridded AOIs 249
- Line Graph 306

Depending on the event type, different parameters will be shown.

Fixation

If you selected a fixation, information will be given about

- start and end time,
- duration of the fixation in [ms],
- the averaged position of the fixation in [pixels],
- the dispersion of the fixation in [pixels].



If the experiment 464 contains head tracking data in a multiple plane scenario 75, additionally image name and plane number are displayed.

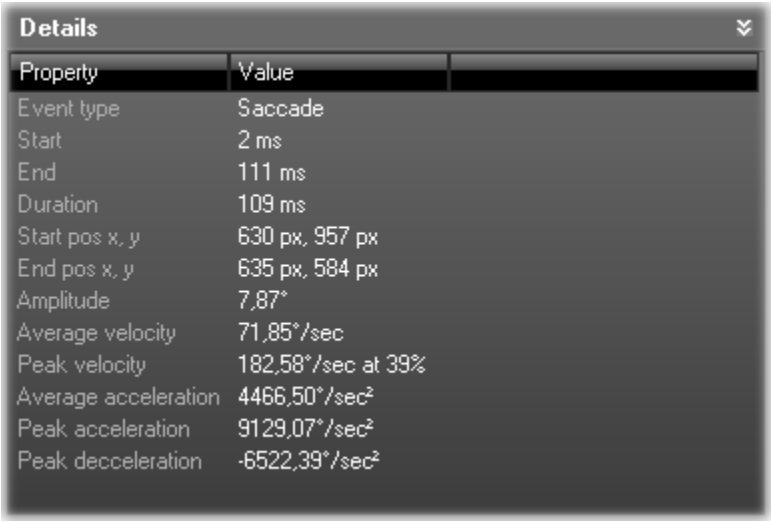
Saccade

If you selected a saccade, you will get information about

- start and end time,
- duration of the saccade in [ms],
- the amplitude of the saccade in [°],

and, for recordings with sampling rate greater than 30Hz,

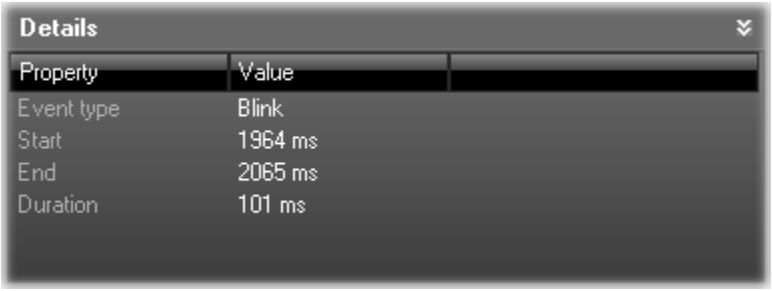
- the average and peak velocity of the saccade in [°/sec],
- the average, peak acceleration and deceleration of the saccade in [°/sec^2].



Blinks

If you selected a blink, you will get information about

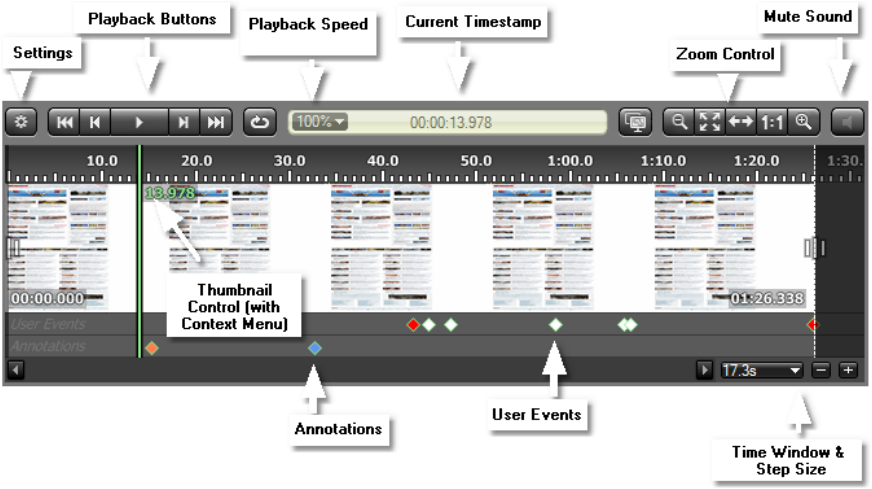
- start and end time,
- duration of the blink in [ms].



6.3.7 Player

6.3.7.1 Player Control

The player control contains commands to navigate in a video stimulus displayed in the AOI Editor 161 and respectively in a Custom Trial Selector 154, Semantic Gaze Mapping 187, Gaze Replay 198, Line Graph 306, Bee Swarm 202, Scan Path 209, Focus Map 221, Heat Map 228, Key Performance Indicators 236 or Gridded AOIs 249 stimulus.



Detailed descriptions for the player control elements can be found in the following sections:

- Playback Control 121
- Zoom Control 123
- Thumbnail Control 124
- Thumbnail Control Context Menu 127

6.3.7.2 Playback Control

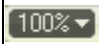
The playback control allows you to control the presentation of gaze measurement data and videos, both in playback or in single step mode.

In the **AOI Editor**, you can use the toolbar buttons to control the display of a video stimulus in the AOI main view. With the **Scan Path, Attention Map** or **Key Performance Indicators** data view, you use the toolbar buttons to control the display of the gaze measurement data.

Playback control buttons and key commands

To control the playback, you can use the following playback control buttons and key commands:

Button	Key command	Description
	[CTRL] + [HOME]	Jumps to the begin of the trial resp. the selected time window (see Thumbnail Control 124)
	Right arrow key	Moves presentation one step forward according to the selected step size (see Thumbnail Control Context Menu 127)
	[SPACE]	Plays/pauses the presentation
	Left arrow key	Moves presentation one step backward according to the selected step size (see Thumbnail Control Context Menu 127)
	[CTRL] + [END]	Jumps to the end of the trial resp. the selected time window (see Thumbnail Control 124)

Button	Key command	Description
		Repeats the presentation with the chosen playback speed under consideration of the selected start and end time (see Thumbnail Control Context Menu 127)
		For video stimuli only: activates and deactivates the speaker of the PC on which BeGaze is running and plays the audio stream of the video Note that the speaker function only works if the video is played back with 100% playback speed (see Thumbnail Control Context Menu 127).
		Sets the playback speed.
	Arrow up key	increases the step size (see Thumbnail Control Context Menu 127)
	Arrow down key	decreases the step size (see Thumbnail Control Context Menu 127)
	[B]	Add/Edit annotation
	[CTRL] + arrow right	Jumps to the next annotation
	[CTRL] + arrow left	Jumps to the previous annotation
	[ALT] + arrow right	Jumps to the next user event
	[ALT] + arrow left	Jumps to the previous user event
	[SHIFT] + arrow right	Jumps to the next annotation
	[SHIFT] + arrow left	Jumps to the previous annotation

Button	Key command	Description
	[CTRL] + [ENTER]	Add/Edit annotation
	[0]	Add/Edit annotation

6.3.7.3 Zoom Control

For large images and videos, you can use the zoom control to adapt the display of the selected stimulus to the size of the data view's main view (e.g. the AOI main view of the **AOI Editor**).

Here is an overview of the buttons and what they are for:

 Zooms out

 Fits the stimulus display to the size of the main view

 Fits the stimulus display to the width of the main view (useful for webpage stimuli)

 Displays stimulus in full-scale (= original stimulus size)

 Zooms in

 Toggles stimulus view on secondary monitor (only in Custom Trial Selector and Gaze Replay)

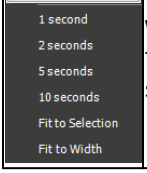
 Whether the zoom control is active or not, depends on the proportion between the BeGaze program window size and the size of the presented stimulus.

You can also navigate in the displayed stimulus using the following procedures if you are using a mouse with a mouse wheel:

a) Turn the mouse wheel to scroll up and down.

b) Press the [SHIFT] key, keep it pressed and turn the mouse wheel to zoom in and out.

6.3.7.4 Time Window and Step Size Control

Button	Description
	Sets the player time window size. Can select a specific time window or **Fit to Selection** or **Fit to Width**. The "+" and "-" buttons step through the list of options from the drop down on their left.
	Sets the movement step size. Accessible from the time window size drop down. Selects how many samples (or video frames in the AOI Editor) are skipped when you navigate the stimulus presentation with the Playback Control) 121

6.3.7.5 Thumbnail Control

The thumbnail control displays the timeline and the video stimulus over time as a sequence of thumbnails which represent the stimulus' single images at specific timestamps. For still images there are no thumbnails, leaving only the timeline present. Using the thumbnail control, you can navigate in the stimulus presentation of the Custom Trial Selector 154, Gaze Replay 198, Line Graph 306, Bee Swarm 202, Scan Path 209, Focus Map 221, Heat Map 228, Key Performance Indicators 236 or Gridded AOIs 249.

The thumbnail control gives an overview on

- the time window of the trial,
- user events (mouse clicks, page scrolls, key presses),

- audio visualization channel in case of video stimuli or available user audio recording

- and in case of a video stimulus in the AOI Editor the set key frames 179 are shown instead of the user events.

You can adapt the settings of the thumbnail control to your needs. For example, you can restrict the number of displayed thumbnails by increasing the interval in seconds that a single thumbnail represents (see Thumbnail Control Context Menu 127).

Controlling playback using the mouse

When you grab the navigation slider with the mouse by clicking it the stimulus/video will be played back in the main view of the data view in real-time. The navigation slider moves according to the mouse movement and indicates the current position within the stimulus. You can lock the navigation slider and thus freeze the video with a single click on the appropriate thumbnail.

Clicking with the mouse over the timeline (the mouse cursor becomes a hand when over the timeline) makes the navigation slider snap to the closest timeline tick.

Managing annotations

Right-clicking with the mouse over the *Annotations* line under the thumbnails allows **adding** new annotations or managing existing ones from the context menu that appears. See Annotations 83 for more information. Annotations can quickly be added by typing "**0**" and selecting the desired predefined annotation by clicking or typing the ID.

Right-clicking over an existing annotation allows to **delete** it or **edit** its content. The option to filter shown annotations by their type is also available in the context menu. Annotations can also be dragged left or right with the mouse in order to **change** their **position** in time or their **duration**.

Annotations spanning more than one trial (coming from Experiment Center) are marked as "read-only" and can't be modified.

Annotation definitions are global for all data views within the experiment.

Filtering user events

The *User Events* line under the thumbnails shows the user events read from the recorded trial data. These are read only as they are not user defined in like the annotations. The context menu shown by right-clicking over the line allow to filter the user events by their type.

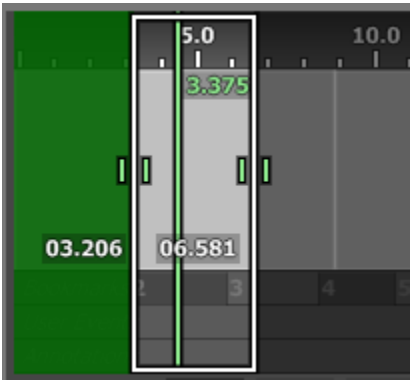
User events are global for all data views within the experiment for the selected stimuli.

Hovering with the mouse over a specific annotation shows a tool-tip containing relevant information (timestamp, content).

Modifying the Time Window

It is possible to limit the analysis time and view a smaller time window.

1. Position the mouse cursor at the left border of the first thumbnail over the white 3-line handler (the mouse cursor becomes a resizing icon).
2. Press the left mouse key and drag the mouse cursor on the timestamp in the thumbnail control which should define the start time.



3. Position the mouse cursor at the right border of the last thumbnail over the white 3-line handler (the mouse cursor becomes a resizing icon).
4. Press the left mouse key and drag the mouse cursor on the timestamp which should define the end time.
5. Position the mouse cursor on the top or bottom border of the time window.
6. Press the left mouse key and drag the mouse cursor left or right to move the whole selected time window.

Alternatively, you can use the handler to limit the time window:

1. Click on the left handler to activate it.
2. Use the left and right arrow keys to limit the time window.

   The selected time window is highlighted. The movement of the navigation slider will now be restricted to this time window. Start and end time of the time window are displayed at the bottom of the thumbnails.

6.3.7.6 Thumbnail Control Context Menu

The context menu of the thumbnail control contains commands to manage the display and the replay of the stimulus.

Right click the thumbnail control. The context menu opens, offering different commands depending on the area where the click was done:

1. Over the timeline, thumbnails and Trials line (if available):
    - **Extra Channels**: Toggle the entries in the pop-up menu to show or hide the associated channels: **Trials, User Events, Annotations**.
    - **Current Position / Start Position / End Position**: Manually adjust the current cursor position and the time window start and end position by typing the desired time value in the text box.
    - **Reset Positions**: Reset the time window start and end positions to the trial's start and end times.
    - **Move Start to Current Position / Move End to Current Position:** Set the time window start or end positions to the current cursor position.
2. Over the *User Events* line:
    - Several check boxes to enable or disable the display of the following user event types: **Keyboard, Left Click, Right Click, Scroll, URL Loaded**.
3. Over the *Annotations* line:
    - **Filter Annotations**: Check-boxes that enable or disable the display of annotations of a certain type. The annotation types are defined manually (see Annotations) 83 or automatically when defining a new annotation of an inexistent type.
    - **Add Annotation to Timeline**: Add a new annotation if one is not already present at the given timestamp.
    - **Delete Annotation**: Deletes the annotation if one exists at that timestamp.
    - **Annotation Locked/Unlocked**: When this option is toggled to locked then annotations can't be moved with the mouse.
    - **Annotation Position**: Sets the annotation timestamp. For interval annotations there are options for start and end positions.

- **Move to Cursor Position**: Moves the annotation under the mouse to the navigation slider position. For interval annotations there are options for moving the start and end to the cursor's position.

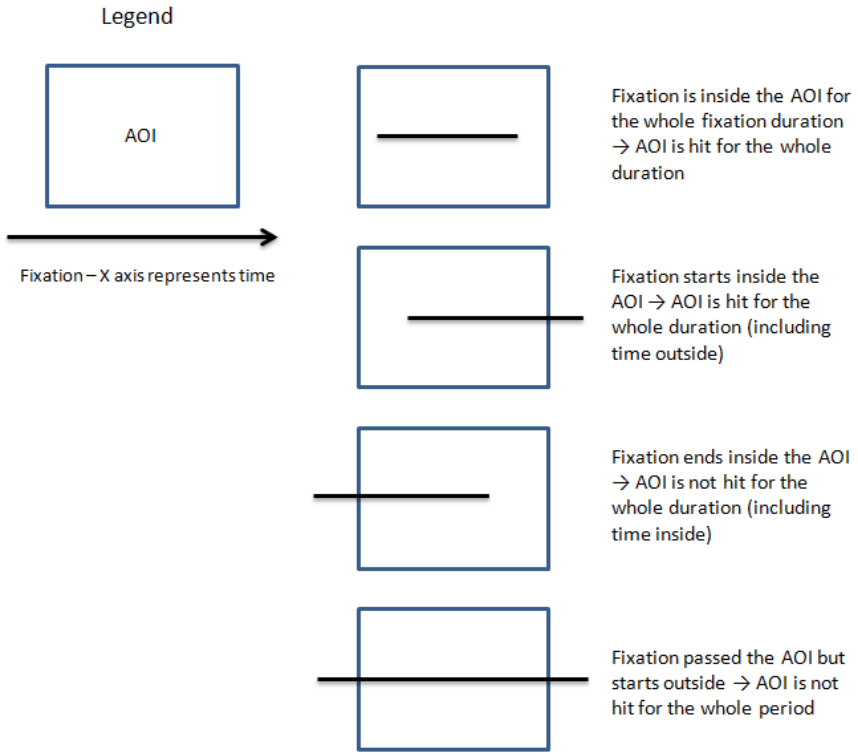
You can also use the Arrow up and the Arrow down keys to increase/ decrease the step size.

For EEG experiments additional channels are available, see Emotiv EEG information 132.

6.3.8 AOI Hits

A number of data views (AOI Sequence Chart 259, Binning Chart 264, Proportion of Looks 271) and exported metrics 341 show information related to the participant's gaze hitting an AOI (area of interest). This is called an **AOI Hit** and is defined as a fixation's position being inside a given AOI at the start of the fixation. If this happens then the whole duration of the fixation is taken into account in the subsequent computations, independent of what happens to the gaze or the AOI at moments after the fixation start time.

The possible situations are shown below, the fixation line indicates its position relative to the AOI from its start to its end time.



6.3.9 Targets

Static or animated targets can be defined in Experiment Center and are imported and shown in the data views. They have automatically associated AOIs created for them which are listed in the AOI Editor 161 but can't be edited. For the animated targets the AOI follows the target movement. Statistics for them are generated in Binning Chart 264, AOI Sequence Chart 259, Proportion of Looks 271 and Metrics Export 339. The target positions, velocities and accelerations are plotted in Line Graph 306.

6.3.10 Gaze Offset Correction

The gaze data recorded during an experiment run has an initial calibration done by the recording equipment before starting the recording. Sometimes it is not good enough or the conditions change during the recording causing the gaze data to not be properly calibrated for all or just some parts of the run. The correction of the gaze data can be done offline, after the data recording was finished. If the data has a consistent offset compared to the expected position then correcting the gaze offset can bring it back to the proper position. This option is available in Custom Trial Selector 154, Semantic Gaze Mapping 187, Gaze Replay 198, Scan Path 209 and Bee Swarm 202.

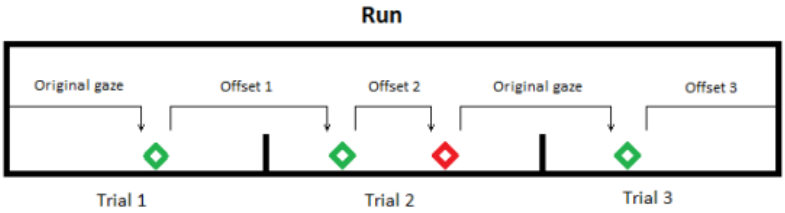
To correct the gaze, open any of the above views and go to the timestamp where the gaze position starts to be wrong. Right click on the stimulus area and select the **Offset Correction** option. Now the gaze position can be changes by dragging the gaze cursor to the proper position. When the mouse button is released, all the gaze data from that point onward until the end of the current run (which can span several trials) will be corrected by offsetting the gaze positions with the same amount as the correction done to the current gaze.

After adding a correction point, going to any later position in time adds a new option to the context menu: **Reset Offset Correction**. Selecting this option cancels the effect of the previous correction point from this point forward.

When data is corrected for the first time, a new channel will appear in the player control showing the positions where correction points were added. The channel shows the existing correction points (green points are regular correction points, red points are reset correction points). There are additional options available by right clicking on this channel. Right clicking on the channel at a timestamp where there is no correction point shows the **Offset Correction** and **Reset** options and also a **Delete All** option which removes all existing calibration points. Right clicking over a correction point shows the options **Cut**, **Copy**, **Delete** and **Modify**. After a **Cut** or **Copy** was selected, right clicking somewhere else along the channels gives the **Paste** option. What is pasted is the gaze data offset

from the original correction point so the gaze data from this point onward will have this offset applied to it. Selecting **Modify** allows the correction point to be edited like the first time it was added.

Each correction or correction reset point cancels any previous correction point and applies its own offset until the next correction point or until the end of the run if no other point exists after it.

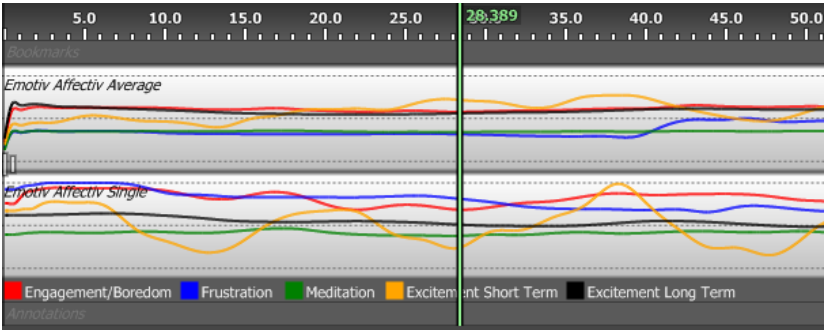


6.3.11 Emotiv EEG Data

EEG data recorded with the Emotiv EEG hardware can be analysed in BeGaze in sync with the eye data. For more information on the Emotiv EEG device please see: http://www.emotiv.com/apps/epoc/299/. When creating an experiment containing EEG data there are several new options available in the Player Control 120 and in the video 134 and data export 136.

Player Control

The player control presents new channels when EEG data is available. These channels display Affective data values in the time interval displayed by the player control. The new channels are: **Emotiv Affectiv Single** and **Emotiv Affectiv Average**. For each of these channels there are a number of Affective data graphs available: Engagement/Boredom, Frustration, Meditation, Excitement Short Term and Excitement Long term. There is also an extra **Emotiv Affectiv Legend** channel that describes these data graphs.



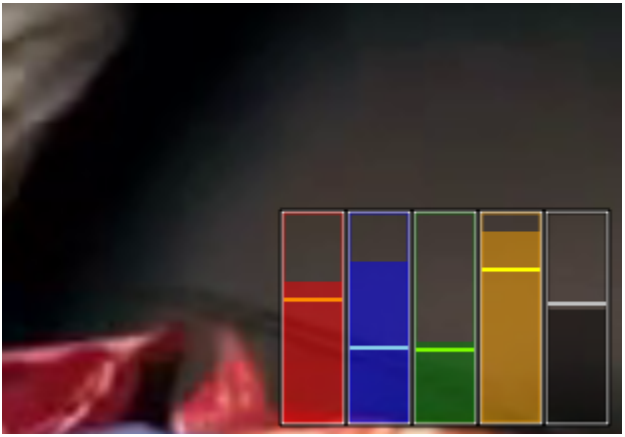
- **Emotiv Affectiv Single** channel: displays a time graph of Affective values for the currently selected user. The Y values are a Bezier spline curve generated from subsampled EEG data, to make it look smooth.
- **Emotiv Affectiv Average** channel: the same as the EEG Single channel, but with the average of the selected participants. This channel is not available in Gaze Replay and Custom Trial Selector.
- **Emotiv Affectiv Legend** channel: describes the displayed signals.

Each of the channels can be toggled on and off by right clicking on the player control area and going to **Extra Channels**, similar to other channels. For each channel the individual data graphs can be toggled on and off by right clicking over the corresponding channel.

The EEG channels are not available in AOI Editor.

Main Data View Overlay

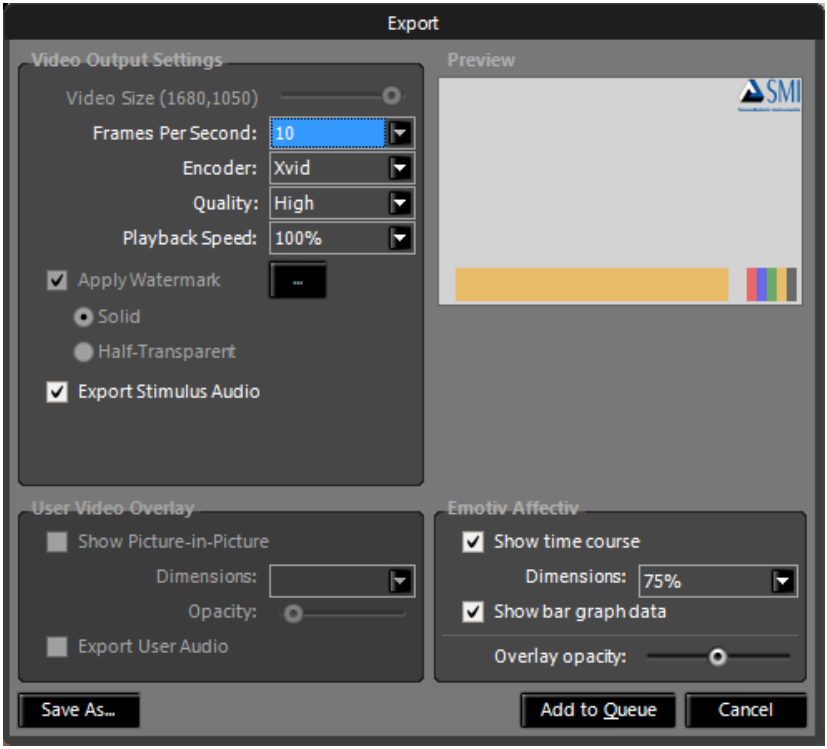
A semitransparent bar graph overlay of Affective values is available in the right bottom corner of the main data view. The bars are vertical, and stacked together in horizontal orientation. Each signal bar has the color of the source signal, the same as described in the Player Control legend. If multiple participants are selected, a horizontal average level indicator is present with a brighter color than the one of the signal.



Video Export

The Emotiv Affectiv overlay is available for video export 443. There are two components available:

- Time course of Affective values: looks the same as the player control EEG channels. The time interval displayed is the entire eye data duration and a cursor is progressing, signaling the current position. The visible EEG channels are the same as the ones currently selected in the player control.
- Bar Graph data: the same as the overlay presented in the Main Data View, with the same source data (single/average if available).



These overlays can be switched on or off and can be moved by dragging in the preview area. They are on by default and placed at the bottom left and right of the video frame respectively.

The relative width to the output size of the time graph is configurable in 4 percentage values: 25%, 50%, 75% and 100%. The default value is 75%.

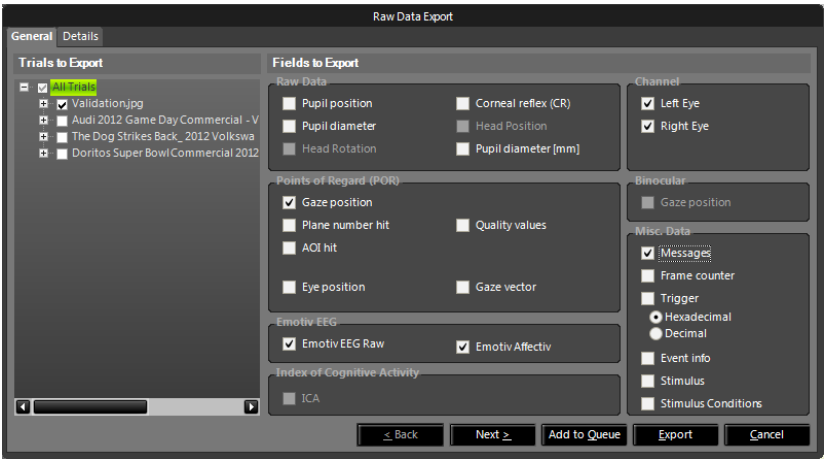
The opacity of the overlays is adjustable and by default it is set to half-transparent.

When EEG data is available the watermark has as default position the top right corner of the video frame.

Raw Data Export

All the EEG recorded data can be exported [425]. Specific columns are added in the output file. To export the data there are checkboxes available in the settings dialog:

- Emotiv EEG Raw
- Emotiv Affectiv



The Emotiv EEG Raw and Emotiv Affectiv data has a different sampling rate than eye data. The sampling rate of Emotiv EEG Raw and Affectiv data is always 128 Hz, while the eye data sampling rates depends on the hardware used to record the experiment.

When exporting Emotiv EEG Raw and Affectiv data, a common frequency that is a multiple of the eye data sampling rate is chosen (see below table).

Eye Tracking Sampling Rate	EEG Sampling Rate	Eye Data Action	EEG Data Action	Export Frequency

30 Hz	128 Hz	Upsample	Low pass filter, downsample	120 Hz
50 Hz	128 Hz	Upsample	Upsample	150 Hz
60 Hz	128 Hz	Upsample	Low pass filter, downsample	120 Hz
120 Hz	128 Hz	-	Low pass filter, downsample	120 Hz
250 Hz	128 Hz	-	Upsample	250 Hz
500 Hz	128 Hz	-	Upsample	500 Hz
1250 Hz	128 Hz	-	Upsample	1250 Hz

The eye data is upsampled to the common export frequency by replicating samples. The Emotiv EEG Raw and Affectiv data is downsampled or upsampled by interpolation using cardinal splines. If the Emotiv is downsampled, a low pass filter is first applied to the EEG Raw data columns. The filter has a cutoff frequency of 0.8 x the Nyquist frequency of the new data rate.

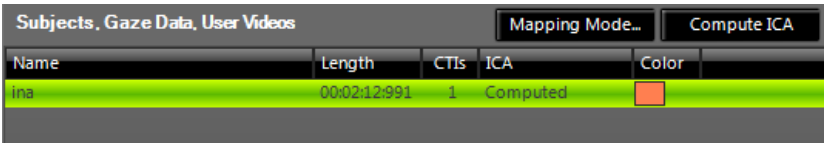
6.3.12 EyeTracking ICA Data

Index of Cognitive Activity (ICA) data can be computed in BeGaze using the Workload RT software from EyeTracking Inc. For more information on ICA please see: http://www.eyetracking.com/Software/Cognitive-Workload. A valid license for EyeTracking, Inc.'s Workload RT is needed and it must be installed and running in the background. On the BeGaze side a license for Experiment Suite Professional or Experiment Suite Mobile Video Analysis

is needed. Workload RT will process eye data from a range of SMI eye-trackers: SMI Eye Tracking Glasses, SMI RED-m and SMI RED250/500.

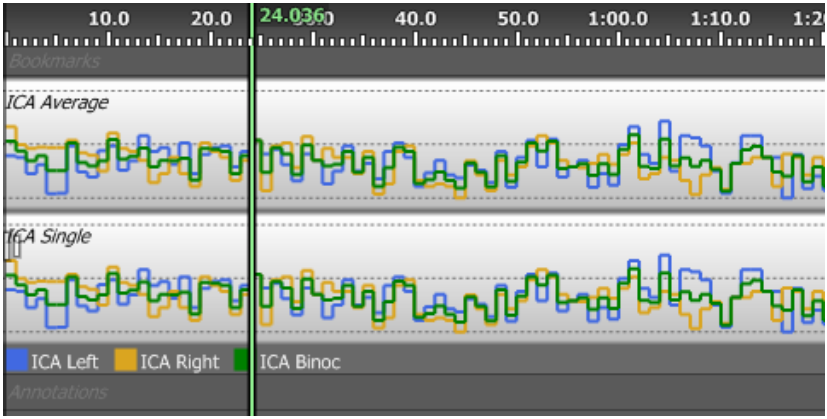
The latest approved version of Workload RT is displayed in the **About BeGaze** dialog along with the currently installed version.

If Workload RT is started when creating an experiment then ICA data is computed automatically by Workload RT and is sent back to BeGaze. Otherwise it can be computed later on already created experiments, by starting Workload RT and clicking **Compute ICA** in the Dashboard 142. When ICA data is computed for a participant then several new options related to it are available in the Player Control 120 and in the video 140 and data export 142.



Player Control

The player control presents new channels when ICA data is available. These channels display ICA data values in the time interval displayed by the player control. The new channels are: **ICA Single** and **ICA Average**. As each eye has its own connection to the brain stem and receives separate activation, ICA values are available for the left and right eye and as an average for both eyes. For each of these channels there are three data graphs available: **Left**, **Right** and **Binoc (**. There is also an extra **ICA Legend** channel that describes these data graphs.



- **ICA Single** channel: displays a time graph of ICA values for the currently selected user. The ICA is scaled between 0 and 1, where 1 indicates high workload.
- **ICA Average** channel: the same as the ICA Single channel, but with the average of the selected participants. This channel is not available in Gaze Replay and Custom Trial Selector.
- **ICA Legend** channel: describes the displayed signals.

Each of the channels can be toggled on and off by right clicking on the player control area and going to **Extra Channels**, similar to other channels. For each channel the individual data graphs can be toggled on and off by right clicking over the corresponding channel.

The ICA channels are not available in AOI Editor.

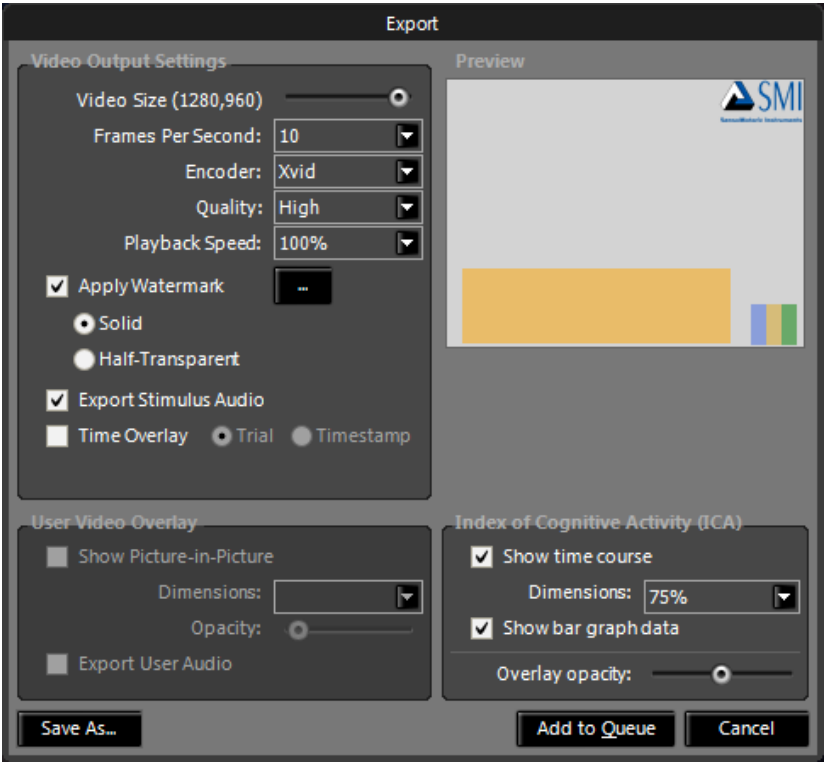
Main Data View Overlay

A semitransparent bar graph overlay of ICA values is available in the right bottom corner of the main data view. The bars are vertical, and stacked together in horizontal orientation. Each signal bar has the color of the source signal, the same as described in the Player Control legend. If multiple participants are selected, a horizontal average level indicator is present with a brighter color than the one of the signal.

Video Export

The ICA overlay is available for video export 443. There are two components available:

- Time course of ICA values: looks the same as the player control ICA channels. The time interval displayed is the entire eye data duration and a cursor is progressing, signaling the current position. The visible ICA channels are the same as the ones currently selected in the player control.
- Bar Graph data: the same as the overlay presented in the Main Data View, with the same source data (single/average if available).



These overlays can be switched on or off and can be moved by dragging in the preview area. They are on by default and placed at the bottom left and right of the video frame respectively.

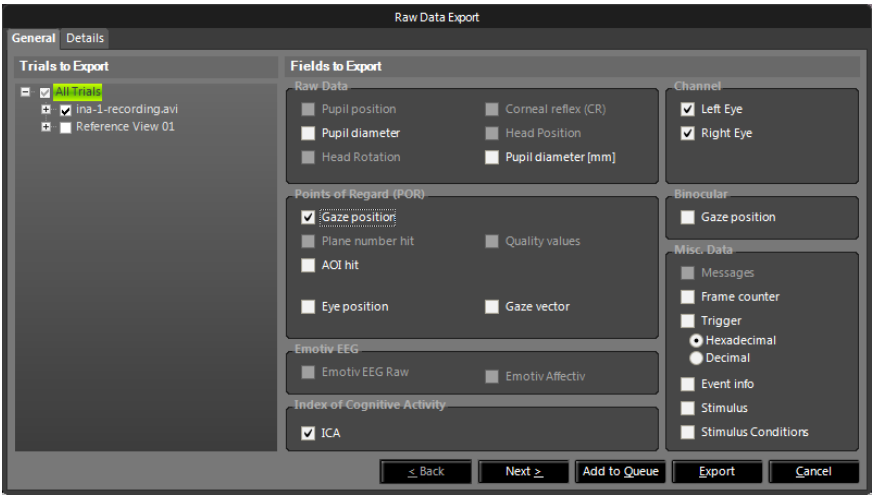
The relative width to the output size of the time graph is configurable in 4 percentage values: 25%, 50%, 75% and 100%. The default value is 75%.

The opacity of the overlays is adjustable and by default it is set to half-transparent.

When ICA data is available the watermark has as default position the top right corner of the video frame.

Raw Data Export

All the ICA data can be exported 425. Specific columns are added in the output file. To export the data there is the **ICA** checkbox available in the settings dialog.



The ICA data sampling rate is the same as the eye data sampling rate.

6.4 Dashboard

6.4.1 Overview

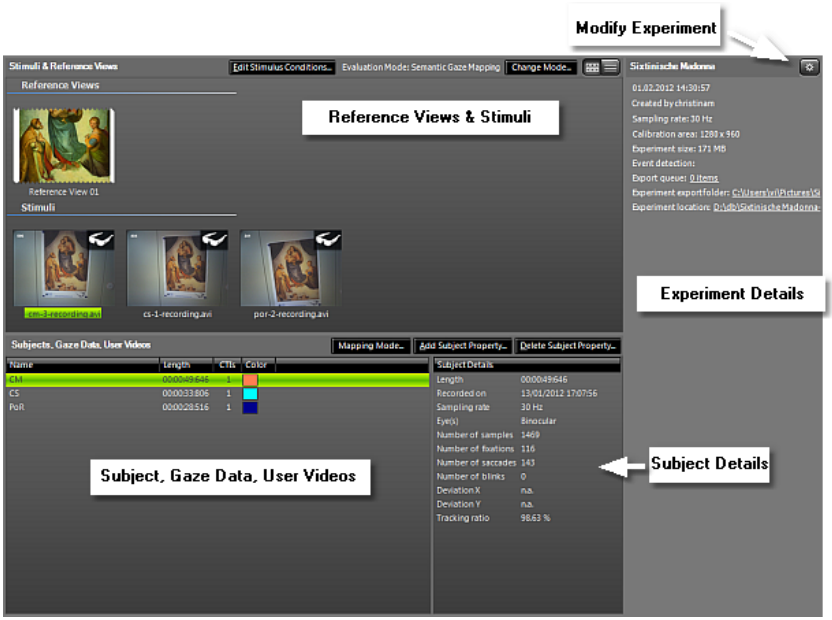
The **Dashboard** is the default view for an open experiment.

It shows:

- The stimuli, custom trials and reference views as thumbnails or list. You can toggle between the two modes using the  buttons at the top of the stimulus list.

- General experiment details. The  button opens the Modify Experiment 78 dialog. Information about the Export Queue 89, with clickable links, is also here.
- List of the participants with gaze data and user video information. If background processing is done on the data, the status and progress is shown here. When a list element is selected, details on the participant and run are shown in the panel next to the list.

Experiments can be dragged and dropped from the outside onto the Dashboard and their data will be merged to the currently opened experiment. In order to create a new experiment through drag and drop no experiment should be opened (if there is an experiment opened it must be closed first).



Allows changing the stimulus conditions 88.

Change web stimuli handling and gaze position source data.

Website Stimulus: specifies whether to use the website screenshot or the background screen recording movie, if any, for a web stimulus

- **Static Screenshot**: use website screenshot. There may be several screenshots for one original web stimulus so several trials will be created.
- **Background Screen Recording**: use background screen recording movie, if one was created during recording. There is only one screen recording for one original web stimulus so a single trial will be created.

This option becomes available when there is at least one background screen recording available in the experiment.

Scene Recording Evaluation Mode: this specifies the type of custom trials which can be defined in the open experiment. There are two options, defined by how eye data is mapped to the custom trial:

- **Dynamic AOIs**: Automatically map gaze data on video content and evaluate it by drawing dynamic AOIs onto the video. Data Segmentation can be achieved by defining Custom Trials to which the eye data is copied from the original trial (see Custom Trial Selector 154).
- **Semantic Gaze Mapping**: Define Reference Views to which the eye data is mapped manually (see Semantic Gaze Mapping) 187. Quantitatively evaluate data by drawing static AOIs on Reference Views.

This option becomes available for HED and ETG and also for RED experiments that contain stimuli associated with a single participant (Screen Recording, External Video, External Camera). For any other experiment type the mode is fixed to Dynamic AOIs.

Associate Web content 106 for web experiments.

Copy stimulus videos to the BeGaze data storage, if stimulus videos are used by soft links.

Change Semantic Gaze Mapping 187 mode. The options are:

- **Event Based**: there is one gaze mapping for each event at a certain frame, the other frame mappings for that event are generated automatically
- **Frame by Frame**: there is one gaze mapping for each frame

Computes the Index of Cognitive Activity 137 (ICA) when the software from EyeTracking Inc. is available.

Allows changing the participant properties 147.

Allows associating a user webcam video to an ETG recording 149 (button exists only for ETG experiments)

There are some context menu options for **Custom Trials / Reference Views** area. Right clicking over the Stimuli & Reference Views area show the following options for the currently selected custom trial or reference view (there is no context menu if a regular stimulus is selected):

- **Change Name**: renames the currently selected custom stimulus
- **Delete**: completely deletes the custom stimulus from the experiment

For the **Gaze Data & Participants** area clicking on the participant name or properties allows editing them and right clicking gives cut, copy and paste options.

There is a main menu option in the "Export" menu, called "Export Smart Recorder Raw Data...", available when the dashboard tab is focused and the experiment was created from a Smart Recorder data file (imported from the Smart Recorder). It exports the experiment original data as a regular set of separate IDF, video and other files.

Dynamic AOIs vs Semantic Gaze Mapping

The choice between using Dynamic AOIs 161 and Semantic Gaze Mapping 187 depends on the type of experiment that is analyzed.

As a general approach, if the experiment contains movie stimuli and participant data that are linked one-to-one (such as the ETG experiments, but also for RED experiments containing screen recordings or other stimuli where each participant has their own video generated during recording) then Semantic Gaze Mapping would be recommended because it allows aggregated statistics for all recorded subjects on a single reference image stimulus. The reference image would contain the elements of interest that the participants saw in their own movies. To achieve this some work must be done to map the eye data in each of the participant recordings from video to a reference image.

On the other hand, if the experiment contains movie stimuli and participant data that are linked one-to-many (such as the RED experiments where the same movie stimulus is shown to multiple participants) then using Dynamic AOIs would be recommended for obtaining statistics. Because there is a single movie stimulus, then, after defining the Dynamic AOI key frames to follow the items of interest in that movie, the resulting statistics are already aggregated for all participants that saw that movie.

In short, choosing one method or the other would involve the experiment content like so:

- Use none of them if the experiment doesn't contain video stimuli. For this case regular AOIs defined on image stimuli are used.

- Use Dynamic AOIs if the video stimuli and participant data recordings are in a one-to-many relationship. Using Dynamic AOIs involves defining their position (key frames) throughout the movie once per AOI and per movie stimulus.

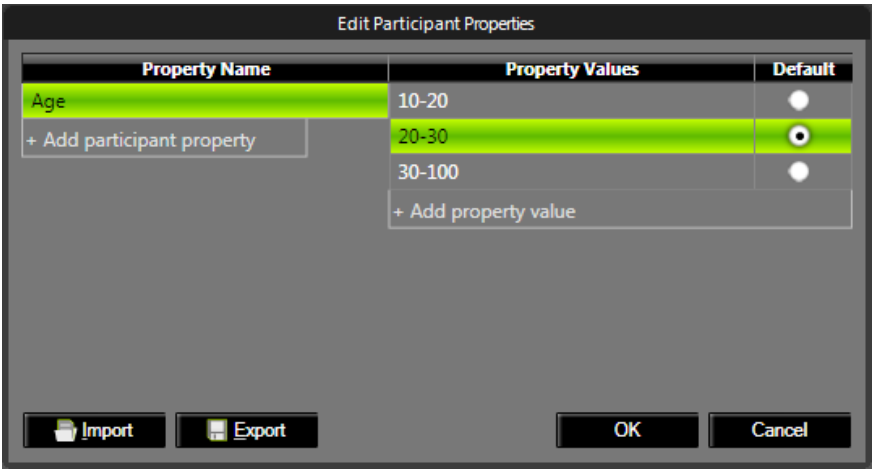
- Use Semantic Gaze Mapping if the video stimuli and participant data recordings are in a one-to-one relationship. Using Semantic Gaze Mapping involves defining reference images and mappings between eye data (events or samples) positions once per participant and reference image stimulus.

6.4.2 Participant Properties

You can define individual participant ”group” parameters for the experiment. These parameters are entered as participant properties and serve as additional information to your experiment (similar to adding stimulus conditions 88 to stimuli). Useful properties may be ”Age” and ”Gender”. The first property is already defined as the participant's **Color** and can be changed at this point or later.

Participant properties are taken automatically from results generated with the SMI Experiment Center (see also New Experiment from Folder 64). You can modify the properties in BeGaze as described below.

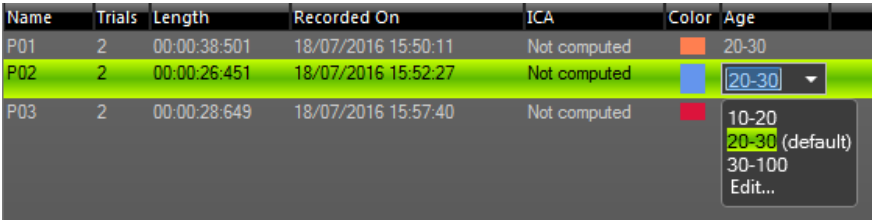
You can edit the participant properties names and values in the Dashboard 142 by clicking the **Edit Participant Properties...** button in the lower part.



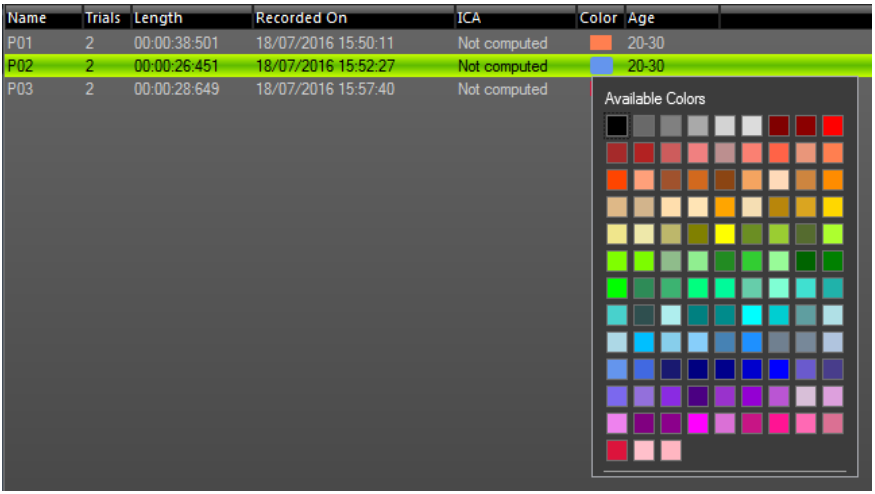
In the left column you can define participant properties and in the right column you can define several values for each property and also select the default value for that property. This default value will be used for all the participants that don't have a specific value set in the Dashboard.

Editing the participant properties values is done in the Dashboard 142 in the Gaze Data & Participants panel in the lower part. By clicking over the participant properties values a drop down list shows up allowing you to change the value for that participant.

Participant name and property values can be edited by clicking on the corresponding field in the participant list in the dashboard. Right clicking gives cut, copy and paste options. Clicking on a participant property value allows typing in a new value for the property or selecting one of the defined ones by clicking the drop down arrow button and selecting a value from the list. Typing a new value will add that value to the list of defined ones. Clicking the **Edit...** drop down value opens the **Edit Participant Properties** dialog.



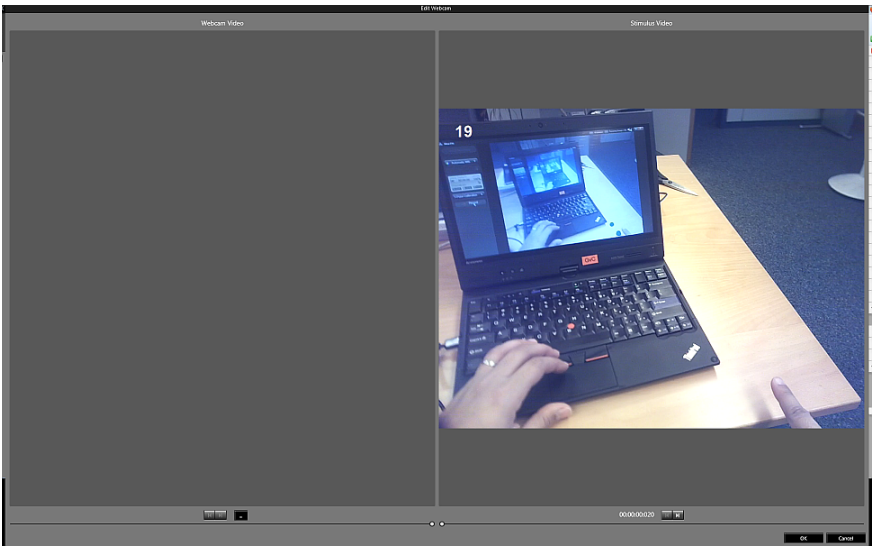
Editing the participant color shows a list of available colors to choose from.



You can also export the currently defined conditions by pressing **Export** or load back previously saved conditions with the **Import** button.

6.4.3 External Camera for ETG

A camera video can be associated with an ETG recording by selecting a participant in the **Gaze Data & Participants** panel in the Dashboard 142 and clicking the **Add External Video...** button above the panel. This opens a dialog that allows selecting and viewing a camera video on the left side and the selected participant video on the right.



To select a certain video file for the camera, click on the "**...**" button on the left lower side an select the desired file. After this you need to determine a point in time for the two videos where they should synchronize. To do this use the seek backward and forward buttons under each video or the seek bars under them. When the frames in both camera and participant movie show content that you know happen and the same time, then the synchronization is done and you can click the **OK** button to add the

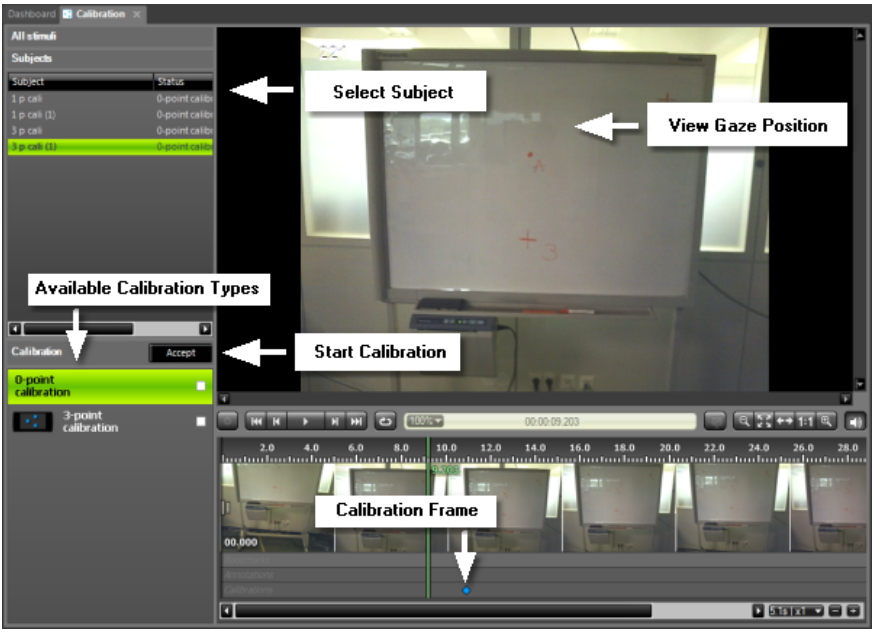
camera video to the experiment and have it shown together with the participant video in the visualizations.

Please note that due to frame rate or other video encoding differences the external camera video might not match the participant video and SMI does not guarantee the synchronization between them, apart from the initial synchronization point.

6.5 Calibration

6.5.1 Overview

The **Calibration** data view allows the calibration of a given participant's eye data by showing the gaze for the selected participant at a certain frame and allowing the user to drag it to a correct position (unless the user accepts the data as is, meaning the "0-point calibration option"). All subsequent gaze position are adjusted based on the manually set calibration.



Operate the **Calibration** data view with the following steps:

1. In the Participants Selection 109, activate the desired participant.

   The Calibration main window is updated and shows the stimulus for the selected participant.

2. In the **Calibration** panel in the bottom-left select the desired calibration type. The available types depend on the recorded data calibration info. Possible types include:
   - **0-point calibration**: accept the gaze positions as they are, without any calibration.
   - **N-point calibration**: do a calibration using the points indicated in the original recorded data (can be 1 point, 3 points, etc.).
3. Click the Calibrate button. The stimulus is centered on a certain video frame indicated in the original recorded data and the calibration process starts.

Double clicking the calibration type in the list also starts the calibration process.

4. The gaze position cursor can now be changed by clicking the left mouse button at the correct position on the stimulus (the correct position is based on a certain object that the participant was supposed to focus when the original recording was created). When the last calibration point is set the calibration is done and all the gaze data is recomputed based on this calibration.

Holding the mouse button while clicking the correct gaze position shows a magnified image of the area under the mouse cursor for improved positioning.

After the calibration is done the **Status** column in the **Participant** list is updated with the type of calibration that was done.

Any other data view will show a warning message over the stimulus window for participants that are not yet calibrated.

6.5.2 Mixed Device Calibration

An experiment can have calibrations already done on the laptop when it is created, before recording data with the Smart Recorder. The last calibration from the laptop is accepted automatically in BeGaze and the user can go back to 0-point calibration if he wants.

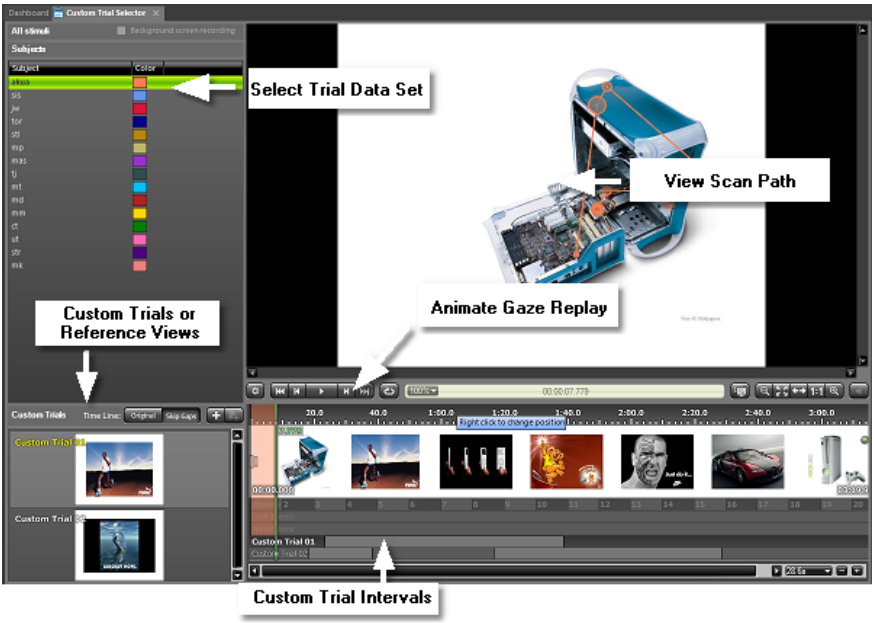
In the image the 3-point calibration was already applied automatically and the icon in front of it indicates it was created on the laptop. The user can switch between this and the 0-point calibration and won't be asked to calibrate each point as it is the case for calibrations done on the Smart Recorder.

6.6 Custom Trial Selector

6.6.1 Overview

The **Custom Trial Selector** data view shows gaze positions and eye events for the selected participant plotted over all the stimuli included in the experiment and it allows cutting out custom trials that can contain any combination of parts from the initial recorded trials.

The behavior of this data view is similar to the Gaze Replay 198 data view (except there are extra options for creating the custom trials).



A specific element of the **Custom Trial Selector** data view is the Trials channel, with the automatic insertion of hidden bookmarks in the player control at the beginning of each stimulus to ease the navigation (Page Up/ Page Down).

Operate the **Custom Trial Selector** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired participant.

   The **Custom Trial Selector** main window is updated and shows the scan path for the selected participant.

3. Use the options in the lower left panel to create new custom trials and define their content using the area below the player control where the custom trial names appear

4. Select the time position in the Thumbnail Control 124. Use the Playback Control 121 to view an animated gaze replay.

5. You can export the animated scan path display to an AVI file. From the **Export** menu, select the **Export Custom Trial Selector Video** command.

   Alternatively, you can export the current view of the custom trial selector to an image file. From the **Export** menu, select the **Save Image...** command.

Gaze Replay on secondary screen

If you have a second display connected to the computer, clicking on the  button in the player control toolbar toggles a full screen visualization of the stimulus on this second display. The visualization here is in sync with the one in the main application window. You can also decide if mouse click and the gaze path overlay has to be drawn or not (settings 160)

Alternating use of background screen recoding with static web images

When the experiment contains web stimuli that also have an associated background screen recording the "**Background screen recording**" checkbox becomes available (above the trial data set selection panel on the left side). Checking it replaces the still webpage screenshot with the

associated screen recording movie in the data view. You can easily switch back and force between background screen recording and still website images.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.6.2 Custom Trials and Segmenting

Besides the regular trials that were physically recorded before loading the experiment in BeGaze you can define custom trials that put together several time segments of the original trials. For any custom trial the segments are user defined and can cover any combination of time segments from various stimuli from any number of users. After defining these segments the custom trial can be analysed in any of the other data views just like a regular trial.

This can be of great use when you want to analyse specific time windows that span over different stimuli or if you want to remove certain areas that are not of interest in the recorded trials.You can cut out parts of the data that correspond to a specific task (Task grouping) or cut out parts of videos (like screen recordings) and align participants together.

Up to 20 custom trials can be defined using the options in the lower part of the player control 120. A new custom trial is created and added to the list by pressing the button in the lower left panel.

In the example above two custom trials were defined, one made up of two segments and the other of only one segment. These are the segments for the currently selected user, but more segments can be defined for each participant in a certain custom trial. A segment is represented by the yellow rectangle over the thumbnail view 124 in the player control 120 and by the bar in the custom trial list below. The bar is yellow when the segment is selected and light gray otherwise.

Editing Segments

To define segments select the desired custom trial from the list and start dragging with the mouse over the thumbnail view in the player control. As you drag the mouse, a yellow rectangle appears over the thumbnails, representing the segment. When the mouse button is released the segment size is set.

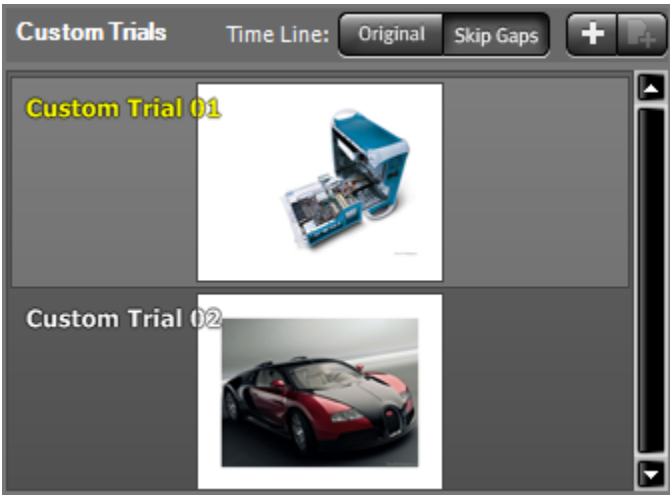
When you have some segments defined you can click on them in the custom trial list to select one. Doing this activates the segment making it show up again as a yellow rectangle in the thumbnail view. You can resize it by dragging the left and right edges with the mouse.

A segment can be moved around as a whole by dragging the top and bottom edges of the yellow rectangle in the thumbnail view or by dragging the yellow bar representation in the custom trial list. You can also delete a segment by right clicking over its bar in the custom trial list and selecting "Delete".

Custom Trial Settings

To manage custom trials a dedicated area is available in the lower left corner. The upper part contains general settings and the lower part is a list

of the custom trials created so far. The list allows selecting a custom trial in order to access specific settings for that trial.



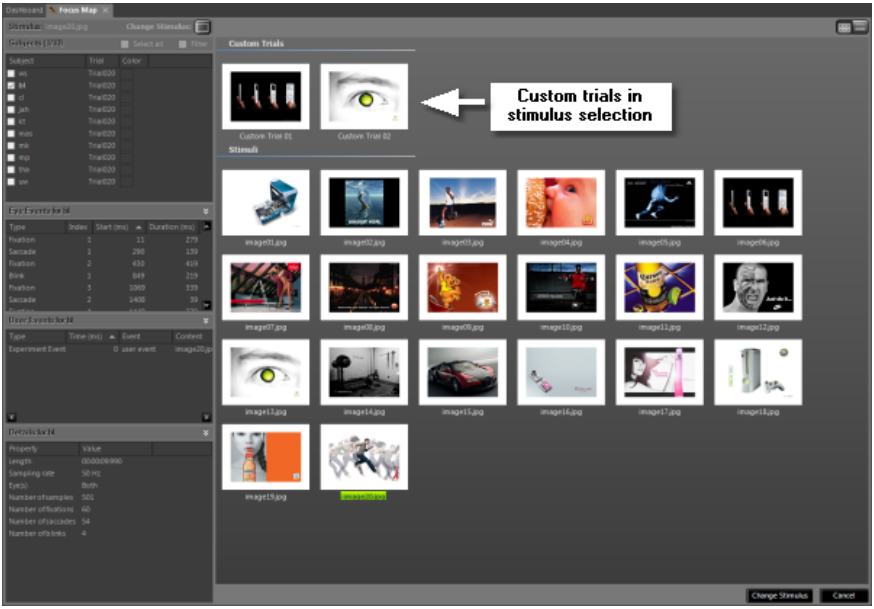
-  : creates a new custom trial from the image shown in the player control at the current position and adds it at the end of the trial list.
- **Time Line:**
  - **Original**: if the selected custom trial contains gaps between segments the timeline in the other data views will span from the beginning of the first segment to the end of the last and include all the gaps between segments, but won't show any data for those gaps

  - **Skip Gaps**: if this is selected the gaps between segments are removed from the timeline in the other data views so that data appears continuous

- **Context Menu** (right click over a trial in the list)
  - o **Name:** edit the trial name
  - o **Jump to position of:** the player control jumps to the position where the reference image for the trial was defined
  - o **Update:** updates the trial reference image to the image at the current position in the player control
  - o **Delete**: deletes the currently selected trial (a trial is selected by clicking on it in the list)

Using the custom trials

The custom trials defined in Custom Trial Selector will be available for analysis in the other data views. To select such a trial press the stimulus selection 104 button and select the custom trial. The custom trial thumbnail will be the image you set in Custom Trial Selector as the reference image for that custom trial.



After selecting the custom trial the analysis continues the same as for a regular stimulus / trial combination.

6.6.3 Settings

In the **View Settings** dialog, you can configure the visualization style and parameters of the **Custom Trial Selector**, which are identical to the Gaze Replay Settings. For a detailed description of the settings see Gaze Replay Settings 200.

6.7 AOI Editor

6.7.1 Overview

The following data views in BeGaze require the existence of AOIs (**A**reas **O**f **I**nterest):

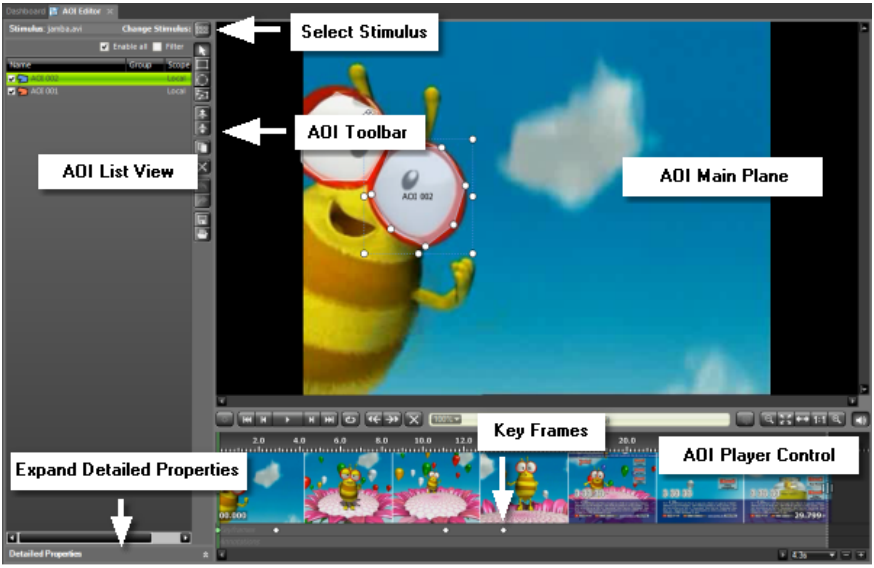
- AOI Sequence Chart 259
- Binning Chart 264
- Metrics Export 339 (some metrics)
- Reading Statistics 279
- Key Performance Indicators 236

AOIs can be defined for still images stimuli as well as for video stimuli where the AOIs change their position and size during the sequence of single video frames (Move&Morph™ functionality).

For the AOI Editor availability please check the BeGaze Product Variants 12 chapter.

If you have already created AOIs for the current stimulus image, they are stored in the database and will be displayed as overlay over the image. Note, that also AOIs that were created with the iView eye tracker will be displayed if they were collected in the Create Experiment wizard 63 with the stimulus images 67. If no AOIs are displayed, you have to create them prior to selecting one of the above views.

You can create new AOIs and edit or delete existing ones in the **AOI Editor**. In the following you find a short description of it's interface:



- The **AOI main view** shows all defined AOIs.
- The **AOI list view** lists all AOIs for the selected stimulus image by name. You can create new AOIs and edit existing ones via the **AOI Editor** toolbar 163 on the right of this view. If several stimuli are used within the experiment, you can select another one via the **stimulus selection** area on the top of the AOI list view.
- In the **AOI detailed properties** view, you can view the properties of an AOI selected in the AOI list view and edit it.
- The **AOI player control** view shows the stimulus presentation over time. In case of a video stimulus, this view will show the video's contents image by image.

BeGaze automatically creates an AOI labeled "White Space" that covers all areas left outside of user defined AOIs. A "White Space" AOI is generated on static stimuli only.

If the reading package is licensed, reading AOIs for paragraphs, sentences, words and character are automatically generated in Experiment Center and are been used in BeGaze. These reading AOIs cannot be self created. For more information, please see Reading AOI Statistics 293

For Composite stimuli created in Experiment Center there are AOIs automatically defined for image and video elements, reading AOIs for the text elements and target AOIs for the target elements 130. The target AOIs can't be edited or disabled. Statistics templates for the targets are available in Metrics Export 389.

6.7.2 Toolbar

The **AOI Editor** toolbar is located on the right of the AOI list view. It gives you short-cuts to create and edit AOIs. Here is an overview of the buttons and what they are for:


Selects an AOI and switches to edit mode


Draws a rectangular AOI


Draws an ellipsoidal AOI


Draws a polygonal AOI


Changes the priority of overlaying AOIs. The selected AOI gets a higher priority.


Changes the priority of overlaying AOIs. The selected AOI gets a lower priority.


Deletes a selected AOI


Duplicates the selected AOI

 Undoes the last step

 Redoes the last step

 Saves AOIs to an XML file

 Loads AOIs from an XML file

6.7.3 Open AOI Editor and Select Stimulus

1. Click  in the toolbar 455.

   The **AOI Editor** opens, displaying the experiment's stimulus. If several stimuli are used in the experiment, you can now select another one (see Stimulus Selection 104).

2. Proceed with one of the following steps:

   – Create AOIs 164

   – Edit AOIs 166

   – Delete AOIs 180

6.7.4 Create AOIs

Prerequisite

A stimulus is displayed in the AOI's main view (see also Stimulus Selection 104).

Create a new AOI

1. Select the shape of the AOI you want to create by clicking on the appropriate button.

   – If you want to create an ellipsoidal AOI, click on the  button. Then left-click in the image to set the start point, keep the mouse button pressed and drag the mouse vertically over the image to define the size of the ellipse. Release the mouse button if the desired size is reached.

   – If you want to create a rectangular AOI, click on the  button. Left-click in the image to set the start point, keep the mouse button pressed and drag the mouse vertically over the image to define the size of the rectangle. Release the mouse button if the desired size is reached.

   – You can also create a polygonal AOI by clicking on the  button. Click in the image to set the starting point of the first straight line. With the second click you set the end point of the first line which is also the starting point of the second line etc. By clicking, moving the mouse, and clicking again you will define the shape of the polygon. When you have completed the AOI except for the last side of the polygon, double click the left mouse button to mark the last corner point. The last corner point of the polygon will automatically be connected with the starting point.

   In case of a video stimulus, BeGaze will automatically set a key frame for each new AOI position, a changed AOI shape/size, and a change of the AOI visibility (see also Navigate through Key Frames 179).

2. Name the AOI. A new AOI is named ”AOI” followed by a serial number (e.g. AOI 001). To assign a meaningful name edit it in the box that appears immediately after you draw the AOI. You can double click the AOI afterwards to get the name editing box back.

   Alternatively, you can double click the AOI in the AOI list view or click on the desired AOI in the AOI main view and overwrite the given name in the **Name** field of the AOI detailed properties view.

3. You may set another new AOI at a later time position (e.g. with a video stimulus). To do this, position the time cursor in the AOI player control on the appropriate image thumbnail (see Thumbnail Control 124).
4. To create the new AOI, repeat steps 1 and 2.

If required, you can change the position, rotation angle or the shape of an AOI. Fore more information, see the topic entitled Edit AOIs 166.

6.7.5 Edit AOIs

You can edit existing AOIs as follows:

- rename AOI 167,
- change position and/or shape of a still image stimulus AOI 169,
- change position and/or shape of a video stimulus AOI 171,
- change the AOI priority 172,
- change the visibility of a selected AOI, see Change AOI's Visibility 177,
- edit several properties for a selected AOI, see Edit AOI Properties 173.

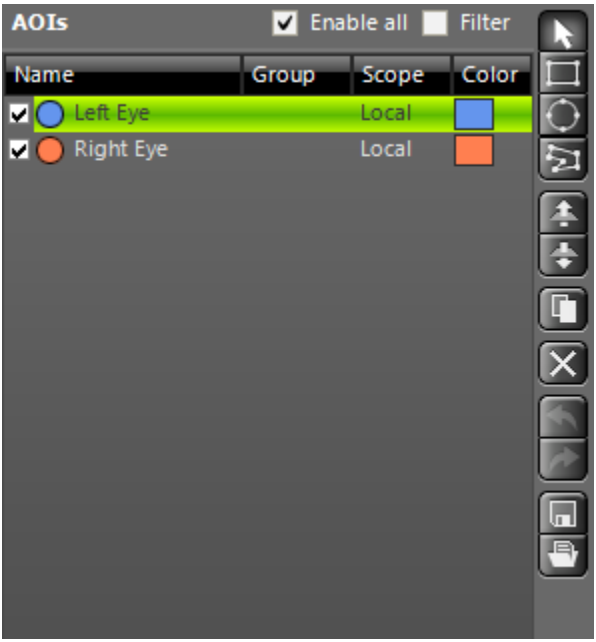
Prerequisite

If you want to edit an AOI, you have to switch to the edit mode by clicking on the button.

Enable/Disable AOI

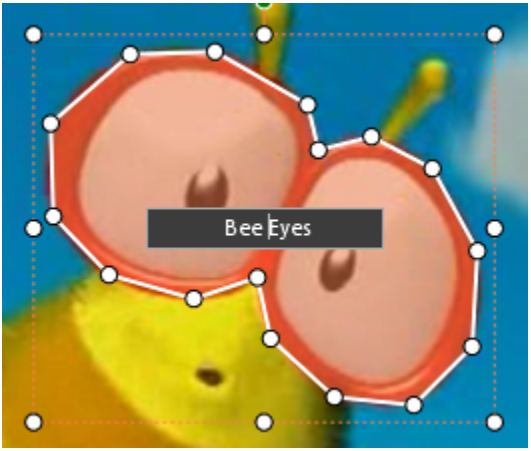
- AOI's are enabled by default and can be disabled if the AOIs shall not be considered in the whole experiment (statistics, ...)
- "Enable all" allows to enable and disable all AOIs in one go or with the filter when clicking on the filter checkbox

- Individual AOIs can be enabled/disabled by clicking on the checkbox left to the AOI name.

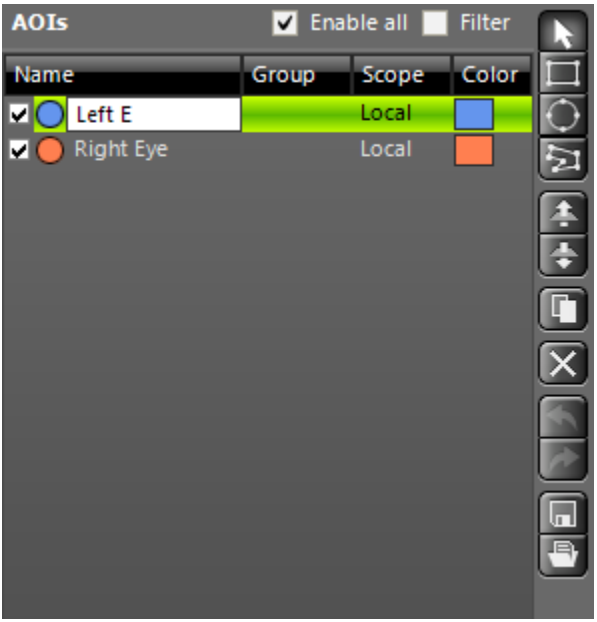


Rename AOI

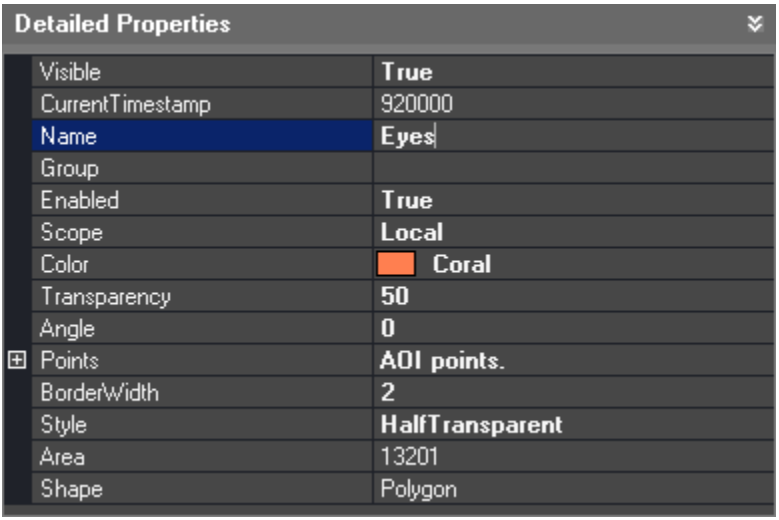
1. Double click the desired AOI in the main view and change the name.



Or you can click the AOI in the AOI list view and overwrite the given name.



Alternatively, you can click on the desired AOI in the AOI main view and overwrite the given name in the **Name** field of the AOI detailed properties view (after expanding it).



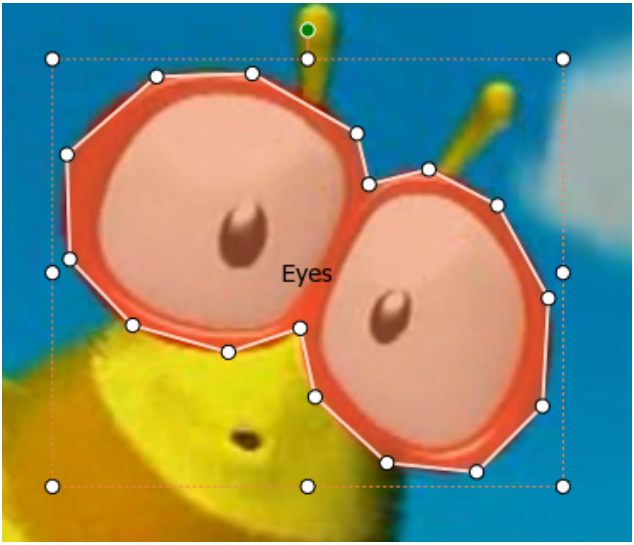
Change position and/or shape of a still image AOI

If you want to change the position or the shape of an AOI, proceed as follows:

1. Click on the desired AOI in the AOI main view.

   The selected AOI is marked by selection handles (small squares at the corner points of the AOI).

   Polygons and group of AOIs are marked in addition with a frame and additional handlers.



2. You can now move the AOI by clicking somewhere in the AOI area and dragging the AOI to the desired position while keeping the left mouse button pressed. To change the shape (e.g. the size) of the AOI, click on the selection handles and drag them in the appropriate directions. The AOI will behave the same as in other graphic programs.
3. AOIs can be rotated by using the round handler on top
4. You can change the size of the selected AOI by pressing the [Shi f t] key and turning the mouse wheel or by using the handlers in the corners.
5. There are two options only available when right-clicking on a polygonal AOI: **Add Point** and **Remove Point**. You can add new points to an existing polygon by hovering over an edge, right-clicking and selecting the **Add Point** option (notice the mouse cursor changing while hovering over an edge). An existing point can be removed by hovering over the point and selecting **Remove Point** from the context menu.

Change position and/or shape of a video stimulus AOI

With a video stimulus, the position and shape of one AOI can change in the course of the video. With the following steps, you adapt the AOI to the changed display detail.

1. Click on the desired AOI in the AOI main view.

   The selected AOI is marked by selection handles (small squares at the corner points of the AOI).

2. In the AOI player control view, position the time cursor on the appropriate video frame (see Thumbnail Control 124).

   The selected video frame is displayed in the AOI main view. The AOI is located on it's former position.

3. Move it to it's new position. If necessary, change it's shape/size/ rotation also (as described in the section Change position and/or shape of a still image AOI 169).

   BeGaze will automatically set a key frame for the new AOI position (see also Navigate through Key Frames 179).

For the video stimulus AOIs availability please check the BeGaze Product Variants 12 chapter.

Tip: It will be efficient to use key commands to navigate in the player control (see Playback Control 121) and to use the mouse for changes on the AOI shape and position.

Removing points from a polygon in a certain key frame affects the shape in all key frames so a warning pops up when using these options on a polygon in a video stimulus.

Change AOI Priority

If you have several AOIs in a stimulus image that overlap each other, and the chosen diagram or statistics only allows evaluation of one AOI per time (which is the case with the Binning Chart 264, Proportion of Looks 271, Event Statistics - Single statistics 352 and Raw Data statistics 346), only the one with the highest priority will be validated. The priority of an AOI corresponds to its position in the list view: AOIs that are placed on top of the list have a higher priority than AOIs with a lower position. You can change the priority of an AOI by proceeding the following two steps:

1. Mark the AOI to be changed in the list view.
2. Click on the  and  buttons to move the AOI to the desired position in the list and, thus, assign it the desired priority.

After changing the Z order of 2 overlapping AOIs, the following analysis change their output:

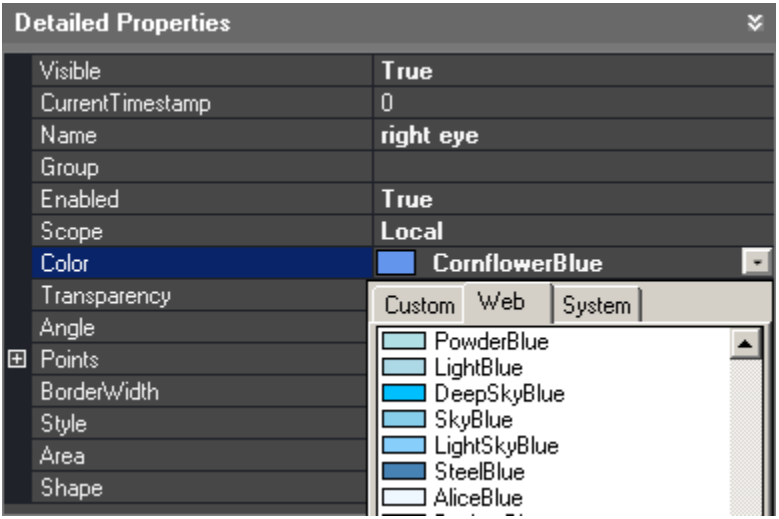
- AOI Sequence Chart 259: the order of the AOI charts is changed, the chart content for each AOI is the same.
- Binning Chart 264: the chart content changes to take the current top-most AOI into account (the overlapping AOI time is added only once, for the highest priority AOI, otherwise the total dwell time could become larger than the trial duration).
- Proportion of Looks 271: the charts content change similarly to the Binning Chart.
- Exported metrics related to AOIs (all AOI statistics templates 364, AOI Transition Matrix 397, Noldus Observer Statistics) 403: in the exported metrics only the order of the records and fields change, but the values remain the same.
- In Event Statistics - Single statistics 352 and Raw Data statistics 346 the hit AOI name indicates the highest priority AOI.

6.7.6 Edit AOI Properties

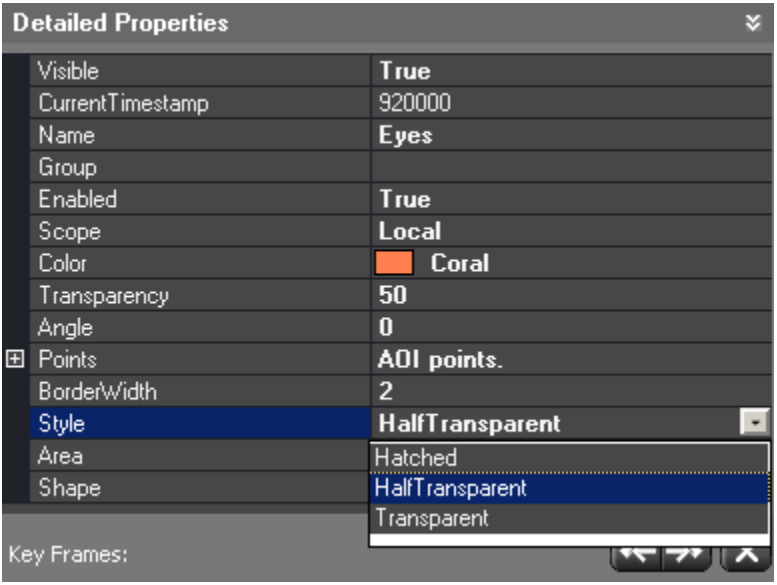
You can change the properties of a selected AOI as follows:

1. Click on the  button to switch to the edit mode.
2. Click the desired AOI in the AOI list view. Alternatively, you can click on the desired AOI in the AOI main view. Expand the AOI detailed properties view.

   Now you can enter the desired values directly in the AOI detailed properties view.
3. **Visible**: This field is displayed with a video stimulus only. Click on  to open the drop-down menu. Select **True** if the AOI is visible at the current timestamp and select **False** if the AOI gets invisible at this time (this means that AOI of the displayed theme fades out).
4. **Name**: If required, overwrite the given name.
5. **Group**: You can assign a group name to several AOIs and use it to sort of filter the AOI list (useful for reading or web experiments).
6. **Enabled**: This sets whether the AOI is taken into account in the other plugins (KPI, Metrics Export and so on). A disabled AOI is drawn in a dash-dot pattern instead of a full line one. This setting is identical to toggling the checkbox in front of the AOI in the AOI list. The default setting is **True**.
7. **Scope**: Can take the values of **Local** or **Global**. **Local** shows that the AOI is available for the current stimulus only and is the default setting while **Global** means it is available in the whole experiment, maintaining its name and color in all stimuli. When first creating an AOI it is set to **Local** and exists in the current stimulus only and changing it to **Global** replicates it in all the other stimuli in the experiment. The position and shape can be changed independently in each stimulus afterwards.
8. **Color**: New AOIs are created with standard colors. It is recommended to change these colors if the AOIs are hardly recognizable on your stimulus image. Click on  to open the color selection drop-down field, offering separate color tabs. Select the desired color.



9. **Points**: Click on ⊞ to display the list of points that define the AOI's position and size. This list is dependent of the type and should contain exactly 2 points for rectangle or ellipse, and at least 3 points for polygon. You can modify the AOI's position and size by entering new values.
10. **Border Width**: Enter a value between 1 and 10 to define the AOI's border width. The default value is 2.
11. **Style**: Click on ⌄ to open the transparency selection drop-down menu. Select the transparency style.

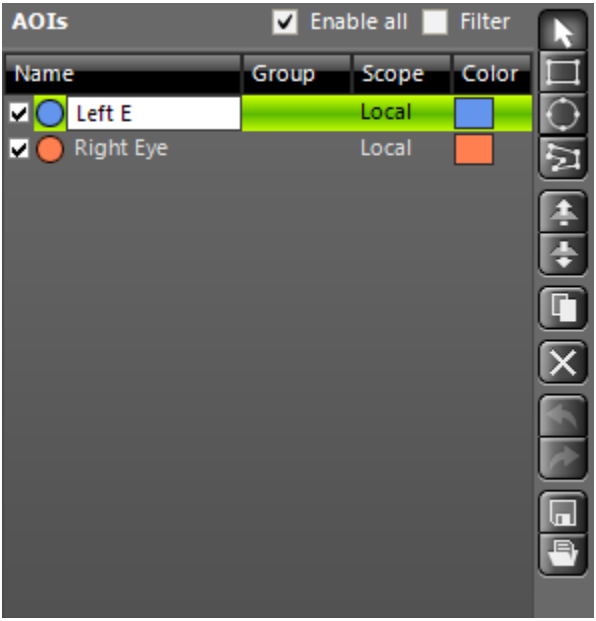


12. **Area** is showing the size of the AOI in square-pixel.

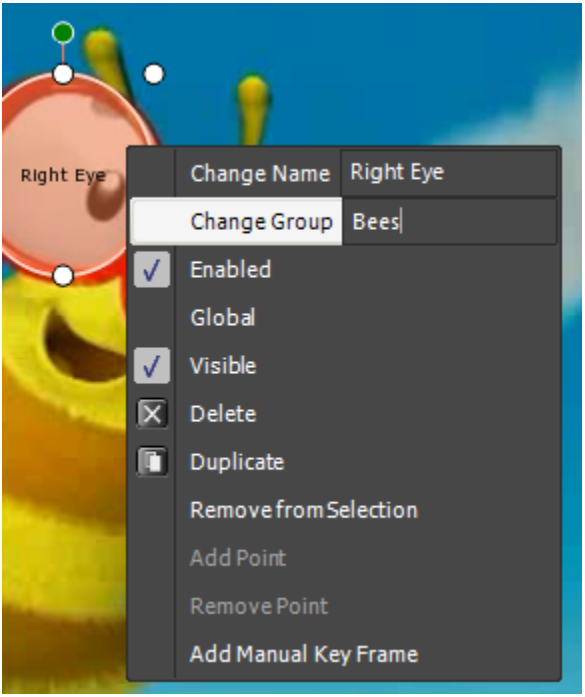
The other fields in the AOI detailed properties view, such as Current Timestamp and Shape give further information on the AOI. These properties cannot be edited.

For convenience there are two alternative methods for editing the most commonly used properties rendering the Detailed Properties panel useful for advanced editing only:

1. Edit the Name, Group, Scope, Color and Enabled state (checkbox) directly in the AOI list view.



2. Edit the above and more in the context menu that shows when you right-click on an AOI in the main view. The options that are not available for the specific AOI are grayed out.



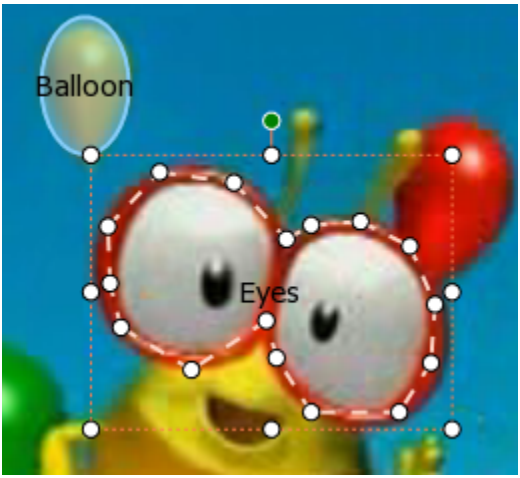
6.7.7 Change AOI's Visibility

The visibility of AOIs affects video stimuli only. A video stimulus shows the objects / protagonists / visuals you are interested in, but they may appear or disappear in the course of the video. To reflect this, an AOI can have the visible and invisible status.

1. Click on the  button to switch to the edit mode.
2. Click the desired AOI in the AOI main view.
3. Pressing the [V] key, you can toggle the visibility of the selected AOI.

Alternatively, you can set the visibility of a selected AOI in the AOI property view (see Edit AOI Properties 173).

Invisible AOIs are indicated with a dotted border.



Note, that no AOI hit 129 is counted while the AOI has the invisible status. This is true even if BeGaze detects the gaze position meets the AOI area. This means that no AOI hits are emitted in the AOI Sequence Chart 259 and the Binning Chart 264.

Example: In the course of the video, a new character appears on the screen. At this timestamp you draw the corresponding AOI in the video's fixed-image (the first key frame for this AOI is set). After some seconds, the character disappears. At this timestamp you set the AOI to invisible (the second key frame for this AOI is set). Some seconds later, the character appears again. You set the AOI to visible again (the third key frame for this AOI is set).

BeGaze evaluates the AOI in the following manner: The video starts with the AOI invisible until the AOI key frame 1 is reached. Between key frame 1 and key frame 2 and from key frame 3 to the end of the video (the AOI is visible), the hits for this AOI are count. Between the key frames 2 and 3

when the AOI is set to invisible, no hits for this AOI are count even if a participant gazed at the AOI.

6.7.8 Navigate through Key Frames

Move&Morph

With a video stimulus BeGaze sets a key frame for each AOI, and also for each changed AOI position, a changed AOI shape/size, and a change of the AOI visibility. Between the successive key frames of an AOI, BeGaze automatically calculates the tweening of the AOI's motion and size and adapts it to the single images of the video sequence lying between these key frames. (Move&Morph)

With the help of key frames, you can navigate through a sequence of AOIs, e.g. to change their position, size or shape if necessary. The Thumbnail Control 124 indicates the key frames which are set for a video stimulus with ◇.

Navigate through key frames

The player control contains buttons for handling key frames.

1. Position the time cursor in the AOI player control at the beginning of the video or on the appropriate video's single image (see Thumbnail Control 124).

2. If you want to restrict the navigation to one special AOI, now select the appropriate AOI in the AOI list view. If you want to navigate through the complete series of the stimulus' key frames, make sure that no AOI is selected.
3. Navigate through the frames:

   – Click  to jump to the next key frame relative to the image currently displayed.

   – Click  to move back to the previous key frame.

   – Click  to delete the current key frame or press [D]

Navigate through key frames using hotkeys

You can use the following hotkeys for fast navigation through the key frames:

Keys	Description
[HOME]	jumps to first key frame
[END]	jumps to last key frame
[PG Up]	goes to next key frame
[PG Dn]	goes to previous key frame
[D]	deletes the current selected key frame

6.7.9 Delete AOIs

You can delete AOIs as follows:

1. Click on the  button to switch to the edit mode.

2. Mark one or more AOIs that should be deleted either in the stimulus image or in the AOI list view. A selection in the stimulus image will automatically select the appropriate item in the AOI list view and vice versa.
3. Click on the  button.

   Alternatively, you can press the [DEL] key or right-click on the AOI and select the **Delete** option in the context menu.

    When deleting AOIs that have the **Scope** setting set to **Global** a warning dialog with several options appears informing you that you are about to delete the global AOIs from all the stimuli in the current experiment.

6.7.10 Save and Load AOIs

Save AOIs

AOIs will be automatically saved in the database when you close the **AOI Editor**. You can also save AOIs in an XML file (*.xml), if, for example, you want to reuse a stimulus image with the appropriate AOIs in further experiments.

1. Click on the  button and select the name and the storage folder for the XML file.

Load AOIs

1. To load AOIs for the current image click on  and select an XML file (*.xml) from the file selection dialog.

 To create an XML file using an external tool, follow the AOI Format Description (see AOI Format Description 182).

6.7.11 AOI Format Description

The XML file that contains the AOIs has the following structure (except for automatic generated reading AOIs):

```
<?xml version="1.0"?>
<ArrayOfDynamicAOI
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <DynamicAOI 183>
    <Points 184>
      <Point>
        <X>1003</X>
        <Y>748</Y>
      </Point>
      <Point>
        <X>1169</X>
        <Y>886</Y>
      </Point>
    </Points>
    <Enabled 184>true</Enabled>
    <Group 184>Main Group</Group>
    <Scope 184>Local</Scope>
    <Angle 185>0</Angle>
    <BorderWidth 184>2</BorderWidth>
    <Type 183>Rectangle</Type>
    <Style 184>HalfTransparent</Style>
    <Transparency 185>50</Transparency>
    <Area 185>22908</Area>
    <Color 184>NamedColor:Blue</Color>
    <Name 183>Logo Name</Name>
    <Font 184>
      <FontName>Tahoma</FontName>
      <FontSize>13</FontSize>
      <FontStyle>Regular</FontStyle>
      <FontUnit>Point</FontUnit>
      <FontGdiCharSet>1</FontGdiCharSet>
      <FontGdiVerticalFont>false</FontGdiVerticalFont>
```

```
    </Font>
    <Visible 185>true</Visible>
    <CurrentTimestamp 185>0</CurrentTimestamp>
    <KeyFrames 185>
      <KeyFrame>
        <Points>
          <Point>
            <X>1</X>
            <Y>37</Y>
          </Point>
          <Point>
            <X>167</X>
            <Y>345</Y>
          </Point>
        </Points>
        <Angle>0</Angle>
        <Area>51128</Area>
        <Visible>true</Visible>
        <Timestamp>0</Timestamp>
      </KeyFrame>
 ...
    </KeyFrames>
  </DynamicAOI>
  ...
</ArrayOfDynamicAOI>
```

Description of Elements:

- **ArrayOfDynamicAOI**: the root element, contains one or more DynamicAOI 183 elements.
- **DynamicAOI**: corresponds to one static AOI and has the following child elements:
- **Name**: defines the name of the AOI
- **Type**: defines the shape of the AOI and should have one of the following values:

  – Rectangle

– Ellipse

– Polygon

- **Enabled**: defines the state of the AOI. Disabled AOIs are present only in AOI Editor 161. This element is optional and the implicit value is true.
- **Group**: contains the name of the group. This element is optional and the implicit value is empty.
- **Scope**: defines the scope of the AOI. This element is optional and the implicit value is Local. It should have one of the following values:

  – Local

  – Global
- **Points**: contains the list of points that defines the AOI and it is dependent of the type 183. The list should contain exactly 2 points for Rectangle or Ellipse, and at least 3 points for Polygon.
- **Angle**: defines the rotation angle of each point defining the AOI around the center of gravity of the AOI. It is expressed in degrees.
- **Color**: defines the color of the pen and brush used to draw the AOI. This element is optional and the implicit value is NamedColor:Black.
- **BorderWidth**: defines the width of the pen used to draw the AOI. This element is optional and the implicit value is 2.
- **Font**: defines the font used to draw the name of the AOI. This element is optional and the implicit values for the child elements are FontName = Tahoma and FontSize = 13.
- **Style**: defines the filling style of the brush used to draw the AOI. This element is optional and the implicit value is HalfTransparent. It should have one of the following values:

  – Hatched

  – Transparent

  – HalfTransparent

- **Transparency**: defines the transparency level (0..100) and is taken into account when the Style 184 is HalfTransparent. This element is optional and the implicit value is 50.
- **Area**: the size of the AOI expressed in square pixels
- **Visible**: true if the AOI is visible at the current timestamp 185.
- **CurrentTimestamp**: defines the current timestamp.
- **KeyFrames**: defines several key frames made up of Points 184, Visible 185 and Timestamp 185. The Dynamic AOI position is interpolated in time between the defined key frames.

Examples

The minimal structure that describes a static AOI should looks like:

```
<DynamicAOI 183>
  <Points 184>
    <Point>
      <X>1003</X>
      <Y>748</Y>
    </Point>
    <Point>
      <X>1169</X>
      <Y>886</Y>
    </Point>
  </Points>
  <Type 183>Rectangle</Type>
  <Name 183>Volvic Logo</Name>
  <Visible 185>true</Visible>
</DynamicAOI>
```

The minimal structure that describes a dynamic AOI should looks like:

```
<DynamicAOI 183>
  <Points 184>
    <Point>
      <X>1</X>
      <Y>37</Y>
    </Point>
```

```
    <Point>
      <X>167</X>
      <Y>345</Y>
    </Point>
  </Points>
  <Type 183>Rectangle</Type>
  <Name 183>Bee</Name>
  <Visible 185>true</Visible>
  <CurrentTimestamp 185>0</CurrentTimestamp>
  <KeyFrames 185>
    <KeyFrame>
      <Points>
        <Point>
          <X>1</X>
          <Y>37</Y>
        </Point>
        <Point>
          <X>167</X>
          <Y>345</Y>
        </Point>
      </Points>
      <Visible>true</Visible>
      <Timestamp>0</Timestamp>
    </KeyFrame>
    <KeyFrame>
      <Points>
        <Point>
          <X>1</X>
          <Y>60</Y>
        </Point>
        <Point>
          <X>221</X>
          <Y>345</Y>
        </Point>
      </Points>
      <Visible>false</Visible>
      <Timestamp>80000</Timestamp>
    </KeyFrame>
```

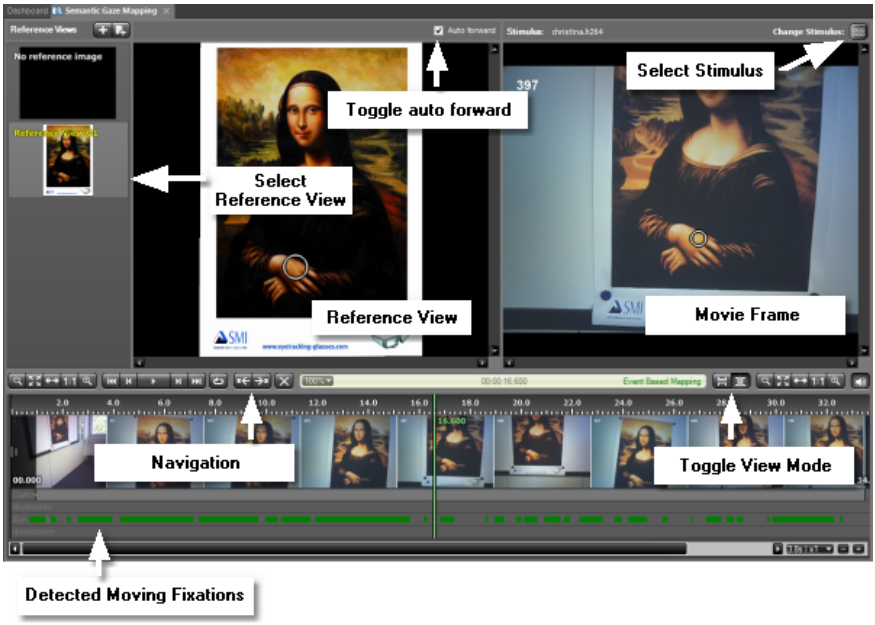
```
    </KeyFrames>
  </DynamicAOI>
```

6.8 Semantic Gaze Mapping

6.8.1 Overview

The **Semantic Gaze Mapping** view allows creating and modifying reference views and mapping gaze data from scene videos to reference views.

For the Semantic Gaze Mapping view availability please check the BeGaze Product Variants 12 chapter.



This view contains two main windows.

1. The reference view window shows the reference view selected for mapping. A gaze cursor indicates the position where the gaze is mapped on the reference view at the current timestamp. The reference view can be selected from the plane selection drop-list.
2. The scene video window shows the scene video, with a cursor showing the gaze position at the current timestamp.

The two windows can be shown side by side or on top of each other, depending on their aspect ratios. The view mode can be toggled using the  buttons.

The **Auto forward** checkbox at the top can be checked in order to move to the next event automatically after the current event was mapped.

AOI Annotations

You can attach AOIs defined on reference views to annotations from this view in order to calculate some dedicated AOI Annotation Statistics (Single 384 and Selection Summary 384). These annotations work like regular annotations, but they are also linked to a certain AOI for statistics purposes.

To define such an annotation and just press numerical **"1"** keyboard shortcut (similar to the **"0"** keyboard shortcut for regular annotations). You need to define AOIs on reference view stimuli in the AOI Editor 164 first, of course. When the key is pressed, the AOIs are highlighted in the reference view window and become clickable. Select the AOI to link to the annotation by clicking on it and then the regular annotation list shows up in order to finish adding the annotation.

6.8.2 Player Control

The player control has some additional features in Semantic Gaze Mapping. On the top of the player control there the following extra buttons:

- Two sets of zoom buttons, one for each of the above windows: the left set zooms the reference image and the right set zooms the scene video.
- **Previous/Next Event**  (keyboard shortcut "A" and "S"): jumps to the middle of the previous/next event from the one being currently mapped.
- **Remove Key Frame**  (keyboard shortcut "D"): removes a previously set key frame for an event mapping (and all the automatically generated key frames associated with that event).
- **Portrait/Landscape Mode**  : toggle the view mode of the two windows between side by side and one on top of the other.

On the bottom of the player control there are two channels specific to the semantic gaze mapping:

- the **Custom Trial Intervals** channel: shows the intervals generated while mapping.
- the **Eye Events** channel: shows the detected eye events for the selected scene video. The events are colored to show their state: white - not mapped, green - mapped, red - skipped/rejected.

The player control also shows the fact that you are in "events mapping" mode in green text next to the current video timestamp value.

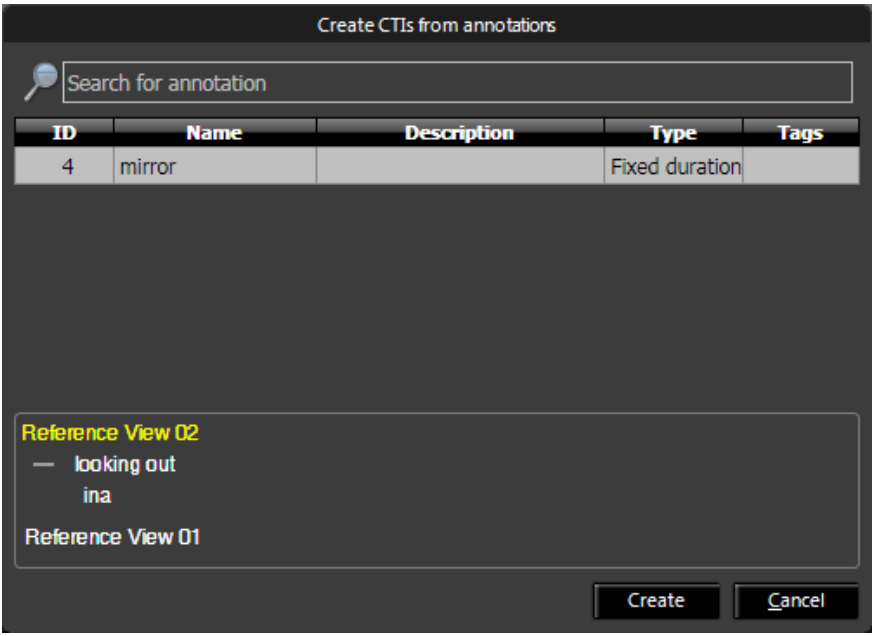
6.8.3 Manual Mapping Workflow

Semantic Gaze Mapping reference image options

The Reference Views panel allowing adding and modifying reference views is found in the lower left part of the data view.

-  : creates a new reference view (custom trial for semantic gaze mapping) from the image shown in the player control at the current position and adds it at the end of the trial list.
-  : creates a new reference view from an external image file and adds it at the end of the trial list. Several images can be selected at once and a reference view will be created for each. The reference views will be named the same as the source images.
- **Context Menu** (right click over a reference view in the list)
  - **Name:** edit the trial name
  - **Jump to position of:** the player control jumps to the position where the reference image for the trial was defined
  - **Update:** updates the trial reference image to the image at the current position in the player control

- **Delete**: deletes the currently selected trial (a trial is selected by clicking on it in the list)
- **Create CTIs from Annotations...**: creates CTIs on the reference image using existing interval annotation start time and duration.



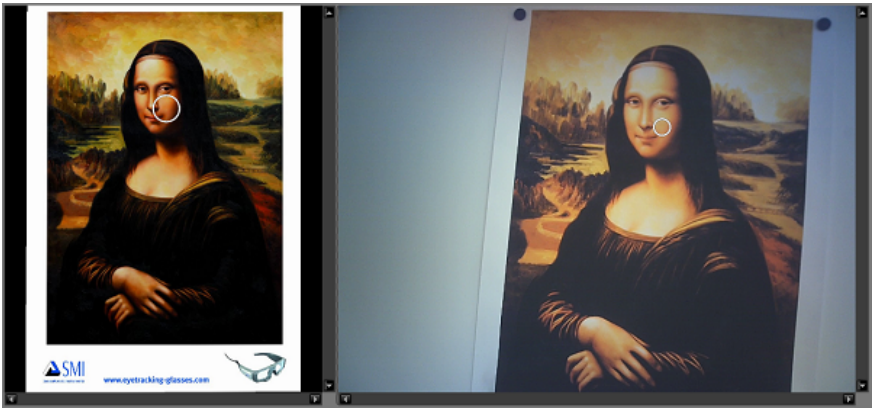
The dialog that appears when selecting **Create CTIs from Annotations...** allows creating some initial CTIs based on existing interval annotations. A list of available interval annotation definitions is available in the upper part of the window and double clicking one will associate the definition with the clicked reference view. You can see the current associations between definitions and reference views in the tree in the lower part of the window. Double clicking an annotation definition here removes it from this tree and moves it back to the list of available definitions. Clicking **Create** adds CTIs with the same start time and duration as all the annotations added to the original trials that have the definition as the one selected in this window.

If you already created some CTIs using this method and later come back to the dialog and remove some associated annotation definitions from the tree in the lower part of the window then the corresponding CTIs will be removed, but only if there were no changes done to the respective CTIs start or duration in the meanwhile (so they must be identical to the initial annotation times and durations in order to be removed).

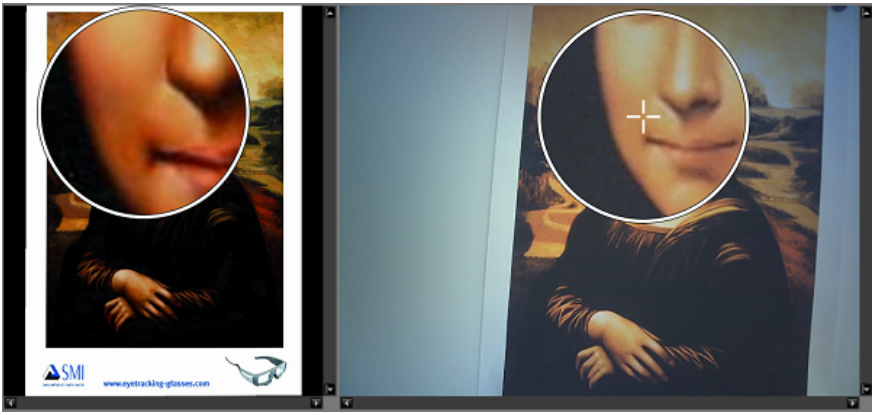
Example Workflow

1. Open the desired experiment. You will enter the Dashboard 142.
2. By clicking on  you will enter the Semantic Gaze Mapping 187.
3. Add an (external) reference image by clicking on the  button in the upper left corner. Select your preferred reference image from an existing folder or file.
4. Alternatively, you can select a reference image screenshot from the participant video stimulus using the  button .
5. You will see the reference image on the left side and the stimulus on the right side. You can navigate through the events (=fixations) by clicking on the left and right arrows below the thumbnail control (below the reference image). Left arrow = previous event, Right arrow = next event. You can also use the keyboard shortcuts “a” for the previous event and “s” for the next event.
6. Gaze Mapping

   Look at the gaze cursor on the stimulus video/image on the right side where. By left clicking with the mouse, you can position the mouse cursor on the reference image (left side) to the position that corresponds with the gaze cursor in the stimulus video. The white circle will indicate the mapped gaze on the reference image.



When pressing the left mouse button you can zoom in the reference image and move the cursor to position the gaze point more accurately.



7. Click on the right arrow to continue with the next event. Then proceed with step 5 for the whole stimulus. This step is skipped if the Auto forward checkbox was toggled on. With this option the next event is selected automatically as soon as the mouse button is released after mapping the current event.

8. In order to see the mapped gaze points accumulated for every participant on the reference image you go to the Scan Path 209 (or Heat Map 228) view. Then go to “Change stimulus” dialog and select the

reference view by double-clicking. On the left side, select “all participants” or select only these participants you are interested in.

The custom trial intervals in the player control channel will extend automatically to cover mapped events as they are being mapped . There are additional context menu options for this channel, see below.

Context Menu Options

When right clicking on the reference image or scene video window a context menu appears. The options include the set of zoom options that exist as buttons in the player control.

For the reference image window there is a specific option named "**Exclude from reference view statistics**" which when selected sets the current event as reviewed but also marks it to be ignored in other data views. This is useful when the event mapping is invalid and it mustn't influence the rest of the analysis. The option can also be triggered with the "X" keyboard shortcut.

The custom trial intervals channel has the following context menu options:

- **Merge Interval with Previous**: creates a continuous interval that includes the previous and current interval under the mouse cursor and the time between them
- **Merge All Intervals**: creates a single continuous interval from the start of the first existing interval to the end of the last
- **Delete Interval**: deletes the interval under the mouse cursor together with the mapped data inside it
- **Split Interval**: splits the interval under the mouse cursor by deleting the mapping of the closest event and the interval area around the event

6.8.4 Review Mode for Automatic Gaze Mapping

The Review Mode is available in the Semantic Gaze Mapping view when automatic gaze mapping data was imported in an ETG experiment. To import automatic gaze mapping data (ASGM data) to an experiment go to **File -> Automated Semantic Gaze Mapping -> Import ASGM Data...** and select the received ASGM data.

The review options are shown in the left **ASGM Data Review** panel and the mapped events status is shown in the bottom player control in the **Eye Events** channel as can be seen in the screenshot. Automatically mapped data is not perfect so event mappings that the automatic algorithm is not sure about need manual review.

The review options allow changing what events need to be reviewed and the changes here are reflected in the Eye Events channel. Selecting a **Sensitivity** level changes the number of events that are considered as having a good mapping (the events marked in green). The higher the setting

the fewer mapped events are considered good enough. the events that fall out of this category get marked as needing review.

Several mapped event categories can be set as available for review by checking them in the options panel. When mappings are not checked here the corresponding events are disabled for manual review and are shown in a faded out color. You want to do this to skip reviewing events that do not need manual review for one reason or another, for example events considered as having good automatic mapping are skipped by default. The types of mapped events that can be toggled for manual review have:

- **Good automatic mapping**: this is disabled by default because you shouldn't normally want to review good automatic mappings. These events are shown colored in green in the Eye Events channel
- **Review automatic mapping**: these are enabled by default because these are places where the automatic algorithm is not very confident in the mapping and manual review is needed. These events are colored yellow. These events and the ones above can switch state between them based on the **Sensitivity** setting above.
- **No automatic mapping in CTI**: no mapping could be found because no corresponding data was found between movie and reference image. These are colored red and are disabled for review by default.
- **Unmapped events**: these events have no automatic mapping. They are shown in white and are disabled for review by default.
- **CTI borders**: these server as an indication of where the automatically mapped intervals (CTIs) start and end. They are colored in blue and a number of events on each border can be marked like this based on the counter set below.

To do the review you go through events like in the manual mapping work-flow, but only the checked event types are enabled for manual mapping. To review events just go through them with the event navigation buttons in the player control (Next Event and Previous Event buttons) and, if needed, correct the mapping by clicking a different position on the reference image. Events are marked as reviewed as soon as you click the Next Event button (or press the S key keyboard shortcut). A thin white line is shown under events that have been reviewed and a review progress percentage is shown

near the current time at the top of the player control. The percentage shows the number of reviewed events relative to the total number of enabled events, so it can change if you toggle event types marked for review from the review options panel.

If no mapping should be considered for an event, for example because there is no correspondence between video and image, it can be rejected by selecting **Exclude from reference view statistics** from the reference image context menu or by pressing the X key. This marks the event as not mapped and reviewed.

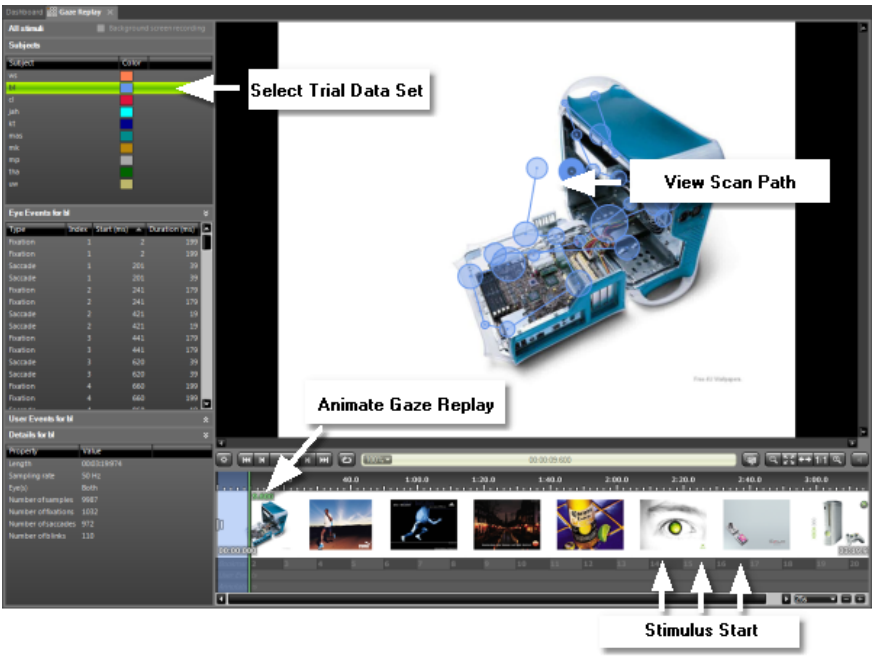
After doing the review, the reviewed mapped data can be exported by going to **File -> Automated Semantic Gaze Mapping -> Export Corrected ASGM Data...** and the resulting file can be sent to SensoMotoric Instruments GmbH to help improve the automatic gaze mapping algorithm.

6.9 Gaze Replay

6.9.1 Overview

The **Gaze Replay** data view shows gaze positions and eye events for the selected participant plotted over all the stimuli included in the experiment. This is useful to get an overview of the participants general behavior during the recording of the experiment.

The behavior of this data view is identical to the Scan Path 209 data view (except for the fact that the stimuli are concatenated one after the other in a single playback).



A specific element of the **Gaze Replay** data view is the Trials channel, with the automatic insertion of hidden bookmarks in the player control at the beginning of each stimulus to ease the navigation (Page Up/Page Down).

Operate the **Gaze Replay** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired participant.

   The Gaze Replay main window is updated and shows the scan path for the selected participant.

   While selecting participants, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.

4. Select the gaze replay time position in the Thumbnail Control 124. Use the Playback Control 121 to view an animated gaze replay.

5. You can export the animated scan path display to an AVI file. From the **Export** menu, select the **Export Gaze Replay Video** command.

   Alternatively, you can export the current view of the gaze replay to an image file. From the **Export** menu, select the **Save Image...** command.

Gaze Replay on secondary screen

If you have a second display connected to the computer, clicking on the  button in the player control toolbar toggles a full screen visualization of the stimulus on this second display. The visualization here is in sync with the one in the main application window. You can also decide if mouse click and the gaze path overlay has to be drawn or not (settings 200)

Alternating use of background screen recoding with static web images

When the experiment contains web stimuli that also have an associated background screen recording the "**Background screen recording**" checkbox becomes available (above the trial data set selection panel on the left side). Checking it replaces the still webpage screenshot with the associated screen recording movie in the data view. You can easily switch back and force between background screen recording and still website images.

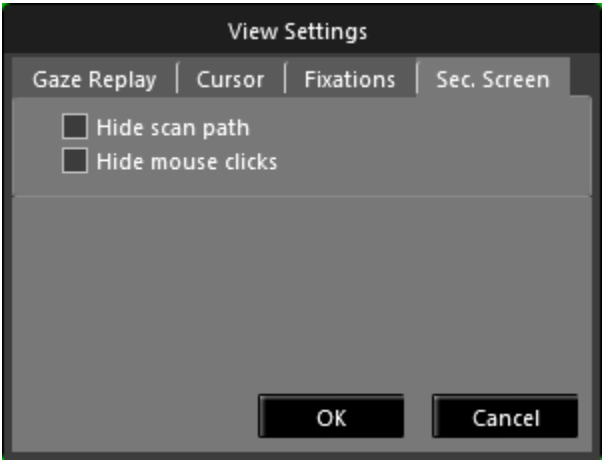
All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.9.2 Settings

In the **View Settings** dialog, you can configure the visualization style and parameters of the **Gaze Replay**. The available settings are identical to the ones in the **Scan Path** except for an extra tab which is described below. For a detailed description of the common settings see Scan Path Settings 214.

In the **Sec. Screen** tab of the settings dialog, you can configure the full screen visualization behavior separately from the main view.

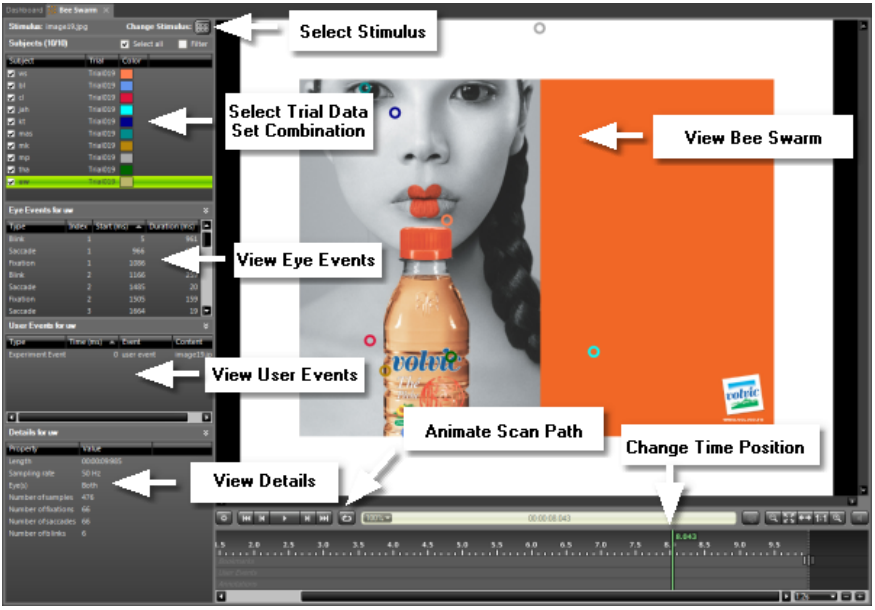


- **Hide scan path**: the scan path will only be draw in the main view, and not on the secondary screen.
- **Hide mouse clicks**: the mouse clicks will only be draw in the main view, and not on the secondary screen.

6.10 Bee Swarm

6.10.1 Overview

The **Bee Swarm** data view shows raw data gaze positions of the selected trial data set plotted on the stimulus image or video.



Operate the **Bee Swarm** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired trial or filter combination.

   The Bee Swarm Main Window 204 is updated and shows the raw data for the activated trial combination.

While selecting trials, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.
4. Select the bee swarm time position in the Thumbnail Control 124. Use the Playback Control 121 to view an animated bee swarm.
5. You can export the animated scan path display to an AVI file. From the **Export** menu, select the **Export Bee Swarm Video** command.

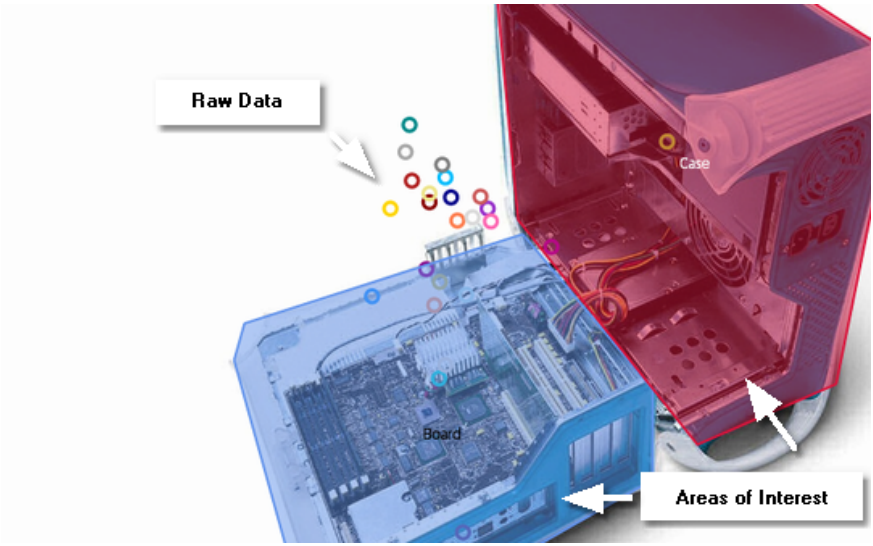
   Alternatively, you can export the current view of the bee swarm to an image file. From the **Export** menu, select the **Save Image...** command.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.10.2 Main Data View

The **Bee Swarm** main view visualizes the selected trial data set as a 2D plot over the stimulus image or video. The following image shows an example:



The view shows raw gaze data as colored circles (each color corresponds to a participant).

You can change the bee swarm display with the following steps:

1. Right click the bee swarm display to open a context menu.
2. Select the **Settings** command to display the Bee Swarm Settings 205 dialog. Change settings and confirm with **OK**.

   The bee swarm display is updated.
3. Select the **Show AOIs** command, to toggle the visibility of AOIs in the bee swarm display.
4. In the **Export** menu, either select the **Save Image...** ([CTRL] + [S]) or select the **Copy Image to Clipboard**

([CTRL] + [C]) keyboard command to export the current bee swarm display to a single image. You can also export the bee swarm to a video file using the **Export Bee Swarm Video** command from the **Export** menu.

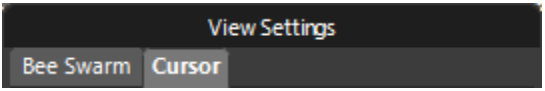
Select Gaze Cursor

If you click on gaze cursor in the bee swarm, the clicked participant will be highlighted Participants Selection 109.

6.10.3 Settings

6.10.3.1 View Settings Dialog

In the **View Settings** dialog, you can change the bee swarm display to your needs.



1. Right click the Bee Swarm Main Window 204 to open a context menu.
2. Select the **Settings** command to open the **View Settings** dialog.
3. Switch to one of the following tabs and change settings:

   – In the Bee Swarm Tab 206 you can change the general appearance of the bee swarm display.

   – In the Cursor Tab 207 you configure the gaze cursor appearance.
4. Confirm your settings with **OK**.

If you open a second Bee Swarm 202 data view, the new data view will inherit the current view settings. If you adapt the view settings of the second data view, you can switch between the two different bee swarm views very fast.

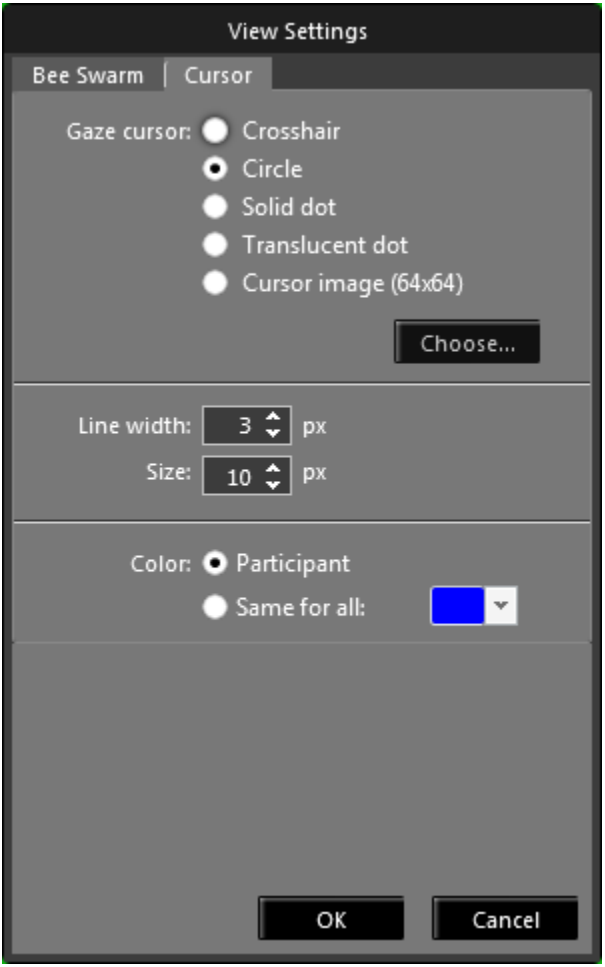
6.10.3.2 Bee Swarm Tab

In the **Bee Swarm** tab of the Bee Swarm Settings 205 dialog, you configure the general appearance of the bee swarm display.

- **Data channel**: Select if you want to view **Left eye** or **Right eye** data. If the currently selected trail data set only has monocular gaze data, the available data channel is selected automatically.
- **Hide 0 Data**: The gaze tracker produces data with position (0,0) if – for some reason – gaze tracking was lost during the recording. Activate the **Hide 0 Data** option to hide these artifacts. This option is enabled by default.
- **Hide toolbar data**: This option applies to web stimuli only. Activate this check box if you want to hide the gaze data which are located on the web toolbar of the stimulus from the bee swarm.
- **Fade out mouse clicks**: Mouse click events are drawn on the screen at the moment they took place in the recording. This settings enables the drawing to fade out while playing after it first appears.

6.10.3.3 Cursor Tab

In the **Cursor** tab of the Bee Swarm Settings 205 dialog, you configure the gaze cursor appearance.



- **Gaze cursor**: Configures the appearance of the shape that shows the current gaze position. You can switch between a **Crosshair**, a **Circle**, a **Solid Dot** and a **Translucent dot** shape.

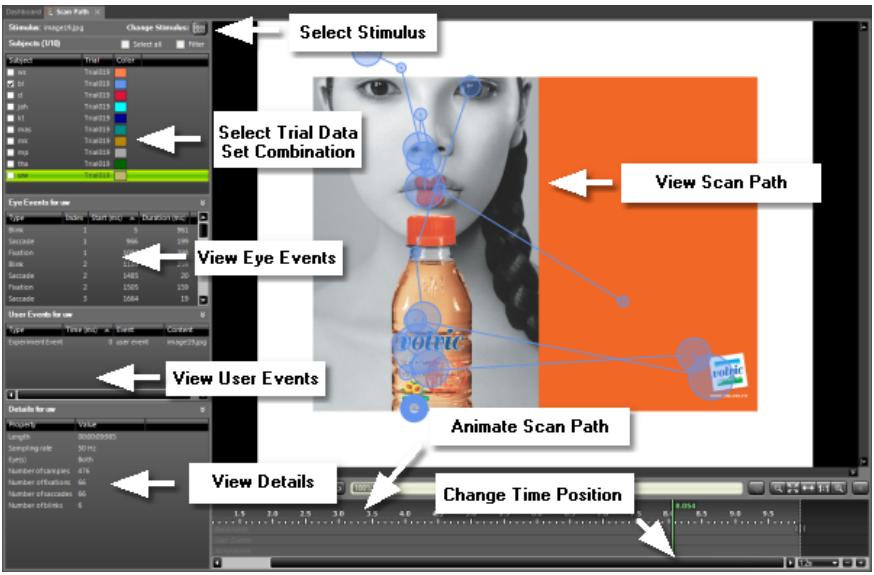
  It is also possible to use a 64x64 pixel bitmap as customized shape. Switch to **Cursor image** and click the **Choose...** button to select a suitable external bitmap graphics file.

- **Line width** (not used with **Cursor image** setting): Changes the line width of the gaze cursor (in pixels).
- **Size** (not used with **Cursor image** setting): Changes the diameter of the gaze cursor (in pixels).
- **Color** (not used with **Cursor image** setting): Changes the gaze cursor color. Click the drop-down icon and select the desired color.

6.11 Scan Path

6.11.1 Overview

The **Scan Path** data view shows gaze positions and eye events of the selected trial data set plotted on the stimulus image or video.



Operate the **Scan Path** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired trial or filter combination.

   The Scan Path Main Window 211 is updated and shows the scan path for the activated trial combination.

   While selecting trials, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.

4. Select the scan path time position in the Thumbnail Control 124. Use the Playback Control 121 to view an animated scan path.

5. You can export the animated scan path display to an AVI file. From the **Export** menu, select the **Export Scan Path Video** command.

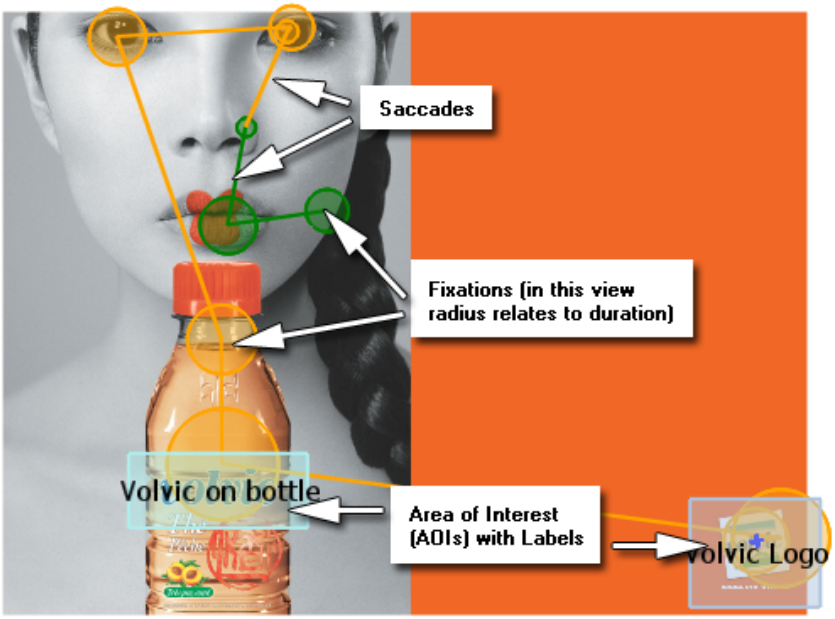
   Alternatively, you can export the current view of the scan path to an image file. From the **Export** menu, select the **Save Image...** command.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.11.2 Main Data View

The **Scan Path** main view visualizes the selected trial data set as a 2D plot over the stimulus image or video. The following image shows an example for a fixation and saccade plot with dynamic fixation radius and AOIs:



Generally, you can select to plot either raw data or to plot fixations and saccades. If you select to plot fixations and saccades, a fixation point is displayed in the center of a circle and the saccades are plotted as connecting lines in-between. It is also possible to configure a fixed circle radius or a circle radius that relates to the fixation duration. A fixation counter can also be displayed in the center of the fixation circle.

You can change the scan path display with the following steps:

1. Right click the scan path display to open a context menu.

2. Select the **Settings** command to display the Scan Path Settings 214 dialog. In the **Scan Path** tab, select between **Fixations** or **Raw data** display. Change other settings as well and confirm with **OK**.

   The scan path display is updated.

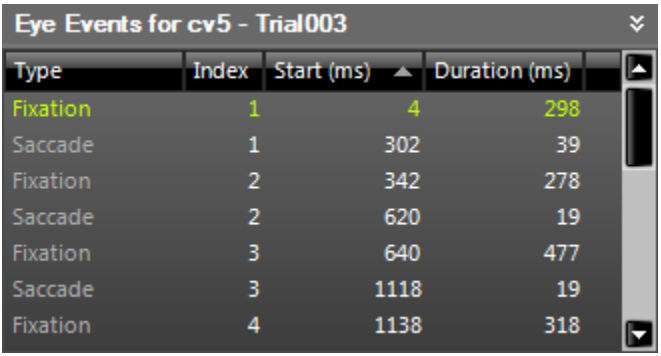
3. Select the **Show AOIs** command, to toggle the visibility of AOIs in the scan path display.

4. In the **Export** menu, either select the **Save Image...** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current scan path display to a single image. You can also export the scan path to a video file using the **Export Scan Path Video** command from the **Export** menu.

Select Events

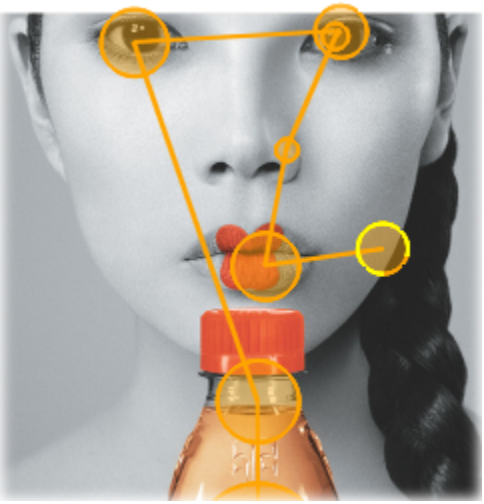
If you click on a fixation circle or on a saccade line, the clicked item will be highlighted. At the same time the corresponding participant and event will be highlighted in the Participants Selection 109 and the Events Selection 115 . The participant and event will be highlighted when clicking on raw data cursors also.

Highlighted event in the **Eye Events** selection:



Type	Index	Start (ms)	Duration (ms)
Fixation	1	4	298
Saccade	1	302	39
Fixation	2	342	278
Saccade	2	620	19
Fixation	3	640	477
Saccade	3	1118	19
Fixation	4	1138	318

Highlighted fixation in the **Scan Path** display:

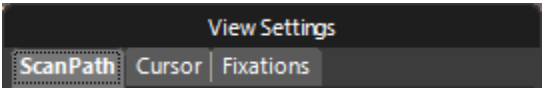


The scan path is drawn in the color of the corresponding participant unless special timers are defined in the Scan Path Settings 214.

6.11.3 Settings

6.11.3.1 View Settings Dialog

In the **View Settings** dialog, you can change the scan path display to your needs.



1. Right click the Scan Path Main Window 211 to open a context menu.
2. Select the **Settings** command to open the **View Settings** dialog.
3. Switch to one of the following tabs and change settings:

   – In the Scan Path Tab 214 you can change the general appearance of the scan path display.

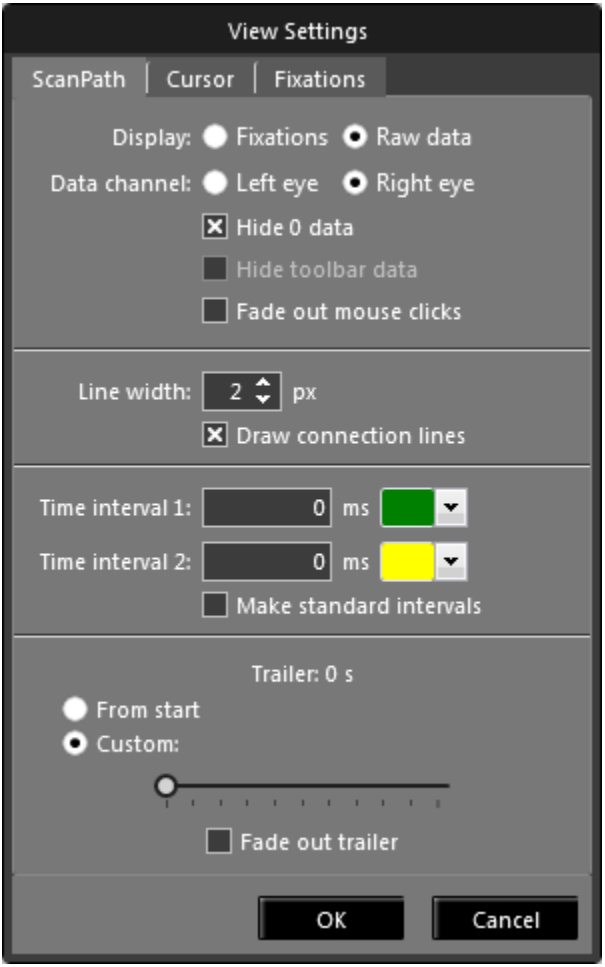
   – In the Cursor Tab 217 you configure the gaze cursor appearance.

   – In the Fixations Tab 219 you adapt the fixations display (tab is inactive if "raw data" is selected in the Scan Path Tab).
4. Confirm your settings with **OK**.

If you open a second Scan Path 209 data view, the new data view will inherit the current view settings. If you adapt the view settings of the second data view, you can switch between the two different scan path views very fast.

6.11.3.2 Scan Path Tab

In the **Scan Path** tab of the Scan Path Settings 214 dialog, you configure the general appearance of the scan path display.



- **Display**: Select if you want to view **Fixations** or **Raw data**. To view saccades as well, enable the **Trailer** option (see below).
- **Data channel**: Select if you want to view **Left eye** or **Right eye** data. If the currently selected trail data set only has monocular gaze data, the available data channel is selected automatically.

- **Hide 0 Data**: The gaze tracker produces data with position (0,0) if – for some reason – gaze tracking was lost during the recording. Activate the **Hide 0 Data** option to hide these artifacts. This option is enabled by default.
- **Hide toolbar data**: This option applies to web stimuli only. Activate this check box if you want to hide the gaze data which are located on the web toolbar of the stimulus from the scan path.
- **Fade out mouse clicks**: Mouse click events are drawn on the screen at the moment they took place in the recording. This settings enables the drawing to fade out while playing after it first appears.
- **Filter raw data:** Applies a filter to raw data before drawing, the same filter that is used in the recording applications to show the live gaze position. It is an IIR filter for iView X recordings and a FIR filter for ETG recordings. The filter is applied for regions with little movement (so it is not applied during saccade or other fast movements).
- **Line width**: Select the line widths for the scan path lines (in pixels).
- **Draw connection lines**: Activate this option, if raw data should be connected with lines. This option is enabled by default.
- **Time interval**: You can define two intervals in which the scan path should be plotted in a different color. After these intervals ended, the scan path plot continues with the defined participant color property in the **Participants** list view. Activate the **Make standard intervals** option if the scan path plot should continue with alternating intervals according to the time interval definition.
- **Trailer**: Determines, how many gaze data is accumulated to display fixations and saccades. Note that the following settings relate to the time window you have set in the Thumbnail Control 124.

  From beginning (still image stimulus only): If activated, all gaze data is displayed from the first sample to the current analysis position.

  Constant length: If activated, the current analysis position leaves "a trail behind". This means: a certain time window of gaze data – which immediately precedes the current analysis position – is displayed. Use

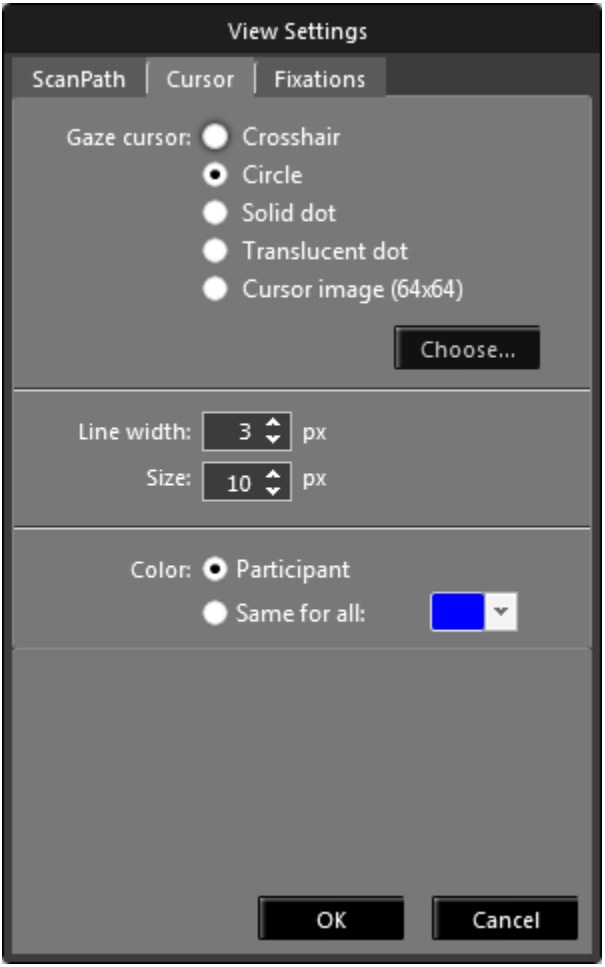
the slider to change the length of time window from 0 seconds up to 10 seconds.

Fade out trailer: If activated, the trailer set above increasingly fades out towards it's tail, so older gaze data is more faded than data closer to the current time position.

If you display an overlay of the real-time gaze positions of multiple participants, this is called the "bee swarm" mode. To activate this display mode, enable the Raw Data display and configure the trailer with a Constant length of zero. Select multiple participants / trials and press play.

6.11.3.3 Cursor Tab

In the **Cursor** tab of the Scan Path Settings 214 dialog, you configure the gaze cursor appearance.



- **Gaze cursor**: Configures the appearance of the shape that shows the current gaze position. You can switch between a **Crosshair**, a **Circle**, a **Solid Dot** and a **Translucent dot** shape.

  It is also possible to use a 64x64 pixel bitmap as customized shape. Switch to **Cursor image** and click the **Choose...** button to select a suitable external bitmap graphics file.

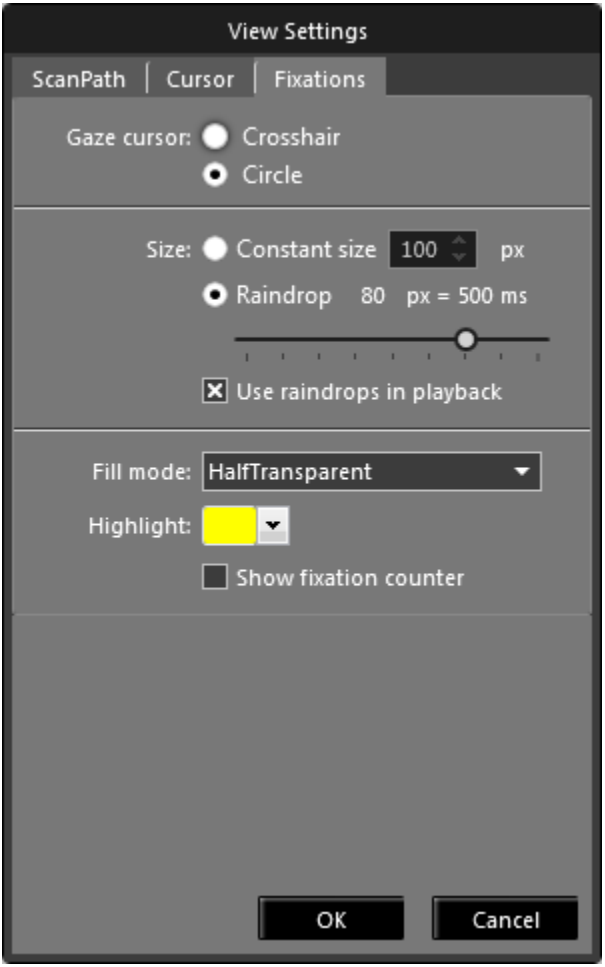
- **Line width** (not used with **Cursor image** setting): Changes the line width of the gaze cursor (in pixels).
- **Size** (not used with **Cursor image** setting): Changes the diameter of the gaze cursor (in pixels).
- **Color** (not used with **Cursor image** setting): Changes the gaze cursor color:

  - **Participant**: sets the gaze cursor color to the participant color property in the **Participants** list view. This is the default selection.

  - **Same for all**: Click the drop-down icon and select the desired color to use for the gaze cursor.

6.11.3.4 Fixations Tab

In the **Fixations** tab of the Scan Path Settings 214 dialog, you configure how fixations are plotted on the scan path display. The following settings only apply if you have activated the **Fixations** option in the Scan Path Settings – Scan Path Tab 214.



- **Shape**: Selects between a **Crosshair** and a **Circle** shaped fixation display.
- **Size**: Determines the fixation shape size.

  Constant size: If checked, the size of the fixation shapes is constant. You can change the shape's size (in pixels).

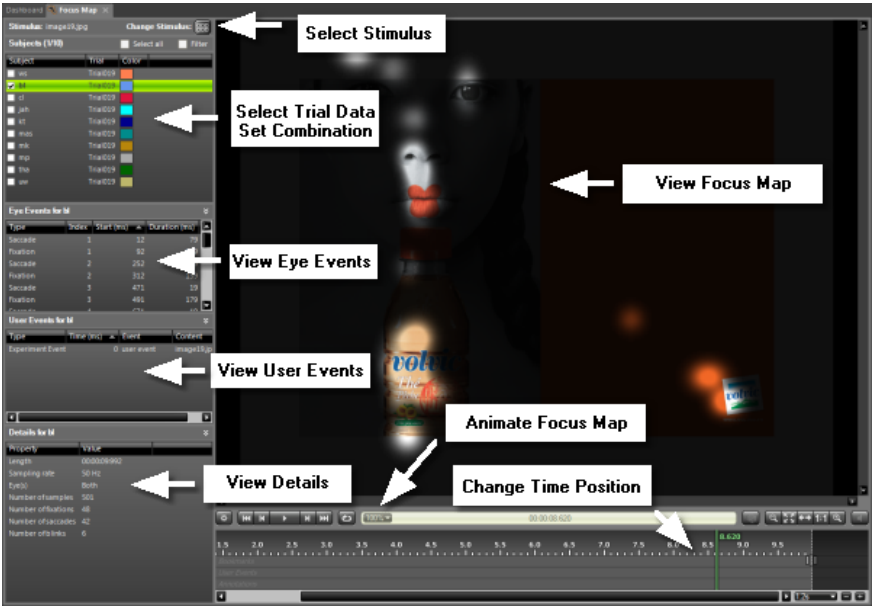
Raindrop: If checked, the size of the fixation shape is proportional to the fixation duration. On the slider, you can set how many pixels represent a 500 ms fixations.

- **Use raindrops in playback**: If checked, the radius of the fixation shapes also changes during replay or while moving the current analysis position.
- **Fill Mode**: Selects the fixation shape fill mode: **Hatched**, **Half Transparent** or **Transparent** fills are supported.
- **Highlight**: Selects the highlight color for the fixation shape. Click the drop-down icon and select the desired color.
- **Show fixation counter**: Counts up the fixations and indicates a counter for each fixation.

6.12 Focus Map

6.12.1 Overview

With the **Focus Map** data view, gaze patterns are visualized by altering the transparency of the stimulus display based on the amount of attention received.



Operate the **Focus Map** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired trial or filter combination.

   The Focus Map Main Window 223 is updated and shows the focus map for the activated trial combination.

   While selecting trials, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

3. If you click on an event in the **Eye vents** selection view, the corresponding event is automatically selected in the main view.

4. Select the focus map time position in the Player Control 120. Use the Playback Control 121 to view an animated attention map.
5. You can export the animated focus map display to an AVI file. From the **Export** menu, select the **Export Focus Map Video** command.

   Alternatively, you can export the current view of the attention map to an image file. From the **Export** menu, select the **Save Image…** command.

The visualization is calculated for still images based on fixations and for video stimuli on raw data.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.12.2 Main Data View

After selecting the desired trial data, the **Focus Map** main view displays the updated map. The **Focus map** shows fixation hits related to brightness between darkest (less hits) and normal brightness (most hits).

Note, that the data interpretation differs with the stimulus type. The map displayed for a still image stimulus is based on fixations while the map displayed for a video stimulus is based on raw data.

Focus map computation

The generated focus map is an absolute gaze duration map. It shows the accumulated time participants spent looking at different areas of the stimulus.

There are two methods of computing the map depending on stimulus type:

- Images: use fixations. Each fixation made by each participant adds a value to the map that is proportional to its duration. Each value is drawn as an ellipse with Gaussian distributed intensity (which gets mapped from a maximum transparency in the center to a minimum at the edge). The fixation duration gives the Gaussian height (intensity) while the fixation dispersion gives the elliptical shape of the Gaussian. Each resulting pixel on the map has an intensity equal to the sum of overlapping pixel intensities from each Gaussian covering that area and that resulting intensity is then mapped to a corresponding transparency value from the chosen minimum-maximum spectrum (greater intensity results in greater transparency): **Resulting Transparency(x, y) = Transparency Mapping(Sum(Gaussian Intensity(x, y)))**.
- Movies: use raw data points. Each raw data point from each participant adds a constant value to the map, the constant value being the time interval between data samples. Each value is drawn the same as above

with the particularity that all Gaussian have the same height (the time interval between data samples) and the same dispersion.

The intensity value is also averaged with the number of participants selected so the formula becomes: **Resulting Transparency(x, y) = Transparency Mapping(Sum(Gaussian Intensity(x, y)) / N)** for N selected participants.

When the **Data Range** in Focus Map Settings 225 is set to **Auto** the whole transparency range is adjusted so that the resulting focus map has a total area of maximum transparency covering, if possible, between 0.01% and 0.02% of the stimulus area. This is done so that the result is not saturated with large areas of full transparency which would make finer details disappear.

Change the focus map display

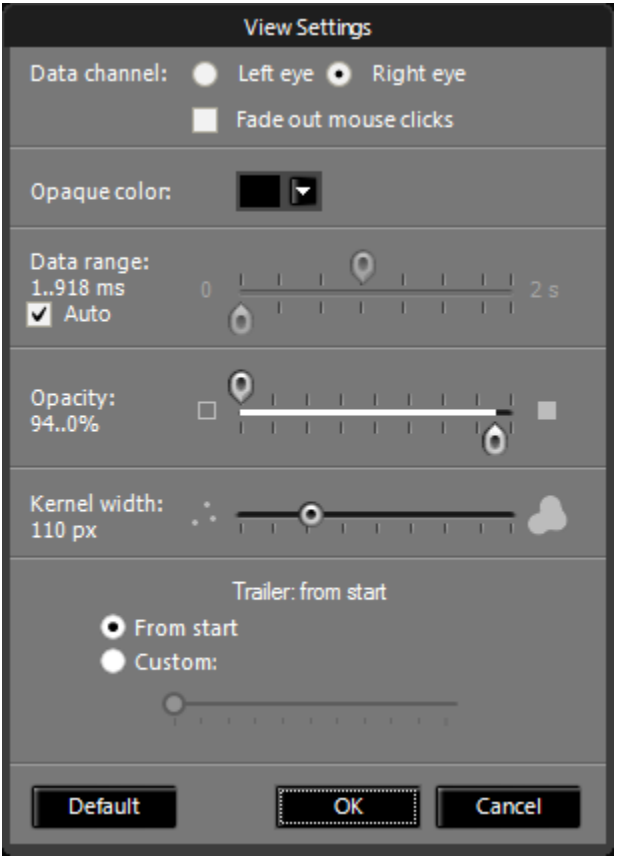
To change the focus map display settings proceed as follows:

1. Right click the map display to open a context menu.
2. Select the **Settings** command to display the Focus Map Settings 225 dialog. Select the map style and confirm with **OK**.

   The focus map display is updated.
3. Select the **Show AOIs** command, to toggle the visibility of AOIs in the map display.
4. In the **Export** menu, either select the **Save Image...** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current focus map display to a single image. You can also export the focus map to a video file using the **Export Focus Map Video** command from the **Export** menu.

6.12.3 Settings

In the **View Settings** dialog, you can configure the visualization style and parameters of the **Focus Map**.



General Settings

- **Data channel**: Select if you want to view left or right eye. In case of monocular gaze data files, the available data channel is selected automatically.
- **Fade out mouse clicks**: Mouse click events are drawn on the screen at the moment they took place in the recording. This settings enables the drawing to fade out while playing after it first appears.

Parameters

- **Opaque Color:** The overlay background color used for unfocused areas (default is black)
- **Data Range (min..max):** For every pixel displayed on the map, the fixation duration is counted and integrated over time. For multiple participants, the sum (over all participants) of the fixation duration is divided by the number of participants. The double slider defines the minimum and maximum duration of the scale.

  If the maximum value is reached or exceeded the matching image pixels will be drawn with the highest value, which is

  – normal brightness for the Focus map,

  – a customized color for Custom map style

  If the minimum value is not reached, the matching image pixels will be drawn with the lowest value, which is

  – no brightness for the Focus Map (or the selected opaque color if changed from black),

  – a customized color for the Custom Map.

  Changing this parameter is useful if you are interested in fixations that exceed a specific fixation duration.
- The **Auto** checkbox automatically selects the best maximum data range value such that the Focus Map is not over-saturated.
- Use the **Opacity** double slider to change the opacity level for the corresponding minimum and maximum data range values above.
- **Kernel width**: To calculate the Focus Map, all fixation hits are filtered with a Gaussian filter. This setting defines the width (in pixels) of the Gaussian curve. If you decrease the value, the analysis resolution will increase. At the same time, the hot spots will become smaller and less spread.

- **Trailer**: Determines, how many gaze data is accumulated to display fixations. Note that the following settings relate to the time window you have set in the Thumbnail Control 124.

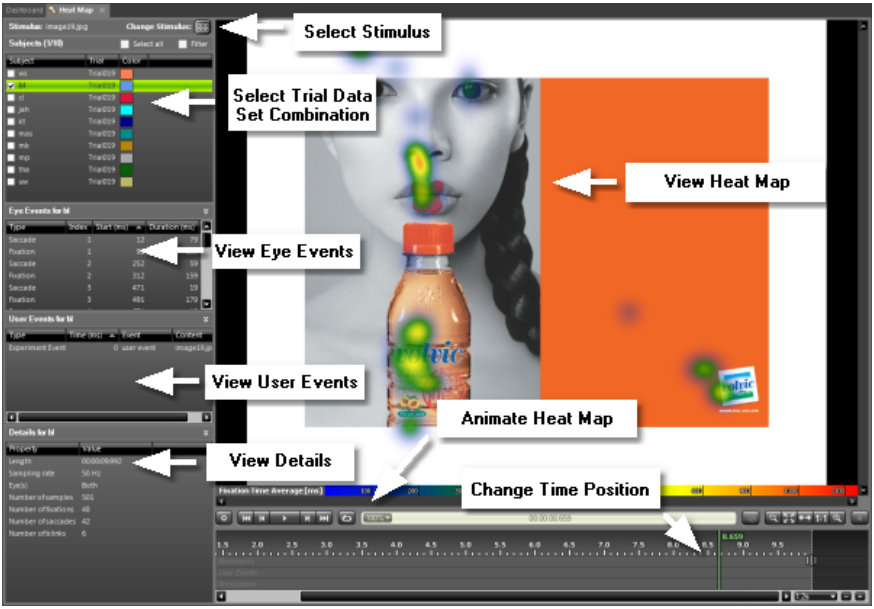
  From Start (still image stimulus only): If selected, all gaze data is displayed from the first sample to the current analysis position.

  Constant length: If selected, the current analysis position leaves "a trail behind". This means: a certain time window of gaze data – which immediately precedes the current analysis position – is displayed. Use the slider to change the length of time window from 0 seconds up to 10 seconds.

6.13 Heat Map

6.13.1 Overview

With the **Heat Map** data view, gaze patterns are visualized by altering the color of the stimulus display based on the amount of attention received.



Operate the **Heat Map** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired trial or filter combination.

   The Heat Map Main Window 230 is updated and shows the heat map for the activated trial combination.

   While selecting trials, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.

4. Select the heat map time position in the Player Control 120. Use the Playback Control 121 to view an animated heatmap.
5. You can export the animated heat map display to an AVI file. From the **Export** menu, select the **Export Heat Map Video** command.

   Alternatively, you can export the current view of the heat map to an image file. From the **Export** menu, select the **Save Image...** command.

The visualization is calculated for still images based on fixations and for video stimuli on raw data.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.13.2 Main Data View

After selecting the desired trial data, the **Heat Map** main view displays the updated map. The **Heat map** shows fixation hits related to the color scale between blue (less hits) and red (most hits) when the 3-color coding (default) is selected or between green and red when the 2-color coding is selected.

The **Heat map** can also have custom 3-color codings by changing the color values in the setting dialog.

Note, that the data interpretation differs with the stimulus type. The map displayed for a still image stimulus is based on fixations while the map displayed for a video stimulus is based on raw data.

Heat map computation

The generated heat map is an absolute gaze duration map. It shows the accumulated time participants spent looking at different areas of the stimulus.

There are two methods of computing the map depending on stimulus type:

- Images: use fixations. Each fixation made by each participant adds a value to the map that is proportional to its duration. Each value is drawn as an ellipse with Gaussian distributed intensity (which gets mapped

from a maximum color, default red, in the center to a minimum color, default blue, at the edge). The fixation duration gives the Gaussian height (intensity) while the fixation dispersion gives the elliptical shape of the Gaussian. Each resulting pixel on the map has an intensity equal to the sum of overlapping pixel intensities from each Gaussian covering that area and that resulting intensity is then mapped to a corresponding color from the chosen minimum-maximum color spectrum (greater intensity result in shifting more towards red): **Resulting Color(x, y) = Color Mapping(Sum(Gaussian Intensity(x, y)))**.

- Movies: use raw data points. Each raw data point from each participant adds a constant value to the map, the constant value being the time interval between data samples. Each value is drawn the same as above with the particularity that all Gaussian have the same height (the time interval between data samples) and the same dispersion.

The intensity value is also averaged with the number of participants selected so the formula becomes: **Resulting Transparency(x, y) = Transparency Mapping(Sum(Gaussian Intensity(x, y)) / N)** for N selected participants.

When the **Data Range** in Heat Map Settings 233 is set to Auto the whole color range is adjusted so that the resulting heat map has a total area of maximum color (default red) covering, if possible, between 0.01% and 0.02% of the stimulus area. This is done so that the result is not saturated with large areas of the same color which would make finer details disappear.

Change the heat map display

To change the heat map display settings proceed as follows:

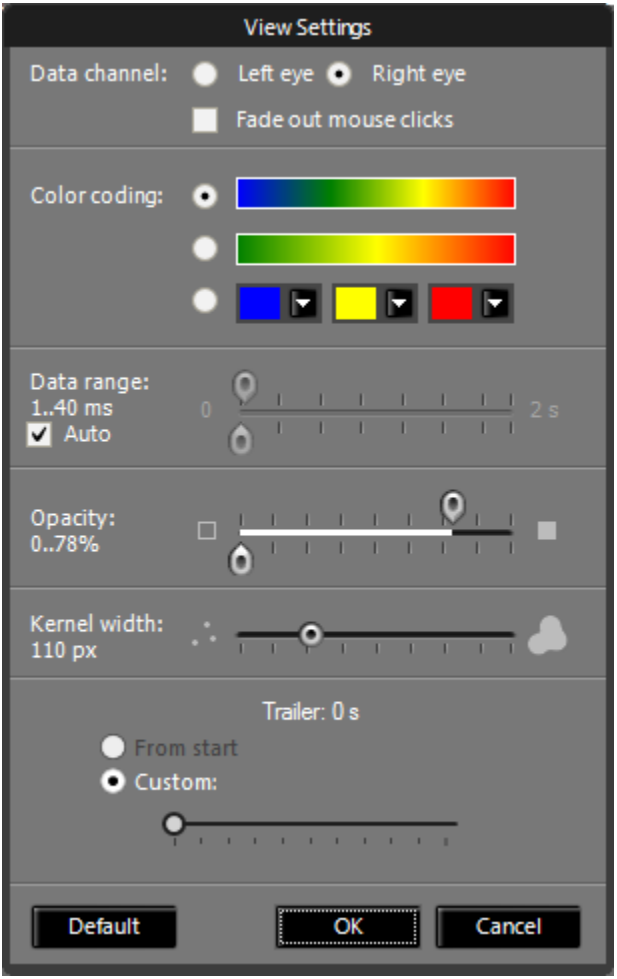
1. Right click the map display to open a context menu.
2. Select the **Settings** command to display the Heat Map Settings 233 dialog. Select the map style and confirm with **OK**.

   The Heat map display is updated.
3. Select the **Show AOIs** command, to toggle the visibility of AOIs in the map display.

4. In the **Export** menu, either select the **Save Image...** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current heat map display to a single image. You can also export the heat map to a video file using the **Export Heat Map Video** command from the **Export** menu.

6.13.3 Settings

In the **View Settings** dialog, you can configure the visualization style and parameters of the **Heat Map**. The available settings are identical to the ones in the **Focus Map** except for the coloring selection which is described below (and replaces the Opaque color setting in Focus Map).



General Settings

- **Data channel**: Select if you want to view left or right eye. In case of monocular gaze data files, the available data channel is selected automatically.

- **Fade out mouse clicks**: Mouse click events are drawn on the screen at the moment they took place in the recording. This settings enables the drawing to fade out while playing after it first appears.

Parameters

- **Color coding**: select between predefined 3-color and 2-color codings and a user defined 3-color coding for the heat map. The heat map is colored with the selected range of colors starting with the left color for the shortest fixations and ending with the right color for the longest ones.
- **Data Range (min..max):** For every pixel displayed on the map, the fixation duration is counted and integrated over time. For multiple participants, the sum (over all participants) of the fixation duration is divided by the number of participants. The double slider defines the minimum and maximum duration of the scale.

  If the maximum value is reached or exceeded the matching image pixels will be drawn with the highest value, which is

  – normal brightness for the Heat map,

  – a customized color for Custom map style

  If the minimum value is not reached, the matching image pixels will be drawn with the lowest value, which is

  – no brightness for the Heat Map (or the selected opaque color if changed from black),

  – a customized color for the Custom Map.

  Changing this parameter is useful if you are interested in fixations that exceed a specific fixation duration.
- The **Auto** checkbox automatically selects the best maximum data range value such that the Heat Map is not over-saturated.
- Use the **Opacity** double slider to change the opacity level for the corresponding minimum and maximum data range values above.

- **Kernel width**: To calculate the Heat Map, all fixation hits are filtered with a Gaussian filter. This setting defines the width (in pixels) of the Gaussian curve. If you decrease the value, the analysis resolution will increase. At the same time, the hot spots will become smaller and less spread.
- **Trailer**: Determines, how many gaze data is accumulated to display fixations. Note that the following settings relate to the time window you have set in the Thumbnail Control 124.

  From Start (still image stimulus only): If selected, all gaze data is displayed from the first sample to the current analysis position.

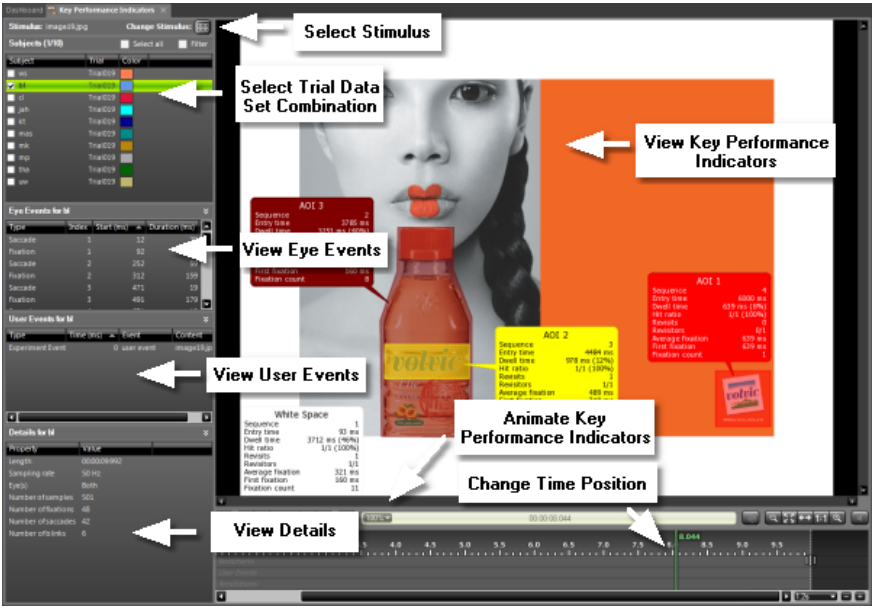
  Constant length: If selected, the current analysis position leaves "a trail behind". This means: a certain time window of gaze data – which immediately precedes the current analysis position – is displayed. Use the slider to change the length of time window from 0 seconds up to 10 seconds.

6.14 Key Performance Indicators

6.14.1 Overview

With the **Key Performance Indicators** data view, a number of important statistical indicators are visualized in text bubbles associated to each AOI. The statistical data is updated in realtime and reflects the selected participants in the participants list view.


For the Key Performance Indicators view availability please check the BeGaze Product Variants 12 chapter.



Operate the **Key Performance Indicators** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired trial or filter combination.

   The Key Performance Indicators Main Window 238 is updated and shows the KPIs for the activated trial combination.

   While selecting trials, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.

4. Select the KPI time position in the Player Control 120. Use the Playback Control 121 to view the KPIs in real time.
5. You can export the animated KPI display to an AVI file. From the **Export** menu, select the **Export KPIs Video** command.

   Alternatively, you can export the current view of the KPIs to an image file. From the **Export** menu, select the **Save Image...** command.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

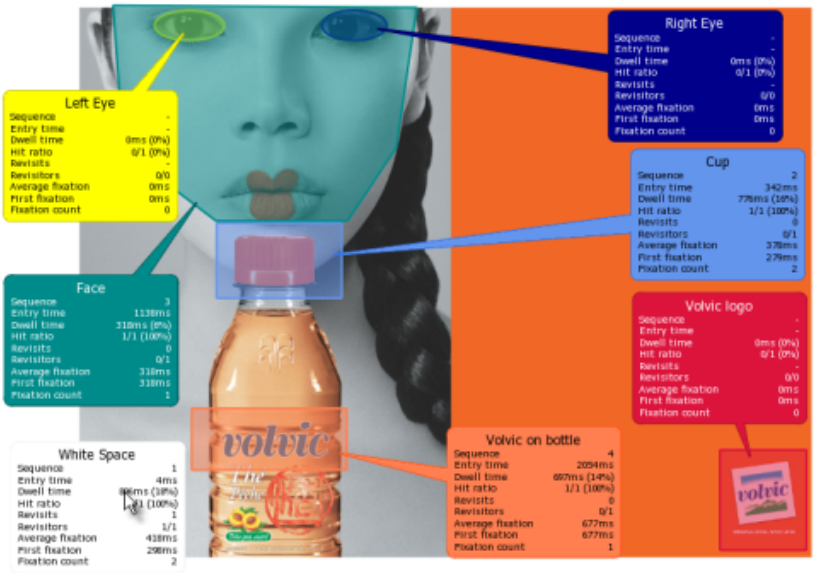
The statistical indicators available in this data view can be exported from the Metrics Export 339 data view, using the AOI Statistics Selection Summary 372 template.

6.14.2 Main Data View

The **Key Performance Indicators** (KPI) main view gets you immediate responses at a glance:

- Which stimuli elements were the eye catchers?
- How many participants watched each element?
- In which order?
- How many revisits?
- What is the rank and share of visual attention among all participants?
- and other indicators

It makes the results quantitative and visible.



KPI functionalities and handling

- Works with still images and video clips, on websites or screen recording videos
- Displayed as overlay on Areas of Interest (AOI) visualization
- Interactive information updated based on selected participants (individual, groups, all) and time of regard
- Select and deselect KPI windows, move their position freely
- Export visualization as BMP or AVI for your exposé, report, documentation etc.
- A White Space KPI exists for still image stimuli only and shows indicators for the area left outside of the AOIs

Change the KPI display

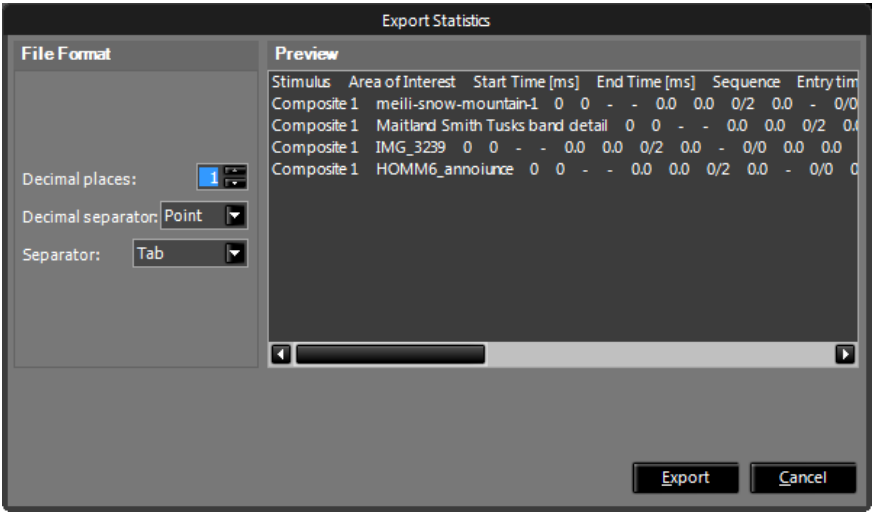
To change the KPI display settings proceed as follows:

1. Right click the main view to open a context menu.
2. Select the **Settings** command to display the KPI Settings 241 dialog. Select the indicators to display and confirm with **OK**.

   The KPI display is updated.
3. In the **Export** menu, either select the **Save Image...** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current KPI display to a single image. You can also export the KPIs to a video file using the **Export KPIs Video** command from the **Export** menu.

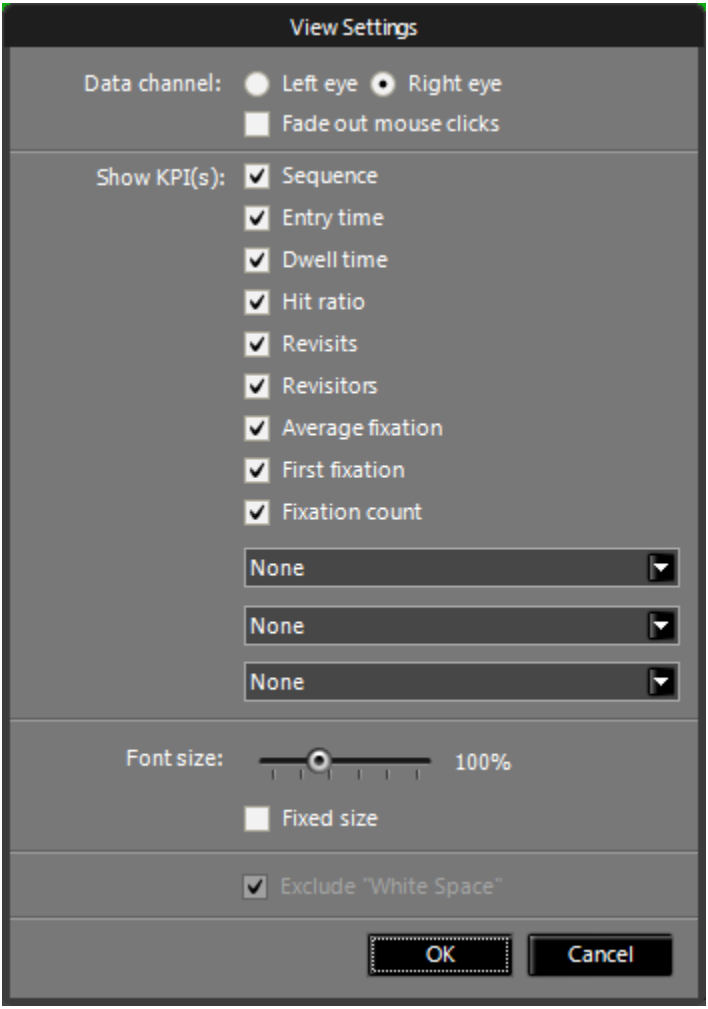
Export Statistics

If you right click on the KPI display the context menu is displayed and the option to **Export Statistics** can be selected. This exports to file or to clipboard all the AOI parameters (name, area) and all the associated KPIs that are selected from the KPI Settings 241 dialog.



6.14.3 Settings

In the **View Settings** dialog, you can select which indicators to show in the **Key Performance Indicators** data view.



General Settings

- **Data channel**: Select if you want to view left or right eye. In case of monocular gaze data files, the available data channel is selected automatically.

- **Fade out mouse clicks**: Mouse click events are drawn on the screen at the moment they took place in the recording. This settings enables the drawing to fade out while playing after it first appears.

Indicators

The available key performance indicators and their meaning are described in the table below.

Additionally there are three combo-boxes that allow to select more indicators (one each) to show together with the ones in the table above. For the description of these parameters see the AOI Statistics Selection Summary 372 and NHTSA AOI Statistics Selection Summary 387 lists.

KPI Name	unit	Description	AOI Statistics Selection Summary Column(s)
Sequence	count	Order of gaze hits into the AOIs based on Entry Time Average (over all selected participants), lowest Entry Time Average = first in Sequence.	Sequence
Entry time	ms	Average duration from start of the trial to the first hit of an AOI.	Entry Time Average [ms]
Dwell time	ms and %	Dwell time average ms = sum (all fixations and saccades within an AOI for all selected participants) / by	Dwell Time Average [ms] Dwell Time Average [%]

		number of selected participant. Dwell time average % = dwell time average * 100 / (current time - start time).	
Hit ratio	count and %	How many participants out of the selected participants looked at least one time into the AOI - "total hit count" / "number of selected participants".	Participant Hit Count Participant Hit Count [%]
Revisits	count	Average Revisits = Number of revisits divided by number of selected participants with at least one glance. Glances = Increments the counter each time a fixation hits the AOI if not hit before.	Revisits Average
Revisitors	count	Revisitors is a number n out of m participants (e.g. 3 revisitors out of 7 visitors) where: - n is the number of participants with more	Revisitors Count, Participant Hit Count (shown as "n / m" as shown in the description)

		than one visit in an AOI; - m is the total number of participants with at least one visit into an AOI.	
Average fixation	ms	Sum of "Average Fixation per participant in an AOI" divided by number of selected participants. The "Average Fixation" is defined as "the sum of fixation times divided by number of fixations".	Average Fixation Average [ms]
First fixation	ms	Sum of all "first fixations" for selected participants divided by number of selected participants.	First Fixation Duration Average [ms]
Fixation count	count	Number of all fixations for selected participants divided by number of selected participants.	Fixation Count Average
AOI area	[px]	Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored.	AOI Size

AOI coverage	%	AOI size in comparison to Stimulus size.	AOI Coverage
Glance duration	ms	Sum of glance duration of all participants divided by number of the participants. (*)	Glance duration average
Diversion duration	ms	Sum of diversion duration of all participants divided by number of the participants. (*)	Diversion duration average
Appearance count	count	Sum of all appearances of one AOI within one trial of all participants by number of the participants.	Appearance count average
Visible time	ms and %	Sum of AOI duration within one trial of all participants by number of the participants.	Sum of AOI duration within one trial of all participants by number of the participants.
Net dwell time	ms and %	Sum of net dwell time of all participants divided by number of the participants. (*)	Net dwell time average
First fixation participant count	count	Number of participants that had their first fixation in the AOI.	First Fixation Participant Count

KPI Name	unit	Description	NHTSA AOI Statistics Selection Summary Column(s)
Glances outside AOI total	count	Number of glances outside AOI	Glances Outside AOI Total
Glances outside AOI above 2 s	count	Number of glances outside AOI duration greater or equal to 2 s.	Glances Outside AOI Above 2 s
Glances outside AOI below 2 s %	%	Percentage of glances outside AOI for which the duration is less than 2 s.	Glances Outside AOI Below 2 s [%]
Glances outside AOI duration total	ms	Sum of durations of glances outside AOI	Glances Outside AOI Duration Total
Glances outside AOI duration average	ms	Sum of durations of glances outside AOI divided by the number of glances outside AOI	Glances Outside AOI Duration Average
Glances outside AOI	ms	Standard Deviation of glances outside AOI durations	Glances Outside AOI Duration STD

duration STD			
Glances outside AOI duration maximum	ms	Longest glance outside AOI duration	Glances Outside AOI Duration Maximum
Glances outside AOI duration minimum	ms	Shortest glance outside AOI duration	Glances Outside AOI Duration Minimum
Glances outside AOI 85th percentile	ms	The shortest glance outside AOI duration that is greater or equal to 85% of NHTSA glance durations.	Glances Outside AOI 85th Percentile

The corresponding parameters marked with an asterisk (*) in AOI Statistics Selection Summary 372 are available only for recordings with sampling rate higher than 30 Hz. The only exceptions to this are for reference views where the following are computed even at 30Hz: Revisits and Revisitors.

Font

- **Font Size**: Selects the size of the KPIs font as a percent of the standard font size used for the main view (the font size used for AOI names in the AOI Editor for example).

- **Fixed Size**: If checked the KPI font size remains the same at all zoom levels, otherwise the font size scales together with the AOIs at different zoom levels. Default is not checked.

Exclude "White Space"

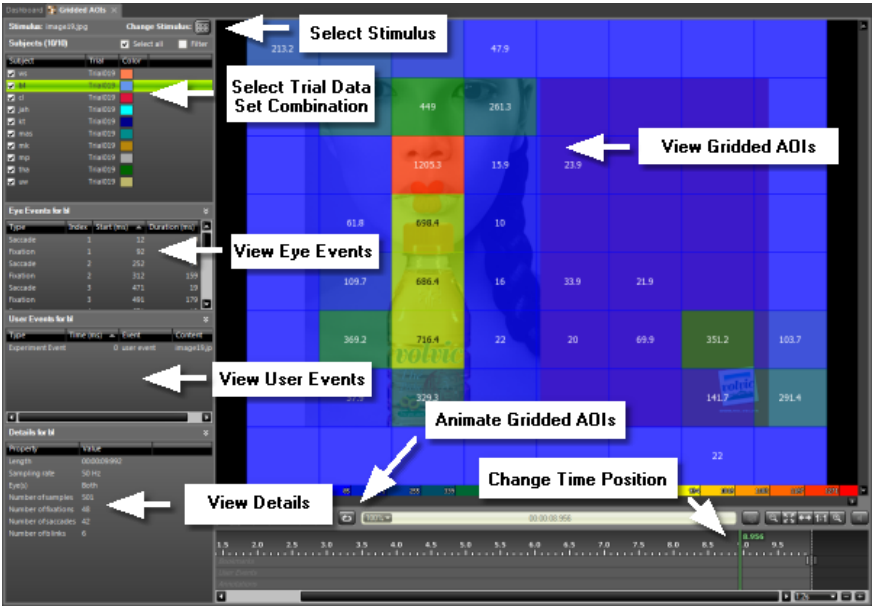
Available for image stimuli, checking the option hides the "White Space" automatically generated AOI and removes it from statistics computations.

6.15 Gridded AOIs

6.15.1 Overview

With the **Gridded AOIs** (aka content independent AOIs) data view, gaze patterns and statistics parameteres are visualized by altering the color of a grid of AOIs overlayed over the stimulus based on the amount of attention received. Gridded AOI maps allows complementary interpretation to heat maps – qualitative and quantitative - and allows the comparison of different stimuli independent of their content.

 For the Gridded AOIs view availability please check the BeGaze Product Variants 12 chapter.



Operate the **Gridded AOIs** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired trial or filter combination.

   The Gridded AOIs Main Window 252 is updated and shows the gridded AOIs for the activated trial combination.

   While selecting trials, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

3. If you click on an event in the **Events** selection view, the corresponding event is automatically selected in the main view.

4. Select the gridded AOIs time position in the Player Control 120. Use the Playback Control 121 to view an animated heatmap.
5. You can export the animated gridded AOIs display to an AVI file. From the **Export** menu, select the **Export Gridded AOIs Video** command.

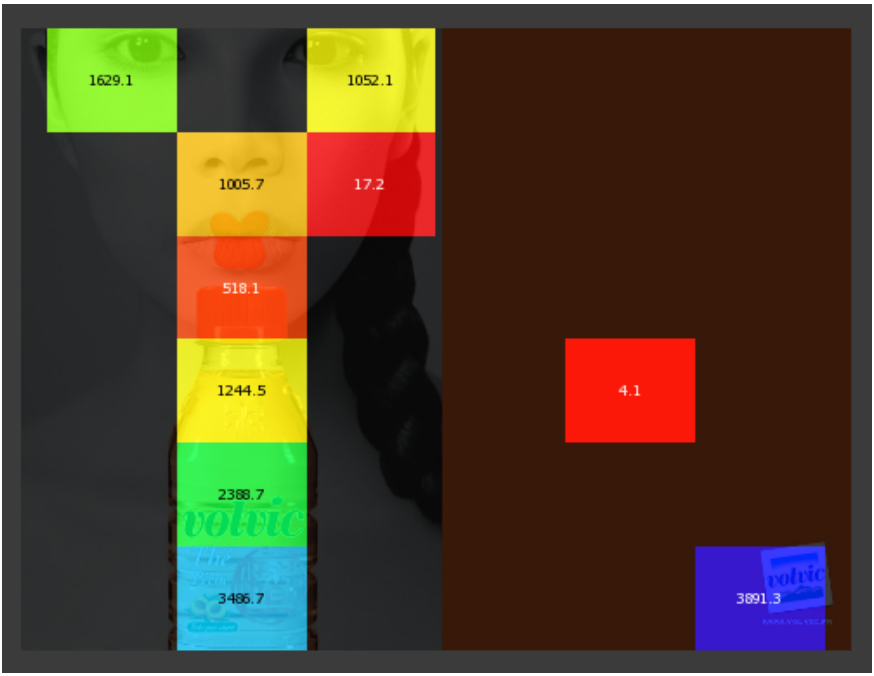
   Alternatively, you can export the current view of the gridded AOIs to an image file. From the **Export** menu, select the **Save Image...** command.

All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze program version 12.

Screen recording experiments and HED videos are only compatible with gaze tracking data which have been generated with the iView X™ version 2.1 or higher.

6.15.2 Main Data View

The **Gridded AOIs** main view visualizes the selected trial data set as a rectangular AOIs grid over the stimulus image or video. The AOIs in the grid show various statistical values like Entry Time, Dwell Time, Revisits and more. The following image shows an example for an 8x8 grid using the Average Entry Time as parameter in milliseconds:



You can change the gridded AOIs display with the following steps:

1. Right click the gridded AOIs display to open a context menu.
2. Select the **Settings** command to display the Gridded AOIs Settings 256 dialog. Select the number of rows and columns for the AOI grid. Change the displayed statistics parameter as well and confirm with **OK**.

   The AOI grid is updated.

3. In the **Export** menu, either select the **Save Image...** ([CTRL] + [S]) or select the **Copy Image to Clipboard** ([CTRL] + [C]) keyboard command to export the current gridded AOIs display to a single image. You can also export the gridded AOIs to a video file using the **Export Gridded AOIs Video** command from the **Export** menu.

The columns are labeled left to right as A, B, C and so on and the rows top to bottom are 1, 2, 3, etc. (like in standard spreadsheet software).

Parameters

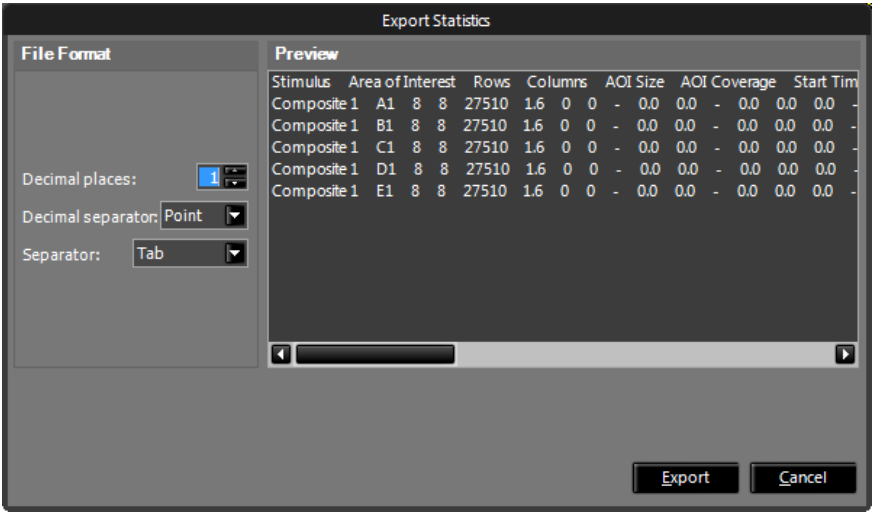
The **Gridded AOIs** view can display one of the following statistics parameters:

- Entry Time (Average)
- Dwell Time (Total)
- Dwell Time (Average)
- Revisits
- Fixation Count (Total)
- Fixation Count (Average)
- Participant Hit
- Sequence (Average)

The displayed parameter can be changed from the **Parameter** drop-down box in Gridded AOIs Settings 256.

Export Statistics

If you right click on the gridded AOIs display the context menu is displayed and the option to **Export Statistics** can be selected. This exports to file or to clipboard all the AOI parameters (name, area) and all the statistics parameters that can be displayed in the gridded AOIs view.



Export Scan Path Strings

Please see Scanpath String 254.

SPSS case format

Checking the **Use SPSS case format** changes the output format so that it contains a single line of data instead of having each trial data on its own line. This is useful to group the data for so called "cases" in SPSS.

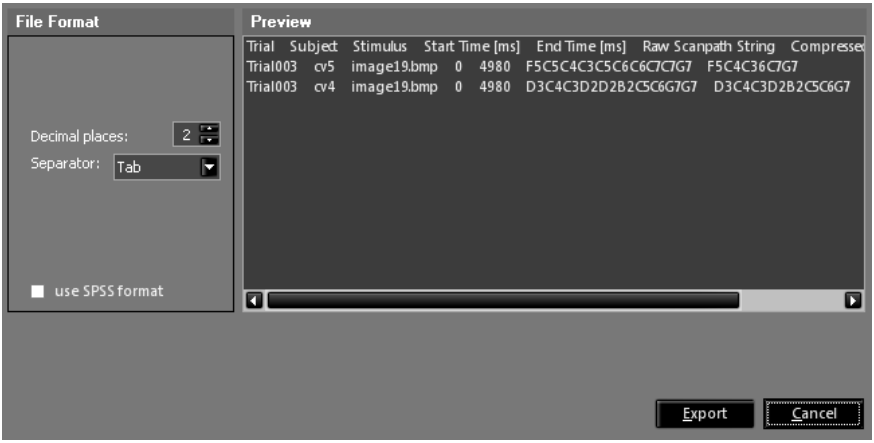
6.15.3 Scan Path Strings

Scanpath strings are used in research to measure scanpath similarities (e.g. Levenshtein distance measure, ClustalG method)

When the scanpath runs over the gridded AOIs, each fixation is replaced by the name of the AOI hit.

Export Scan Path Strings

Selecting the **Export Scanpath Strings...** from the context menu allows to export to file the scanpath string for each trial in the experiment. The scanpath string represents the sequence of AOIs in the grid that the scan path has fixations in. See the Scan Path 211 description for more details.



Raw scanpath strings

An AOI in the grid is represented as a letter-number combination representing the row and the column of that particular AOI. The columns are labeled left to right as A, B, C and so on and the rows top to bottom are 1, 2, 3, etc. (like in standard spreadsheet software). So a scanpath string can look like this: F5-C5-C4. This shows that the scan path for that trial had fixations in order in AOIs F5, C5 and C4. This string is called the *raw scanpath string.*

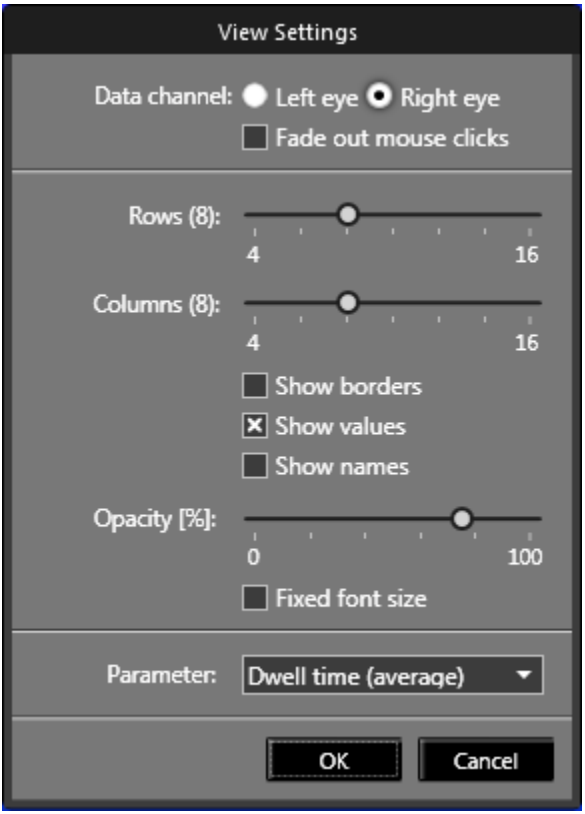
Compressed scanpath string

Additionally a *compressed scanpath string* is also exported. The compressed string is obtained by eliminating duplicated consecutive AOIs (A1A1 becomes A1) and duplicated sequences (A1-B1-C1-A1-B1 becomes A1-B1-C1).

The compressed string is obtained by eliminating duplicated consecutive AOIs (A1-A1 becomes A1) and duplicated sequences (A1-B1-C1-A1-B1 becomes A1-B1-C1).As described in http://research.chtsai.org/papers/scanpath-compression.html

6.15.4 Settings

In the **View Settings** dialog, you can select which indicators to show in the **Gridded AOIs** data view.



General Settings

- **Data channel**: Select if you want to view left or right eye. In case of monocular gaze data files, the available data channel is selected automatically.
- **Fade out mouse clicks**: Mouse click events are drawn on the screen at the moment they took place in the recording. This settings enables the drawing to fade out while playing after it first appears.

Grid Configuration

- **Rows**: number of rows for the generated AOI grid
- **Columns**: number of columns for the generated AOI grid
- **Show borders**: display the grid lines betwen AOIs
- **Show value**: display the values of the selected statistics parameter inside the AOIs
- **Show names**: displays the gridded AOI names
- **Opacity**: selects the opacity level of the AOI grid colors
- **Fixed font size**: keeps the font size constant when zooming the stimulus

Parameter

The available parameters to be displayed and their meaning are described in the table below:

KPI Name	unit	Description
Entry Time (Average)	ms	Average duration before the first fixation into the AOI

Dwell time (Total)	ms	Dwell time ms = sum (all fixations and saccades within an AOI for all selected participants)
Dwell time (Average)	ms	Dwell time average ms = sum (all fixations and saccades within an AOI for all selected participants) / by number of selected participants
Revisits	count	Average Revisits = (Number of glances divided by selected participants with at least one visit) -1 Glances = Increments the counter each time a fixation hits the AOI if not hit before
Fixation count (Total)	count	Number of all fixations for selected participants
Fixation count (Average)	count	Number of all fixations for selected participants divided by number of selected participants
Participant Hit	count	Number of participants that looked into the AOI
Sequence (Average)	count	The order of gaze hits into the AOIs based on the Entry Time (Average) (see first entry in this table), lowest Entry Time = first in Sequence.

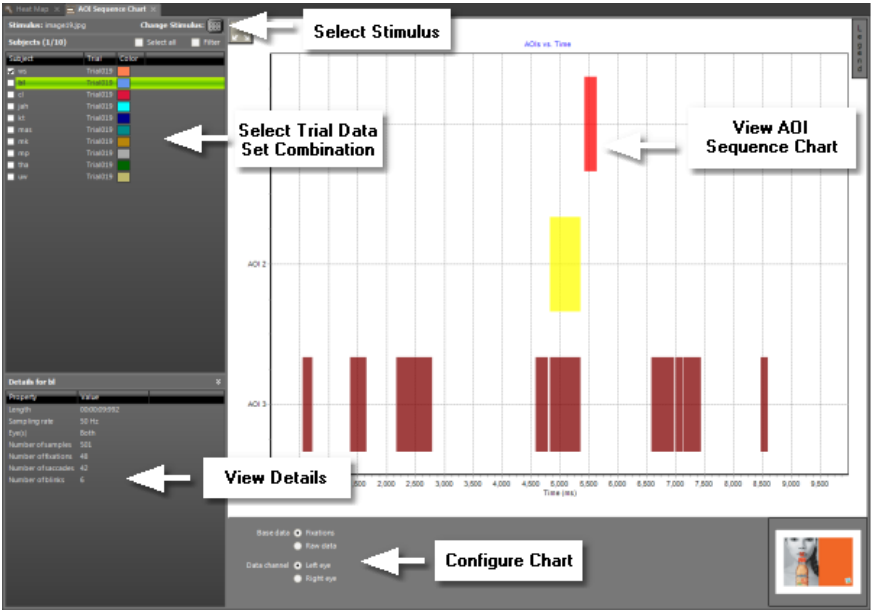
These parameters are among those found in the AOI Statistics Selection Summary 372 list.

6.16 AOI Sequence Chart

6.16.1 Overview

The **AOI Sequence Chart** shows the temporal order at which AOIs were hit by a particular participant.

For the AOI Sequence Chart view availability please check the BeGaze Product Variants 12 chapter.



Operate the **AOI Sequence Chart** data tab with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, select one or multiple trials.

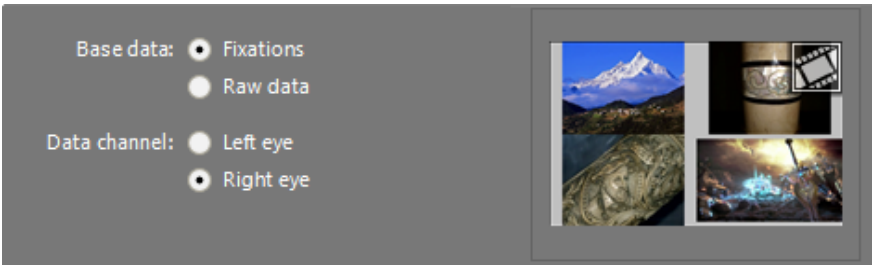
   The AOI Sequence Chart Main View 261 is updated and shows the AOI hits 129 for the selected trial.

   While selecting trials, the Trial Details 113 view shows information about the currently selected trial.

3. Configure the chart to further adapt the display to your needs.

Configuring the Chart

You can adapt the chart using the options present under the main chart view. If you change a setting, the respective display will update immediately.



The lower area also displays a thumbnail of the currently selected stimulus to the right. The following options are available:

1. **Base data**: Select whether AOI hits percentages are computed using data from calculated **Fixations** or measured **Raw data**.
2. **Data channel**: Select the data channel to be considered for AOI hits. In case of monocular recordings, the channel is selected automatically.

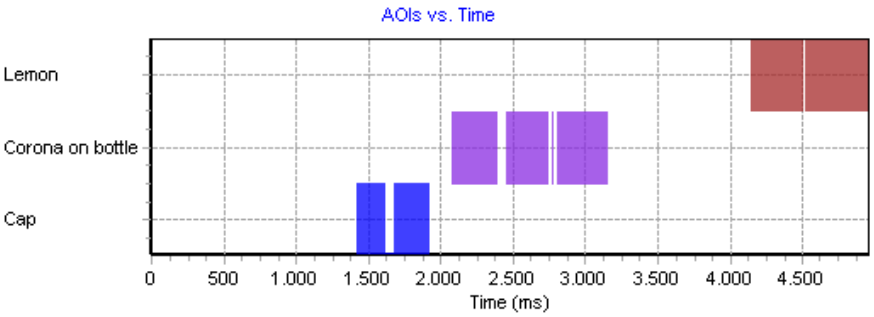
Navigation (Zoom in and out)

1. To zoom in on an arbitrary display portion, click and drag down and to the right in order to span a dotted zoom box. When you release the mouse button, the display is zoomed accordingly.
2. To zoom out fully click the **Reset Scaling** icon in the top left corner. Or just do the opposite of zooming in: click and drag in any direction except down and to the right.

6.16.2 Main Data View

Single Participant Selection

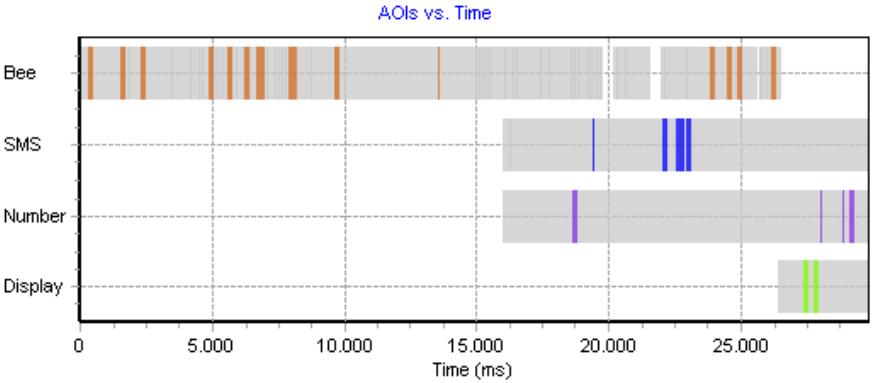
After selecting the desired trial data, the **AOI Sequence Chart** main view displays the updated chart. The following image shows the display for a still image stimulus.



The colored bars represent the different AOIs hits. If the AOIs are labeled, their names appear at the y-axis. The x-axis shows the time in milliseconds. If you right click on one of the bars, a tooltip will pop up displaying detailed information on the AOI (name, start / end time of it's presentation, and the duration of the AOI presentation).

In the example above the selected participant was looking at the AOI labeled "Cap" (colored in blue), then the gaze switches to the AOI labeled "Corona on bottle" (colored in violet).

For video stimuli, the display also indicates when a specific AOI has the visibility property set. In the example below, the AOI labeled "Bee" is visible ("active") from start until the 24th second while the AOI labeled "SMS" starts invisible ("not active") and gets visible around the 16th second.

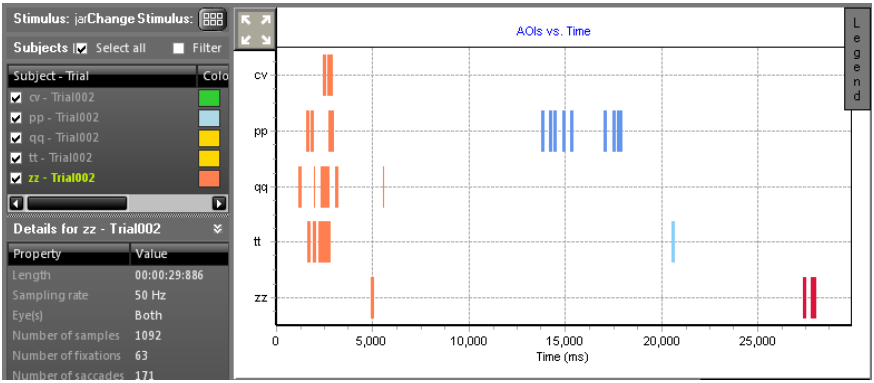


You can change the AOIs and also change the AOI colors in the AOI Editor 161.

If annotations are present for the selected participants then they will be shown underneath the main chart.

Multiple Participant Selection

After selecting the desired trial data, the **AOI Sequence Chart** main view displays the updated chart. The representation is the same for still images and video stimuli.



The colored bars represent the different AOIs hits. If the AOIs are labeled, their names appear at the Legend. The x-axis shows the time in milliseconds. If you right click on one of the bars, a tooltip will pop up displaying detailed information on the AOI (name, start / end time of it's presentation, and the duration of the AOI presentation).

In the example above the selected participant was looking at the AOI labeled "Cap" (colored in blue), then the gaze switches to the AOI labeled "Corona on bottle" (colored in violet).

Click the **Reset Scaling** icon in the top left corner to revert display scaling and positioning.

Click the **Legend** button in the top right corner to hide or unhide the legend.

6.17 Binning Chart

6.17.1 Overview

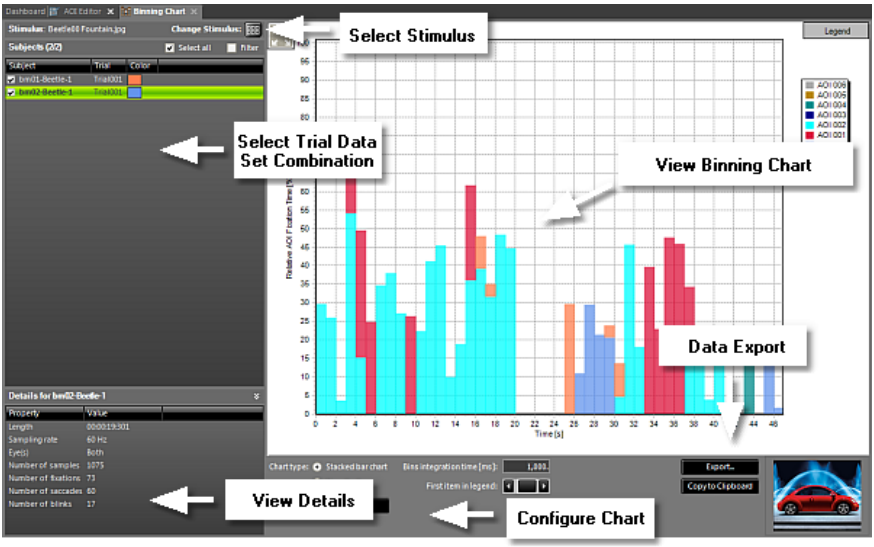
The **Binning Chart** shows percentages of AOI dwell time over time (see "dwell time [%] in AOI Statistics Trial Summary 367). With each time bin for each AOI the percentage of dwell time is computed. The percentages for all AOIs are stacked in each bin. A value of 100% means that for the whole time of the time bin for all selected trials one ore more AOIs were always hit. The time distance of the bins can be adjusted using “Bins integration time [ms]”.

For the Binning Chart view availability please check the BeGaze Product Variants 12 chapter.

The bins are generated as follows:

- the total trial time is divided in equal time slices (the slice duration can be adjusted);
- for each time slice and for each AOI the total duration that the gaze stays inside that AOI during the time slice is computed;
- the percent of dwell time is computed by dividing this amount of time by the total duration of the time slice (and multiplied by 100);
- the percents for all the AOIs that are hit in the given time slice are stacked one on top of the other in the stack;

The Binning Chart provides information about how attention has changed in average over time for the selected trials.



Operate the **Binning Chart** data view with the following steps:

1. Use the Stimulus Selection 104 to change to the desired stimulus.

   The Participants Selection 109 displays matching participants together with their trial gaze data sets.

2. In the Participants Selection 109, activate the desired trial or filter combination.

   The Binning Chart Main Window 267 is updated and shows the AOI hit 129 percentages for the activated trial combination.

   While doing this, the Trial Details 113 view shows information about the currently selected trial.

3. Configure the chart to further adapt the display to your needs.

4. Export data in bins to a text file. The **Export...** button offers some output customization options while **Copy to Clipboard** exports data to clipboard with default settings.

Configuring the Chart

You can adapt the chart using the options present under the main chart view. If you change a setting, the respective display will update immediately.

The lower area also displays a thumbnail of the currently selected stimulus to the right. The following options are available:

1. **Chart type**: Switch between bar and line chart styles.
2. **Settings**: Opens the available settings 268 for the Binning Chart.
3. **Bins integration time [ms]**: Change the duration for the time slices displayed. You can adjusted the time for single time slices in milliseconds ranging from the sampling interval value up to the trial duration.
4. **Export...**: exports the chart data to file. Please check Export Data 270 for information about the content.
5. **Copy to clipboard**: copies the chart data to clipboard.

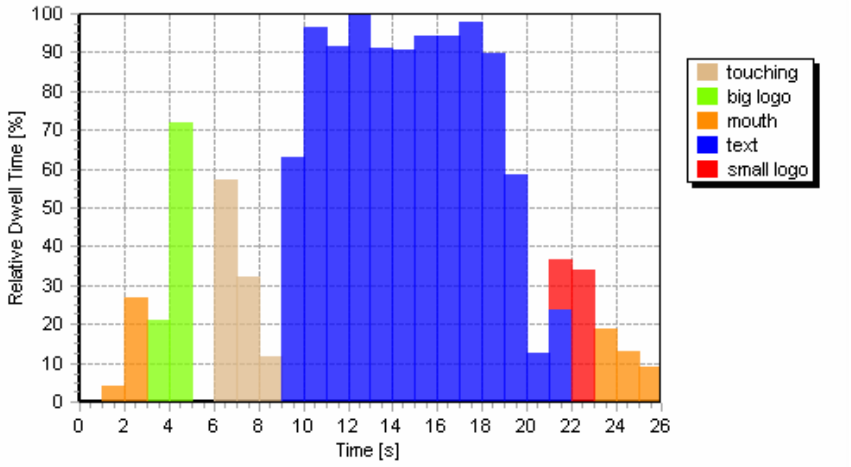
Navigation (Zoom in and out)

1. To zoom in on an arbitrary display portion, click and drag down and to the right in order to span a dotted zoom box. When you release the mouse button, the display is zoomed accordingly.
2. To zoom out fully click the **Reset Scaling** icon in the top left corner. Or just do the opposite of zooming in: click and drag in any direction except down and to the right.

You can change the time slice granulation in the configuration area available below the main display area. You can change the Bins integration time [ms] setting from sampling frequency (e.g. 20ms for 50Hz data) up to 60 seconds.

6.17.2 Main Data View

After selecting the desired trial data, the **Binning Chart** main view displays the updated chart.



The AOI hit percentages are presented using different colors. The legend below the chart shows which colors are used.

In the above example between the 20th and 21st second the "text" AOI was hit at about 14%, whereas all other AOIs were not hit in this time slice. In the next second another AOI ("small logo") was also hit.

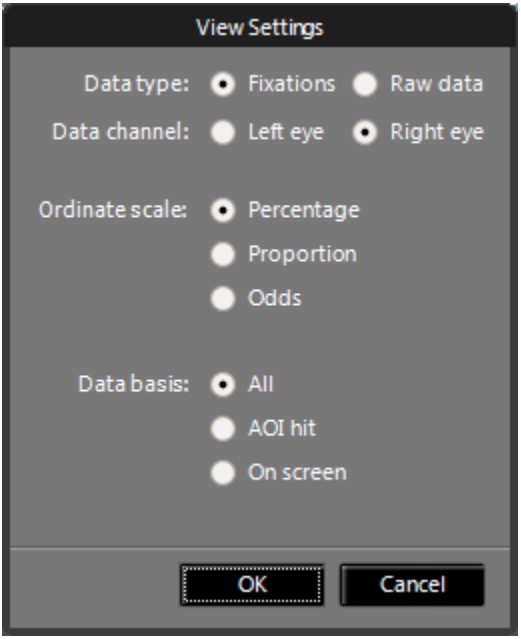

You can change the AOIs and also change the AOI colors in the AOI Editor 161.


For overlapping AOIs, the topmost hit one is used in the chart. See the explanation about AOI Priority 172.


If annotations are present for the selected participants then they will be shown underneath the main chart.

6.17.3 Settings

In the **View Settings** dialog, you can configure the visualization style and parameters of the **Binning Chart** and way in which the data points are computed.



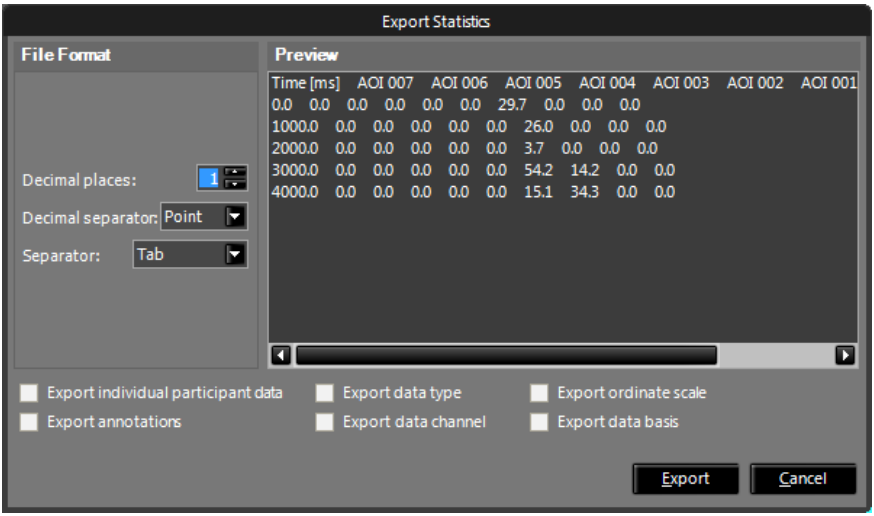
- **Data type**: Select if you to include all data points (raw data) or just those belonging to fixations into the calculation.
- **Data channel**: Select if you want to view left or right eye. In case of monocular gaze data files, the available data channel is selected automatically.
- **Ordinate Scale**: Select if you want to display computed data as **Percentage**, **Proportion** or **Odds**, where odds are defined as:

$$Odds(\text{AOI1}) = \frac{P(\text{AOI1})}{1 - P(\text{AOI1})}$$

- **Data basis**: Select if you want to compare hits into the AOIs (the selected AOIs in case of the Proportion of Looks 271 chart) with **All** data (whether on screen or off screen), only data that hit the screen (**On screen**) or only data that hit any AOI (**AOI hit**).

6.17.4 Export Data

The **Binning Chart** numerical data can be exported to file by using the **Export** button in the lower right part of the main view.This exports the AOI hit values to file as they are displayed in the **Binning Chart**.



Besides the AOI hit data, additional information can be exported for each data point:

- **Export individual participant data** adds data for all participants in additional columns, e.g AOI1 participant1, … AOI4 participant1, AOI1 participant2, … AOI4 participant2, etc.
- **Export annotations** gives information on which annotations are active.
- **Export data type** gives information on whether all data points or those belonging to a fixation were used for the calculation.
- **Export data channel** adds whether left or right eye was used for event detection.
- **Export ordinate scale** adds whether data is scaled as percentage, proportion or odds.

- **Export data basis** gives information on whether data basis is All, On screen or AOI hit.

6.18 Proportion of Looks

6.18.1 Overview

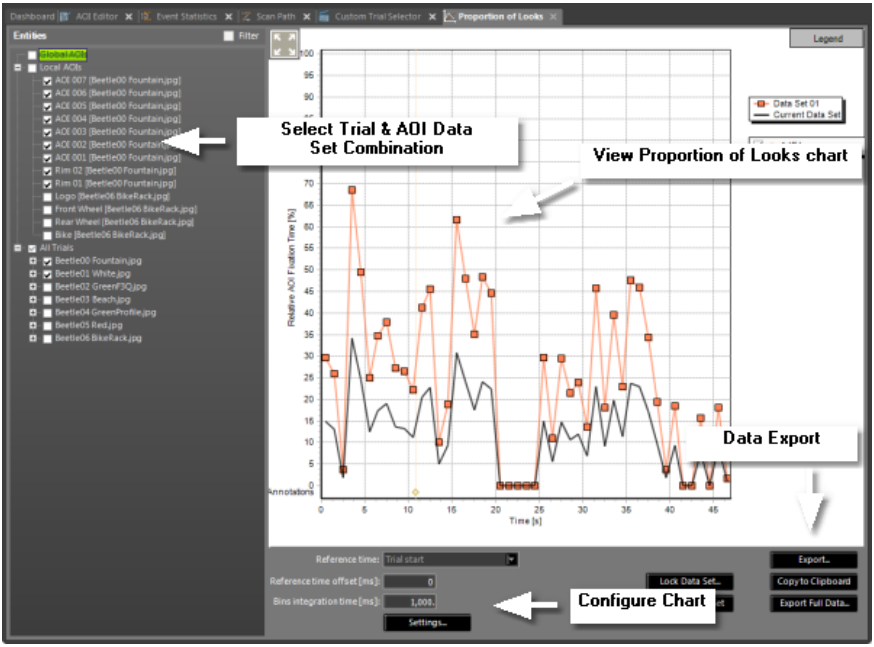
The **Proportion of Looks** chart allows to aggregate and compare AOI hits 129 across stimuli, participants and AOIs by enabling a flexible selection and step-by-step building up of comparisons. For this, each data set that is included in the comparison in individually built and “locked” to the chart.

 For the Proportion of Looks view availability please check the BeGaze Product Variants 12 chapter.

The Proportion of Looks chart shows relative AOI hits over time, such as "dwell time [%]" in AOI Statistics Trial Summary 367. With each time bin for each AOI or AOI group the relative AOI hit value is computed. The time distance of the bins can be adjusted using the **Bins integration time [ms]** setting in the lower part of the view.

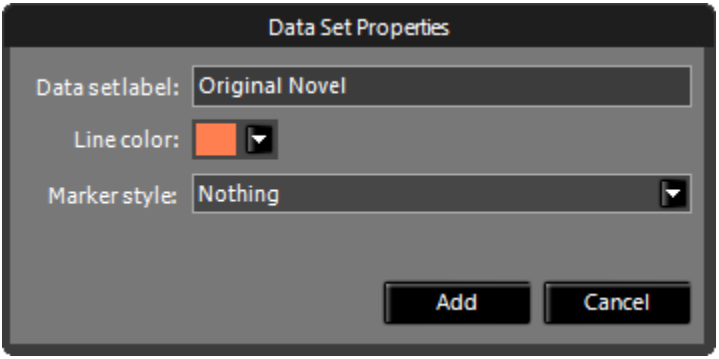
The bins are generated as follows:

- the total trial time is divided in equal time slices (the slice duration can be adjusted);
- for each time slice and for each AOI the total duration that the gaze stays inside that AOI during the time slice is computed;
- the relative AOI hit value is computed by dividing this amount of time by the total duration of the time slice, and given either as a percent, proportion or odds value of the data (where the data can either be all data point s or those that belong to a fixation);
- The data that is used for each data set is determined by the AOIs, participants and stimuli selected in the Trial Data set combination;

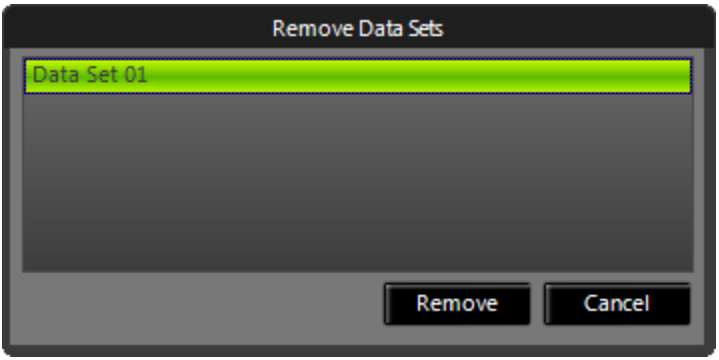


Operate the **Proportion of Looks** Chart data view with the following steps:

1. For each data set, select the desired stimulus, participant and AOI combination in the Trial Data Set Combination. The resulting graph is displayed with a black line in the main view as the transient **Current Data Set**.
2. Lock the data set with the **Lock Data Set...** button. Here, the visualization and name of the data set can be adjusted.



3. The data set will be fixed and the display updated as adjusted in the main data view and legend.
4. An incorrect locked data set can be removed with the **Remove Data Set** button.



5. Additional data sets can be added using the same procedure.
6. Configure the chart to further adapt the display to your needs.
7. Export data to a text file using the **Export...** and **Export Full Data...** options.

Configuring the Chart

You can adapt the chart using the options present under the main chart view. If you change a setting, the respective display will update immediately.

The following options are available:

1. **Reference time**: Gives the common reference time for all data set. By default, this is the trial start time. Alternatively, Annotations that are present in all trials in all data sets can be used as the reference time.
2. **Reference time offset [ms]**: If the data set should be offset with regards to the reference time, this value can be set in Reference time offset in milliseconds. This can be of interest when looking behavior before an event is of interest.
3. **Bins integration time [ms]**: Change the duration for the time slices displayed. You can adjusted the time for single time slices in milliseconds ranging from the sampling interval value up to the trial duration.
4. **Settings**: Opens the available settings 277 for the Proportion of Looks Chart.
5. **Export...** and **Export Full Data...**: export the chart data to file. Please check Export Data 277 for information about the content.
6. **Copy to Clipboard**: copies the chart data to clipboard.

Navigation (Zoom in and out)

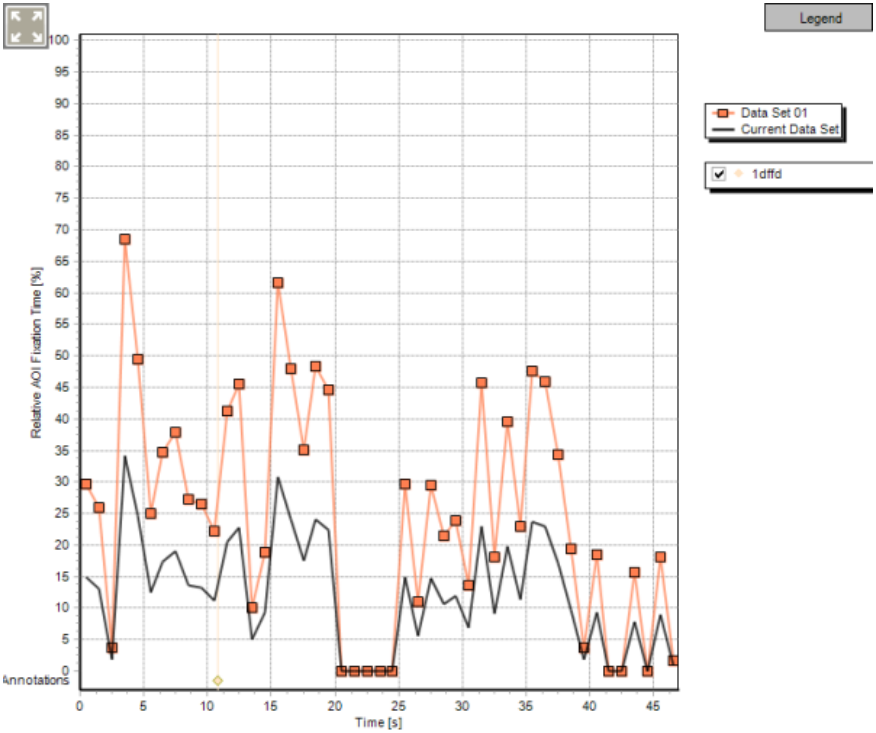
1. To zoom in on an arbitrary display portion, click and drag down and to the right in order to span a dotted zoom box. When you release the mouse button, the display is zoomed accordingly.

2. To zoom out fully click the **Reset Scaling** icon in the top left corner. Or just do the opposite of zooming in: click and drag in any direction except down and to the right.

You can change the time slice granulation in the configuration area available below the main display area. You can change the Bins integration time [ms] setting from sampling frequency (e.g. 20ms for 50Hz data) up to 60 seconds.

6.18.2 Main Data View

After selecting the desired trial data, the Proportion of Looks Chart main view displays the updated chart.



Every data set will be displayed as defined when locking the data set with a defined line color and optional data point marker. The legend on the right side of the chart shows the names and styling of the individual data set. The transient current data set is always displayed with a black line before locking it to the graph.

If annotations are present for the selected participants then they will be shown underneath the main chart.

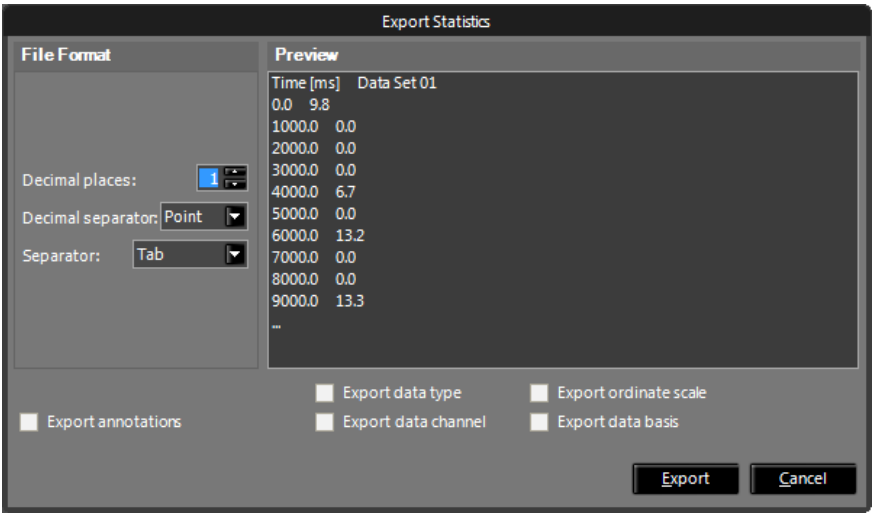
6.18.3 Settings

In the **View Settings** dialog, you can configure the visualization style and parameters of the **Proportion of Looks**, which are identical to the **Binning Chart** Settings. For a detailed description of the settings see Binning Chart Settings 268.

6.18.4 Export Data

The Proportion of Looks chart numerical data can be exported to file in two different ways by using the buttons in the lower right part of the main view **Export** and **Export Full Data**.

Export Data exports the AOI hit values to file as they are displayed in the Proportion of Looks chart.

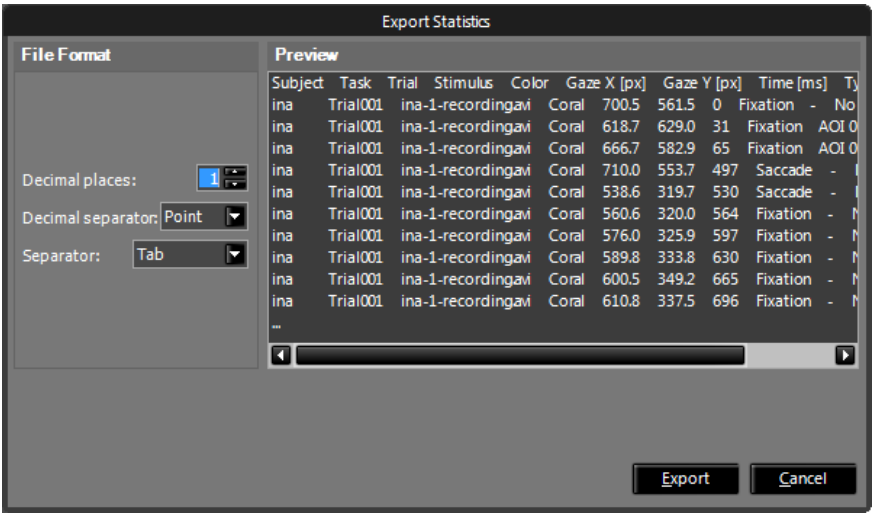


Besides the AOI hit data, additional information can be exported for each data point:

- **Export annotations** gives information on which annotations are active.

- **Export data type** gives information on whether all data points or those belonging to a fixation were used for the calculation.
- **Export data channel** adds whether left or right eye was used for event detection.
- **Export ordinate scale** adds whether data is scaled as percentage, proportion or odds.
- **Export data basis** gives information on whether data basis is All, On screen or AOI hit.

With **Export Full Data**, every underlying point of the diagram can be exported, i.e. for each graph all data points of each participant and each stimulus in the selected AOIs for a certain bin. Information on participant, participant properties, trial, stimulus and stimulus conditions are included.

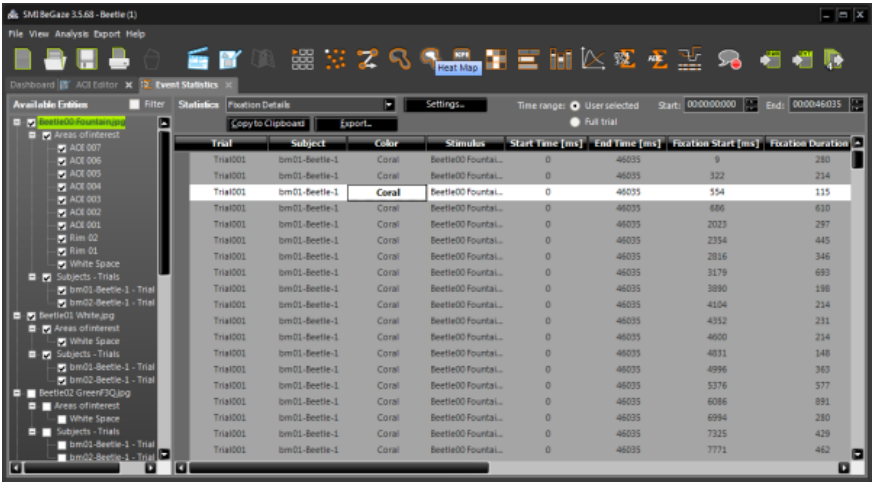


6.19 Reading Statistics

6.19.1 Overview

The **Reading Statistics** data view presents information and statistics regarding gaze tracking events. The data view's main view consists of different parts identified in the image below.

For specific Reading Statistics availability please check the BeGaze Product Variants 12 chapter.



You operate the **Reading Statistics** data view with the following steps. While doing so, the Results Grid 286 updates in real-time displaying the outcome of your selections and settings.

1. Use the **Selection Tree** displayed to the lower left to select the stimuli, trials, and areas of interest for statistic analysis. To narrow down or qualify your selection, enable the **Filter** option to display the **Filter Tree** (upper left). See Statistics Selection Trees 280 for an in depth explanation.

2. Choose the desired **Statistics Template** from the Statistics selection box. The list offers both predefined and user defined templates. You may duplicate and change a predefined statistics template. See Statistics Template 282 for an in-depth explanation.
3. Press **Settings** button to select or deselect cells from the template, to create own templates and switch between evaluation of **Left eye** or **Right eye** gaze tracking data
4. As an option, you may specify the desired Time Interval 285. Furthermore, it is also possible to re-arrange the columns, sort the data or only show columns of your interest within the Results Grid 286.
5. If the display suits your requirements, click **Export...** to write the current display to a file. See Export Statistics 286 for details.
6. Click on **Copy to Clipboard** button to copy the current shown statistic into the clipboard for further use in other programs, e.g. Microsoft Excel.
7. The **Time Range** for which the statistics are computed can be switched between the **Full trial** and a custom time range (**User selected**) where the start and end time relative to each trial is specified.

The statistics display is calculated in real-time. Depending on the complexity of the experiment and on the computer performance, the calculation might take some time.

The Reading Statistics 303 data view is available only when the Reading Package is licensed.

6.19.2 Selection Trees

Selection Tree

The **Selection Tree** is used to select the stimuli, trials and areas of interest for which the **Reading Event Statistics** data view outcome is computed. Using the selection tree is straightforward:

1. The top level (root) nodes selects or de-selects stimuli available in the current experiment. To help in the selection, a thumbnail of the stimulus is displayed as tooltip when you hover the mouse over the respective screen region.
2. If you enable or disable a node, all child nodes follow that selection. For example: to de-select all child entries associated below a specific stimulus, disable the corresponding top level node.
3. On the tree's second level, you select or de-select statistics for all **Areas of interest** or statistic entries for all **Participants – Trials**. Note, that you can narrow down the selection of participants and trials with the **Filter Tree** (see below).
4. On the tree's third level, you select a specific combination of AOIs or a specific combination of trials. BeGaze automatically creates an AOI labeled "White Space" that covers all areas left outside of user defined AOIs. A "White Space" AOI is generated on static stimuli only.

Right-clicking over the **Selection Tree** shows options to expand or collapse all nodes or both, depending on the current state of the nodes.

Once a selection is made, the results are computed and displayed in the Results Grid 286 immediately.

Filter Tree

With the **Filter Tree**, a specific set of trials / participants can be selected. This is especially helpful, if you have a large number of trials or if you want to select trials / participants by additional participant properties collected while running the experiment.

1. Activate the **Filter** option above the **Selection Tree**.

   A separate tree view opens. The new tree view lists all **Participants** as well as customized participant properties as top level experiment. Note, that customized participant properties (for example **Gender** or **Age**)

need to be defined when creating the experiment using SMI Experiment Center. When running the experiment, these properties are available for operator input when starting a new trials.

2. Open the available top level nodes and select the desired combination of **Participants** or customized participant properties. For example: if your experiment includes the participant property **Gender**, you are now able to select trials linked to male or female participants.

   The selected filter combination is applied. The results are computed and displayed in the Results Grid 286 immediately. Note, that the selection in the **Filter Tree** is independent from the selection already made in the **Selection Tree**. For this reason, already de-selected items from the **Selection Tree** may show up in the **Results Grid** now.

3. After doing the selection in the **Filter Tree**, you can de-select items in the **Selection Tree** to temporarily hide specific items from the **Results Grid**.

4. Deactivate the **Filter** option to switch off the settings made in the **Filter Tree**.

Switch between tooltip view of AOI and AOI preview

1. To switch between the tooltip view of an AOI and the AOI preview, press [CTRL] + [T].

6.19.3 Template List

For optimized handling of the large count of statistical data items, BeGaze groups them as **Statistic Templates**. Each statistic template covers a specific purpose. For details about the predefined templates see Definitions and Examples 288.

To operate the statistics templates, proceed as follows:

1. Select an item from the **Statistics** list at the top left of the data view.

   This will activate a set of statistic items, which are computed and displayed in the Results Grid 286 immediately.

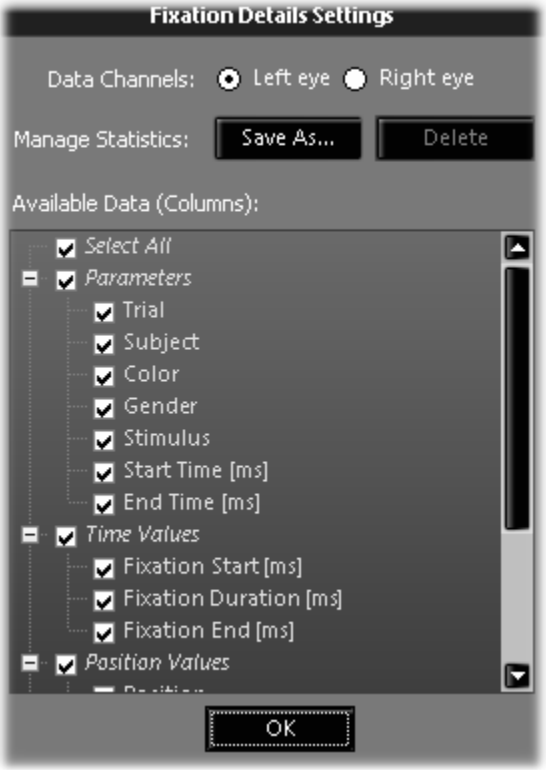
2. After activating the desired template, you can modify the **Results Grid** to suit your needs. This can be done by

   – changing the column selection,

   – changing the column sorting, or by

   – changing the column order.

3. Click the **Settings** button to change the columns selection or to copy the modified settings to a new statistic template.



To save the customized **Statistic Templates** press the "Save As..." button in the settings dialog

4. To remove a customized statistic template, open the settings dialog and click the **Delete** button.

5. Optionally, when the settings dialog is closed, you can ...

   – select the **Save Settings for Experiment** menu command or press the [CTRL] + [E] key combination to save the **Statistic Templates** list to the currently opened experiment or

   – select the **Save Settings Globally** menu command or press the [CTRL] + [G] key combination, to save the **Statistic**

Templates list for use with other experiments. Note that this command will overwrite a previously saved global list.


It is not possible to delete the default statistic templates.

6.19.4 Time Interval

The settings grouped under **Time Range** limit the data to be evaluated while computing the event statistics. The default setting includes all gaze tracking data currently selected for display in the Statistics Selection Trees 280. There is a toggle between **User selected**, where a custom time window can be set, and **Full trial** data. **Start** and **End** time settings denote a relative time in milliseconds where each trial starts at zero. You can narrow the time window with the following steps:

1. Enter the starting time in the **Start** input. You can enter a number in milliseconds, which is automatically converted to the hh:mm:ss:ms format. You can also enter the time value in the hh:mm:ss:ms format where **hh** denotes a two digit hour value, **mm** denotes minutes, **ss** denotes seconds, and **ms** denote milliseconds.

   All gaze tracking data before this time will be filtered out.

2. Enter the ending time in the **End** input. Note, that the **End** time needs to be larger than the **Start** time.

   All gaze tracking data after this time will be filtered out.


To revert to the default setting just toggle to **Full trial** (or enter "0" in both the Start and End input fields and select a new trial data set in the selection tree).

6.19.5 Results Grid

The **Result Grid** shows the parameters of the statistics and the computed values. You can customize the results grid view settings and export the current view to a statistics data file (see Export Statistics 286).

To operate the results grid in order to customize the view settings proceed as follows:

1. To resize columns drag a column header's separator.
2. To move columns to another position drag and drop a column header.
3. To sort the results grid click on the desired column header. To reverse the sort order, click the same column header again.
4. To remove columns, click on the Settings button to open the settings dialog
5. To resize all rows hover the mouse over the left border of the results grid. If the mouse cursor changes, drag and drop to indicate the new height.

The results grid view settings are applied temporary for the currently displayed results. The results grid reverts to the former settings, if new results are computed. New results are computed if you change the Selection Tree 280 or when you change the Time Interval 285 settings. To make the results grid settings permanent, proceed as described under Statistics Template 282.

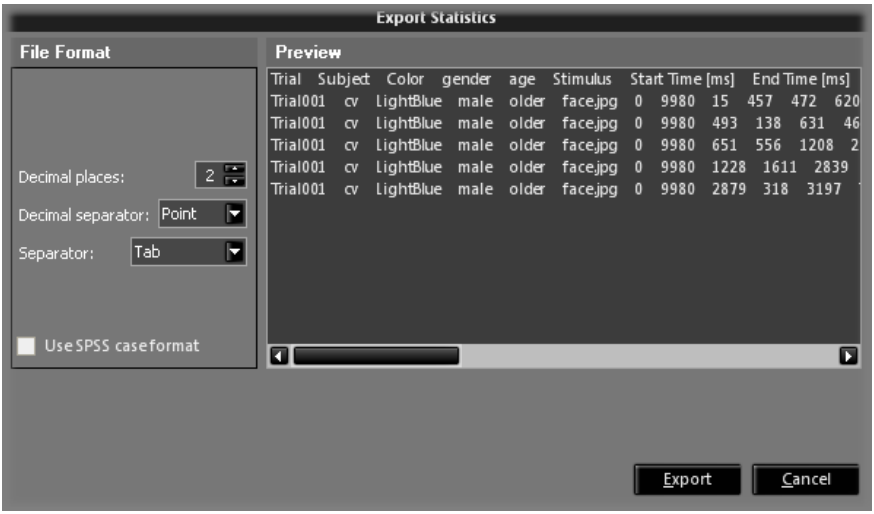
6.19.6 Export Statistics

You can export the current display of the Results Grid 286 to an ASCII data file.

Copy to Clipboard

Click on **Copy to Clipboard** button to copy the current shown statistic into the clipboard for further use in other programs, e.g. MS-Excel.

Export to file



1. Click the **Export...** button available at the top of the Reading Event Statistics 279 data view.

   The **Export Statistics** dialog opens. The dialog shows a preview of the ASCII data to be exported.

2. Change the exported number precision in the **Decimal places** input.

3. Change the data separator character in the **Decimal Separator** drop-down list. While most applications will import ASCII data separated by the tab character, some applications may require another separator character.

4. If the first two columns of the exported statistics are "Trial" and "Participant" then a checkbox option called **Use SPSS case format** appears in the File Format area. Checking this option changes the output format so that it contains a single line of data instead of having each trial data on its own line. This is useful for certain analysis done outside the program.
5. Click the **Export** button. Select the storage location and enter a file name in the subsequent **Save as...** dialog.

The first line of the exported data file lists the column header names. If you import the ASCII file to another application, these names are then available for identifying the columns.

6.19.7 Definitions and Examples

The following tables list details about the reading statistic templates that are shipped with the BeGaze when the reading package is licensed.

Default Statistic Templates

Fixation Duration 290

Saccadic Amplitude 291

AOI Statistics 293

Landing Position AOI 295

Pause Duration 296

First Pass Regression Scanpath 297

Return Sweep 298

Inner-AOI Regressions 300

Between AOI Regressions 301

AOI Hits per Minute 302

Notes and Definitions

All processing is constrained to the selected time interval. All fields without a comment represent information extracted directly from the event properties, with average/max/min as the only statistic measurement done when indicated.

Reading AOI's are generated for

- Paragraphs
- Words
- Sentences
- Characters

Reading AOIs are automatically generated and cannot be self defined but modified in size and position in the AOI editor.

Please note, that character AOIs are disabled by default. When character AOIs are enabled, please be aware that this creates a huge amount of additional data (several thousands of additional AOIs) and will slow down the calculation process for statistics and other computations. It is strongly recommended to leave the character AOIs disabled until they are really needed.

The term "regression", used in several of the following definitions, refer to the reading behavior of a participant. The general meaning of "regression" in reading studies is that of a movement that is opposite to the normal reading order. As such it can mean eye movements that go back inside the same word, or go back to a previous word or line of text. A regression scanpath is a reading event defined as going back

in the text and re-reading a passage until the point where the gaze first went back in the text is reached. Regression is detected by numbering the AOIs in the normal reading order and detecting events that go against this numbering (e.g. saccade from word AOI 5 to word AOI 3).

In reading event statistics only fixations that follow a saccade of type "regressive" or "progressive" are listed. As a consequence, the first fixation inside a given AOI is not available in the reading event statistics for any AOI type.

The following color codes denote the parameter origin:

- parameters
- event properties
- computed values

Fixation Duration

This template shows one row per fixation, process all fixations from all selected trials.

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Fixation Start	[ms]	Beginning of a fixation
Fixation Duration	[ms]	Duration of a fixation *Note*: A longer fixation duration is often associated with a deeper and more effortful cognitive processing. Just and Carpenter (1980) formulated this relation in the influential Strong Eye-Mind

		Hypothesis, which claims that there is no appreciable temporal lag between what is fixated and what is processed. In reading research, words that are less frequent, and would therefore require a longer lexical activation process, generally get longer fixation durations (Rayner 1998). More complicated texts give rise to longer average fixation durations, ranging from around 200 ms in light fiction to around 260 ms for physics and biology texts (Rayner and Pollatsek, 1989). More complicated grammatical structures give rise to longer fixation durations (Rayner 1978, 1982). Note that fixation duration is an idiosyncratic measure.
Fixation End	[ms]	End of a fixation
Fixation Position XY		Geographical position of a fixation
Word		Fixated word
Reading AOI number		Fixated AOI number
Reading direction		Reading direction (Left to Right or Right to Left)
Eye		Which eye fixated

Saccadic Amplitude

This template shows one row per saccade, process all saccades from all selected trials.

Parameter	Dimension unit	Description

Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Saccade start	[ms]	Beginning of a saccade
Saccade duration	[ms]	Duration of a saccade
Saccade end	[ms]	End of a saccade
Saccade startPosition XY		Geographical position where the saccade begins
Saccade endPosition XY		Geographical position where the saccade ends
Saccade amplitude	[px]	Distance from start to end point of the saccade (average velocity * saccade duration). *Note*: The same effect on saccadic amplitude (and fixation duration) can be found when participant read texts of varying difficulty (Rayner and Pollatsek 1989). Beginning, poor and dyslectic readers have shorter saccadic amplitudes. In oral reading, average saccadic amplitude falls to around 6 letters (1:5), while during music reading and typing, saccades are a mere 1 on average. For participants reading musical scores, Kinsler and Carpenter (1995) found that the mean saccadic amplitude increased as the tempo of the performance increased.
Start word		Fixated word before saccade started
Start reading AOI number		Fixated AOI before saccade started
End word		Fixated word after saccade ended

End reading AOI number		Fixated AOI after saccade ended
Reading direction		Reading direction (Left to Right or Right to Left)
Eye		Which eye does a saccade

AOI Statistics

This template shows one row for each AOI-trial combination, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Area of Interest		AOI name
Reading AOI Type		AOI type
Reading AOI number		AOI number
Fixation count		Number of fixations inside an AOI
Progressive fixations		Number of progressive fixations (preceded by progressive saccades)
Regressions into AOI		Number of regressions into an AOI
Regressions out of AOI		Number of regressions out of an AOI *Note*: While regressions inside words are thought to reflect lexical activation processes (understanding the word), regressions between word reflect sentence integration processes (understanding how several words relate),

		see chapters 4 and 5 in Underwood (1998).
Regressive fixations		Number of regressive fixations (preceded by regressive saccades)
Single fixation duration	[ms]	The fixation duration of the fixation on a word, for AOIs in which only one fixation has been made *Note*: Single fixation duration is one of the measures for studying lexical activation; known as early processes.
First fixation duration	[ms]	The duration of the first fixation in an AOI (if any) *Note*: Generally, Rayner and Pollatsek (1989) argue that very fast cognitive operation (like lexical activation and recognition) can be measured with first fixation duration, while slower cognitive processes affect gaze duration (=dwell time). The word properties that affect first fixation duration include word frequency, morphological complexity, metaphorical status, orthographic properties, the degree of polysemy and other linguistic computations.
First pass reading time	[ms]	Sum of fixation durations from the first entry into an AOI until the eye leaves it in any direction *Note*: First pass gaze duration is considered a measure of linguistic processes slower than lexical activation. Rayner (1998), reviewing reading research using the fixation based gaze duration measure, concludes that gaze duration is indicative both of word

		frequency and of comprehension processes integrating several words. Gaze duration on a word thus contrasts to first fixation duration, the other major reading measure, which is used as an index on word frequency. "Gaze duration" is a reading research term. It is defined exactly as dwell time.
First return to AOI	[ms]	Time of occurrence for the first re-entry into an AOI
Second pass reading time	[ms]	Sum of fixation durations from the second entry into an AOI until the eye leaves it in any direction *Note*: Second pass gaze duration on a word is assumed to reflect late effects (word integration processes).
Ratio saccade / next fixation	[%]	Saccade duration divided by next fixation duration
Ratio saccade / prev fixation	[%]	Saccade duration divided by previous fixation duration
Is first skip		AOIs (words) that are not fixated during first pass reading (although they may be fixated during later regressions) *Note*: Readers skip over high predictable words more frequently than low predictable words (Rayner & Well 1996).
Is total skip		AOIs (words) that are never fixated
Eye		Which eye fixated inside an AOI

Landing Position AOI

This template shows one row for each AOI-trial combination, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Area of Interest		AOI name
Reading AOI Type		AOI type
Reading AOI number		AOI number
Reading AOI landing position	[%]	Quotient between AOI length and fixation position inside the AOI
Eye		Which eye fixated inside an AOI

Pause Duration

This template shows one row for each AOI-trial combination, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Fixation Start	[ms]	Beginning of a fixation
Fixation Duration	[ms]	Duration of a fixation
Fixation End	[ms]	End of a fixation
Fixation Position XY		Geographical position of a fixation
Word		Fixated word

Reading AOI number		AOI number
Fixation pause	[ms]	Fixation duration + the duration of the subsequent saccade
Eye		Which eye fixated

First Pass Regression Scanpath

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Event type		Type of user event
Start	[ms]	First Pass Regression start time
Duration	[ms]	First Pass Regression duration *Note*: The duration of the regression scanpath is a measure of sentence integration processes.
End	[ms]	First Pass Regression end time
StartPosition XY		Position when first pass regression started
EndPosition XY		Position when first pass regression ended
Start word		Fixated word when first pass regression started
Start reading AOI number		AOI number when first pass regression started
End word		Fixated word when first pass regression ended

End reading AOI number		AOI number when first pass regression ended
Number		Number of events durring first pass regression
Eye		Which eye fixated

Return Sweep

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Saccade return sweep start	[ms]	Return sweep start time
Saccade return sweep duration	[ms]	Return sweep duration
Saccade return sweep end	[ms]	Return sweep end time
Saccade return sweep startPosition XY		Start position for return sweep
Saccade return sweep endPosition XY		End position for return sweep
Saccade correction start	[ms]	Correction saccade start time
Saccade correction duration	[ms]	Correction saccade duration
Saccade correction end	[ms]	Correction saccade end time

Saccade correction startPosition XY		Start position for correction saccade
Saccade correction endPosition XY		End position for correction saccade
Saccade return sweep start word		Fixated word before return sweep
Saccade return sweep start reading AOI number		Fixated AOI number before return sweep
Saccade return sweep end word		Fixated word after return sweep
Saccade return sweep end reading AOI number		Fixated AOI number after return sweep
Saccade correction end word		Fixated word after correction saccade
Saccade correction end reading AOI number		Fixated AOI after correction saccade
Fixation intermediate start	[ms]	Intermediate fixation start time
Fixation intermediate duration	[ms]	Intermediate fixation duration
Fixation intermediate end	[ms]	Intermediate fixation end time
Fixation intermediatePosition XY		Position for intermediate fixation
Fixation intermediate word		Fixated word in intermediate fixation

Fixation intermediate reading AOI number		AOI number in intermediate fixation

Inner-AOI Regressions

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Prev. Fixation start	[ms]	Previous fixation start time
Prev. Fixation duration	[ms]	Previous fixation duration
Prev. Fixation end	[ms]	Previous fixation end time
Prev. FixationPosition XY		Previous fixation position
Next Fixation start	[ms]	Next fixation start time
Next Fixation duration	[ms]	Next fixation duration
Next Fixation end	[ms]	Next fixation end time
Next FixationPosition XY		Next fixation position
Regressive Saccade start	[ms]	Intermediate regressive saccade start time
Regressive Saccade	[ms]	Intermediate regressive saccade duration

duration		
Regressive Saccade end	[ms]	Intermediate regressive saccade end time
Regressive Saccade startPosition XY		Intermediate regressive saccade start position
Regressive Saccade endPosition XY		Intermediate regressive saccade end position
Area of Interest		AOI name
Reading AOI number		AOI number
Eye		Which eye fixated inside an AOI

Between AOI Regressions

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Prev. Fixation start	[ms]	Previous fixation start time
Prev. Fixation duration	[ms]	Previous fixation duration
Prev. Fixation end	[ms]	Previous fixation end time
Prev. FixationPosition XY		Previous fixation position
Next Fixation start	[ms]	Next fixation start time

Next Fixation duration	[ms]	Next fixation duration
Next Fixation end	[ms]	Next fixation end time
Next FixationPosition XY		Next fixation position
Regressive Saccade start	[ms]	Intermediate regressive saccade start time
Regressive Saccade duration	[ms]	Intermediate regressive saccade duration
Regressive Saccade end	[ms]	Intermediate regressive saccade end time
Regressive Saccade startPosition XY		Intermediate regressive saccade start position
Regressive Saccade endPosition XY		Intermediate regressive saccade end position
Area of Interest start		Previous AOI name
Reading AOI number start		Previous AOI number
Area of Interest end		Next AOI name
Reading AOI number end		Next AOI number
Eye		Which eye fixated inside an AOI

AOI Hits per Minute

This template shows one row per selected trials.

Parameter	Dimension unit	Description
Trial		Trial number
Participant		Participant name
Stimulus		Stimulus name
Reading AOI Hits character		Character AOI hits per minute
Reading AOI Hits word		Word AOI hits per minute *Note*: This is the word-per-minute (WPM) measure, a classical measure for reading speed. In the eye-tracking version, WPM can be made a continuous measure that varies along the text.
Reading AOI Hits sentence		Sentence AOI hits per minute
Reading AOI Hits paragraph		Paragraph AOI hits per minute
Eye		Which eye fixated inside an AOI

6.19.8 References

Berséus, P. (2002). Eye movement in prima vista singing and vocal text reading.
Unpublished master's thesis, Lund University.
Clifton, C., Staub, A., & Rayner, K. (2006). Eye movements: A window on
mind and brain. In R. P. G. van Gompel, M. H. Fischer, W. S.Murray, & R. L. Hill (Eds.), (chap. Eye movements in reading words and sentences.). Elsevier, Oxford.
Diepen P.M.J. van, M., W., & G. d'Ydewalle. (1998). Eye guidance in reading,
driving, and scene perception. In G. Underwood (Ed.), (chap. Functional division of the visual field: moving masks and moving windows.). Oxford:

Elsevier.
Holmqvist, K., Holsanova, J., Barthelson, M., & Lundqvist, D. (2003). Reading
or scanning? a study of newspaper and net paper reading. In The mind's eye: Cognitive and applied aspects of eye movement research (p. 657-670). Elsevier Science Ltd.
Holmqvist, K., & Wartenberg, C. (2005). The role of local design factors for newspaper reading behaviour – an eye-tracking perspective (Tech. Rep. No. 127). Lund University Cognitive Studies.
Holsanova, J., Holmberg, N., & Holmqvist, K. (2008). Reading information
graphics: The role of spatial contiguity and dual attentional guidance. Appl. Cognit. Psychol..
Holsanova, J., Rahm, H., & Holmqvist, K. (2006). Entry points and reading
paths on newspaper spreads: comparing a semiotic analysis with eyetracking
measurements. Visual Communication, 5 (1), 65-93. Available from http://vcj.sagepub.com/cgi/content/abstract/5/1/65
Huey, E. B. (1898). Preliminary experiments in the physiology and psychology
of reading. American Journal of Psychology, 9 , 575-586.
Hyrskykari, A. (2006). Utilizing eye movements: Overcoming inaccuracy while tracking the focus of attention during reading. Computers
in Human Behavior, 22 (4), 657 - 671. Available from http://www.sciencedirect.com/science/article/B6VDC-4J72YW1-2/2/8ba5466cc55abcaaf639bc20d15314c3
(Attention aware systems - Special issue: Attention aware systems)
Inhoff, A. W., & Radach, R. (1998). Eye guidance in reading, driving and scene
perception. In G. Underwood (Ed.), (p. 29-53). New York: Elsevier.
Johansson, R., Holmqvist, K., Mossberg, F., & Lindgren, M. (2009). Music you
prefer to study to impairs reading comprehension.
Johansson, R., Johansson, V., Wengelin, Å., & Holmqvist, K. (2008). Reading
during writing: Four groups of writers. (Working Papers No. 53). Department of Linguistics, Lund University.

Johansson, R., Johansson, V., Wengelin, Å., & Holmqvist, K. (in press). Looking
at the keyboard or the monitor: Relationship with text production processes. Reading and Writing.
Kollmorgen, S., & Holmqvist, K. (2009). Automatically detecting reading in eye
tracking data (LUCS No. 144). Department of Cognitive Science.
Krischer, C., & Zangemeister, W. (2007). Scanpaths in reading and picture
viewing: Computer-assisted optimization of display conditions. Computers in Biology and Medicine, 37 (7), 947 - 956. Available from http://www.sciencedirect.com/science/article/B6T5N-4NB2SN9-2/2/73537cff18bfb34e14d8e45538be90a2
(Vision and Movement in Man and Machines)
Liversedge, S., Paterson, K., & M.J., P. (1998). Eye guidance in reading, driving,
and scene perception. In G. Underwood (Ed.), (chap. Eye movements and measures of reading time.). Oxford: Elsevier.
Liversedge, S., White, S., Findlay, J., & Rayner, K. (2006). Binocular coordination
of eye movements during reading. Vision research, 46 (15), 2363–2374.
McConkie, G. W., Kerr, P. W., Reddix, M. D., & Zola, D. (1988). Eye movement
control during reading: I the location of initial eye fixations on words. Vision Research, 28 , 1107-1118.
**McConkie, G. W., Kerr, P. W., Reddix, M. D., Zola, D., & Jacobs, A. M.
(1989)**. Eye movement control during reading: Ii frequency of refixating a word. Perception and Psychophysics, 46 , 245-253.
Rayner, K. (1998). Eye movements in reading and information processing: 20
years of research. Psychological Bulletin, 124 (3), 372–422.
Rayner, K., Li, X., Williams, C., Cave, K., & Well, A. (2007). Eye movements
during information processing tasks: Individual differences and cultural effects. Vision Research, 47 (21), 2714–2726.

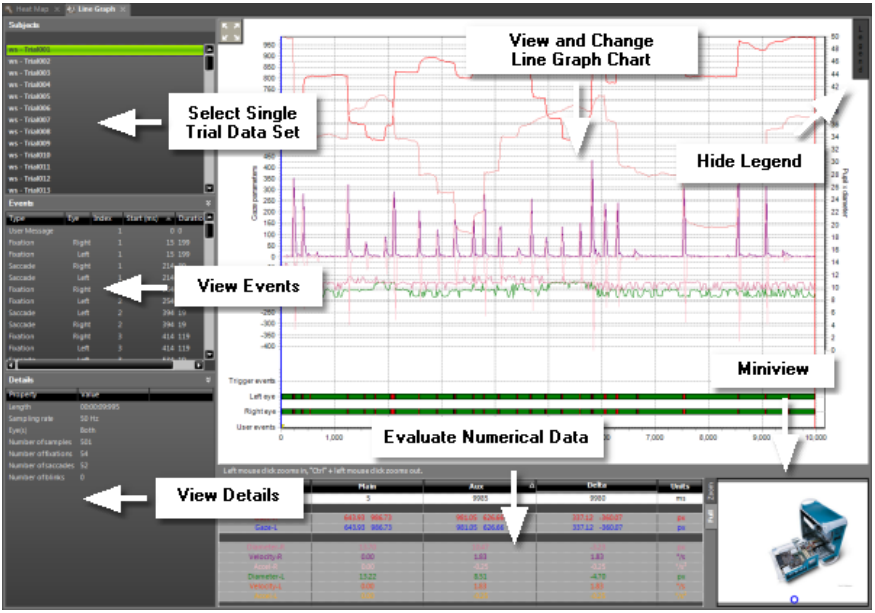
Rayner, K., & Pollatsek, A. (1989a). The psychology of reading. Englewood
Cliffs, NJ: Prentice Hall.
Rayner, K., & Pollatsek, A. (1989b). The psychology of reading.
Renshaw, J. A., Finlay, J. E., Tyfa, D., & Ward, R. D. (2004). Regressions
re-visited: a new definition for the visual display paradigm. In Chi '04: Chi '04 extended abstracts on human factors in computing systems (pp. 1437–1440). New York, NY, USA: ACM.
Sullivan, B., Jovancevic, J., Hayhoe, M., & Sterns, G. (2005). Use of gaze in natural tasks in stargardt's disease: A preferred retinal region. International Congress Series, 1282 , 608 - 612. Available from http://www.sciencedirect.com/science/article/B7581-4H8DPNP-4W/2/e4819ada0573583ad3ed7a0277723bbf
(Vision 2005 - Proceedings of the International Congress held between 4 and 7 April 2005 in London, UK)
Takeda, Y., Sugai, M., & Yagi, A. (2001). Eye fixation related potentials in a proof reading task. International Journal of Psychophysiology, 40 (3), 181 - 186. Available from http://www.sciencedirect.com/science/article/B6T3M-42DP0HD-2/2/586b0c37ba4efcd04248bea842b36f2c
Underwood, G. (1998). Eye guidance in reading, driving, and scene perception.
Elsevier.

6.20 Line Graph

6.20.1 Overview

The **Line Graph** data view displays un-interpreted eye tracking data and gaze events for scientific or informal purposes. Data and events are plotted as lines on a timeline diagram.


For the Line Graph view availability please check the BeGaze Product Variants 12 chapter.



Operate the **Line Graph** data view with the following steps:

1. In the Participants Selection 109, select a single trial.

   The Line Graph Main Window 310 and Line Graph Data Table 312 the are updated for the selected trial.

   While selecting trials, the Events Selection 115 view and the Trial Details 113 view shows information about the currently selected trial or event.

2. In the Line Graph Miniview 313, change to the desired view tab.

   The **Miniview** displays the selected stimulus correlated with the gaze position of the current Diagram Cursors 312.

For target elements 130 added to Composite stimuli in Experiment Center there are position, velocity and acceleration lines plotted here.

6.20.2 Events List

The general functionality of this view is described in Events List 115. The blue data cursor and the red auxiliary cursor will frame the marked event in the Line Graph Main view 310. The gaze cursor in the Line Graph Miniview 313 will jump to the position at the start time of the event.

A highlighted event in the **Events** list. The marked event is framed by two cursors in the Graph Area:

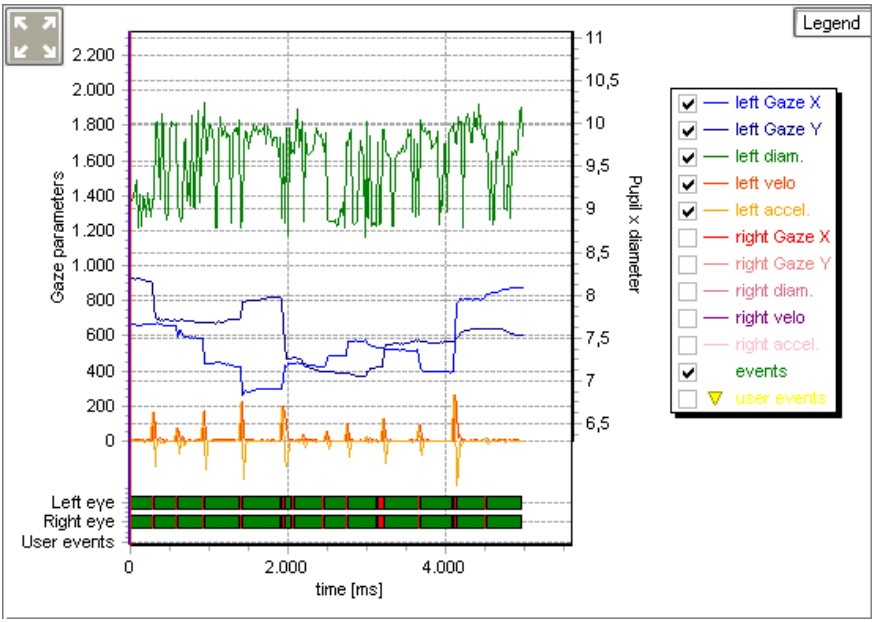
The gaze cursor (blue dot in the full view, a cross in the zoomed view) is at the start time of the event in the Miniview:

Line Graph Overview 306

6.20.3 Graph Area

In the **Line Graph** main view, the following gaze data will be visualized over the timeline:

- **Gaze parameters**: The Y-axis at the left displays the gaze position in the stimulus (x- and y-direction) as well as angular velocity and acceleration of the eye.
- **Pupil diameter**: The Y-axis at the right displays the pupil diameter.
- **Time [ms]**: The X-axis at the bottom displays fixations, saccades, blink, and user events.

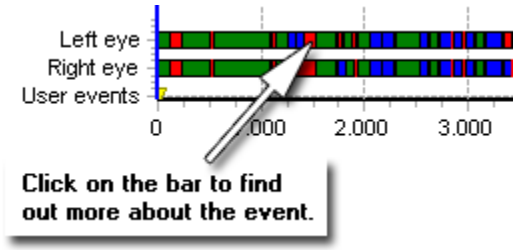


You can customize the line graph display with the following steps:

1. Right click the line graph display to open a context menu. Select the **Settings** command and change line colors and display in the Line Graph Settings Dialog 314.

2. Click the **Reset Scaling** icon in the top left corner to revert display scaling and positioning.
3. Click the **Legend** button in the top right corner to hide or unhide the legend.

   If the legend is displayed, activate or deactivate the options next to the labels. This selects the desired combination of lines to draw.
4. To shift the line graph display scales, drag the left or right Y-axis or drag the bottom X-axis using the finger mouse cursor. To shift the line graph position, hold down the [SPACE] key and drag the display using the hand mouse cursor.
5. To zoom in, simply click into the display. To zoom an arbitrary display portion, click and drag to span a dotted zoom box. If you release the mouse button, the display is zoomed accordingly.
6. To zoom out, hold down the [CTRL] key and click into the display.
7. Click the colored event bar displayed at the bottom of the line graph display. This selects a single event and moves the Line Graph Diagram Cursors 312 as well. The respective event is highlighted in the Events Selection, 115 view, which in turn also updates the Trial Details 113 view and the Line Graph Miniview 313. Note, that you can manually drag the diagram cursors using the drag mouse cursor.



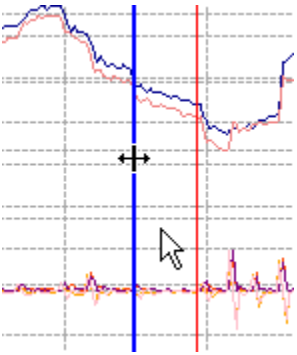
The default event colors are as follows: Blinks - Blue, Fixations - Green, Saccades - Red, User Events - Yellow.

8. In the **Export** menu, either select the **Save Image...** ([CTRL] + [S]) or select the **Copy image to clipboard**

([CTRL] + [C]) keyboard command to export the current line graph display to a single image.

6.20.4 Diagram Cursors

If you create a new Line Graph, you will find a blue vertical line in the middle of the Graph Area, the main data cursor. The data cursor is movable, you can drag it to every time in the Graph Area. Simply hover with the mouse over the data cursor until a double slider becomes visible, then click the left mouse button and drag the data cursor to the desired position. Alternatively, you can use the arrow left / arrow right keys on the keyboard.



The data cursor can be used to find out the exact values for the gaze data at a particular time. The gaze data values are displayed in the Data Table 312 and are immediately updated for the current data cursor position. Furthermore, the gaze point at this time on the stimulus image is displayed in the Miniview 313 below the Graph Area.

Apart from the data cursor a red auxiliary cursor is visible.

6.20.5 Data Table

In the data table, the data values are displayed numerically for the current Line Graph Diagram Cursor 312 positions. You will find information about:

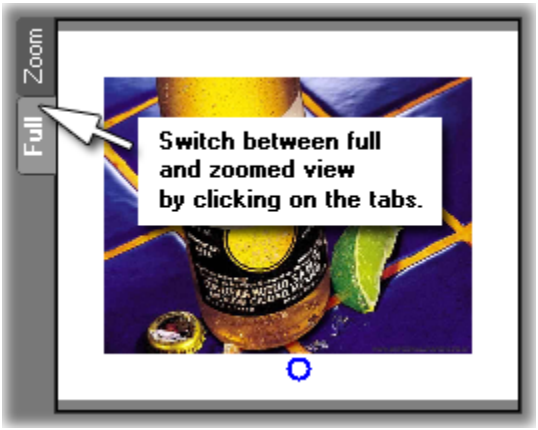
- the exact time for the time cursor positions.
- the pupil diameter at this time
- the gaze point in x- and y-direction in [pixels]. (0,0) is the upper left corner of the stimulus image.
- the angular speed of the eye
- the angular acceleration of the eye

If you work with binocular data, the values for both eyes will be displayed.

6.20.6 Miniview

In the **Miniview**, the gaze position at the current data cursor 312 is displayed in the stimulus. The Miniview offers two display tabs:

- **Full** tab: shows the complete and resized stimulus.
- **Zoom** tab: shows a magnified area around the gaze position.



6.20.7 Settings

In the **Linegraph Settings** dialog, you select line colors, event colors and customize the line graph chart settings.

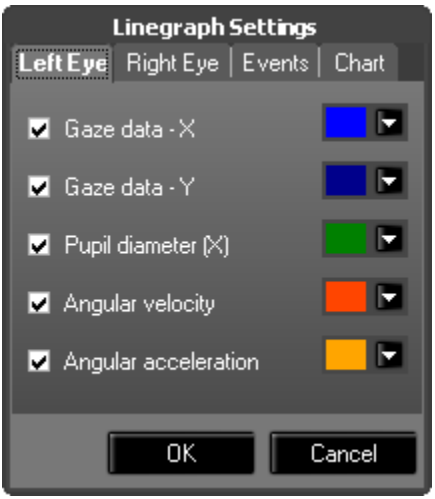
1. Right click into the Line Graph Main Window 310 to open a context menu. Select the **Settings** command.

   The **Linegraph Settings** dialog opens.

2. Switch to one of the available dialog tabs and change settings.
3. Confirm your settings with **OK**.

The following dialog tabs are available.

Left Eye

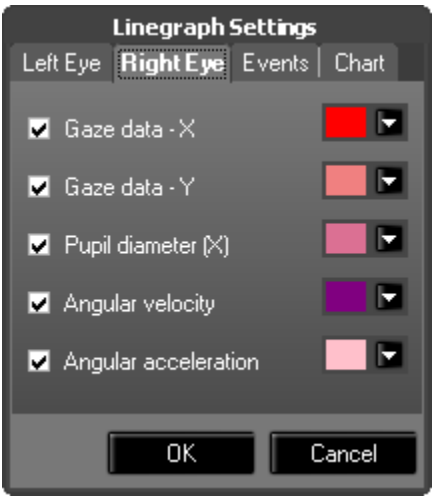


In this tab you can configure, for left data channel the color and the visibility of:

- gaze data on X
- gaze data on Y

- pupil diameter
- angular velocity
- angular acceleration

Right Eye



In this tab you can configure, for right data channel the color and the visibility of:

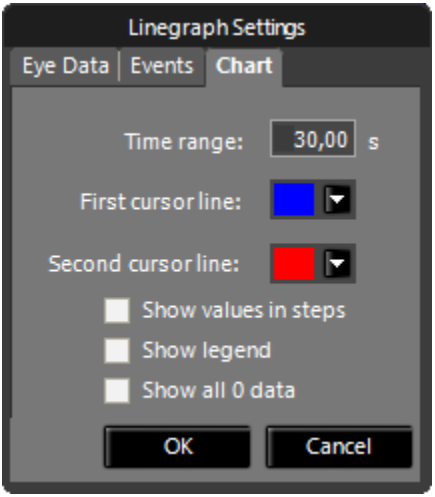
- gaze data on X
- gaze data on Y
- pupil diameter
- angular velocity
- angular acceleration

Events

In this tab you can configure the color for the following types of events:

- fixation
- saccade
- blink
- user event

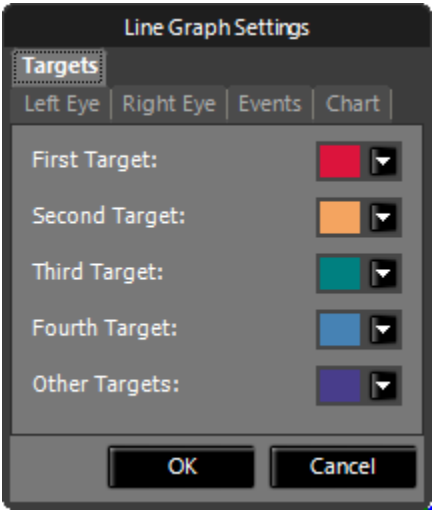
Chart



In this tab you can configure:

- the time range in [s]
- the color of the first cursor line
- the color of the second cursor line
- whether to show values in steps
- whether to show the legend
- whether to show all 0 data. When unchecked, 0 data is shown only during blink events

Targets



In this tab you can configure the color of targets, if present in the experiment, in the order that they were defined during the recording:

- first target
- second target
- third target
- fourth target
- other targets

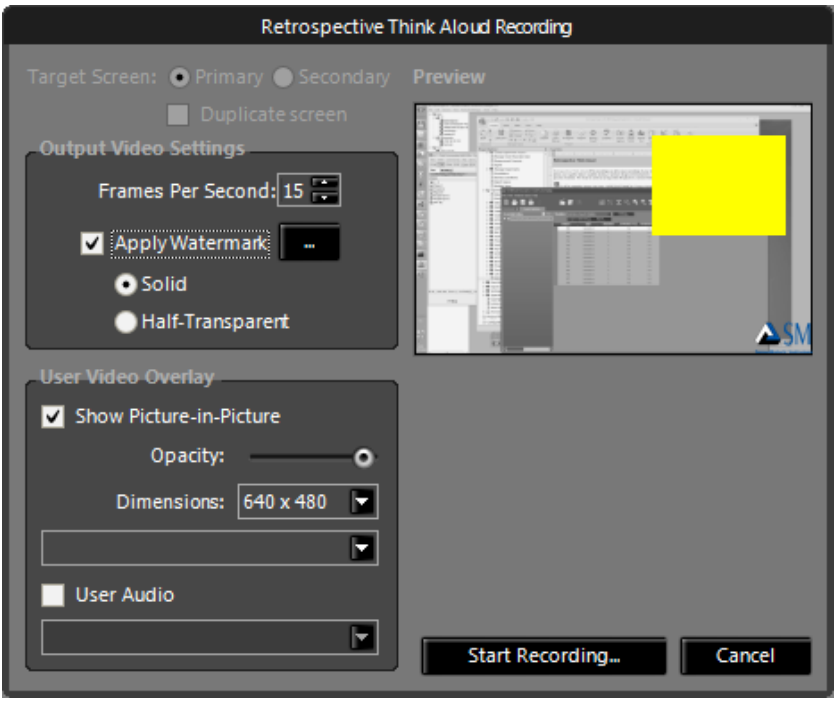
6.21 Retrospective Think Aloud

Retrospective Think Aloud (RTA) recordings are full screen recordings of your desktop contents together with audio notes done while using BeGaze. This allows you to gather data in usability testing, in product design and development, in psychology and a range of social sciences (e.g., reading,

writing and translation process research). The result is saved as an AVI video file placed in a chosen folder.

For RTA availability please check the BeGaze Product Variants 12 chapter.

In order to start an RTA recording you must first have an experiment opened. At this moment the button in the toolbar 455 becomes enabled and can be clicked. On clicking the button the following dialog shows up:



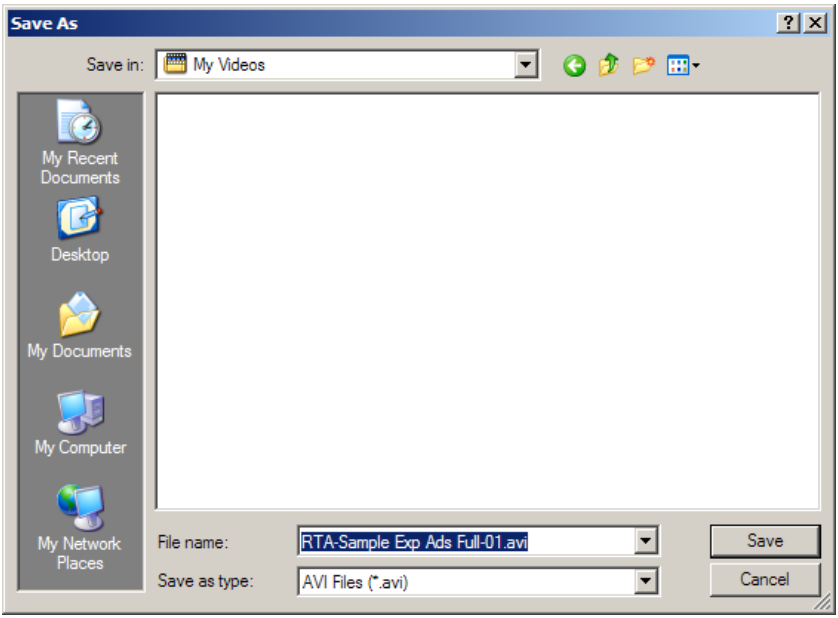
Dialog Settings

- **Target Screen**: If a secondary screen is available choose between recording the content on the primary or secondary screen.
- **Duplicate Screen**: Duplicates the target screen selected above to the other screen.
- **Frames Per Second**: Sets the resulting AVI video frame rate.
- **Apply Watermark**: Overlay a watermark image over the exported video. The overlay can be Solid or Half Transparent. You can also select a custom image by pressing the button "...". The watermark position in the video can be changed by dragging it around in the **Preview** panel on the right of the dialog.
- For experiments that contain user videos (user data recorded with a webcam) several other options are available. If no used data exists the **User Video** options are grayed out.
- **Show Picture-in-Picture**: If checked user video from an attached webcam is overlayed as a smaller image (picture-in-picture style) inside the animated data visualization.
  - **Opacity**: Selects the opacity level of the user video. Moving the slider to the left fades out the user video more.
  - **Dimensions**: Size of the user video to embed in the main video.
  - **Source**: The drop down box below shows all available video recording sources (you may see several devices here besides your webcam).
- **User Audio**: If checked the sound from the user video is used as the sound for the exported AVI (if the stimulus is a video with sound then this setting replaces the stimulus sound with the user sound)
  - **Source**: The drop down box below shows all available sound recording sources (you may see several devices here besides your webcam's microphone or your sound card's input).

- **Preview**: The yellow rectangle can be dragged on the gray surface to set the position of the user video relative to the main video in the exported AVI.

Start the recording

When finished with the settings pressing the "Start Recording..." button opens a file selection dialog that allows to select the location and name of the recorded RTA video.



After selecting this and clicking "Save" the RTA starts. You can tell that an RTA recording is running by the glowing  button in the toolbar. Everything you do on your desktop from now on is recorded togheter with any user video and audio you configured before.

Stop the recording

To stop the recording just press the glowing button again. When stopping an ongoing RTA recording the following dialog appears, allowing you to just continue working or to preview the recording that just ended.

When clicking the "Play Video" button the recorded RTA video will be played in the associated media player on your system.

Event Detection

Chapter

7 Event Detection

7.1 Built-In Event Detector

BeGaze has a built-in saccade, fixation and blink detector. A saccade is defined as a rapid change in gaze location, and a fixation is regarded as being bordered by two saccades. A blink can be considered a special case of a fixation, where eye data is not present.

In general, there are two approaches for the built-in detector: Either it can first look for fixations and the other events are derived from them, or it can first look for saccades, followed by the computation of the other events.

Which event the detector searches first, we call *primary event*. If the primary event is *fixation*, the detector uses a *dispersion* based algorithm. If the primary event is saccade, a *velocity* based algorithm is used.

For low speed eye tracking data (< 200 Hz), choosing fixations as primary event achieves the best results, whereas primary looking for saccades is sensible for high speed eye tracking data.

Depending on the sample rate the built-in detector selects the detection method:

sample rate	**detection method**	**primary event**	**algorithm based on**
all data rates	low speed event detection 329	fixation	dispersion
200 Hz and above	high speed event detection 331	saccade	velocity
ETG data	SMI event detection 334	saccade	velocity
HED 60Hz and below	SMI event detection 334	saccade	velocity

Please note, that the low and high speed event detection algorithms are currently not suited to detect fixations on moving targets in videos where the eyes are following with a smooth pursuit. This issue is currently addressed in ongoing research work.

Please note that some restrictions apply for event detection on HED recorded data. The current event detection implementation works reliable on objects that are in a distance of about 70cm (held in arm length distance) from the scene camera, e.g. packages, hand held devices and newspapers. For statistical analysis, we recommend to use the "net dwell time" for other distances.

The event detection algorithms work independently on each trial, so events from one trial cannot continue in the next trial. Events are detected on all the data in a trial until the last sample where they end and are accepted if they pass the requirements for that event type.

7.2 Adjust Event Detection

In the **Adjust Event Detection** dialog, you can change the event detection parameters as well as the stimulus geometry for one or more trials.

For Adjust Event Detection availability please check the BeGaze Product Variants 12 chapter.

1. In the File menu 451 select the **Adjust Event Detection** command.

   The **Adjust Event Detection** dialog opens.

2. In the **Fixation detection parameters** section of the dialog, you can change settings for low speed event detection or for high speed event detection. Which type of settings are available, depends on the gaze tracking device used.

3. In the **Geometry** section of the dialog, you can adapt resolution and dimension of the presented stimuli.
4. Confirm you settings with **OK**.

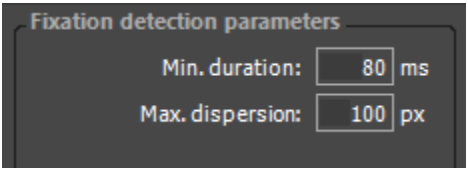
When creating an experiment, you can adjust these parameters in the Event Detection 70 tab of the **Create Experiment** wizard.

Exclude first fixation

The first fixation can be deleted from all datasets in the experiment if required.

Low Speed Event Detection Settings

For Low Speed Event Detection 329 the following parameters are displayed and can be changed:

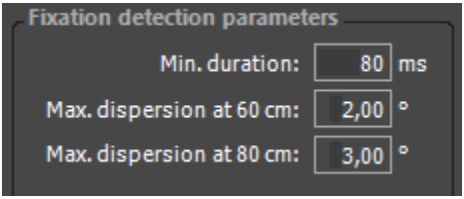


Min. duration: minimum fixation duration in [ms]

Max. dispersion: maximum dispersion value. The unit depends on the experiment type 464:

	Unit
standard data	pixels
data with head tracking	degrees

For REDn and RED250mobile the maximum dispersion is set differently (see Low Speed Event Detection 329 chapter):



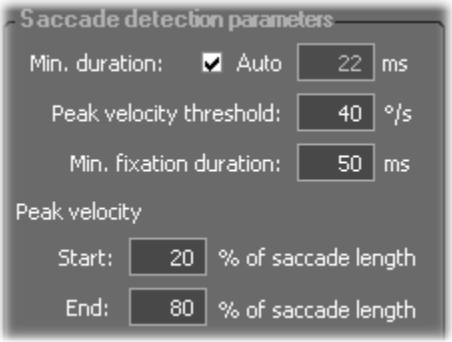
Min. duration: minimum fixation duration in [ms]

Max. dispersion at 60 cm: maximum dispersion value at 60 cm in [degrees].

Max. dispersion at 80 cm: maximum dispersion value at 80 cm in [degrees]

High Speed Event Detection Settings

For High Speed Event Detection 331 the following parameters are displayed and can be changed:



Min. duration: minimum saccade duration in [ms]. If the Auto option is checked, the minimum duration varies and is automatically set dependent on the peak threshold.

Peak velocity threshold: peak velocity threshold in [°/s]

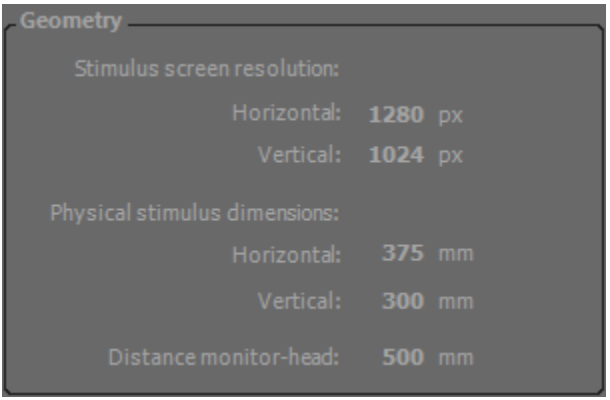
Min. fixation duration: minimum fixation duration in [ms]. All fixations below the threshold are rejected.

Peak velocity window: The single peak value has to lie in this window. Start and end is given in % of the saccade length.

For more information see Built-In Event Detector 324.

If you click on **Adjust**, the saccades, fixations and blinks will be recalculated for all the trials in the experiment, using the displayed detection parameters. The changes are persistent for each trial.

Geometry



This panel shows the screen resolution and physical stimulus dimension settings from the gaze tracking data file.

Stimulus screen resolution: Horizontal and vertical resolution (in pixels) of the monitor which originally displayed all the visual stimuli.

Physical stimulus dimensions: Horizontal and vertical stimulus dimensions in millimeters. Note, that a typical CRT or LCD computer screen has a display resolution between 72 dpi and 120 dpi with the same horizontal and vertical dpi resolution. Example: a 96 dpi LCD monitor displaying 1280 horizontal pixels should have a width of 338 mm (1280 px / 96 dpi * 25,4 mm per inch). Note also that other displays such as a video beamer emitting camcorder material typically use a different dpi resolution for horizontal and vertical display.

Distance monitor-head: The approximate distance between the displaying monitor and the participant's head. Note that during calibration the individual relation between the gaze tracking system and the participant is established.

7.3 Low Speed Event Detection

In the Low Speed Event Detection method, Fixation is selected as primary event. The Built-In Detector 324 will first search for fixation events, using a dispersion based algorithm, after which saccade events are computed and derived from the primary fixation events.

Blink Detection

A blink can be regarded as a special case of a fixation, where the pupil diameter is is either zero or outside a dynamically computed valid pupil range (based on the whole trial data) or the horizontal and vertical gaze positions are zero . If either of these conditions are met we create a blink event. However, the duration of the blink event is expanded in order to include the transition period between valid gaze data and the blink.

Blink events with the duration shorter than 70 ms are discarded. It is not possible to differentiate between a true blink and a "eye tracking lost" state so both cases are detected as blinks. The blink duration doesn't have an upper limit because of this.

Fixation Detection

The Minimum Fixation Duration defines the minimum time window in which the gaze data is analyzed. Fixations smaller than the time window will not be caught.

The algorithm identifies fixations as groups of consecutive points within a particular dispersion, or maximum separation. It uses a moving window that spans consecutive data points checking for potential fixations. The moving window begins at the start of the protocol and initially spans a minimum

number of points, determined by the given Minimum Fixation Duration and sampling frequency.

The algorithm then checks the dispersion of the points in the window by summing the differences between the points' maximum and minimum x and y values and comparing that to the Maximum Dispersion Value; so if [max(x) - min(x)] + [max(y) - min(y)] > Maximum Dispersion Value, the window does not represent a fixation, and the window moves one point to the right. If the dispersion is below the Maximum Dispersion Value, the window represents a fixation. In this case, the window is expanded to the right until the window's dispersion is above threshold. The final window is registered as a fixation at the centroid of the window points with the given onset time and duration.

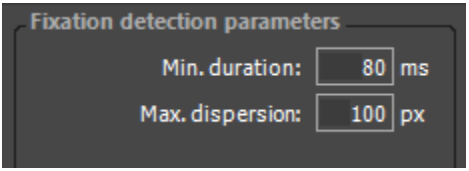
For SMI's iViewRED (RED250mobile, REDn) eye tracking systems, which have an extended tracking range, the Maximum Dispersion Value is distance-dependent, and calculated in angular dimensions. The user defines the Maximum Dispersion Values for 60 and 80 cm. The Maximum Dispersion values at other distances are then calculated by linear interpolation between those two points.

Saccade Detection

At the end a saccade event is created between the newly and the previously created blink or fixation.

Parameters

The parameters can be changed in the Adjust Event Detection 325 dialog.

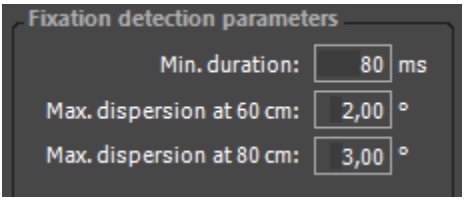


Min. duration: minimum fixation duration in [ms]

Max. dispersion: maximum dispersion value. The unit depends on the experiment type 464:

	Unit
standard data	pixels
data with head tracking	degrees

For REDn and RED250mobile the maximum dispersion is set differently:



Min. duration: minimum fixation duration in [ms]

Max. dispersion at 60 cm: maximum dispersion value at 60 cm in [degrees].

Max. dispersion at 80 cm: maximum dispersion value at 80 cm in [degrees]

Further Reading:

Dario D. Salvucci & Joseph H. Goldberg:

Identifying Fixations and Saccades in Eye-Tracking Protocols

In: Proceedings of the Eye Tracking Research and Applications Symposium (pp. 71-78). New York, 2000

7.4 High Speed Event Detection

In the High Speed Event Detection method, Saccade is selected as primary event. The Built-In Detector 324 will first search for saccade events, using a velocity based algorithm. Blinks and fixations are computed and derived from the primary saccade events.

Saccade Detection

From the gaze stream all velocities are calculated. From all velocities the peaks are detected. A peak is defined as the peak value of velocities above the Peak Threshold [°/s]. The peak could indicate a saccade, but as we are not sure, yet, we call it saccade-like event. To detect the start of the saccade-like event, we search for the first velocity to the left which is lower than the fixation velocity threshold. To detect the end of the saccade-like event, we search for the first velocity to the right which is lower than the fixation velocity threshold. The fixation velocity threshold is an internal value calculated from the first peak-less velocities of the velocity stream (that is the velocity values before the first velocity peak). We assume the saccade-like event a real saccade, if

a) the distance between start and end exceeds the Minimum Saccade Duration [ms] and

b) the single peak value lies in the range of 20% to 80% of the distance between start and end

Blink Detection

However, the saccade we have found could still be an artifact as a result of a start or end of a blink. If so, we discard the saccade event and assign the artificial saccade to a blink. To determine if this is the case we evaluate the pupil diameter during the saccade period. If the pupil diameter changes faster than an internal threshold value or the pupil diameter is zero the saccade is assumed artificial and part of the blink.

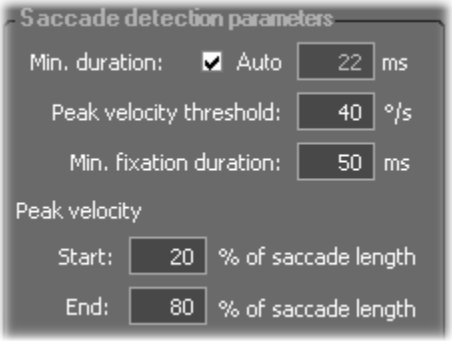
It is not possible to differentiate between a true blink and a "eye tracking lost" state so both cases are detected as blinks. The blink duration doesn't have an upper limit because of this.

Fixation Detection

Finally, we create a fixation event between the newly and the previously created blink or saccade.

Parameters

The parameters can be changed in the Adjust Event Detection 325 dialog.



Min. duration: minimum saccade duration in [ms]. If the Auto option is clicked, the minimum duration varies and is automatically set dependent on the peak threshold.

Peak threshold: peak velocity threshold in [°/s]

Min. fixation duration: minimum fixation duration in [ms]. All fixations below the threshold are rejected. The default value is 50 ms.

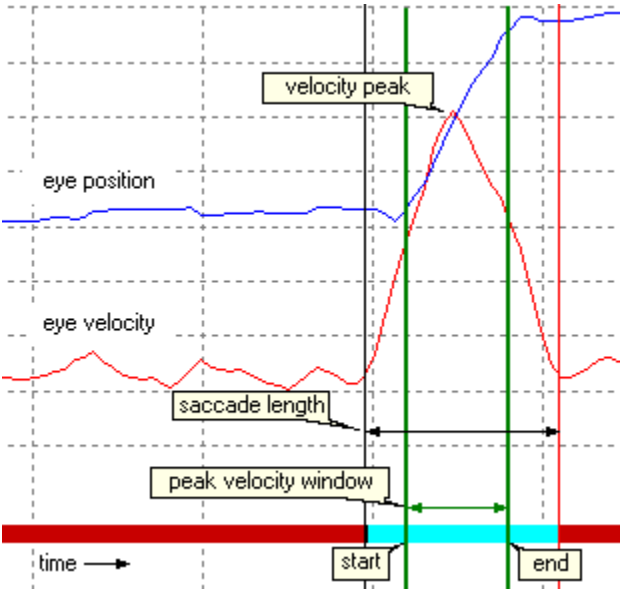
Peak Velocity Window

The velocity curve must resemble a certain pattern to be regarded as the velocity of a saccade. In a typical saccade the velocity of the eye movement increases, reaches a peak and decreases. At first, the detector assumes this kind of movement to be a saccade. The time between start and end of movement is called saccade length. Then the detector searches, if the velocity peak lies within a certain time window inside of the saccade. If the peak lies outside, the assumed saccade is discarded. The start and end of the time window is given in % of the saccade length.

Default values:

Start: 20% of saccade length

End: 80% of saccade length



7.5 SMI Event Detection

The SMI Event Detection algorithm classifies gaze samples into four categories: “Visual Intake”, “Saccade”, “Blink” and “Undefined”. Resulting from this classification is a list of eye events, which contains “Visual Intakes”, “Saccades” and “Blinks”. Gaze samples classified as “Undefined” do not belong to any events.

In the presence of head motion, traditional methods, such as the IDT algorithm, would detect two separate fixations, even though the gaze has been focused on one object.

The IDT algorithm incorrectly splits a fixation into two separate events due to head movement.

In contrast, the SMI ETG Event Detection algorithm correctly recognizes a single, longer, Visual Intake event.

The SMI ETG Event Detection algorithm correctly identifies a single, longer, Visual Intake event.

The event detection pipeline for 60Hz and 120Hz data consists of six steps:

Step	Description

1. Preprocessing	1.1 Convert the POR (Point of Regard) pixel values to degrees.
	1.2 Compute velocity and acceleration of the POR (in degrees).
	1.3 Compute velocity skewness (here defined as the ratio of velocity mean to velocity median over a 5-sample window).
2. Noise Detection	Identify single-sample spikes in the POR and remove them by interpolation.
3. Blink Detection	Identify Blinks based on pupil confidence (minimum duration of a Blink event is 3 samples).
4. Saccade Detection	4.1 Detect midpoints of Saccade candidates by searching for samples, which have either: - POR velocity values above the threshold α_{def}, or - POR velocity values above α_{min} and skewness above β.
	4.2 Find beginnings and ends of Saccade candidates by searching for local maxima in absolute POR acceleration values.
	4.3 Accept Saccade candidates as Saccades if the detections for left and right eye are consistent.
5. Visual Intake Detection	Mark all the remaining samples as Visual Intake.
6. Post-processing	6.1 Remove Saccade events smaller than y in amplitude, or only one sample in duration, by interpolating with neighbors.
	6.2 Mark Visual Intake events shorter than 50ms as “Undefined”.

	6.3 If Undefined event occurs immediately after Saccade, merge Undefined with Saccade.
	6.4 If Undefined event occurs immediately after Blink, merge Undefined with Blink.

The SMI ETG Event Detection algorithm pipeline

Threshold Name	Value	Units
α_{def}	100	°/s
α_{min}	8	°/s
β	5	
γ	0.5	°

Threshold values

Export and Conversions

Chapter

8 Export and Conversions

8.1 Overview

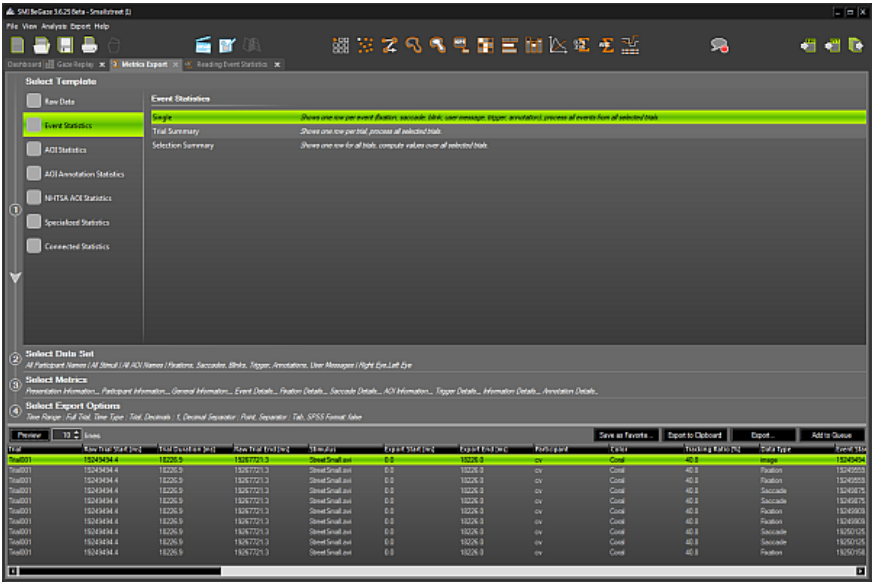
BeGaze allows events export 434 and raw data export 425. Furthermore, you can record the replay of the scan path, attention map or key performance indicators to an AVI file (see Video Export 443).

8.2 Metrics Export

8.2.1 Overview

The **Metrics Export** data view presents statistics and metrics regarding gaze data. The data view's main view consists of different parts identified in the image below.

For specific Metrics Export availability please check the BeGaze Product Variants 12 chapter.



You operate the **Metrics Export** data view with the following steps. While doing so, the Preview Grid 413 can be updated by clicking the Preview button to display the outcome of your selections and options. There are four main steps to go through to select the desired metrics and data sets: Select Template, Select Data Set, Select Metrics and Select Export Options.

1. For optimized handling of the large count of statistical data items, BeGaze groups predefined sets of statistics templates into templates categories. Each statistic template covers a specific purpose. Choose the desired statistics from the **Select Template** expandable panel. The list offers both predefined templates, under their corresponding template category, and also user defined templates in the Favorites category (if any was previously saved). You may duplicate and change a predefined statistics template using the **Save as Favorite...** button. See template Definitions 341 for an in-depth explanation.

2. Click the **Select Data Set** step to expand this panel and select the participants, stimuli, trials, areas of interest, eye channels and other

relevant sets for statistic analysis. See Data Set 408 for an in depth explanation.

3. Click the **Select Metrics** button to add or remove Metrics 409 columns from the results.
4. Going to the **Select Export Options** step you may specify the desired Time Range 410, numeric values decimals layout, SPSS formatted export and others.
5. You can preview the exported data in the Preview Grid 413. If the preview suits your requirements, click the **Export...** button above the preview grid to write the current selection output to a file. Click on **Export to Clipboard** button to copy the currently shown results into the clipboard for further use in other programs, e.g. MS-Excel. See Preview Grid 413 for other details.

All the collapsed steps (Template 341, Data Set 408, Metrics 409, Export Options 410) show a summary of the currently selected options for that step, below the step name.

Depending on the complexity of the experiment and on the computer performance, the calculation of statistics might take some time.

8.2.2 Select Template

The following tables list details about the default statistics templates and metrics that are provided by BeGaze.

Default Statistic Templates

Template Group	Template Name	Description
Raw Data	Raw Data 346	Raw data from selected trials. One sample per line.

Template Group	Template Name	Description
Event Statistics	Single 352	Metrics for all events from selected trials. One event per line.
	Trial Summary 357	Metrics for all events from selected trials, summarized for every trial and participant. One trial and participant per line.
	Selection Summary 360	Metrics for all events from selected trials, summarized across selected trials and participants. One line.
AOI Statistics	Single 364	AOI-related metrics for every fixation* in selected AOIs. One fixation per line.
	Trial Summary (AOI) 367	AOI-related metrics for selected AOIs, summarized for every trial, participant and AOI. One trial, participant and AOI per line.
	Selection Summary (AOI) 372	AOI-related metrics for selected AOIs, summarized for every AOI across trials and participants. One AOI per line.
	Trial Summary (AOI Group) 367	AOI-related metrics for selected AOI Groups, summarized for every trial, participant and AOI Group. One trial, participant and AOI Group per line.
	Selection Summary (AOI Group) 372	AOI-related metrics for selected AOI Groups, summarized for every AOI Group across trials and participants. One AOI Group per line.
AOI Annotation Statistics	Single 384	Data for annotations linked to selected AOIs. One AOI annotation instance per line.

Template Group	Template Name	Description
	Selection Summary 384	Data for annotations linked to selected AOIs summarized across trials and participants. One AOI annotation combination per line.
NHTSA AOI Statistics (needs Off-road Glance Duration Analysis license)	Single 385	NHTSA AOI-related metrics for every fixation* in selected AOIs. One fixation per line.
	Trial Summary 386	NHTSA AOI-related metrics for selected AOIs, summarized for every trial, participant and AOI. One trial, participant and AOI per line.
	Selection Summary 387	NHTSA AOI-related metrics for selected AOIs, summarized across trials and participants. One AOI per line.
Target Statistics	Single (Static) 389	Metrics for all static targets from select trials. One target per line.
	Single (Animated) 393	Metrics for all animated targets from select trials. One target per line.
Specialized Statistics	Transition Matrix 397	Matrix of number of transitions of fixations* from one AOI to another.
	Questionnaire Overview 398	Overview information for every question of every selected participant. One question per line.
	Trial Overview 399	Overview information for every selected trial. One trial per line.
	Custom Trial Overview 400	Overview information for every selected Custom Trial. One Custom Trial per line.

Template Group	Template Name	Description
	Participant Overview 400	Overview information for every selected participant. One participant per line.
	Validation Results Overview 401	Overview information for every validation performed. One validation result per line.
	AOI Overview 402	Overview information for every selected AOI. One AOI per line.
Connected Statistics	Noldus Observer 403	Export format compatible with Noldus Observer XT. One participant per file.
	BrainVision Analyzer 403	Export format compatible with BrainVision Analyzer 2. One participant per file.
	BIOPAC AcqKnowledge 405	Export format compatible with BIOPAC AcqKnowledge. One participant per file.

NHTSA statistics are available only with the Off-road Glance Duration Analysis license.

For certain eye tracking devices used for recording the term "visual intake" will be used instead of "fixation" for all statistics entries.

Notes and Definitions

All processing is constrained to the selected time interval. All fields without a comment represent information extracted directly from the event properties, with average/max/min as the only statistic measurement done when indicated.

The following table comments terms used in the subsequent table texts.

Name	Definition
Dwell Time	Dwell Time is the sum of all Dwell Times for each visit of an AOI. Dwell Time for one visit is the sum of durations of all saccades and fixations inside the AOI.
Glance Duration	Saccade duration for entering the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = dwell time + duration of saccade entering AOI.
Diversion Duration	Sum of saccade durations for entering and leaving the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = glance duration + duration of saccade leaving AOI.
Entry Time	Time until AOI is found in the scene by the participant = start time of first fixation to enter the AOI.
Glances	Number of glances to a target (saccades coming from outside) within a certain period (increment the counter each time a fixation hits the AOI, if not hit before).
Saccade Latency	Duration between consecutive saccades = average of the time difference between the end of a saccade and the start of the consecutive one.
Glance Outside AOI	The amount of time between the moment the gaze leaves an AOI and the moment the gaze reenters the AOI, measured between the end of the last fixation before leaving the AOI and the start of the first fixation after returning to the AOI.

The following color codes denote the parameter origin:

- general information
- data properties
- computed values

The parameters marked with an asterisk (*) are available only for recordings with sampling rate higher than 30 Hz. The only exceptions to this are for reference views where the following are computed even at 30Hz: Glances Count and Revisits for AOI Summary and AOI Detailed Statistics.

The origin (0, 0) of the stimulus coordinate system is in the upper left corner of the stimulus.

When stimulus conditions are defined they will be added as columns (one column for each condition) in all trial-based statistics and the values will be the ones set for the stimulus associated to the respective trial.

For overlapping AOIs, the topmost hit one is used in Raw Data statistics and Event Statistics - Single. In the other statistics that involve AOIs the metrics values are the same, only the row order changes based on the AOI order. See the explanation about AOI Priority 172. See AOI Hits 129 for information on when an AOI is considered hit.

Raw Data

This template shows one row per eye data timestamp (eye samples or messages), process all samples from all selected trials.

Parameter	Dimension unit	Description
Recording Time	[ms]	Timestamp of the eye sample (milliseconds since the start of the iViewNG application for ETG data or milliseconds since start of iViewX PC for other data).
Time of Day	[h:m:s:ms]	Timestamp of the eye sample in hour:minute:sec:millisecond form. The time is the local time of the computer where the data was recorded.
Trial		Trial name
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Export Start Trial Time	[ms]	Data export start time
Export End Trial Time	[ms]	Data export end time
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property
Tracking Ratio	[%]	Number of non-zero gaze positions divided by sampling frequency multiplied by run duration, expressed in percent. (computed on right eye data if available)
Category Group		General description of data category: Eye, Annotation or Information.

Parameter	Dimension unit	Description
Category Right		Right eye event type (fixation, saccade, blink, trigger, annotation instant, annotation interval, user events: DOM loaded, URL loaded, mouse click left, mouse click right, scroll, key press,separator, text)
Category Left		Left eye event type (fixation, saccade, blink, trigger, annotation instant, annotation interval, user events: DOM loaded, URL loaded, mouse click left, mouse click right, scroll, key press,separator, text)
Index Right		Index of right event type relative to its category
Index Left		Index of left event type relative to its category
Pupil Size Right X	[px]	Right eye horizontal pupil diameter
Pupil Size Right Y	[px]	Right eye vertical pupil diameter
Pupil Diameter Right	[mm]	Right circular pupil diameter in mm
Pupil Size Left X	[px]	Left eye horizontal pupil diameter
Pupil Size Left Y	[px]	Left eye vertical pupil diameter
Pupil Diameter Left	[mm]	Left circular pupil diameter in mm
Point of Regard Binocular X	[px]	Binocular eye horizontal gaze position (for eye data that has this info, such as ETG)

Parameter	Dimension unit	Description
Point of Regard Binocular Y	[px]	Binocular eye vertical gaze position (for eye data that has this info, such as ETG)
Point of Regard Right X	[px]	Right eye horizontal gaze position
Point of Regard Right Y	[px]	Right eye vertical gaze position
Point of Regard Left X	[px]	Left eye horizontal gaze position
Point of Regard Left Y	[px]	Left eye vertical gaze position
AOI Name Right		Name of the topmost area of interest (AOI) that is hit by current sample position on the right eye
AOI Group Right		Group of AOI for the AOI that is hit by current sample position on the right eye
AOI Scope Right		Scope of AOI for the AOI that is hit by current sample position on the right eye
AOI Order Right		Depth order for the AOI that is hit by current sample position on the right eye
AOI Name Left		Name of the topmost area of interest (AOI) that is hit by current sample position on the left eye
AOI Group Left		Group of AOI for the AOI that is hit by current sample position on the left eye
AOI Scope Left		Scope of AOI for the AOI that is hit by current sample position on the left eye

Parameter	Dimension unit	Description
AOI Order Left		Depth order for the AOI that is hit by current sample position on the left eye
Gaze Vector Right X		Right eye gaze vector on X
Gaze Vector Right Y		Right eye gaze vector on Y
Gaze Vector Right Z		Right eye gaze vector on Z
Gaze Vector Left X		Left eye gaze vector on X
Gaze Vector Left Y		Left eye gaze vector on Y
Gaze Vector Left Z		Left eye gaze vector on Z
Plane Right		Plane number on which the sample appears on the left eye (only present for experiments with head tracking data)
Plane Left		Plane number on which the sample appears on the right eye (only present for experiments with head tracking data)
Video Time	[h:m:s:ms]	Sample timestamp relative to the start of the video stimulus (only present for HED and ETG experiments)
Eye Position Right X	[mm]	Right eye position on X
Eye Position Right Y	[mm]	Right eye position on Y
Eye Position Right Z	[mm]	Right eye position on Z

Parameter	Dimension unit	Description
Eye Position Left X	[mm]	Left eye position on X
Eye Position Left Y	[mm]	Left eye position on Y
Eye Position Left Z	[mm]	Left eye position on Z
Pupil Position Right X	[px]	Right eye horizontal pupil position
Pupil Position Right Y	[px]	Right eye vertical pupil position
Pupil Position Left X	[px]	Left eye horizontal pupil position
Pupil Position Left Y	[px]	Right eye vertical pupil position
Port Status		Hardware trigger numerical value (can be configured 410 to have a hexadecimal, decimal or binary format)
Annotation Name		The name of the annotation definition
Annotation Description		The description of the annotation definition
Annotation Tags		Tags associated with the annotation definition
Mouse Position X	[px]	Mouse click X position
Mouse Position Y	[px]	Mouse click Y position
Scroll Direction X		Web page scroll direction on X
Scroll Direction Y		Web page scroll direction on Y

Parameter	Dimension unit	Description
Content		Content of the message
Emotive EEG Raw Values 1..n		Emotive EEG Raw values 132
Emotive Affective Values 1..n		Emotive Affective values 132
ICA Values 1..n		ICA values 137

Annotations are mapped to the closest eye sample for purposes of exporting their information for each sample entry.

Event Statistics

Single

This template shows one row per eye event, process all events from all selected trials.

Parameter	Dimension unit	Description
Trial		Trial number
Trial Start Raw Time	[ms]	Eye data start timestamp
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Export Start Trial Time	[ms]	Export start time, normally zero

Parameter	Dimension unit	Description
Export End Trial Time	[ms]	Export end time
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Tracking Ratio	[%]	Number of non-zero gaze positions divided by sampling frequency multiplied by run duration, expressed in percent. (computed on right eye data if available)
Category Group		General description of the data category below. Can be: fixation, saccade, blink, annotation, information.
Category		Event type (fixation, saccade, blink, trigger, annotation instant, annotation interval, user events: DOM loaded, URL loaded, mouse click left, mouse click right, scroll, key press,separator, text)
Eye L/R		The eye on which the event happened
Index		Index of the event (starts from 1 and is counted separately for each event type: fixation, saccade, blink, user event)
Event Start Trial Time	[ms]	Event start time, relative to the trial start
Event End Trial Time	[ms]	Event end time, relative to the trial start
Event Start Raw Time	[ms]	Data start timestamp of the event

Parameter	Dimension unit	Description
Event End Raw Time	[ms]	Data end timestamp of the event
Event Duration	[ms]	Duration of the event
Event Start Video Time	[h:m:s:ms]	Event start time, relative to the video stimulus start (only present for HED and ETG experiments)
Event End Video Time	[h:m:s:ms]	Event end time, relative to the video stimulus start (only present for HED and ETG experiments)
Fixation Position X	[px]	Geometric X position of a fixation on the stimulus; the position of a fixation is calculated as the average of the positions of all samples in that fixation
Fixation Postion Y	[px]	Geometric Y position of a fixation on the stimulus; the position of a fixation is calculated as the average of the positions of all samples in that fixation
Fixation Average Pupil Size X	[px]	Average pupil width during the fixation in pixels
Fixation Average Pupil Size Y	[px]	Average pupil height during the fixation in pixels
Fixation Average Pupil Diameter	[mm]	Average mapped pupil diameter during the fixation in mm (only available for RED systems data)
Fixation Dispersion X	[px]	Dispersion of a fixation in the x-direction given by [max(x) - min(x)]
Fixation Dispersion Y	[px]	Dispersion of a fixation in the y-direction given by [max(y) - min(y)]

Parameter	Dimension unit	Description
Saccade Start Position X	[px]	Geometric X position of a saccade start on the stimulus. The position of a fixation is the positions of the first sample in the saccade
Saccade Start Position Y	[px]	Geometric Y position of a saccade start on the stimulus. The position of a fixation is the positions of the first sample in the saccade
Saccade End Position X	[px]	Geometric X position of a saccade end on the stimulus. The position of a fixation is the positions of the last sample in the saccade
Saccade End Position Y	[px]	Geometric Y position of a saccade end on the stimulus. The position of a fixation is the positions of the last sample in the saccade
Saccade Amplitude	[°]	Distance from start to end point of the saccade (average velocity * saccade duration)
Saccade Acceleration Average	[°/s^2]	Average acceleration of a saccade in x. (*)
Saccade Acceleration Peak	[°/s^2]	Peak value of acceleration of gaze during a saccade. (*)
Saccade Deceleration Peak	[°/s^2]	Peak value of deceleration of gaze during a saccade. (*)
Saccade Velocity Average	[°/s]	Average velocity of gaze during a saccade. (*)

Parameter	Dimension unit	Description
Saccade Velocity Peak	[°/s]	Peak value of velocity of gaze during a saccade. (*)
Saccade Peak Velocity at	[%]	Position of the peak velocity within the saccade. (*)
AOI Name		Name of the topmost AOI hit 129 by the fixation event (if the event is a fixation)
AOI Group		Name of AOI group of the AOI hit by the fixation event
AOI Scope		Scope of hit AOI - local or global
AOI Order		Hit AOI order number
Port Status		Hardware trigger numerical value (can be configured 410 to have a hexadecimal, decimal or binary format)
Annotation Name		The name of the annotation definition
Annotation Description		The description of the annotation definition
Annotation Tags		Tags associated with the annotation definition
Mouse Position X	[px]	Mouse click X position
Mouse Position Y	[px]	Mouse click Y position
Scroll Direction X		Web page scroll direction on X
Scroll Direction Y		Web page scroll direction on Y
Content		Content of the message
Emotive Affective Values 1..n		Emotive Affective values 132
ICA Values 1..n		ICA values 137

(*) parameter is available only for recordings with sampling rate higher than 30 Hz.

Trial Summary

This template show one row per trial, process all selected trials.

Parameter	Dimension unit	Description
Trial		Trial number
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Export Start Trial Time	[ms]	Export start time, normally zero
Export End Trial Time	[ms]	Export end time
Participant		Participant Name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Fixation Count		Number of fixations in the trial.
Fixation Frequency	[count/s]	Number of fixations per second.
Fixation Duration Total	[ms]	Sum of duration of all fixations.
Fixation Duration Average	[ms]	Sum of duration of all fixations divided by number of fixations in the trial.
Fixation Duration Maximum	[ms]	Longest fixation duration.

Parameter	Dimension unit	Description
Fixation Duration Minimum	[ms]	Shortest fixation duration.
Fixation Dispersion Total	[px]	Sum of all fixation dispersions on X and Y
Fixation Dispersion Average	[px]	Sum of all fixation dispersions on X and Y divided by number of fixations in the trial.
Fixation Dispersion Maximum	[px]	Largest value for the sum of X and Y dispersions of one fixation.
Fixation Dispersion Minimum	[px]	Smallest value for the sum of X and Y dispersions of one fixation.
Saccade Count		Number of saccades in the trial.
Saccade Frequency	[count/s]	Number of saccade per second.
Saccade Duration Total	[ms]	Sum of duration of all saccades..
Saccade Duration Average	[ms]	Sum of duration of all saccades divided by number of saccades in the trial.
Saccade Duration Maximum	[ms]	Longest saccade duration.
Saccade Duration Minimum	[ms]	Shortest saccade duration.
Saccade Amplitude Total	[°]	Sum of all saccades amplitude.
Saccade Amplitude Average	[°]	Sum of all saccades amplitude divided by number of saccades in the trial.

Parameter	Dimension unit	Description
Saccade Amplitude Maximum	[°]	Max. saccade amplitude
Saccade Amplitude Minimum	[°]	Min. saccade amplitude
Saccade Velocity Total	[°/s]	Sum of all saccades velocities. (*)
Saccade Velocity Average	[°/s]	Sum of all saccades velocities divided by number of saccades in the trial. (*)
Saccade Velocity Maximum	[°/s]	Max. value of the saccade velocity. (*)
Saccade Velocity Minimum	[°/s]	Min. value of the saccade velocity. (*)
Saccade Latency Average	[ms]	saccade latency = time between the end of a saccade and the start of the next saccade. Saccade latency average = total saccade latency for all saccades / saccade count
Blink Count		Number of blinks in the trial.
Blink Frequency	[count/s]	Number of blinks per second.
Blink Duration Total	[ms]	Sum of duration of all blinks.
Blink Duration Average	[ms]	Sum of duration of all blinks divided by number of blinks in the trial.
Blink Duration Maximum	[ms]	Longest blink duration.

Parameter	Dimension unit	Description
Blink Duration Minimum	[ms]	Shortest blink duration.
Left Mouse Click Count		Number of left button mouse clicks in the trial.
Left Mouse Click Frequency	[count/s]	Frequency of left button mouse clicks in the trial: number of clicks divided by trial duration.
Right Mouse Click Count		Number of right button mouse clicks in the trial.
Right Mouse Click Frequency	[count/s]	Frequency of right button mouse clicks in the trial: number of clicks divided by trial duration.
Scanpath Length	[px]	Sum of distances between the positions of all consecutive fixations in the scanpath.

(*) parameter is available only for recordings with sampling rate higher than 30 Hz.

Selection Summary

This template shows one row for all trials, compute values over all selected trials.

Parameter	Dimension unit	Description
Export Start Trial Time	[ms]	Export start time, normally zero
Export End Trial Time	[ms]	Export end time

Parameter	Dimension unit	Description
Fixation Count		Number of fixations of all selected trials.
Fixation Frequency	[count/s]	Number of fixations of all selected trials divided by the sum of trial durations of all selected trials in seconds.
Fixation Duration Total	[ms]	Sum of duration of all fixations of all selected trials.
Fixation Duration Average	[ms]	Sum of duration of all fixations of all selected trials divided by the number of fixations of all selected trials.
Fixation Duration Maximum	[ms]	Longest fixation duration of all selected trials.
Fixation Duration Minimum	[ms]	Shortest fixation duration of all selected trials.
Fixation Dispersion Total	[px]	Sum of all fixation dispersions on X and Y of all selected trials.
Fixation Dispersion Average	[px]	Sum of dispersion of all fixations of all selected trials divided by the number of fixations of all selected trials.
Fixation Dispersion Maximum	[px]	Largest value for the sum of X and Y dispersions of fixation of all selected trials.
Fixation Dispersion Minimum	[px]	Smallest value for the sum of X and Y dispersions of fixation of all selected trials.
Saccade Count		Number of saccades of all selected trials.
Saccade Frequency	[count/s]	Number of saccades of all selected trials divided by the sum of trial durations of all selected trials in seconds.

Parameter	Dimension unit	Description
Saccade Duration Total	[ms]	Sum of all saccade duration of all selected trials.
Saccade Duration Average	[ms]	Sum of all saccade duration of all selected trials divided by the number of saccades of all selected trials.
Saccade Duration Maximum	[ms]	Longest saccade duration of all selected trials.
Saccade Duration Minimum	[ms]	Shortest saccade duration of all selected trials.
Saccade Amplitude Total	[°]	Sum of all saccades amplitude of all selected trials.
Saccade Amplitude Average	[°]	Sum of all saccades amplitude of all selected trials divided by the number of saccades of all selected trials.
Saccade Amplitude Maximum	[°]	Max. saccade amplitude of all selected trials.
Saccade Amplitude Minimum	[°]	Min. saccade amplitude of all selected trials.
Saccade Velocity Total	[°/s]	Sum of all saccades velocities of all selected trials. (*)
Saccade Velocity Average	[°/s]	Sum of all saccades velocities of all selected trials divided by the number of saccades of all selected trials. (*)
Saccade Velocity Maximum	[°/s]	Max. value of the saccade velocity of all selected trials. (*)

Parameter	Dimension unit	Description
Saccade Velocity Minimum	[°/s]	Min. value of the saccade velocity of all selected trials. (*)
Saccade Latency Average	[°/s]	saccade latency = time between the end of a saccade and the start of the next saccade. Saccade latency average = total saccade latency for all saccades / saccade count in all selected trials
Blink Count		Number of blinks of all selected trials.
Blink Frequency	[count/s]	Number of blinks of all selected trials divided by the sum of trial durations of all selected trials in seconds.
Blink Duration Total	[ms]	Sum of duration of all blinks of all selected trials.
Blink Duration Average	[ms]	Sum of duration of all blinks of all selected trials divided by the number of blinks of all selected trials.
Blink Duration Maximum	[ms]	Longest blink duration of all selected trials.
Blink Duration Minimum	[ms]	Shortest blink duration of all selected trials.
Left Mouse Click Count		Number of left button mouse clicks in all selected trials.
Left Mouse Click Frequency	[count/s]	Frequency of left button mouse clicks in all selected trials: number of clicks divided by sum of trial duration.
Right Mouse Click Count		Number of right button mouse clicks in all selected trials.

Parameter	Dimension unit	Description
Right Mouse Click Frequency	[count/s]	Frequency of right button mouse clicks in all selected trials: number of clicks divided by sum of trials duration.
Scanpath Length	[px]	Sum of distances between the positions of all consecutive fixations in the scanpath.

(*) parameter is available only for recordings with sampling rate higher than 30 Hz.

AOI Statistics

Single

This template shows one row for each fixation that hits one AOI, process all selected trials, only on selected AOIs.

Parameter	Dimension unit	Description
Trial		Trial number
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Export Start Trial Time	[ms]	Export start time, normally zero
Export End Trial Time	[ms]	Export end time
Participant		Participant name

Parameter	Dimension unit	Description
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Eye L/R		Which eye fixated inside an AOI.
AOI Name		Area of interest name
AOI Group		Name of AOI group of the AOI
AOI Scope		Scope of hit AOI - local or global
AOI Order		AOI order number
AOI Size	[px]	Size of AOI in pixel - the part overlapping the stimulus is taken into consideration, parts outside the stimulus area are ignored. For dynamic AOIs the size is the sum of sizes at each sample timestamp (as defined above) where the AOI is visible averaged by the number of samples where the AOI is visible.
AOI Coverage	[%]	AOI size in comparison to Stimulus size
Time to First Appearance	ms	Time when the AOI becomes visible for the first time relative to the trial start
Appearance Count		Sum of all appearances of one AOI within one trial: – For static AOIs on still images it is always 1 – For dynamic AOIs it is the number of slices where the AOI was visible
Visible Time	[ms]	Sum of AOI duration within one trial – For static AOI it is end time – start

Parameter	Dimension unit	Description
		time – For dynamic AOI it is the sum of all durations where the AOI was visible within start and end time
Visible Time	[%]	Visible time (ms) / (end time - start time) (**)
Index		Index of the fixation.
Event Start Trial Time	[ms]	Beginning of a fixation in an AOI.
Event End Trial Time	[ms]	End of a fixation in an AOI.
Event Duration	[ms]	Duration of a fixation in an AOI.
Fixation Position X	[px]	Geometric X position of a fixation inside an AOI. The position of a fixation is calculated as the average of the positions of all samples in that fixation.
Fixation Position Y	[px]	Geometric X position of a fixation inside an AOI. The position of a fixation is calculated as the average of the positions of all samples in that fixation.
Fixation Average pupil size X	[px]	Average size on X of the pupil inside an AOI.
Fixation Average pupil size Y	[px]	Average size on Y of the pupil inside an AOI.
Fixation Average Pupil Diameter	[mm]	Average diameter of the pupil inside an AOI.
Fixation Dispersion X	[px]	Dispersion on X of a fixation inside an AOI.

Parameter	Dimension unit	Description
Fixation Dispersion Y	[px]	Dispersion on Y of a fixation inside an AOI.
Mouse Position X	[px]	Position on X of mouse click inside the AOI.
Mouse Position Y	[px]	Position on Y of mouse click inside the AOI.

Trial Summary (AOI / AOI Group)

This template shows one row for each AOI - trial combination, process all selected trials, only on selected AOIs.

For the "group" version of the template there is one row for each AOI Group - trial combination, instead of each individual AOI, so the statistics are added up for all AOIs belonging to the same group (they have the same Group property set in AOI Editor 173). The AOI Group statistics are computed for image stimuli only.

Parameter	Dimension unit	Description
Trial		Trial number
Stimulus		Stimulus Name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Export Start Trial Time	[ms]	Export start time, normally zero
Export End Trial Time	[ms]	Export end time
Participant		Participant name

Parameter	Dimension unit	Description
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Eye L/R		Which eye fixated inside an AOI.
AOI Name		Area of interest name (not present for AOI Group)
AOI Group		Name of AOI group of the AOI
AOI Scope		Scope of hit AOI - local or global (not present for AOI Group)
AOI Order		AOI order number (not present for AOI Group)
AOI Size	[px]	Size of AOI in pixel - the part overlapping the stimulus is taken into consideration, parts outside the stimulus area are ignored. For dynamic AOIs the size is the sum of sizes at each sample timestamp (as defined above) where the AOI is visible averaged by the number of samples where the AOI is visible.
AOI Coverage	[%]	AOI size in comparison to Stimulus size
Time to First Appearance	ms	Time when the AOI becomes visible for the first time relative to the trial start
Appearance Count		Sum of all appearances of one AOI within one trial: – For static AOIs on still images it is always 1 – For dynamic AOIs it is the number of slices where the AOI was visible

Parameter	Dimension unit	Description
		(not present for AOI Group)
Visible Time	[ms]	Sum of AOI duration within one trial – For static AOI it is end time – start time – For dynamic AOI it is the sum of all durations where the AOI was visible within start and end time (not present for AOI Group)
Visible Time	[%]	Visible time (ms) / (end time - start time) (**) (not present for AOI Group)
Entry Time	[ms]	Duration from start of the trial to the first fixation hit of the AOI (fixation position is inside the AOI).
Sequence		Order of gaze hits into the AOIs based on Entry Time, lowest Entry Time = first in sequence.
Net Dwell Time	[ms]	Sum of sample durations for all gaze data samples that hit the AOI. (*)
Dwell Time	[ms]	Dwell Time is the sum of all Dwell Times for each visit of an AOI. Dwell Time for one visit is the sum of durations of all saccades and fixations inside the AOI.
Normalized Dwell	[ms/Coverage]	Dwell time divided by AOI Coverage
Glance Duration	[ms]	Saccade duration for entering the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = dwell time + duration of saccade entering AOI. (*)

Parameter	Dimension unit	Description
Diversion Duration	[ms]	Sum of saccade durations for entering and leaving the object + sum of all fixation durations and saccade durations before the eyes begin to leave the AOI = glance duration + duration of saccade leaving AOI. (*)
First Fixation Duration	[ms]	Duration of the first fixation to hit the AOI.
Glances Count		Number of glances to a target (saccades coming from outside) within a certain period (increment the counter each time a fixation hits the AOI, if not hit before). [both eyes] (*)
Revisits		Glances count - 1
Fixation Count		Number of fixations inside the AOI.
Net Dwell Time	[%]	Net dwell time (ms) / (end time - start time) (*, **)
Dwell Time	[%]	Dwell time (ms) / (end time - start time) (**)
Fixation Time	[ms]	Sum of the fixation durations inside the AOI
Fixation Time	[%]	Fixation time (ms) / (end time - start time) (**)
Average Fixation Duration	[ms]	The sum of fixation times divided by number of fixations inside an AOI.
Time to First Saccade	[ms]	Start time of first saccade that enters the AOI relative to the start of the trial

Parameter	Dimension unit	Description
		(similar to Entry Time for fixations).
Time to First Left Mouse Click	[ms]	Time of first left button mouse click into the AOI, similar to “Entry Time” for gaze data.
Left Mouse Click Count		Number of left button mouse clicks into the AOI.
Left Mouse Click Frequency	[count/s]	Frequency of left button mouse clicks into the AOI: number of clicks divided by AOI visibility duration.
Time to First Right Mouse Click	[ms]	Time of first right button mouse click into the AOI, similar to “Entry Time” for gaze data.
Right Mouse Click Count		Number of right button mouse clicks into the AOI.
Right Mouse Click Frequency	[count/s]	Frequency of right button mouse clicks into the AOI: number of clicks divided by AOI visibility duration.

(*) parameter is available only for recordings with sampling rate higher than 30 Hz. The only exceptions to this are for reference views where the following are computed even at 30Hz: Glances Count and Revisits for AOI Summary and AOI Detailed Statistics.

(**) start and end time represent the selected time window start and end times (for end time it will be the trial end time if that is smaller than the window end time).

The Entry Time cell contains "-" if the corresponding AOI is not hit by any fixation during the selected period of time.

Selection Summary (AOI / AOI Group)

This template shows one row per AOI, compute values over all selected trials associated with one AOI.

For the "group" version of the template there is one row for each AOI Group, instead of each individual AOI, so the statistics are added up for all AOIs belonging to the same group (they have the same Group property set in AOI Editor 173). The AOI Group statistics are computed for image stimuli only.

Parameter	Dimension unit	Description
Stimulus		Stimulus name
Export Start Trial Time	[ms]	Export start time, normally zero
Export End Trial Time	[ms]	Export end time
Eye L/R		Which eye fixated inside an AOI
AOI Name		Area of interest name (not present for AOI Group
AOI Group		AOI group name
AOI Scope		Scope of AOI - local or global (not present for AOI Group)
AOI Order		AOI order number (not present for AOI Group)
AOI Size	[px]	Size of AOI in pixel - the part overlapping the stimulus is taken into consideration, parts outside the stimulus area are ignored For dynamic AOIs the size is the sum of sizes at each sample timestamp (as

Parameter	Dimension unit	Description
		defined above) where the AOI is visible averaged by the number of samples where the AOI is visible.
AOI Coverage	[%]	AOI size in comparison to Stimulus size.
Entry Time Total	[ms]	Sum of Entry Time of all participants.
Entry Time Average	[ms]	Sum of Entry Time of all participants divided by number of participants.
Entry Time STD	[ms]	Standard deviation of the Entry Time values.
Entry Time Maximum	[ms]	Max. Entry Time of all participants.
Entry Time Minimum	[ms]	Min. Entry Time of all participants.
Sequence		Order of gaze hits into the AOIs based on Entry Time Average, lowest Entry Time Average = first in sequence.
Net Dwell Time Total	[ms]	Sum of net dwell time of all participants. (*)
Net Dwell Time Average	[ms]	Sum of net dwell time of all participants divided by number of participants. (*)
Net Dwell Time STD	[ms]	Standard deviation of the Net Dwell Time values. (*)
Net Dwell Time Maximum	[ms]	Max. net dwell time of all participants. (*)
Net Dwell Time Minimum	[ms]	Min. net dwell time of all participants. (*)

Parameter	Dimension unit	Description
Dwell Time Total	[ms]	Sum of dwell time of all participants.
Dwell Time Average	[ms]	Sum of dwell time of all participants divided by number of participants.
Dwell Time STD	[ms]	Standard deviation of the Dwell Time values
Dwell Time Maximum	[ms]	Max. dwell time of all participants.
Dwell Time Minimum	[ms]	Min. dwell time of all participants.
Normalized Dwell Total	[ms/Coverage]	Sum of Normalized Dwell of all participants.
Normalized Dwell Average	[ms/Coverage]	Sum of Normalized Dwell of all participants divided by number of participants.
Normalized Dwell STD	[ms/Coverage]	Standard deviation of the Normalized Dwell values.
Normalized Dwell Maximum	[ms/Coverage]	Max. Normalized Dwell of all participants.
Normalized Dwell Minimum	[ms/Coverage]	Min. Normalized Dwell of all participants.
Glance Duration Total	[ms]	Sum of glance duration of all participants. (*)
Glance Duration Average	[ms]	Sum of glance duration of all participants divided by number of participants. (*)
Glance Duration STD	ms]	Standard deviation of the Glance duration values. (*)

Parameter	Dimension unit	Description
Glance Duration Maximum	[ms]	Max. glance duration of all participants. (*)
Glance Duration Minimum	[ms]	Min. glance duration of all participants. (*)
Diversion Duration Total	[ms]	Sum of diversion duration of all participants. (*)
Diversion Duration Average	[ms]	Sum of diversion duration of all participants divided by number of participants. (*)
Diversion Duration STD	ms]	Standard deviation of the Diversion duration values (*)
Diversion Duration Maximum	[ms]	Max. diversion duration of all participants. (*)
Diversion Duration Minimum	[ms]	Min. diversion duration of all participants. (*)
First Fixation Duration Total	[ms]	Sum of first fixation duration of all participants.
First Fixation Duration Average	[ms]	Sum of first fixation duration of all participants divided by number of participants.
First Fixation Duration STD	[ms]	Standard deviation of the First fixation duration values. (*)
First Fixation Duration Maximum	[ms]	Max. first fixation duration of all participants.
First Fixation Duration Minimum	[ms]	Min. first fixation duration of all participants.

Parameter	Dimension unit	Description
First Fixation Participant Count		Number of participants that had their first fixation in the AOI.
Glances Count Total		Sum of glances count of all participants. (*)
Glances Count Average		Sum of glances count of all participants divided by number of participants. (*)
Glances Count STD		Standard deviation of the Glances count values. (*)
Glances Count Maximum		Max. glances count of all participants. (*)
Glances Count Minimum		Min. glances count of all participants. (*)
Revisits Total		Glances count total - 1
Revisits Average		Glances count average - 1
Revisits STD		Standard deviation of the Revisits values
Revisits Maximum		Glances count maximum - 1
Revisits Minimum		Glances count minimum - 1
Fixation Count Total		Sum of fixation count of all participants.
Fixation Count Average		Sum of fixation count of all participants divided by number of participants.
Fixation Count STD		Standard deviation of the Fixation count values
Fixation Count Maximum		Max. fixation count of all participants.

Parameter	Dimension unit	Description
Fixation Count Minimum		Min. fixation count of all participants.
Time to First Appearance	ms	Time when the AOI becomes visible for the first time relative to the trial start
Appearance Count Total		Sum of all appearances of one AOI within one trial of all participants.
Appearance Count Average		Sum of all appearances of one AOI within one trial of all participants divided by number of participants.
Appearance Count STD		Standard deviation of the Appearance count values
Appearance Count Maximum		Max. sum of all appearances of one AOI within one trial of all participants.
Appearance Count Minimum		Min. sum of all appearances of one AOI within one trial of all participants.
Visible Time Total	[ms]	Sum of AOI duration within one trial of all participants.
Visible Time Average	[ms]	Sum of AOI duration within one trial of all participants divided by number of participants.
Visible Time STD	[ms]	Standard deviation of the Visible time values
Visible Time Maximum	[ms]	Max. sum of AOI duration within one trial of all participants.
Visible Time Minimum	[ms]	Min. sum of AOI duration within one trial of all participants.
Visible Time Total	[%]	Visible time total (ms) / (end time - start time) (**)

Parameter	Dimension unit	Description
Visible Time Average	[%]	Visible time average (ms) / (end time - start time) (**)
Visible Time STD	[%]	Visible time STD (ms) / (end time - start time) (**)
Visible Time Maximum	[%]	Visible time maximum (ms) / (end time - start time) (**)
Visible Time Minimum	[%]	Visible time minimum (ms) / (end time - start time) (**)
Net Dwell Time Total	[%]	Net dwell time total (ms) / (end time - start time) (*, **)
Net Dwell Time Average	[%]	Net dwell time average (ms) / (end time - start time) (*, **)
Net Dwell Time STD	[%]	Net dwell time STD (ms) / (end time - start time) (*, **)
Net Dwell Time Maximum	[%]	Net dwell time maximum (ms) / (end time - start time) (*, **)
Net Dwell Time Minimum	[%]	Net dwell time minimum (ms) / (end time - start time) (*, **)
Dwell Time Total	[%]	Dwell time total (ms) / (end time - start time) (**)
Dwell Time Average	[%]	Dwell time average (ms) / (end time - start time) (**)
Dwell Time STD	[%]	Dwell time STD (ms) / (end time - start time) (**)
Dwell Time Maximum	[%]	Dwell time maximum (ms) / (end time - start time) (**)

Parameter	Dimension unit	Description
Dwell Time Minimum	[%]	Dwell time minimum (ms) / (end time - start time) (**)
Fixation Time Total	[ms]	Sum of fixation durations of all participants.
Fixation Time Average	[ms]	Sum of fixation durations of all participants divided by number of participants.
Fixation Time STD	[ms]	Standard deviation of the Fixation time values
Fixation Time Maximum	[ms]	Max. added fixation durations of all participants.
Fixation Time Minimum	[ms]	Min. added fixation durations of all participants.
Fixation Time Total	[%]	Fixation time total (ms) / (end time - start time) (**)
Fixation Time Average	[%]	Fixation time average (ms) / (end time - start time) (**)
Fixation Time STD	[%]	Fixation time STD (ms) / (end time - start time) (**)
Fixation Time Maximum	[%]	Fixation time maximum (ms) / (end time - start time) (**)
Fixation Time Minimum	[%]	Fixation time minimum (ms) / (end time - start time) (**)
Participant Hit Count		Number of participants that looked into the AOI
Participant Hit Count	[%]	Number of participants that looking into the AOI in comparison to all selected participants

Parameter	Dimension unit	Description
Revisitors Count		Number of participants that looked into the AOI at least 2 times.
Average Fixation Duration Total	[ms]	Sum of "Average Fixation Duration" per participant in an AOI for all participants. The "Average Fixation Duration" is defined as "the sum of fixation times divided by number of fixations" (all times inside an AOI).
Average Fixation Duration Average	[ms]	Sum of "Average Fixation Duration" per participant in an AOI divided by number of participants.
Average Fixation Duration STD	[ms]	Standard deviation of the Average Fixation Duration values
Average Fixation Duration Maximum	[ms]	Max. "Average Fixation Duration" of all participants.
Average Fixation Duration Minimum	[ms]	Min. "Average Fixation Duration" of all participants.
Time to First Saccade Total	[ms]	Sum of "Time To First Saccade" for all participants
Time to First Saccade Average	[ms]	Time of "Time To First Saccade" divided by number of participants.
Time to First Saccade STD	[ms]	Standard deviation of the "Time To First Saccade"
Time to First Saccade Maximum	[ms]	Max. "Time To First Saccade" of all participants.
Time to First Saccade Minimum	[ms]	Min. "Time To First Saccade" of all participants.

Parameter	Dimension unit	Description
Time to First Left Mouse Click Total	[ms]	Sum of the times of first left mouse click into the AOI of all participants.
Time to First Left Mouse Click Average	[ms]	Time of first left mouse click into the AOI divided by number of participants.
Time to First Left Mouse Click STD	[ms]	Standard deviation of the Time to first left mouse click values
Time to First Left Mouse Click Maximum	[ms]	Max. time to first left mouse click of all participants.
Time to First Left Mouse Click Minimum	[ms]	Min. time to first left mouse click of all participants.
Left Mouse Click Count Total		Sum of the number of left mouse clicks into the AOI of all participants.
Left Mouse Click Count Average		Number of left mouse click into the AOI divided by number of participants.
Left Mouse Click Count STD		Standard deviation of the number of left mouse click values
Left Mouse Click Count Maximum		Max.number of left mouse click of all participants.
Left Mouse Click Count Minimum		Min. number of left mouse click of all participants.
Left Mouse Click Frequency Total	[count/s]	Sum of the frequency of left mouse clicks into the AOI of all participants.
Left Mouse Click Frequency Average	[count/s]	Frequency of left mouse click into the AOI divided by number of participants.

Parameter	Dimension unit	Description
Left Mouse Click Frequency STD	[count/s]	Standard deviation of the frequency of left mouse click values
Left Mouse Click Frequency Maximum	[count/s]	Max. frequency of left mouse click of all participants.
Left Mouse Click Frequency Minimum	[count/s]	Min. frequency of left mouse click of all participants.
Time to First Right Mouse Click Total	[ms]	Sum of the times of first right mouse click into the AOI of all participants.
Time to First Right Mouse Click Average	[ms]	Time of first right mouse click into the AOI divided by number of participants.
Time to First Right Mouse Click STD	[ms]	Standard deviation of the Time to first right mouse click values
Time to First Right Mouse Click Maximum	[ms]	Max. time to first right mouse click of all participants.
Time to First Right Mouse Click Minimum	[ms]	Min. time to first right mouse click of all participants.
Right Mouse Click Count Total		Sum of the number of right mouse clicks into the AOI of all participants.
Right Mouse Click Count Average		Number of right mouse click into the AOI divided by number of participants.
Right Mouse Click Count STD		Standard deviation of the number of right mouse click values

Parameter	Dimension unit	Description
Right Mouse Click Count Maximum		Max.number of right mouse click of all participants.
Right Mouse Click Count Minimum		Min. number of right mouse click of all participants.
Right Mouse Click Frequency Total	[count/s]	Sum of the frequency of right mouse clicks into the AOI of all participants.
Right Mouse Click Frequency Average	[count/s]	Frequency of right mouse click into the AOI divided by number of participants.
Right Mouse Click Frequency STD	[count/s]	Standard deviation of the frequency of right mouse click values
Right Mouse Click Frequency Maximum	[count/s]	Max. frequency of right mouse click of all participants.
Right Mouse Click Frequency Minimum	[count/s]	Min. frequency of right mouse click of all participants.

(*) parameter is available only for recordings with sampling rate higher than 30 Hz. The only exceptions to this are for reference views where the following are computed even at 30Hz: Glances Count and Revisits for AOI Summary and AOI Detailed Statistics.

(**) start and end time represent the selected time window start and end times (for end time it will be the trial end time if that is smaller than the window end time).

The Entry Time values are computed only on valid trials (the ones that contain at least one fixation inside the corresponding AOI during the selected period of time) associated with a stimulus. The other values are computed on all selected trials associated with the stimulus.

AOI Annotation Statistics

Single

Parameter	Dimension unit	Description
AOI Name		Area of interest name
Participant		Participant name
Stimulus		Stimulus name
Name		The name of the linked annotation definition
Description		The description of the linked annotation definition
Tags		Tags associated with the linked annotation definition
AOI Annotation Start Trial Time	[ms]	Start time of the linked annotation in the original trial where it was added.
Duration	[ms]	Duration of the linked annotation

Selection Summary

Parameter	Dimension unit	Description
AOI Name		Area of interest name
Name		The name of the linked annotation definition
Description		The description of the linked annotation definition

Parameter	Dimension unit	Description
Tags		Tags associated with the linked annotation definition
Average AOI Annotation Start Trial Time	[ms]	Sum of linked annotations start times in the original trials divided by number of participants
Average Duration	[ms]	Sum of linked annotations durations divided by number of participants

NHTSA AOI Statistics

Single

Parameter	Dimension unit	Description
AOI Name		Area of interest name
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Eye L/R		Which eye fixated inside an AOI
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
AOI Exit Time	[ms]	End of the last fixation before leaving the AOI (start of the NHTSA glance)
AOI Reentry Time	[ms]	Start of the first fixation after returning to the AOI (end of the NHTSA glance)

Parameter	Dimension unit	Description
Glance Outside AOI Duration	[ms]	The amount of time between the moment the gaze leaves an AOI and the moment the gaze reenters the AOI, measured between the end of the last fixation before leaving the AOI and the start of the first fixation after returning to the AOI.

Trial Summary

Parameter	Dimension unit	Description
AOI Name		Area of interest name
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Eye L/R		Which eye fixated inside an AOI
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Glances Outside AOI Total		Number of glances outside AOI
Glances Outside AOI Above 2 s		Number of glances outside AOI duration greater or equal to 2 s. The threshold value can be modified in the export options 410 panel.

Parameter	Dimension unit	Description
Glances Outside AOI Below 2 s [%]	[%]	Percentage of glances outside AOI for which the duration is less than 2 s. The threshold value is the same as the above value.
Glances Outside AOI Duration Total	[ms]	Sum of durations of glances outside AOI
Glances Outside AOI Duration Average	[ms]	Sum of durations of glances outside AOI divided by the number of glances outside AOI
Glances Outside AOI Duration STD	[ms]	Standard Deviation of glances outside AOI durations
Glances Outside AOI Duration Maximum	[ms]	Longest glance outside AOI duration
Glances Outside AOI Duration Minimum	[ms]	Shortest glance outside AOI duration
Glances Outside AOI 85th Percentile	[ms]	The shortest glance outside AOI duration that is greater or equal to 85% of NHTSA glance durations. The percentile number can be modified in the export options 410 panel.

Selection Summary

Parameter	Dimension unit	Description
AOI Name		Area of interest name

Parameter	Dimension unit	Description
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Eye L/R		Which eye fixated inside an AOI
Glances Outside AOI Total		Number of glances outside AOI
Glances Outside AOI Above 2 s		Number of glances outside AOI duration greater or equal to 2 s. The threshold value can be modified in the export options 410 panel.
Glances Outside AOI Below 2 s [%]	[%]	Percentage of glances outside AOI for which the duration is less than 2 s. The threshold value is the same as the above value.
Glances Outside AOI Duration Total	[ms]	Sum of durations of glances outside AOI
Glances Outside AOI Duration Average	[ms]	Sum of durations of glances outside AOI divided by the number of glances outside AOI
Glances Outside AOI Duration STD	[ms]	Standard Deviation of glances outside AOI durations
Glances Outside AOI Duration Maximum	[ms]	Longest glance outside AOI duration
Glances Outside AOI Duration Minimum	[ms]	Shortest glance outside AOI duration

Parameter	Dimension unit	Description
Glances Outside AOI 85th Percentile	[ms]	The shortest glance outside AOI duration that is greater or equal to 85% of NHTSA glance durations. The percentile number can be modified in the export options 410 panel.

Target Statistics

Single (Static)

Parameter	Dimension unit	Description
Trial		Trial number
Trial Start Raw Time	[ms]	Export start time, as written in the eye data file
Stimulus		Stimulus Name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Export Start Trial Time	[ms]	Export start time, normally zero
Export End Trial Time	[ms]	Export end time
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Eye L/R		Which eye fixated inside an AOI.

Parameter	Dimension unit	Description
Target Name		Name of target
Target Position X	[px]	Target position in the stimulus on the X axis
Target Position Y	[px]	Target position in the stimulus on the Y axis
Target Start Trial Time	[ms]	Time when target becomes visible during the trial
Target End Trial Time	[ms]	Time when the target becomes invisible during the trial
Target Duration	[ms]	Duration while target is visible
Saccade 1 Start Trial Time	[ms]	Start time of the first saccade after target appears
Saccade 1 End Trial Time	[ms]	End time of the first saccade after target appears
Saccade 1 Duration	[px]	Saccade duration
Saccade 1 Start Position X	[px]	Saccade start position on stimulus on X axis
Saccade 1 Start Position Y	[px]	Saccade start position on stimulus on Y axis
Saccade 1 End Position X	[px]	Saccade end position on stimulus on X axis
Saccade 1 End Position Y	[px]	Saccade end position on stimulus on Y axis
Saccade 1 Amplitude	[°]	Distance from start to end positions of the saccade (average velocity * saccade duration)

Parameter	Dimension unit	Description
Saccade 1 Latency	[ms]	Time since target appeared until saccade started
Saccade 1 Orientation	[°]	Angle of the saccade direction (line from start to end positions) relative to the horizontal
Saccade 1 Target Orientation	[°]	Angle of the saccade to target direction (line from saccade start position to target position) relative to the horizontal
Saccade 1 Gain	[%]	Ratio between saccade amplitude (start to end point distance) and target to saccade amplitude (distance between saccade start position and target position)
Saccade 1 Acceleration Average	[°/s^2]	Average acceleration of a saccade in x.
Saccade 1 Acceleration Peak	[°/s^2]	Peak value of acceleration of gaze during a saccade.
Saccade 1 Deceleration Peak	[°/s^2]	Peak value of deceleration of gaze during a saccade.
Saccade 1 Velocity Average	[°/s]	Average velocity of gaze during a saccade.
Saccade 1 Velocity Peak	[°/s]	Peak value of velocity of gaze during a saccade.
Saccade 1 Peak Velocity at	[%]	Position of the peak velocity within the saccade.

Parameter	Dimension unit	Description
Saccade 2 Start Trial Time	[ms]	Start time of the second saccade after target appears
Saccade 2 End Trial Time	[ms]	End time of the second saccade after target appears
Saccade 2 Duration	[px]	Saccade duration
Saccade 2 Start Position X	[px]	Saccade start position on stimulus on X axis
Saccade 2 Start Position Y	[px]	Saccade start position on stimulus on Y axis
Saccade 2 End Position X	[px]	Saccade end position on stimulus on X axis
Saccade 2 End Position Y	[px]	Saccade end position on stimulus on Y axis
Saccade 2 Amplitude	[°]	Distance from start to end point of the saccade (average velocity * saccade duration)
Saccade 2 Latency	[ms]	Time since target appeared until saccade started
Saccade 2 Orientation	[°]	Angle of the saccade direction (line from start to end positions) relative to the horizontal
Saccade 2 Target Orientation	[°]	Angle of the saccade to target direction (line from saccade start position to target position) relative to the horizontal
Saccade 2 Gain	[%]	Ratio between saccade amplitude (start to end point distance) and target to saccade amplitude (distance

Parameter	Dimension unit	Description
		between saccade start position and target position)
Saccade 2 Acceleration Average	[°/s^2]	Average acceleration of a saccade in x.
Saccade 2 Acceleration Peak	[°/s^2]	Peak value of acceleration of gaze during a saccade.
Saccade 2 Deceleration Peak	[°/s^2]	Peak value of deceleration of gaze during a saccade.
Saccade 2 Velocity Average	[°/s]	Average velocity of gaze during a saccade.
Saccade 2 Velocity Peak	[°/s]	Peak value of velocity of gaze during a saccade.
Saccade 2 Peak Velocity at	[%]	Position of the peak velocity within the saccade.
Intersaccadic Interval	[ms]	Duration between the end of the first saccade and the start of the second one.

Single (Animated)

Parameter	Dimension unit	Description
Trial		Trial number
Trial Start Raw Time	[ms]	Export start time, as written in the eye data file
Stimulus		Stimulus Name

Parameter	Dimension unit	Description
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
Export Start Trial Time	[ms]	Export start time, normally zero
Export End Trial Time	[ms]	Export end time
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Eye L/R		Which eye fixated inside an AOI.
Target Name		Name of target
Target Type		
Target Start Trial Time	[ms]	Time when target becomes visible during the trial
Target End Trial Time	[ms]	Time when the target becomes invisible during the trial
Target Duration	[ms]	Duration while target is visible
Target Start Position X		Target start position in the stimulus (when target appears) on the X axis
Target Start Position Y		Target start position in the stimulus (when target appears) on the Y axis
Target End Position X		Target end position in the stimulus (when target disappears or stimulus ends) on the X axis

Parameter	Dimension unit	Description
Target End Position Y		Target end position in the stimulus (when target disappears or stimulus ends) on the Y axis
Target Motion Amplitude		Average target velocity * duration of target being visible (target start trial time - target end trial time)
Target Average Velocity		Average velocity of the target while it is visible
Target Peak Velocity		Maximum velocity of the target while it is visible
Target Average Acceleration		Average acceleration of the target while it is visible
Target Peak Acceleration		Maximum acceleration of the target while it is visible
Saccade Right Count		Number of saccades on the right eye while the target is visible
Saccade Frequency Right	[count/s]	Frequency of saccades on the right eye while the target is visible (saccade right count / target duration)
Gain Right	[%]	Ratio between saccade average velocity over all saccades on the right eye while the target is visible and target average velocity
Peak Velocity Right	[°/s]	Maximum right eye velocity while the target is visible
Peak Velocity w/o Saccades Right	[°/s]	Maximum right eye velocity while the target is visible excluding the saccade periods

Parameter	Dimension unit	Description
Average Velocity Right	[°/s]	Average right eye velocity while the target is visible
Average Velocity w/o Saccades Right	[°/s]	Average right eye velocity while the target is visible excluding the saccade periods
Peak Acceleration Right	[°/s^2]	Maximum right eye acceleration while the target is visible
Peak Acceleration w/o Saccades Right	[°/s^2]	Maximum right eye acceleration while the target is visible excluding the saccade periods
Average Acceleration Right	[°/s^2]	Average right eye acceleration while the target is visible
Average Acceleration Right w/o Saccades Right	[°/s^2]	Average right eye acceleration while the target is visible excluding the saccade periods
Saccade Left Count		Number of saccades on the left eye while the target is visible
Saccade Frequency Left	[count/s]	Frequency of saccades on the left eye while the target is visible (saccade left count / target duration)
Gain Left	[%]	Ratio between saccade average velocity over all saccades on the left eye while the target is visible and target average velocity
Peak Velocity Left	[°/s]	Maximum left eye velocity while the target is visible
Peak Velocity w/o Saccades Left	[°/s]	Maximum left eye velocity while the target is visible excluding the saccade

Parameter	Dimension unit	Description
		periods
Average Velocity Left	[°/s]	Average left eye velocity while the target is visible
Average Velocity w/o Saccades Left	[°/s]	Average left eye velocity while the target is visible excluding the saccade periods
Peak Acceleration Left	[°/s^2]	Maximum left eye acceleration while the target is visible
Peak Acceleration w/o Saccades Left	[°/s^2]	Maximum left eye acceleration while the target is visible excluding the saccade periods
Average Acceleration Left	[°/s^2]	Average left eye acceleration while the target is visible
Average Acceleration Right w/o Saccades Left	[°/s^2]	Average left eye acceleration while the target is visible excluding the saccade periods

Specialized Statistics

Transition Matrix (Stacking Order, All)

The Transition Matrix gives the number of transitions of fixations from one specific AOI to another. The AOIs listed in the column on the left give the start AOI, the AOIs listed in the row at the top gives the end AOI. For each cell in the matrix the number of transitions is counted. Only fixations are taken into account.

Example: There have been three fixations in AOI 1 which have each been followed by a fixation in AOI 2. Then the cell in the matrix for [AOI 1, AOI 2] is computed to be 3.

If there has been an additional fixation on the background between the fixations on AOI 1 and AOI 2, no transition between those AOIs is counted.

Instead, if a "White Space" AOI exists that covers the background, a transition from AOI 1 to "White Space" and a transition from "White Space" to AOI 2 is counted.

Stacking Order: In case of overlapping AOI 172 the top-most AOI is taken into consideration.

All: All AOI are taken into consideration, even when they are overlapping.

Parameter	Dimension unit	Description
Stimulus		Stimulus name
from \ to (count)		Column lists all AOI names
Area of Interest 1..n		One column and one row for each AOI (including white space)
[Matrix cells]		Number of transitions from AOI to AOI

Questionnaire Overview

Parameter	Dimension unit	Description
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Source		Question identifier
Question		Question text
Answer		User selected answer

Trial Overview

Parameter	Dimension unit	Description
Stimulus		Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
File Name		Stimulus file name in the original recording results
Trial Start Raw Time	[ms]	Eye data start timestamp
Trial Duration	[ms]	Duration of the associated trial
Trial Index		Position of the associated trial inside the run
Width	[px]	Stimulus width
Height	[px]	Stimulus height
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Tracking Ratio	[%]	Number of non-zero gaze positions divided by sampling frequency multiplied by run duration, expressed in percent. (computed on right eye data if available)

Custom Trial Overview

Parameter	Dimension unit	Description
Stimulus		Stimulus name
Reference Image		Reference image name
Start Time	[ms]	Interval start time
End Time	[ms]	Interval end time
Duration	[ms]	Interval duration

Participant Overview

The participant statistics is independent of the participant, trial and stimuli filtering/selection and shows the general statistics for the participants.

Parameter	Dimension unit	Description
Participant		Participant name
Participant Property 1..n		Participant properties values, one column per property with the property name as column header
Right Eye Deviation X	[°]	Calibration deviation on X for right eye data (only available for RED experiments)
Right Eye Deviation Y	[°]	Calibration deviation on Y for right eye data (only available for RED experiments)
Left Eye Deviation X	[°]	Calibration deviation on X for left eye data (only available for RED experiments)

Parameter	Dimension unit	Description
Left Eye Deviation Y	[°]	Calibration deviation on Y for left eye data (only available for RED experiments)
Tracking Ratio	[%]	Number of non-zero gaze positions divided by sampling frequency multiplied by run duration, expressed in percent. (computed on right eye data if available)

Validation Results Overview

The participant statistics is independent of the participant, trial and stimuli filtering/selection and shows the validation results for the participants.

Parameter	Dimension unit	Description
Participant		Participant name
Type		Type of check: Validation or Quantitative Feedback
Iteration		Number of times the validation was performed
Right Eye Deviation X	[°]	Deviation on X for right eye data (only available for RED experiments)
Right Eye Deviation Y	[°]	Deviation on Y for right eye data (only available for RED experiments)
Left Eye Deviation X	[°]	Deviation on X for left eye data (only available for RED experiments)
Left Eye Deviation Y	[°]	Deviation on Y for left eye data (only available for RED experiments)

AOI Overview

Parameter	Dimension unit	Description
Stimulus	[ms]	Stimulus name
Stimulus Condition 1..n		Stimulus conditions values, one column per condition with the condition name as column header
AOI Name		Area of interest name
AOI Group		AOI Group name
AOI Scope		AOI Scope(global: AOI present in all stimuli, local: AOI present in one stimulus only)
AOI Order		AOI depth order on the Z axis
AOI Size	[px]	Size of AOI in pixel - the part overlapping the stimulus is taken into consideration, parts outside the stimulus area are ignored. For dynamic AOIs the size is the sum of sizes at each sample timestamp (as defined above) where the AOI is visible averaged by the number of samples where the AOI is visible.
AOI Coverage	[%]	AOI size in comparison to Stimulus size
Time to First Appearance	ms	Time when the AOI becomes visible for the first time relative to the trial start
Appearance Count		Sum of all appearances of one AOI within the stimulus (the number of slices where the AOI was visible) (*)

Parameter	Dimension unit	Description
Visible Time	[ms]	Sum of the AOI appearance durations within the stimulus (sum of all durations where the AOI was visible within the stimulus) (*)
Visible Time	[%]	Visible time (ms) / stimulus duration (*)

(*) Values are computed only for movie stimuli.

Connected Statistics

Noldus Observer

Parameter	Dimension unit	Description
Time	[ms]	Time of the event
Type		State start/State stop/Point
AOI Name		Area of interest name

The integration is described in a dedicated manual available from Noldus.

BrainVision Analyzer

Parameter	Dimension unit	Description
Time	[us]	Timestamp of the eye sample (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for other data).

Parameter	Dimension unit	Description
Type		Message/Sample
Trial		Trial index
L Raw X	[px]	Left eye horizontal pupil position
L Raw Y	[px]	Left eye vertical pupil position
R Raw X	[px]	Right eye horizontal pupil position
R Raw Y	[px]	Right eye vertical pupil position
L Dia X	[px]	Left eye horizontal pupil diameter
L Dia Y	[px]	Left eye vertical pupil diameter
R Dia X	[px]	Right eye horizontal pupil diameter
R Dia Y	[px]	Right eye vertical pupil diameter
L CR1..n X	[px]	Left eye horizontal corneal reflex positions
L CR1..n Y	[px]	Left eye vertical corneal reflex positions
R CR1..n X	[px]	Right eye horizontal corneal reflex positions
R CR1..n Y	[px]	Right eye vertical corneal reflex positions
L POR X	[px]	Left eye horizontal gaze position
L POR Y	[px]	Left eye vertical gaze position
R POR X	[px]	Right eye horizontal gaze position
R POR Y	[px]	Right eye vertical gaze position
Timing		Quality values
Latency		Quality values
L AOI Hit		Name of the topmost area of interest (AOI) that is hit by current sample

Parameter	Dimension unit	Description
		position on the left eye
R AOI Hit		Name of the topmost area of interest (AOI) that is hit by current sample position on the right eye
Trigger		Hardware trigger numerical value (can be configured 410 to have a hexadecimal, decimal or binary format)
L Event Info		Type of event detected on the left eye for the interval containing this sample (fixation, saccade, blink)
R Event Info		Type of event detected on the right eye for the interval containing this sample (fixation, saccade, blink)
Stimulus		Stimulus name

If the "Message" entry is checked in the Select Metrics tab is then the full message text is written for the message rows in the first column after the Trial column.

BIOPAC AcqKnowledge

Parameter	Dimension unit	Description
Time	[us]	Timestamp of the eye sample (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for other data).
Type		Message/Sample

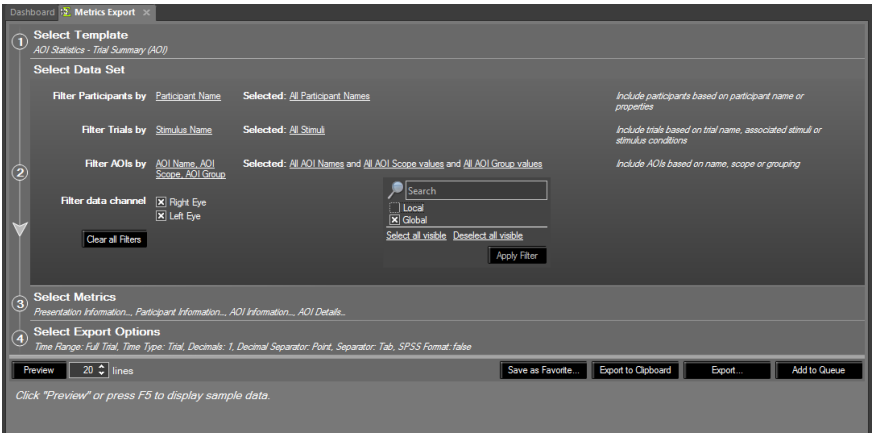
Parameter	Dimension unit	Description
Trial		Trial index
Time of Day	[h:m:s:ms]	Timestamp of the eye sample in hour:minute:sec:millisecond form
Stimulus		Stimulus name
R Raw X	[px]	Right eye horizontal pupil position
R Raw Y	[px]	Right eye vertical pupil position
L Raw X	[px]	Left eye horizontal pupil position
L Raw Y	[px]	Left eye vertical pupil position
R Dia X	[px]	Right eye horizontal pupil diameter
R Dia Y	[px]	Right eye vertical pupil diameter
R Pupil Diameter	[mm]	Right circular pupil diameter in mm
L Dia X	[px]	Left eye horizontal pupil diameter
L Dia Y	[px]	Left eye vertical pupil diameter
L Pupil Diameter	[mm]	Left circular pupil diameter in mm
R POR X	[px]	Right eye horizontal gaze position
R POR Y	[px]	Right eye vertical gaze position
L POR X	[px]	Left eye horizontal gaze position
L POR Y	[px]	Left eye vertical gaze position
R AOI Hit		Name of the topmost area of interest (AOI) that is hit by current sample position on the right eye
L AOI Hit		Name of the topmost area of interest (AOI) that is hit by current sample position on the left eye

Parameter	Dimension unit	Description
R GVEC X		Right eye gaze vector on X
R GVEC Y		Right eye gaze vector on Y
R GVEC Z		Right eye gaze vector on Z
L GVEC X		Left eye gaze vector on X
L GVEC Y		Left eye gaze vector on Y
L GVEC Z		Left eye gaze vector on Z
R EPOS X		Right eye position on X
R EPOS Y		Right eye position on Y
R EPOS Z		Right eye position on Z
L EPOS X		Left eye position on X
L EPOS Y		Left eye position on Y
L EPOS Z		Left eye position on Z
Trigger		Hardware trigger numerical value (can be configured 410 to have a hexadecimal, decimal or binary format)
R Event Info		Type of event detected on the right eye for the interval containing this sample (fixation, saccade, blink)
L Event Info		Type of event detected on the left eye for the interval containing this sample (fixation, saccade, blink)

If the "Message" entry is checked in the Select Metrics tab is then the full message text is written for the message rows in the first column after the Trial column.

8.2.3 Select Data Set

This panel allows filtering and selecting the desired data based on certain eye data characteristics such as: participant, trial, AOIs, data channels, data categories (eye events, annotations, information) and others.



Filtering is done by clicking on specific "**Filter ... by**" items and selecting the criteria you wish to filter by. For example in "**Filter participants by**" you can choose the participant name or any of the defined participant properties, such as color; or in "**Filter trials by**" you can choose to filter by stimulus name, trial name or any of the defined stimulus conditions. After checking the desired filtering criteria press the **Activate Filter** button. Each filter line has a short description on the right side of the panel.

Selecting various filters has the effect that the chosen filters appear on the right side, in the "**Selected:**" fields. Now clicking on each filter allows selecting specific items from all the experiment data matching the respective filter. For example, if you checked the participant filter categories "**Name**" and "**Color**" property then you get the filters, "**All Participant Names**" and "**All Color properties**". Clicking on any of them allows checking or unchecking specific values covered by the filter, like all the participant names and colors. Clicking the **Apply Filter** button will pick only data to be exported that matches the selected filters.

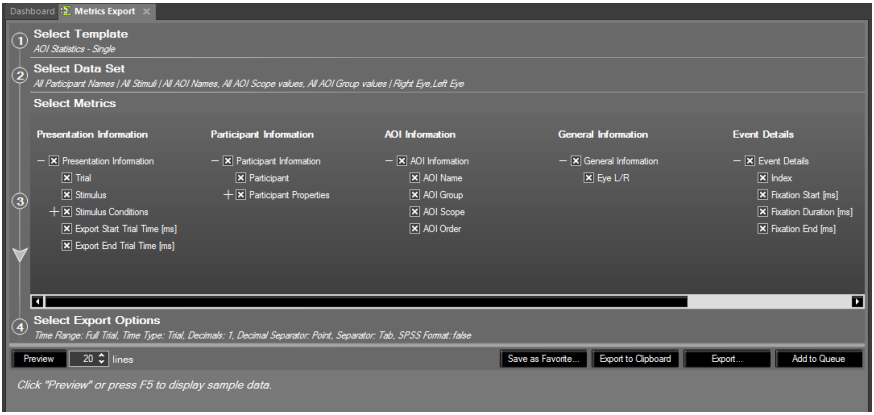
The available filters depend on the selected template. For example, for AOI Statistics templates there is a "**Filter AOIs by**" filter which allows selecting filtering by **AOI Name**, **Scope** and **Group** name, as can be seen in the screenshot above. After selecting the filters you can do the actual filtering in the "**Selected:**" fields. Clicking on **AOI Names** you get a tree of all defined AOIs grouped by stimulus and the possibility to select some of them based on various criteria. You can collapse or expand the stimulus tree with the "**Collapse all**" and "**Expand all**" options on the bottom. You can type a few characters in the search box to filter the shown AOIs that contain those characters and then you can filter by them or not by clicking "**Select all visible**" or "**Deselect all visible**" and then "**Apply Filter**".

BeGaze automatically creates an AOI labeled "White Space" that covers all areas left outside of user defined AOIs. A "White Space" AOI is generated on static stimuli only.

A preview of how the selected filters influence the resulting data can be seen by pressing the **Preview** 413 button.

8.2.4 Select Metrics

Click the **Select Metrics** panel to change the data columns that get exported. Each metric can be toggled on or off which has the result that the corresponding columns are added to the results or not. For a complete listing of available metrics check the Template 341 chapter.



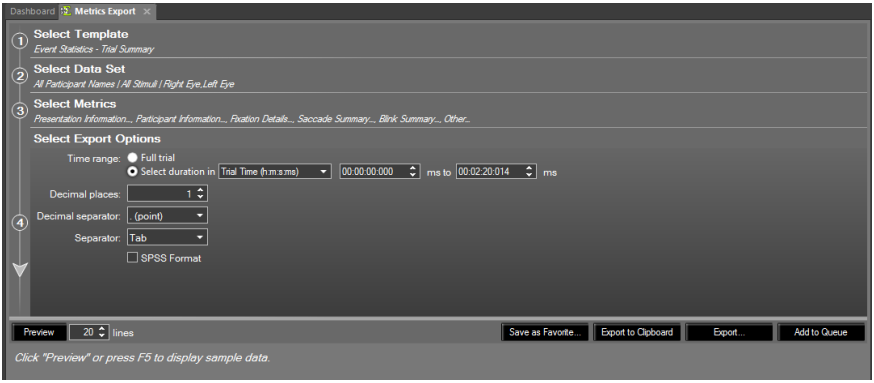
Related metrics are grouped together under a common group name, some refer to general experiment information, like **Presentation Information** or **Participant Information**, and show up in many templates, and some are specific to the template, like **AOI Information** or **Event Details**. All the entries in a category can be toggled on or off at once using the checkbox for the respective category. When the same metric is split by some criteria (left eye, right eye, total, average, etc.) they are again grouped together in a subgroup. All groups and subgroups can be expanded or collapsed by pressing the +/- sign in front of the group name.

The available metrics can also differ depending on experiment and eye tracker type used when recording the data.

A preview of how the selected metrics influence the resulting data can be seen by pressing the **Preview** 413 button.

8.2.5 Select Export Options

There are several options in this step that influence the format of the exported data.



Time Range: The settings grouped under **Time Range** limit the data to be evaluated while computing the event statistics. The default setting includes all gaze tracking data currently selected for display in the other steps. There is a toggle between **Select duration**, where a custom time window can be set, and **Full trial** data. Start and end times can be input either relative to the trials start time or as absolute raw data timestamps. If **Trial Time** is selected from the drop down then the values denote a relative time in milliseconds where each trial starts is zero, if **Raw Data** is selected then the values are given in milliseconds. You can narrow the time window with the following steps:

1. Enter the starting time in the first input field. When Trial Time is selected you can click on each group, hours, minutes, seconds, milliseconds and write a value or click on a group and use the up and down arrows to change the current value. For raw data the input is a number value indicating milliseconds.

   All gaze tracking data before this time will be filtered out.

2. Enter the ending time in the second input field. Note, that the end time needs to be larger than the start time and at most the length of the longest trial. For raw data the input is a number value indicating milliseconds.

   All gaze tracking data after this time will be filtered out.

To revert to the default setting just toggle to **Full trial**.

Glance Duration Threshold: available only for NHTSA statistics 386, changes the threshold value for the glance duration metrics

Percentile: available only for NHTSA statistics 386, changes the percentile threshold value for the glance duration metrics.

Port Status: available for Raw Data 346, Event Statistics Single 352, BIOPAC AcqKnowledge 405 and BrainVision Analyzer 403, if the data contains hardware trigger information; changes the numeric format between **Hexadecimal**, **Decimal** and **Binary**.

Decimal places: set the number of decimals that the exported values have.

Decimal separator: indicates the character used to separate the decimal places from the rest of the value. Option not present for Noldus Observer 403 template for compatibility reasons.

Separator: indicates the character used to separate values from each column (metric). While most applications will import ASCII data separated by the tab character, some applications may require another separator character. Option not present for Noldus Observer 403 and BIOPAC AcqKnowledge 405 templates for compatibility reasons.

SPSS Export: If the exported statistics contain "Trial" and "Participant" columns then this option is available. Checking this option changes the output format so that it contains a single line of data instead of having each trial data on its own line. This is useful for certain analysis done outside the program. For certain statistics (such as the Event Statistics - Single and AOI Statistics - Single), if both eyes are checked in Data Set selection, the option is not available because the output would need to contain 2 lines, one for each eye, and the SPSS format allows a single line.

Stacking Order: (available only for the Transition Matrix 397 template) toggles the "stacked" mode for the transition matrix.

Write Header: (available only for Connected Statistics 403 templates, Raw Data 346 and Event Statistics Single 352) adds a specific header in the file containing some experiment info. The Connected Statistics templates always write a header so the checkbox can't be unchecked there.

Some exported data in SPSS format might have very long lines (especially the Event Statistics - Single and AOI Statistics - Single) and won't be accepted by the SPSS tool. The limit for the text line length is 200000 bytes and there is also a limit of 64 bytes for each column name. In this case either reduce the selected metrics or stimuli and trials to the minimum needed. A workaround that allows larger files is to copy and paste the exported file content to MS Excel, save the spreadsheet and then import the excel file in the SPSS tool.

8.2.6 Preview Grid

The preview grid, on the bottom of the view, shows a number of rows from the output values. You can change the number of rows shown by changing the lines field value.

To save the currently selected metrics, filters and export options as a customized statistics template press the "**Save as Favorite...**" button above the preview grid. The new template will show up in the **Select Template** step in the new category **Favorites**. To remove a customized statistic template, go to the **Favorites** category and right click on the template item: a Delete option will appear.

It is not possible to delete the default statistic templates.

Click the **Export...** button to export the currently selected data. Select the storage location and enter a file name in the subsequent **Save as...** dialog. Or click the **Export to Clipboard** button to copy this data to the clipboard for further use in other programs, e.g. Microsoft Excel.

Click **Add to Queue** to export the selected data later, during a batch run of multiple items.

The first line of the exported data file lists the column header names. If you import the ASCII file to another application, these names are then available for identifying the columns.

8.2.7 Comparison with previous Event Statistics

This chapter shows the statistics template names and metrics changes between the previous Event Statistics templates and the current Metrics Export ones.

The tables show on the first row the Begaze version the column refers to and on the second row the equivalent template names between the two versions. The rest of the rows show metrics that changed names between versions. For metrics or templates that where not present in the previous version the table cell shows "*n/a*" (not available).

Begaze 3.5	Begaze 3.6
n/a	Raw Data 346

The Raw Data template did not exist in Event Statistics templates. Similar data was obtained in the previous version from the Export Raw Data dialog.

Begaze 3.5	Begaze 3.6
Fixation / Saccade / Blink / Annotation Details / User Event Statistics	Event Statistics - Single 352
Stimulus Properties	Stimulus Condition 1..n
Subject	Participant
n/a	Participant Property 1..n
Start Time [ms]	Export Start Trial Time [ms]

End Time [ms]	Export End Trial Time [ms]
n/a	Tracking Ratio
n/a	Category Group
n/a (or Event for User Events)	Category
Number	Index
Fixation / Saccade / Blink Start (or Time Trial for User Event or Start Time Trial for Annotation Details)	Event Start Trial Time
Fixation / Saccade / Blink End (or End Time Trial for Annotation Details)	Event End Trial Time
Fixation / Saccade / Blink Duration	Event Duration
n/a	Event Start Raw Time
n/a	Event End Raw Time
n/a	Event Start Video Time
n/a	Event End Video Time
Position XY	Fixation Position X and Y (2 columns)
Average Pupil Size	Fixation Average Pupil Size X and Y (2 columns)
Average Pupil Diameter	Fixation Average Pupil Diameter
Dispersion	Fixation Dispersion X and Y (2 columns)
Start Position XY	Saccade Start Position X and Y (2 columns)
End Position XY	Saccade End Position X and Y (2 columns)

Amplitude	Saccade Amplitude
Acceleration Average	Saccade Acceleration Average
Acceleration Peak	Saccade Acceleration Peak
Deceleration Peak	Saccade Deceleration Peak
Velocity Average	Saccade Velocity Average
Velocity Peak	Saccade Velocity Peak
Peak Velocity at	Saccade Peak Velocity at
n/a	AOI Name
n/a	AOI Group
n/a	AOI Scope
n/a	AOI Order
n/a	Port Status
n/a (or Name for Annotation Details)	Annotation Name
n/a (or Description for Annotation Details)	Annotation Description
n/a (or Tags for Annotation Details)	Annotation Tags
n/a (or Content 2 for User Events)	Mouse Position X
n/a (or Content 2 for User Events)	Mouse Position Y
n/a (or Content 2 for User Events)	Scroll Direction X
n/a (or Content 2 for User Events)	Scroll Direction Y
n/a (or Content for User Events)	Content
n/a	Emotive Affective Values 1..n
n/a	ICA Values 1..n

The Event Statistics - Single template merges the Blink, Fixation, Saccade Annotation Details and User Event Statistics templates from the previous version. To get results that resemble each of the previous templates you can do the following (and don't forget that these custom selections can be saved as new templates by using the **Save as Favorite...** button):

- To obtain a Blink Details equivalent: Check "Blinks" only in the Select Data Set step and check only "Trial", "Stimulus", "Export Start Trial Time", "Export End Trial Time", "Participant", "Eye L/R", "Index", "Event Start Trial Time", "Event End Trial Time" and "Event Duration" (optionally check "Participant Properties") in the Select Metrics step.
- To obtain a Saccade Details equivalent: Check "Saccades" only in the Select Data Set step and check only "Trial", "Stimulus", "Export Start Trial Time", "Export End Trial Time", "Participant", "Eye L/R", "Index", "Event Start Trial Time", "Event End Trial Time", "Event Duration" and all the items under the "Saccade Details" metrics category (optionally check "Participant Properties") in the Select Metrics step.
- To obtain a Fixation Details equivalent: Check "Fixations" only in the Select Data Set step and check only "Trial", "Stimulus", "Export Start Trial Time", "Export End Trial Time", "Participant", "Eye L/R", "Index", "Event Start Trial Time", "Event End Trial Time", "Event Duration" and all the items under the "Fixation Details" metrics category (optionally check "Participant Properties") in the Select Metrics step.
- To obtain an Annotation Details equivalent: Check "Annotations" only in the Select Data Set step and check only "Trial", "Stimulus", "Participant", "Event Start Trial Time", "Event End Trial Time", "Event Duration" and all the items under the "Annotation Details" metrics category in the Select Metrics step.
- To obtain a User Event Statistics equivalent: Check "Information" only in the Select Data Set step and check only "Trial",

"Stimulus", "Participant", "Category", "Event Start Trial Time", "Event Start Raw Time", and all the items under the "Information Details" metrics category in the Select Metrics step.

Begaze 3.5	Begaze 3.6
Event Detailed Statistics	Event Statistics - Trial Summary 357
n/a	Stimulus Condition 1..n
Subject	Participant
n/a	Participant Property 1..n
Start Time [ms]	Export Start Trial Time [ms]
End Time [ms]	Export End Trial Time [ms]

Begaze 3.5	Begaze 3.6
Event Summary Statistics	Event Statistics - Selection Summary 360
Start Time [ms]	Export Start Trial Time [ms]
End Time [ms]	Export End Trial Time [ms]

Begaze 3.5	Begaze 3.6
AOI Fixations	AOI Statistics - Single 364
n/a	Trial

n/a	Stimulus
Stimulus Properties	Stimulus Condition 1..n
Area of Interest	AOI Name
n/a	AOI Group
n/a	AOI Scope
n/a	AOI Size
n/a	AOI Coverage
n/a	Appearance Count
n/a	Visible Time
n/a	Export End Trial Time [ms]
n/a	Export Start Trial Time [ms]
n/a	Eye L/R
Subject	Participant
n/a	Participant Property 1..n
Number	Index
Fixation Start	Event Start Trial Time
Fixation Duration	Event End Trial Time
Fixation End	Event Duration
Position XY	Fixation Position X and Y (2 columns)
Average Pupil Size	Fixation Average Pupil Size X and Y (2 columns)
n/a	Fixation Average Pupil Diameter
Dispersion	Fixation Dispersion X and Y (2 columns)

Begaze 3.5	Begaze 3.6
AOI (Group) Detailed Statistics	AOI Statistics - Trial Summary (AOI/ AOI Group) 367
Area of Interest	AOI Name
End Time [ms]	Export End Trial Time [ms]
Start Time [ms]	Export Start Trial Time [ms]
n/a	Eye L/R
Subject	Participant

Begaze 3.5	Begaze 3.6
AOI (Group) Summary Statistics	AOI Statistics - Selection Summary (AOI/AOI Group) 372
Area of Interest	AOI Name
End Time [ms]	Export End Trial Time [ms]
Start Time [ms]	Export Start Trial Time [ms]
n/a	Eye L/R
Subject Hit Count	Participant Hit Count

Begaze 3.5	Begaze 3.6
Annotation Details	AOI Annotation Statistics - Single 384

Area of Interest	AOI Name
Subject	Participant
	Stimulus
Time	AOI Annotation Start Trial Time

Begaze 3.5	**Begaze 3.6**
Annotation Details	**AOI Annotation Statistics - Selection Summary** 384
Area of Interest	AOI Name
Average Time	Average AOI Annotation Start Trial Time

Begaze 3.5	**Begaze 3.6**
NHTSA Glance Detailed Statistics	**NHTSA AOI Statistics - Single** 385
Area of Interest	AOI Name
n/a	Stimulus Condition 1..n
n/a	Eye L/R
Subject	Participant

Begaze 3.5	**Begaze 3.6**

NHTSA Glance Subject Statistics	NHTSA AOI Statistics - Trial Summary 386
Area of Interest	AOI Name
n/a	Stimulus Condition 1..n
n/a	Eye L/R
Subject	Participant

Begaze 3.5	Begaze 3.6
NHTSA Glance Summary Statistics	NHTSA AOI Statistics - Selection Summary 387
Area of Interest	AOI Name
n/a	Stimulus Condition 1..n
n/a	Eye L/R

Begaze 3.5	Begaze 3.6
Questionnaire Statistics	Questionnaire Overview 398
Subject	Participant
n/a	Participant Property 1..n

Begaze 3.5	Begaze 3.6

Stimulus Statistics	Trial Overview 399
Subject	Participant
Property 1..n	Participant Property 1..n
Stimulus Properties	Stimulus Condition 1..n
n/a	File Name
n/a	Trial Start Raw Time
Duration	Trial Duration
Order	Trial Index
n/a	Tracking Ratio

Begaze 3.5	Begaze 3.6
Custom Trial Interval Statistics	Custom Trial Overview 400

Begaze 3.5	Begaze 3.6
Subject Statistics	Participant Overview 400
Subject	Participant
Property 1..n	Participant Property 1..n
Calibration Deviation X/Y	Right/Left Eye Deviation X/Y

Begaze 3.5	Begaze 3.6
Validation Results Statistics	Validation Results Overview 401
Subject	Participant
n/a	Type
Validation	Iteration
Deviation X/Y	Right/Left Eye Deviation X/Y

Begaze 3.5	Begaze 3.6
n/a	AOI Overview 402

Begaze 3.5	Begaze 3.6
Noldus Observer Export	Noldus Observer 403

Begaze 3.5	Begaze 3.6
n/a	BrainVision Analyzer 403

Begaze 3.5	Begaze 3.6

n/a	BIOPAC AcqKnowledge 405

8.2.8 Legacy: Export Raw Data

8.2.8.1 Export Raw Data

This legacy feature is still available although the same data can now be exported with more options and flexibility using the Raw Data 346 template in the Metrics Export 339 data view.

In case you want to perform further evaluation with third party software, it is possible to export the raw data to a custom delimited table in ASCII text format.

If you go to the **Export** menu and select **Legacy: Export Raw Data to File...**, a window will be displayed, containing the following tabs:

- General
- Preview

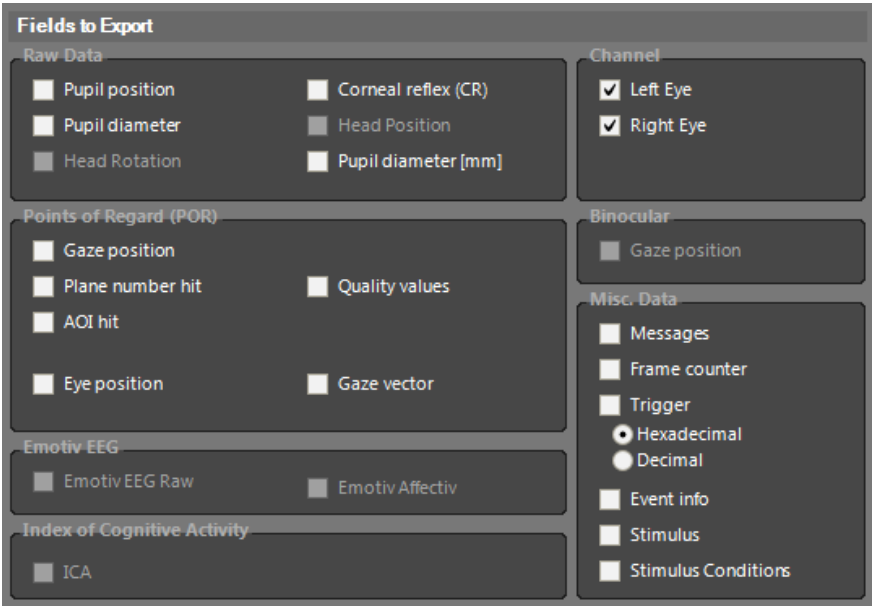
On the bottom there are two buttons for exporting the data: **Export** will export it immediately while **Add to Queue** will add it to the Export Queue 89 for later processing.

Trial selection

Select the Trials from the Experiment, whose Raw Data should be exported. For each Trial a separated file will be created.

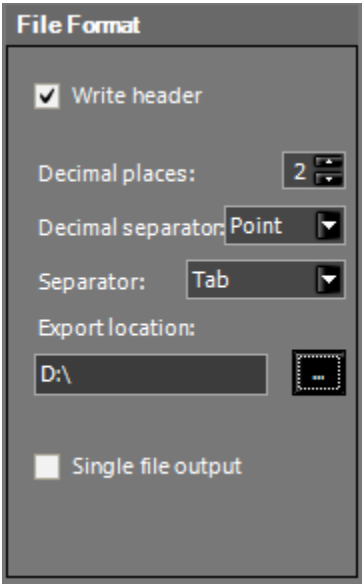
Fields to Export

Select from the available events the ones that should be contained in export file 429.



File Format

Configure the format of the export file 429.



Write Header

Select whether the Header 430 will be written in the file.

Decimal Places

Configure the format of the numerical values.

Decimal Separator

Configure the numerical decimal separator.

Separator

The separator between values can be one of the following:

- Tab
- Space

- Comma
- Semicolon

Export Location

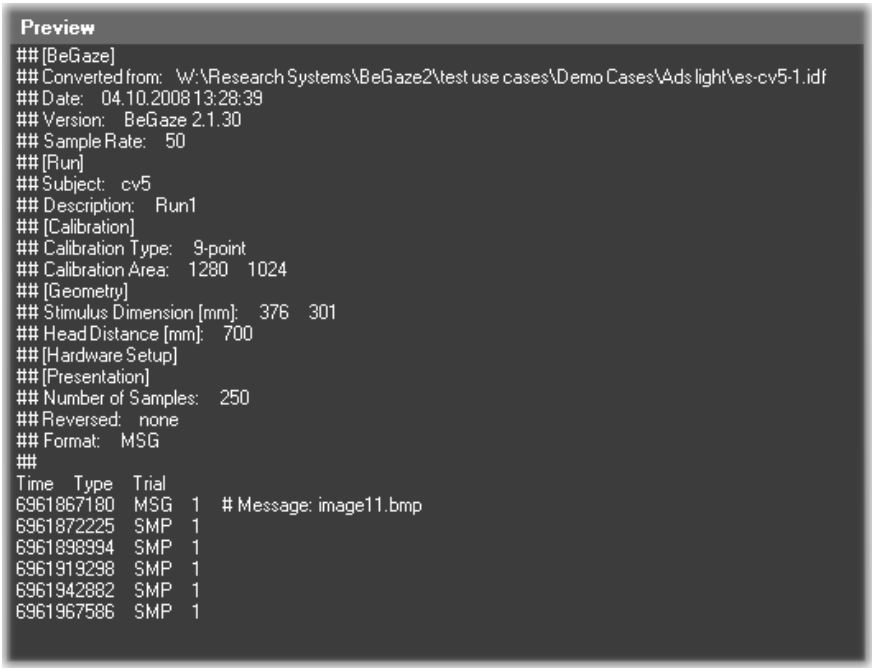
Click on  to browse for the folder or to create a new folder. BeGaze will create the file names automatically.

Single File Output

With this checked a single file per participant will be exported instead of one file for each trial.

Preview

You can preview the exact format of the export file. Note: in trial section, only a few data lines are shown.



8.2.8.2 Export Raw File Format

8.2.8.2.1 Export Raw File Format

The BeGaze export file starts with a short header 430 section, followed by the trial section 430.

The file can be opened and read with any text editor, but as the entries are tab limited, it will be best read with a spreadsheet program like Microsoft Excel or similar.

8.2.8.2.2 Header

The header consists of the following few lines:

Converted from:	Complete path of the IDF file.
Date:	Date and time of data recording. The time is the local time of the computer where the data was recorded.
Version:	Version, with which the export file is created.
Sample Rate:	Sample rate of the recording.
Subject:	Participant as written to IDF file or modified in experiment creation.
Description:	Description of Run as written to IDF file or modified in experiment creation.
Calibration Area:	Width and height of the calibration area.
Stimulus Dimension:	Width and height of the stimulus.
Head Distance:	Distance between participant and stimulus during recording.
Number of Samples:	Number of samples in the exported trial.
Reversed:	Specifies whether the recorded values were reversed on horizontal and/or vertical axis.
Format:	Format of the exported fields.

8.2.8.2.3 Trial Section

The table header description is followed by the list of samples and messages.

Raw Data Export Samples

The following fields can be exported for one sample, if available. The data can contain left channel data (L), right channel data (R) or both. In case of binocular recordings, data from both channels (named L and R) can be exported.

Time:	Timestamp of the sample (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for all other data).
Type:	The type is SMP.
Trial:	Number of current trial.
L/R Raw X [px]:	Horizontal pupil position.
L/R Raw Y [px]:	Vertical pupil position.
L/R Dia X [px]:	Horizontal pupil diameter.
L/R Dia Y [px]:	Vertical pupil diameter.
L/R Pupil Diameter [mm]:	Circular pupil diameter in mm.
L/R CR1 X [px]:	Horizontal corneal reflex positions.
L/R CR1 Y [px]:	Vertical corneal reflex positions.
L/R/B POR X [px]:	Horizontal gaze position (B is the binocular gaze position and exists only for ETG 30 data)

L/R/B POR Y [px]:	Vertical gaze position (B is the binocular gaze position and exists only for ETG 30 data)
Timing:	Quality values
Pupil Confidence	Quality values: confidence that the pupil was detected
L/R Plane:	Plane number
L/R AOI Hit:	Name of area of interest (AOI) that is hit by current sample.
H POS X [mm]:	Head position on X
H POS Y [mm]:	Head position on Y
H POS Z [mm]:	Head position on Z
H ROT X [°]:	Head rotation on X
H ROT Y [°]:	Head rotation on Y
H ROT Z [°]:	Head rotation on Z
L/R EPOS X [mm]:	Eye position on X
L/R EPOS Y [mm]:	Eye position on Y
L/R EPOS Z [mm]:	Eye position on Z

L/R GVEC X:	Gaze vector on X
L/R GVEC Y:	Gaze vector on Y
L/R GVEC Z:	Gaze vector on Z
Trigger	Hardware trigger value (can be configured to have a hexadecimal, decimal or binary format)
Frame:	Frame counter
L/R Event Info:	Type of event detected for the interval containing this sample (fixation, saccade, blink)
Stimulus:	Stimulus associated with this sample
[Stimulus conditions]:	Several columns appear if stimulus conditions are defined, one column per condition
17 Emotiv EEG Raw columns	Emotiv EEG Raw data (exists only for EEG experiments 136)
5 Emotiv Affectiv columns	Emotiv Affectiv data (exists only for EEG experiments 136)
L/R/B ICA	Index of Cognitive Activity (see ICA 137)

For data created with the ETG Smart Recorder 40 Version 1.0 the exported values are 0-calibrated, except for the B POR X/Y data which is calibrated according to the settings in the Calibration 151 data view.

Raw Data Export Messages

The following fields are exported for one message, along with the actual message:

Time:	Timestamp of the sample.
Type:	The type is MSG
Trial:	Number of current trial

If stimulus conditions 88 are defined then they are added after the other columns, one column per stimulus condition. The stimulus condition value corresponding to the stimulus associated with the trial will be written on each row.

Note, that the origin of the calibration area is always in the upper left corner.

8.2.9 Legacy: Export Events

8.2.9.1 Export Events

This legacy feature is still available although the same data can now be exported with more options and flexibility using the Event Statistics Single 352 template in the Metrics Export 339 data view.

In case you want to perform further evaluation with third party software, it is possible to export the events to a custom delimited table in ASCII text format.

If you go to the **Export** menu and select **Legacy: Export Event Data to File...**, a window will be displayed, containing the following tabs:

- General
- Preview

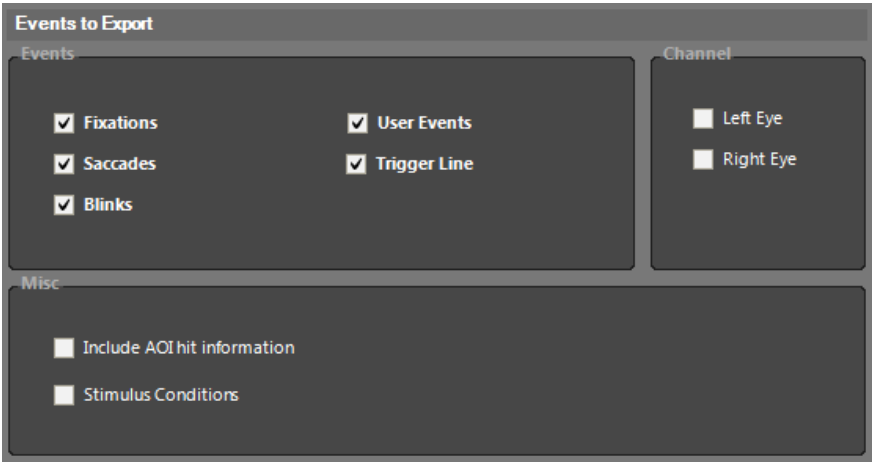
On the bottom there are two buttons for exporting the data: **Export** will export it immediately while **Add to Queue** will add it to the Export Queue 89 for later processing.

Trial selection

Select the Trials from the Experiment, whose Events should be exported. For each Trial a separated file will be created.

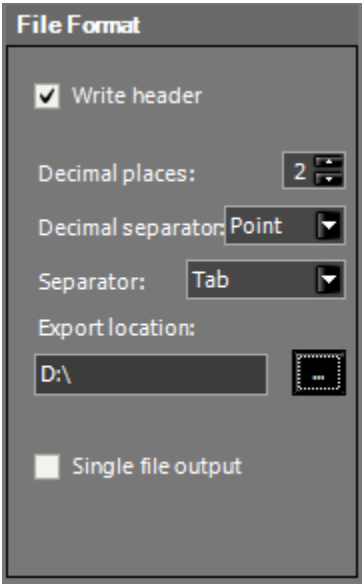
Events to Export

Select from the available events the ones that should be contained in export file 438.



File Format

Configure the format of the export file 438.



Write Header

Select whether the Header 438 will be written in the file.

Decimal Places

Configure the format of the numerical values.

Decimal Separator

Configure the numerical decimal separator.

Separator

The separator between values can be one of the following:

- Tab
- Space

- Comma
- Semicolon

Export Location

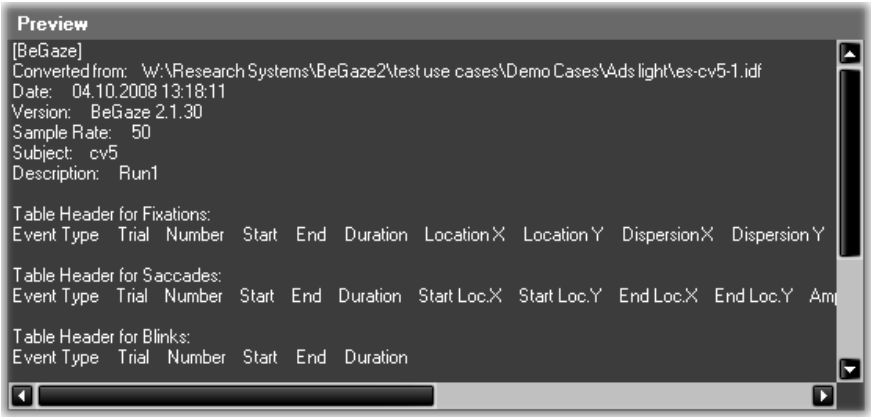
Click on  to browse for the folder or to create a new folder. BeGaze will create the file names automatically.

Single File Output

With this checked a single file per participant will be exported instead of one file for each trial.

Preview

You can preview the exact format of the export file. Note: in trial section, only a few data lines are shown.



The Export file may include information about:

- the start and the end time of the fixation, the fixation duration.
- the gaze coordinates at the beginning of the fixation.
- the dispersion during the fixation in [pixels]

- the AOI hit during the fixation
- the amplitude of a saccade
- the maximum speed and acceleration of the saccade and the time when these maxima occurred

In case the experiment 464 contains head tracking data, additionally will be exported:

- the image name connected to a plane during a fixation on this plane
- the plane number during a fixation on it

8.2.9.2 Export File Format

8.2.9.2.1 Export File Format

The BeGaze export file starts with a short header 438 section, followed by the trial section 439.

The file can be opened and read with any text editor, but as the entries are tab limited, it will be best read with a spreadsheet program like Microsoft Excel or similar.

8.2.9.2.2 Header

The header consists of the following few lines:

Converted from:	**Complete path of the IDF file.**
Date:	Date and time of the export.
Version:	Version, with which the export file is created.
Sample Rate:	Sample rate of the recording.
Subject:	Participant as written to IDF file or modified in experiment creation.
Description:	Description of Run as written to IDF file or modified in experiment creation.

8.2.9.2.3 Trial Section

The table header description is followed by the list of events.

Every event type has a different table header.

Event Export Fixations

The table header for fixations applies for all lines starting with the word Fixation.

The table headers mean the following:

Event Type:	fixation, L for left or R for right (or B for binocular in ETG 30 experiments)
Trial:	number of current trial
Number:	index of current fixation
Start:	start time in microseconds (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for all other data).
End:	end time in microseconds (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for all other data).
Duration:	duration of fixation in microseconds
Location X:	horizontal location of fixation in pixel on calibration area
Location Y:	vertical location of fixation in pixel on calibration area
Dispersion X:	horizontal dispersion of fixation in pixel
Dispersion Y:	vertical dispersion of fixation in pixel

AOI hit:	name of area of interest (AOI) that is hit by current fixation. The field could be '-', if no AOI is hit.
Image:	name of image corresponding to the plane where the AOI hit happened (column exists for experiments with head tracking data only).
Plane:	plane number where the event happened (column exists for experiments with head tracking data only)
Avg. Pupil Size X:	average pupil size on the horizontal direction during the fixation (in pixels)
Avg. Pupil Size Y:	average pupil size on the vertical direction during the fixation (in pixels)
[Stimulus conditions]:	several columns appear if stimulus conditions are defined, one column per condition

Event Export Saccades

The table header for saccades applies for all lines starting with the word Saccade.

The table headers mean the following:

Event Type:	saccade, L for left or R for right (or B for binocular in ETG 30 experiments)
Trial:	number of current trial
Number:	index of current saccade
Start:	start time in microseconds (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for all other data).
End:	end time in microseconds (microseconds since the start of the iViewNG application for ETG data or

	microseconds since start of iViewX PC for all other data).
Duration:	duration of saccade in microseconds
Start Pos X:	horizontal start position of saccade in pixel on calibration area
Start Pos Y:	vertical start position of saccade in pixel on calibration area
End Pos X:	horizontal end position of saccade in pixel on calibration area
End Pos Y:	vertical end position of saccade in pixel on calibration area
Amplitude:	length of saccade in degrees
Peak Speed:	maximum speed of eye movement during current saccade
Peak Speed At:	location of speed maximum in parts of complete amplitude (a value of 0.416 means peak speed reached at 41.6% of amplitude)
Average Speed:	average velocity of current saccade in degrees per second
Peak Accel.	maximum acceleration of current saccade in deg/s2
Peak Decel.:	maximum deceleration of current saccade in deg/s2
Average Accel.	average acceleration of current saccade in deg/s2
[Stimulus conditions]:	several columns appear if stimulus conditions are defined, one column per condition

Event Export Blinks

The table header for blinks applies for all lines starting with the word Blink.

The table headers mean the following:

Event Type:	blink, L for left or R for right (or B for binocular in ETG 30 experiments)
Trial:	number of current trial
Number:	index of current blink
Start:	start time in microseconds (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for all other data).
End:	end time in microseconds (microseconds since the start of the iViewNG application for ETG data or microseconds since start of iViewX PC for all other data).
Duration:	duration of blink in microseconds
[Stimulus conditions]:	several columns appear if stimulus conditions are defined, one column per condition

Event Export User Messages

The table header for user messages applies for all lines starting with the word Blink.

The table headers mean the following:

Event Type:	user message
Trial:	number of current trial
Number:	index of current user message
Start:	start time in microseconds (since start of iView PC).
Description:	content of the message
[Stimulus conditions]:	several columns appear if stimulus conditions are defined, one column per condition

If stimulus conditions 88 are defined then they are added after the other columns, one column per stimulus condition. The stimulus condition value corresponding to the stimulus associated with the trial will be written on each row.

Note, that the origin of the calibration area is always in the upper left corner.

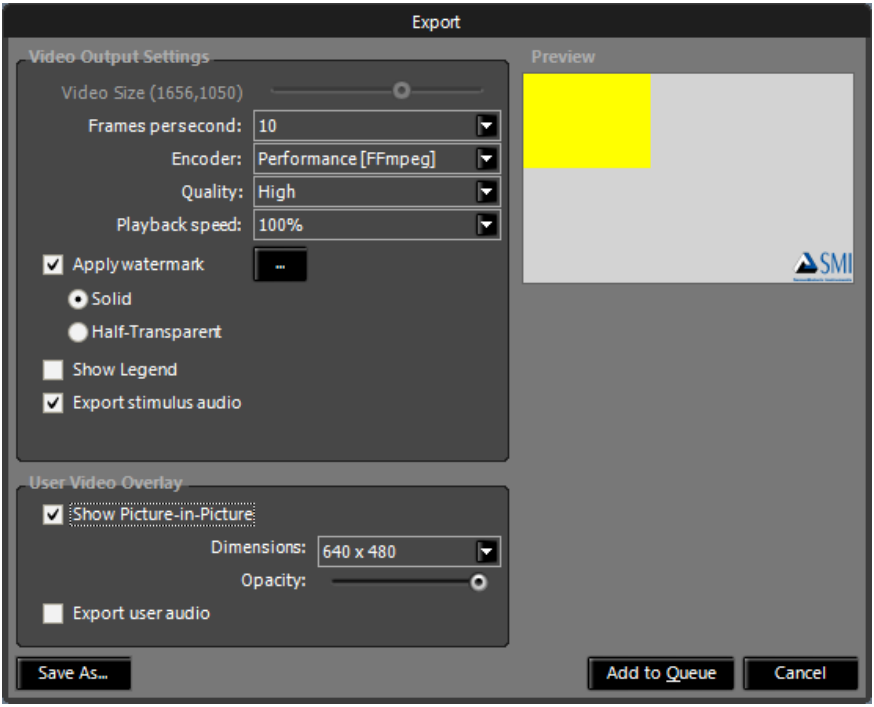
8.3 Export Media Files

8.3.1 Video Export

You can record the animated **Scan Path**, **Bee Swarm**, **Focus Map**, **Heat Map**, **Gaze Replay** or **Key Performance Indicators** replays to an AVI file.

1. From the **Export** menu, select **Export Scan Path Video...**, **Export Heat Map Video...**, etc. (text depends on the selected data view).

   The **Export** dialog opens, where you can set the recording options and start the export.



2. Press **Save As...** to immediately export the video and save it to a file. A popup dialog appears allowing you to select the desired video file name and location. Click "Save" to finish.
3. Or press **Add to Queue** to add the video export to the Export Queue 89 for later processing.

Dialog Settings

- **Video Size**: Selects an exported video size.
- **Frames per second**: This setting applies to a still image stimulus. In case of a video stimulus, the stimulus' frame rate will be adopted. Select the number of frames per second for the exported video. You can select 10, 25 or 50 frames per second or the eye tracking sampling rate. Higher frame rates result in longer export times.

- **Encoder**: Selects which video encoder to use to compress the video. Options are **Performance [FFmpeg]** (recommended, might need a free MKV format decoder installed), **Legacy Default [Xvid]** and **Compatibility [WMV3]**. Note, that for XVID and WMV export to work you need to install the codecs from the product installation CD if not already installed.
- **Quality**: Chooses between High and Normal video quality levels.
- **Playback speed**: Chooses the speed of the exported video playback (in comparison to the normal play speed of the stimulus). Similar to the playback speed in the player control.
- **Apply Watermark**: Overlay a watermark image over the exported video. The overlay can be Solid or Half Transparent. You can also select a custom image by pressing the button "...". The location of the watermark can be changed by dragging it on the gray surface on the right.
- **Show Legend**: For plugins that can show a color legend (Heat Map, gridded AOIs) this setting toggles the visibility of such legend in the exported video.
- **Export Stimulus Audio**: Toggles audio from the stimulus (if it exists) in the exported video.
- **Time Overlay**: Shows a time overlay on the exported video, either as time from the start of the trial in hour:minute:second.millisecond format (**Trial** option), or as the corresponding eye sample timestamp at the beginning of the video frame in milliseconds (**Timestamp** option).

For experiments that contain user videos (user data recorded with a webcam) several other options are available. If no used data exists the **User Video** options are grayed out.

- **Show Picture-in-Picture**: If checked the user video is overlayed as a smaller image (picture-in-picture style) inside the animated data visualization.
  - **Dimensions**: Size of the user video to embed in the main video.

  - o **Opacity**: Selects the opacity level of the user video. Moving the slider to the left fades out the user video more.

- **Export User Audio**: If checked the sound from the user video is used as the sound for the exported AVI (if the stimulus is a video with sound then this setting replaces the stimulus sound with the user sound)
- **User Video Location**: The yellow rectangle can be dragged on the gray surface to set the position of the user video relative to the main video in the exported AVI.

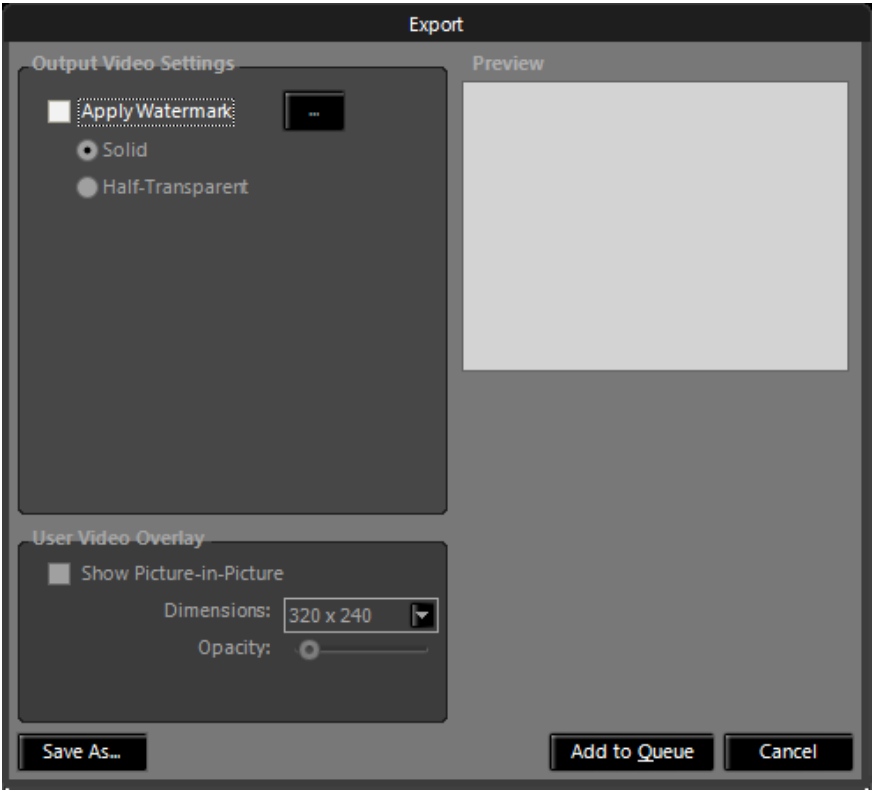

For EEG experiments additional options are available, see Emotiv EEG information 134.


All exported videos have a standard stereo wave audio track (PCM format, 2 channels, 44kHz), except when using the FFmpeg encoder, where the audio is compressed to open format FLAC to save space (installing a free FLAC decoder may be needed if sound doesn't play in the exported videos). The input video stimuli should also be in PCM format in order to be processed.

8.3.2 Image Export

You can exports the currently selected view in any data view to an image file. For all the views that also offer a Video Export option, there is similar

1. From the **Export** menu, select **Save Image...**. For data views that support video export the **Export** dialog opens, which is similar to the video export 443 dialog.



2. Press **Save As...** to immediately export the image and save it to a file. A popup dialog appears allowing you to select the desired image file name and location. Click "Save" to finish.
3. Or press **Add to Queue** to add the video export to the Export Queue 89 for later processing. Image exports in particular are exported immediately so they will show up as "done" in the Export Queue.

Dialog Settings

- **Apply Watermark**: Overlay a watermark image over the exported video. The overlay can be Solid or Half Transparent. You can also select a custom image by pressing the button "...". The location of the

watermark can be changed by dragging it on the gray surface on the right.

For experiments that contain user videos (user data recorded with a webcam) several other options are available. If no used data exists the **User Video** options are grayed out.

- **Show Picture-in-Picture**: If checked the user video is overlayed as a smaller image (picture-in-picture style) inside the animated data visualization.
  - **Dimensions**: Size of the user video to embed in the main video.
  - **Opacity**: Selects the opacity level of the user video. Moving the slider to the left fades out the user video more.

8.3.3 Optimizing AVI Videos

The real-time video display and edit functions require appropriate computing resources. While it is necessary to use a modern and powerful PC, it is possible to optimize video data for use with BeGaze. The video file conversion described below will give a faster response while editing AOIs and working with the video data during analysis.

All video streams are stored as a sequence of single images. To save disk space or transport bandwidth, the following techniques are used:

- The stored image frames are compressed, which normally means that an algorithm is used to encode and decode the single image frames. Most of the image codecs (“Coder/Decoder”) will discard visible information for better compression. There is a tradeoff between file size and visible details.
- If you store images frame after frame, the resulting file size is huge even if the frames are compressed. For this reason, only some frames are stored completely – as “key frames”. All frames following a key frame are generated based on the key frame with additional transformations applied. A high compression video codec will insert key frames only, if it detects major scene changes in the base material. While this is fine for sequential watching, stepping some frames backward requires a lot of

calculation. There is also a tradeoff between file size and necessary CPU resources.

- To optimize the user experience for the standard use case “watching the video”, post-processing is applied while reading the video file and displaying it’s contents on the screen. This includes for example to sharpen the video, video scaling or de-interlacing TV material for a non-interlaced computer monitor. There is a tradeoff between screen rendering quality and CPU resources.

BeGaze works best with the customized Xvid Solutions MPEG-4 codec (XMP-4) installed during BeGaze setup. The post-processing configuration for this codec, which is also applied during setup, is optimized for editing and analyzing purposes.

HED Videos or videos been used or produced with Experiment Center are already recorded in the correct video format.


The XMP-4 codec is compatible to standard Xvid and DivX codecs for playback.

8.3.4 Background Information

The AVI (“Audio Video Interleaved”) container file format is highly suitable for editing purposes. The file format was invented in the 1990’s, with the developing focus on CPU resources with no copy/edit protection nor internet distribution in mind. One of the major drawbacks of this format is the CBR (“Constant Bit Rate”) audio support. It is possible to add VBR (“Variable Bit Rate”) audio material – but this violates the original format specification which may trigger viewer incompatibilities. VBR audio is used most likely for internet video or converted DVD material while self-recorded material usually has CBR audio. If you experience audio dropouts or audio-lag, you can extract the audio file from the AVI file, convert the audio using a CBR codec and re-include the CBR audio to a new AVI file. Another option is to use a special version of VirtualDub called “Nandub” for writing an AVI with VBR audio.

Workspace Reference

Chapter

9 Workspace Reference

9.1 Menu Commands

The following gives an overview of the menu commands:

File

New Experiment from Folder...	Creates an experiment on the basis of a results folder which has been stored by SMI Experiment Center or SMI iViewETG.
Manual Experiment Creation...	Starts the Create Experiment wizard 63 to create a new experiment.
Open Experiment...	Opens a dialog box to select a saved experiment from the database 465.
Close Experiment	Closes the current experiment.
Multi User Gaze Mapping	Handles experiment owner and password for multi-user experiment handling.
Automated Semantic Gaze Mapping	Handle importing and exporting of automatically mapped gaze data 195.
Collect Smart Recorder Data...	Allows experiment data collection from connected Smart Recorders.
Save Experiment	Saves the current experiment to the database 465.
Save Experiment As...	Saves the current experiment as a new experiment in the database 465.
Annotation Editor...	Opens the Define Annotations 83 dialog where new annotation types can be defined.
Modify Experiment...	Opens the Modify Experiment wizard 78, where all parameters used to create an

	experiment can be changed.
Adjust Event Detection...	Opens the dialog to change and edit the event detection parameters.
Delete Experiment from Database...	Opens a dialog to delete a saved experiment from the database 465.
Backup Experiment to File...	Opens a dialog to select a saved experiment from the database 465. A backup of the selected experiment will be created in a file.
Restore Experiment from File...	Opens a file selection dialog to select and restore an experiment from file.
Print Preview	Opens the print preview.
Print...	Opens the printing dialog.
Global Settings...	Opens a dialog that allows to select another location for the database 465 or to change the default behavior.
Reset Plugin Detection	On the next run of BeGaze, the available data views will be dynamically detected.
Recent Experiments	Opens a sub menu with the last opened experiments.
Quit	Closes BeGaze.

View

Close Selected View	Closes the selected view.
Close All	Closes all opened views.
Close All but Selected View	Closes all the views except selected one.
Toolbar	Toggles activation/deactivation of the toolbar 455.

Analysis

Calibration	Opens the Calibration 151 data view (available for Smart Recorder Version 1.0 only).
Custom Trial Selector	Opens the Custom Trial Selector 154 data view.
AOI Editor	Opens the AOI Editor 161 data view.
Semantic Gaze Mapping	Opens the Semantic Gaze Mapping 187 data view.
Gaze Replay	Opens the Gaze Replay 198 data view.
Bee Swarm	Opens the Bee Swarm 202 data view.
Scan Path	Opens the Scan Path 209 data view.
Focus Map	Opens the Focus Map 221 data view.
Heat Map	Opens the Heat Map 228 data view.
Key Performance Indicators	Opens the Key Performance Indicators 236 data view.
Gridded AOIs	Opens the Gridded AOIs 249 data view.
AOI Sequence Chart	Opens the AOI Sequence 259 data view.
Binning Chart	Opens the Binning Chart 264 data view.
Proportion of Looks	Opens the Proportion of Looks 271 data view.
Line Graph	Opens the Line Graph 306 data view.

Export

Export Smart Recorder Raw Data...	Exports the experiment original data as a regular set of separate IDF, video and other files. Option is available only when

	the dashboard tab is focused and the experiment was created from a Smart Recorder data file (imported from the Smart Recorder).
Export [...] Video...	Exports the currently selected view to a video file. These Menu commands are available only if the corresponding data views are activated.
Save Image...	Exports the currently selected view to an image file.
Copy Image to Clipboard	Copies the graph/chart from the currently selected view to clipboard. Afterwards, it can be pasted into other third party applications.
Show Export Queue...	Shows the current list of items (images, videos and other exported items) that were added to the export queue.
Open Experiment Export Folder	Opens in Windows Explorer the configured export folder where export items from the current experiment are placed.
Collect Log Files...	Saves an archive of all the BeGaze log files to the selected folder.
Start RTA Recording...	Starts a Retrospective Think Aloud 318 video recording.
Metrics Export	Opens the Metrics Export 339 data view.
Reading Statistics	Opens the Reading Statistics 279 data view.

Help

Help Topics	Opens this manual

Check for Updates...	Opens a dialog to check for Experiment Suite updates.
About BeGaze...	Shows general information about BeGaze (see About Box 462).

9.2 The Toolbar

The toolbar is at the top of the workspace. It gives you short-cuts to important features.

Here is an overview of the buttons and its meanings:

General buttons

Creates an experiment on the basis of a results folder which has been stored by SMI Experiment Center or SMI iViewETG

Opens a dialog to select an existing experiment

Saves the current experiment

Prints the current diagram.

Opens a dialog to remove existing experiment(s)

Experiment definition

Opens the Calibration 151 (available for Smart Recorder Version 1.0 only)

 Opens the Custom Trial Selector 154

 Opens the AOI Editor 161

 Opens the Semantic Gaze Mapping 187

Data Views

 Gaze Replay 198: displays a quick gaze data overlay over all the stimulus images in the experiment

 Bee Swarm 202: displays raw gaze data overlay over the stimulus image

 Scan Path 209: displays gaze data overlay over the stimulus image

 Focus Map 221: shows gaze patterns over the stimulus image visualized as a transparent map

 Heat Map 228: shows gaze patterns over the stimulus image visualized as a colored map

Key Performance Indicators 236: displays relevant statistical data for each defined AOI over the stimulus image

 Gridded AOIs 249: displays relevant statistical data for an automatically defined AOI grid over the stimulus image

 AOI Sequence Chart 259: displays AOI hit order over time

 Binning Chart 264: gives a statistical overview of AOI hits per binning frame

 Proportion of Looks 271: gives a statistical overview of AOI fixations over time

 Line Graph 306: displays x and y directions of gaze data plotted as graphs over time and events displayed in a timeline

Other buttons

Opens Retrospective Think Aloud 318

Export buttons

Reading Statistics 279: computes diverse statistics based on events and AOI hits on text for reading experiments

Metrics Export 339: computes diverse metrics and statistics based on participants, trials, events, AOI hits, etc.

Opens the export queue 89 dialog.

9.3 Hotkeys Overview

Several functions of BeGaze can be executed using keyboard commands. The following tables give you an overview.

General keyboard commands

Keys	Description
[CTRL] + [N]	opens the New experiment from Folder 64 dialog
[CTRL] + [O]	opens the Open Experiment 79 dialog to select a saved Experiment from the Database 465
[CTRL] + [W]	closes the view of the selected data view
[CTRL] + [SHIFT] + [W]	closes all views of opened plug-ins
[CTRL] + [B]	closes all views of opened data views but selected one
[CTRL] + [G]	saves current settings globally

Keys	Description
[CTRL] + [E]	saves current settings for the current experiment
[CTRL] + [C]	copies selected diagram to clipboard, so it can be pasted into other third-party applications
[CTRL] + [S]	saves selected diagram to an image file
[CTRL] + [V]	saves selected diagram to a video file
[CTRL] + [R]	starts a retrospective think aloud
[F1]	opens this help file
[CTRL] + [X]	opens and closes the stimuli selection
[CTRL] + [TAB]	steps forward through the data view tabs
[CTRL] + [SHIFT] + [TAB]	steps backwards through the data view tabs
[CTRL] + [MOUSEWHEEL]	only when zoom 123 is available: zooms in and out

AOI Editor 161 keyboard commands

Keys	Description
[DEL]	deletes selected AOIs
[HOME]	jumps to first key frame
[END]	jumps to last key frame
[PG Up]	goes to next key frame
[PG Dn]	goes to previous key frame
[CTRL] + [Z]	undo action
[CTRL] + [Y]	redo action

[V]	toggles the visibility of the selected AOI
[D]	deletes current keyframe
[SHIFT] + [MOUSEWHEEL]	changes the size of a selected AOI

Semantic Gaze Mapping 187 keyboard commands

Keys	Description
[A]	move to previous event
[S]	move to next event
[D]	delete mapping for current event (removes keyframes)
[X]	exclude current event mapping from statistics

Video keyboard commands

The following keyboard commands are available to navigate in a video (see Player Control 120). They are available in the AOI Editor 161, Scan Path 209, Attention Map 221 and Key Performance Indicators 236 data views.

Keys	Description
[SPACE]	plays/pauses the presentation
Right arrow key	moves presentation one step forward according to the selected step size
Left arrow key	moves presentation one step backward according to the selected step size
Arrow up key	increases the step size
Arrow down key	decreases the step size

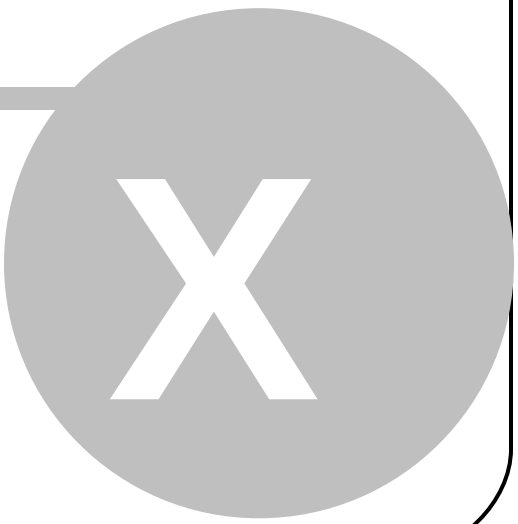
[CTRL] + [HOME]	jumps to the begin of the trial resp. the selected time window
[CTRL] + [END]	jumps to the end of the trial resp. the selected time window
[B]	Add/Edit annotation
[CTRL] + arrow left	Jumps to the previous annotation
[CTRL] + arrow right	Jumps to the next annotation
[ALT] + arrow right	Jumps to the next user event
[ALT] + arrow left	Jumps to the previous user event
[SHIFT] + arrow right	Jumps to the next annotation
[SHIFT] + arrow left	Jumps to the previous annotation
[CTRL] + [ENTER]	Add/Edit annotation
[0]	Add/Edit annotation

Line Graph 306 keyboard commands

Keys	Description
Left arrow key	moves selected time cursor to the left
Right arrow key	moves selected time cursor to the right

Appendix

Chapter



10 Appendix

10.1 About Box

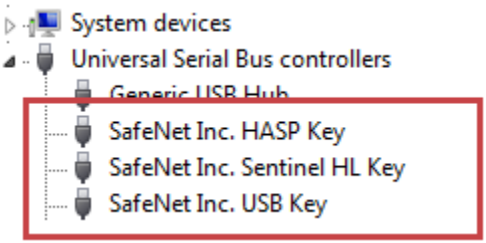
To get general information about BeGaze go to the Help menu of the Menu Commands 451 and select About BeGaze.

- BeGaze Version: The line displays the current version number.
- Copyright: The line displays copyright information.
- Home Page: Here you can visit our home page.
- Licensed data view packages: BeGaze is licensed to one computer only. Here you can see a list with all licensed data view packages.
- Copy to Clipboard: In a service case please click here to copy to clipboard detailed information about each licensed data view and report this to the customer support and service team of your local distributor or SMI 482.

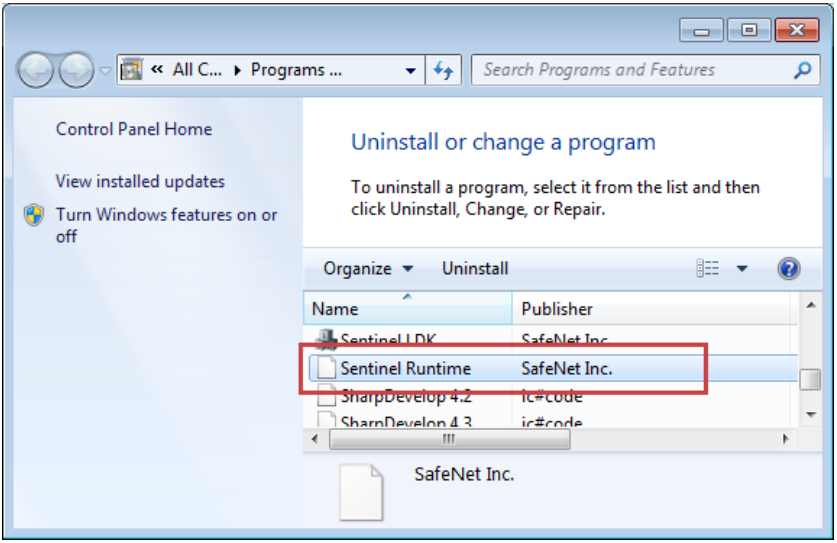
10.2 Dongle - Installation and Troubleshooting

BeGaze is dongle-protected. You may have to place the USB-dongle in the appropriate PC before you can start the program. If BeGaze displays a message box stating **HASP SRM Protection System**: **The software requires a hardware key (dongle)**, check the following:

1. The activity LED of the USB-dongle should show a red light if the dongle is plugged in.
2. If the activity LED does not show a red light, check the USB port status in the Windows hardware settings dialog. Open the Windows **Control Panel** and double click the **System** icon. Click on **Device Manager** in the left bar. Verify, that the **Universal Serial Bus controllers** tree does not show any yellow warning signs (⚠). The screen shot below shows a functional USB port with a correct Windows driver installation.



   If the dialog displays a warning sign (⚠) for a driver, right click the entry and select the **Update Driver...** command from the context menu.
3. Verify, that the dongle driver is installed properly. Open the Windows **Control Panel** and double click the **Programs and Features** icon. Check if the list shows the **Sentinel Runtime** from SafeNet Inc entry.



Note, that the **Sentinel Runtime** is installed during the installation of BeGaze. Do not deny the installation of this software during installation when prompted.

Type and status of your licenses are stored on the dongle device, not on the PC on which BeGaze is installed. With the license update procedure, the dongle is updated. That means, that you can run BeGaze on any PC when the dongle is plugged in.

10.3 Experiment Types

The eye tracking experiments fall into two major groups:

- experiments with eye tracking data (standard data)
- experiments with eye tracking and head tracking data

Dependent on the type of experiment the way data is collected differs slightly.

10.4 Database

All BeGaze experiments will be collected in a database. Once you imported the data files, images and AOI files in BeGaze, you will no longer have to keep in mind the location of these files as they are stored bundled in the database.

The path where the database is located can be changed by going to the **File** menu and selecting **Change Data Storage Location**.

Initially, the database is located in the user's data folder ("%APPDATA% \SMI\BeGaze 2\BeGaze 2 Database"). This corresponds to "AppData \Roaming" folder in Windows. For example, if your user name is "BegazeUser", the complete path to the database will be: C:\Users \BegazeUser\AppData\Roaming\SMI\BeGaze 2\BeGaze 2 Database.

If more users decide upon sharing the data base, they should change data storage location to a local folder where all have enough security rights.

Due to performance and concurrent access issues, a common network folder should not be used.

Note that the Change Data Storage Location menu command is available only if all experiments are closed.

10.5 System Requirements

Hardware requirements

BeGaze should be installed on a personal computer or laptop with the following **minimum** requirements:

OS: Windows 10

CPU: AMD or Intel Quad Core with 2.6 GHz (recommended i7 core)

RAM: minimum 2 GB

VGA: 3D accelerated, 512 MB RAM, DirectX 9 Compatible, OpenGL V2.0 compatible (V3.0 recommended)

HDD: at least 10 GB of free hard disk space

For best views the monitor should be of size 19" or larger, with a minimum resolution of 1280x1024 pixels.

Some functions of BeGaze need a printer connected.

Graphic card compatibility with OpenGL

BeGaze is using OpenGL functionality in order to achieve best performance. The graphic card needs to be compliant with the OpenGL standard V2.0 and for best support of all features OpenGL V3.0 is recommended. Unfortunately not all graphic card drivers fully support this OpenGL standard, even though they are giving compliance statements to OpenGL. This might result in corrupted visualizations in the scan path and attention map views.

The OpenGL version can be verified with the Extension Viewer from RealTech VR:
http://www.realtech-vr.com/glview/index.html

Compliant and non-compliant graphic cards for Experiment Center and BeGaze

The following list contains the tested graphic card models that are compliant (recommended = yes) and non compliant (recommended=no) with Experiment Center and BeGaze.

(This list is not intended to be complete)

Recommended	Vendor	Model	Memory (MB)	Shared Memory	OpenGL

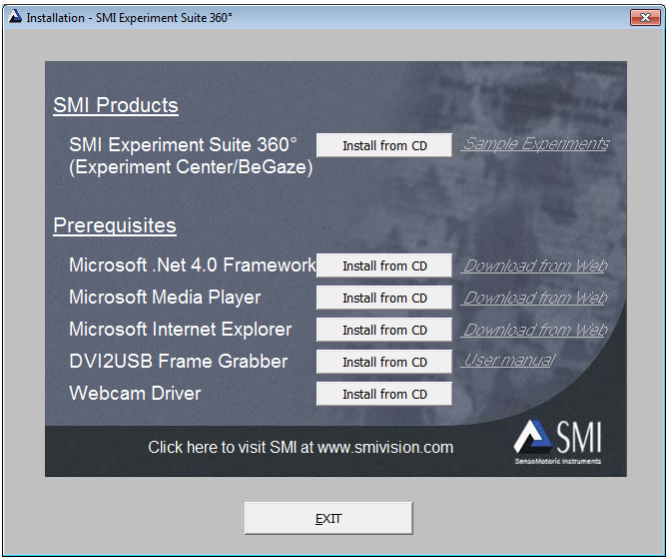
					Version
yes	Intel	GMA 3100	384	Yes	1.4
yes	NVIDIA	GeForce 7600 GS	256	No	2.1
yes	NVIDIA	GeForce 8500 GT	512	No	2.1
yes	NVIDIA	GeForce 9600 GT	512	No	3.0
yes	NVIDIA	GeForce 6200	128		2.1
yes	NVIDIA	Geforce 8800 GTS	320	No	2.1
yes	ATI	Radeon X1050	256		2.1
yes	NVIDIA	GeForce 8600 GT	256	No	3.2
yes	NVIDIA	GeForce 9500 GT	512	No	3
yes	NVIDIA	GeForce 9400	512	No	3.2
yes	ATI	Mobility Radeon 9000 IGP	128		1.3
yes	NVIDIA	GeForce GTX440	512	No	4.0
yes	NVIDIA	GeForce GTX460	768	No	4.1
yes	NVIDIA	GeForce GTX580	1536	No	4.1
yes	NVIDIA	GeForce GT440	1024		4.0
yes	NVIDIA	GeForce GTX460GS	1024		4.0
yes	NVIDIA	GeForce GTX570	1280		4.0
yes	NVIDIA	GeForce GTX660	2048	No	4.3
yes	ATI	Mobility Radeon HD 4570	512	No	3.0
yes	NVIDIA	NVS 4200M	1024	Yes	4.1
yes	Intel	Intel HD Graphics Family (i3/i5/i7 integrated)	1556	Yes	3.0

no	Matrox	Orion	32	No	
no	Matrox	G550 DH	32	No	
no	NVIDIA	GeForce 5200 FX	128	No	2.1
no	ATI	FireGL V 3400			
no	NVIDIA	GeForce 8400			
no	NVIDIA	Quadro FX1700			
no	NVIDIA	Quadro FX570			
no	NVIDIA	Quadro FX5500			
no	ATI	FireGL V 3100	128 MB		
no	ATI	Radeon HD4350	512		4.0

no	ATI	Radeon HD5450	512		4.0
no	ATI	Radeon HD5770	1024		4.0
no	ATI	Radeon HD5830	1024		4.0
no	NVIDIA	GeForce 210	512		4.0

10.6 Program Installation

The product installation media (CD-Rom) offers suitable software packages to install. Please run the auto-start application from the installation medium and click on the respective buttons to install necessary software.



The Experiment Suite includes the BeGaze as well as the Experiment Center 3.7 software. To install the Experiment Suite, proceed as follows:

1. Insert the installation media (CD-Rom).

   The auto-start application opens.

2. Click on the **Install from CD** button.

   Follow the steps of the installation wizard.

While installing the Experiment Suite, the USB dongle driver (Sentinel Runtime) is installed or updated. You may need to update the USB dongle license information. Refer to Dongle Protection and License Update 14 for details.

The Microsoft .NET Framework, the Microsoft Internet Explorer, and the Microsoft Media Player software components are available from the BeGaze installation media. These software components are also available from the Microsoft web site where you can download them for installation to the desired PC workstation. Both software components will inspect your PC workstation during installation and may issue warning messages if the PC resources do not meet the necessary performance.

Please use always the latest versions that are available for download from the Microsoft web site.

10.7 Software Limitations

SMI guarantees BeGaze to work within the following limits:

Max. number of stimuli in one experiment	250
Max. number of trials per stimulus	250
Max. number of trials per experiment	62500
Max. number of custom trials per experiment	30
Max. number of reference views per experiment	30
Max. length of video / max. number of videos	2h / 5
Max. length of video / max. number of videos	1min / 200
Max. number of participants per experiment	200

Max. length per trial / max. number of stimuli	2h / 5
Max. length per trial / max. number of stimuli	10min / 200
Max. number of AOIs per stimulus	250
Max. stimulus size (excl. Web)	1920x1200
Max. stimulus size for Web	1920x10.000
Max. screen recording resolution	1920x1200

Copyright and Trademarks

Chapter

11 Copyright and Trademarks

Copyright

Trademarks

License Agreement and Warranty

Chapter

12 License Agreement and Warranty

IMPORTANT – PLEASE READ CAREFULLY: This license agreement ("Agreement") is an agreement between you (either an individual or a company, "Licensee") and SensoMotoric Instruments GmbH ("SMI"). The "Licensed Materials" provided to Licensee subject to this Agreement include the software programs, which were installed on the equipment Licensee purchased from SMI (the "Designated Equipment") at the time of delivery of the Designated Equipment and/or other software programs SMI has granted Licensee access to (the "Software") as well as any "on-line" or electronic documentation associated with the Software, or any portion thereof (the "Documentation"), as well as any updates or upgrades to the Software and Documentation, if any, or any portion thereof, provided to Licensee at SMI's sole discretion.

By installing, downloading, copying or otherwise using the Licensed Materials, you agree to abide by the following provisions. This Agreement is displayed for you to read prior to using the Licensed Materials.

The Software is provided with and uses libraries from the FFmpeg project under the LGPLv2.1, GNU Lesser General Public License (LGPL) version 2.1 or later (the "FFmpeg Libraries"), which are not owned by SMI. The FFmpeg code owners' contact information and the LGPLv2.1 licensing terms and conditions can be found at http:// ffmpeg.org

If you do not agree with these provisions, do not download, install or use the Licensed Materials. If you have already paid for the Licensed Materials, you may return them for a full refund to: SensoMotoric Instruments, Warthestraße 21, 14513 Teltow, Germany. If the Licensed Materials were installed on Designated Equipment, you may also return such Designated Equipment for a full refund.

1. **License.** Subject to the terms of this Agreement, SMI hereby grants and Licensee accepts a non-transferable, non-exclusive, non-

assignable license without the right to sublicense to use the Licensed Materials only (i) for Licensee's business operations, (ii) on the Designated Equipment, if any, or on a back-up equipment while the Designated Equipment is inoperable, and (iii) in accordance with the Documentation. Licensee may make one copy of the Software in machine readable form for backup purposes only; every notice on the original will be replicated on the copy. Installation of the Software, if any, is Licensee's sole responsibility.

2. **Rights in Licensed Materials.** Title to and ownership in the Licensed Materials and all proprietary rights with respect to the Licensed Materials and all copies and portions thereof, remain exclusively with SMI. The Agreement does not constitute a sale of the Licensed Materials or any portion or copy of it. Title to and ownership in Licensee's application software that makes calls to but does not contain all or any portion of the Software remains with Licensee, but such application software may not be licensed or otherwise transferred to third parties without SMI's prior written consent.

3. **Confidentiality.** Licensed Materials are proprietary to SMI and constitute SMI trade secrets. Licensee shall maintain Licensed Materials in confidence and prevent their disclosure using at least the same degree of care it uses for its own trade secrets, but in no event less than a reasonable degree of care. Licensee shall not disclose Licensed Materials or any part thereof to anyone for any purpose, other than to its employees and sub-contractors for the purpose of exercising the rights expressly granted under this Agreement, provided they have in writing agreed to confidentiality obligations at least equivalent to the obligations stated herein.

4. **No Reverse Engineering**. License shall not, and shall not allow any third party to, decompile, disassemble or otherwise reverse engineer or by any means whatsoever attempt to reconstruct or discover any source code or underlying ideas, algorithms, file formats or programming or interoperability interfaces of the Software or of any files contained or generated using the Software. The obligations under this Section shall survive any termination of the Agreement. Licensee may apply to SMI at the address above for further information on the

interface between the Software and other applications; SMI will on reasonable terms and conditions provide such information as the Licensee may reasonably require to enable the Software to interoperate with its applications. These restrictions do not apply to the FFmpeg Libraries.

5. **Warranty.**
   a) If Licensed Materials show a defect during the limitation period specified in Sec. 5 d), which already existed at the time of transfer of risk, SMI will provide Licensee with a corrected version of such defective Licensed Material ("Repeat Performance").
   b) Licensed Materials are defective, if they do not conform to the written agreement between SMI and Licensee, if any, or to SMI's specification.
   c) Licensee's claims for defects are excluded:
      - for insignificant divergences from the agreement or specification;
      - for damages caused after the transfer of risk by external influences such as fire, water, currency surge, etc.; improper installation, operation, use or maintenance; use in fields of application and environmental conditions other than those expressly specified by SMI; and use in combination with other products not approved by SMI for this purpose, excessive stress or normal wear and tear;
      - for defects of the Software, which cannot be reproduced;
      - for Licensee's or a third party's modifications of Licensed Materials and results therefrom;
      - in as far as Licensee has not notified SMI of apparent defects within 5 business days of delivery and of hidden defects within 5 business days of discovery.
   d) The limitation period for warranty claims is 12 months. This does not apply in cases of fraud, intent, gross negligence and personal injury. Repeat performance does not restart the limitation period.
   e) Licensee has to always first provide SMI the opportunity for Repeat Performance within a reasonable period of time. Repeat Performance does not constitute acceptance of a legal obligation.
   f) If the Repeat Performance fails even within an additional period of time of reasonable length to be granted by Licensee, Licensee

shall, notwithstanding its claims under Section 6, if any, be entitled to rescind the contract or to claim a price reduction.

g) If the analysis of an alleged defect shows that it is not covered by the above warranty, SMI may charge for the failure analysis and correction of the defect, if any, at SMI's then applicable rates.

6. **Liability Limitations.**

a) SMI is only liable for damages caused by slight negligence if such are due to a material breach of duty, which endangers the achievement of the objective of the Agreement, or the failure to comply with duties, the very discharge of which is an essential prerequisite for the proper performance of the Agreement.

b) In cases of Section 6 a), the liability is limited to the damage, which is typical for contracts like this Agreement and which could have been foreseen.

c) SMI's liability is also limited to the damage, which is typical for contracts like this Agreement and which could have been foreseen for damages caused by the gross negligence of an agent or an employee of SMI, who is not an officer or executive of SMI.

d) In cases of Sections 6 a) and c), SMI's liability is limited to a maximum amount of EURO 500.000, respectively EURO 100.000 for financial losses.

e) Licensee's claims for damages caused by slight negligence or caused by the gross negligence of an agent or an employee of SMI, who is not an officer or executive of SMI, which are not based on defects and thus not subject to time-barring in accordance with Sec. 5 d) are time-barred at the latest 2 years from the point in time Licensee became aware of the damage and regardless of Licensee's awareness at the latest 3 years after the damaging event.

f) With the exception of liability under the Product Liability Law, for defects after having given a guarantee, for fraudulently concealed defects and for personal injury, the above limitations of liability shall apply to all claims, irrespective of their legal basis, in particular to all claims based on breach of contract or tort.

g) The above limitations of liability also apply in case of Licensee's claims for damages against SMI's employees or agents.

7. **SMI Indemnity.** SMI will defend or settle any action brought against Licensee to the extent based on a claim that Licensed Materials, used within the scope of the license granted in this Agreement, infringe any copyright valid in the European Union or the European Economic Area and will pay the cost of any final settlement or judgment attributable to such claim, provided (i) Licensee has given prompt notice to SMI of such claim, (ii) Licensee has not recognized an infringement of the third party's copyright, and (iii) the entire defense and the settlement negotiations are reserved for SMI with Licensee's full cooperation and support. If Licensee discontinues the use of Licensed Materials for damage reduction or other important reasons, Licensee is obligated to point out to the third party that the discontinuation of use does not constitute an acknowledgement of a copyright infringement. If SMI believes Licensed Materials are likely to be the subject of an infringement claim, it may elect to replace or modify such Software or Documentation to make it non-infringing or terminate the Agreement on written notice to Licensee. SMI shall have no obligation to defend (or any other liability) to the extent any claim involves a Software release other than the current, unaltered release, if such would have avoided infringement, or use of the Software in combination with non-SMI programs or data, unless the infringement would also incur without such combination. The foregoing states the entire obligation and liability of SMI with respect to any infringement by Licensed Materials of any intellectual property rights or other proprietary rights of Licensee or a third party without prejudice to any claims for damages in accordance with Section 6.

8. **Licensee Indemnity.** Licensee will defend and indemnify SMI, and hold it harmless from all costs, including attorney's fees, arising from any claim that may be made against SMI by any third party as a result of Licensee's use of Licensed Materials, excluding claims for which SMI is obligated to defend or indemnify Licensee under Section 7.

9. **Export Restriction.** Licensee will not remove or export from Germany or from the country Licensed Materials were originally shipped to by SMI or re-export from anywhere any part of the Licensed Materials or any direct product of the Software except in compliance with all

applicable export laws and regulations, including without limitation, those of the U.S. Department of Commerce.

10. **Non-Waiver; Severability; Non-Assignment.** The delay or failure of either party to exercise any right provided in this Agreement shall not be deemed a waiver. If any provision of this Agreement is held invalid, all others shall remain in force. Licensee may not, in whole or in part, assign or otherwise transfer this Agreement or any of its rights or obligations hereunder.

11. **Termination.** This Agreement may be terminated without any fee reduction (i) by Licensee without cause on 30 days notice; (ii) by SMI, in addition to other remedies, if Licensee fails to cure any breach of its obligations hereunder within 30 days of notice thereof; (iii) on notice by either party if the other party ceases to do business in the normal course, becomes insolvent, or becomes subject to any bankruptcy, insolvency, or equivalent proceedings. Upon termination by either party for any reason, Licensee shall at SMI's instructions immediately destroy or return the Licensed Materials and all copies thereof to SMI and delete the Software and all copies thereof from the Designated Equipment.

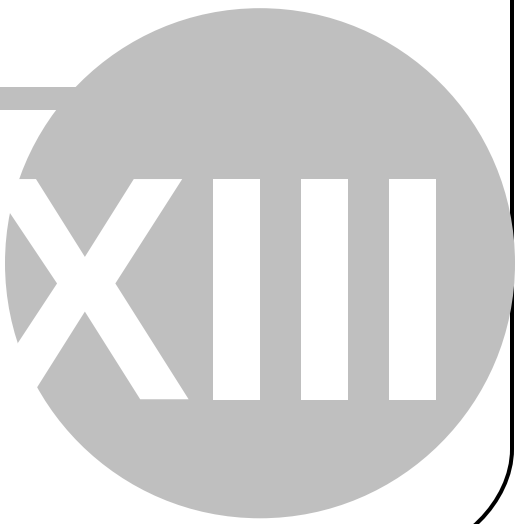
12. **Entire Agreement; Written Form Requirement.** There are no separate oral agreements; any supplementary agreements or modifications hereto must be made in writing. This also applies to any waiver of this requirement of written form.

13. **Notices.** All notices under the Agreement must be in writing and shall be delivered by hand or by overnight courier to the addresses of the parties set forth above.

14. **Applicable Law and Jurisdiction.** German law applies with the exception of its conflict of laws rules. The application of the United Nations Convention on Contracts for the International Sale of Goods (CISG) is expressly excluded The courts of Berlin, Germany, shall have exclusive jurisdiction for any action brought under or in connection with this Agreement.

About SMI

Chapter



13 About SMI

SensoMotoric Instruments (SMI) is a world leader in dedicated computer vision applications, developing and marketing eye & gaze tracking systems and OEM solutions for a wide range of applications.

Founded in 1991 as a spin-off from academic research, SMI was the first company to offer a commercial, vision-based 3D eye tracking solution. We now have over 17 years of experience in developing application-specific solutions in close collaboration with our clients.

We serve our customers around the globe from our offices in Teltow, near Berlin, Germany and Boston, USA, backed by a network of trusted local partners in many countries.

Our products combine a maximum of performance and usability with the highest possible quality, resulting in high-value solutions for our customers. Our major fields of expertise are:

- Eye & gaze tracking systems in research and industry
- High speed image processing, and
- Eye tracking and registration solutions in ophthalmology.

More than 4,000 of our systems installed worldwide are testimony to our continuing success in providing innovative products and outstanding services to the market. While SMI has won several awards, the largest reward for us each year is our trusted business relationships with academia and industry.

Please contact us:

Europe, Asia, Africa, South America, Australia

SensoMotoric Instruments GmbH (SMI)
Warthestraße 21
D-14513 Teltow
Germany
Phone:+49 3328 3955 0

Fax:+49 3328 3955 99
email: info@smi.de

North American Headquarters

SensoMotoric Instruments, Inc.
28 Atlantic Avenue
236 Lewis Wharf
Boston, MA 02110
USA
Phone: +1 - 617 - 557 - 0010
Fax: +1 - 617 - 507 - 83 19
Toll-Free: 888 SMI USA1
email: info@smivision.com

Please also visit our home page: http://www.smivision.com

Last updated: August 2017

Index

- A -

- B -

- C -

- D -

- E -

- F -

- G -

- R -

- S -

- T -

- U -

- V -

- W -

- Z -