# BeGaze 2.4 Manual

**Version 2.4**

*February 2010*

SMI
SensoMotoric Instruments

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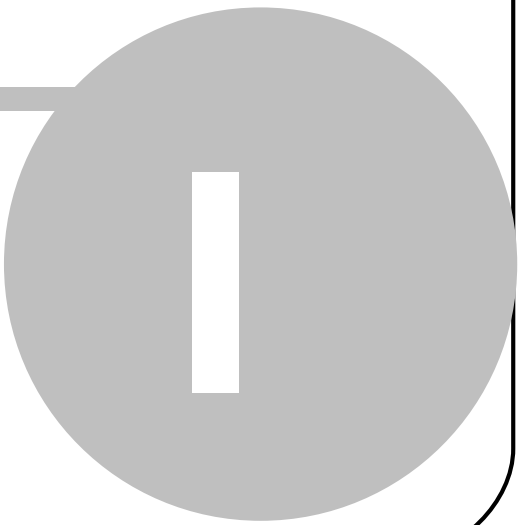


# 1 Introduction

Congratulations on your purchase of SMI BeGaze™ 2.4 behavioral and gaze analysis software for eye tracking data. SMI BeGaze™ 2.4 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 2.4.

Latest software versions covered in this document: BeGaze – Version 2.4

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).

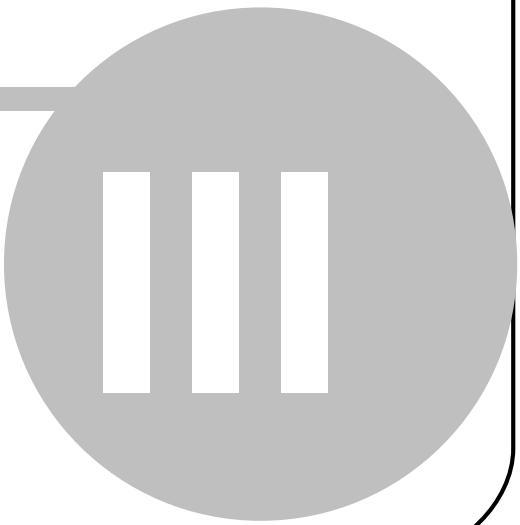
All the information in this manual can also be accessed through the program. Press F1 to get help on the menu-item or the element that has been currently selected.

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

Last updated: <February 2010>

# Important Notice

Chapter



# 3 Important Notice

## Experiment Responsibility

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

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

Do not offend against your subject'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 subjects during experiments.

Stop immediately and consult a doctor if a subject 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™ 2.4) software simplifies monocular and binocular tracking data analysis by structuring the information on experiments and subjects, 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, subject demographics and graphics in its internal database
- Analyzes several subjects or trials simultaneously
- Changes easily the parameters for reanalyzing previous data

### Various Stimuli

SMI BeGaze™ 2.4 displays, analyses and visualizes various kind of stimuli - whether

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

SMI BeGaze™ 2.4 analysis does not limit the choice of stimulus for experiments.

## Multiple Subjects

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

## Smart Visualizations

SMI BeGaze™ 2.4 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™ 2.4 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 subject, or AOI Binning Chart for groups of subjects
- 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 subject 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™ 2.4 fully integrates with SMI Experiment Center™ 2.4 - the software to make gaze tracking experiments and visual stimuli creation a snap
- Load all experiment data into SMI BeGaze™ 2.4 by 1-click: Fail-safe, fast, convenient

- SMI BeGaze™ 2.4 offers an experiment creation wizard to load manually the experiment data, allow to assign attributes to the subjects for later grouping and filtering
- Assignment of stimulus and subject‘s gaze data is done manually or automatically

# 4.2 General Product Information

## 4.2.1 BeGaze 2.4 Product Variants

BeGaze 2.4 is distributed in various variants that are customized to the variety of research needs.

- The BeGaze 2.4 **Light** version is delivered with the iView X™ system together with the SMI Experiment Center™ 2 Light software. BeGaze 2.4 allows to analyze experiments with two subjects and five still image stimuli and predefined video examples.

- The BeGaze 2.4 **Professional** version offers the full range of program features to analyze and export eye tracking data for still images stimuli, without any restrictions concerning the number of subjects or stimuli.
- The **Video** extension supports video stimuli in addition to still images stimuli.
- The **Reading Package** extension adds detailed statistics for reading experiments.
- The **Observation Package** extension adds the User video and User audio playback.

- The BeGaze 2.4 **Video** version offers the same range of features as the BeGaze 2.4 **Professional** version especially for video stimuli but without still image stimuli support.

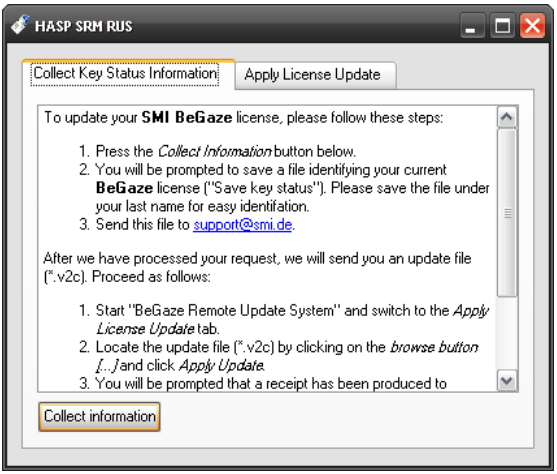
## 4.2.2 Dongle Protection and License Update

BeGaze 2.4 is dongle-protected and requires a license. If you want to update your BeGaze 2.4 version, please contact the SMI sales department 275 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 360° Remote Update Utility**.
2. In the **Collect Key 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 2.4 license ("Save key status"). Please save the file under your last name for easy identification.

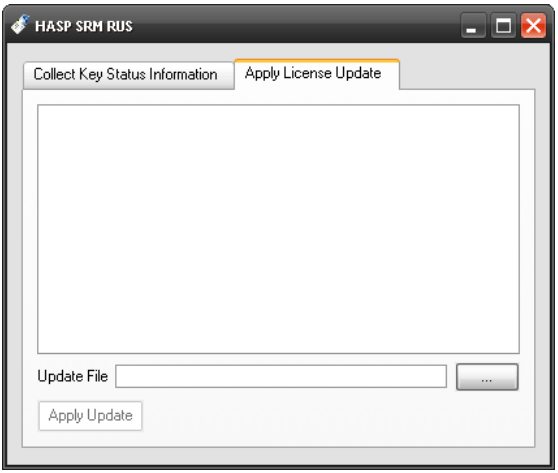
4. Send this file to sales@smi.de.

   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 360° Remote Update Utility**.
2. Switch to the **Apply License Update tab**.




Ensure that only the BeGaze 2.4 dongle is plugged. Remove all other dongles from the PC.

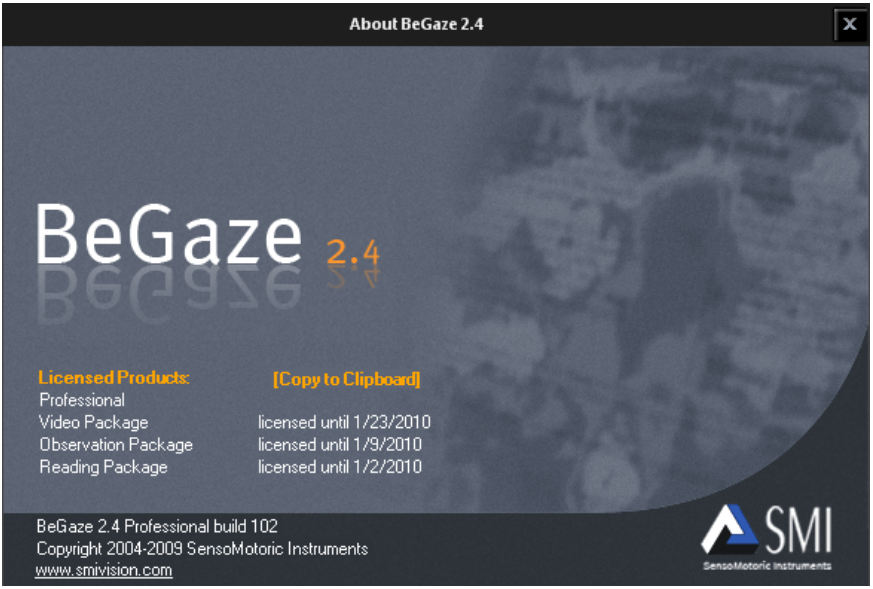
3. Locate the update file (*.v2c) by clicking on the browse button ... and click **Apply Update**. This will write the updated license information to the dongle device.
4. You will be prompted that a receipt has been produced to confirm the update. Please send this receipt file to sales@smi.de.
5. Close the **Remote Update Utility** and start BeGaze 2.4. You can view

detailed licensing information in the BeGaze 2.4 About Box 256.

Type and status of your licenses are stored on the dongle device, not on the PC on which BeGaze 2.4 is installed. With the license update procedure, the dongle is updated. That means, that you can run BeGaze 2.4 on any PC when the dongle is plugged in.

### 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.

# 4.3 How to Operate the Program

## 4.3.1 Basic Operation

In BeGaze 2.4 you process the measurement data with the following steps:

1. Collect and assemble all data which belong to one experiment.
2. Select an analysis, its data sources (stimulus, subjects, time interval).
3. Modify single or multiple dimensions of the data source to adapt the analysis.
4. Role over a selection of data sources to the next analysis for a different perspective or drill down.
5. Evaluate, export and/or print diagrams or data.

### Data collection and experiment structure

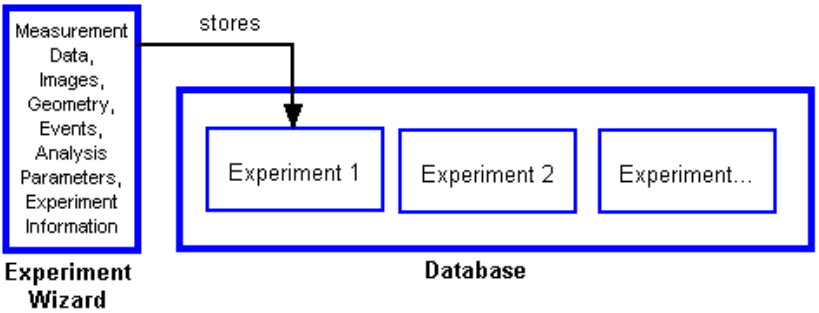
In a typical eye tracking *Experiment*, a number of subjects are presented with a certain stimulus. For each subject a data file is recorded which is called a *Run*. In order to synchronize the measurement data with changes in stimulus presentation, the data files contain either a *Trial Number* or a *User Message* at the onset time of the stimulus change. This synchronizing information can be used to separate each run into *Trials*, where each trial is associated with a certain stimulus image. So a typical BeGaze 2.4 experiment has the following structure:

## Experiment

- Run 1 (a measurement data file)
  - Trial 1 (associated with a certain stimulus image)
  - Trial 2
  - Trial [...]
- Run 2
  - Trial 1
  - Trial [...]
- Run [...]

A BeGaze 2.4 experiment is a data collection which consists of one or several measurement data files (runs), a number of stimulus images and some additional information you have to provide.

The BeGaze 2.4 experiment is assembled with the Create Experiment wizard 27 and is stored into a database 259, which may consist of a number of different experiments.

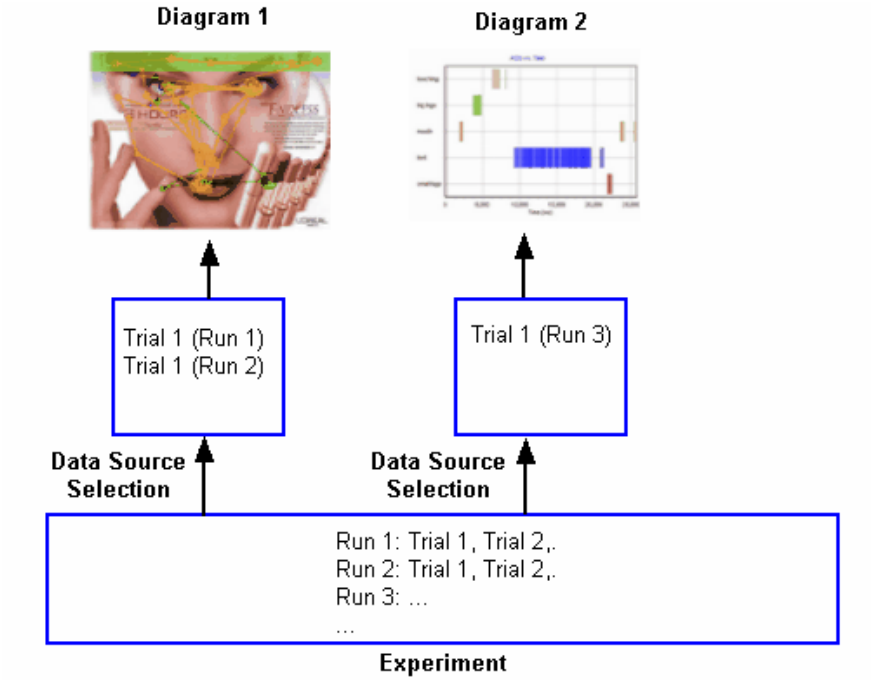



## Combine stimulus images with the data

The **Create Experiment** wizard has automatically combined the stimulus images with the data.

## Select a diagram and its data sources

After the experiment has been created, you can select the desired diagram 51 and choose the trials from the experiment that should be displayed.




## Export and print the diagram

Finally you can export 225 the data to a text file or print the diagram.

### 4.3.2 Use Cases

BeGaze 2.4 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 subjects using the SMI Experiment Center. With this use case, you present the same visual stimuli to a larger group of subjects.

- Prerequisites:

  – min. versions for still images: iView X 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) up to 1280x1024 pixels

  – Typical video presentation: Videos (AVI) with 30 to 300 seconds in length and a typical video size of 320x200, 640x480, or 720x576 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 subject protocols, and the meta data (subject properties, experiment design).

- Typical evaluation: The analysis of this common use case is described step-by-step in the Getting Started 21 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 subjects using the SMI Experiment Center. To evaluate the user navigation, Experiment Center provides screen recording of all actions the subjects perform during the web browsing session.

- Prerequisites: min. version is iView X 2.1.16 and Experiment Center 2.1
- Experiment design: Experiment Center is used to create the experiment and to record the subjects' web site perception and/or navigation within the site.

  – Use **Full Website** mode to store the web page as one large picture with automatic scroll compensation

  – Record keystrokes and mouse clicks

  – Optionally, use the 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, or screen shots of landing pages, and (optional) background screen recordings. In the results folder, the IDF files (gaze tracking data and user events), the subject protocols, and the meta data (subject properties, experiment design) are stored also.

- Typical evaluation: Open the experiment in BeGaze 2.4 by using the Load Experiment from Folder 28 command. Evaluate the experiment together with the recorded mouse clicks and key presses (which BeGaze 2.4 indicates as **User Messages**) with the Gaze Replay 100, Bee Swarm 102, Scan Path 108, Focus Map 119, Heat Map 125 and AOI statistics data views (Key Performance Indicators 130, Gridded AOIs 137, AOI Sequence Chart 146 and Binning Chart 150).

### Software Usability

A third use case is to monitor subjects with the objective to improve software usability. For this, a group of subjects 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 subjects' actions (mouse clicks and key presses). For each subject, 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 subject protocols, and the meta data (subject properties, experiment design).
- Typical evaluation: Open the experiment in BeGaze 2.4 by using the Load Experiment from Folder 28 command. Analyze the videos together with the recorded user actions, such as mouse clicks and key presses (which BeGaze 2.4 indicates as **User Messages**) with the Gaze Replay 100, Bee Swarm 102, Scan Path 108, Focus Map 119, Heat Map 125, and AOI statistics data view (Key Performance Indicators 130, Gridded AOIs 137, AOI Sequence Chart 146 and Binning Chart 150).

### HED Videos

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

- Prerequisites: min. iView X 2.1
- Experiment design: For each subject, 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 2.4 analysis data view (Scan Path 108 and Attention Map 119) and AOI statistics data view (Key Performance Indicators 130, AOI Sequence Chart 146 and Binning Chart 150) to analyze the recorded video data.

## 4.4 Getting Started

The following steps describe how to analyze a typical **Advertising** experiment (see Use Cases 18) recorded using SMI Experiment Center. If you start BeGaze 2.4 for the first time, you may proceed as described below. Alternatively, you can open one of the provided sample experiments (see Open Experiment 42).

1. Create a BeGaze 2.4 experiment directly from the Experiment Center's results folder (see Load Experiment from Folder 28).
2. Open the **Scan Path** plug-in (see Scan Path Overview 108).

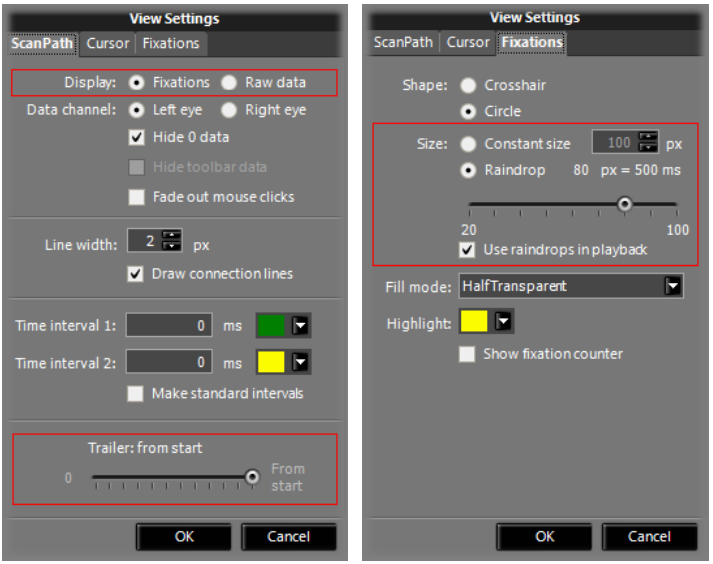
   – Select a stimulus (see Stimulus Selection 55).

   – Select subjects, either manual or based on a subject property filter (see Subjects Selection 56).

   – Modify the **Scan Path** settings (see View Settings Dialog 113). For video stimuli, you may configure the "bee swarm" mode. Therefore, change the **Display** setting to **Raw Data** with the **Trailer** switched to **Constant Length** 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 Beginning**. When displaying **Fixations**, you should open the **Fixations** tab and change the **Size** of

fixation circles (right picture).



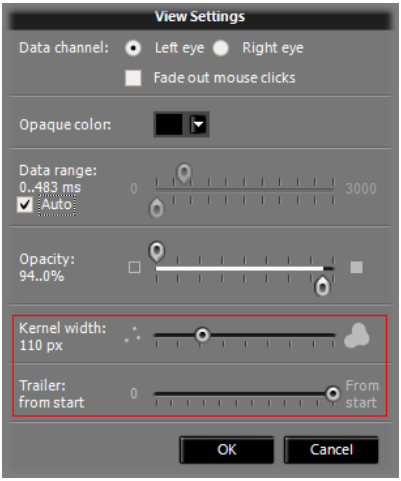

– Use the Player Control 66 to play the scan path presentation. To move to a specific event, use the **Events** view (see Events Selection 61).

– Export the data – either to a picture or to a video (see Export Overview 225).

3. Now open the **Focus Map** data view (see Focus Map Overview 119).

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

   – Modify the **View Settings** (see Focus Map Settings 122). 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 66 to play the attention map presentation. To move to a specific event, use the **Events** view (see Events Selection 61).

– Export the data – either to a picture or to a video (see Export Overview 225).

4. Open the **AOI Editor** data view (see AOI Editor Overview 75). 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 subjects 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 55).

   – 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 66).

   – Select an AOI type: rectangle, polygon, or circle and paint it on the object (see AOI Editor Toolbar 77). 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 81).

– Add more AOIs as required.

5. Open the **Key Performance Indicators** data view (see Key Performance Indicators Overview 130). This data view shows relevant statistical indicators for the defined AOIs.

   – Modify the **View Settings** (see Key Performance Indicators Settings 133) to select the desired indicators and the font size used for the display.

   – Select the desired subjects, either manual or based on a subject property filter (see Subjects Selection 56).

   – Select the **Save Image to File...** 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 146). This data view shows the correlation between subject and AOI hits.

   – Modify the settings available in the bottom view (see Chart Display Modes 74). It is recommended to select **Raw data** for video stimuli and **Fixations** for still image stimuli.

   – Select the desired subjects, either manual or based on a subject property filter (see Subjects Selection 56).

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

7. Open the **Binning Chart** data view (see Binning Chart Overview 150). This data view shows a statistical overview of AOI hits for separated time slices (bins).

   – Select a stimulus (see Stimulus Selection 55).

   – Select the desired subjects, either manual or based on a subject property filter (see Subjects Selection 56).

   – Modify the settings available in the bottom view (see Chart Display

Modes 74). 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 to File...** 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 50),
- export data to CSV files (see Export data to files 225),
- print or save images of the currently opened diagram (see Export menu commands 246), or
- backup your experiment (see Backup 43).

# Experiment Setup

## Chapter

# 5 Experiment Setup

## 5.1 Create Experiment Wizard

### 5.1.1 Overview

With the **Create Experiment** wizard you assemble all data to be analyzed to a BeGaze 2.4 experiment (see Basic Operation 15). There are two ways to do so.

#### Load experiment from folder

You can load a results folder which has been stored with the SMI Experiment Center to BeGaze 2.4 and thus easily create your experiment (see Load Experiment from Folder 28).

#### Create experiment step-by-step

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

1. Click on the  icon in the toolbar 249 or go to the **File** menu and select **New Experiment**.

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

   Gaze Data 30: Here you select the eye tracker data files to be analyzed, if needed the plane file is selected in this tab.

   Stimulus Images 34: All images for one experiment need to be selected in this tab.

Stimulus Association 36: Based on the experiment type the selected stimuli need to be associated with the trials or planes of the experiment.

Event Detection 216: 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.

## 5.1.2 Load Experiment from Folder

You can easily create an experiment based on the data generated with the SMI Experiment Center. The stored gaze tracking data will be processed to BeGaze 2.4. During this process the stored meta data such as subject properties and the properties of the presented stimuli will be parsed and the experiment will then be created automatically in BeGaze 2.4.

### Load experiment from folder

1. 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.

### Load experiment from folder with drag and drop

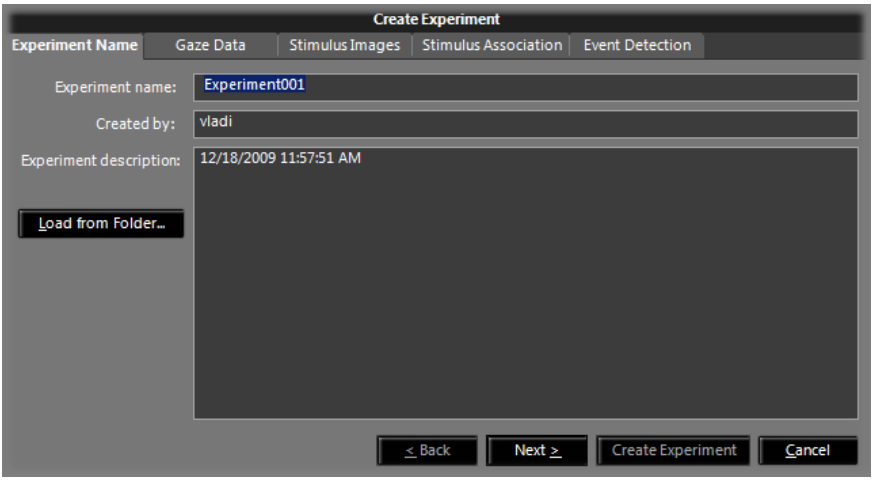
Another way to achieve the same as the above is to simply drag the experiment folder from any file browser and drop it in the main BeGaze window. Creating the experiment then proceeds as explained above.

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 27 dialog which appears when selecting **New Experiment** 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.

### 5.1.3 Experiment Name Tab

In this tab you can enter general information for the experiment. The experiment will be saved in the database 259 with the chosen name and description.

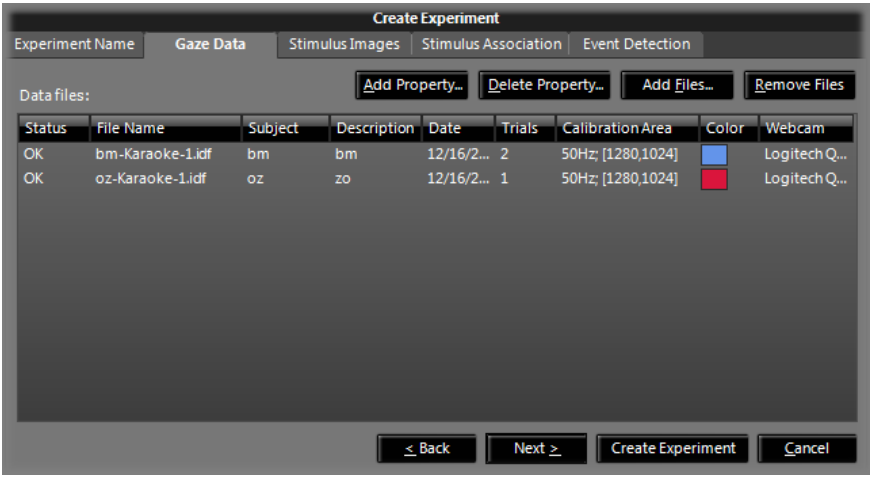
The **Load from Folder** command allows you to automatically fill the data and to create the experiment (see Load Experiment from Folder 28).



### 5.1.4 Gaze Data Tab

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




#### Select files

BeGaze 2.4 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.

#### Add, delete or modify subject properties

You can define individual subject ”group” parameters for the experiment.

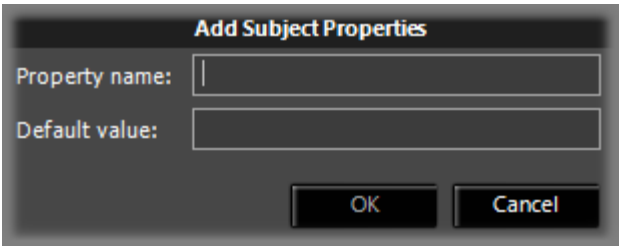
These parameters are entered as subject properties and serve as additional information to your experiment. Useful properties may be ”Age” and ”Gender”. The first property is already defined as the subject's **Color** and can be changed at this point or later.

Subject properties are taken automatically from results generated with the SMI Experiment Center (see also Load Experiment from Folder 28). You can modify the properties in BeGaze 2.4 as described below.

To add new subject properties proceed as follows:

1. Click on **Add Property**.

   The **Add Subject Properties** dialog opens.



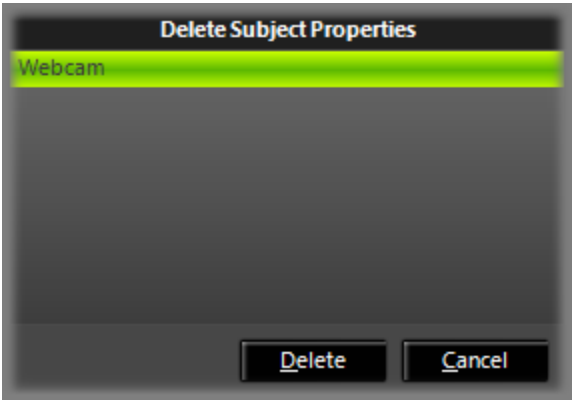

2. Enter a property name, e.g. ”Gender”.
3. Optionally, you can enter a default value.
4. Click **OK** to confirm your entry.

   The new property will be inserted in the gaze data table. If you didn’t enter a default value for the property, you can now enter a value for a selected table entry.
5. Select an entry and enter a value in the property column. If you want to change the value, simply overwrite it.

To remove an existing subject property proceed as follows:

1. Click on **Delete Property**.

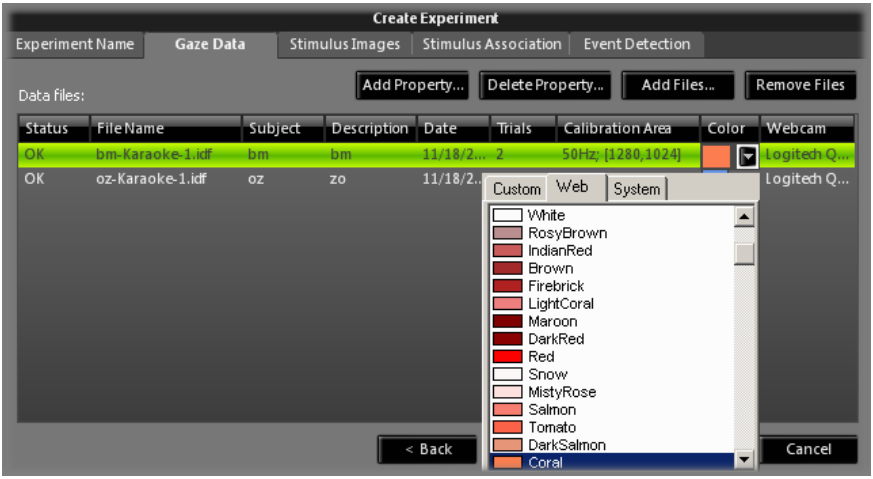
   The **Delete Subject Properties** dialog opens.




2. Select a property name, e.g. ”Webcam”.
3. Click **Delete** to delete the property.

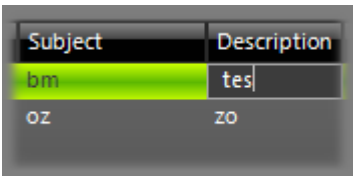
   The corresponding property column will be removed in the gaze data table.

Properties can also be directly edited in the gaze replay 100, bee swarm 102, scan path 108, focus map 119, heat map 125, key performance indicators 130, gridded aois 137, aoi sequence chart 146 or binning chart 150 data view when you click on the property.




## 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.
- **Subject** and **Description**: If the files contain subject and description information they will be listed here. In this tab, they can be edited with a single click of the mouse.



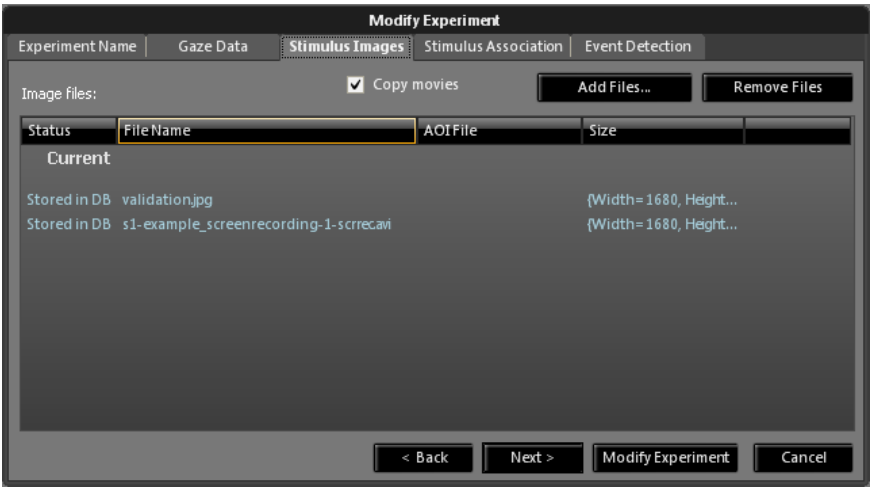

- **Trials**: The number of trials in the file are computed and shown in this column.

- **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 39 is determined by the number of planes in the selected file.

### 5.1.5 Stimulus Images Tab

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




#### Copy movies (only for video files)

The **Copy movies** check box is checked by default. This effects that the video files used in the experiment are copied to the database 259.

Note that this may cause a high data volume in the database directory. If you backup an experiment 43, the video data will be stored in the database even if the **Copy movies** check box has been deactivated during the experiment analysis.

Warning: When the **Copy movies** check box is deactivated, videos are taken from their original location. If video files are deleted or moved, the experiment cannot be loaded any more.

Warning: Movies over 1Gb in size (HED experiments) will be automatically split into parts smaller than 1Gb while creating the experiment. The associated trial from the data file will also be split into corresponding trials (one trial per movie part).

### 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 30.

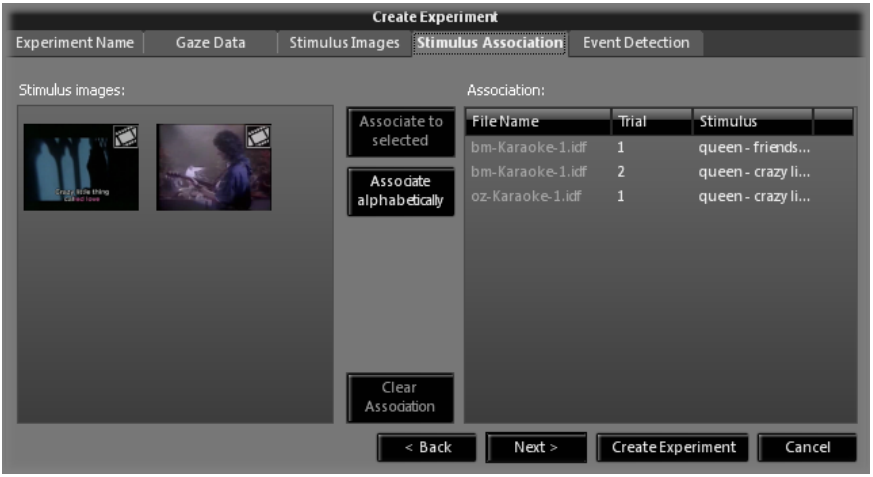
  If the stimulus fits the criteria, the status is ok. If the stimulus fails, the status will give a clue about the reason of failure and the color of the row will be red.

- **AOI File**: Images and Videos can be associated with AOI files. The AOI files should have the .xml extension (see also AOI Format Description 94) 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.

### 5.1.6 Stimulus Association Tab

In this tab you can associate each trial (or plane in the case of a multiple plane Measurement Scenario 39) 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 39, 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.

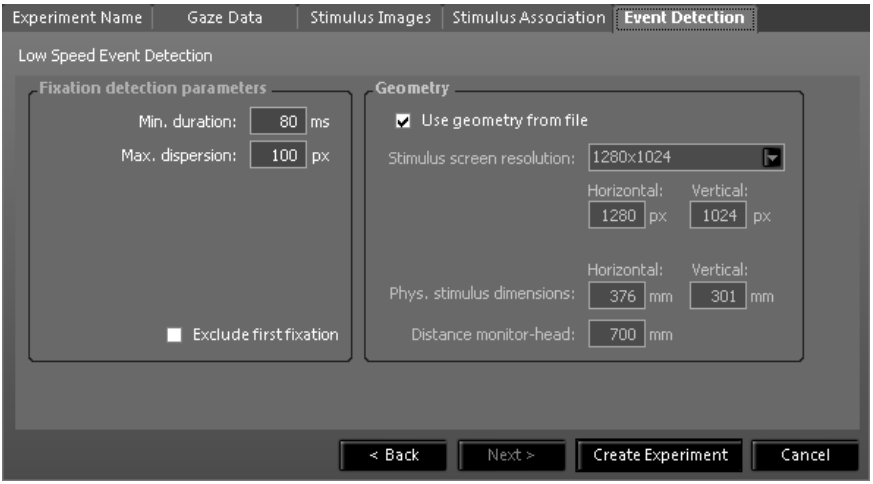
d) With the **Associate alphabetically** button, all associations are redone by associating images to all trials in alphabetical order.

## 5.1.7 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 216.

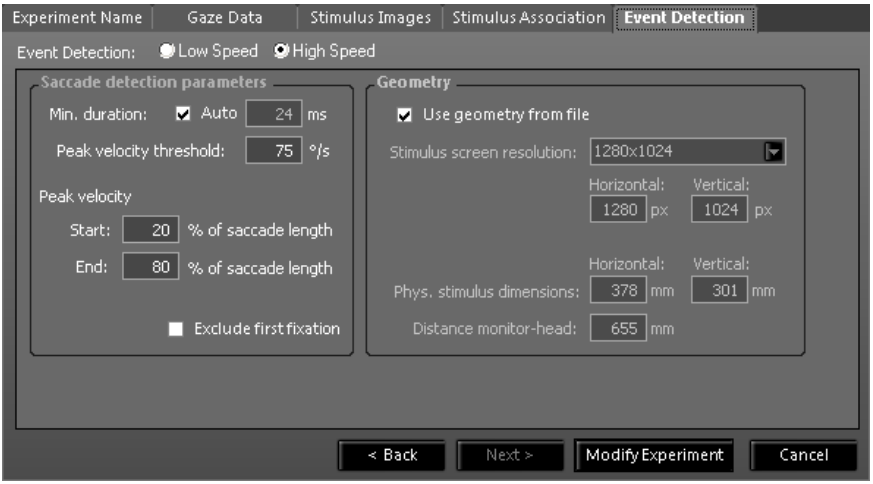
 

Low - Speed data (<200Hz):




**z**

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



## 5.2 Measurement Scenario

There are three scenarios that BeGaze 2.4 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: subjects 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: subject sits in a cockpit and watches the various panels.

## 5.3 Signal

### Data Trial Separator

For a better overview each BeGaze 2.4 experiment run is separated into *Trials* (see Basic Operation 15). 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 2.4 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 36 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 36 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"

# 5.4 Manage Experiments

## 5.4.1 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.

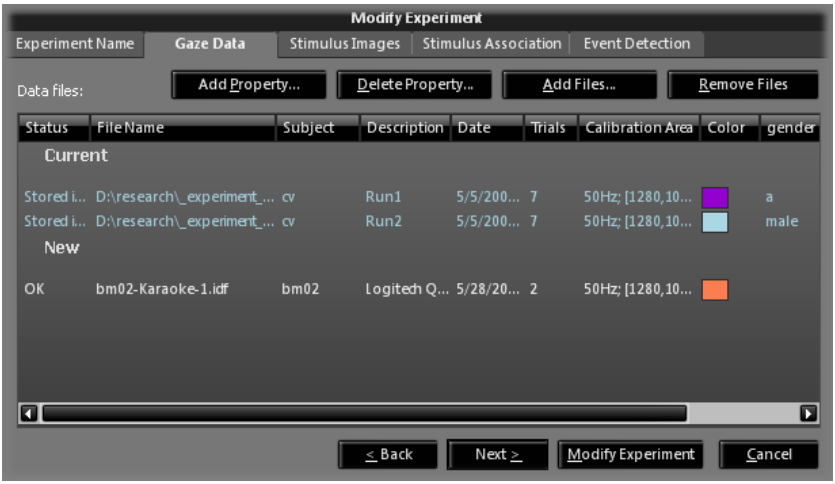
   A dialog opens with several tabs.

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

   Gaze Data 30: 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. You can also add new subject properties or modify the content of existing subject properties.



Stimulus Images 34: Here you can add new stimuli and also remove existing stimuli from the data base. The existing stimuli will be removed permanently.

Stimulus Association 36: Based on the experiment type the selected stimuli need to be (re)associated with the trials or planes of the Experiment.

Event Detection 216: 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.

### 5.4.2 Save Experiment

To save an experiment proceed as follows:

1. Click on the  icon in the toolbar 249 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 259 directory.

### 5.4.3 Open Experiment

To open an experiment proceed as follows:

1. Click on the  icon in the toolbar 249 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**.

### 5.4.4 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 42 it again.

### 5.4.5 Experiment Backup

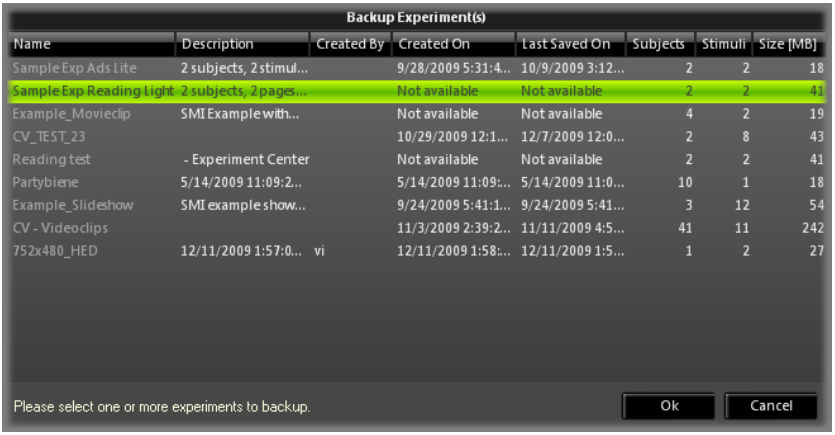
You can backup a saved experiment to a file. To backup an experiment proceed as follows:

1. Close 43 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.



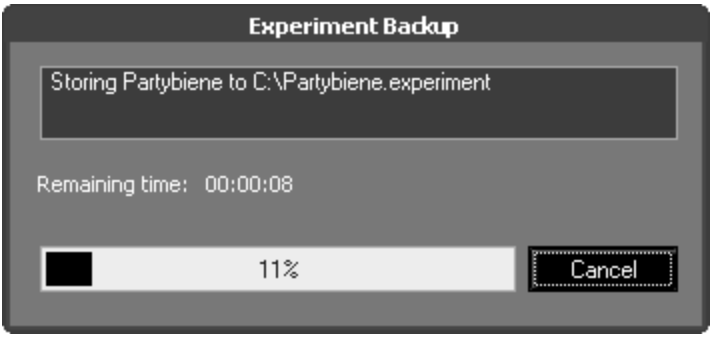

4. Enter the desired experiment file name. Browse for the folder or create a new folder where the backup will be stored.

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

   – path of the file

   – remaining time

   – progress bar



### 5.4.6 Experiment Restore

To restore an experiment proceed as follows:

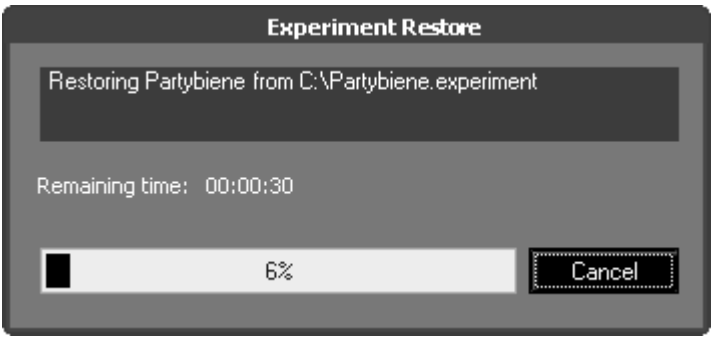
1. From the **File** menu, select the **Restore Experiment from File** command. No experiment must be loaded for the option to be available.
2. In the file selection dialog, browse for the file corresponding to the experiment you want to restore.
3. Select the experiment you want to restore.

   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 2.4.

### 5.4.7 Delete Experiment

To delete a saved 42 experiment from the database proceed as follows:

1. From the **File** menu, 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**.

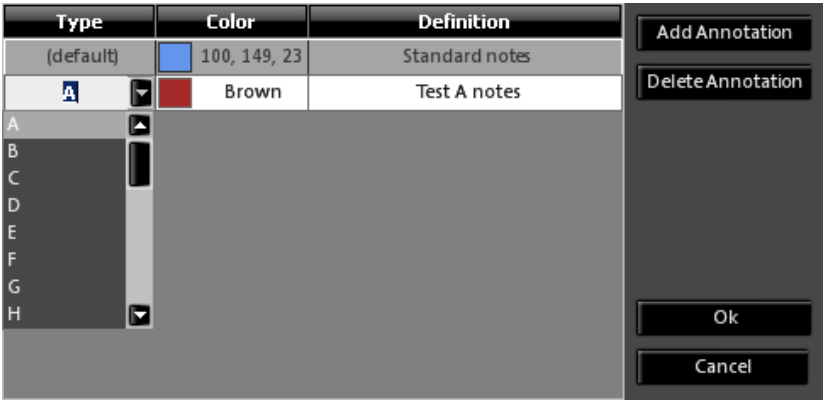
The experiment will be removed from the database. This process is irreversible.

## 5.5 Annotations

Annotations are user defined notes associated with a certain moment of time in a data recording. They can either be previously defined during gaze recording in Experiment Center or they can be defined offline during analysis in any of the Data Views that offers a Player Control 66.

#### Annotation types

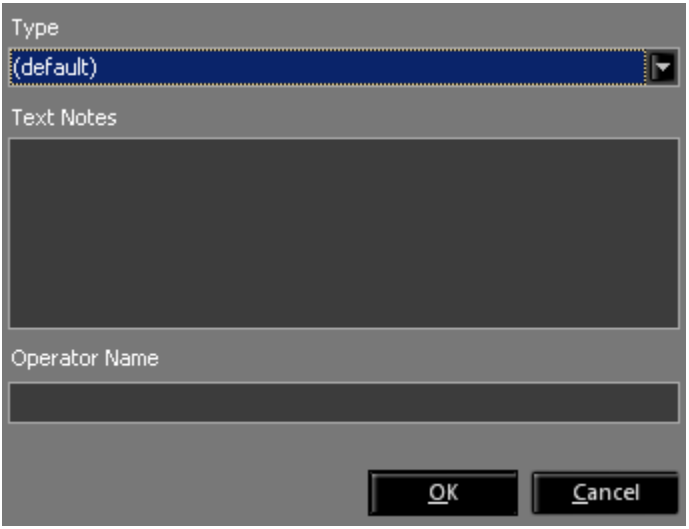
All annotations have an associated *Type* to allow various filtering scenarios. Types can be defined beforehand by selecting **Define Annotations...** from the **File** menu.




The type can range from A to Z. Additionally a color and a type definition can be associated to a particular type. Types can be added and deleted from here (except for the "default" type which is always present for annotations that don't need a specific type). Types are also automatically added here when new annotations are created.

### Creating and editing annotations

When adding a new annotation or editing an existing one from the context menu of the *Annotations* line in the Player Control 66 the following window appears:




Here one can define the following fields:

- **Type**: any type from A to Z.
- **Text Notes**: note content.
- **Operator Name**: name of person placing the note.

Defined annotations are shown in their separate timeline underneath the Player Control 66 thumbnails in the color defined for their type.

# Experiment Analysis

## Chapter

# 6 Experiment Analysis

## 6.1 Overview of Analysis Data View

BeGaze 2.4 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 |
|---|---|
|  | In the AOI Editor 75, you define the AOIs (**A**reas **O**f **I**nterest) that should be evaluated for the stimulus. |
|  | The Gaze Replay 100 displays a quick overview of all stimuli associated to a subject, with a visualisation similar to the scan path one. |
|  | The Bee Swarm 102 displays a raw gaze data overlay over the stimulus image/stimulus video. |
|  | The Scan Path 108 displays a gaze data (raw or eye events) overlay over the stimulus image/stimulus video. |
|  | The Focus Map 119 shows gaze patterns over the stimulus image visualized as a transparent map. |
|  | The Heat Map 125 shows gaze patterns over the stimulus image visualized as a colored map. |
|   | The Key Performance Indicators 130 displays relevant statistical data for each defined AOI over the stimulus image |
|  | The Gridded AOIs 137 displays relevant statistical data for an automatically defined grid of rectangular AOIs over the stimulus image |
|  | The AOI Sequence Chart 146 displays the AOI hit order over time. |

| | |
|---|---|
|  | The Binning Chart 150 gives a statistical overview of AOI hits per binning frame. |
|  | The Event Statistics 152 computes diverse statistics based on events and AOI hits. |
|  | The Reading Statistics 184 computes statistics for reading experiments based on automatic generated AOIs |
|  | The Line Graph 203 displays x and y directions of gaze data plotted as graphs over time and events displayed in a timeline. |

**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.

## 6.2 Data View Selection

### Select data view

1. Select a data view by clicking on the respective icon of the toolbar 249. Alternatively, you can choose the respective entry from the Analysis 246 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 subjects/trials.

The AOI Editor and Gaze Replay can be opened only once in an experiment.

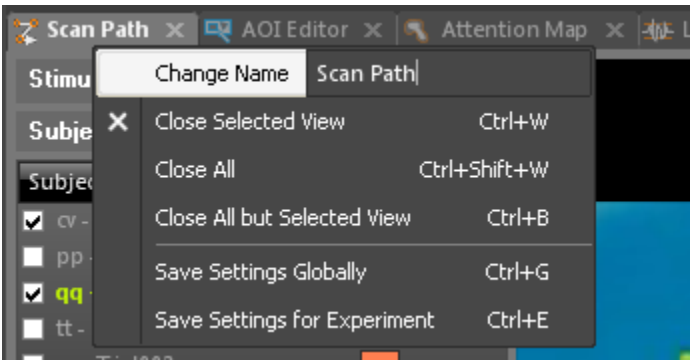
1. You can switch between the data views by clicking on the tab titles. You can also use the [ CTRL ] + [ Tab ] keyboard command to switch between the tabs.

   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. In the context menu, click  to expand it.

4. Enter a new name in the **Change name** field.



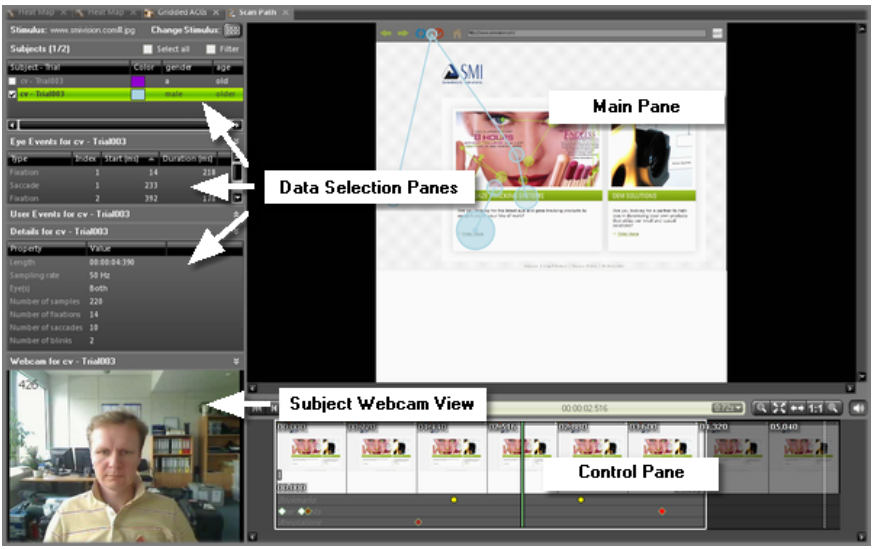

5. Press [ ENTER ] to confirm your entry.

# 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 75, the left view serve to create and edit AOIs.
- **Subject Usercam and Audio**: If user videos (recorded with a webcam in Experiment Center 2.4) are available, the video corresponding to the selected subject 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 subject video is played in sync with the main stimulus and the subject 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.

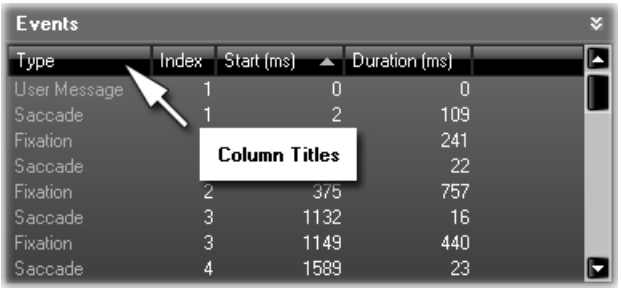
b) To display the view again, click on it's button.

#### Sort and modify order of columns

You can sort the lists displayed in the data selection view (see Data Views Overview 53).

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 75
- Bee Swarm 102
- Scan Path 108
- Focus Map 119
- Heat Map 125
- Key Performance Indicators 130
- Gridded AOIs 137
- AOI Sequence Chart 146
- Binning Chart 150

### 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.

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 Subjects

### 6.3.4.1 Subjects Selection

In the **Subjects** view all subjects together with their associated trials are listed. The list entries are related to the selected stimulus (see Stimulus Selection 55).

The subjects selection is available in the following data views:

- Gaze Replay 100
- Line Graph 203
- Bee Swarm 102
- Scan Path 108
- Focus Map 119
- Heat Map 125

- Key Performance Indicators 130
- Gridded AOIs 137
- AOI Sequence Chart 146
- Binning Chart 150
- Event Statistics 152
- Reading Statistics 152

### Select subjects

You can decide whether you want to use all subjects trials 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 subject group properties which have been set with the SMI Experiment Center. They are stored in the experiments IDF files. If no subject properties are given, you can configure them afterwards in BeGaze 2.4 by modifying the experiment (see Modify Experiment 41) or by double-clicking on the property you would like to change.

You can select one ore more subjects/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 subjects 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.


The checked items will represent the subjects 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:

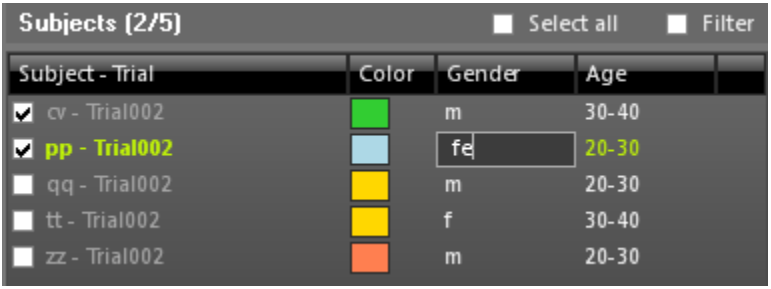
- and the Trial Details 60
- the Events List 61

Sorting is possible by clicking on the column titles.

### Modify properties

While you are operating the scan path 108, attention map 119, key performance indicators 130, aoi sequence chart 146 or binning chart 150 data view, you can change the properties of a subject if required. To do so:

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




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

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

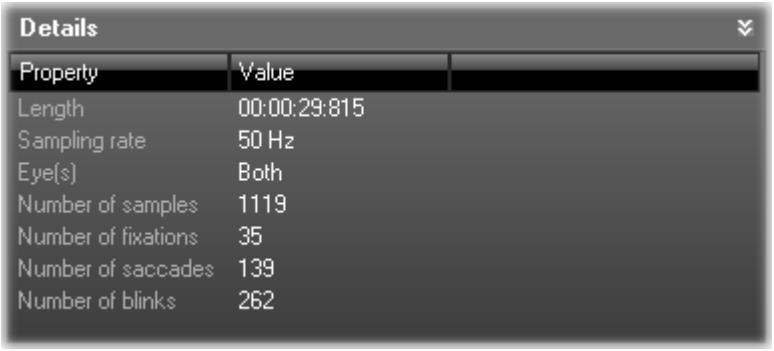
### 6.3.4.2 Subject-Trial Details

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

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

- Gaze Replay 100
- Line Graph 203
- Bee Swarm 102
- Scan Path 108
- Focus Map 119
- Heat Map 125
- Key Performance Indicators 130
- Gridded AOIs 137
- AOI Sequence Chart 146
- Binning Chart 150




If a subject trial is selected (see Subjects Selection 56), 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.

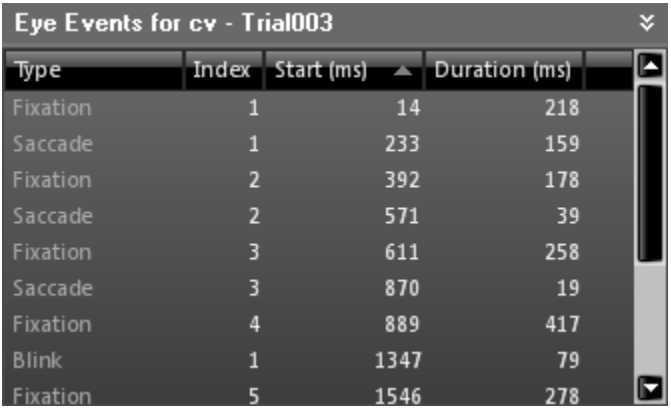
## 6.3.5 Events

### 6.3.5.1 Events Selection

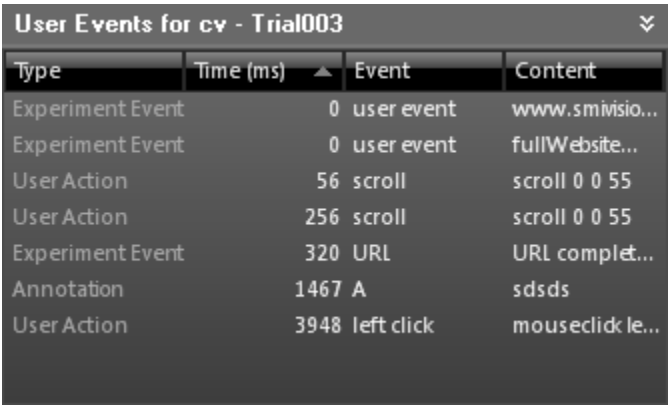
The **Events** views contain the summary of events of the currently selected subjects trial (see Subjects Selection 56). There are two views available:

- Eye Events




- User Events




The events are listed in chronological order. For detailed information on the various eye events see Event Details 63. 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 events views are available in the following data views:

- Gaze Replay 100
- Line Graph 203
- Bee Swarm 102
- Scan Path 108
- Focus Map 119
- Heat Map 125
- Key Performance Indicators 130
- Gridded AOIs 137

### 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 63 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.

### 6.3.5.2 Event Details

In the **Details** view more detailed information of the currently selected event is displayed (see Events Selection 61).

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

- Gaze Replay 100
- Line Graph 203
- Bee Swarm 102
- Scan Path 108

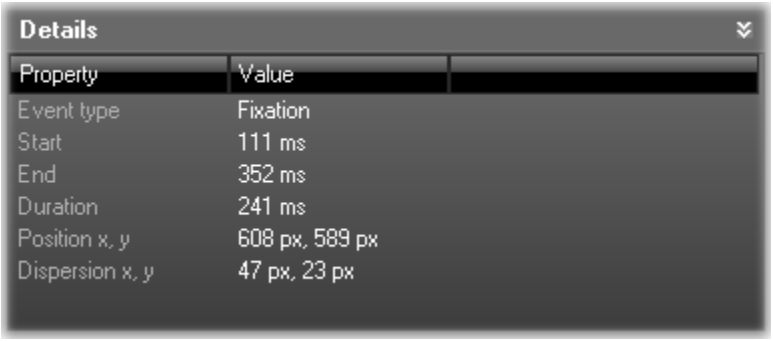
- Focus Map 119
- Heat Map 125
- Key Performance Indicators 130
- Gridded AOIs 137

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].



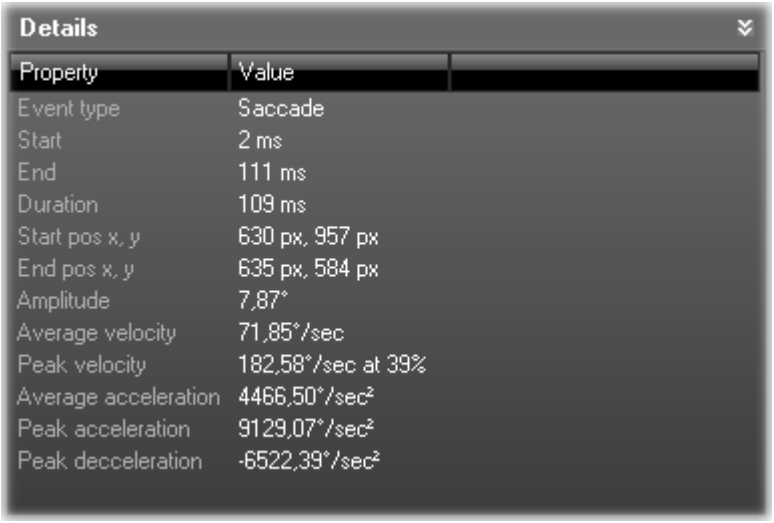

If the experiment 258 contains head tracking data in a multiple plane scenario 39, additionally image name and plane number are displayed.

### Saccade

If you selected a saccade, you will get information about

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

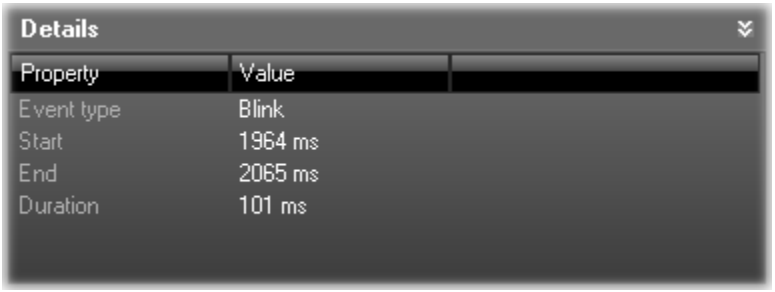
- the amplitude of the saccade in [°],
- the average and peak velocity of the saccade in [°/sec],
- the average, peak acceleration and deceleration of the saccade in [°/sec$^2$].




### Blinks

If you selected a blink, you will get information about

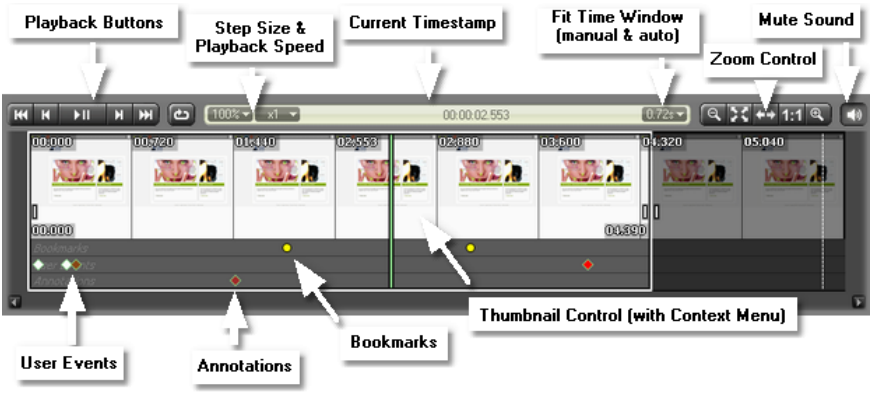
- start and end time,
- duration of the blink in [ms].




## 6.3.6 Player

### 6.3.6.1 Player Control

The player control contains commands to navigate in a video stimulus displayed in the AOI Editor 75 and respectively in a Gaze Replay 100, Line Graph 203, Bee Swarm 102, Scan Path 108, Focus Map 119, Heat Map 125, Key Performance Indicators 130 or Gridded AOIs 137 stimulus.




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

- Playback Control 67

- Zoom Control 69
- Thumbnail Control 70
- Thumbnail Control Context Menu 72

### 6.3.6.2 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 70) |
|  | Right arrow key | Moves presentation one step forward according to the selected step size (see Thumbnail Control Context Menu 72) |
|  | [ SPACE ] | Plays/pauses the presentation |
|  | Left arrow key | Moves presentation one step backward according to the selected step size (see Thumbnail Control Context Menu 72) |

| Button | Key command | Description |
|---|---|---|
|  | [ CTRL ] + [ END ] | Jumps to the end of the trial resp. the selected time window (see Thumbnail Control 70) |
|  | | Repeats the presentation with the chosen playback speed under consideration of the selected start and end time (see Thumbnail Control Context Menu 72) |
|  | | For video stimuli only: activates and deactivates the speaker of the PC on which BeGaze 2.4 is running and plays the audio stream of the video<br>Note that the speaker function only works if the video is played back with 100% playback speed (see Thumbnail Control Context Menu 72). |
|  | | Sets the playback speed. |
|  | | Sets the movement step size |
|  | | Sets the thumbnail time window size manually or automatically |
| | Arrow up key | increases the step size (see Thumbnail Control Context Menu 72) |
| | Arrow down key | decreases the step size (see Thumbnail Control Context Menu 72) |
| | [B] | Sets and resets a bookmark (video stimuli) |
| | [CTRL] + arrow right | Jumps to the next bookmark |

| Button | Key command | Description |
|---|---|---|
| | [CTRL] + arrow left | Jumps to the previous bookmark |
| | [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 |

#### 6.3.6.3 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


Whether the zoom control is active or not, depends on the proportion between the BeGaze 2.4 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.

#### 6.3.6.4 Thumbnail Control

The thumbnail control displays the stimulus presentation over time as a sequence of thumbnails which represent the stimulus' single images at specific timestamps. Using the thumbnail control, you can navigate in the stimulus presentation of the Gaze Replay 100, Line Graph 203, Bee Swarm 102, Scan Path 108, Focus Map 119, Heat Map 125, Key Performance Indicators 130 or Gridded AOIs 137.

The thumbnail control gives an overview on

- the time window of the trial,
- user defined bookmarks in all stimuli types (video, still image, web),
- user events (mouse clicks, page scrolls, key presses),
- and in case of a video stimulus in the AOI Editor the set key frames 92 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 72).

**Control 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.

### Add and delete bookmarks

Press B on the keyboard in order to add a bookmark on the current position where the green navigation slider is positioned. A yellow circle is added to show the bookmark positions. You can use the key combination Ctrl + Left/Right to navigate between bookmarks. Press B a second time while you are on a bookmark to deletes the bookmark.

Alternatively, position the mouse over the thumbnail or the *Bookmarks* line under the thumbnails and right click. From the context menu select "Add bookmark". If a bookmark is already present in that position right-clicking shows the option "Delete Bookmark" in the context menu.

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

### 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 46 for more information. Adding a new annotation of a type that is not defined yet automatically adds that type to the list of defined annotation types.

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.

Defined annotations can also be dragged left or right with the mouse in order to **change** their **position** in time.

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

### 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 bookmarks or the user defined 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 bookmark, user event or annotations shows a tool-tip containing relevant information (timestamp, content).

### Modify 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.
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.
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.

#### 6.3.6.5 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 thumbnails and *Bookmarks* line:

- **Playback Speed**: Select one of the entries in the pop-up menu to modify the playback speed (**10%**, **25%**, **50%**, **100%**, **200%**, **400%, 800%, 1600%**).
- **Thumbnail Time Window**: You can adjust the number of thumbnails which are displayed in the thumbnail control. Select one of the entries in the pop-up menu (**1 second**, **2 seconds**, **5 seconds**, **10 seconds**, **Fit to Width, Fit to selection**). For example, the **5 seconds** entry will set a thumbnail every 5 seconds, the **Fit to Width** entry will distribute the stimulus' thumbnails according to the available space on the screen whereas the **Fit to Selection** will distribute the thumbnails like **Fit to Width** but only for the selected video area.
- **Step Size**: Video streams are stored as a sequence of single images. The step size determines how many image frames are skipped when you navigate the stimulus presentation with the Playback Control 67. Select one of the entries (**Single Step (Videoframe)**, **Videoframe x 2**, **Videoframe x 4**, **Videoframe x 8**, **Videoframe x 16**, **Videoframe x 32**, **Videoframe x 64**, **Videoframe x 128**, **Videoframe x 256**).
- **Add/Remove Bookmark**: Allows adding a bookmark, or if one already exist at that timestamp, to remove it.

2. Over the *User Events* line:

- Several checkboxes 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) 46 or automatically when defining a new annotation of an inexistent type.
- **Add Annotation**: Add a new annotation if one is not already

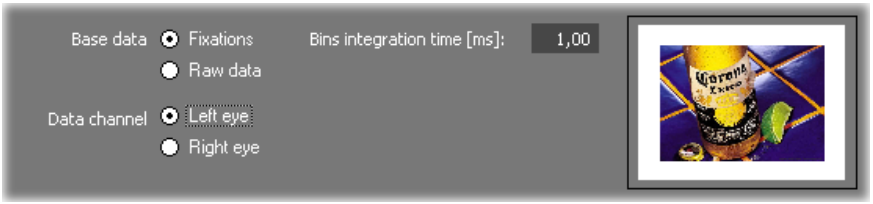
present at the given timestamp.

- **Delete Annotation**: Deletes the annotation if one exists at that timestamp.
- **Edit Annotation**: Edits the annotation content (type, text, operator name) if an annotation exists at that timestamp.
- **Move to Cursor Position**: Moves the annotation under the mouse to the navigation slider position.

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

### 6.3.7 Chart Display Modes

In the Chart Display Modes view, you can adapt the settings for the AOI Sequence Chart 146 and the Binning Chart 150. If you change a setting, the respective display will update immediately.




The view also displays a thumbnail of the currently selected stimulus to the right. Operate this view with the following steps:

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.
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. Note, that this setting is available with the **Binning Chart** data view only.

 You can change, delete or create AOIs with the AOI Editor 75.

## 6.4 AOI Editor

### 6.4.1 Overview

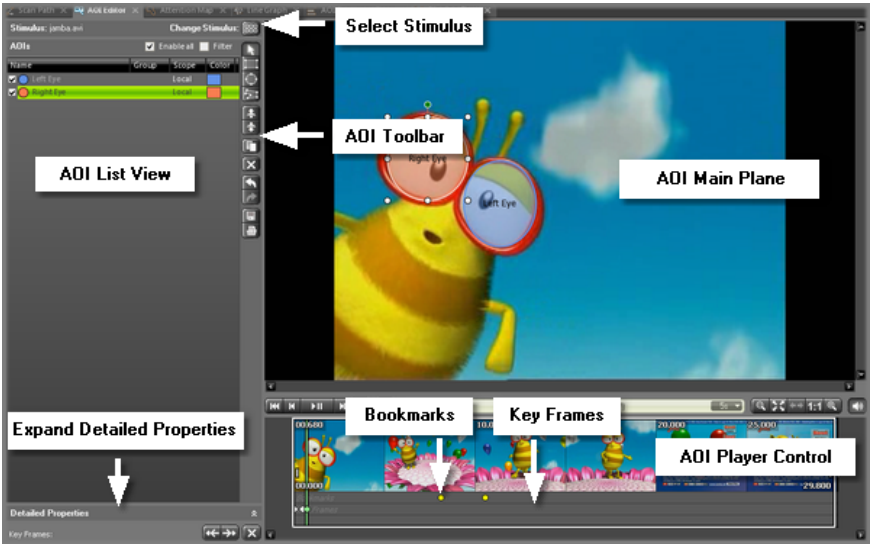
The following data views in BeGaze 2.4 require the existence of AOIs (**A**reas **O**f **I**nterest):

- AOI Sequence Chart 146
- Binning Chart 150
- Event Statistics 152
- Reading Statistics 152
- Key Performance Indicators 130

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).

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 27 with the stimulus images 34. 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 77 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.

If the reading package is licensed, reading AOIs for paragraphs, sentences, words and character are automatically generated in Experiment Center and been used in BeGaze. These reading AOIs cannot be self created. For more information, please see Reading AOI Statistics 199

### 6.4.2 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

### 6.4.3 Open AOI Editor and Select Stimulus

1. Click  in the toolbar 249.

   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 55).

2. Proceed with one of the following steps:

   – Create AOIs 78

   – Edit AOIs 80

   – Delete AOIs 93

### 6.4.4 Create AOIs

#### Prerequisite

A stimulus is displayed in the AOI's main view (see also Stimulus Selection 55).

#### 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 2.4 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 92).

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 70).

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 80.

### 6.4.5 Edit AOIs

You can edit existing AOIs as follows:

- rename AOI 81,
- change position and/or shape of a still image stimulus AOI 83,
- change position and/or shape of a video stimulus AOI 85,
- change the AOI priority 85,
- change the visibility of a selected AOI, see Change AOI's Visibility 90,
- edit several properties for a selected AOI, see Edit AOI Properties 86.

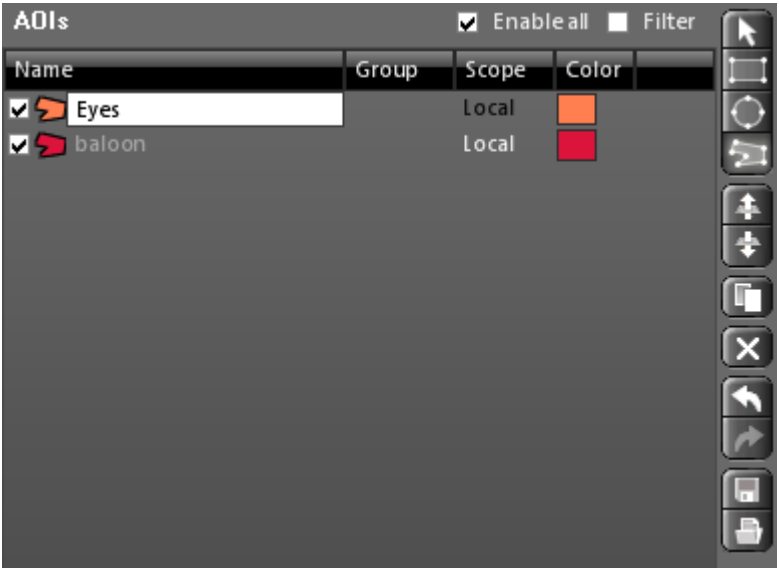
#### Prerequisite

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

#### Enable/Disable AOI

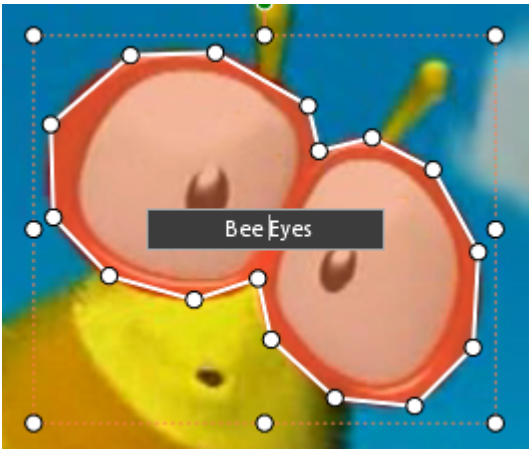
- AOI's are enabled by default and can be disabled if the AOIs shall not be considered in the whole experiment (statistics, ...)
- "Enable all" allows to enable and disable all AOIs in one go or with the filter when clicking on the filter checkbox
- Individual AOIs can be enabled/disabled by clicking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



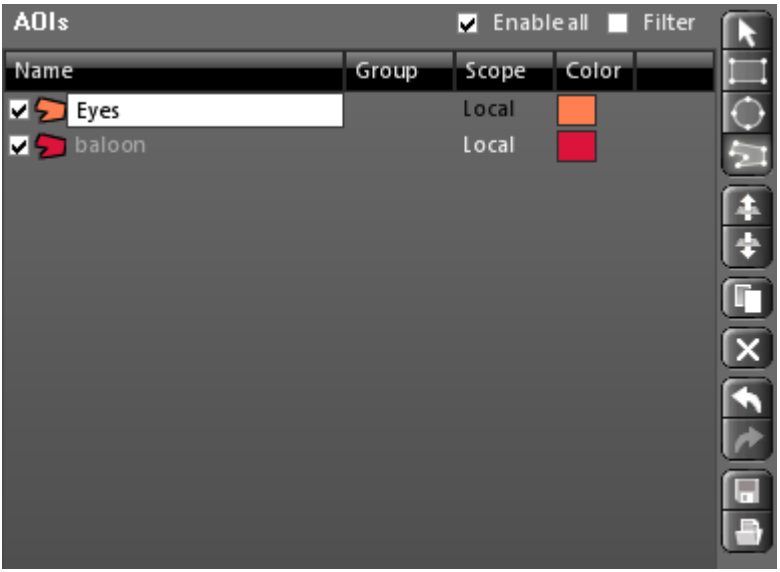

### Rename AOI

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



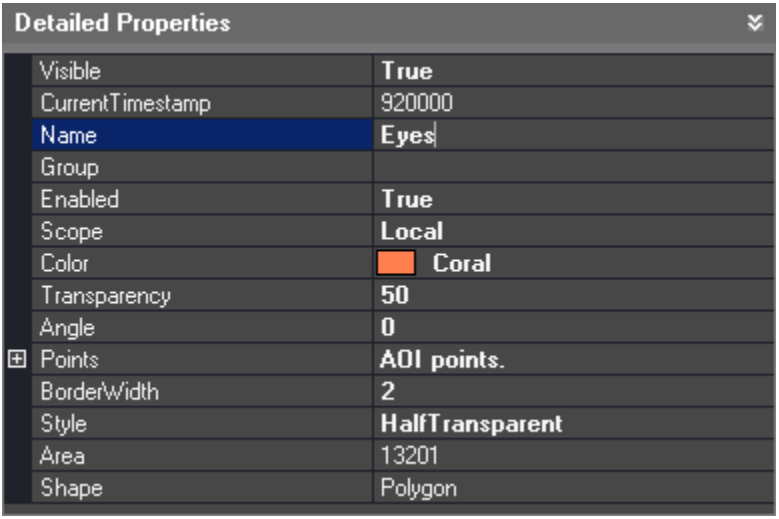

Or you can click the AOI in the AOI list view and overwrite the given

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).



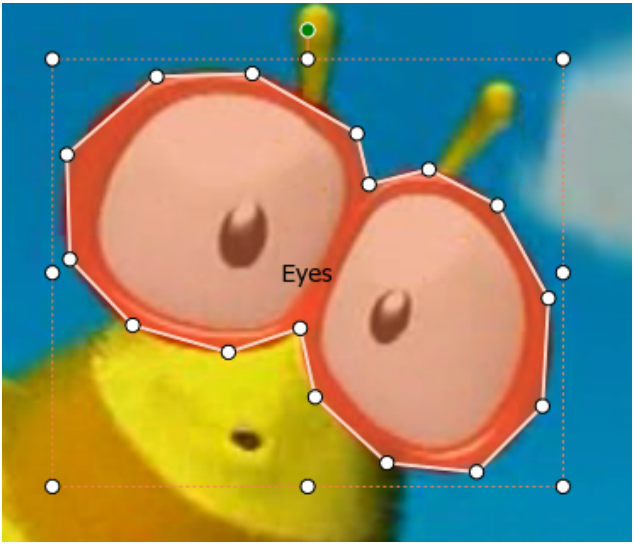

### Change position and/or shape of a still image AOI

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 `[Shift]` 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 70).

   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 83).

   BeGaze 2.4 will automatically set a key frame for the new AOI position (see also Navigate through Key Frames 92).

Tip: It will be efficient to use key commands to navigate in the player control (see Playback Control 67) 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 overlay upon each other, and the chosen diagram only allows evaluation of one AOI per time (which is the case with the Binning Chart 150), 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.

### 6.4.6 Edit AOI Properties

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

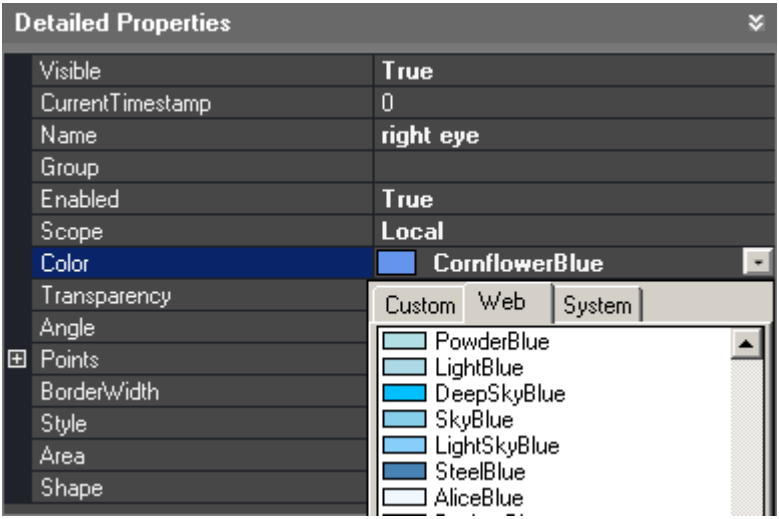
1. Click on the  button to switch to the edit mode.
2. Click the desired AOI in the AOI list view. Alternatively, you can click on the desired AOI in the AOI main view. Expand the AOI detailed properties view.

   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, Event Statistics 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.

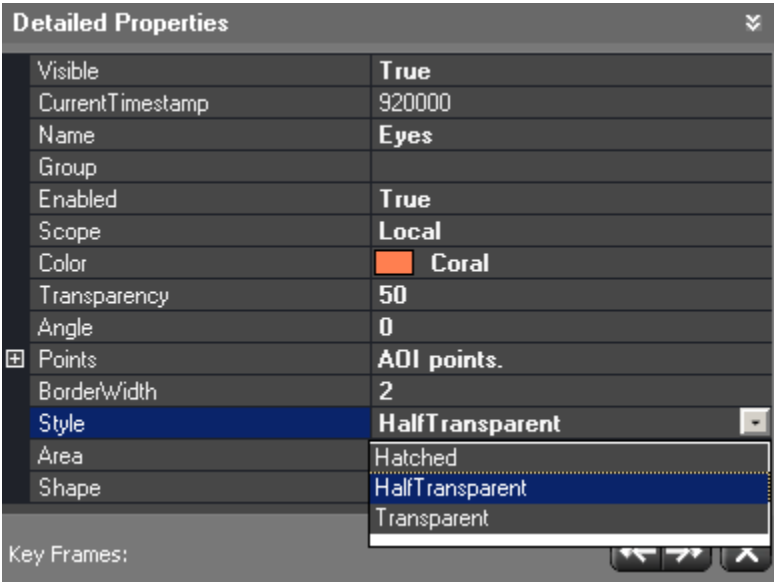
8. **Color**: New AOIs are created with standard colors. It is recommended to change these colors if the AOIs are hardly recognizable on your stimulus image. Click on to open the color selection drop-down field, offering separate color tabs. Select the desired color.




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.



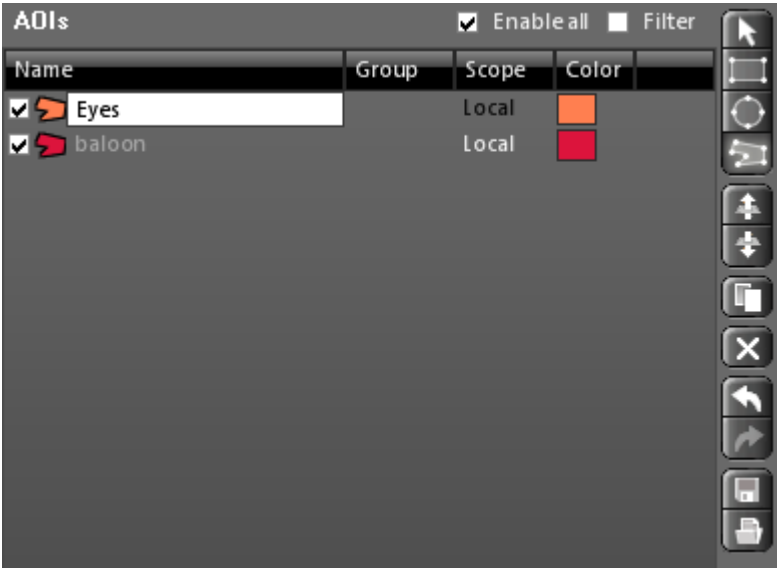

12. **Area** is showing the size of the AOI in square-pixel.

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.

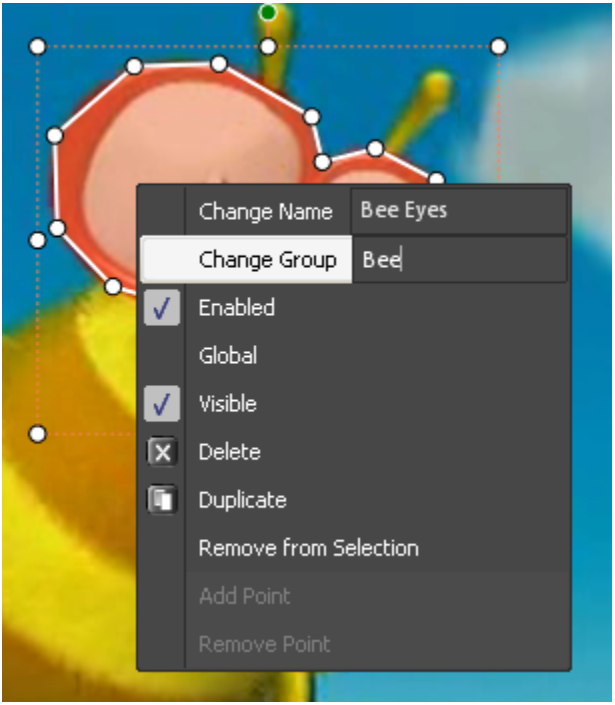
For convenience there are two alternative methods for editing the most commonly used properties rendering the Detailed Properties panel useful for advanced editing only:

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.



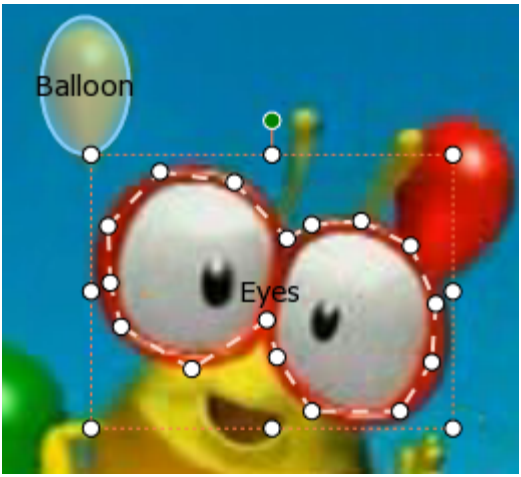

### 6.4.7 Change AOI's Visibility

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 86).

Invisible AOIs are indicated with a dotted border.




Note, that no AOI hit is counted while the AOI has the invisible status. This is true even if BeGaze 2.4 detects the gaze position meets the AOI area. This means that no AOI hits are emitted in the AOI Sequence Chart 146 and the Binning Chart 150.

**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 2.4 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 subject gazed at the AOI.

## 6.4.8 Navigate through Key Frames

### Move&Morph

With a video stimulus BeGaze 2.4 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 2.4 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 70 indicates the key frames which are set for a video stimulus with ◇.


### Navigate through key frames

The key frames control is located on the bottom of the **AOI Editor**.


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 70).
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 |

## 6.4.9 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.

## 6.4.10 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 94).

## 6.4.11 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 96>
    <Points 97>
      <Point>
        <X>1003</X>
        <Y>748</Y>
      </Point>
      <Point>
        <X>1169</X>
        <Y>886</Y>
      </Point>
    </Points>
    <Enabled 96>true</Enabled>
    <Group 96>Main Group</Group>
    <Scope 96>Local</Scope>
    <Angle 97>0</Angle>
    <BorderWidth 97>2</BorderWidth>
    <Type 96>Rectangle</Type>
    <Style 97>HalfTransparent</Style>
    <Transparency 97>50</Transparency>
    <Area 97>22908</Area>
    <Color 97>NamedColor:Blue</Color>
    <Name 96>Logo Name</Name>
    <Font 97>
      <FontName>Tahoma</FontName>
      <FontSize>13</FontSize>
      <FontStyle>Regular</FontStyle>
      <FontUnit>Point</FontUnit>
      <FontGdiCharSet>1</FontGdiCharSet>
      <FontGdiVerticalFont>false</FontGdiVerticalFont>
    </Font>
    <Visible 97>true</Visible>
    <CurrentTimestamp 97>0</CurrentTimestamp>
    <KeyFrames 97>
      <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 96 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 75. 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 96. 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 97 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 97.
- **CurrentTimestamp**: defines the current timestamp.
- **KeyFrames**: defines several key frames made up of Points 97, Visible 97 and Timestamp 97. 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 96>
  <Points 97>
    <Point>
      <X>1003</X>
      <Y>748</Y>
    </Point>
    <Point>
      <X>1169</X>
      <Y>886</Y>
    </Point>
  </Points>
  <Type 96>Rectangle</Type>
  <Name 96>Volvic Logo</Name>
  <Visible 97>true</Visible>
</DynamicAOI>
```

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

```
<DynamicAOI 96>
  <Points 97>
    <Point>
      <X>1</X>
      <Y>37</Y>
    </Point>
    <Point>
      <X>167</X>
      <Y>345</Y>
    </Point>
  </Points>
  <Type 96>Rectangle</Type>
  <Name 96>Bee</Name>
  <Visible 97>true</Visible>
  <CurrentTimestamp 97>0</CurrentTimestamp>
  <KeyFrames 97>
    <KeyFrame>
      <Points>
        <Point>
          <X>1</X>
```

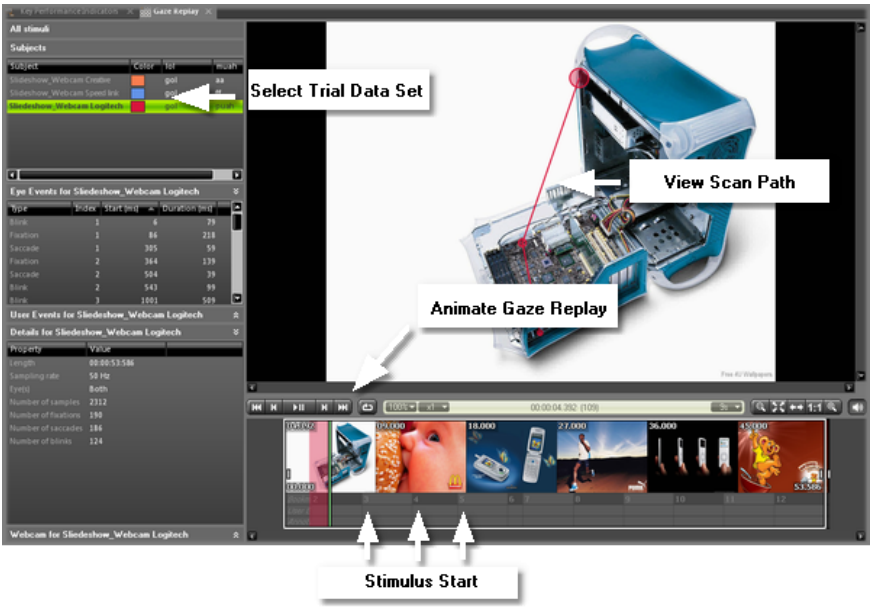
```
            <Y>37</Y>
          </Point>
          <Point>
            <X>167</X>
            <Y>345</Y>
          </Point>
        </Points>
        <Visible>true</Visible>
        <Timestamp>0</Timestamp>
      </KeyFrame>
      <KeyFrame>
        <Points>
          <Point>
            <X>1</X>
            <Y>60</Y>
          </Point>
          <Point>
            <X>221</X>
            <Y>345</Y>
          </Point>
        </Points>
        <Visible>false</Visible>
        <Timestamp>80000</Timestamp>
      </KeyFrame>
    </KeyFrames>
  </DynamicAOI>
```

# 6.5 Gaze Replay

## 6.5.1 Overview

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

The behavior of this data view is identical to the Scan Path 108 data view (except for the fact that the stimuli are concatenated one after the other in a single playback). For more information on the settings see the Scan Path Settings 113.




A specific element of the **Gaze Replay** data view is the automatic insertion of hidden bookmarks in the player control at the beginning of each stimulus to ease the navigation. The usual bookmark navigation keyboard shortcuts apply here ([ CTRL ] + left/right arrow ).

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

1. Use the Stimulus Selection 55 to change to the desired stimulus.

   The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, activate the desired trial or filter combination.

   The Bee Swarm Main Window 104 is updated and shows the raw data for the activated trial combination.

   While selecting trials, the Events Selection 61 view and the Trial Details 60 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 70. Use the Playback Control 67 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 Gaze Replay 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 to File…** command.

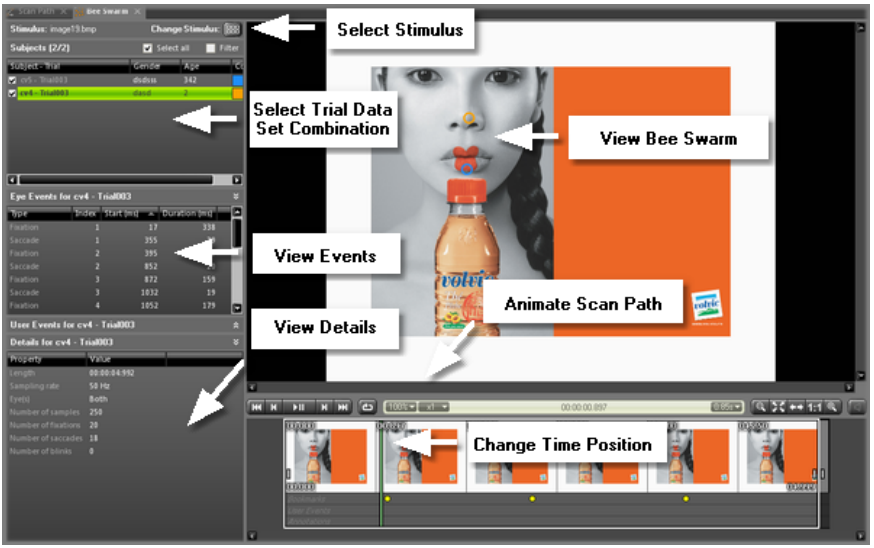
All features of this data view are available with gaze tracking data generated with the iView X™ system. Note that the type of stimuli (still images and/or videos) which can be analyzed depends on the acquired BeGaze 2.4 program version 11.

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 Bee Swarm

## 6.6.1 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 55 to change to the desired stimulus.

   The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, activate the desired trial or filter combination.

   The Bee Swarm Main Window 104 is updated and shows the raw data for the activated trial combination.

   While selecting trials, the Events Selection 61 view and the Trial Details 60 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 70. Use the Playback Control 67 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.

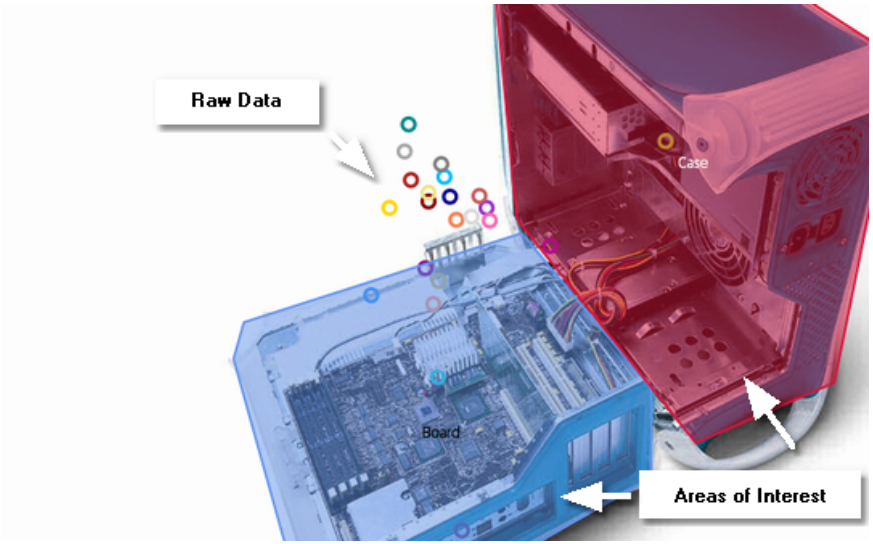
   Alternatively, you can export the current view of the bee swarm to an image file. From the **Export** menu, select the **Save Image to File…** command.

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 2.4 program version 11.

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 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 subject).

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 105 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 to File** ( [ 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 subject will be highlighted Subjects Selection 56.

### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Click the desired property and overwrite its content.

## 6.6.3 Settings

### 6.6.3.1 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 104 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 106 you can change the general appearance of the bee swarm display.

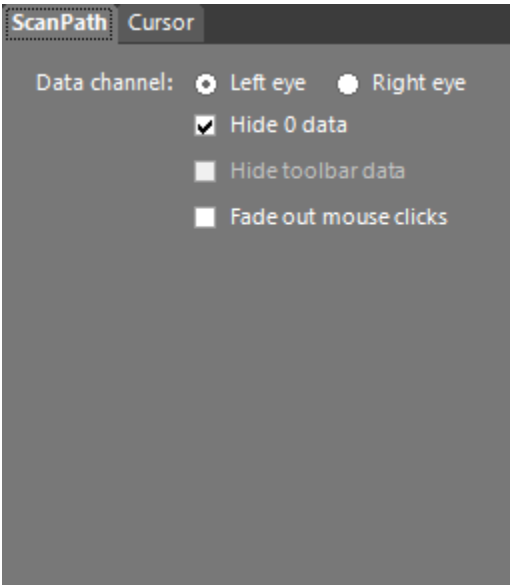
   – In the Cursor Tab 107 you configure the gaze cursor appearance.
4. Confirm your settings with **OK**.

If you open a second Bee Swarm 102 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.

### 6.6.3.2 Bee Swarm Tab

In the **Bee Swarm** tab of the Bee Swarm Settings 105 dialog, you configure the general appearance of the bee swarm display.

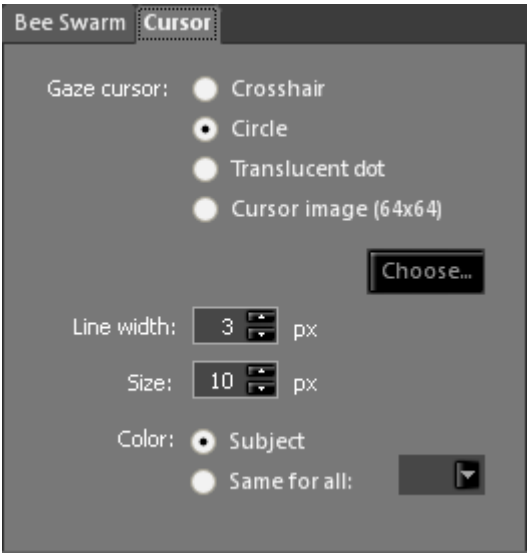



- **Data channel**: Select if you want to view **Left eye** or **Right eye** data. If the currently selected trail data set only has monocular gaze data, the available data channel is selected automatically.
- **Hide 0 Data**: The gaze tracker produces data with position (0,0) if – for some reason – 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.

#### 6.6.3.3 Cursor Tab

In the **Cursor** tab of the Bee Swarm Settings 105 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**, 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

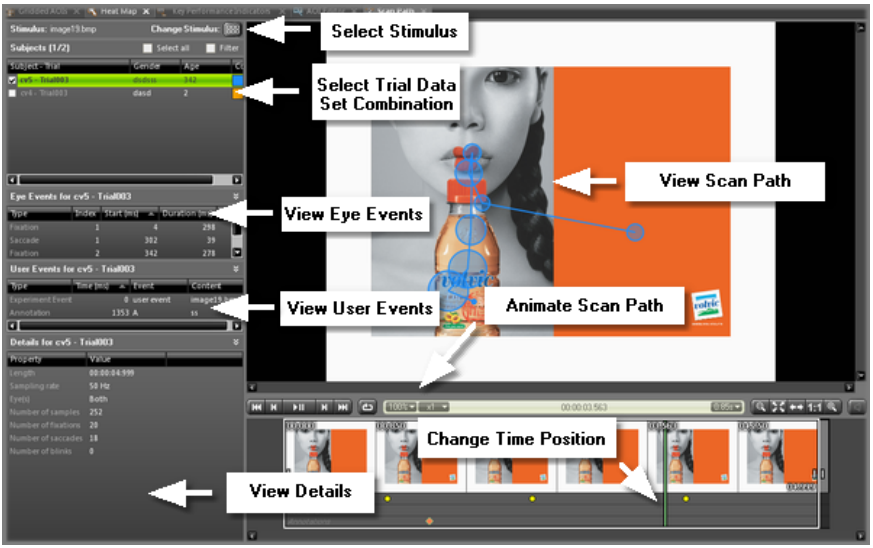
the gaze cursor (in pixels).

- **Color** (not used with **Cursor image** setting): Changes the gaze cursor color. Click the drop-down icon and select the desired color.

# 6.7 Scan Path

## 6.7.1 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 55 to change to the desired stimulus.

   The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, activate the desired trial or filter

combination.

The Scan Path Main Window 110 is updated and shows the scan path for the activated trial combination.

While selecting trials, the Events Selection 61 view and the Trial Details 60 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 70. Use the Playback Control 67 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.

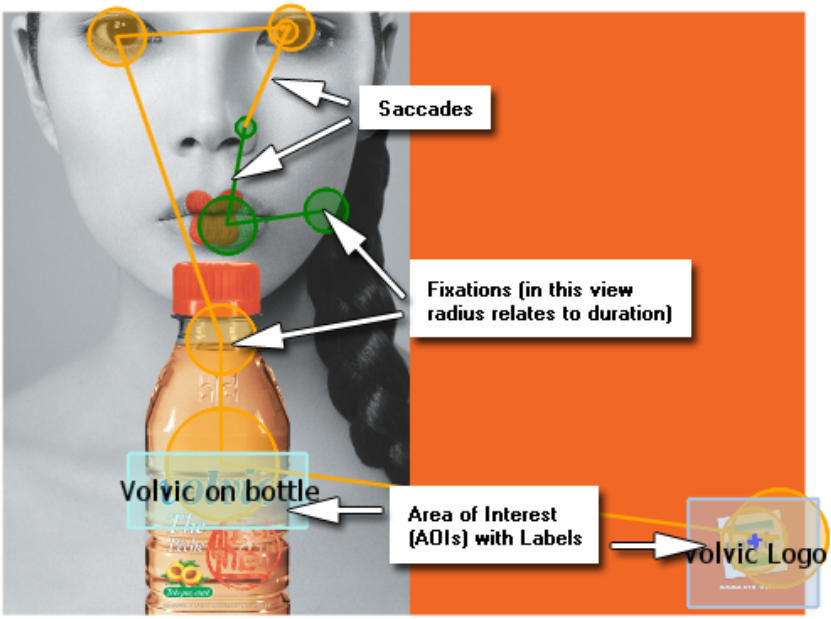
   Alternatively, you can export the current view of the scan path to an image file. From the **Export** menu, select the **Save Image to File…** command.

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 2.4 program version 11.

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.

### 6.7.2 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 113 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.

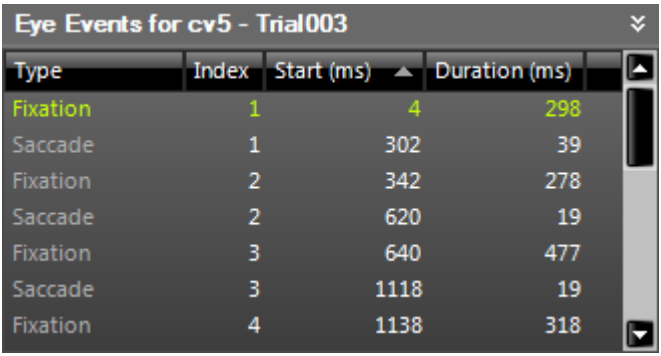
3. Select the **Show AOIs** command, to toggle the visibility of AOIs in the scan path display.

4. In the **Export** menu, either select the **Save Image to File** ( [ 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 subject and event will be highlighted in the Subjects Selection 56 and the Events Selection 61. The subject and event will be highlighted when clicking on raw data cursors also.

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




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

The scan path is drawn in the color of the corresponding subject unless special timers are defined in the Scan Path Settings 113.

### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Click the desired property and overwrite its content.

## 6.7.3 Settings

### 6.7.3.1 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 110 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 113 you can change the general appearance of the scan path display.

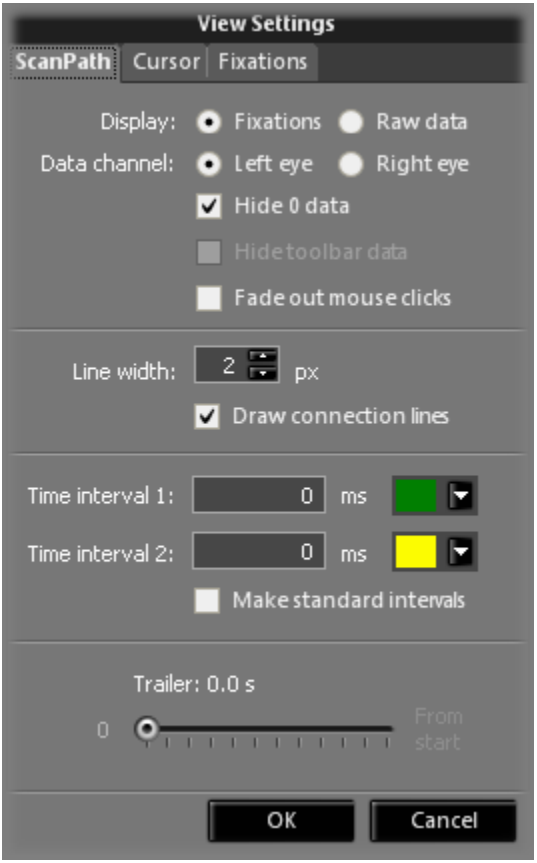
   – In the Cursor Tab 116 you configure the gaze cursor appearance.

   – In the Fixations Tab 117 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 108 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.

### 6.7.3.2 Scan Path Tab

In the **Scan Path** tab of the Scan Path Settings 113 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.
- **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 subject color property in the **Subjects** 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 70.

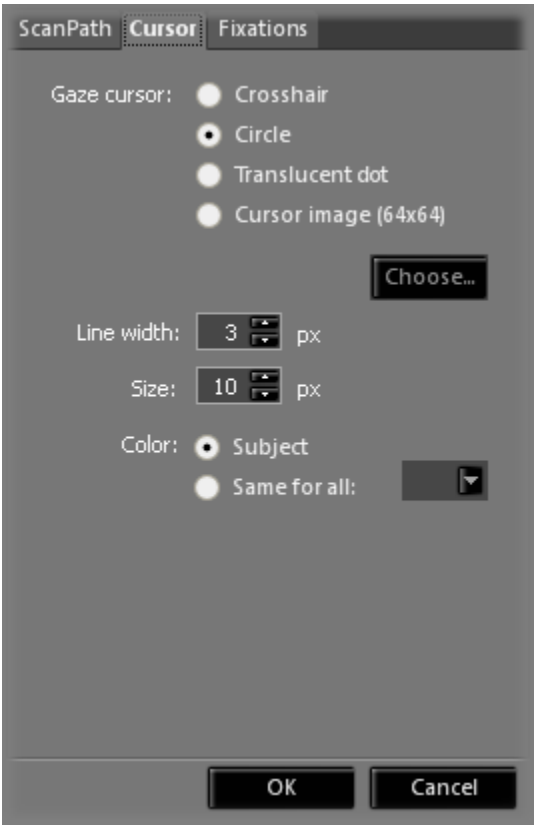
  **From beginning** (still image stimulus only): If activated, all gaze data is displayed from the first sample to the current analysis position.

  **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.

If you display an overlay of the real-time gaze positions of multiple subjects, 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 subjects / trials and press play.

### 6.7.3.3 Cursor Tab

In the **Cursor** tab of the Scan Path Settings 113 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**, 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.

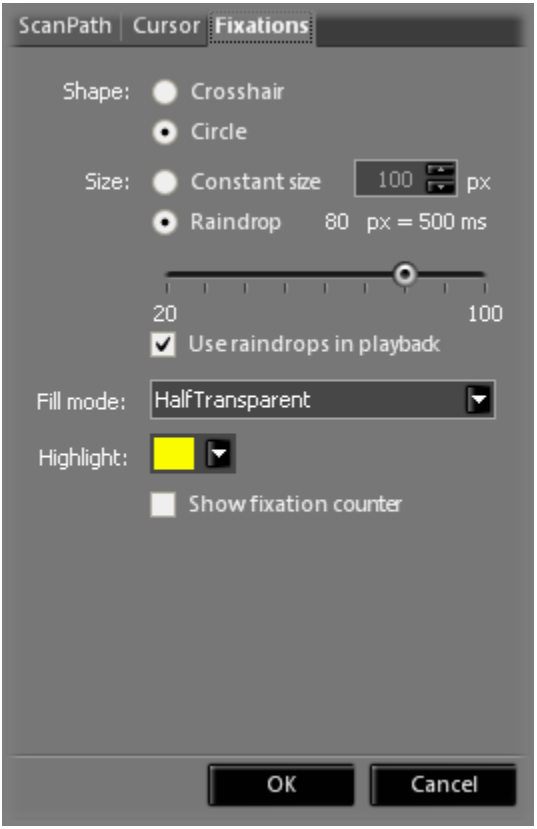
- **Line width** (not used with **Cursor image** setting): Changes the line width of the gaze cursor (in pixels).
- **Size** (not used with **Cursor image** setting): Changes the diameter of the gaze cursor (in pixels).
- **Color** (not used with **Cursor image** setting): Changes the gaze cursor color:

  - **Subject**: sets the gaze cursor color to the subject color property in the **Subjects** 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.

#### 6.7.3.4 Fixations Tab

In the **Fixations** tab of the Scan Path Settings 113 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 113.




- **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

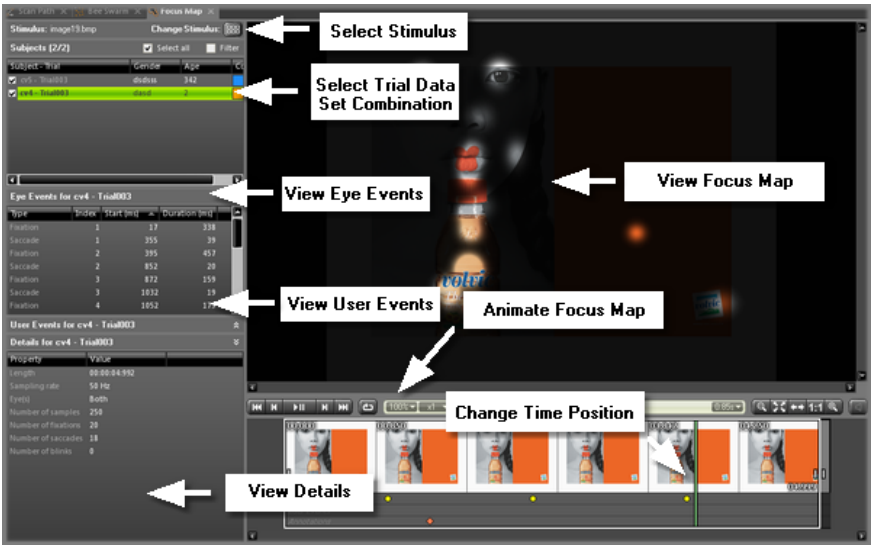
shapes also changes during replay or while moving the current analysis position.

- **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.

# 6.8 Focus Map

## 6.8.1 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 55 to change to the desired stimulus.

   The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, activate the desired trial or filter combination.

   The Focus Map Main Window 121 is updated and shows the focus map for the activated trial combination.

   While selecting trials, the Events Selection 61 view and the Trial Details 60 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 66. Use the Playback Control 67 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 to File…** 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 2.4 program version 11.

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.

### 6.8.2 Main Data View

After selecting the desired trial data, the **Focus Map** main view displays the updated map. Two visualization styles are possible:

- The **Focus map** shows fixation hits related to brightness between darkest (less hits) and normal brightness (most hits).


- The **Custom map** shows fixation hits related to a custom defined color scale.


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.

#### 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 122 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 to File** ( [ 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.

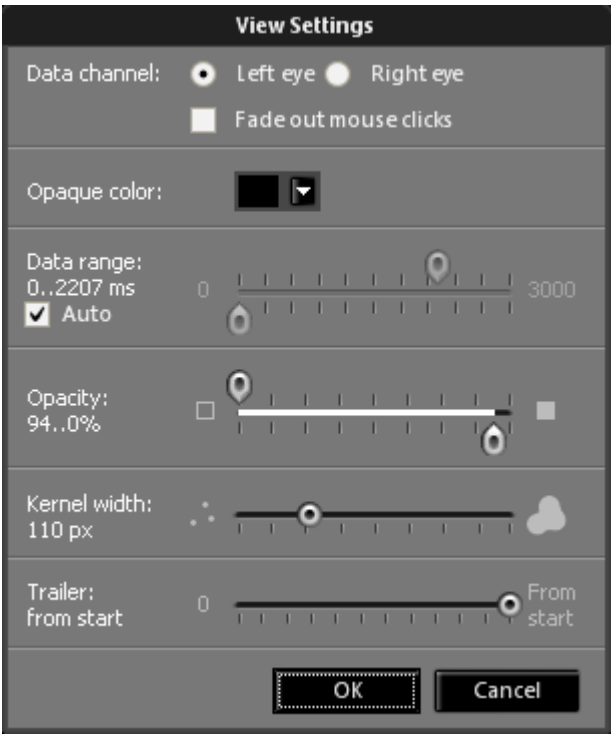
### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Click the desired property and overwrite its content.

## 6.8.3 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.
- **Saturation**: Select if you want to see a **Focus map** with the maximum saturation value computed dynamically for each trial or a **Custom** map.
- **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.

Note that the saturation and color parameters settings in the dialog are available for the Custom map only.

### Parameters

- **Opaque Color:** The overlay backgound 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 subjects, the sum (over all subjects) of the fixation duration is calculated. 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.
- 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 more 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 70.

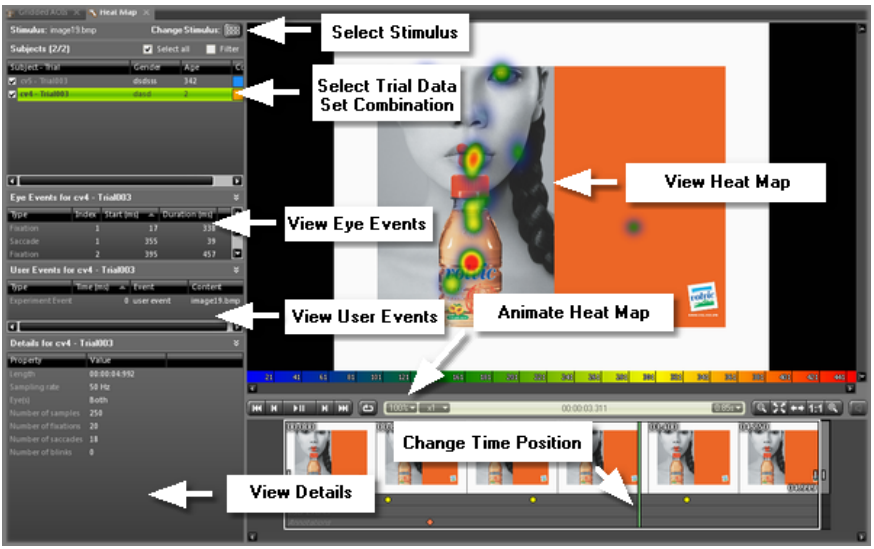
**From Start** (still image stimulus only): If selected, all gaze data is displayed from the first sample to the current analysis position.

**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.

# 6.9 Heat Map

## 6.9.1 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 55 to change to the desired stimulus.

The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, activate the desired trial or filter combination.

   The Heat Map Main Window 126 is updated and shows the heat map for the activated trial combination.

   While selecting trials, the Events Selection 61 view and the Trial Details 60 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 66. Use the Playback Control 67 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 to File…** 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 2.4 program version 11.

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 Main Data View

After selecting the desired trial data, the **Heat Map** main view displays the updated map. Two visualization styles are possible:

- The **Heat map** shows fixation hits related to the color scale between

blue (less hits) and red (most hits).


- The **Custom map** shows fixation hits related to a custom defined color scale.


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.

### 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 128 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 to File** ( [ 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.

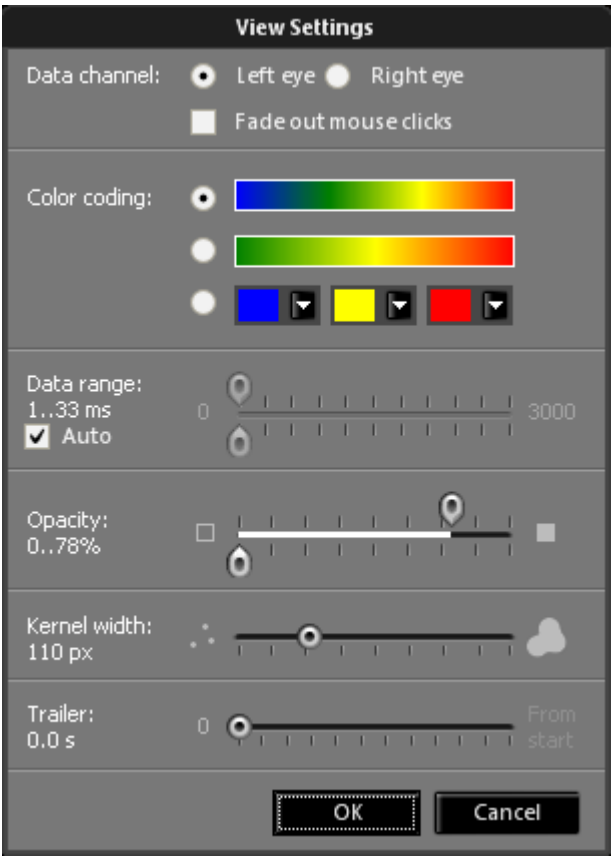
### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Click the desired property and overwrite its content.

## 6.9.3 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). For a detailed description of the common settings see Focus Map Settings 122.




- **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.

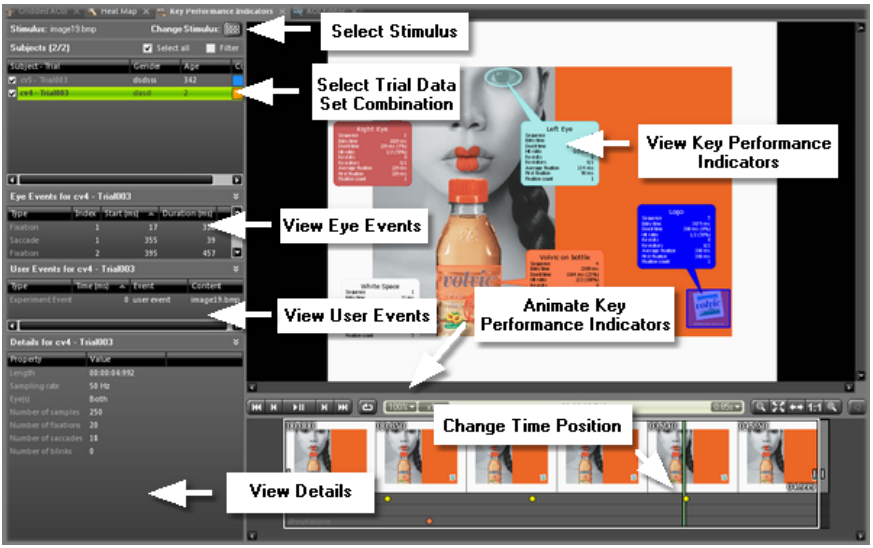
See also:

Heat Map Main Window 126
Heat Map Overview 125

# 6.10 Key Performance Indicators

## 6.10.1 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 subjects in the Subjects list view.




Operate the **Key Performance Indicators** data view with the following steps:

1. Use the Stimulus Selection [55] to change to the desired stimulus.

   The Subjects Selection [56] displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection [56], activate the desired trial or filter combination.

   The Key Performance Indicators Main Window [131] is updated and

shows the KPIs for the activated trial combination.

While selecting trials, the Events Selection 61 view and the Trial Details 60 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 66. Use the Playback Control 67 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 to File…** 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 2.4 program version 11.

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.

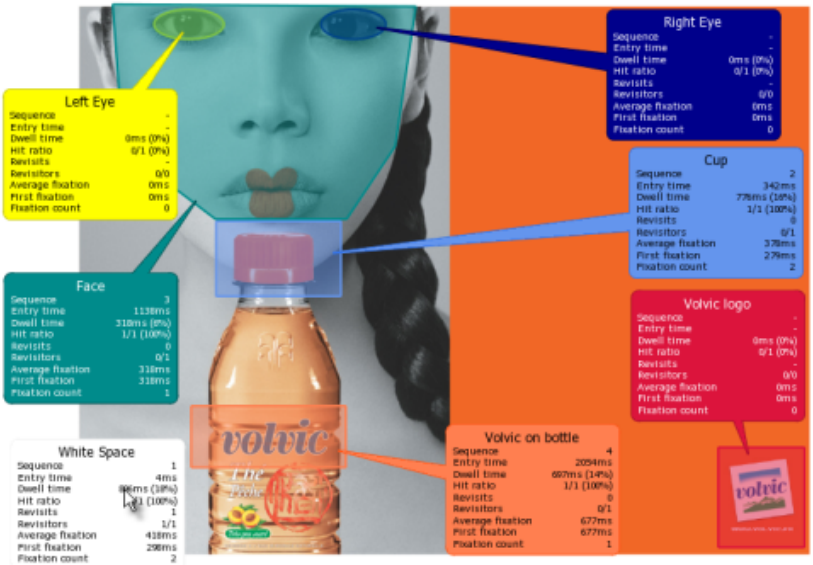
### 6.10.2 Main Data View

The **Key Performance Indicators** (KPI) main view gets you immediate responses at a glance:

- Which stimuli elements were the eye catchers?
- How many subjects watched each element?
- In which order?
- How many revisits?
- What is the rank and share of visual attention among all subjects?

- 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 subjects (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 133 dialog. Select the indicators to display and confirm with **OK**.

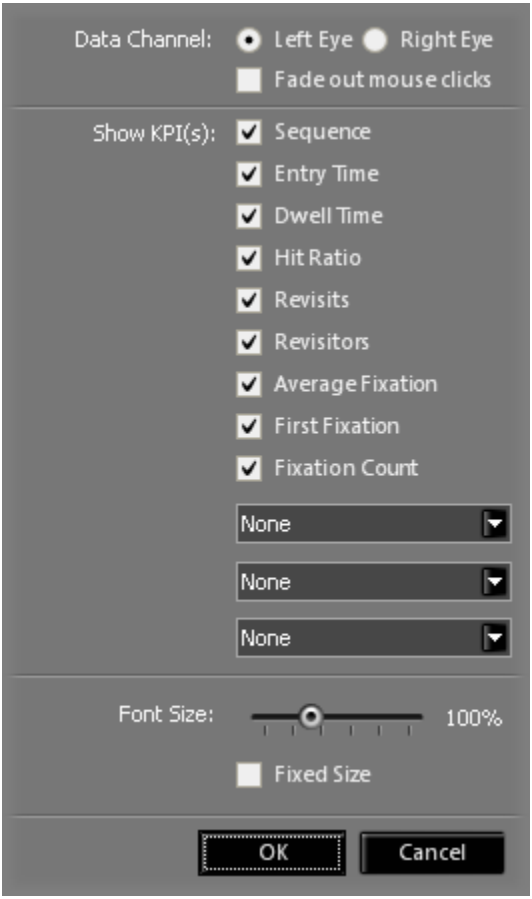
   The KPI display is updated.
3. In the **Export** menu, either select the **Save Image to File** ( [ CTRL ] + [ S ]) or select the **Copy Image to Clipboard** ( [ CTRL ] + [ C ]) keyboard command to export the current KPI display to a single image. You can also export the KPIs to a video file using the **Export KPIs Video** command from the **Export** menu.

### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Click the desired property and overwrite its content.

## 6.10.3 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:

| KPI Name | unit | Description |
|---|---|---|
| Sequence | count | Order of gaze hits into the AOIs based on Entry time, lowest entry time = first in Sequence |
| Entry time | ms | Average duration for the first fixation into the AOI |
| Dwell time | ms and % | Dwell time average ms = sum (all fixations and saccades within an AOI for all selected subjects) / by number of selected subject<br>Dwell time average % = dwell time average * 100 / (current time - start time) |
| Hit ratio | count and % | How many subjects out of the selected subjects looked at least one time into the AOI - "total hit count" / "number of selected subjects" |
| Revisits | count | Average Revisits = (Number of glances divided by selected subjects with at least one visit) -1<br>Glances = Increments the counter each time a fixation hits the AOI if not hit before |
| Revisitors | count | 1. Number of subjects with more than one visit in an AOI<br>2. Total number of subjects with at least one visit into an AOI<br>e.g. 3 revisitors out of 7 visitors |

| | | |
|---|---|---|
| **Average Fixation** | ms and % | Sum of "average fixation time per subject in an AOI" divided by number of selected subjects |
| **First fixation** | ms | Sum of all "first fixations" for selected subjects divided by number of selected subjects |
| **Fixation count** | count | Number of all fixations for selected subjects divided by number of selected subjects |

Additionally there are three combo-boxes that allow to select two more indicators (one each) to show together with the ones in the table above. For the description of these parameters see the AOI Summary Statistics 175 list. The available extra indicators can be the following:

- AOI Area
- AOI Coverage
- Glance Duration
- Diversion Duration
- Appearance Count
- Visible Time
- Net Dwell Time

### Font

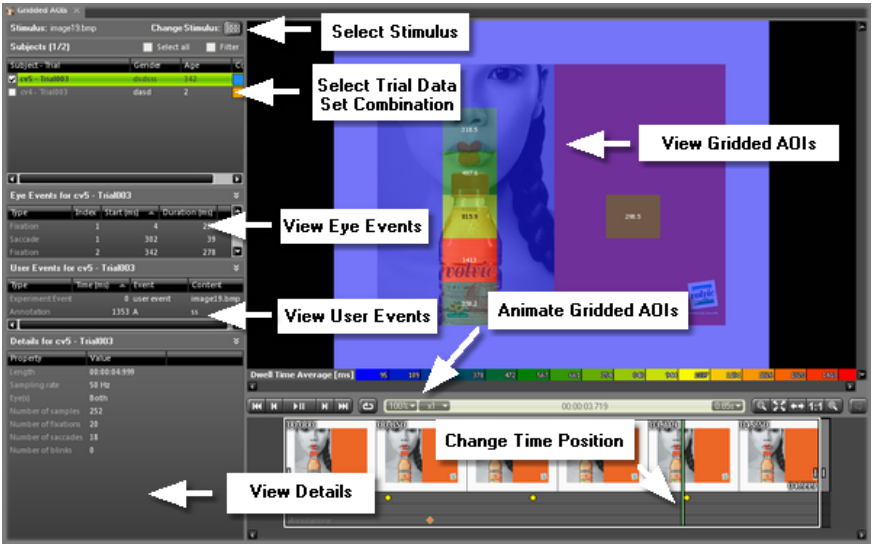
- **Font Size**: Selects the size of the KPIs font as a percent of the standard font size used for the main view (the font size used for AOI names in the AOI Editor for example).
- **Fixed Size**: If checked the KPI font size remains the same at all zoom levels, otherwise the font size scales together with the AOIs at different zoom levels. Default is not checked.

# 6.11 Gridded AOIs

## 6.11.1 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.




Operate the **Gridded AOIs** data view with the following steps:

1. Use the Stimulus Selection 55 to change to the desired stimulus.

   The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, activate the desired trial or filter combination.

The Gridded AOIs Main Window 139 is updated and shows the gridded AOIs for the activated trial combination.

While selecting trials, the Events Selection 61 view and the Trial Details 60 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 66. Use the Playback Control 67 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.

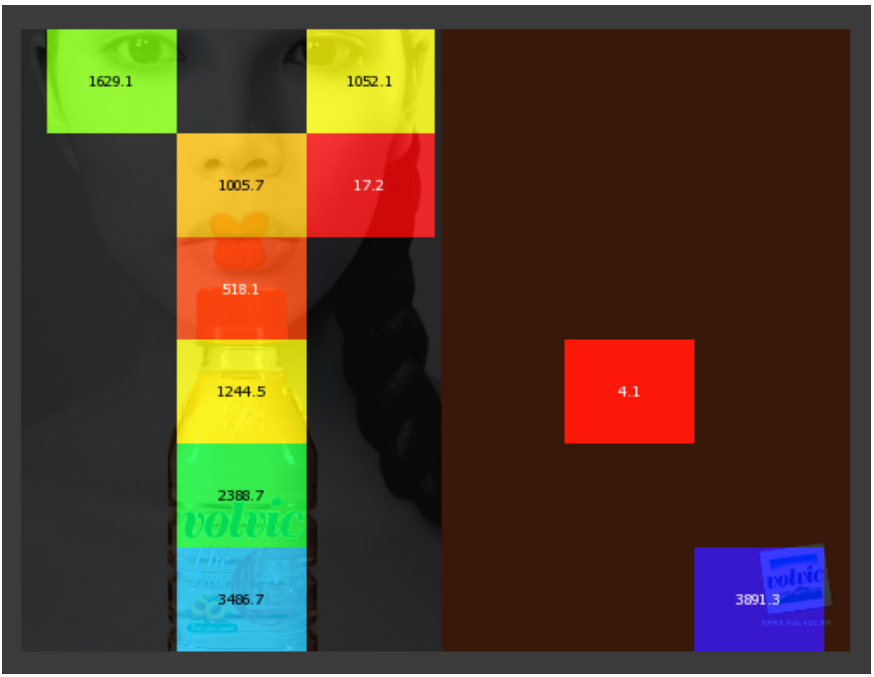
   Alternatively, you can export the current view of the gridded AOIs to an image file. From the **Export** menu, select the **Save Image to File…** command.

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 2.4 program version 11.

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 **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 143 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 to File** ( [ 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.

### Parameters

The **Gridded AOIs** view can display one of the following statistics parameters:

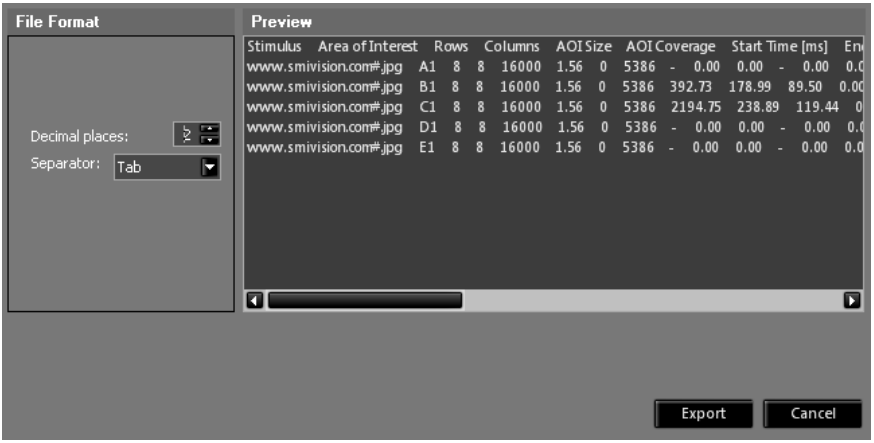
- Entry Time (Average)
- Dwell Time (Total)
- Dwell Time (Average)
- Revisits
- Fixation Count (Total)
- Fixation Count (Average)
- Subject Hit
- Sequence (Average)

The displayed parameter can be changed from the **Parameter** drop-down box in Gridded AOIs Settings 143.

### 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 141.

### 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.

### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Click the desired property and overwrite its content.

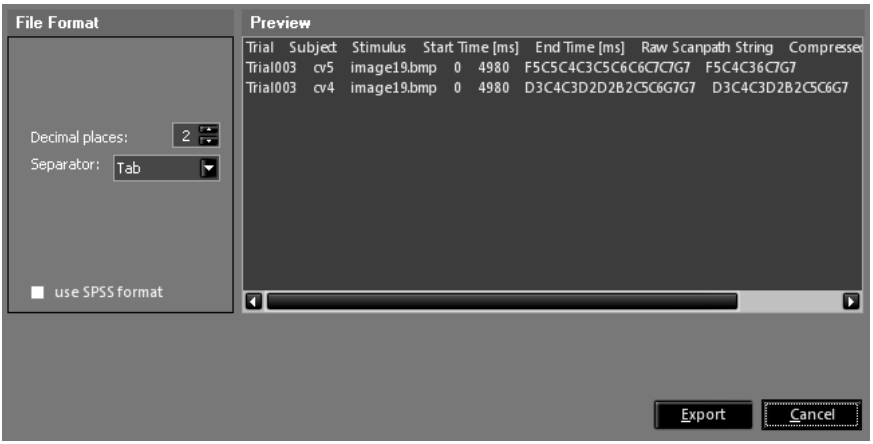
## 6.11.3 Scan Path Strings

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 110 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 rows are labeled left to right as A, B, C and so on and the columns top to bottom are 1, 2, 3... 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

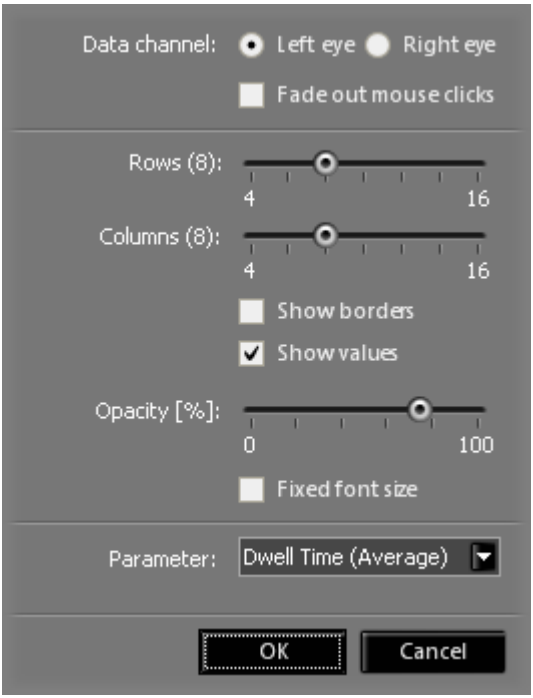
Additionally a *compressed scanpath string* is also exported. The compressed string is obtained by eliminating duplicated consecutive AOIs (A1A1 becomes A1) and duplicated sequences (A1-B1-C1-A1-B1 becomes A1-B1-C1).

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

### 6.11.4 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
- **Opacity**: selects the opacity level of the AOI grid colors

### 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 for the first fixation into the AOI |
| **Dwell time (Total)** | ms | Dwell time ms = sum (all fixations and saccades within an AOI for all selected subjects) |

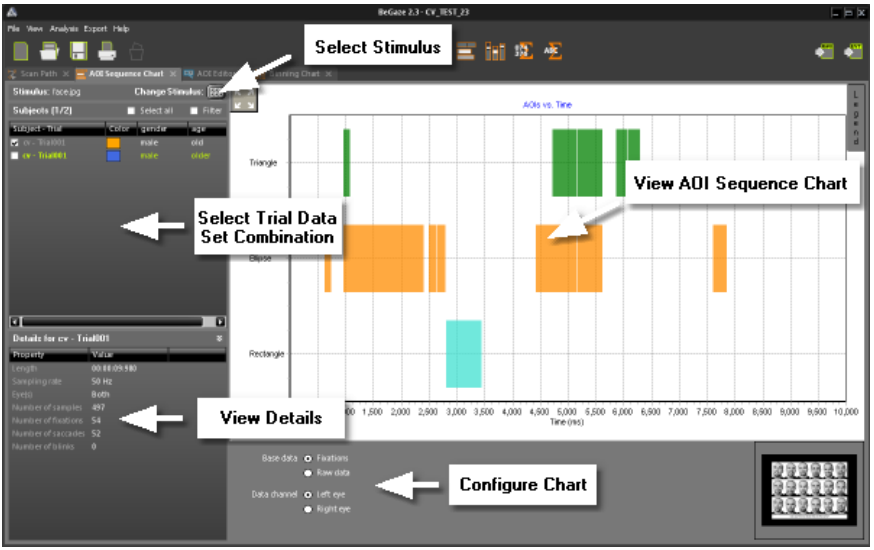
| | | |
|---|---|---|
| **Dwell time (Average)** | ms | Dwell time average ms = sum (all fixations and saccades within an AOI for all selected subjects) / by number of selected subjects |
| **Revisits** | count | Average Revisits = (Number of glances divided by selected subjects with at least one visit) -1<br>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 subjects |
| **Fixation count (Average)** | count | Number of all fixations for selected subjects divided by number of selected subjects |
| **Subject Hit** | count | Number of subjects that looked into the AOI |
| **Sequence (Average)** | count | How many subjects out of the selected subjects looked at least one time into the AOI - "total hit count" / "number of selected subjects" |

These parameteres are among those found in the AOI Summary Statistics 175 list.

# 6.12 AOI Sequence Chart

## 6.12.1 Overview

The **AOI Sequence Chart** shows the temporal order at which AOIs were hit by a particular subject.




Operate the **AOI Sequence Chart** data tab with the following steps:

1. Use the Stimulus Selection 55 to change to the desired stimulus.

   The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, select one or multiple trials.

   The AOI Sequence Chart Main View 147 is updated and shows the AOI hits for the selected trial.

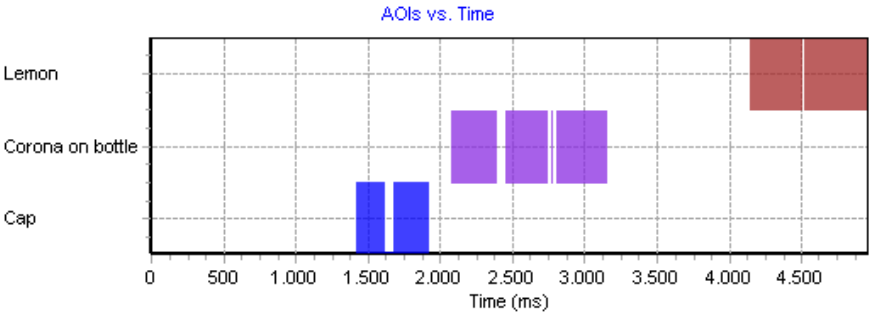
   While selecting trials, the Trial Details 60 view shows information about the currently selected trial.

3. Configure the Chart Display Modes 74 to further adapt the display to your needs.

## 6.12.2 Main Data Tab

### Single Subject 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.

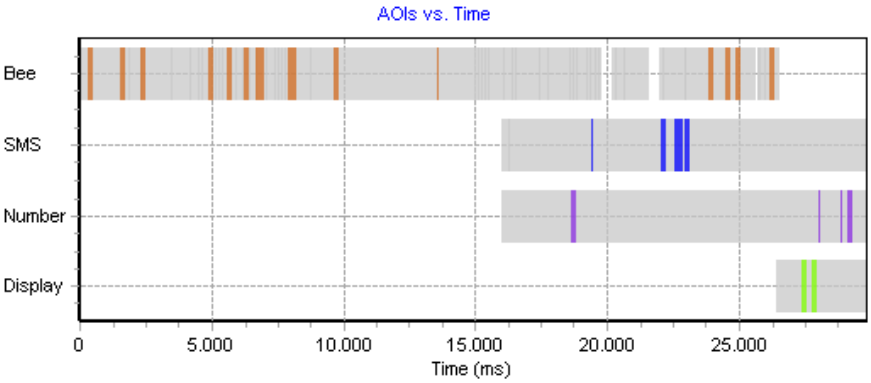



The colored bars represent the different AOIs hits. If the AOIs are labeled, their names appear at the y-axis. The x-axis shows the time in milliseconds. If you right click on one of the bars, a tooltip will pop up displaying detailed information on the AOI (name, start / end time of it's presentation, and the duration of the AOI presentation).

In the example above the selected subject 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.

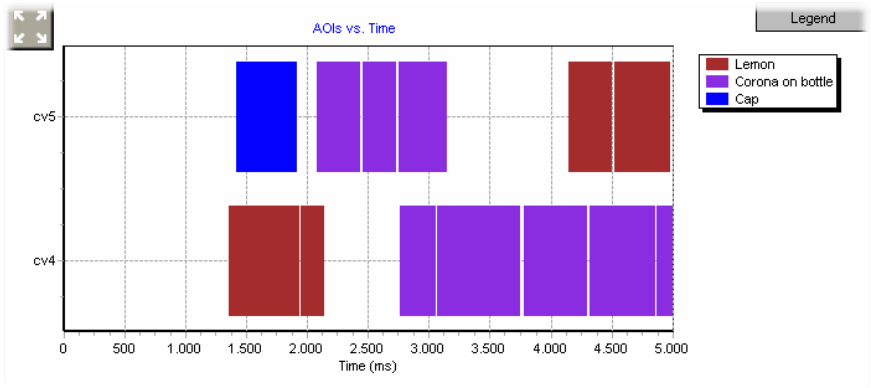
 




You can change the AOIs and also change the AOI colors in the AOI Editor 75.

## Multiple Subject 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 subject 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.

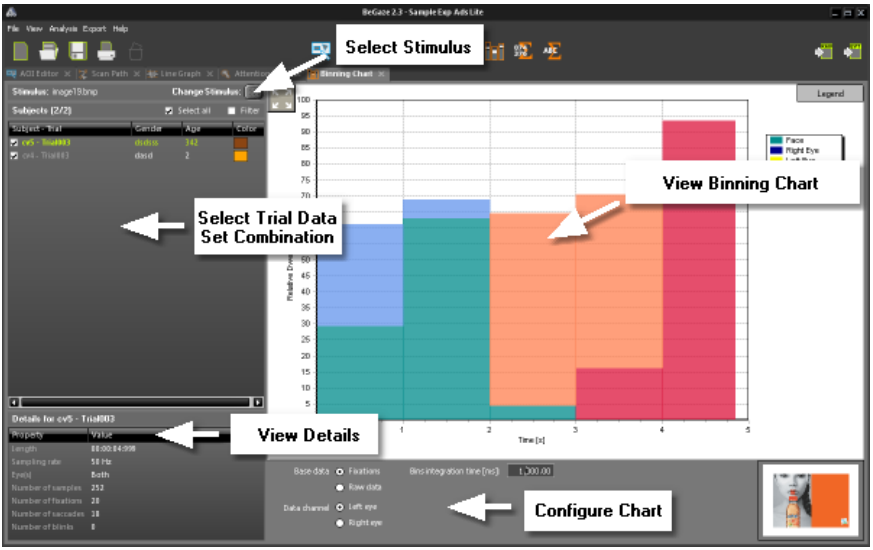
### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Double click the desired property and overwrite its content.

# 6.13 Binning Chart

## 6.13.1 Overview

The **Binning Chart** shows a statistical overview of AOI hits for separated time slices (bins). For each time slice, the AOI hit percentages for all selected trials are summarized and displayed as stacked column.




Operate the **Binning Chart** data view with the following steps:

1. Use the Stimulus Selection 55 to change to the desired stimulus.

   The Subjects Selection 56 displays matching subjects together with their trial gaze data sets.

2. In the Subjects Selection 56, activate the desired trial or filter combination.

   The Binning Chart Main Window 151 is updated and shows the AOI hit percentages for the activated trial combination.

   While doing this, the Trial Details 60 view shows information about the

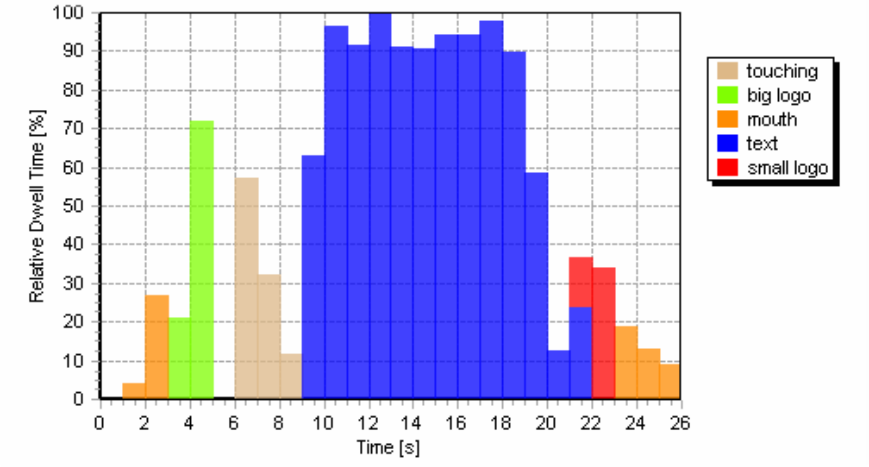
currently selected trial.

3. Configure the Chart Display Modes 74 to further adapt the display to your needs.

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.

### 6.13.2 Main Data Tab

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 75.

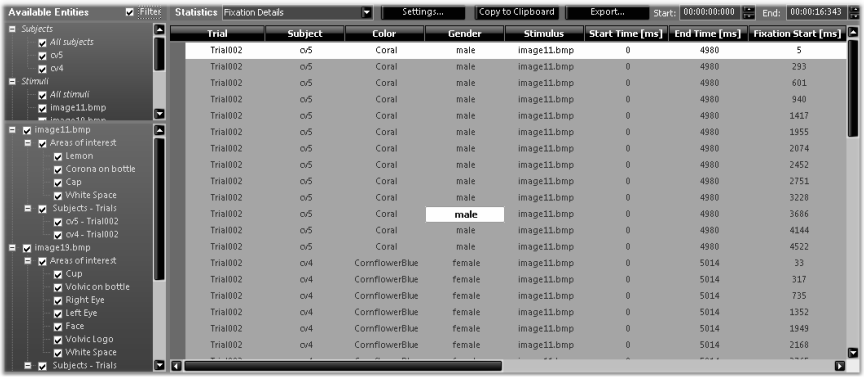
### Modify subject properties

If required, you can edit the subject properties displayed in the Subjects Selection 56 view. Double click the desired property and overwrite it's content.

## 6.14 Event and Reading Statistics

### 6.14.1 Overview

The **Event Statistics** and **Reading Statistics** data tabs presents information and statistics regarding gaze tracking events. The data view's main view consists of different parts identified in the image below.




You operate the **Event Statistics** and **Reading Statistics** data views with the following steps. While doing so, the Results Grid 158 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 153 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 155 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 157. Furthermore, it is also possible to re-arrange the columns, sort the data or only show columns of your interest within the Results Grid 158.
5. If the display suits your requirements, click Export to write the current display to a file. See Export Statistics 158 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. MS-Excel.

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 199 data view is available when the Reading Package is licensed.

## 6.14.2 Selection Trees

### Selection Tree

The **Selection Tree** is used to select the stimuli, trials and areas of interest for which the **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 **Subjects – Trials**. Note, that you can narrow down the selection of subjects 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. A "white space" AOI is generated to cover all areas left outside of defined AOIs.

Once a selection is made, the results are computed and displayed in the Results Grid 158 immediately.

### Filter Tree

With the **Filter Tree**, a specific set of trials / subjects can be selected. This is especially helpful, if you have a large number of trials or if you want to select trials / subjects by additional subject 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 **Subjects** as well as customized subject properties as top level experiment. Note, that customized subject 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 **Subjects** or customized subject properties. For example: if your experiment includes the subject property **Gender**, you are now able to select trials linked to male or female subjects.

   The selected filter combination is applied. The results are computed

and displayed in the Results Grid 158 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 ].

## 6.14.3 Template List

For optimized handling of the large count of statistical data items, BeGaze 2.4 groups them as **Statistic Templates**. Each statistic template covers a specific purpose. For details about the predefined templates see Statistics Definitions and Examples 160.

To operate the statistics templates, proceed as follows:

1. Select an item from the **Statistics** list at the top left of the data view.

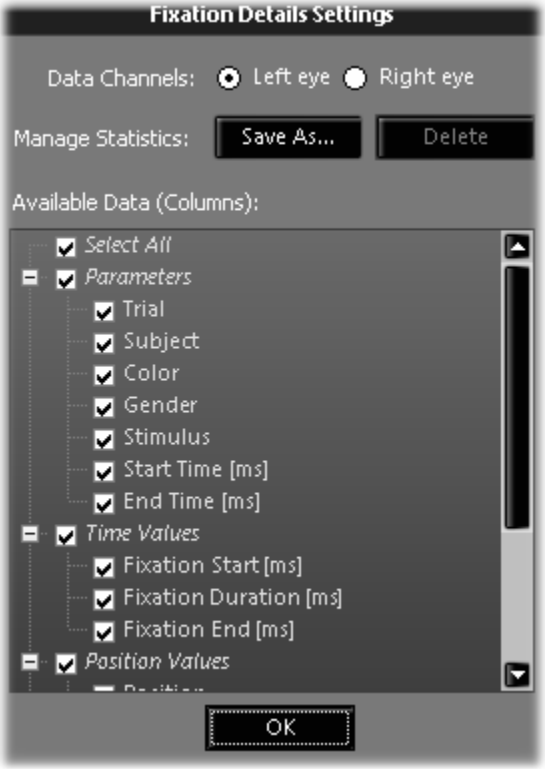
   This will activate a set of statistic items, which are computed and displayed in the Results Grid 158 immediately.
2. After activating the desired template, you can modify the **Results Grid** to suit your needs. This can be done by

   – 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.

### 6.14.4 Time Interval

The settings grouped under **Time Window** 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 153. Both 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, enter "0" in both the Start and End input fields and select a new trial data set in the selection tree.

### 6.14.5 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 158).

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 153 or when you change the Time Interval 157 settings. To make the results grid settings permanent, proceed as described under Statistics Template 155.

### 6.14.6 Export Statistics

You can export the current display of the Results Grid 158 to an ASCII data file.

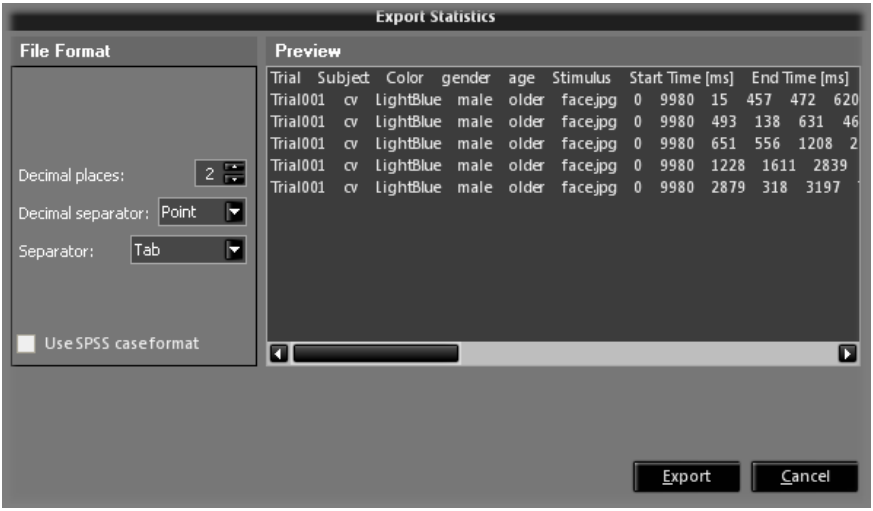
#### Copy to Clipboard

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 Event Statistics 152 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 "Subject" 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.

## 6.14.7 Event Statistics - Definitions and Examples

The following tables list details about the default statistic templates that are shipped with the BeGaze 2.4.

### Default Statistic Templates

| | |
|---|---|
| Fixation Details 162 | One row per fixation, process all fixations from all selected trials |
| Saccade Details 163 | One row per saccade, process all saccades from all selected trials |
| Blink Details 164 | One row per blink, process all blinks from all selected trials |
| Trigger Line Details 165 | One row per trigger event, taken from IDF file |
| Event Detailed Statistics 165 | One row per trial, process all selected trials |
| Event Summary Statistics 168 | One row for all trials, compute values over all selected trials |
| AOI Fixations 171 | One row for each fixation that hits one AOI, process all selected trials, only on selected AOIs |

| | |
|---|---|
| AOI Detailed Statistics 172 | One row for each AOI-trial combination, process all selected trials, only on selected AOIs |
| AOI Summary Statistics 175 | One row per AOI, compute values over all selected trials associated with one AOI |
| AOI Transition Matrix 181 | One row per AOI, number of consecutive fixation transitions inside and between selected AOIs for all selected trials |
| User Event Statistics 182 | One row per recorded user event for all selected trials. |
| Noldus Observer Export 183 | One state change per row |
| Questionnaire Statistics 183 | One questionnaire per line, taken from Experiment Center questionnaires |
| Subject Statistics 183 | One row per subject, shows subject calibration information |
| Stimulus Statistics 184 | One stimulus per row, shows stimulus information |

### 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 starts at the moment the AOI is fixated and ends at the moment the last fixation on the AOI ends = sum of durations from all fixations and saccades that hit 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 |
| Duration Before | Time until AOI is found = 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 |

The following color codes denote the parameter origin:

- parameters
- event properties
- computed values

### Fixation Details

This template shows one row per fixation, process all fixations from all selected trials.

| Parameter | Dimension unit | Description |
|---|---|---|
| Trial | | Trial Number |
| Subject | | Subject Code |

| | | |
|---|---|---|
| Stimulus | | Stimulus Name |
| Start Time | [ms] | Trial Start Time, normally zero |
| End Time | [ms] | Trial End Time |
| Fixation Start | [ms] | Beginning of a fixation. |
| Fixation Duration | [ms] | Duration of a fixation. |
| Fixation End | [ms] | End of a fixation. |
| Position XY | | Geographical position of a fixation . |
| Average pupil size | [px] | Average size of a pupil. |
| Dispersion | [px] | Dispersion of a fixation. |
| Eye L/R | | Which eye fixated |
| Number | | Number of the fixation. |

### Saccade Details

This template shows one row per saccade, process all saccades from all selected trials.

| Parameter | Dimension unit | Description |
|---|---|---|
| Trial | | Trial Number |
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Start Time | [ms] | Trial Start Time, normally zero |
| End Time | [ms] | Trial End Time |
| Saccade Start | [ms] | Beginning of a saccade. |
| Saccade Duration | [ms] | Duration of a saccade. |
| Fixation End | [ms] | End of a saccade. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Start Position XY | | Geographical position where the saccade begins. |
| End Position XY | | Geographical position where the saccade ends. |
| Amplitude | [°] | Max. oscillation from the rest position of a saccade. |
| Acceleration average | [°/s²] | Average acceleration of a saccade in x. |
| Acceleration peak | [°/s²] | Peak value of acceleration of gaze during a saccade. |
| Deceleration peak | [°/s²] | Peak value of deceleration of gaze during a saccade. |
| Velocity average | [°/s] | Average velocity of gaze during a saccade. |
| Velocity peak | [°/s] | Peak value of velocity of gaze during a saccade. |
| Peak velocity at | [%] | Position of the peak velocity within the saccade. |
| Eye L/R | | Which eye does a saccade |
| Number | | Number of the saccade. |

### Blink Details

This template shows one row per blink, process all blinks from all selected trials.

| Parameter | Dimension unit | Description |
|---|---|---|
| Trial | | Trial Number |

| | | |
|---|---|---|
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Start Time | [ms] | Trial Start Time, normally zero |
| End Time | [ms] | Trial End Time |
| Blink Start | [ms] | Beginning of a blink. |
| Blink Duration | [ms] | Duration of a blink. |
| Blink End | [ms] | End of a blink. |
| Eye L/R | | Which eye blinked |
| Number | | Number of the blinks. |

### Trigger Line Details

| Parameter | Dimension unit | Description |
|---|---|---|
| Trigger Line start | [ms] | Start time of the trigger event. |
| Trigger Line duration | [ms] | Duration of the trigger event. |
| Trigger Line end | [ms] | End time of the trigger event. |
| Number | | Trigger event count. |
| Port Status | | Hardware port ID from where the event was triggered. |

### Event Detailed Statistics

This template shows one row per trial, process all selected trials.

| Parameter | Dimension unit | Description |
|---|---|---|
| Trial | | Trial Number |

| Parameter | Dimension unit | Description |
|---|---|---|
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Start Time | [ms] | Trial Start Time, normally zero |
| End Time | [ms] | Trial End Time |
| 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. |
| Blink duration minimum | [ms] | Shortest blink duration. |
| 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. |
| Fixation duration minimum | [ms] | Shortest fixation duration. |
| Fixation dispersion total | [px] | Sum of all fixation dispersions on X and Y |

| Parameter | Dimension unit | Description |
|---|---|---|
| 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. |
| Saccade amplitude maximum | [°] | Max. saccade amplitude |

| Parameter | Dimension unit | Description |
|---|---|---|
| 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 | [°/s] | saccade latency = time between the end of a saccade and the start of the next saccade.<br>Saccade latency average = total saccade latency for all saccades / saccade count |

### Event Summary Statistics

This template shows one row for all trials, compute values over all selected trials.

| Parameter | Dimension unit | Description |
|---|---|---|
| Start Time | [ms] | Trial Start Time, normally zero |
| End Time | [ms] | Trial End Time |
| Blink count | | Number of blinks of all selected trials. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Blink frequency | [count/s] | Number of blinks of all selected trials per second divided by the number of selected trials. |
| 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 selected trials. |
| Blink duration maximum | [ms] | Longest blink duration of all selected trials. |
| Blink duration minimum | [ms] | Shortest blink duration of all selected trials. |
| Fixation count | | Number of fixations of all selected trials. |
| Fixation frequency | [count/s] | Number of fixations of all selected trials per second divided by the number of selected trials. |
| 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 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 selected trials. |

| Parameter | Dimension unit | Description |
|---|---|---|
| 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 per second of all selected trials divided by the number of selected trials. |
| 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 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 in the trial. |
| Saccade amplitude maximum | [°] | Max. saccade amplitude of all selected trials. |

| Parameter | Dimension unit | Description |
|---|---|---|
| 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 in the trial. |
| Saccade velocity maximum | [°/s] | Max. value of the saccade velocity of all selected trials. |
| 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.<br>Saccade latency average = total saccade latency for all saccades / saccade count |

### AOI Fixations

This template shows one row for each fixation that hits one AOI, process all selected trials, only on selected AOIs.

| Parameter | Dimension unit | Description |
|---|---|---|
| Subject | | Subject Code |
| Area of Interest | | AOI Name |
| AOI Order | | AOI Order Number |
| Fixation Start | [ms] | Beginning of a fixation in an AOI. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Fixation Duration | [ms] | Duration of a fixation in an AOI. |
| Fixation End | [ms] | End of a fixation in an AOI. |
| Position XY | | Geographical position of a fixation inside an AOI. |
| Average pupil size | [px] | Average size of a pupil inside an AOI. |
| Dispersion | [px] | Dispersion of a fixation inside an AOI. |
| Eye L/R | | Which eye fixated inside an AOI. |
| Number | | Number of the fixation. |

### AOI Detailed 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 |
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| AOI Coverage | [%] | AOI size in comparison to Stimulus size |
| Start Time | [ms] | Trial Start Time, normally zero |

| Parameter | Dimension unit | Description |
|---|---|---|
| End Time | [ms] | Trial End Time |
| Duration before | [ms] | Duration from start of the trial to the first hit of the AOI. |
| Sequence | | Order of gaze hits into the AOIs based on Entry time (Duration before), 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] | Starts at the moment the AOI is fixated and ends at the moment the last fixation on the AOI ends = sum of durations from all fixations and saccades that hit the AOI. |
| 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. |
| 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] |

| Parameter | Dimension unit | Description |
|---|---|---|
| Fixation count | | Number of fixations inside the AOI. |
| Fixation count | | Number of fixations inside the AOI. |
| Appearance count | | Sum of all appearances of one AOI within one trial:<br>– For static AOIs on still images it is always 1<br>– For dynamic AOIs it is the number of slices where the AOI was visible |
| Visible time | [ms] | Sum of AOI duration within one trial<br>– For static AOI it is end time – start time<br>– For dynamic AOI it is the sum of all durations where the AOI was visible within start and end time |
| Net dwell time | [%] | Value is calculated with:<br>Net dwell time (ms) / (end time - start time) |
| Dwell time | [%] | Value is calculated with:<br>Dwell time (ms) / (end time - start time) |
| Fixation time (ms) | [ms] | Adds the fixations times |
| Fixation time (%) | [%] | Value is calculated with:<br>Fixation time (ms) / (end time - start time) |
| Time to first mouse click | [ms] | Time of first mouse click into the AOI, similar to “Duration before” for gaze data. |

The Duration before cell contains "-" if the corresponding AOI is not hit by any fixation during the selected period of time.

### AOI Summary Statistics

This template shows one row per AOI, compute values over all selected trials associated with one AOI.

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Group | | AOI Group Name |
| AOI Scope | | Scope of AOI - local or global |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| AOI Coverage | [%] | AOI size in comparison to Stimulus size |
| Start Time | [ms] | Trial Start Time, normally zero |
| End Time | [ms] | Trial End Time |
| Duration before total | [ms] | Sum of duration before of all subjects. |
| Duration before average | [ms] | Sum of duration before of all subjects divided by number of the subjects. |
| Duration before maximum | [ms] | Max. duration before of all subjects. |
| Duration before minimum | [ms] | Min. duration before of all subjects. |
| Sequence | | The order in which the AOIs were fixated. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Group | | AOI Group Name |
| AOI Scope | | Scope of AOI - local or global |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| Net dwell time total | [ms] / [%] | Sum of net dwell time of all subjects. |
| Net dwell time average | [ms] / [%] | Sum of net dwell time of all subjects divided by number of the subjects. |
| Net dwell time maximum | [ms] / [%] | Max. net dwell time of all subjects. |
| Net dwell time minimum | [ms] / [%] | Min. net dwell time of all subjects. |
| Dwell time total | [ms] / [%] | Sum of dwell time of all subjects. |
| Dwell time average | [ms] / [%] | Sum of dwell time of all subjects divided by number of the subjects. |
| Dwell time maximum | [ms] / [%] | Max. dwell time of all subjects. |
| Dwell time minimum | [ms] / [%] | Min. dwell time of all subjects. |
| Glance duration total | [ms] | Sum of glance duration of all subjects. |
| Glance duration average | [ms] | Sum of glance duration of all subjects divided by number of the subjects. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Group | | AOI Group Name |
| AOI Scope | | Scope of AOI - local or global |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| Glance duration maximum | [ms] | Max. glance duration of all subjects. |
| Glance duration minimum | [ms] | Min. glance duration of all subjects. |
| Diversion duration total | [ms] | Sum of diversion duration of all subjects. |
| Diversion duration average | [ms] | Sum of diversion duration of all subjects divided by number of the subjects. |
| Diversion duration maximum | [ms] | Max. diversion duration of all subjects. |
| Diversion duration minimum | [ms] | Min. diversion duration of all subjects. |
| First fixation duration total | [ms] | Sum of first fixation duration of all subjects. |
| First fixation duration average | [ms] | Sum of first fixation duration of all subjects by number of the subjects. |
| First fixation duration maximum | [ms] | Max. first fixation duration of all subjects. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Group | | AOI Group Name |
| AOI Scope | | Scope of AOI - local or global |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| First fixation duration minimum | [ms] | Min. first fixation duration of all subjects. |
| Glances count total | | Sum of first glances count of all subjects. |
| Glances count average | | Sum of first glances count of all subjects by number of the subjects. |
| Glances count maximum | | Max. first glances count of all subjects. |
| Glances count minimum | | Min. first glances count of all subjects. |
| Fixation count total | | Sum of first fixation count of all subjects. |
| Fixation count average | | Sum of first fixation count of all subjects by number of the subjects. |
| Fixation count maximum | | Max. first fixation count of all subjects. |
| Fixation count minimum | | Min. first fixation count of all subjects. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Group | | AOI Group Name |
| AOI Scope | | Scope of AOI - local or global |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| Appearance count total | | Sum of all appearances of one AOI within one trial of all subjects. |
| Appearance count average | | Sum of all appearances of one AOI within one trial of all subjects by number of the subjects. |
| Appearance count maximum | | Max. sum of all appearances of one AOI within one trial of all subjects. |
| Appearance count minimum | | Min. sum of all appearances of one AOI within one trial of all subjects. |
| Visible time total | [ms] / [%] | Sum of AOI duration within one trial of all subjects. |
| Visible time average | [ms] / [%] | Sum of AOI duration within one trial of all subjects by number of the subjects. |
| Visible time maximum | [ms] / [%] | Max. sum of AOI duration within one trial of all subjects. |
| Visible time minimum | [ms] / [%] | Min. sum of AOI duration within one trial of all subjects. |
| Fixation time total | [ms] / [%] | Added fixations times of all subjects. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Group | | AOI Group Name |
| AOI Scope | | Scope of AOI - local or global |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| Fixation time average | [ms] / [%] | Added fixations times of all subjects by number of the subjects. |
| Fixation time maximum | [ms] / [%] | Max. added fixations times of all subjects. |
| Fixation time minimum | [ms] / [%] | Min. added fixations times of all subjects. |
| Subject Hit Count | | Number of subjects that looked into the AOI |
| Subject Hit Count | [%] | Number of subjects that looking into the AOI in comparison to all selected subjects |
| Revisitors count | | Number of subjects that looked into the AOI at least 2 times. |
| Time to first mouse click total | [ms] | Sum of the times of first mouse click into the AOI of all subjects. |
| Time to first mouse click average | [ms] | Time of first mouse click into the AOI by number of subjects. |

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Area of Interest | | AOI Name |
| AOI Group | | AOI Group Name |
| AOI Scope | | Scope of AOI - local or global |
| AOI Order | | AOI Order Number |
| AOI Size | [px] | Size of AOI in pixel - the part overlaying the stimulus is taking into consideration, parts outside of the stimuli area are ignored |
| Time to first mouse click maximum | [ms] | Max. time to first mouse click of all subjects. |
| Time to first mouse click minimum | [ms] | Min. time to first mouse click of all subjects. |

The duration before values are computed only on valid trials which associated with a stimulus (the ones that contain at least one fixation inside the corresponding AOI during the selected period of time). The other values are computed on all selected trials associated with the stimulus.

### Transition Matrix (Stacking Order, All)

This template shows one row per AOI, number of consecutive fixation transitions inside and between selected AOIs for all selected trials.

**Stacking Order**: In case of overlapping AOI the most top AOI is taken into consideration

**All:** All AOI are taken into consideration, even though when they are overlapping

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| from \ to (count) | | Column lists all AOI names |
| Area of Interest | | One column for each AOI, all columns for a matrix |
| [Matrix cells] | | Number of transitions from AOI to AOI |

### User Event Statistics

This template shows one row per recorded user event for all selected trials.

| Parameter | Dimension unit | Description |
|---|---|---|
| Trial | | Trial Number |
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Time Trial | [ms] | Time, relative to the start of the trial |
| Time Run | [ms] | Time, relative to the start of the run |
| Type | | User Action/Experiment Event |
| Event | | Scroll/URL/mouse click/key pressed |
| Content | | Content of the message |
| Content 2 | | Extra content, e.g. mouse click position |

### Noldus Observer Export

| Parameter | Dimension unit | Description |
|---|---|---|
| Time | [ms] | Time of the event |
| Type | | State start/State stop/Point |
| AOI Name | | Name of the AOI |

### Questionnaire Statistics

| Parameter | Dimension unit | Description |
|---|---|---|
| Subject | | Subject Code |
| Question | | Question text |
| Answer | | User selected answer |

### Subject Statistics

The subject statistics is independent of the subject, trial and stimuli filtering/selection and shows the general statistics for the subjects.

| Parameter | Dimension unit | Description |
|---|---|---|
| Subject | | Subject Code |
| *Property 1..n* | | Subject properties |
| Calibration Deviation X | [°] | Calibration deviation on X |
| Calibration Deviation Y | [°] | Calibration deviation on Y |

| Parameter | Dimension unit | Description |
|---|---|---|
| Tracking Quality | [%] | Number of non-zero gaze positions divided by sampling frequency multiplied by run duration, expressed in percent. |

### Stimulus Statistics

| Parameter | Dimension unit | Description |
|---|---|---|
| Stimulus | | Stimulus Name |
| Subject | | Subject Code |
| Order | | Position of the associated trial inside the run |
| Duration | [ms] | Duration of the associated trial |
| Width | [px] | Stimulus width |
| Height | [px] | Stimulus height |

## 6.14.8 Reading Statistics - Definitions and Examples

The following tables list details about the reading statistic templates that are shipped with the BeGaze 2.4 when the reading package is licensed.

### Default Statistic Templates

Fixation Duration 186

Saccadic Amplitude 188

AOI Statistics 189

### 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 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 |
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Fixation Start | [ms] | Beginning of a fixation |

| | | |
|---|---|---|
| Fixation Duration | [ms] | Duration of a fixation<br><br>*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 |
| Subject | | Subject Code |
| 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] | Max. oscillation from the rest position of a saccade<br><br>*Note*: The same effect on saccadic amplitude (and fixation duration) can be found when subject 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 subjects 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 |
| Subject | | Subject Code |
| 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<br><br>*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<br><br>*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)<br><br>*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 duration | [ms] | Sum of fixation durations from the first entry into an AOI until the eye leaves it in any direction<br><br>*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 duration | [ms] | Sum of fixation durations from the second entry into an AOI until the eye leaves it in any direction<br><br>*Note*: Second pass gaze duration on a word is assumed to reflect late effects (word integration processes). |
| Ratio saccade / next fixation | [%] | Saccade time divided by next fixation time |
| Ratio saccade / prev fixation | [%] | Saccade time divided by previous fixation time |
| Is first skip | | AOIs (words) that are not fixated during first pass reading (although they may be fixated during later regressions)<br><br>*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 |
| Subject | | Subject Code |
| 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 |
| Subject | | Subject Code |

| | | |
|---|---|---|
| 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 |
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Event type | | Type of user event |
| Start | [ms] | First Pass Regression start time |
| Duration | [ms] | First Pass Regression duration<br><br>*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 |
| Subject | | Subject Code |
| 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 |
| Subject | | Subject Code |
| 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 | | AOI name |
| Reading AOI number | | AOI number |
| Eye | | Which eye fixated inside an AOI |

### Between AOI Regressions

| Parameter | Dimension unit | Description |
|---|---|---|
| Trial | | Trial Number |
| Subject | | Subject Code |
| 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 |
| Subject | | Subject Code |
| Stimulus | | Stimulus Name |
| Reading AOI Hits character | | Character AOI hits per minute |
| Reading AOI Hits word | | Word AOI hits per minute<br><br>*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 |

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# 6.15 Line Graph

## 6.15.1 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.


Operate the **Line Graph** data view with the following steps:

1. In the Subjects Selection 56, select a single trial.

   The Line Graph Main Window 206 and Line Graph Data Table 208 the are updated for the selected trial.

   While selecting trials, the Events Selection 61 view and the Trial Details 60 view shows information about the currently selected trial or event.

2. In the Line Graph Miniview 209, change to the desired view tab.

   The **Miniview** displays the selected stimulus correlated with the gaze

position of the current Diagram Cursors 208.

## 6.15.2 Events List

The general functionality of this view is described in Events List 61. The blue data cursor and the red auxiliary cursor will frame the marked event in the Line Graph Main view 206. The gaze cursor in the Line Graph Miniview 209 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:

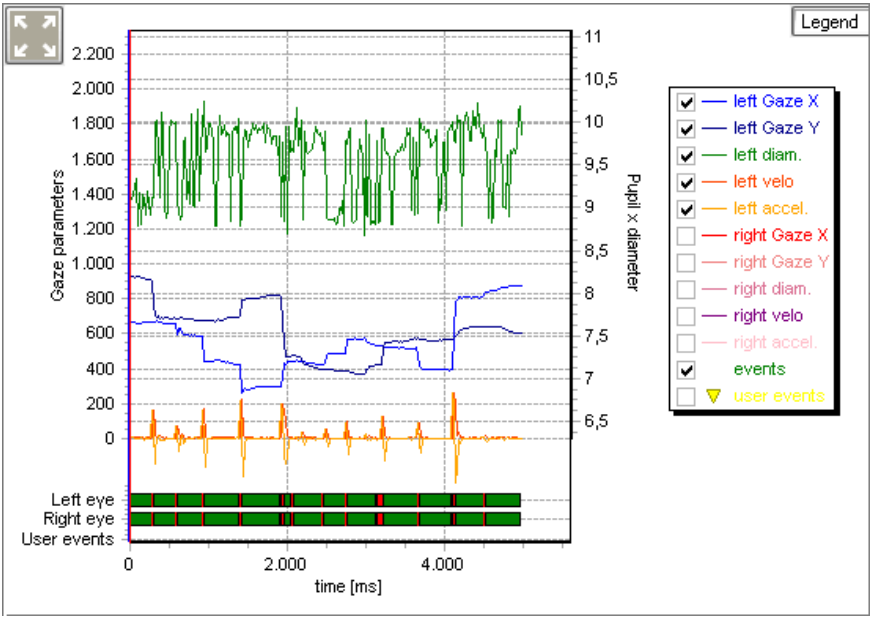

Line Graph Overview 203

### 6.15.3 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.

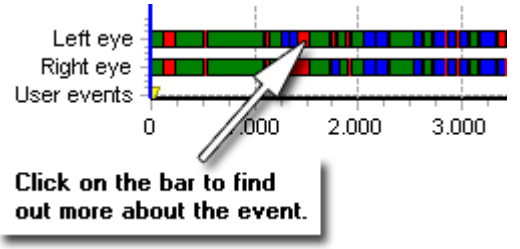



You can customize the line graph display with the following steps:

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 210.

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.

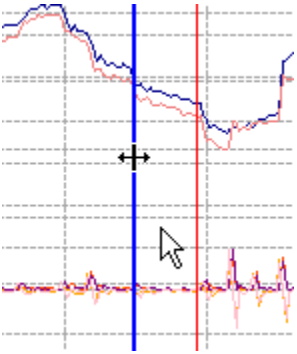
   If the legend is displayed, activate or deactivate the options next to the labels. This selects the desired combination of lines to draw.
4. To shift the line graph display scales, drag the left or right Y-axis or drag the bottom X-axis using the finger mouse cursor. To shift the line graph position, 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 208 as well. The respective event is highlighted in the Events Selection, 61 view, which in turn also updates the Trial Details 60 view and the Line Graph Miniview 209. Note, that you can manually drag the diagram cursors using the drag mouse cursor.




8. In the **Export** menu, either select the **Save image to file** ( [ CTRL ] + [ S ]) or select the **Copy image to clipboard** ( [ CTRL ] + [ C ]) keyboard command to export the current line graph display to a single image.

### 6.15.4 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 208 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 209 below the Graph Area.

Apart from the data cursor a red auxiliary cursor is visible.

### 6.15.5 Data Table

In the data table, the data values are displayed numerically for the current Line Graph Diagram Cursor 208 positions. You will find information about:

- the exact time for the time cursor positions.
- the pupil diameter at this time

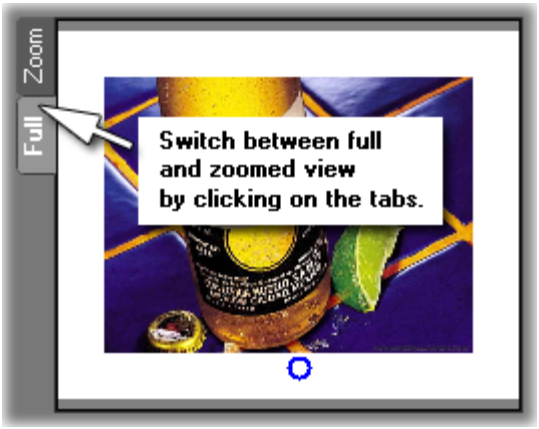
- the gaze point in x- and y-direction in [pixels]. (0,0) is the upper left corner of the stimulus image.
- the angular speed of the eye
- the angular acceleration of the eye

If you work with binocular data, the values for both eyes will be displayed.

### 6.15.6 Miniview

In the **Miniview**, the gaze position at the current data cursor 208 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.



## 6.15.7 Settings

In the **Linegraph Settings** dialog, you select line colors, event colors and customize the line graph chart settings.

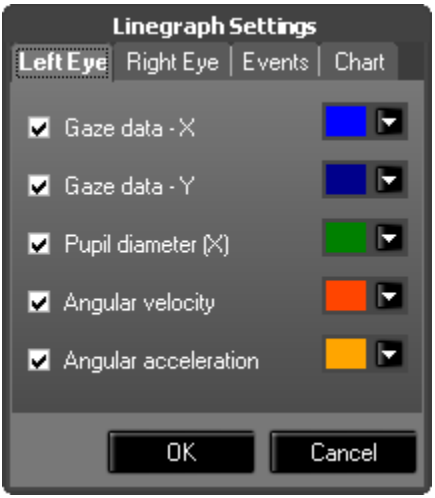
1. Right click into the Line Graph Main Window 206 to open a context menu. Select the **Settings** command.

   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

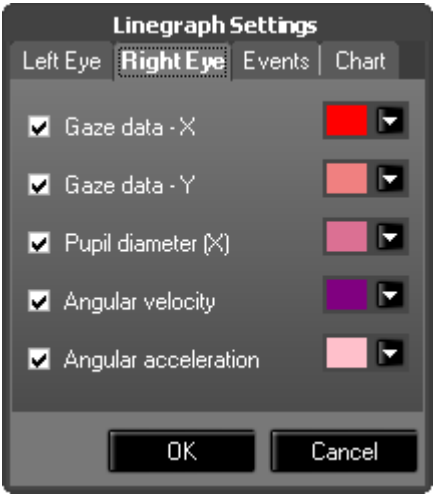



In this tab you can configure, for left data channel the color and the visibility of:

- 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:

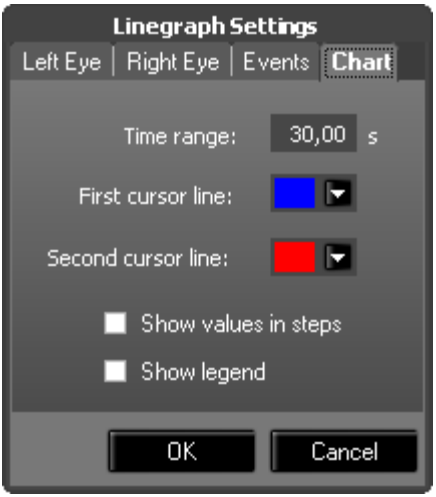
- gaze data on X
- gaze data on Y
- pupil diameter
- angular velocity
- angular acceleration

## 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

# Event Detection

Chapter

# 7 Event Detection

## 7.1 Built-In Event Detector

BeGaze 2.4 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 219 | fixation | dispersion |
| 200 Hz and above | high speed event detection 221 | saccade | velocity |

Please note, that none of the algorithms are currently well 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.

# 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.

1. In the File menu 246 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**.

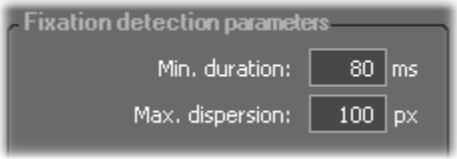
When creating an experiment, you can adjust these parameters in the Event Detection 37 tab of the **Create Experiment** wizard.

### 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 219 the following parameters are displayed and can be changed:



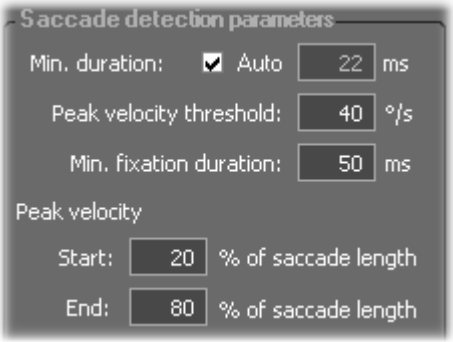
**Min. duration**: minimum fixation duration in [ms]

**Max. dispersion**: maximum dispersion value. The unit depends on the experiment type 258:

| | Unit |
|---|---|
| standard data | pixels |
| data with head tracking | degrees |

### High Speed Event Detection Settings

For High Speed Event Detection 221 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.

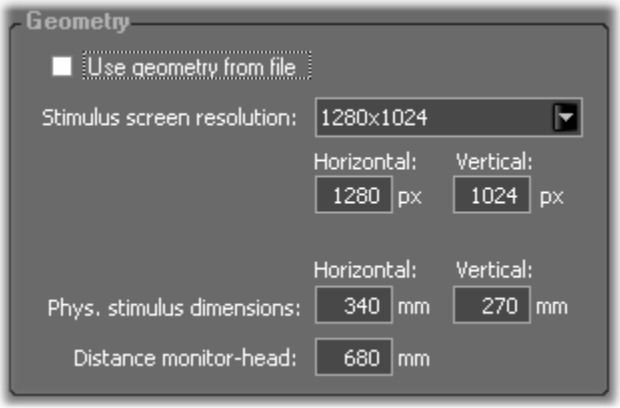
For more information see Built-In Event Detector 215.

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 Settings




Activate the **Use geometry from file** option to read in the screen resolution and physical stimulus dimension settings from the gaze tracking data file. Activating this option immediately reads in the settings from the gaze tracking data file and disables the respective controls.

Deactivate the **Use geometry from file** option if you want to overwrite these settings manually. Deactivating this option enables the following settings:

**Stimulus screen resolution**: Enter the horizontal and vertical resolution (in pixels) of the monitor which originally displayed all visual stimuli. A list of typical screen resolutions is offered in a drop-down list for selection. To enter a screen resolution not available in the list, select the **user defined** entry or simply enter the desired resolution in the respective text input controls. Note, that all visual stimuli attributed with the **Fit to Screen** option will be recalculated and scaled to this resolution.

**Phys. stimulus dimensions**: Enter the horizontal and vertical display dimensions in millimeters. Note, that a typical CRT or LCD computer monitor 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**: If you change the **Phys. stimulus dimensions** settings, you need to adapt the approximate distance between the displaying monitor and the subjects head accordingly. Note that during calibration the individual relation between the gaze tracking system and the subject is established. The calibration outcome is not changed nor invalidated with this setting.

Overwriting and changing the geometry settings requires BeGaze 2.4 to re-calculate the gaze tracking data in order to adapt to the new settings. For longer experiments, the recalculation may require some time with the progress indicated by a status dialog.

## 7.3 Low Speed Event Detection

In the Low Speed Event Detection method, Fixation is selected as primary event. The Built-In Detector 215 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 horizontal and vertical gaze position equals 0. If this is the case, 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.

### 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; in other words, dispersion D = [max(x) - min(x)] + [max(y) - min(y)]. If the dispersion is above the 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.

### 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 216 dialog.


**Min. duration**: minimum fixation duration in [ms]

**Max. dispersion**: maximum dispersion value. The unit depends on the experiment type 258:

| | Unit |
|---|---|
| standard data | pixels |

| | Unit |
|---|---|
| data with head tracking | 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 215 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 [º/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. 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

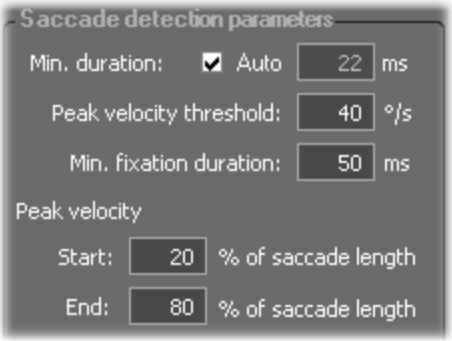
However, the saccade we have found could still be an artifact as a result of a start or end of a blink. If so, we discard the saccade event and assign the artificial saccade to a blink. To determine, if this is the case we evaluate the pupil diameter during the saccade period. If the speed of the pupil diameter change exceeds an internal threshold value, the saccade is assumed artificial and part of the blink.

### 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 216 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.

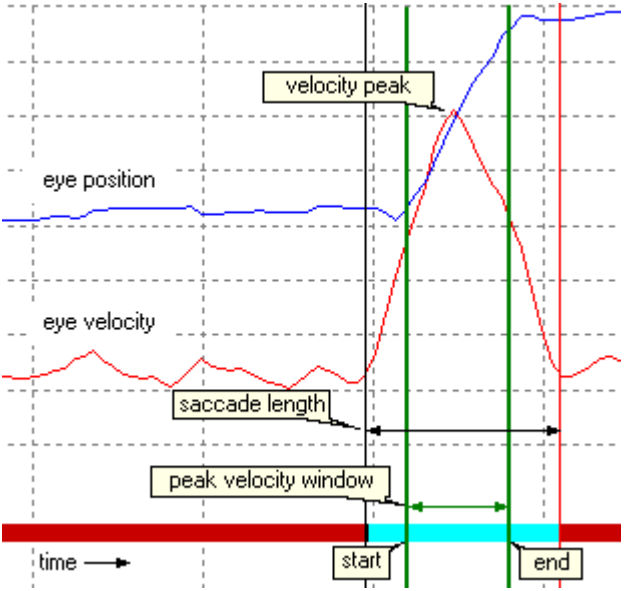
### Peak Velocity Window

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



# Export and Conversions

Chapter

# 8 Export and Conversions

## 8.1 Overview

BeGaze 2.4 allows events export 225 and raw data export 232.
Furthermore, you can record the replay of the scan path, attention map or key performance indicators to an AVI file (see Video Export 239).

## 8.2 Export Events

### 8.2.1 Export Events

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 click on the toolbar item or go to the Export menu and select Export event data to file, a window will be displayed, containing the following tabs:

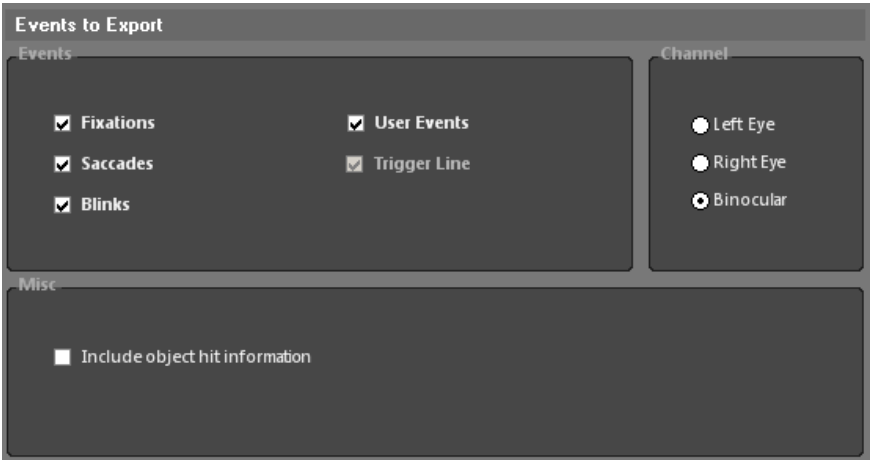
- General
- Preview

#### 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 228.




## File Format

Configure the format of the export file 228.

### Write Header

Select whether the Header 229 will be written in the file.

### Decimal Places

Configure the format of the numerical values.

### Separator

The separator between values can be one of the following:

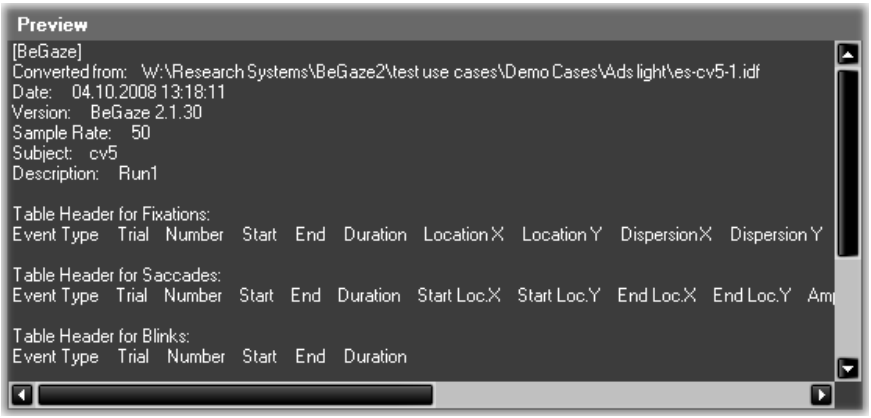
- Tab
- Space
- Comma
- Semicolon

### Export Location

Click on  to browse for the folder or to create a new folder. BeGaze 2.4 will create the file names automatically.

### 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 object 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 258 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

## 8.2.2 Export File Format

### 8.2.2.1 Export File Format

The BeGaze 2.4 export file starts with a short header 229 section, followed by the trial section 229.

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.

#### 8.2.2.2 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: | Subject as written to IDF file or modified in experiment creation. |
| Description: | Description of Run as written to IDF file or modified in experiment creation. |

#### 8.2.2.3 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 |
| Trial: | number of current trial |
| Number: | index of current fixation |

| | |
|---|---|
| Start: | start time in microseconds, relative to start time of beginning of the current trial |
| End: | end time in microseconds, relative to start time of beginning of the current trial |
| 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 |
| Object hit: | name of area of interest (AOI) that is hit by current fixation. The field could be '-', if no AOI is hit. |

### 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 |
| Trial: | number of current trial |
| Number: | index of current saccade |
| Start: | start time in microseconds, relative to start time of beginning of the current trial |
| End: | end time in microseconds, relative to start time of beginning of the current trial |
| 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 |

### 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 |
| Trial: | number of current trial |
| Number: | index of current blink |
| Start: | start time in microseconds, relative to start time of beginning of the current trial |

| | |
|---|---|
| End: | end time in microseconds, relative to start time of beginning of the current trial |
| Duration: | duration of blink in microseconds |

### 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, relative to start time of beginning of the current trial |
| Description: | content of the message |


Note, that the origin of the calibration area is always in the upper left corner.

# 8.3 Export Raw Data

## 8.3.1 Export Raw Data

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 click on the toolbar item or go to the Export menu and select Export raw data to file, a window will be displayed, containing the following tabs:

- General
- Preview

### 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 236.


### File Format

Configure the format of the export file 236.


### Write Header

Select whether the Header 236 will be written in the file.

### Decimal Places

Configure the format of the numerical values.

### 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 2.4 will create the file names automatically.

## Preview

You can preview the exact format of the export file. Note: in trial section, only a few data lines are shown.

**Preview**

```
## [BeGaze]
## Converted from:  W:\Research Systems\BeGaze2\test use cases\Demo Cases\Ads light\es-cv5-1.idf
## Date:  04.10.200813:28:39
## Version:  BeGaze 2.1.30
## Sample Rate:  50
## [Run]
## Subject:  cv5
## Description:  Run1
## [Calibration]
## Calibration Type:  9-point
## Calibration Area:  1280  1024
## [Geometry]
## Stimulus Dimension [mm]:  376  301
## Head Distance [mm]:  700
## [Hardware Setup]
## [Presentation]
## Number of Samples:  250
## Reversed:  none
## Format:  MSG
##
Time  Type  Trial
6961867180  MSG  1  # Message: image11.bmp
6961872225  SMP  1
6961898994  SMP  1
6961919298  SMP  1
6961942882  SMP  1
6961967586  SMP  1
```

## 8.3.2 Export Raw File Format

### 8.3.2.1 Export Raw File Format

The BeGaze 2.4 export file starts with a short header 236 section, followed by the trial section 237.

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.

### 8.3.2.2 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: | Subject 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 Type: | Type of calibration used during recording. |
| Calibration Area: | Width and height of the calibration area. |
| Stimulus Dimension: | Width and height of the stimulus. |
| Head Distance: | Distance between subject 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. |

#### 8.3.2.3 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):

| | |
|---|---|
| Time: | Timestamp of the sample. |
| Type: | The type is SMP. |
| Trial: | Number of current trial. |
| L Raw X [px]: | Horizontal pupil position. |
| L Raw Y [px]: | Vertical pupil position. |
| L Dia X [px]: | Horizontal pupil diameter. |
| L Dia Y [px]: | Vertical pupil diameter. |
| L CR1 X [px]: | Horizontal corneal reflex position. One or two CRs can be present. |
| L CR1 Y [px]: | Vertical corneal reflex position. |
| L POR X [px]: | Horizontal gaze position |
| L POR Y [px]: | Vertical gaze position |
| Timing, Latency: | Quality values |
| L Plane: | Plane number |
| L Object 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 EPOS X: | Eye position on X |
| L EPOS Y: | Eye position on Y |
| L EPOS Z: | Eye position on Z |
| L GVEC X: | Gaze vector on X |
| L GVEC Y: | Gaze vector on Y |
| L GVEC Z: | Gaze vector on Z |
| Frame: | Frame counter |
| L Event Info: | Type of event detected for the interval containing this sample (fixation, saccade, blink) |
| Stimulus: | Stimulus associated with this sample |

In case of binocular recordings, data from both channel (named L and R) can be exported.

### 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 |


Note, that the origin of the calibration area is always in the upper left corner.

# 8.4 Video Files

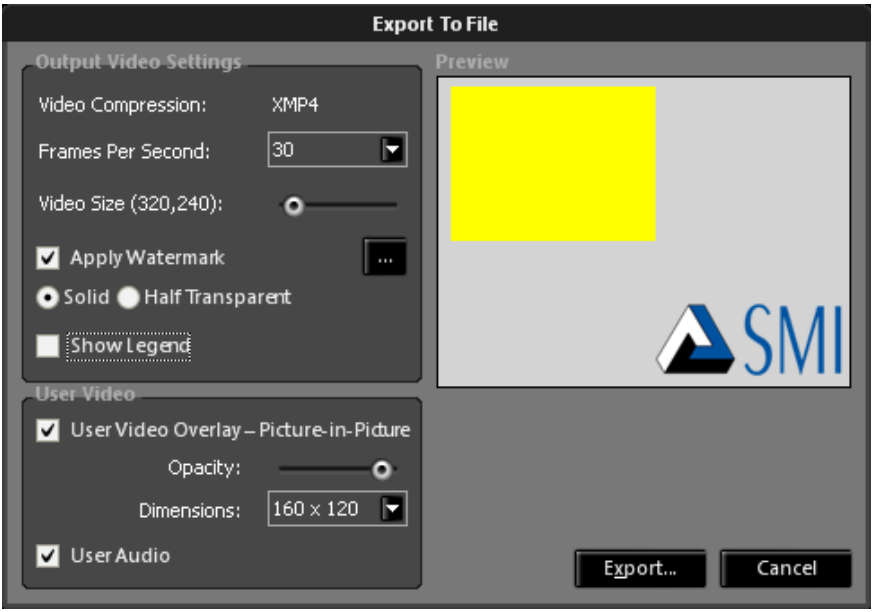
## 8.4.1 Video Export

You can record the animated **Attention Map** as well as the **Scan Path** or the **Key Performance Indicators** replays to an AVI file.

1. From the **Export** menu, select the **Export Scan Path Video, Export Attention Map Video** or **Export KPIs Video** command.

   The **Export to File** dialog opens, where you can set the recording options and start the export.

2. Press **Export...**.




3. A popup dialog appears allowing you to select the desired video file name and location. Click "Save" to finish.

### Dialog Settings

- **Video Compression**: Shows that the “XMP4” video encoder is used. Note, that you need to install this codec from the product installation CD.
- **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 AVI video. You can select 10, 25 or 50 frames per second or the eye tracking sampling rate. Higher framerates results in longer export times.
- **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 "...".
- **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.

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.

- **User Video Overlay**: If checked the user video 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.
- **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.

### 8.4.2 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 2.4. 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 2.4 works best with the customized Xvid Solutions MPEG-4 codec (XMP-4) installed during BeGaze 2.4 setup. The post-processing configuration for this codec, which is also applied during setup, is optimized for editing and analyzing purposes. You should convert your video material to this codec and insert more key frames while doing so.


The XMP-4 codec is compatible to standard Xvid and DivX codecs

for playback.

### 8.4.3 Converting Videos with SMI Video Optimizer

Videos are automatically converted while creating experiment in Experiment Center V2.4.

As an alternative, the SMI Video optimizer can be used to convert videos as well (**Start->SMI->Experiment Suite 360°->Tools**)

The SMI Video Optimizer converts (re-encodes) nearly every kind of video into our recommended XMP4 avi format with optimal codec settings.

The XMP4 codec is automatically installed and configured on the PC during the installation of Experiment Center and BeGaze.

#### Supported Video Formats

The video optimizer has been successfully tested with a huge variety of video formats and codecs, including DVD (vob), MPEG and Flash (flv) videos.

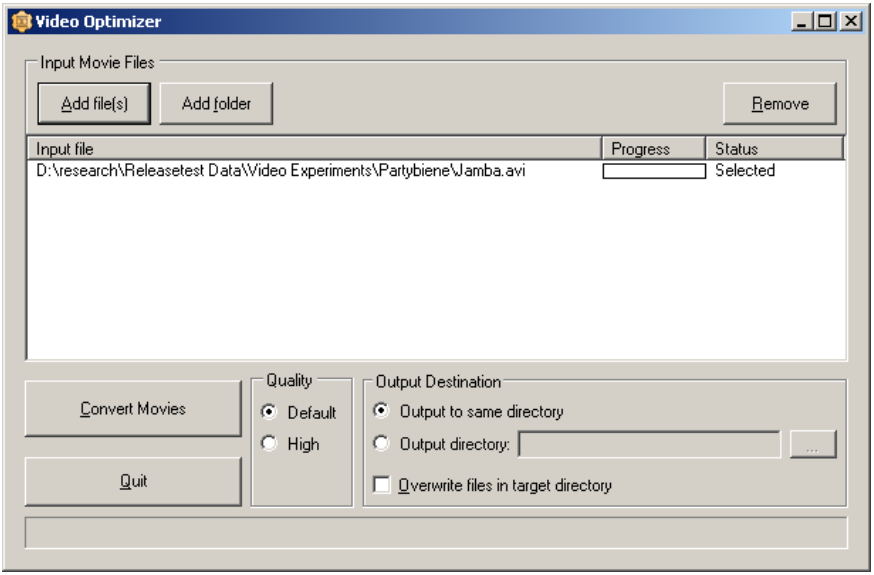
Nevertheless it depends on the installed and licensed codecs if the selected videos can be converted, which is the responsibility of the user.

The Video Optimizer is using Microsofts Direct X interface to read and convert the selected videos. Please ensure that you have all codecs licensed and installed that your original video needs in order to be read.

#### Open Video Optimizer

Click on the Video Optimizer entry in the start menu under All Programs -> SMI -> Experiment Suite 360° -> Tools -> Video Optimizer to execute the program.




## Adding Videos

1. Click on the buttons **Add file(s)** or **Add folder** to add the videos you want to re-encode.
2. You can also add files by drag&drop of video files from programs like the Windows Explorer into the **Input file** area of the Video Optimizer.

## Convert Videos

Press the **Convert Movies** button to start the re-encoding of your videos.

Please note that the new video files are renamed. The re-encoded videos are saved as Originalname + "(optimized).avi"

Original AVI file are not overwritten, please rename the converted video if necessary.

### 8.4.4 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... | Starts the Create Experiment wizard 27 to create a new experiment |
| New Experiment from Folder... | Creates an experiment on the basis of a results folder which has been created with the SMI Experiment Center |
| Open Experiment... | Opens a dialog box to select a saved experiment from the database 259 |
| Close Experiment | Closes the current experiment |
| Save Experiment | Saves the current experiment to the database 259 |
| Save Experiment As... | Saves the current experiment as a new experiment in the database 259 |
| Define Annotations... | Opens the Define Annotations 46 dialog where new annotation types can be defined |
| Modify Experiment... | Opens the Modify Experiment wizard 41, 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 259 |

| | |
|---|---|
| Backup Experiment to File... | Opens a dialog to select a saved experiment from the database 259. 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 |
| Change Data Storage Location... | Opens a folder selection dialog to select another location for the database 259 |
| Reset Plugin Detection | On the next run of BeGaze 2.4, the available data views will be dynamically detected |
| Recent Experiments | Opens a sub menu with the last opened experiments |
| Quit | Closes BeGaze 2.4 |

## 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 249 |

## Analysis

| | |
|---|---|
| AOI Editor | Opens the AOI Editor 75 data view |
| Gaze Replay | Opens the Gaze Replay 100 data view |
| Bee Swarm | Opens the Bee Swarm 102 data view |
| Scan Path | Opens the Scan Path 108 data view |

| | |
|---|---|
| Focus Map | Opens the Focus Map 119 data view |
| Heat Map | Opens the Heat Map 125 data view |
| Key Performance Indicators | Opens the Key Performance Indicators 130 data view |
| Gridded AOIs | Opens the Gridded AOIs 137 data view |
| AOI Sequence Chart | Opens the AOI Sequence 146 data view |
| Binning Chart | Opens the Binning Chart 150 data view |
| Event Statistics | Opens the Event Statistics 152 data view |
| Reading Statistics | Opens the Reading Statistics 184 data view |
| Line Graph | Opens the Line Graph 203 data view |

## Export

| | |
|---|---|
| Export [...] Video | Exports the currently displayed gaze replay, bee swarm, scan path, focus map, heat map, kpis or gridded aois to a video file. These Menu commands are available only if the corresponding data views are activated. |
| Save Image to File... | Saves the graph/chart from the currently selected view to an image file. The following file formats are supported: BMP, JPG, PNG. |
| 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. |
| Export Raw Data to File... | Opens the **Raw Data Export** dialog, which allows the creation of text files from the raw data of an experiment |

| | |
|---|---|
| Export Event Data to File... | Opens the **Event Export** dialog, which allows the creation of text files from the computed event data of an experiment |

### Help

| | |
|---|---|
| Help Topics | Opens this manual |
| About BeGaze 2.4 | Shows general information about BeGaze 2.4 (see About Box 256) |

## 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

Starts the Create Experiment wizard 27 to create a new experiment for standard data

Opens a dialog to select an existing experiment

Saves the current experiment

Prints the current diagram.

Opens a dialog to remove existing experiment(s)

## Diagram selection


Gaze Replay 100: displays a quick gaze data overlay over all the stimulus images in the experiment


Bee Swarm 102: displays raw gaze data overlay over the stimulus image


Scan Path 108: displays gaze data overlay over the stimulus image


Focus Map 119: shows gaze patterns over the stimulus image visualized as a transparent map


Heat Map 125: shows gaze patterns over the stimulus image visualized as a colored map

Key Performance Indicators 130: displays relevant statistical data for each defined AOI over the stimulus image


Gridded AOIs 137: displays relevant statistical data for an automatically defined AOI grid over the stimulus image


AOI Sequence Chart 146: displays AOI hit order over time


Binning Chart 150: gives a statistical overview of AOI hits per binning frame

Event Statistics 152: computes diverse statistics based on events and AOI hits

Reading Statistics 184: computes diverse statistics based on events and AOI hits on text for reading experiments


Line Graph 203: displays x and y directions of gaze data plotted as graphs over time and events displayed in a timeline

### Export buttons


Opens a dialog that allows to export raw data to file


Opens a dialog that allows to export events to file

### Other commands

Opens the AOI Editor 75

## 9.3 Hotkeys Overview

Several functions of BeGaze 2.4 can be executed using keyboard commands. The following tables give you an overview.

### General keyboard commands

| Keys | Description |
|---|---|
| [ CTRL ] + [ O ] | opens a dialog box to select a saved Experiment from the Database 259 |
| [ 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 |
| [ 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 69 is available: zooms in and out |

## AOI Editor 75 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 |

### Video keyboard commands

The following keyboard commands are available to navigate in a video (see Player Control 66). They are available in the AOI Editor 75, Scan Path 108, Attention Map 119 and Key Performance Indicators 130 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] | set and resets a bookmark |
| [ CTRL ] + arrow left | jump to previous bookmark |
| [ CTRL ] + arrow right | jump to next bookmark |
| [ 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 |

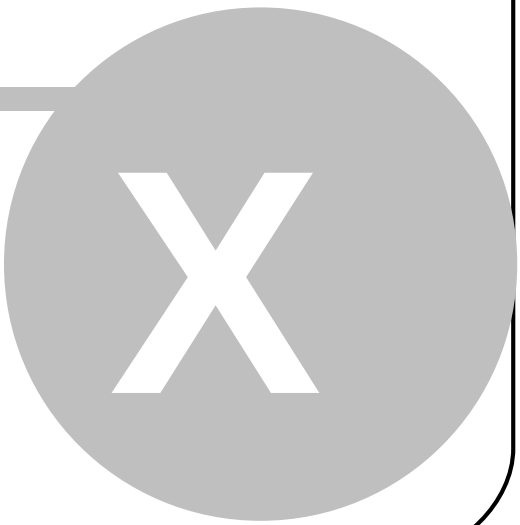
## Line Graph 203 keyboard commands

| Keys | Description |
|---|---|
| Left arrow key | moves selected time cursor to the left |
| Right arrow key | moves selected time cursor to the right |

# Appendix

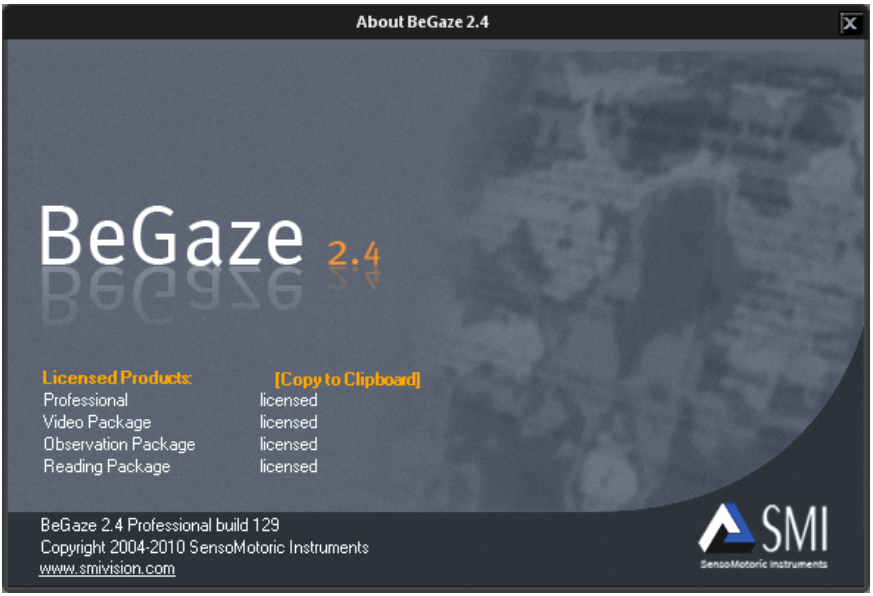
Chapter



# 10 Appendix

## 10.1 About Box

To get general information about BeGaze 2.4 go to the Help menu of the Menu Commands 246 and select About BeGaze 2.4.



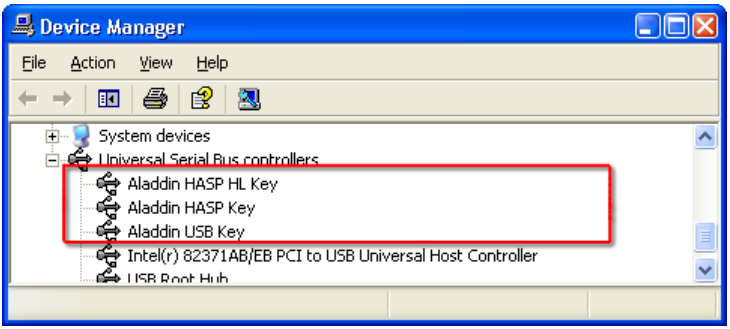

- BeGaze 2.4 Version: The line displays the current version number.
- Copyright: The line displays copyright information.
- Home Page: Here you can visit our home page.
- Licensed data view packages: BeGaze 2.4 is licensed to one computer only. Here you can see a list with all licensed data view packages.
- 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 275.

## 10.2 Dongle - Installation and Troubleshooting

BeGaze 2.4 is dongle-protected. You may have to place the USB-dongle in the appropriate PC before you can start the program. If BeGaze 2.4 displays a message box stating **HASP SRM Protection System**: **The software requires a hardware key (dongle)**, check the following:

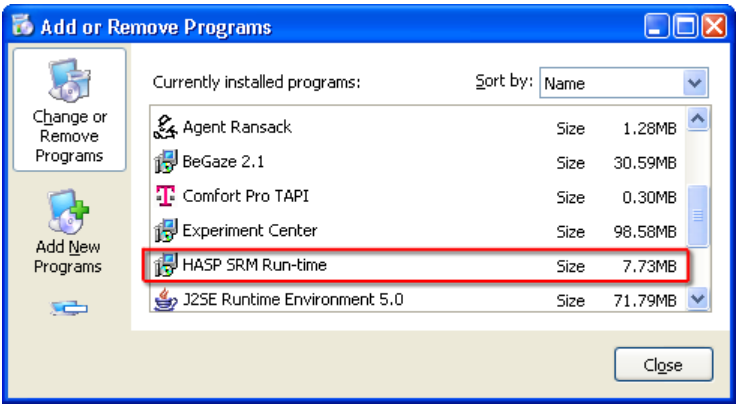
1. The activity LED of the USB-dongle should show a red light if the dongle is plugged in.
2. If the activity LED does not show a red light, check the USB port status in the Windows hardware settings dialog. Open the Windows **Control Panel** and double click the **System** icon. Switch to the **Hardware** tab and click on the **Device Manager** button. 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 **Add or Remove Programs** icon.

Check if the list shows the **HASP SRM Run-time** entry.




Note, that the **HASP SRM Run-time** is installed during the installation of BeGaze 2.4. 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 2.4 is installed. With the license update procedure, the dongle is updated. That means, that you can run BeGaze 2.4 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 2.4 experiments will be collected in a database. Once you imported the data files, images and AOI files in BeGaze 2.4, 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. This corresponds to "Application Data" folder in Windows XP and "AppData \Roaming" folder in Windows Vista. For example, if your computer is running Windows XP and your user name is "BegazeUser", the complete path to the database will be: C:\Documents and Settings\BegazeUser \Application Data\SMI\BeGaze 2\BeGaze 2 Data Base.

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 2.4 should be installed on a personal computer or laptop with the following minimum requirements:

OS: Windows XP Service Pack 2 / Windows Vista / Windows 7

CPU: AMD or Intel Dual Core with 2.6 GHz

RAM: minimum 2 GB

VGA: 3D accelerated, 512 MB RAM, DirectX 9 Compatible, OpenGL V1.2 compatible

HDD: at least 10 GB of free hard disk space

For best views the monitor should be of size 19" or bigger with a minimum resolution of 1280x1024 pixels.

For database backups a DVD writer is recommended.

Some functions of BeGaze 2.4 need a printer connected.

### Graphic card compatibility with OpenGL

BeGaze 2.4 is using OpenGL functionality in order to achieve best performance. The graphic card needs to be compliant with the OpenGL standard V1.2. 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 | 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 | Intel | GMA 3100 | 384 | Yes | 1,4 |
| yes | NVIDIA | GeForce 9800 GT | 512 | No | 3,1 |
| yes | Winfast | 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 |
| no | NVIDIA | GeForce 5200 FX | 128 | No | 2,1 |
| no | NVIDIA | GeForce 8800 GTS | 320 | 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 | Matrox | Orion | 32 MB | | |
| no | ATI | FireGL V 3100 | 128 MB | | |
| no | Matrox | G550 DH | 32 MB | no | |

## 10.6 Limits

SMI guarantees BeGaze to work within the following limits:

| | |
|---|---|
| Max. number of stimuli in one experiment | 250 |
| Max. number of trials per stimuli | 250 |
| Max. length of video / max. number of videos | 2h / 5 |
| Max. length of video / max. number of videos | 1min / 200 |

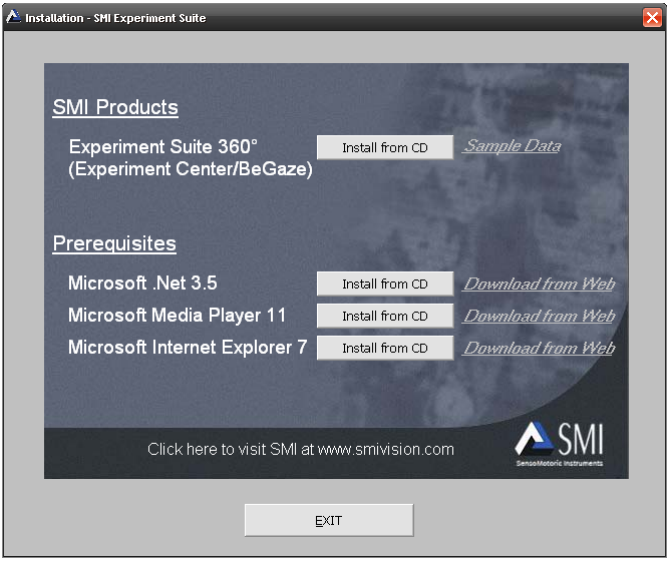
| | |
|---|---|
| Max. file size of video | 1GB |
| Max. number of subjects per experiment | 200 |
| Max. length per trial / max. number of stimuli | 2h / 5 |
| Max. length per trial / max. number of stimuli | 10min / 200 |
| Max. number of AOIs per stimulus | 250 |
| Max. stimulus size (excl. Web) | 1680x1050 |
| Max. stimulus size for Web | 1680x10.000 |

Due to a limitation of Microsoft video handling, avi files are limited to 1GB of size. HED videos are split into multiple trials when the 1GB file size is exceeded.

## 10.7 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 360° includes the BeGaze 2.4 as well as the Experiment Center 2.4 software. To install the Experiment Suite 360°, 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 360°, the USB dongle driver (HASP SRM Run-time) is installed or updated. You may need to

update the USB dongle license information. Refer to Dongle Protection and License Update 12 for details.

The Microsoft .NET Framework, the Microsoft Internet Explorer, and the Microsoft Media Player software components are available from the BeGaze 2.4 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.

# Copyright and Trademarks

## Chapter

# 11 Copyright and Trademarks

## Copyright



## Trademarks

# License Agreement and Warranty

Chapter

# 12 License Agreement and Warranty

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Teltow, Germany, 2004-2010
SensoMotoric Instruments GmbH

# 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.
75 Arlington Street
Boston, MA 02116
USA
Phone:+1 (857) 241 3865
Fax:+1 (857) 241 3601
Toll-Free: 888 SMI USA1
email: info@smiusa.com

Please also visit our home page: http://www.smivision.com



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