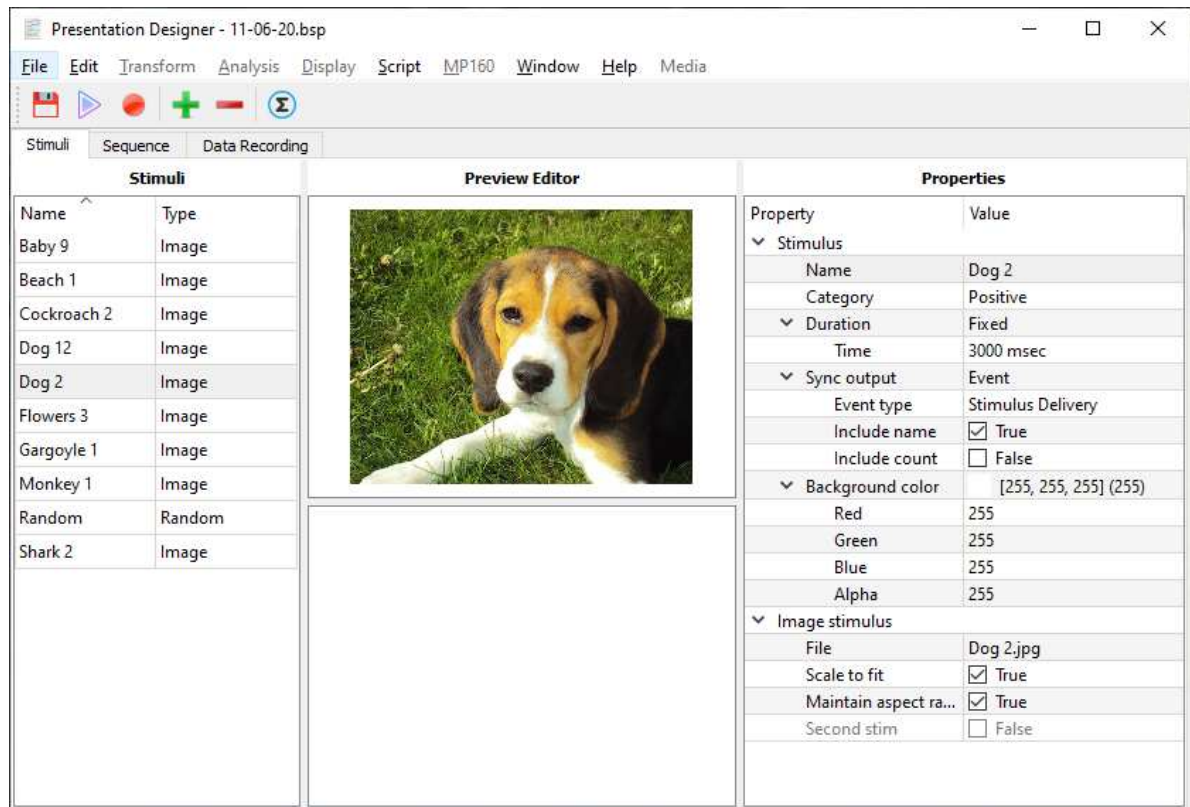


Chapter 33 AcqKnowledge Stimulus Presentation License with Eye Tracking and FaceReader Support

AcqKnowledge Stimulus Presentation is an optional license for AcqKnowledge 5.06 or above and is designed for use with Eye Tracking Bars with an Eye Tracking Integration license; also compatible with licensed FaceReader integration. AcqKnowledge Stimulus Presentation runs on Windows only and current releases are supported on Windows 10. Contact BIOPAC for details.



AcqKnowledge Stimulus Presentation is a licensed feature that enables users to create stimulus programs from within the AcqKnowledge application, thereby bypassing the need for third-party stimulus software. The AcqKnowledge Stimulus Presentation program simplifies the setup and running of stimulus protocols, while integrating the stim output with available Eye Tracking and FaceReader, in addition to the full range of physiological signals supported by AcqKnowledge and the MP160 System.

With this feature, the user can create simple presentations using the following stimuli:

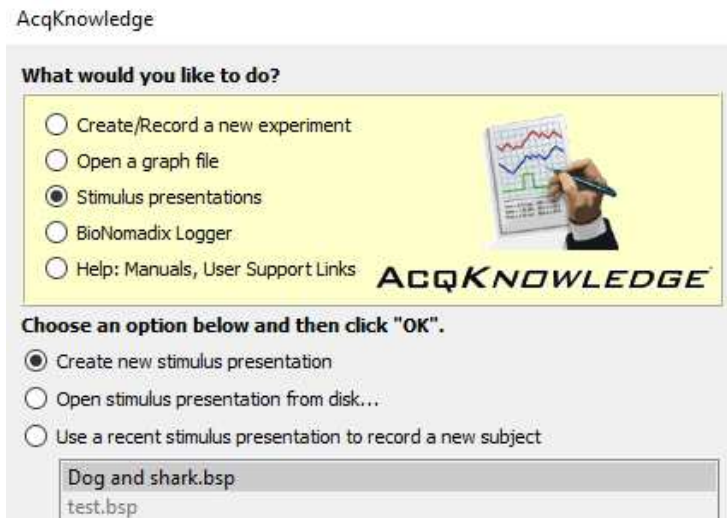
- Text
- Images
- Video
- PDF
- Random

A *presentation* is a sequential list of stimuli presented on a computer monitor to a subject in a fixed or random order.

An overview of the various AcqKnowledge Stimulus Presentation features are explained on the following pages.

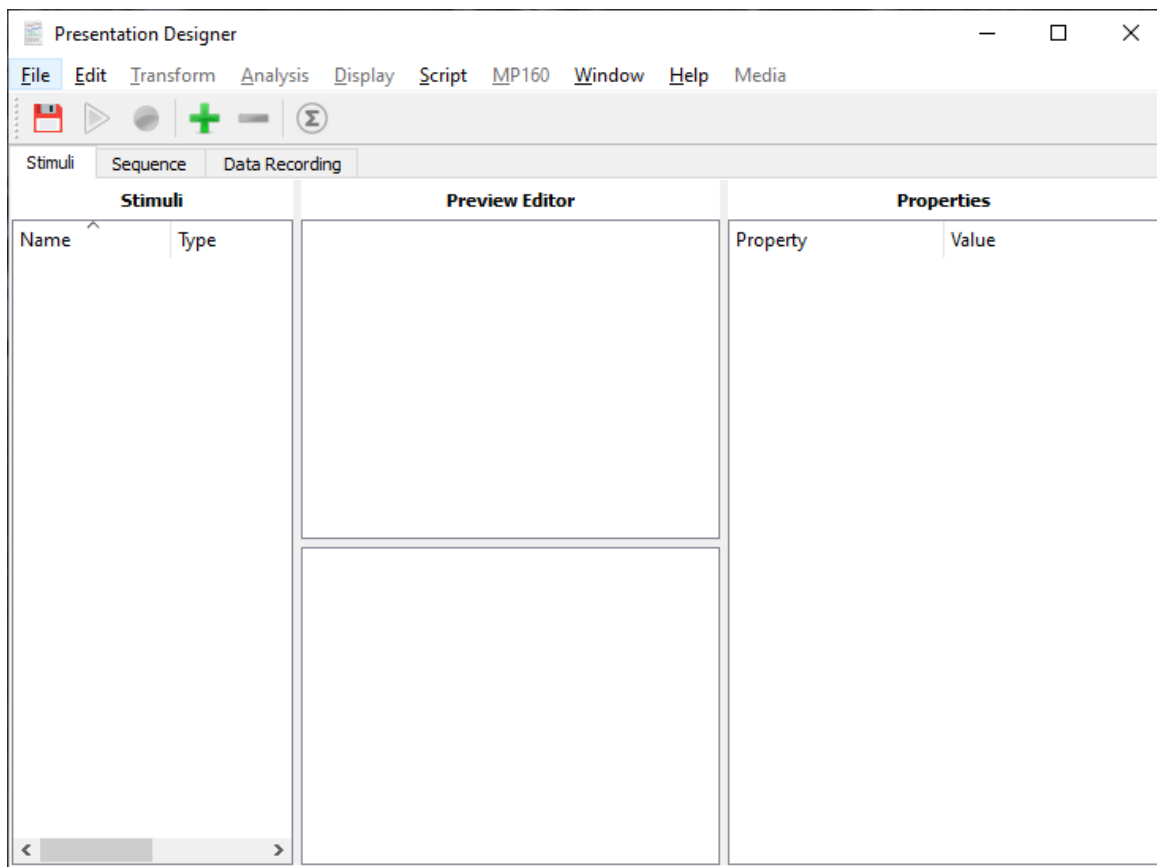
Presentation Designer

The Presentation Designer is the interface used for setting up the stimulus experiment. To open the Presentation Designer in *AcqKnowledge*, choose the “Stimulus presentations” startup option.



The available options are Create a new presentation, open an existing saved presentation, or choose a recent saved presentation from the provided list. (Saved presentations use a unique *.bsp file extension and incorporate all *AcqKnowledge* graph settings.)


After choosing “Create new stimulus presentation,” the following screen will appear with the “Stimuli” tab selected.



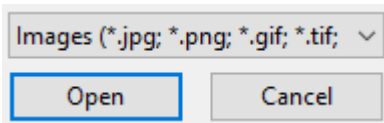
The Presentation Designer window

Creating a new presentation

The Presentation Designer window contains the following three tabs: “Stimuli”, “Sequence” and “Data Recording”. The three tabs of this window are used to build up a library of items (“Stimuli”), arrange those items into the order they should be presented to the subject (“Sequence”), and to configure the collection of data to be obtained from the subject during the presentation (Data Recording”). To create a new presentation, the “Stimuli” tab must be selected in

the designer. Click the “Add” button on the toolbar . This action presents options for selecting supported stimulus types, such as images, videos, or text.

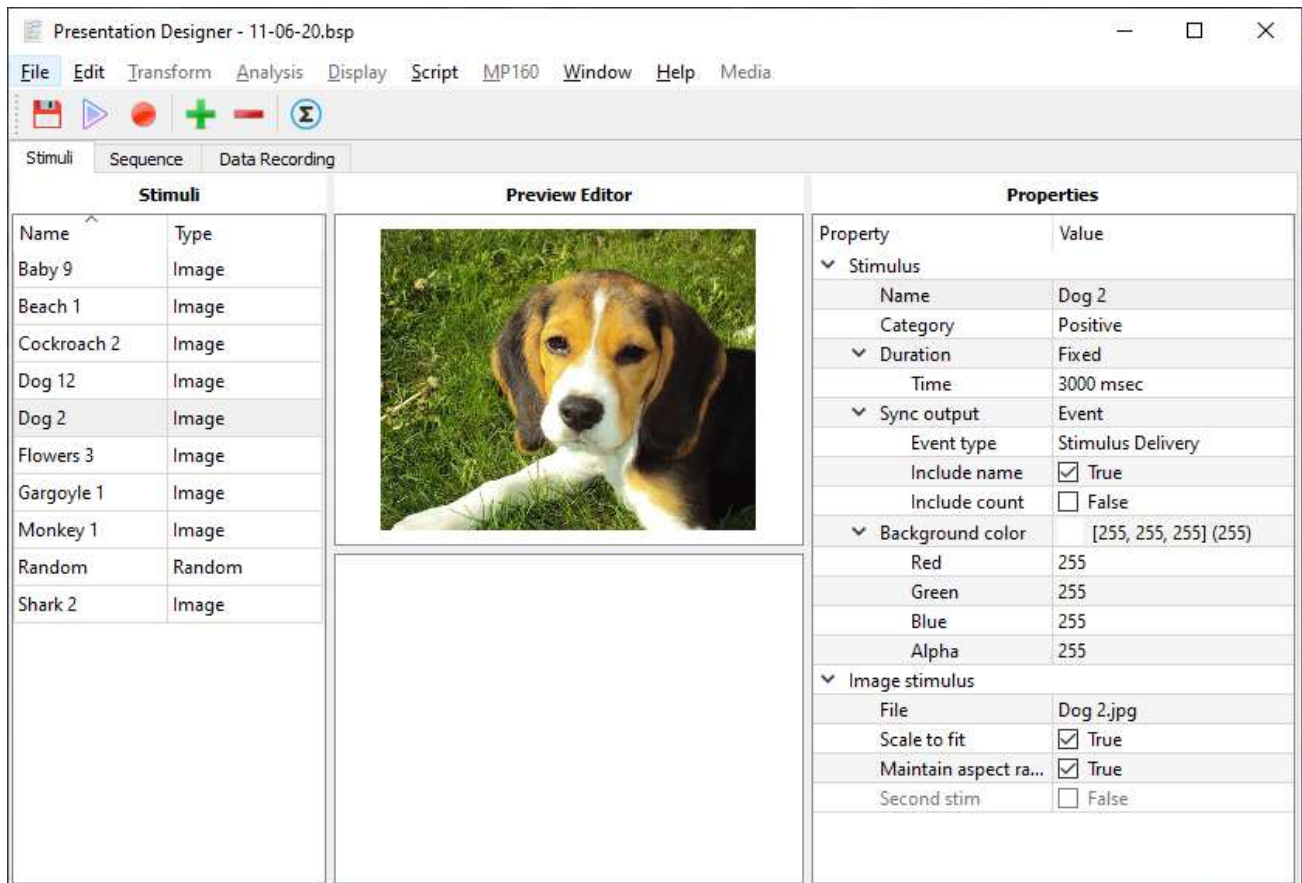
“File...” opens a file chooser for selecting single or multiple supported stimulus file types from any directory.



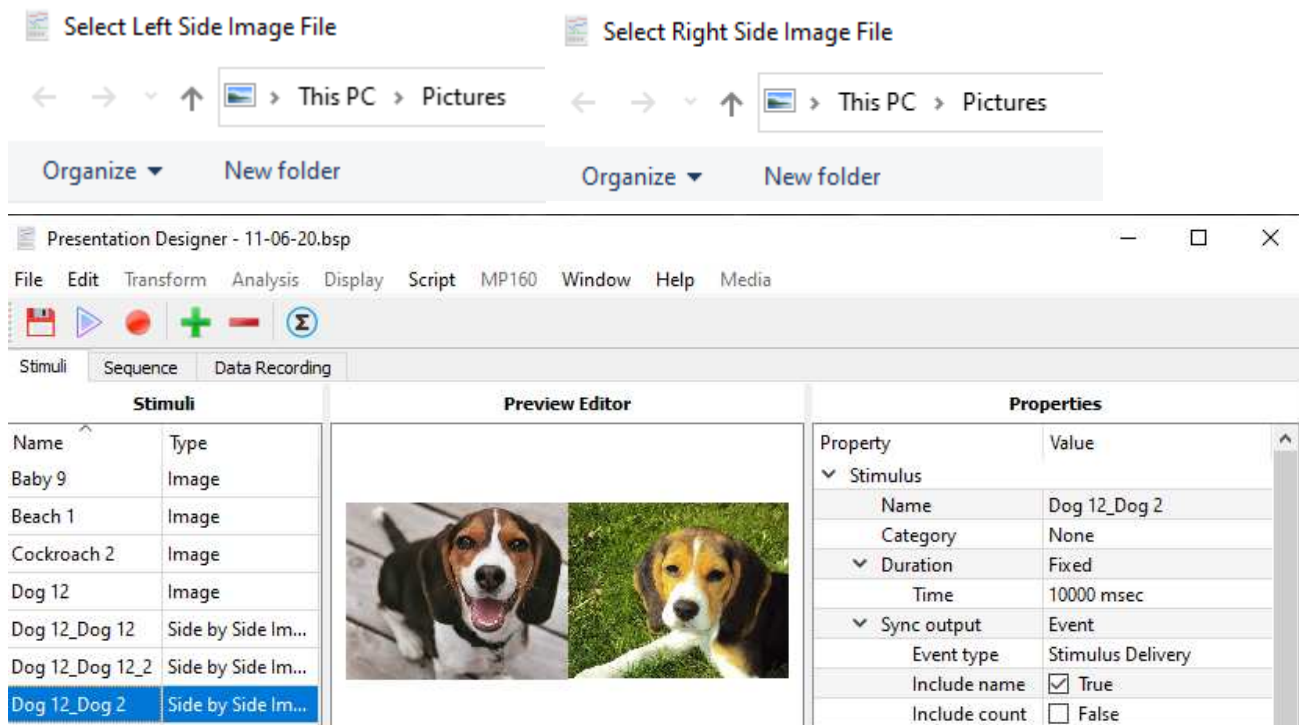
After choosing a format from the list, a File > Open window will appear, allowing navigation to files of the selected type. After Clicking “Open,” the selected file will appear in the Stimuli list, the Preview Editor pane, and the Properties sheet.

A supported stimulus can be added directly to the selected format, or from any folder directory. You may add as many stimulus elements as desired and multiple files for import can be selected using the Ctrl key.

“Folder...” opens a chooser for selecting an entire folder of supported stimulus types from any directory.



The “Side by Side Image” option places two images next to each other in the same Preview pane. The File Chooser dialog allows users to select the image that appears on the left and right.



Adding a “Random” item allows the experimenter to have stimuli randomly drawn from other items added to the library. Learn more in the section below titled “Adding a Random Stimulus to the Presentation”.

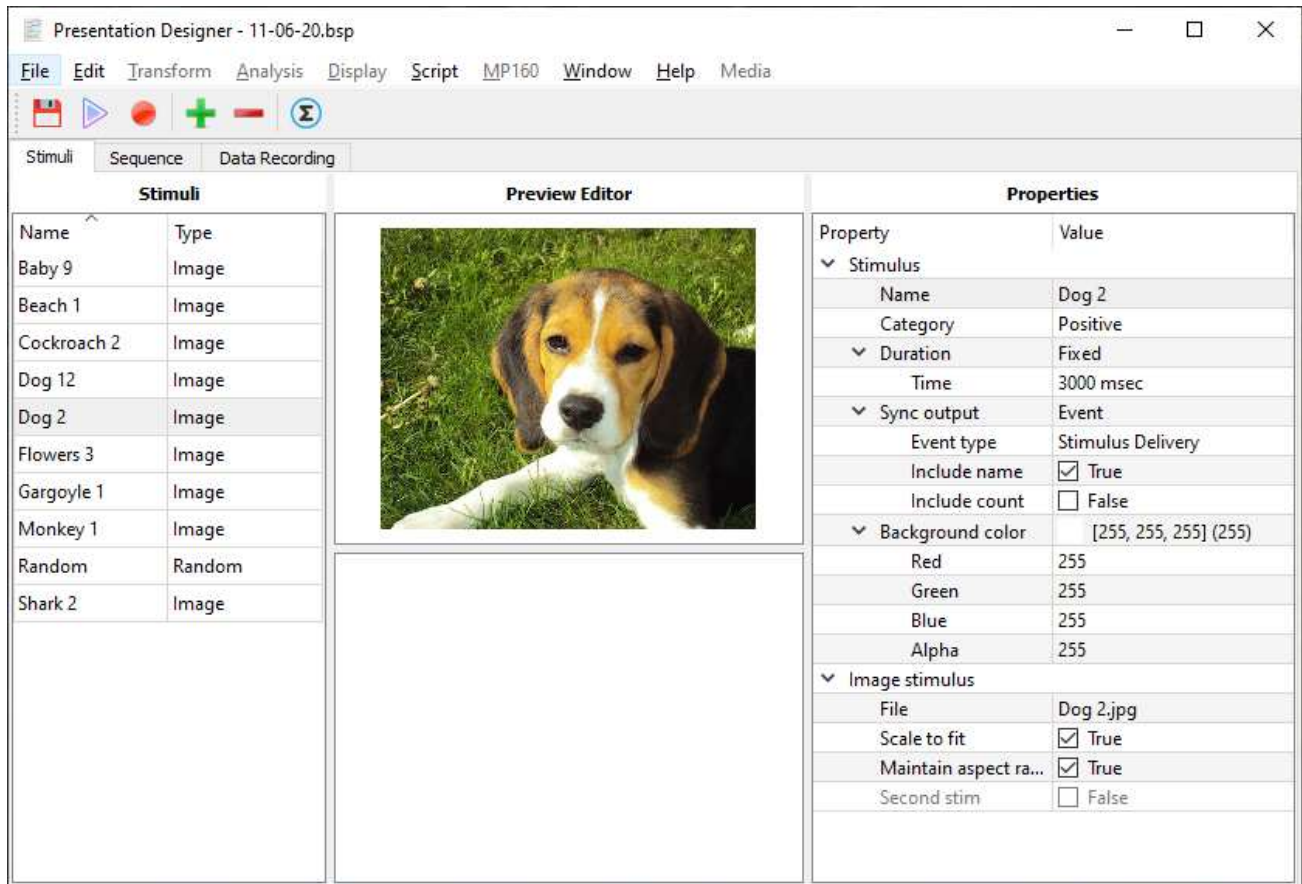
Stimuli Tab and the Stimulus Presentation Toolbar (available under Stimuli tab only)



The Stimulus Presentation Toolbar in the upper left of the Presentation Designer window includes the following options:

Button	Icon	Action
Save		Saves the Stimulus Presentation as a BIOPAC Stimulus Presentation (*.bsp) file. This file can be saved to any location and re-opened for subsequent uses.
Dry Run		Use this button to visually run through the Stimulus Presentation Sequence without recording data.
Record		Creates a new window in <i>AcqKnowledge</i> and opens the Visual Experiment View window which contains an option to Start Recording.
Add		Use this button to add a supported stimulus to the Stimulus Presentation. Note: Stimulus types are not presented in the order they are added to the Stimulus Presentation. Use the “Sequence” tab to specify order.
Delete		Use this button to delete a selected stimulus from the presentation.
Summary		Displays an onscreen summary of the Stimulus Presentation elements.

Stimulus Presentation Details



The **Stimuli** pane displays the stimulus names and types in list format.

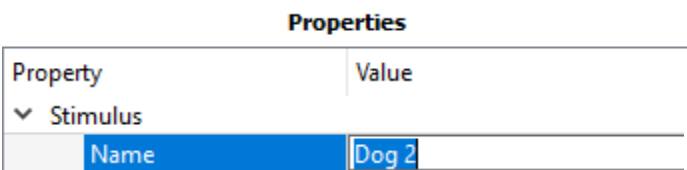
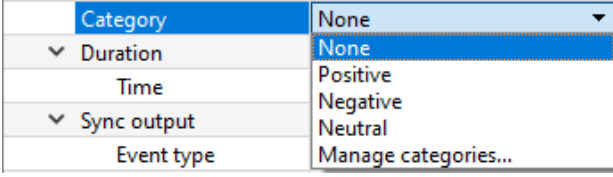
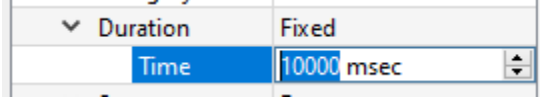

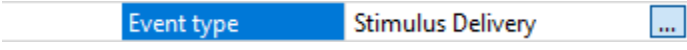
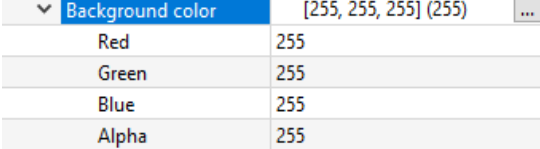
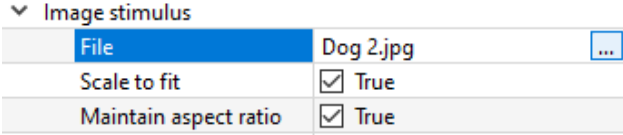
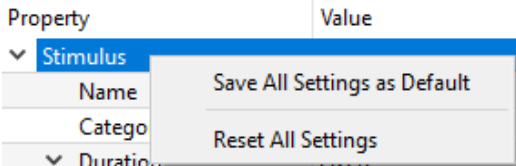
The **Preview Editor** shows the currently selected stimulus as it will appear to the participant.

The **Properties** pane consists of two elements:

- **“Property”** shows the various attributes in the selected stimulus.
- **“Value”** consists of editable fields for customizing various elements of the stimulus and how each element will be displayed to the participant.

Setting the Stimulus Properties and Values

Each stimulus image can be modified using the following options:

	<p>Click into the “Value” field to edit name of the stimulus displayed in the library.</p>
	<p>Assign a stimulus category for the expected response to the stimulus from the Category pop-up menu. Click “Manage categories...” to create a custom category.</p> <p>Categories are important when adding random stimuli. Please refer to the “Adding a Random Stimulus to the Presentation” section for more information.</p>
	<p>Use this field to set the desired time duration the stimulus will be displayed to the participant. This field is directly editable, or the value can be increased or decreased using the arrow buttons.</p>
	<p>The Sync Output specifies the output type generated when the onscreen stimulus is presented. When set to Event, a global event will be defined when the stimulus is presented.</p>
	<p>Click the button to choose the event type to be outputted during the stimulus.</p>
	<p>The background color can be customized by entering numerical values, or by clicking the “...” button to open a color picker.</p>
	<p>Click the “...” button to the right of “File” to navigate to the directory containing the selected stimulus or use it to select a different file.</p>
	<p>Right-click any property to save modified settings as the new default or choose “Reset all settings” to revert to the original default. This option is global for all properties.</p>

Tip Right-click any stimulus selected in the stimuli list to open a contextual menu for the following options. Use the “Find” feature to quickly locate any stimulus in the list. This is useful for protocols requiring large numbers of stimuli in the presentation.

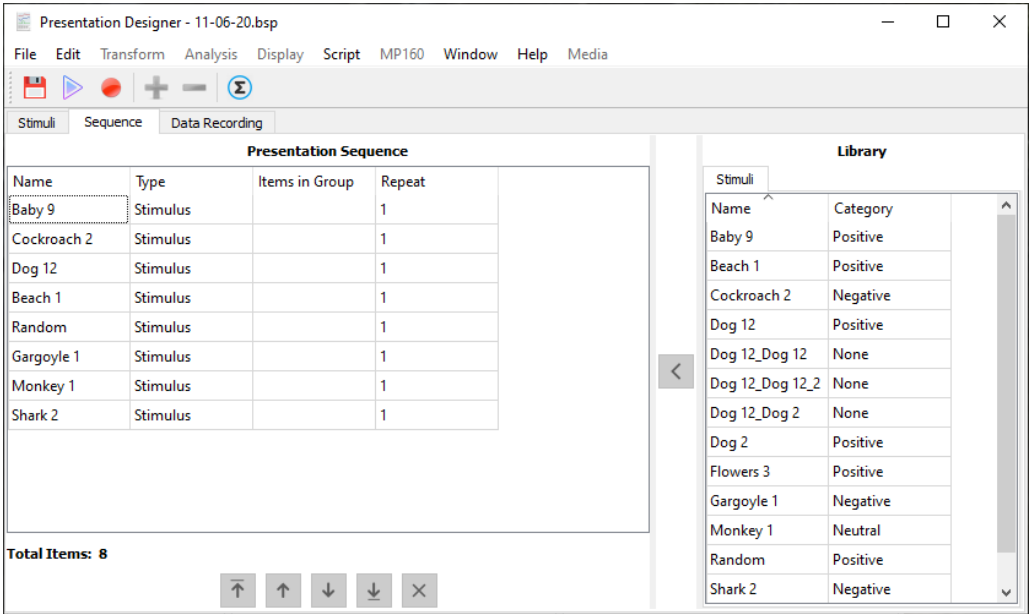
Baby 9	Image	
Beach 1	Image	
Cockroach 2	Image	
Dog 12	Image	
Dog 2	Image	
Flowers 3	Image	
Gargoyle 1	Image	
Monkey 1	Image	
Random	Random	
Shark 2	Image	


Dry Run
Add New
Delete
Find...

File...
Folder...
Text
Image
Video
PDF
Side by Side Image
Random

The Sequence Tab

Once stimuli are added under the **Stimuli** tab and assigned properties, they can be organized into a desired order under the **Sequence** tab. The **Library** pane on the right displays all stimuli available in the presentation file (i.e., all items added using controls under the **Stimuli** tab).








To add stimuli to the **Presentation Sequence**, select the desired stimuli in the Library and use the  button to copy the stimuli into the **Presentation Sequence** list. Multiple stimuli may also be selected by using the Ctrl (select singly) or Shift key (select a range of stimuli).

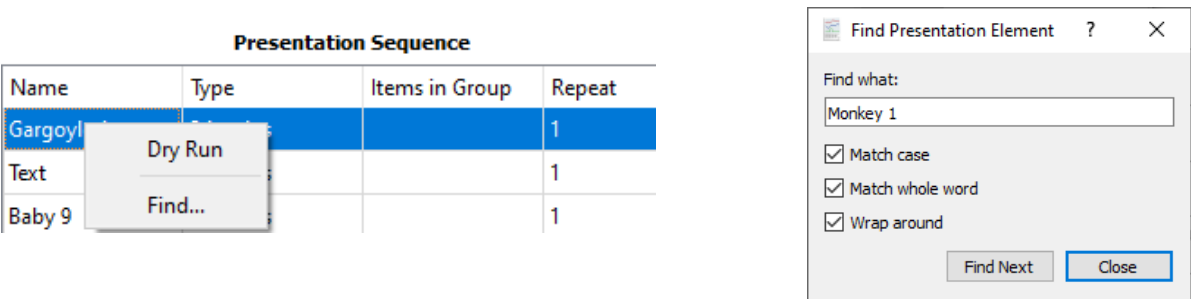
Repeat is an editable field that specifies how many times a stimuli is presented before the next stimuli used.

Sequencing Buttons

The arrow buttons at the bottom of the screen are used for moving items (stimulus) up or down the Stimulus Presentation sequence list. To move an item, click to select it in the list and click the buttons. Multiple items can be selected in the list.

	Move selected item(s) to the top of the Presentation Sequence.
	Moves selected item(s) up one space in the Presentation Sequence.
	Moves selected item(s) down one space in the Presentation Sequence.
	Move selected item(s) to the bottom of the Presentation Sequence.
	Deletes an item from the Presentation Sequence. NOTE: This action deletes from the Presentation Sequence only—it does <i>not</i> delete the item from the Library.

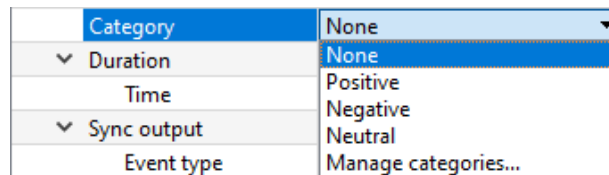
Tip Right-click an item in the Presentation Sequence list to generate a shortcut pop-up menu. **Dry Run** will perform a presentation run-through without recording data, **Find...** will locate items in the list that may be out of view. To use **Find**, type the file name of the desired element in the list and click **Find Next**.




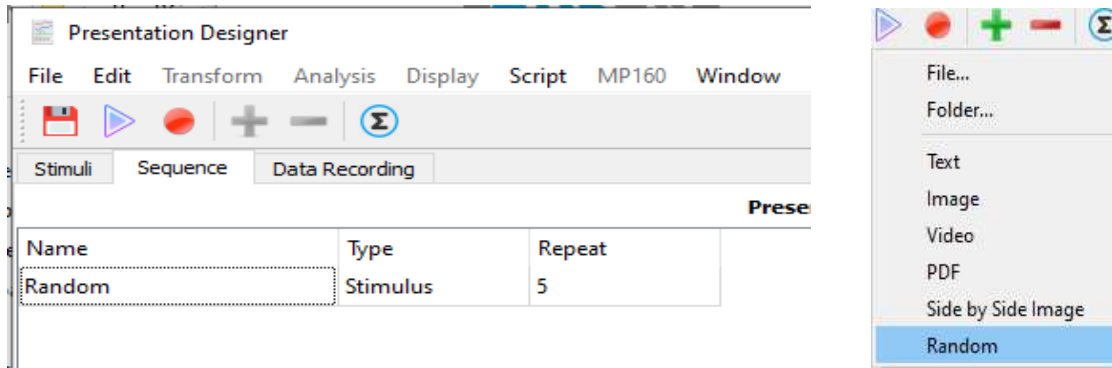
Adding a Random Stimulus to the Presentation

In addition to presenting the stimuli in a fixed order, there is the option to introduce a randomization element to the list. For every random stimulus added to the list, a stimulus will be selected at random and presented to the participant. Single or multiple random events can be added to the Stimuli list, but a random stimulus will only be applied to new or existing presentations already containing stimulus items. To add a random stimulus to the list:

1. Under the Stimuli tab, make certain the Stimuli list is populated with stimulus items (images, text, video, etc.)
2. Make certain the stimuli in the list have been assigned a category (Positive, Negative, Neutral, or custom) in the Stimuli Properties.

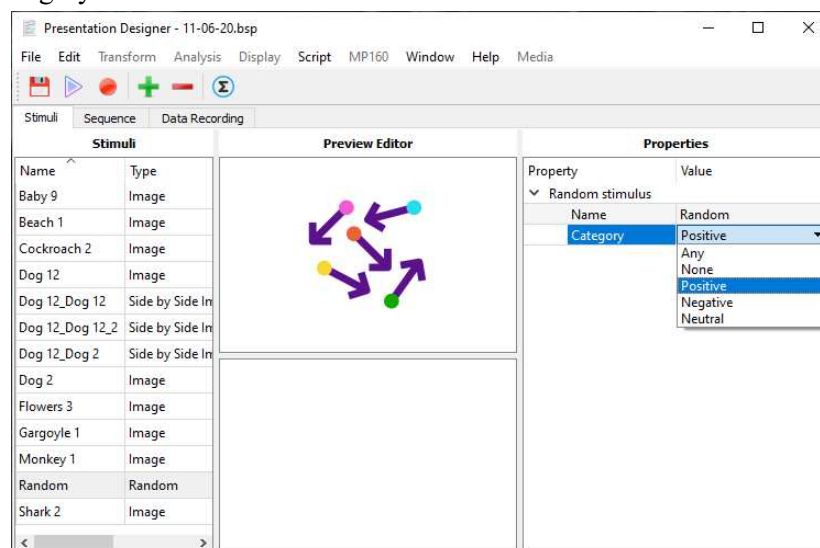


3. With the Stimuli tab selected in the Presentation Designer, click the  toolbar button and choose the “Random” option.



Note: Stimuli are drawn randomly with replacement, so a stimulus may appear more than once if multiple random draws are selected.

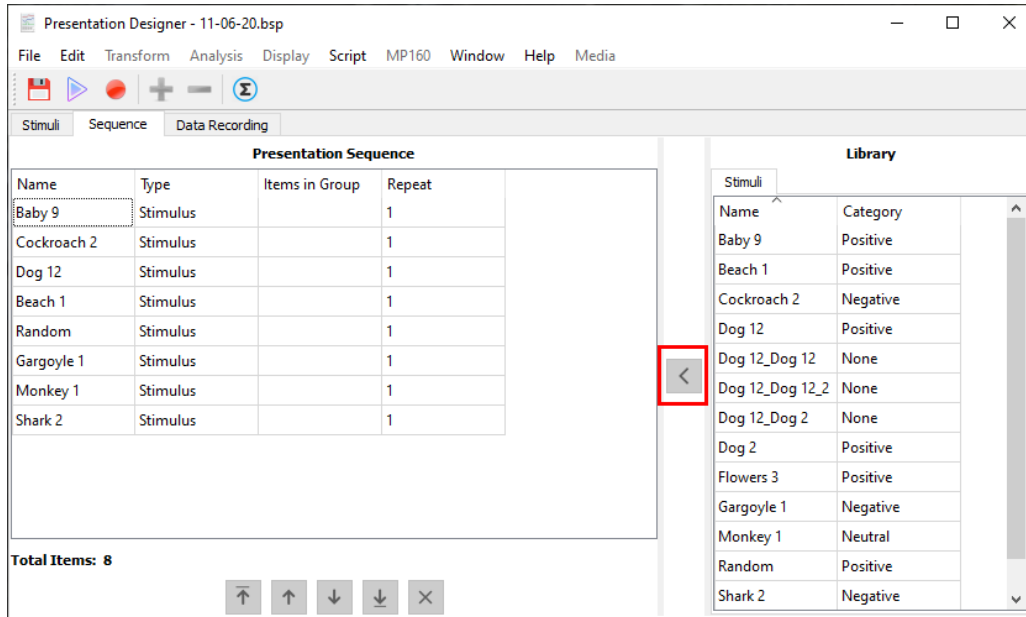
4. Under the Properties of the newly-added random stimulus, assign a Category. This tells the randomization which category to draw the stimulus item from. For example, if “Positive” is selected, the Random stimulus will be selected only from a batch of stimuli that have been previously assigned a positive category.



You may repeat the “Random” option any number of times in the Stimuli list. (For example, to have five random presentations appear, you can choose “Random” stimulus and enter 5 into the “Repeat”

column.) Alternatively, you may also right-click any item in the list and choose from the “Add New” pop-up menu. Unless the Category is set to “Any”, the only way to randomly draw stimuli with different categories is to add “Random” for each category. Choosing “Any” will draw stimuli from a union of the sets of stimuli from all categories.

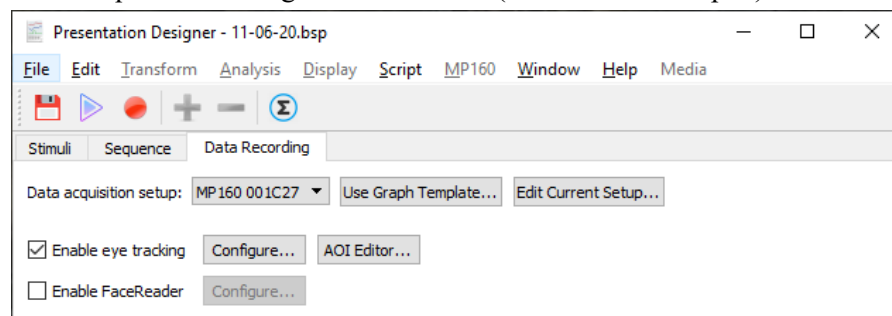
- Next, switch to the “Sequence” tab. Use the left arrow button to add the Random stimulus (or any other files) over to the Presentation Sequence. Files in the Library can be added multiple times if desired.



- Use the arrow keys at the bottom of the Presentation Sequence screen to position the Random stimuli (or any other stimuli from the set of stimuli in that Category) into the desired location in the list. When a Random stimulus comes up during the presentation, that stimulus will be randomly drawn from a stimuli matching the defined category.

The Data Recording Tab

The **Data Recording** tab contains options for selecting the MP hardware, a pre-configured graph template, or for modifying the data acquisition settings in the software (Edit Current Setup...).



Data acquisition setup The pop-up menu immediately to the right of “Data acquisition setup:” provides access to main hardware settings for selecting the connected MP hardware.

Use Graph Template Opens a dialog for selecting an existing saved graph template to use with the Stimulus Presentation.

Edit Current Setup Opens the Data Acquisition Settings dialog used for modifying the *AcqKnowledge* recording and channel settings.

IMPORTANT: If the length of the Stimulus Presentation exceeds the set length of the data acquisition, the Stimulus Presentation length will override the set Data Acquisition length. (For example, if your Data Acquisition length is set to 60 seconds but the Stim Presentation takes 75 seconds to complete, the acquisition length will be 75 seconds.)

Enable eyetracking (available only with Eye Tracking License)

This option is available only when an EyeTech Eye Tracking Bar is connected (not included with the Stimulus Presentation License). Use with EYE-TRACK-BAR. Requires Windows OS. Eye Tracking is supported in AcqKnowledge 5.0.6 and higher only.

The Eye Tracking Integration License fully integrates remote screen-based eye tracking bars with AcqKnowledge to manage set up, calibration, plotting, and more.

- Synchronized eye tracking and physiology data
- Single user interface—presentation, eye tracking and physiology data
- Fixation displays—gaze path, graduated gaze path, fixations and graduated fixations
- Attention maps—heat, 3D surface, and luminance
- Area of Interest (AOI) creation
- Stimulation, beep alert and external triggering
- Detailed Key Performance Indicator (KPI) reports—eye tracking and physiology combined in one single report

This integrated eye tracking feature can be combined with the Stimulus Presentation. Additionally, other physiological signals can be simultaneously acquired with the data recorded by the eye tracking hardware. (The MP160 unit and 100C/100D amplifiers record the physiological signals, and the EyeTech hardware records the eye tracking data.)

All signals are merged into a single AcqKnowledge graph and saved with the Stim Presentation *.bsp file and separate AcqKnowledge *.acq file. These files are linked for accessibility in case files are transferred to a new location. If not recording additional signals aside from eye tracking, the MP160 hardware must still be connected and one Analog channel enabled in the graph. This is because the Eye Tech hardware works with the MP160 to interface with the AcqKnowledge graph. The “empty” MP160 Analog channel can be hidden from view by checking “Acquire” but leaving “Plot” unchecked.

Note A single *.bsp file can be used in separate AcqKnowledge graphs, and subsequently separate saved *.acq files. Each *.acq file saved after recording with the same *.bsp file (for example, when running the same experiment on multiple subjects) will be associated with that *.bsp file. This association will prevent users from changing a .bsp file after it has recorded data.

Enable Eye Tracking > Configure

Configure Opens a wizard for selecting the eye tracking signals to be recorded and for setting the fixation algorithms. For more information about eye tracking options, see the following section.

Enable Eye Tracking > AOI Editor

AOI Editor: Opens a setup dialog for configuring Areas of Interest (AOIs) for the presentation used with the eye tracking experiment. For more information about eye tracking AOIs, see the following section on page 13.

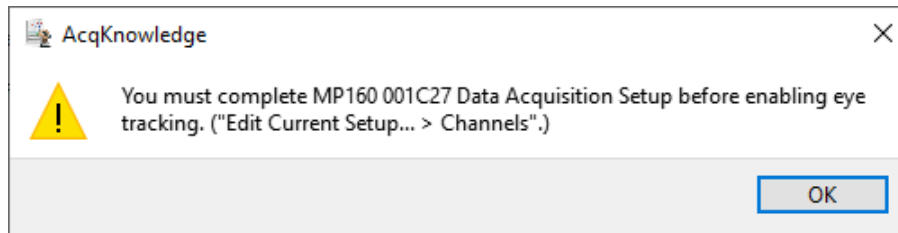
Enable FaceReader

This opens a dialog for setting software options for FaceReader facial expression data. This option is available only when a FaceReader license is installed. See *Chapter 32 FaceReader License* for information about using FaceReader.

Eye Tracking Configuration Options–Eye Tracker Wizard

The Eye Tracker Wizard in the Data Recording tab is used to configure the eye tracking signals via the following steps.

1. Make certain the Eye Tracking hardware is connected to a USB port.
2. Make certain the MP160 hardware is connected and powered on.
3. Make certain at least one MP160 Analog channel has the “Acquire” box checked. If not, the following warning will appear:



To complete the MP160 setup, click the “Edit Current Setup” button on the upper right of the Presentation Designer’s Data Recording screen and add a new module (“View by Modules > Add New Module”) or enable an Analog channel (choose “View by Channels” and check “Acquire”).

4. Check the “Enable eye tracking” checkbox.
5. Click “Configure” to open the Eye Tracker Wizard.
6. Select the tracker signals to be recorded and then click “Next.”

← Eye Tracker Wizard

Record the following eye tracker signals

Acquire	Label
<input checked="" type="checkbox"/>	LeftEye_Pupil_x
<input checked="" type="checkbox"/>	LeftEye_Pupil_y
<input checked="" type="checkbox"/>	LeftEye_PupilDi...
<input checked="" type="checkbox"/>	LeftEye_Found
<input checked="" type="checkbox"/>	RightEye_Pupil_x
<input checked="" type="checkbox"/>	RightEye_Pupil_y
<input checked="" type="checkbox"/>	RightEye_Pupil...
<input checked="" type="checkbox"/>	RightEye_Found
<input checked="" type="checkbox"/>	Gaze_x
<input checked="" type="checkbox"/>	Gaze_y
<input checked="" type="checkbox"/>	Distance

← Eye Tracker Wizard

Gaze velocity preprocessing

Fixation algorithm

☐ dispersion ☐ velocity ☒ none

☒ AOI calculation

Next Cancel

7. Select the desired gaze velocity preprocessing setting and click “Next.”
 - After selecting the the Fixation Algorithm (see descriptions on next page) and clicking “Next,” the Stimulus Display setup will appear.

Fixation algorithm

☐ dispersion ☒ velocity ☐ none

IVT

Threshold: degrees/sec

- **Stimulus Display** dialog is used to select the monitor displays for the director and the participant. Click “**Identify**” to check the stimulus display and click “**Finish**” to exit the Stimulus wizard.

? ×

← Eye Tracker Wizard

Stimulus Display

Stimulus display: \\.\\DISPLAY1

Identify

Vertical size: 6.54593 inch

Horizontal size: 12.1654 inch

Finish Cancel

Stimulus display	Selects the monitor used to display the stimulus presentation. This would be the monitor the participant is using, not the monitor the researcher is using.
Identify button	Identifies the stimulus display selected.
Vertical size	Vertical screen size of the detected monitor display.
Horizontal size	Horizontal screen size of the detected monitor display.

Fixation Algorithms

Fixations are periods when a subject is focusing on a particular location in their visual field.

The following fixation algorithms are available:

Note Algorithms for both sets of computations are described in this paper:

<https://doi.org/10.1145/355017.355028>

Salvucci, D.D., and Goldberg, J.H. (2000). "Identifying Fixations and Saccades in Eye-Tracking Protocols", *Proceedings of the 2000 Symposium on Eye Tracking Research and Applications*, 71-78.

Dispersion

The dispersion algorithm identifies fixations by locating periods where the gaze position remains within a specified visual angle for a fixed duration of time. Dispersion algorithms are useful for eye trackers with sample rates too low to extract useful velocity information. While robust, dispersion algorithms are unable to precisely identify the starting and ending time of a fixation within a time window. The dispersion algorithm can only determine that the time window contained a fixation and its probable center location.

Fixation algorithm

☒ dispersion ☐ velocity ☐ none

IDT

Window width: 100 ms

Dispersion angle: 1 degree

Dispersion Parameters	Description
Window width:	Selects the time window width for applying the dispersion algorithm in milliseconds. The default value is 100 ms.
Dispersion angle:	Sets the dispersion angle in degrees the gaze must remain within to be considered a fixation. The default value is 1 degree.

Velocity

Velocity algorithms identify fixations as periods where eye motion does not exceed a specific threshold. More often these algorithms are designed to detect saccadic, fixed pursuit, and other motions along with fixations. A higher sampling rate frequency eye tracker is required to accurately use a velocity based algorithm, given the timing resolution necessary to accurately detect changes in gaze angle. With superior temporal resolution, velocity algorithms are able to better identify fixation onsets, offsets, and duration and are also useful for categorizing other types of eye motions.

Note Algorithms for both sets of computations are described in this paper:

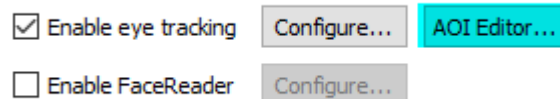
<https://doi.org/10.1145/355017.355028>

Salvucci, D.D., and Goldberg, J.H. (2000). "Identifying Fixations and Saccades in Eye-Tracking Protocols", *Proceedings of the 2000 Symposium on Eye Tracking Research and Applications*, 71-78.

Velocity Parameters	Description
Velocity threshold:	Threshold in degrees per second that separates saccades from other eye movements. Default value is 20 degrees/sec.

Area of Interest (AOI) Editor

To open the AOI Editor, click the “AOI Editor...” button.



The AOI (Area of Interest) Editor is used for defining specific areas within the stimulus file where the participant’s gaze might be expected to fall and to measure how long the gaze was held. The point at which the participant’s gaze on an AOI is first detected can be recorded by outputting an AOI Hit Event and placing it in the *AcqKnowledge* graph. The point at which a participant looks away from the AOI can be similarly recorded and is referred to as an AOI Exit Event.

Multiple AOIs can be created within a stimulus file, **but please note:** Although AOIs can technically overlap, overlapping is not recommended because not all AOI events will be recorded. The most recent overlapped event will be the only one recorded. Maintain space between AOIs.

These AOI events are inserted into the graph upon AOI Hit and Exit. AOI Hit and Exit events may also be used to initiate the following actions; Next stimulus, Beep, Start stimulator, Stop stimulator, or Set digital output. Also note that Hit and Exit events will not align with Event Marks, which must be added manually.

An optional “dwell time trigger” may be added for each individual AOI. If a subject fixates within an AOI and the gaze remains within the AOI for a fixed time interval, the dwell time trigger will fire, resulting in an event insertion in the graph as well as any stimulus presentation system triggers. Hit events are inserted only if a subject remains fixated for the user-specified dwell time. That event mark should be inserted at the same time that all other outputs (next slide, set digital output, start/stop simulator, beep) occur.

The AOIs are recorded and can be viewed in the Eye Tracking analysis using a number of tools.

Area of Interest Creation Tool

- Rectangle
- Elliptical
- Polygonal – free form

Area of Interest Controls








- Event mark insertion
- Start and stop stimulator
- Digital I/O control

AOI Analysis Tools

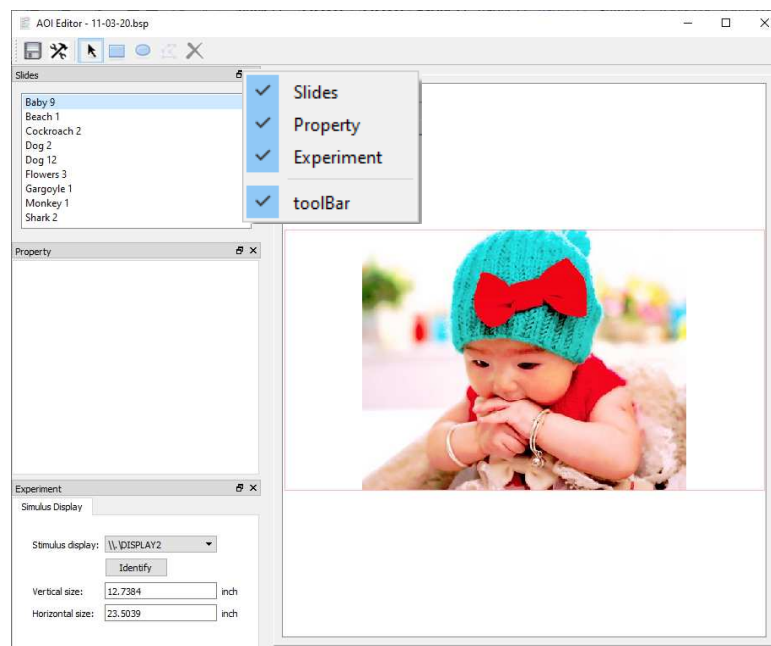
- Attention Maps
 - Heat map
 - Luminance map
 - 3D surface map
- Area of Interest (AOI) Reports
 - Pie Chart – recording KPIs for Areas of Interest
 - Scarf Plot
 - String Plot
 - Combining eye tracking metrics with physiological data: e.g., mean heart rate and total time on the AOI/time of first hit in one single Excel report

The AOI Editor Toolbar



	Save button. Saves the AOI edits for the experiment.
	Slides button. Shows or hides the list of slides (files) in the AOI Editor.
	Selection tool. Use to select an AOI to reposition it on the stimulus image or to access the selected AOI Properties dialog.
	Rectangle tool. Use this to create a square or rectangular AOI area.
	Ellipse tool. Use this to create a round, oval, or elliptical AOI area.
	Line or multipath tool. Use this to create a freeform AOI area.
	Delete tool. Use this to delete an AOI from the slide. An AOI must be created for this control to become active.

The AOI Editor Screen



Tip To show or hide the main toolbar, Slides, Property, or Experiment windows, right click in the gray toolbar area, and check/uncheck the desired item. (See above figure.)

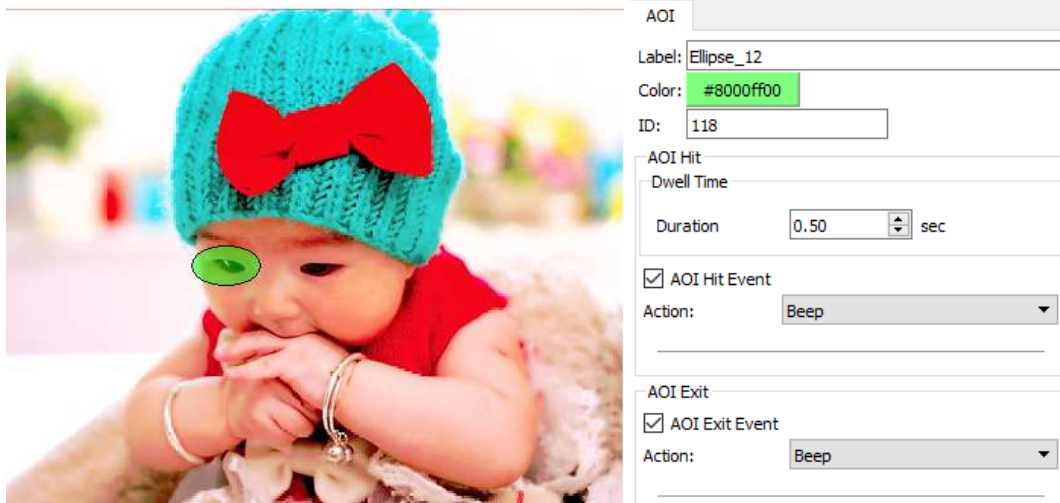
After opening the AOI Editor, note the “Slides” pane in the upper left of the screen. This is where stimuli to be used in the Stimulus Presentation are listed and can be selected for defining the AOIs. The “Slides,” “Property,” and “Experiment” panes can also be detached from the window for a floating display if desired.

Property: This is the area where the properties for a defined AOI will appear by default.

Experiment—Stimulus Display: The “Stimulus display” menu is used to select the monitor or display where the Stimulus Presentation will be presented to the participant. This is normally a dedicated display in addition to the one the director is using. The “Identify” button flashes a green screen on the monitor selected in the “Stimulus display” menu.



Defining Areas of Interest (AOIs)

1. Double-click a slide in the Slides list to display it in the viewing pane.
2. Click the Rectangle, Ellipse, or Line toolbar button.
3. Hold the mouse button down and draw a shape around the portion of the slide where you want the AOI to appear. The below example is an ellipse.



4. When a colored shape appears over the defined area, the AOI Properties dialog will appear. This includes configurable options for the AOI.

Properties for the AOI include the following:

Label	The default title will include the shape of the selected AOI along with a sequence number. However, this field is editable and the title will appear in the <i>AcqKnowledge</i> graph.
Color	The color is editable by clicking the colored box, which opens a standard colorwell.
ID	A sequential ID number assigned to the AOI. This value is also user-definable.
AOI Hit	<p>Dwell Time This is the duration a participant’s gaze remains on an AOI before a Hit event is created. The default is 0.5 seconds, but this can be set to any value greater than or equal to zero.</p> <p>Event Check this box to generate an AOI Hit Event  to be inserted into the <i>AcqKnowledge</i> graph events bar. This event occurs when the participant’s gaze is detected within the AOI for the specified Dwell Time.</p> <p>Action: Defines the action to take place when an AOI Hit Event is created. See next for more details about these actions.</p>
AOI Exit	<p>Exit Event Check this box to generate an AOI Exit Event  to be inserted into the <i>AcqKnowledge</i> graph events bar. This event occurs when the participant’s gaze falls outside the AOI.</p> <p>Action: Defines the action to take place when an AOI Exit Event is created. See next for more details about these actions.</p>

Assigning Actions to AOI Hit and Exit events

The following actions can be assigned to AOI Hit and Exit events:

☒ AOI Hit Event
Action: None

☐ AOI Exit Event
☒ AOI Exit Event

None

When “None” is selected, no action is taken when AOI Hit or Exit events are detected.

Next stimulus

Choosing “Next stimulus” will advance the presentation to the next item in the presentation sequence when AOI Hit or Exit events are detected.

Beep

When “Beep” is selected, an audible beep will be heard when AOI Hit or Exit events are detected. **NOTE:** The beep is generated by the computer system sound scheme. Make sure the computer sounds are enabled or the beep will not be audible.

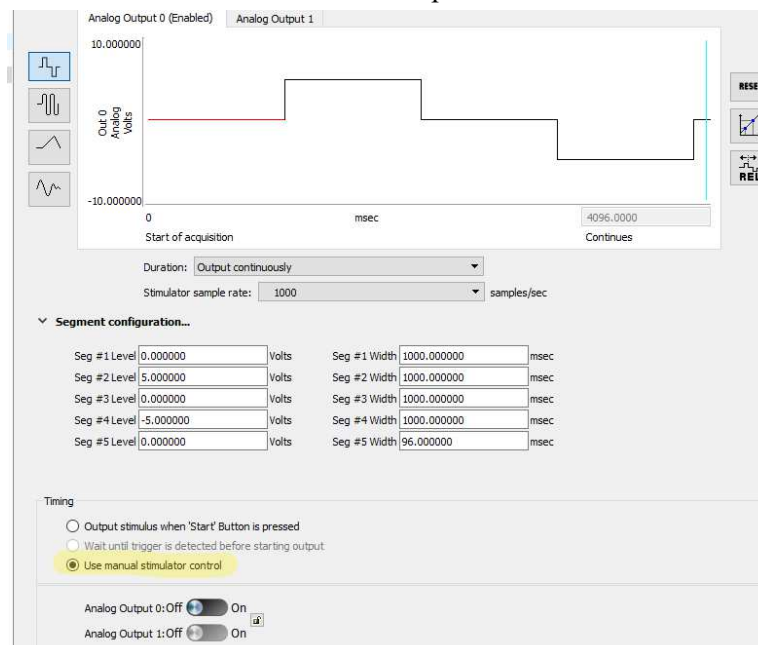
Start stimulator

☒ AOI Hit Event
Action: Start stimulator

Channel: ☒ 0 ☐ 1

When “Start stimulator” is selected, the *AcqKnowledge* Stimulator will start output when AOI Hit or Exit events are detected. In order for the Stimulator to start, you must first set up the Stimulator signal in *AcqKnowledge* and connect the stimulator to the appropriate Analog Output port on the AMI100D or connect to STM100C with 'Source' switch set to Out 0 or Out 1 as appropriate. Enable “0” or “1” to select the Analog Out channel for this action.

Tip The stimulator should be configured to start with the On/Off button. This can be configured by selecting “Use manual stimulator control” under the “Timing” section. Please refer to the Stimulator Setup for more information.



Stop stimulator

☒ AOI Hit Event

Action: Stop stimulator

Channel: ☒ 0 ☐ 1

When “Stop stimulator” is selected, the *AcqKnowledge* Stimulator will stop output when AOI Hit or Exit events are detected. Enable “0” or “1” to select the Analog Out channel for this action.

Set digital output

☒ AOI Hit Event

Action: Set digital output

Set: ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

CH: 0 1 2 3 4 5 6 7

Val: 0 0 0 0 0 0 0 0

When “Set digital output” is selected, the digital channels can be toggled on and off when AOI Hit or Exit events are detected. This can be used to control external hardware, such as a STP100C Isolated Digital Interface.

AOI

Label: Zero Out

Color: #80ff0000

ID: 116

AOI Hit

Dwell Time

Duration: 0.00 sec

☒ AOI Hit Event

Action: Set digital output

Set: ☒ ☐ ☐ ☐ ☐ ☐ ☐ ☐

CH: 0 1 2 3 4 5 6 7

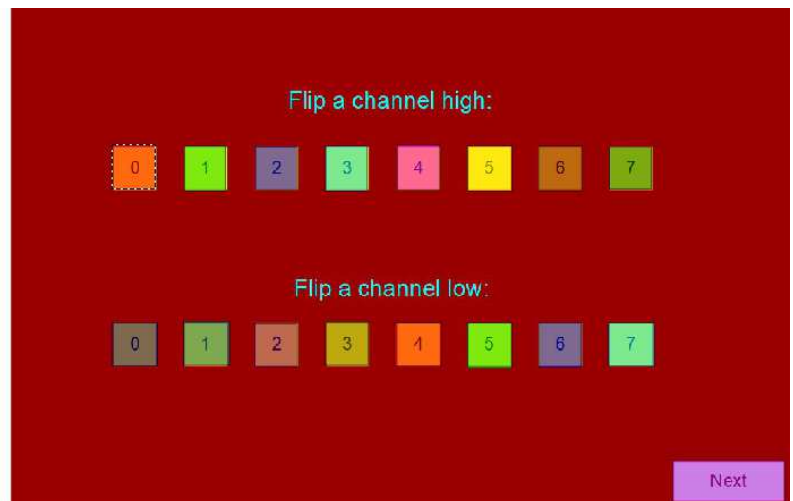
Val: 1 0 0 0 0 0 0 0

AOI Exit

☒ AOI Exit Event

Action: None

Experiment



Calibration and Recording

Before recording eye tracking data, the Eye Tracker hardware must be calibrated for the experiment participant. It is recommended that the experimenter configure the presentation and observe data collection on a separate monitor from the one used for presenting stimuli to the subject.

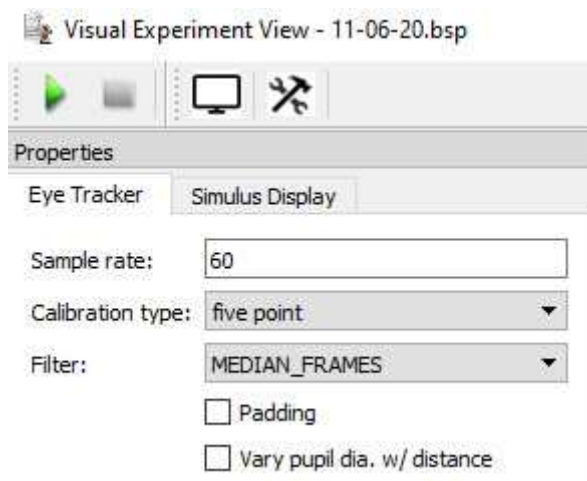
Before beginning, make sure the Eye Tracker is connected to a USB port and the participant is seated comfortably in front of the presentation monitor.

To begin Calibration setup in preparation for recording, click the red button in the Presentation Designer toolbar.



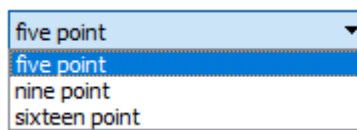
This action generates the **Visual Experiment View** dialog, with the “Eye Tracker” Calibration tab enabled. A new *AcqKnowledge* graph window is also opened, unless a saved graph template is selected and opened prior to calibration.

Eye Tracker tab

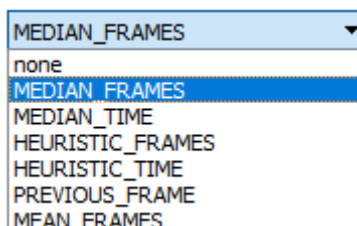


Sample rate: This is the rate at which the processor is digitizing the images of the participant’s eyes. This value is not editable and is determined by the connected EyeTech hardware’s capability.

Calibration type: This menu selects the number of visual calibration points to be presented to the participant in the Stimulus Display. The options are five point, nine point, or sixteen point. The default setting is five point. (The calibration cross will be presented at five different areas of the Stimulus Display screen.)



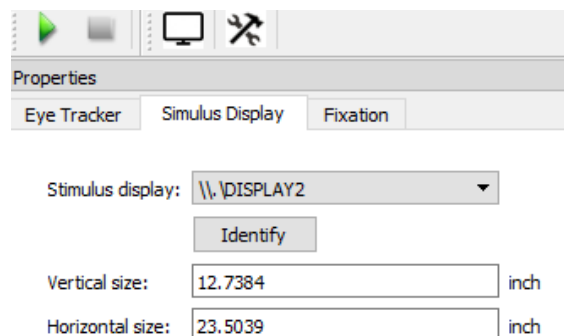
Filter: This option selects the filtering algorithm to be applied to the Calibration. The default setting is Median Frames, which is adequate for most eye tracking experiments..



Eye Tracker Filter Settings

None	No gaze point filtering will be applied.
Median Frames	The median gaze point value over the last X number of frames, where X equals the value represented by the setting.
Median Time	The median gaze point value over the last X number of frames, where X is the number of frames gathered over twice the amount of milliseconds represented by the setting.
Heuristic Frames	The heuristic filter uses different filtering strengths when the eye is moving and when it is fixating. When the eye is moving, very little filtering is done which results in very low latency. When the eye is fixating, large amounts of filtering are being done which greatly reduce the amount of jitter. During fixation, filtering is done over the last X number of frames where X equals the value represented by the setting.
Heuristic Time	The heuristic filter uses different filtering strengths when the eye is moving and when it is fixating. When the eye is moving, very little filtering is done which results in very low latency. When the eye is fixating, large amounts of filtering are being done which greatly reduce the amount of jitter. During fixation, filtering is done over the last X number of frames where X equals the number of frames gathered over twice the amount of milliseconds represented by the setting. This produces approximately the same amount of latency during fixation for all frame rates.
Previous Frame	The weighted previous frame mode filters the gaze point by summing the current weighted gaze point location and the previous weighted gaze point location. The weights are based on the distance the current gaze point is away from the previous gaze point. The larger the distance, the greater the weight on the current gaze point; the smaller the distance, the greater the weight on the previous gaze point. This results in very low latency when the eye is moving and very low jitter when the eye is fixating. The weighting changes from the previous gaze point to the current gaze point. Possible values range between 0 and 200.
Mean Frames	The mean gaze point value over the last X number of frames, where X equals the value represented by the setting.

Stimulus Display tab



The Stimulus Display tab contains options for choosing the monitor display to be used for the stimulus presentation. This will also be the monitor used to perform Eye Tracker calibration.

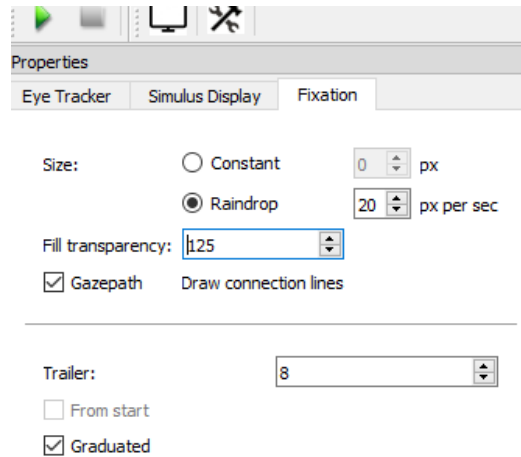
Stimulus display: Choose the stimulus display from the detected monitors available in the pop-up menu.

Identify: Projects a green background onto the selected stimulus display for approximately two seconds to verify which monitor is selected for the stimulus display and Eye Tracker calibration

Vertical size: Indicates the viewable vertical area of the selected stimulus display.

Horizontal size: Indicates the viewable horizontal area of the selected stimulus display.

Fixation tab



The screenshot shows the 'Fixation' tab in a software interface. It includes controls for 'Size' (Constant or Raindrop), 'Fill transparency' (a slider set to 125), 'Gazepath' (checked), 'Draw connection lines' (unchecked), 'Trailer' (a slider set to 8), and checkboxes for 'From start' (unchecked) and 'Graduated' (checked).

The Fixation tab becomes available after the green Start button  is clicked, and only if the dispersion or velocity fixation algorithm option was selected in Eye Tracker Setup Wizard.

These parameters determine the gazepath and fixation cause of the Eye Tracking experiment.

- Size:** Determines the fixation shape size.
- Constant:** Fixations are displayed as a solid dots and the size remains constant.
- Raindrop:** In Raindrop mode, the size of the fixation shape is proportional to the fixation duration. The fixation size can be modified using the “px per sec” control. This sets how many pixels represent a 500 ms fixation.
- Fill transparency:** This adjustment determines the solidity or opacity of the fixation appearance.
- Gazepath:** Enables the gazepath to be displayed as a connecting line between fixations.
- Trailer:** Adjusting this value upward will increase the intensity of the trailing edge of the fixation display. Decreasing the value will fade the trailing edge of the fixation display.
- From Start:** Renders all fixations from the stimulus start time to the graph cursor selection time.
- Graduated:** Choosing this setting will display the gazepath and fixation to become more transparent as it progresses.



Constant Fixation



*Raindrop Fixation
(Graduated)*



Gazepath



Graduated Gazepath

Fixation Only (Constant)

The fixation only drawing method searches through the fixation time interval and draws an overlay on the stimulus image of all fixations detected within the time interval, all at 100% opacity.

Graduated Fixation (Raindrop)

In addition to their location in the stimulus, each fixation also has an associated onset time. The graduated fixation display uses transparency of the fixation overlay to convey where in the fixation time interval it occurs. A fixation occurring at the precise end of the time interval will be drawn with 100% opacity, that is, obscuring all of the stimulus image underneath it. A fixation occurring at the precise beginning of the time interval will be drawn with the user specified opacity, allowing the underlying stimulus image to be

partially visible beneath the fixation indicator. Fixations that are “clustered” close in time will all be drawn with a similar opacity. In the example below, fixations are overlaid in a graduated fashion from 65% opacity at the earliest time of the interval. The variations in opacity indicate both that the earliest fixation was on the lower left in the grass with the final on the blurred bowl in the background with a fixation “pace” over the entire fixation interval that is fairly consistent across the interval.





Gazepath

The gazepath display is similar to the fixation only display. All fixations within the fixation time interval are drawn as circles with lines drawn between the center of each fixation, the path starting from the center of the earliest fixation within the time period and ending at the last fixation within the time period. Fixations and lines are all drawn at 100% opacity.

Graduated Gazepath


The graduated gazepath display is an extension of the graduated fixation display with connecting lines drawn in the overlay between the center of each fixation. For each pair of fixations, the connecting path line is drawn at the opacity of the earliest fixation time. This allows the intensity of the gazepath itself to reflect the time and speed at which the subject changed their point of interest during the fixation time interval.

Visual Experiment View Toolbar

	Start button to begin calibration.
	Stop button to abort calibration.
	Shows the selected stimulus display in full screen with the following instruction: <i>Eye Tracker stimulus display full screen. Close display: Alt-F4, switch back: Alt-TAB.</i>
	Toggles the Properties window view on/off.

Calibration

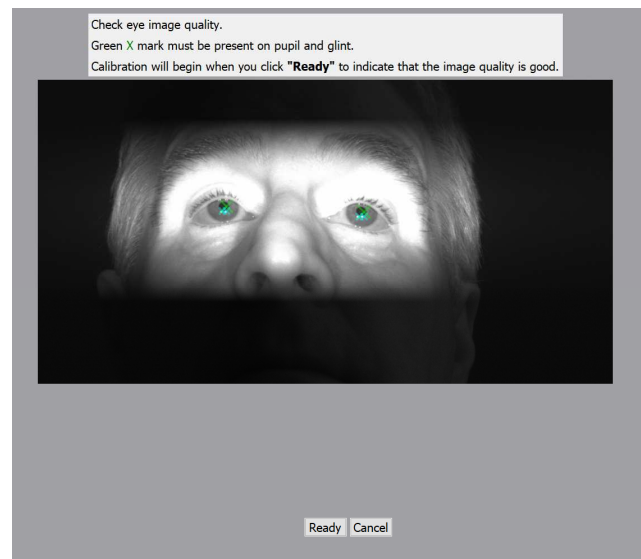
To begin the **Calibration** sequence, click the green

Start  button on the toolbar.

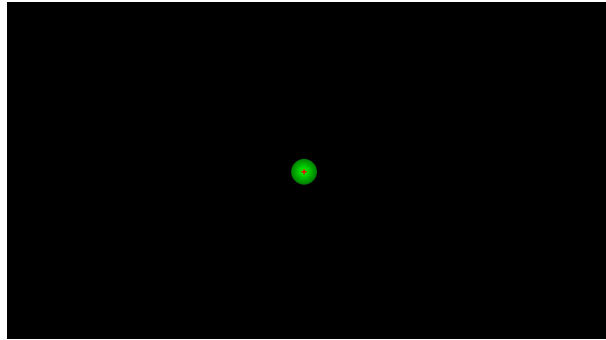
Have the subject follow the onscreen instructions. Click “Ready” when the subject is prepared to look at the fixation points or “Cancel” to abort the experiment.

Special Notes

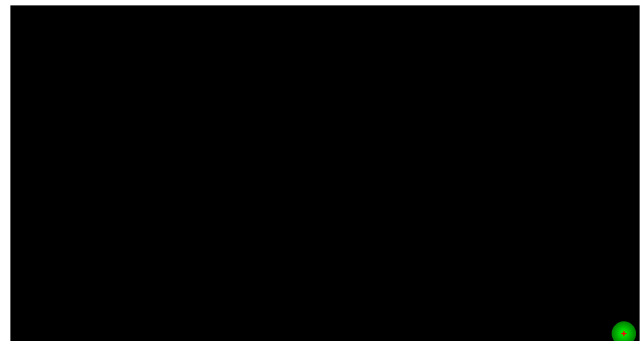
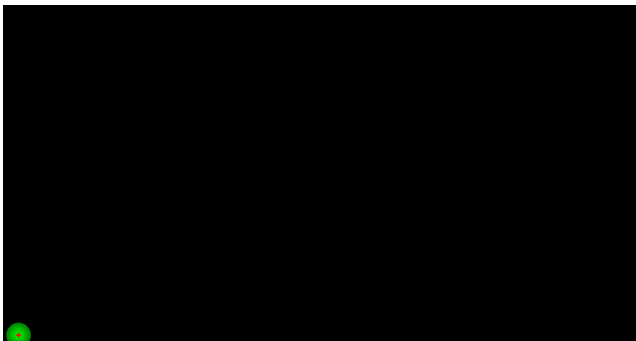
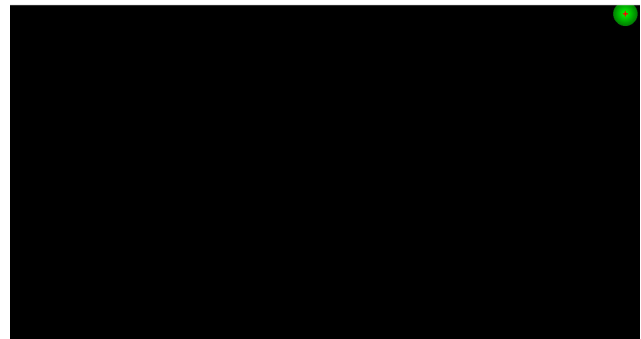
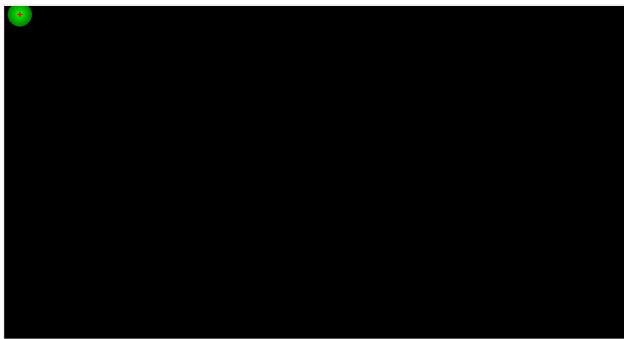
- Eyeglasses, excessive light, reflections, drooping lids, excessive blinking can affect the quality of the calibration. Make sure the green X mark is clearly visible over the pupil.
- Infrared and florescent lights can also affect the quality of the eye tracking signal and result in poor calibration results.
- Eye Track bar works best when the subject’s eyes are within a finite volume in a three dimensional space in front of the monitor. Subject’s eyes should be about 0.75 meters away from the monitor. Positioning the subject nearer or further away can have a dramatic effect on the hardware’s ability to correctly compute gaze angle. Green LEDs on the Eye Track bar indicate when each of the two pupils are captured. When the subject is positioned well, the LEDs should turn off only when the subject blinks.



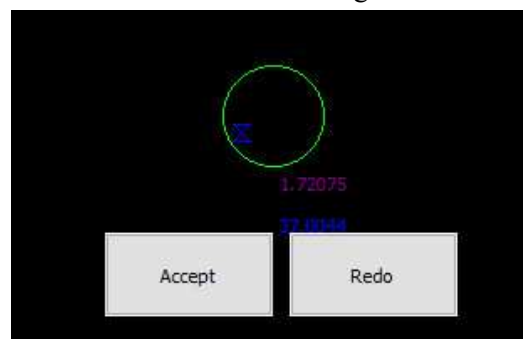
After clicking “Ready,” the calibration screen will appear.



Have the subject look at each fixation point (the green circle) as soon as it appears and continue fixating on that point until it disappears. The images above and below indicate all points used when “five point” calibration is selected.



At the end of calibration, the X's should be near or within the green circles. If not, click “Redo.”



Accepting the calibration result will start the Stimulus Display program. (A three-second onscreen countdown will cue the participant.)

At the conclusion of the presentation, the *AcqKnowledge* acquisition will stop. The Eye Tracking data will appear in the graph along with any other physiological data that was acquired.

Eye Tracking Data Analysis

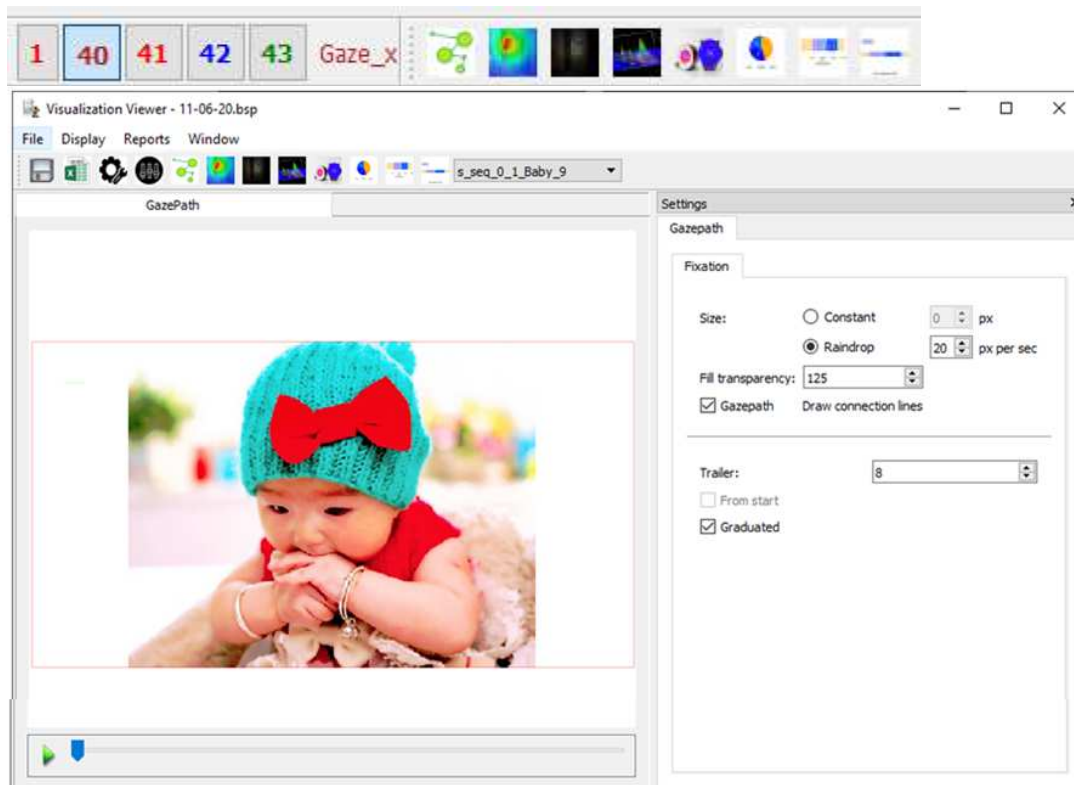
The following options are available in the MP160 > Gaze menu of the completed *AcqKnowledge* graph.



Note The following Edit menu items are **disabled** in Stimulus Presentation *AcqKnowledge* graphs:

Cut	Clear	Insert Waveform	Remove Last Appended Segment
Paste	Clear All	Remove Waveform	

With the *AcqKnowledge* graph open, choose MP160 > Gaze > Show Visualization Viewer. The Visualization Viewer can also be accessed by selecting the data (or a portion of data) with the I-beam cursor and selecting one of the Visualization toolbar buttons for gaze path, heat map, luminance map, attention map, AOI KPI, pie chart, scarf plot, or string plot. (See following page for further details.)



The Visualization Viewer allows the Gazepath Fixation settings to be modified for better viewing during analysis and includes a video-style scrollbar that synchronizes the stimulus and AOI display with the Eye Tracking graph data.

Other tools available in the Visualization Viewer:


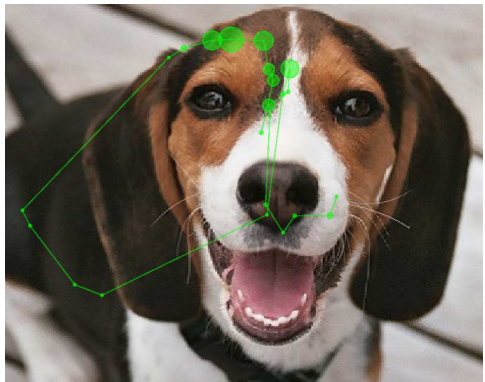

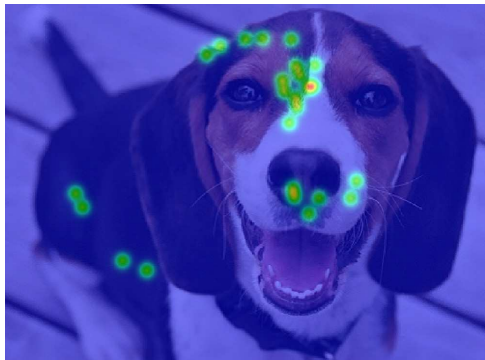



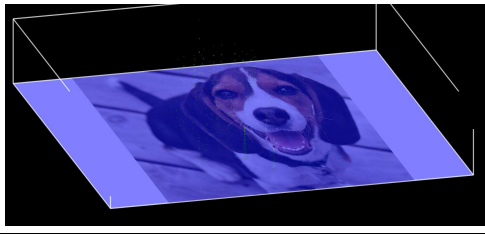

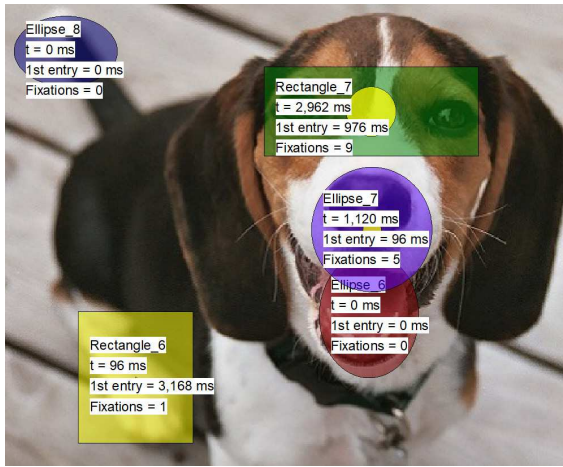
- Attention Maps
 - Heat map
 - Luminance map
 - 3D surface map
- Area of Interest (AOI) Reports
 - Pie Chart – recording Key Performance Indicators (KPIs) for Areas of Interest
 - Scarf Plot
 - String Plot
 - Combining eye tracking metrics with physiological data: mean heart and total time on the AOI/time of first hit in one single Excel report


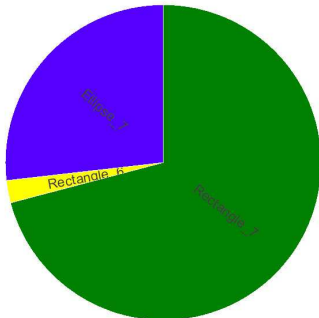

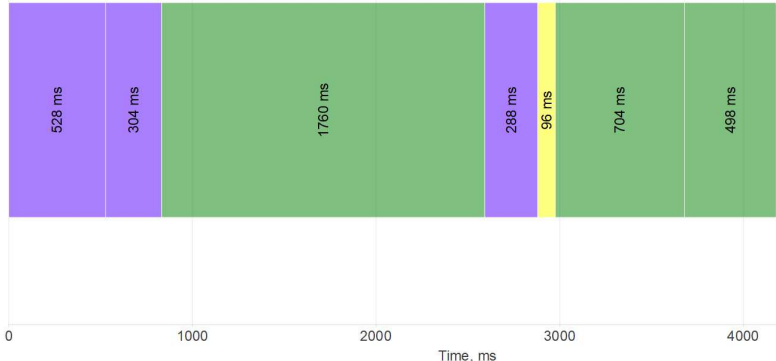


Visualization Viewer Toolbar

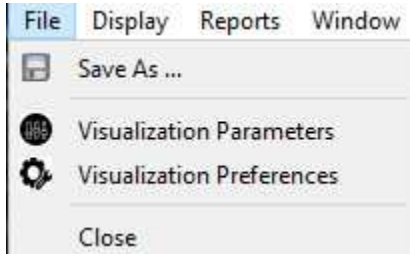
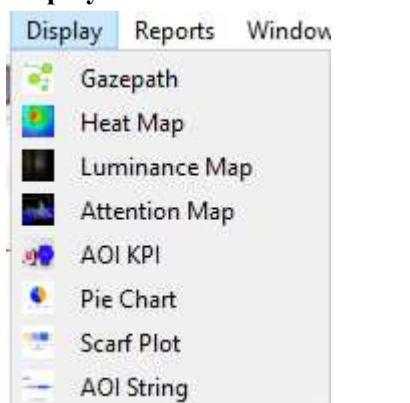

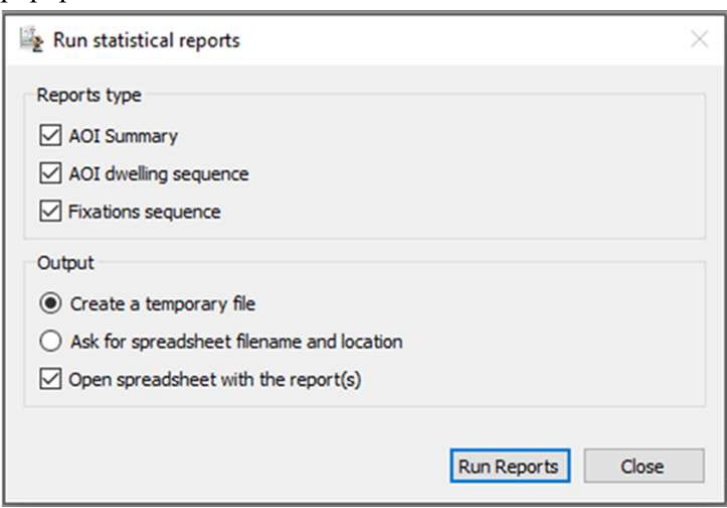
File Display Reports Window



	<p>Saves the selected AOI map or chart as a *.jpg file.</p>
	<div data-bbox="245 384 878 831"> </div> <div data-bbox="938 375 1455 497"> <p>Opens the statistical report setup dialog for generating a spreadsheet output of the AOI summary, dwelling sequence, and fixations sequence.</p> </div> <div data-bbox="938 504 1281 535"> <p>The report can be output as:</p> </div> <div data-bbox="938 543 1451 724"> <p>Create a temporary file—generates a spreadsheet file that is viewable but not saved. Ask for spreadsheet filename and location—opens a save dialog box for selecting a location for saving the report spreadsheet.</p> </div> <div data-bbox="938 732 1455 825"> <p>Open spreadsheet with report(s)—report spreadsheet opens automatically when this option is checked.</p> </div>
	<div data-bbox="245 856 1032 1623"> </div> <div data-bbox="1062 848 1455 970"> <p>Opens the AOI Visualization Preferences setup dialog for setting appearance, colors, label position of the AOI KPIs.</p> </div>
	<div data-bbox="245 1654 906 1919"> </div> <div data-bbox="927 1646 1429 1707"> <p>Opens the Visualization Parameters setup screen.</p> </div>

		<p>Opens the Gazepath overlay recorded during the presentation. Gazepath properties on right.</p>
		<p>Opens the Heat Map display recorded during the presentation. Heatmap properties on right.</p>
		<p>Opens the Luminance Map display recorded during the presentation.</p>
		<p>Opens the Attention Map display recorded during the presentation.</p>
	 <p>Ellipse_8 t = 0 ms 1st entry = 0 ms Fixations = 0</p> <p>Rectangle_7 t = 2,962 ms 1st entry = 976 ms Fixations = 9</p> <p>Ellipse_7 t = 1,120 ms 1st entry = 96 ms Fixations = 5</p> <p>Ellipse_6 t = 0 ms 1st entry = 0 ms Fixations = 0</p> <p>Rectangle_6 t = 96 ms 1st entry = 3,168 ms Fixations = 1</p>	<p>Opens the AOI KPIs recorded during the presentation.</p>

	 <div> <div> Rectangle_7 t = 2,962 ms 1st entry = 976 ms Fixations = 9 </div> <div> Ellipse_8 t = 0 ms 1st entry = 0 ms Fixations = 0 </div> <div> Ellipse_6 t = 0 ms 1st entry = 0 ms Fixations = 0 </div> <div> Rectangle_6 t = 96 ms 1st entry = 3,168 ms Fixations = 1 </div> <div> Ellipse_7 t = 1,120 ms 1st entry = 96 ms Fixations = 5 </div> </div> <div> ■ Rectangle_7 ■ Ellipse_8 ■ Ellipse_6 ■ Rectangle_6 ■ Ellipse_7 </div>	<p>Displays Pie Chart of AOIs recorded during the presentation. Mouse over an individual section of the pie chart to display statistics for the KPI represented by that sector.</p>
	 <div> <div>528 ms</div> <div>304 ms</div> <div>1760 ms</div> <div>288 ms</div> <div>96 ms</div> <div>704 ms</div> <div>498 ms</div> </div> <div> ■ Ellipse_7 ■ Rectangle_7 ■ Rectangle_6 </div>	<p>Displays Scarf Plot of AOIs recorded during the presentation.</p> <p>Check “Show time outside AOIs” to include areas outside of AOIs</p> <div> <input type="checkbox"/> Show time outside AOIs </div>
	<div>EEAE DAA</div>  <div> ■ Ellipse_7 (E) ■ Rectangle_7 (A) ■ Rectangle_6 (D) </div>	<p>Displays String Plot of AOIs recorded during the presentation.</p>
<div>s_seq ▼</div>	<div> <div>s_seq_0_1_Baby_9 ▼</div> <div> s_seq_0_1_Baby_9 s_seq_0_2_Cockroach_2 s_seq_0_3_Dog_12 s_seq_0_4_Beach_1 s_seq_0_5_Random s_seq_0_6_Gargoyle_1 s_seq_0_7_Monkey_1 s_seq_0_8_Shark_2 </div> </div>	<p>Use the pop-up menu on the toolbar to select stimuli for individual display in any of the Visualization Viewer options.</p>

<p>File Menu</p> 	<p>The Visualization Viewer File menu provides an alternate method for saving the selected overlay view as a *.jpg file and for accessing the Visualization Parameters and Preferences.</p>
<p>Display Menu</p> 	<p>The Visualization Viewer Display menu provides an alternate method for accessing the Gazepath, various overlays, and charts.</p>
<p>Reports Menu</p> 	<p>The Visualization Viewer Reports menu provides an alternate control for generating statistical reports. Selecting this will display the following popup window:</p>  <p>After running reports, a notification will show that the statistical reporting has been completed, and an excel sheet is created with the selected types of reports.</p>
<p>AOI Summary</p>	<p>This report is a high-level overview about each image in the presentation and associated AOI within those images.</p> <p><i>Note</i> This report highlights the difference between fixation and dwell time; if a specific point is fixated upon without the subject's eyes moving multiple times, multiple fixation events will be recorded. However, if the subject looks around an AOI without ever fixating on one point, no fixation events would be recorded, but a dwell time event would still be recorded.</p>

	The following labels appear in the AOI Summary report:	
	Stim Image	The image displayed with Areas of Interest
	Start Time/End Time	The time markers for how long the image was displayed to the subject. Measured in milliseconds.
	All AOIs dwell time, ms	Sum of the total dwell time on all AOIs in the image. Measured in milliseconds.
	AOI ID/Label	Corresponding numerical and descriptive identifiers of the AOI within the image.
	Dwell time, ms	Time subject was recorded looking at an AOI. Measured in milliseconds.
	# of entries	Number of times a subject looked at the specific AOI within the image.
	Time to first entry, ms	Amount of time after the image was displayed before the subject gazes at the AOI. Measured in milliseconds.
	Min/Max/Mean Dwell time, ms	The shortest amount of time, longest amount of time, and mean average of each entry in dwell time for the AOI. These numbers will all be the same if there is only one entry into dwell time for the specific AOI. Measured in milliseconds.
	# of fixations	Number of fixations within an AOI on a specific point.
	Time to first fixations, ms	Amount of time after the image was displayed before the subject fixated on a point within the AOI. Measured in milliseconds.
	Total fixations time, ms	Sum of the time the subject was fixated on a point between all events
	STD	Standard deviation of time in milliseconds between dwell times. This value will be 0 for all events with 1 entry.
AOI dwelling sequence	The generated report displays detailed information on dwell time and events within Areas of Interest for images in a presentation. The following labels appear in the AOI dwelling sequence report:	
	Stim Image	The image displayed with Areas of Interest
	Start Time/End Time	The time markers for how long the image was displayed to the subject. Measured in milliseconds.
	All AOIs dwell time, ms	Sum of the total dwell time on all AOIs in the image. Measured in milliseconds.
	AOI ID/Label	Corresponding numerical and descriptive identifiers of the AOI within the image. Space not enclosed within an AOI is listed as “Background” with an AOI ID of -1.
	Dwell time, ms	Time subject was recorded looking at an AOI. Measured in milliseconds.

<p>Fixations sequence</p>	<p>The generated report will display a list of all fixations in each image, with columns indicating if the fixations were within an AOI or not. Space not enclosed within an AOI is listed as “Background” with an AOI ID of -1.</p> <p>The following labels appear in the Fixations sequence report:</p> <table border="1" data-bbox="625 336 1469 871"> <tr> <td>Stim Image</td><td>The image displayed with Areas of Interest</td></tr> <tr> <td>Start Time/End Time</td><td>The time markers for how long the image was displayed to the subject</td></tr> <tr> <td>Fixation Time, ms</td><td>Time that the subject’s pupils were detected in milliseconds. Note that this is recorded differently from a Hit Event.</td></tr> <tr> <td>Fixation X/Y coord</td><td>X and Y coordinates by pixel count on the specific fixations</td></tr> <tr> <td>Fixation Duration, ms</td><td>Length of time the subject is recorded fixated on a single point</td></tr> <tr> <td>AOI ID/Label</td><td>Corresponding numerical and descriptive identifiers of the AOI within the image.</td></tr> </table>	Stim Image	The image displayed with Areas of Interest	Start Time/End Time	The time markers for how long the image was displayed to the subject	Fixation Time, ms	Time that the subject’s pupils were detected in milliseconds. Note that this is recorded differently from a Hit Event.	Fixation X/Y coord	X and Y coordinates by pixel count on the specific fixations	Fixation Duration, ms	Length of time the subject is recorded fixated on a single point	AOI ID/Label	Corresponding numerical and descriptive identifiers of the AOI within the image.
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<p>Window Menu</p> <p>Window</p> <ul style="list-style-type: none"> Tabbed Close Close All Tile Cascade Next Ctrl+Tab Previous Ctrl+Shift+Backtab <input checked="" type="checkbox"/> GazePath Heat Map Luminance Map Attention Map AOI KPI Pie Chart Scarf Plot String Plot 	<p>The Window Menu provides options for changing the display of the visible Visualization Viewer options.</p> <p>Deselecting “Tabbed” allows the various map overlays to be displayed as individual resizable windows.</p> <p>Map overlays can be tiled or cascaded for viewing more than one at a time; examples of maps and charts are shown below:</p> <div data-bbox="625 1108 1469 1753"> <p>Tile</p> <p>Cascade</p> </div>												