USER MANUAL

SennsLab

Version 7.20

March 2025

Bitbrain

CONTENT

INTRODUCTION

SennsLab is a human behavior research application for study design and data collection, with several sensor modalities seamlessly synchronized. It supports the entire workflow of your project, from the experimental methodology setup to data collection and export. The typical workflow is as follows:

1. Create a new study in SennsLab, which includes a set of hardware devices (for example, biosignals, EEG, eye tracking, mouse position), and optionally behavior recording logs such as the screenshot or the webcam. Data recording can be done in conjunction with visual stimuli presentation.

2. Once the study has been defined you can go to the next step: recording participant data. Participant data and logs are recorded simultaneously and synchronized to optional stimuli presentation. Data can be exported from SennsLab for 3rd party analysis. Alternately, with the proper plugins, data from each participant recorded can be uploaded to the SennsCloud service for specific analysis of biometric, attention and position data. Analyzed data can be downloaded for visualization in SennsMetrics.

WORKFLOW DIAGRAM

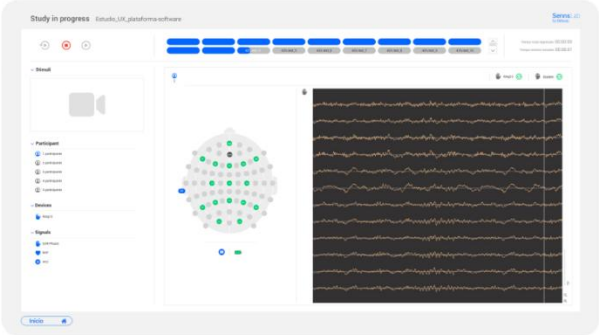
STEP 1

Study design

Biosensors | EEG | InTrack | Eye tracker

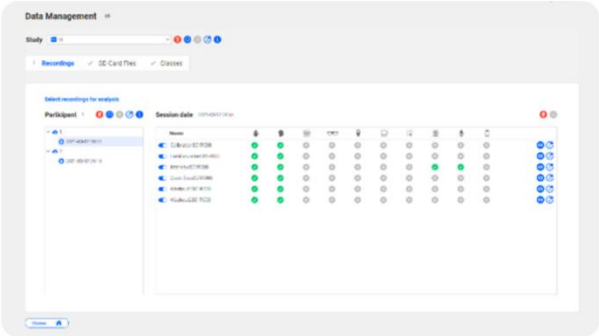
STEP 2

Data Collection



STEP 3

Data Export



SennsCloud / SennsMetrics

Export and upload that data to SennsCloud where biometric and position sensor data can be extracted.

Third-party Analysis Tool

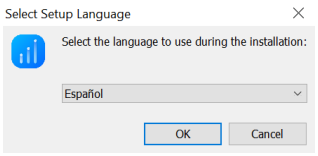
Export that data in SennsLab and analyze it with a third-party tool.

1. INSTALLATION

1.1 INSTALLATION OF THE SOFTWARE

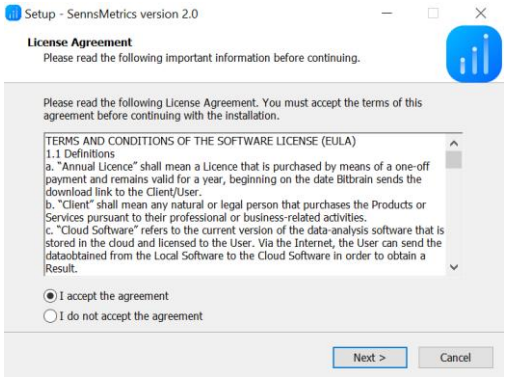
Perform the following steps to install the SennsLab application:

1. Execute the provided installation file sennslab_installer.exe and select the language for the installation.



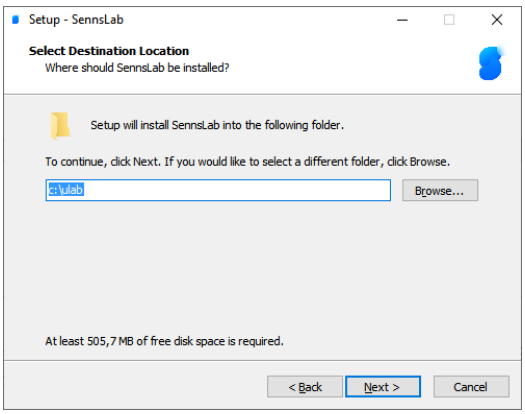
Screen 1: Language selection

2. The following window shows the end-user license agreement for use of the program. To continue, select "I accept the agreement" and click next.



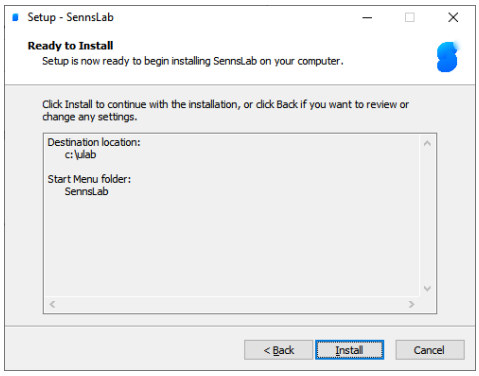
Screen 2: License agreement

3. The default installation path is "c:\ulab". This can be modified through the "Browse" button. Once the path is set, click "Next".



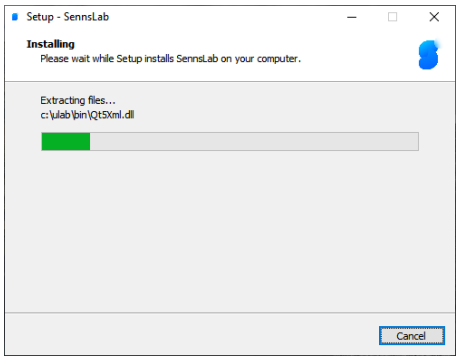
Screen 3: Select installation location

4. Review the options you selected and click "Install".



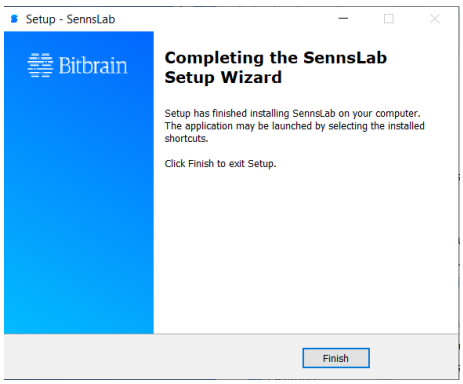
Screen 4: Installation settings and confirmation

5. Please wait while the program is installed.



Screen 5: Installation in progress

6. Once the **SennsLab** installation is complete, click "Finish" and the process will end.



Screen 6: Installation complete

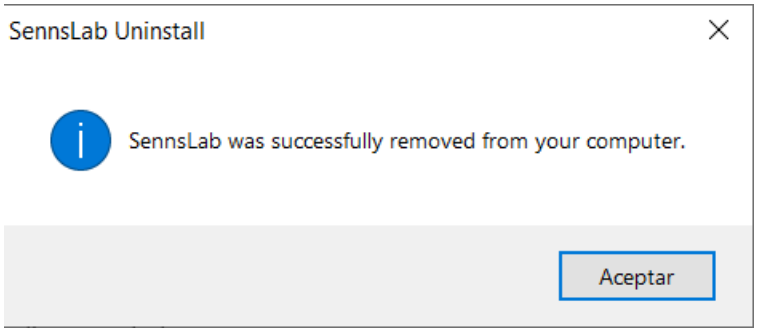
1.2 UNINSTALLING THE SOFTWARE

To uninstall SennsLab from the computer:

1. Access the installation folder (by default, “c:\ulab”) and double click on the executable file “unins000.exe”.

2. To remove the program, click "Yes" in the pop-up message. The uninstallation will be carried out automatically.

3. To finish the process, click on the "Accept" button. SennsLab has been removed.



Screen 7: Uninstallation complete

IMPORTANT: When uninstalling SennsLab, the data related to previously designed studies and participants created on that computer is *not* deleted.

1.3 INSTRUCTIONS FOR CUSTOMER SUPPORT

If you have questions, contact us through support@bitbrain.com. Send an email to this address in the following format:

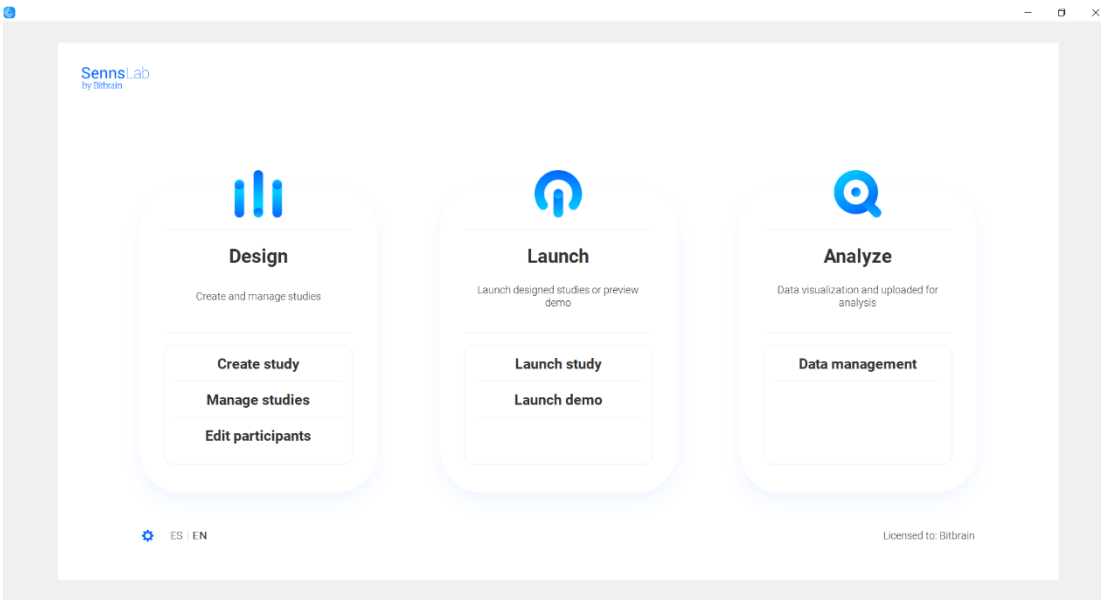
> **Subject:** [BITBRAIN support] Subject + Company name.
>
> **Example:** [BITBRAIN support] Design study ad TV - BBI research.
>
> **Body:** Describe the question or need in question.

2. SCREENS

2.1 MAIN SCREEN

The primary software options will be displayed on the main screen. These features are organized into three sections: 'Design', 'Launch' and 'Analyze'.

Follow these steps from left to right to navigate the complete workflow.



Screen 8: Main Screen

Design: creates studies using different templates, manages already-created studies and the participant database.

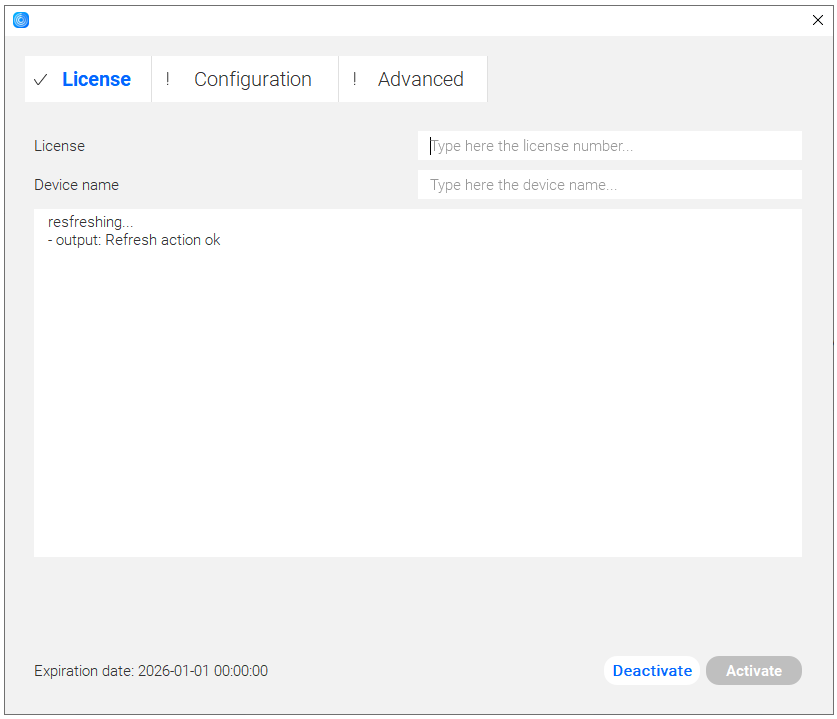
Launch: executes studies and dry-run demos.

Analyze: manages data, including data export and uploading for analysis by SennsCloud.

The Configuration dialog is available in the ⚙ button located in the left-bottom corner. In this section you can find license activation/deactivation, general and advanced configuration options.

2.1.1 License activation and deactivation:

To activate your license and start using SennsLab, click on the button :



Screen 9: License set up

License:

- License: enter the code provided in the activation email.
- Device name: type a device name to identify this computer.

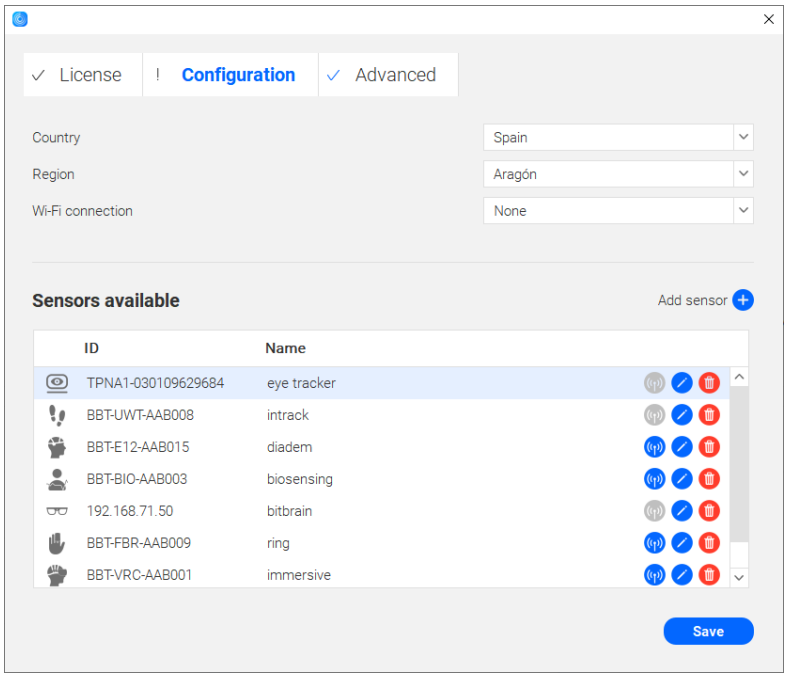
Press “Activate” to initiate the use of the license. The license does not allow activation on more than one computer at a time.

If you wish to switch SennsLab to another computer, you must deactivate the license first on the first computer by clicking “Deactivate” in the ´License´ menu. (Screen 9)

2.1.2 Configuration

In this screen, the Wi-Fi connection and general configuration parameters can be set. For example, the country and region where the SennsLab software is geographically located can be assigned as a default when designing a study. This information is necessary if you want to obtain geographic *benchmarking* in the future. The available sensor list is displayed on this screen. Individual sensors can be added or removed from here. This can also be done elsewhere in SennsLab.

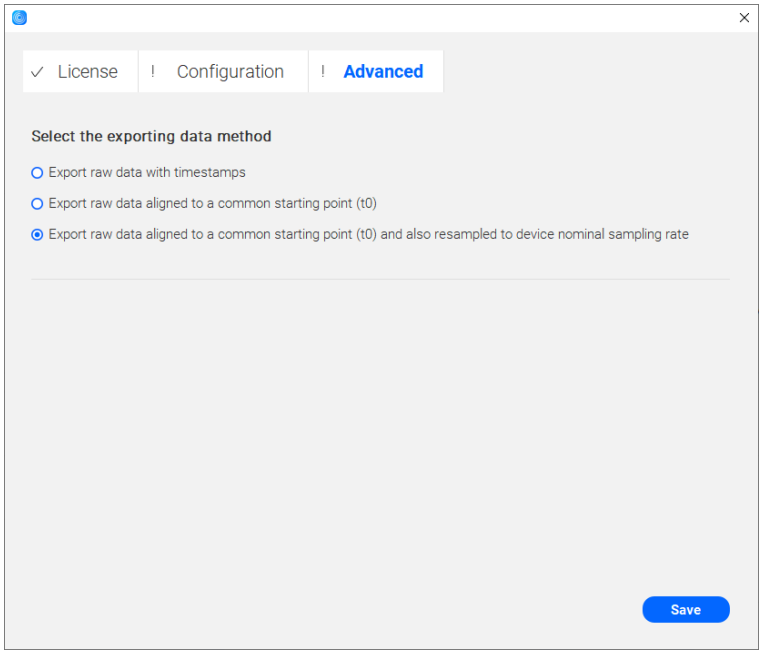
For details, please see annex 2 "Devices Configuration".



Screen 10: Configuration menu

2.1.3 Advanced

In this section the default format can be defined for raw data export. For more details, see annex 6 "Researchers Guide".



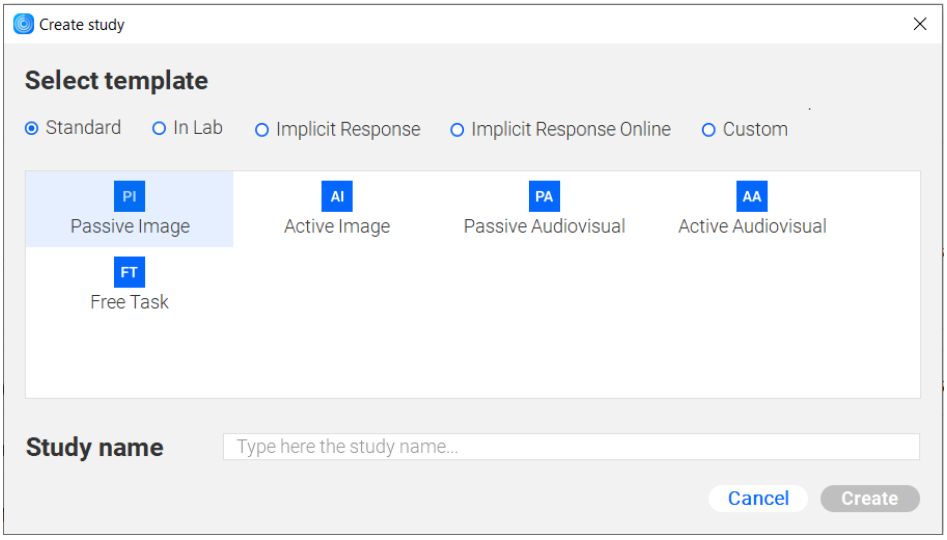
Screen 11: Advanced menu - Export data options

2.2 DESIGN

In this section, new studies can be created, existing studies managed, and the participant database administered.

2.2.1 Create a new study

Select the option "Create study". A window will open with a list of available study templates. These are defined experimental protocols that will help you to design your study. In the top section, you will find the different possible categories. The bottom section shows the available templates for the selected category.



Screen 12: Select template

1. Select template: determine the appropriate template for the study. Each template defines the kind of stimuli that will be used and the calibration required by the experiment protocol. For more information on the configuration of each template, please visit section 2.2.4.

1.1 Standard Templates: There are experimental protocols designed to measure based on the stimuli that will be used in the study, and the behavior requested from the participant. These templates are designed for experiments using emotional/cognitive analysis in SennsMetrics and will incorporate appropriate calibration steps.

1. Passive Image: allows the evaluation of static images, when no action is requested from the participant.
2. Active Image: allows the evaluation of static images when the participant is requested to perform certain tasks, such as searching for an item in a photo of a brand shelf or answering questions about the content. Active image tasks can have a fixed or variable duration.
3. Passive Audiovisual: allows the evaluation of videos, when no action is requested from the participant.

4. Active Audiovisual: allows the evaluation of videos when the participant is requested to perform certain tasks.
5. Free task: allows the evaluation of any kind of tasks performed by the participant (for example a PC-based task such as using an application or website, or an interactive task such as food tasting or walking around). Free tasks can have a fixed or variable duration.

1.2 In Lab Templates: these are templates for designing specific studies that will be run in laboratory settings. These templates are also designed for emotional/cognitive analysis in SennsMetrics and include appropriate calibration steps.

1. Audiovisual recording: allows the recording of an interview with the participant while the emotional response is being monitored.
2. Focus group: allows the recording of a focus group while the emotional responses of multiple participants are being monitored.
3. Ux App on PC: allows the evaluation of user experience while the participant is using a PC-based application.
4. Ux Web on PC: allows the evaluation of user experience while the participant is browsing a website.
5. Ux Web on Mobile: allows the evaluation of user experience while the participant is using an application or a website on a mobile device. For more details, see Annex 8 "Mobile Setup".

The following templates will only show if the user has purchased an Implicit Response Test Module License.

1.4 Implicit Response Templates: These are templates for designing in-lab studies related to the subconscious association between two concepts.

1. Implicit association test (IAT): measures the implicit association of a series of attributes with two concepts. (Brands, cultural, sociological aspects)
2. Semantic priming (SP): measures the implicit association between a series of attributes (text) and two brands / products.
3. Visual priming (VP): measures the implicit association between a series of attributes (image) and two brands / products.

1.5 Online implicit response templates: These templates are used to design studies related to the subconscious association between two concepts, but they are executed online via a website. The templates feature the same experiments as in the previous section (IAT, SP, VP).

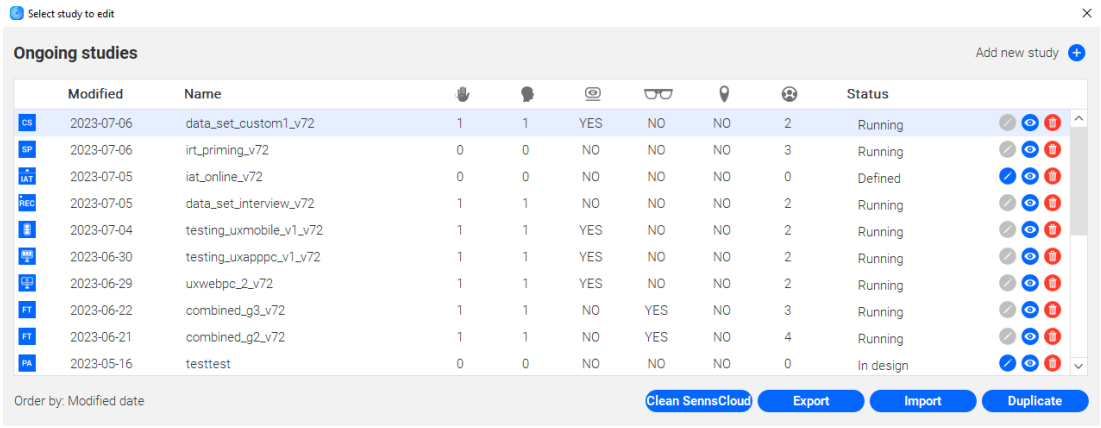
1.6 Custom templates:

1. **Custom study:** this template allows the creation of a study that is completely controlled and customized by the researcher. Any stimulus and task can be added (Audiovisual, images and free tasks). This is the default template for researchers planning to use 3rd party analysis tools. However:

    - The software does not apply any procedural additions to the design. No automatic emotional/cognitive calibration is included.
    - This template is not compatible either with **SennsCloud** nor with **SennsMetrics** analysis software.
    - Custom studies only produce raw data output. The raw data format full explanation is included in Annex 6 "Researchers Guide".

2. Study Name: Add a study name (no spaces nor special characters allowed. Use a maximum of 40 characters). Follow the instructions in section 2.2.4 to continue the study setup.

2.2.2 Manage studies



Screen 13: Popup window with previously created

On this screen (screen 13), a general view with a brief description of each previously created study is shown. The studies can be ordered by clicking on the title of each column:

- Blue icon referring to the type of template used
- **Modified:** indicates the last date the study was modified.
- **Name** of the study
-  Number of biosensor devices recorded.
-  Number of EEG devices recorded.
-  Screen based eye tracking device.
-  Mobile eye tracking device.
-  Indoor human tracking device.
-  Number of study sessions executed.
- **Status**: Current status of the study according to the following:
    - In design: The study is not yet completely set up.
    - Defined: All parameters have been completed and the study is ready to run the first time.
    - Running: At least one study session has already been run.
    - Submitted: Registered data has been uploaded for analysis (only included for retro compatibility, current version does not require this designation.)

At the end of the row, three buttons are presented with the following functionalities:

 Open and edit study.

 View the settings of the study.

 Delete the study.

At the bottom section of this screen, the following buttons are enabled: "Export", "Import" and “Duplicate”. The “Duplicate” feature makes a copy of a study with a different name, with all settings copied (but not recorded data). After duplicating, the new study will be available in the Manage Studies list and it can then be modified or executed. This option is especially useful to reuse a study setup for a new experiment.

Next, we will address the export and import features.

1. Exporting and Importing studies:

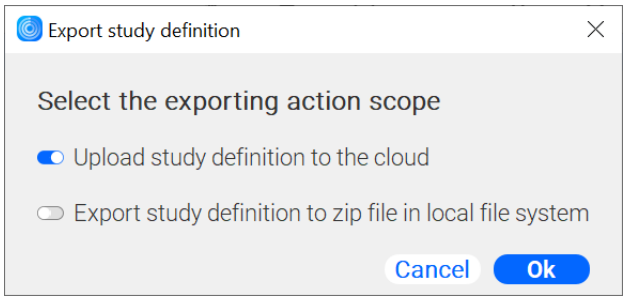
These features are normally used when there is more than one recording station and the experiment must be copied between them. If you only have one license for SennsLab, consider skipping ahead to section 2.2.3. There are two different ways to share study definitions in more than one PC. The first is using the Bitbrain **Cloud Service,** and the second is using a zip file.

1.1 Exporting and importing studies using the Bitbrain Cloud Service

The study is created on a computer (named "primary station"), and then exported using the **Cloud Service** option. Next, this study can be imported on a second computer (named "secondary station"). After importing, the study will be available in the Manage studies list.

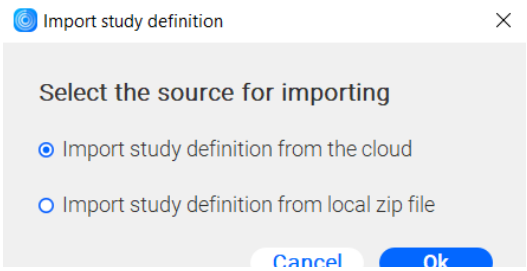
The **Cloud Service** will keep the study settings synchronized in both PCs. In this case, data collected from both computers (primary and secondary) will be analyzed together (as in a single station study) in **SennsMetrics**.

"Exporting": In this option, all the information relevant to study settings is uploaded. After this, the study definition will be able to be downloaded it in a different recording station (a second SennsLab license is required).

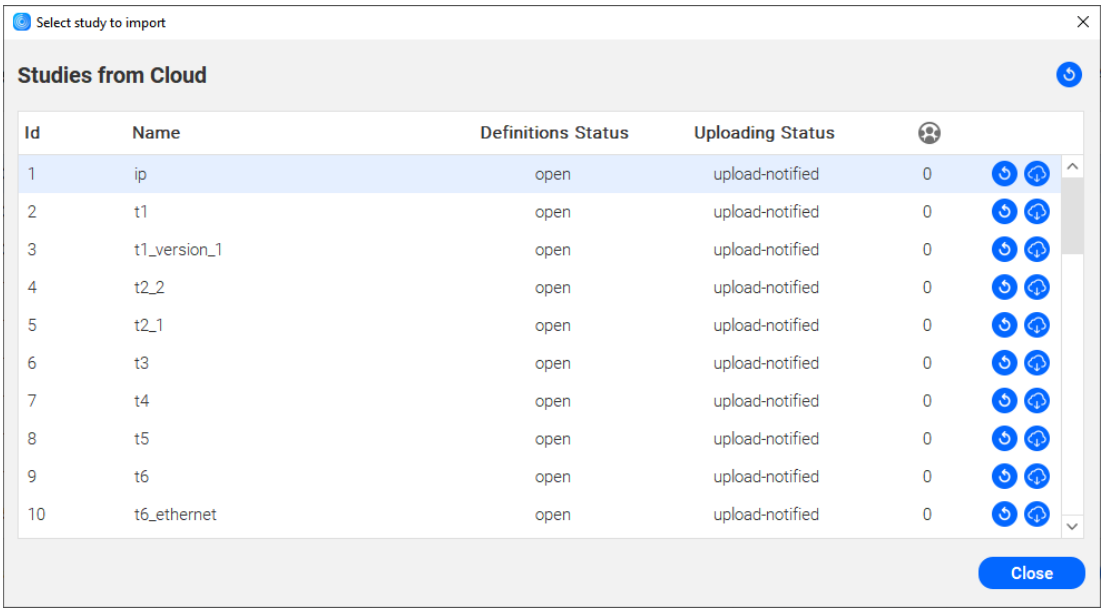


Screen 14: Export study definition

"Importing": In this option, any study definition can be imported if it was previously exported from another computer (master station). A list with all the exported studies is shown. You can import any study directly from the cloud or update any study that was previously imported .



Screen 15: Import study definition



Screen 16: Import studies from Cloud

"Keep them synchronized": Keep in mind that on the "secondary station" any imported study can be inspected but not modified. Only the primary station can modify a shared study. After any modification, update the second station to apply the changes.

An imported study can be executed as far as its design has been locked on the master station. The study design is automatically locked when a participant is recorded. In addition, the study design can optionally be locked when the study is exported. Please note that after the study design is locked it cannot be modified.

1.2 Exporting and importing studies using a "zip" file

There is a second way to share the study setup between more than one PC, using a "zip" file. To do this follow these steps:

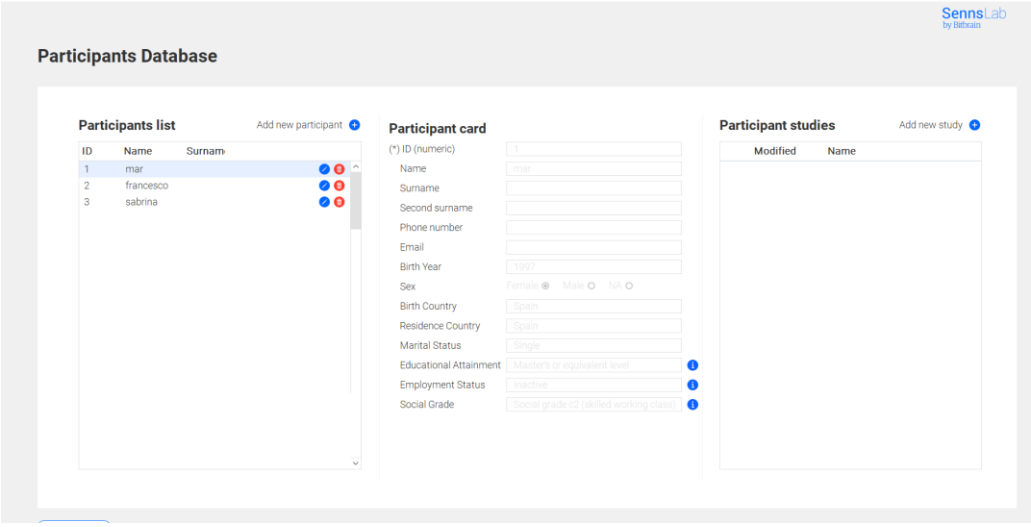
- Export study definition to a "zip" file located in the file system, then copy the file from the path C:\SennsLabZipFiles\Studies on to the second station.
- Import the study using the option "Import study definition from local zip file". After that, the new study will be available in the ´Manage studies´ list and can be modified or executed.

By using this procedure, data collected on each computer will be considered as two different studies, and they will not be analyzed together in SennsMetrics.

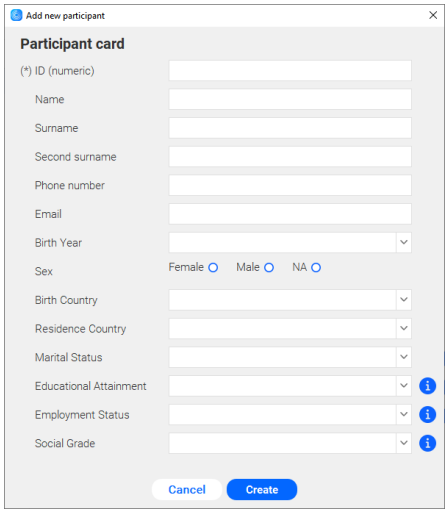
2.2.3 Edit participants

The participant database can be managed here. Participants can be added, edited or deleted.

1. Add a participant to the database: click the "Add new participant" button and fill in the demographic data*.



Screen 17: Participant database management screen



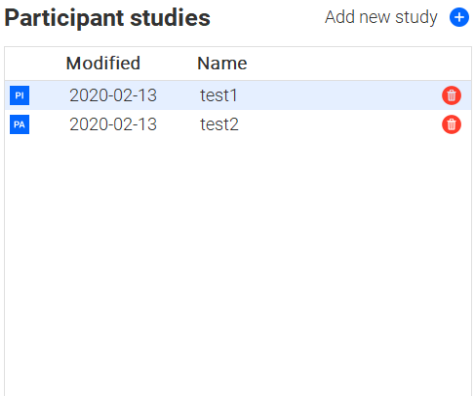
Screen 18: New participant popup

Note*: The fields marked with a (*) are mandatory in order to save a participant in the database.

2. View the information of a participant already included in the database: Check the demographic data and the studies with which the participant has been associated.

3. Modify the information for a participant already included in the database: to modify the demographic data click on the button of the corresponding participant.

4. Delete a participant from the database: click on the button of the corresponding participant. If a recording has already been run with this participant included, it will not be possible to delete them from the database.



Screen 19: Pop-up window to associate a study with a participant

5. Associate a study with a participant: click on the "Add new study" button in the "Participant studies" section and click on the link.

6. Dissociate a study from a participant: click on the bin study icon to dissociate. If a recording has already been run with a participant, it will not be possible to delete them from the study.

2.2.4 Study edit screen

This section will allow the study configuration. The experimental information is organized into different tabs. Each tab includes an icon to indicate its state. The state may be:

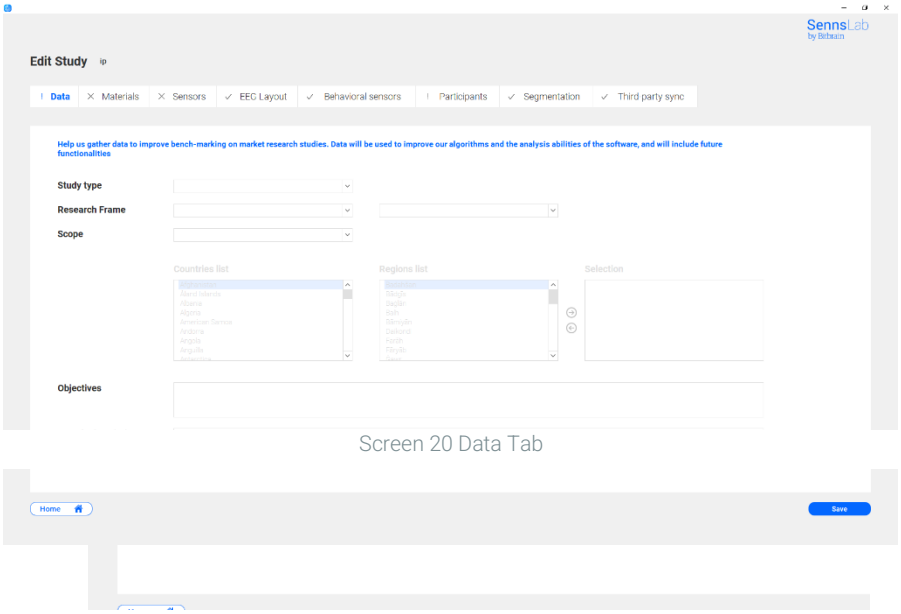
✓ state correct, it means that the tab has been filled appropriately. ✗ state wrong, it means that some fields have not been defined yet in this tab. In this case, you could go to the tab header and a tooltip will be shown. pointing out the sections to be completed. ! state optional, it means that the tab has not been completely filled in, but it is not mandatory information.

A study will be available to be launched if all its tabs have the correct or optional state. If any tab has the wrong state (X), the study status will be held "In Design" until completed. SennsLab has several pre-designed templates based on different experimental protocols. Only tabs that are significant to the selected template will be displayed. In this section, we will show

how to use the tabs that are common for all templates. In the following section, we will address template-specific tabs.

1. Tab: Data. On this tab, general information about the study can be filled in. This information includes some general aspects of the study as well as the characteristics of the study execution. This information will be displayed on SennsMetrics together with the results. We recommend filling in all the information in order to help us gather data to improve benchmarking on market research studies. Data will be used to improve our algorithms and the analytical abilities of the software, and will include future functionalities.

2. Tab: Sensors. On this tab, you can select the sensing devices that will be used for the



Screen 20 Data Tab

recording. Devices are classified into four different categories: biosensing,

Screen 21: Sensors tab

electroencephalogram (EEG) or eye-tracking. The specific instrumentation can be selected from each list.

2.1 Biosensing: Configure any biosensor device you will record in this experiment. The available biosensors are:

- Ring
- Biosensors

2.2 EEG: Configure any EEG system you will record in this experiment. The available EEG systems are:

- Diadem WIFI
- Diadem
- Air
- Immersive
- Hero
- Versatile EEG 08
- Versatile EEG 16
- Versatile EEG 32
- Versatile EEG 64
- Versatile Kids

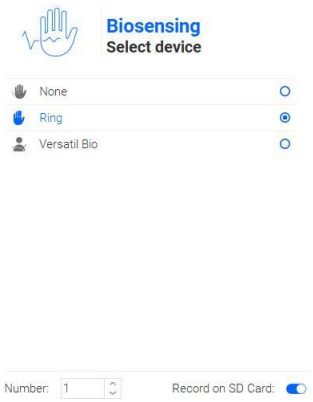
2.3 Eye Tracker: Configure any eye tracker system you will record in this experiment. Select between the following devices:

- Tobii Pro Screen-Based Eye Tracker
  - Tobii Pro Nano
  - Tobii Pro Spark
  - Tobii Pro Fusion
  - Tobii Pro Spectrum*

    *Please check with our support team

- Tobii Pro Glasses
  - Tobii Pro Glasses 2
  - Tobii Pro Glasses 3

Below the sensor selection menu the number of devices used in the experiment can be specified. In addition, you can optionally set up recording to SD card.

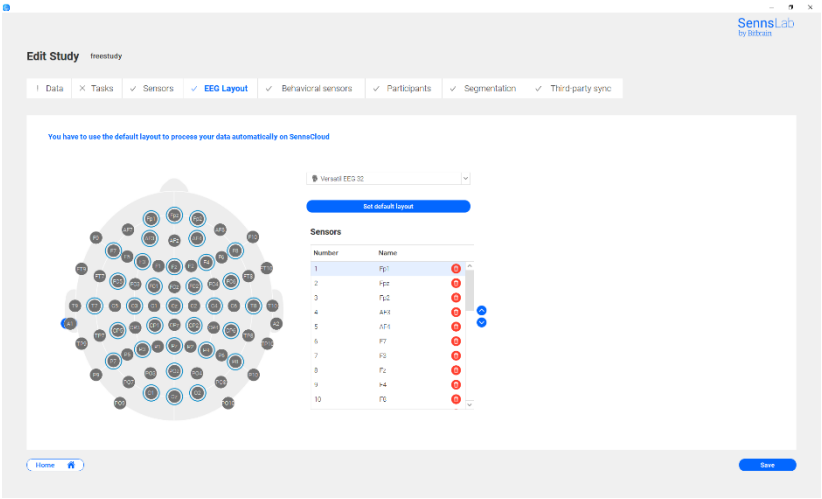


Note: Only use 8G SD cards Class 10 or more. Recommended Kingston 8GB (UHS-I 1, Class 10)

Screen 22: Record on SD Card on the selected device

3. Tab: EEG Layout.

On this tab you can view the EEG sensors layout, in case of any EEG device is selected in Sensors tab.



Screen 23: EEG sensors layout tab

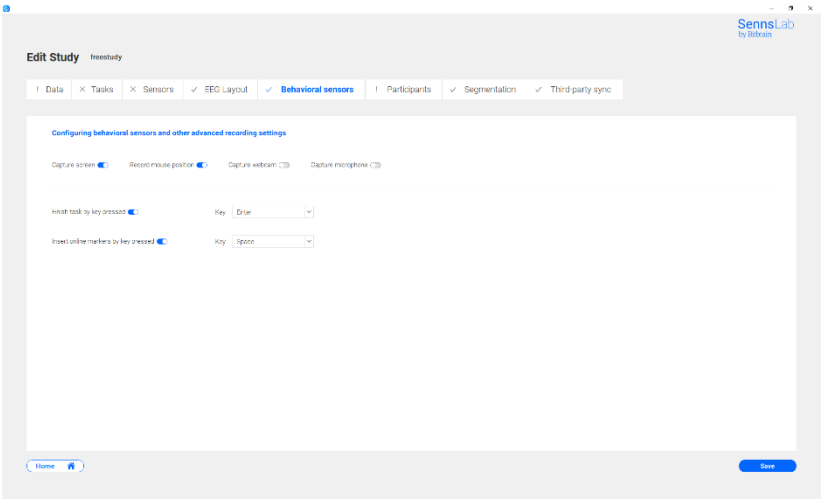
In addition, for any versatile EEG device the sensors layout could be customized. But, the SennsCloud service is available only for the default EEG layout.

4. Tab: Behavioral Sensors.

On this tab, behavioral sensors such as webcams and microphones can be defined, along with relevant settings. The options that will appear on this tab will depend on the template selected.

The behavioral sensors available are:

- Record mouse position
- Capture screen
- Capture webcam
- Capture microphone



Screen 24: Behavioral sensors tab

In addition, some advanced settings are available:

- Task finished by key pressed: Define the key that will be used to finish tasks.

- Insert online markers by key pressed: Define the key that will be used by the researcher to mark events during the study execution. These markers could be visualized in SennsMetrics.

- Open set up mobile (UxMobile): Define the mobile position, which is required for Ux studies on mobile devices.

- Chrome path (UxWebOnPc): Define the path where the Chrome browser is installed, which is required for Ux Web studies on Pc.

Setup behavioral sensors before participant recording

If a behavioral sensor is selected, a popup screen will appear when starting a recording. This screen will display options to configure the recording.

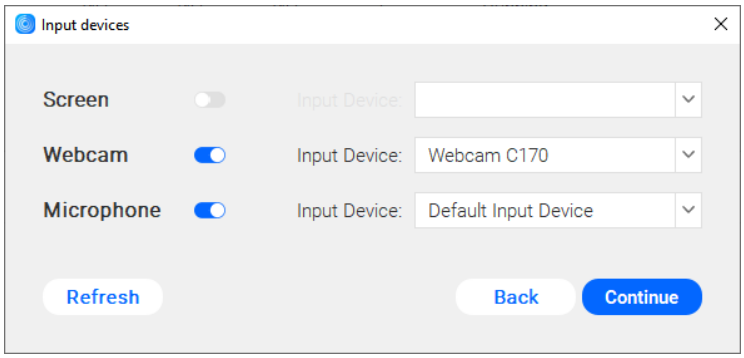
A checkbox is displayed that allows you to enable or disable each item. The drop-down list shows all the devices that are available:

Screen: In case there is a secondary screen connected to the recording laptop, you must choose which screen to record (primary or secondary, as defined in Windows).

Webcam: Select the device for webcam recording. The webcam must be installed properly in Windows. Not all the cameras are compatible with SennsLab. Some compatible models are:

- Logitech Webcam BCC950
- Logitech Webcam C505
- Logitech Webcam C930e

When the system is running on a laptop, and an external webcam will be used to record the participant experience, then disable the internal laptop webcam before starting the experiment to ensure the “InputDevice” webcam is the only one available for recording.



Screen 25: Input devices popup

Microphone: audio is recorded with the microphone that is defined as the default in Windows.

If you connect a device while viewing this screen, click "Refresh" to display the newly connected microphone in the drop-down list.

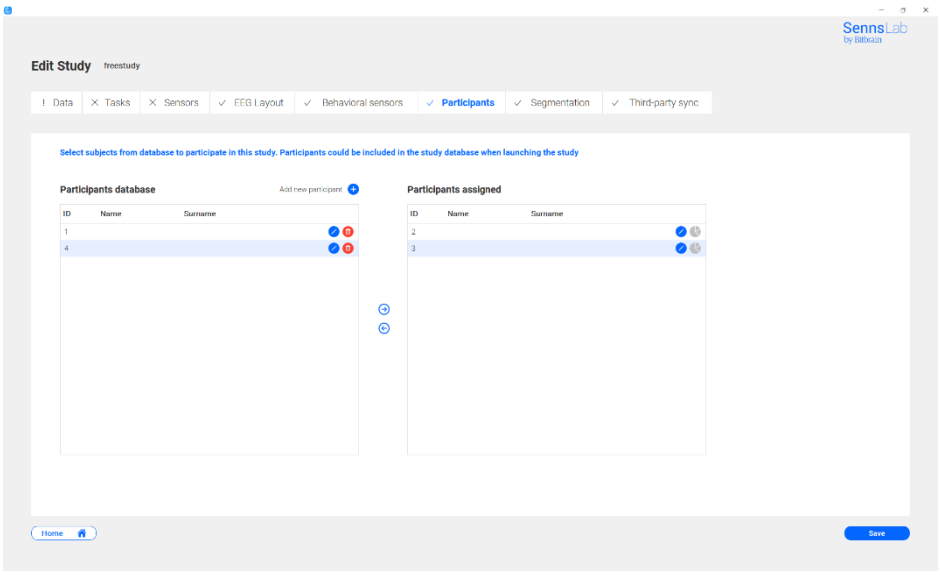
IMPORTANT: if the study includes a webcam, screen recording, or microphone devices, we recommend running a single participant recording as a test to verify that all components are

working properly, before running the study participants

5. Tab: Participants.

On the participants tab, existing participants from the database can be added to the study (see section 2.2.3 “Edit participants”) and new participants can be defined (see section 2.2.3 Section 1).

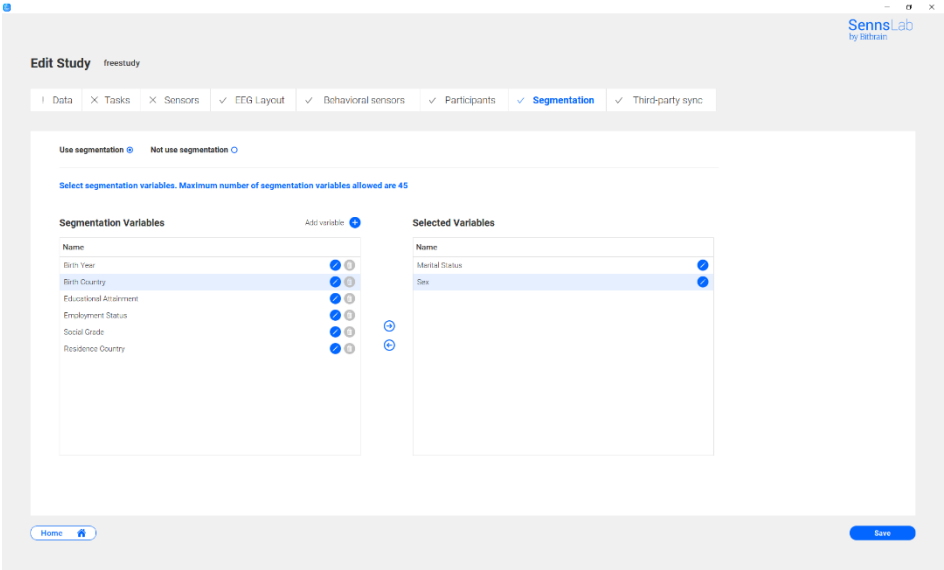
If the participant has already been created previously, click on to add them to the study. Otherwise, click on the "Add new participant" button to create a new participant. To remove a participant from the assigned list just selecting him and then clicking on .



Screen 26: Participants tab

6. Tab: Segmentation. SennsLab allows filtering of results according to pre-defined demographic categories (gender, marital status, etc) or by new segmentation variables defined here.

Segmentation variables can be defined during the design phase or after recording in SennsMetrics. In order to use the segmentation option, mark the "Use segmentation" check box.



Screen 27: Segmentation tab

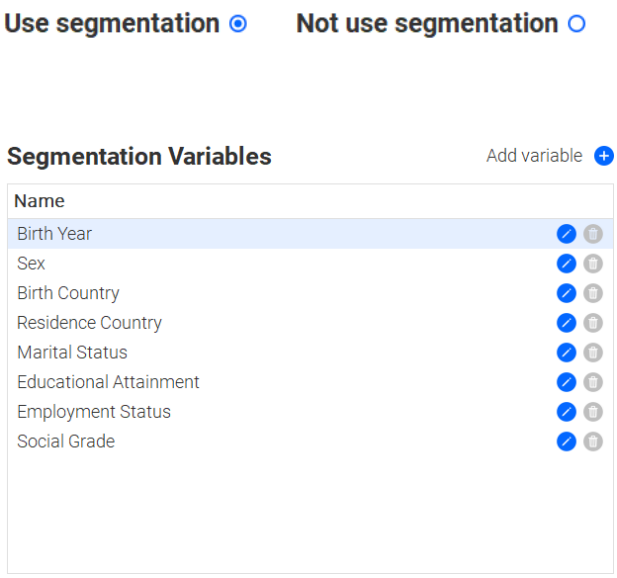
Selected variables

To select the segmentation criteria, click on the variable of interest and click on. To eliminate a variable of your study, click on .

Note: The maximum number of segmentation variables that can be included in a study design is 45.

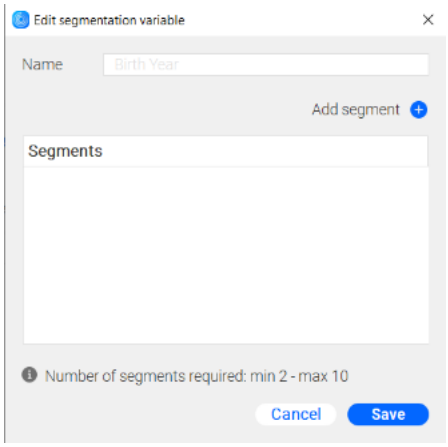
1. Standard segmentation variables

We called “standard segmentation variables” to segmentation based on demographic values.



Screen 28: Activate segmentation - Standard segmentation variables

When selecting the segmentation variable, define all possible values for it by clicking on the edit button.



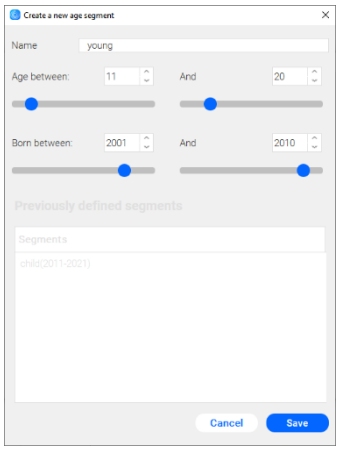
Screen 29: Edit segmentation variable

Note: There is a minimum of 2 and a maximum of 10 values for each segmentation variable.

Birth date variable

Segmentation based on age could be defined by just clicking on next to Birth Year variable. To edit the segments, click "Add segment".

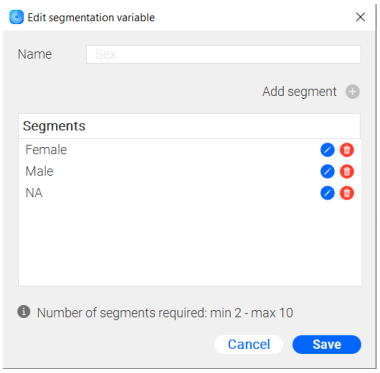
A new window will appear. Insert the name of the segment and define the age intervals. Save the new segment and the rest of the changes made by clicking on “Save”



Screen 30: Edit birth date segmentation variable

Sex variable

Segmentation based on gender can be defined by clicking on next to Sex variable. By default, some segments have been included. You can accept them (click on Save) or modify. In any case, click on “Save” to complete the configuration.



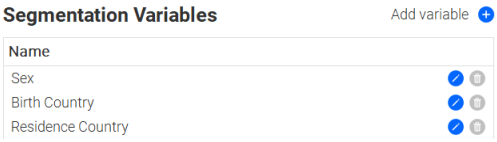
Screen 31: Edit sex segmentation variable

The rest of the standard segmentation variables

Variables as Residence Country, Birth Country, Marital Status, Educational Attainment, Employment Status, and Social Grade all operate the same way. Clicking on , each will open the edit screen. By clicking on "Add Segment", you can define the segment and the items that define it.

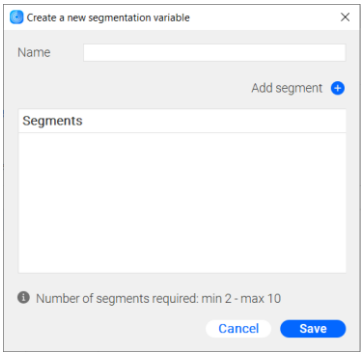
2. Create new segmentation variables

Click on the "Add Variable" button, located next to "Segmentation Variables".



Screen 32: Add new segmentation variables

Define the variable name and assign the segments using the "Add Segments" button, then click "Save". Then the new variable must be selected.



Screen 33: Create a new segmentation variable

3. Assign segmentation values to participants

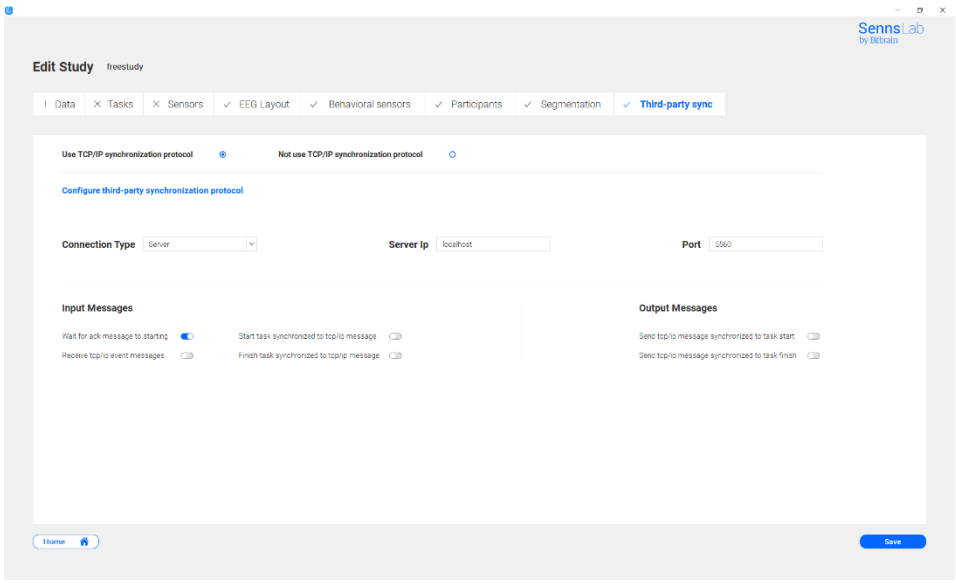
There are two different ways to assign segmentation values to the participants:

Assign a value to a participant during the study design

To edit these values, go to the Participants Tab then click on in the list “Participants assigned”.

Assign a value to a participant immediately before starting the study

Before the study is executed, you can edit and fill in the segmentation values for the participant that is going to be recorded. Once the participant is created or selected from the list, click on to define the values in the popup menu.



Screen 34: Third-party sync tab

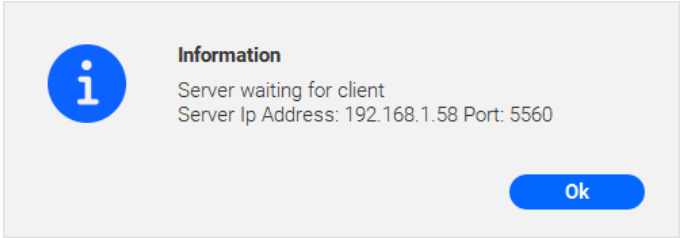
7. Tab: Synchronization.

During the execution of a study, SennsLab can be synchronized with third-party software. For this, a communication protocol has been implemented that includes a set of input/output messages that are sent through a TCP/IP network connection between SennsLab and the third-party application.

Connection type:

SennsLab can be set as a server or client.

- If the TCP/IP connection is established as a ***server***, only the communication port should be specified. The connection will be established allowing the connection of only one client device.



Screen 35: Information Ip Server

- If the TCP/IP connection is established as a ***client***, the communication port and the IP address of the server to which it must connect must be specified. When the study is launched, the connection will be established. The server must be running beforehand.

During the design phase, the input and / or output messages that will be received and / or sent during the execution of the study are defined. Incoming messages are those messages that the SennsLab software would receive through the TCP/IP connection with third-party software. The "outgoing messages" refer to the messages that SennsLab sends by TCP/IP to the third-party software.

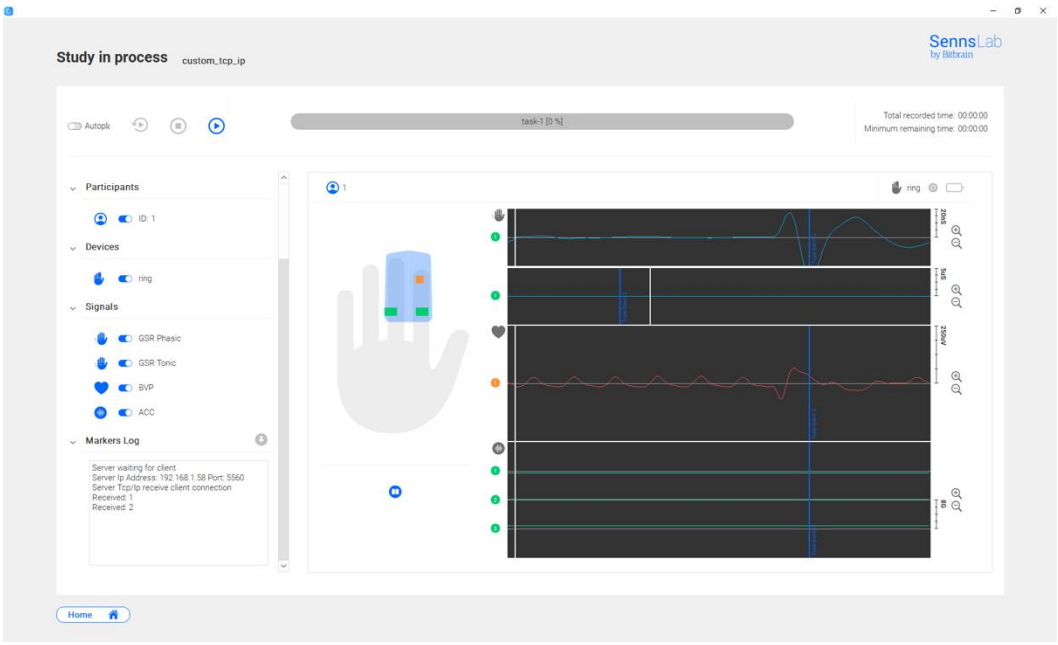
Input Messages:

- Wait for "Ack" message before starting: When running a study, the software will not start the first task until this message has been received. When that happens, an event is generated and saved, which is then timestamped and exported with the data from the EEG and biosignals.

- Start task synchronized with TCP/IP message: This message allows you to start recording a task remotely, but the message is not saved to the file. Starting the task in SennsLab through a third-party software signal does not disable the ability to start the recording through SennsLab manually.

- End task synchronized with TCP/IP message: This message allows you to end the recording of a task remotely, but this message is not saved to the file. Configuring task completion in SennsLab through third-party software does not disable the ability to end the recording through SennsLab manually.

- Receive events by TCP/IP messages: This message allows you to synchronize SennsLab data with relevant events that occurred outside of it. You can associate a different code for each event that you want to analyze. During the execution of a task in SennsLab, when a message of this type is received, an event is generated that is synchronized, saved to the data file, and exported later. In addition, SennsLab allows real-time visualization of these trigger signals through the data window.



Screen 36: Real time visualization

Output Message:

- Send a TCP/IP message synchronized with the start of the task: A message is sent each time a task in a study begins.

- Send a TCP/IP message synchronized with the end of the task: A message is sent every time a task in a study is completed.

For more details about the format of these messages see Annex 5 “Synchronization message format”

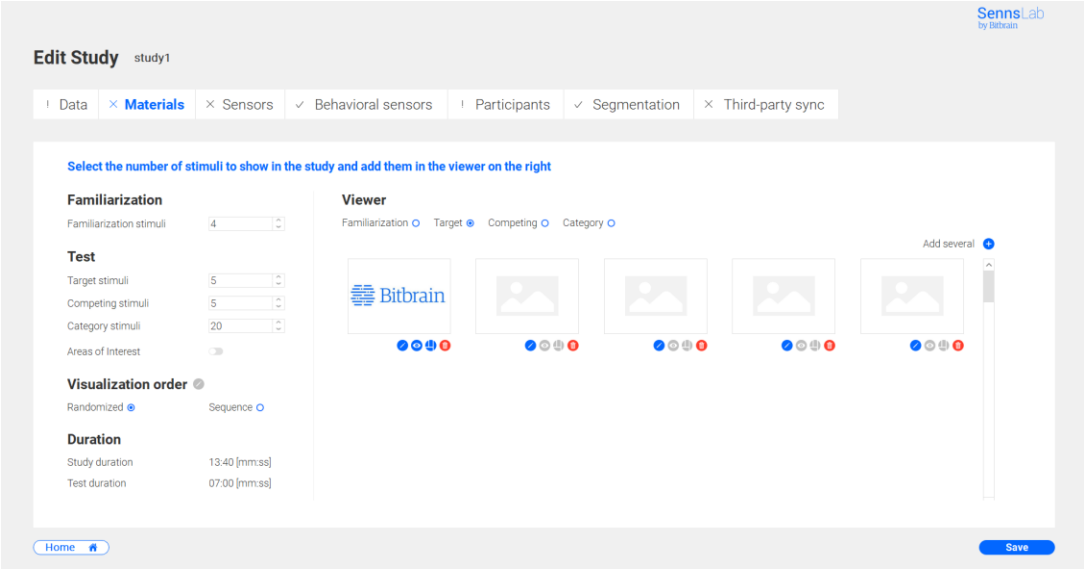
8. Specific settings according to the template selected

Tabs as: “Materials”, “Tasks” or “Stimuli” are specific for each template. Each one allows importing different types of stimuli with specific settings.

Standard templates

1. Passive image template

This template is used to present stimuli (images) when no action is requested from the participant. This template is typically used to evaluate banners, logos, brochures, advertisements, etc.



Screen 37: Materials Tab - Passive Image Template

Some important considerations when designing a passive image study:

- When SennsLab presents images, they will be resized to fit the size and resolution of the presentation screen, while still maintaining the aspect ratio. If an image is too small for the monitor size, it could appear pixelated. Consider pre-formating your images into the proper resolution before using them.
- A specific image (name) can be included only once in a study.
- Accepted file formats are: *.jpg, *.jpeg, *.png, *.bmp.

The duration of the study changes according to the number of images added in each stimuli section.

1.1 Choose the number of stimuli to be presented in each section:

- Familiarization: this is a set of images presented to adapt the participant to the test context and the stimuli images that are going to be displayed. *These images are not analyzed.* SennsLab, by default, will automatically include 4 nonspecific images for familiarization purposes. The researcher can choose to include between 0 and 4 additional target-specific images.
- Assessment Categories:
  - Target stimuli: Add between 1-30 target images for evaluation.
  - Competing stimuli: (optional) Add 0-10 images from the competition for evaluation in comparison with target stimuli.
  - Category stimuli: (optional) Add 0-60 "noise" images that are primarily used in order to disguise which images are the intended target of the study. *These images are not analyzed.*

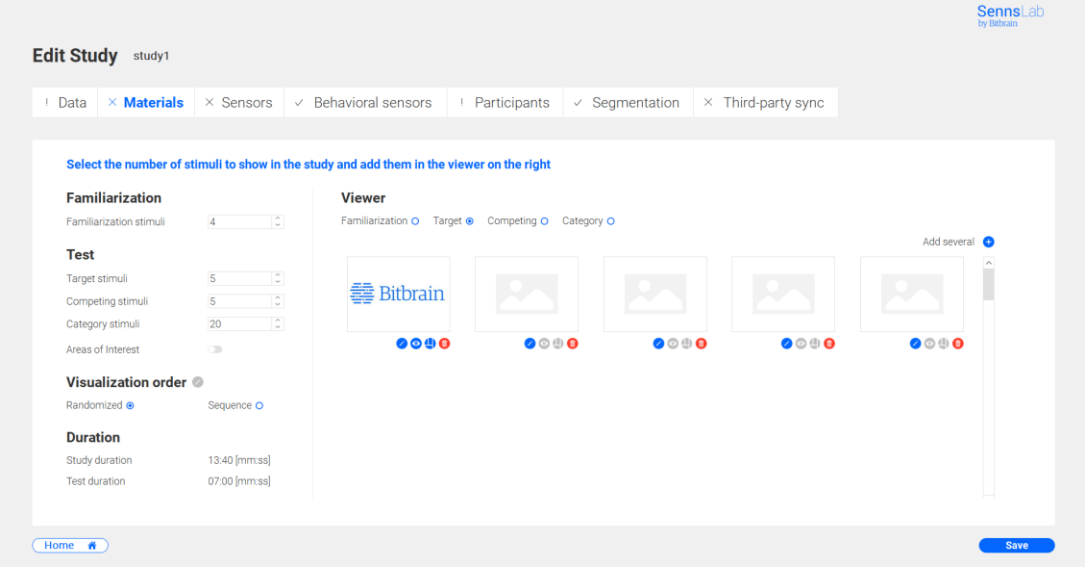
1.2 Choose whether or not the stimuli should be presented in random order. The randomization is unique for each study session and all images imported in the previous step are randomized. Alternately, choose "Sequence" to maintain precise control over the presentation order for all participants.

1.3 Once the number of stimuli for each category has been selected, load the material in the viewer on the right side. Select the category on the menu above and click on the icon. To view the loaded images, press the button. To delete an image press the button.

To add more than one image at the same time in the same category, select the option "Add several".

Areas of interest (AOI)

AOI are specific regions of the static image that can be used to compare the data when analyzing the results. The drawing of AOIs will segment both eye tracking data as well as the emotional data for comparison within an image, or between comparable areas of multiple images. Emotional data is calculated according to attention “hit” on the AOI. AOI can be created when setting up the study, or alternately when analyzing the data in SennsMetrics.

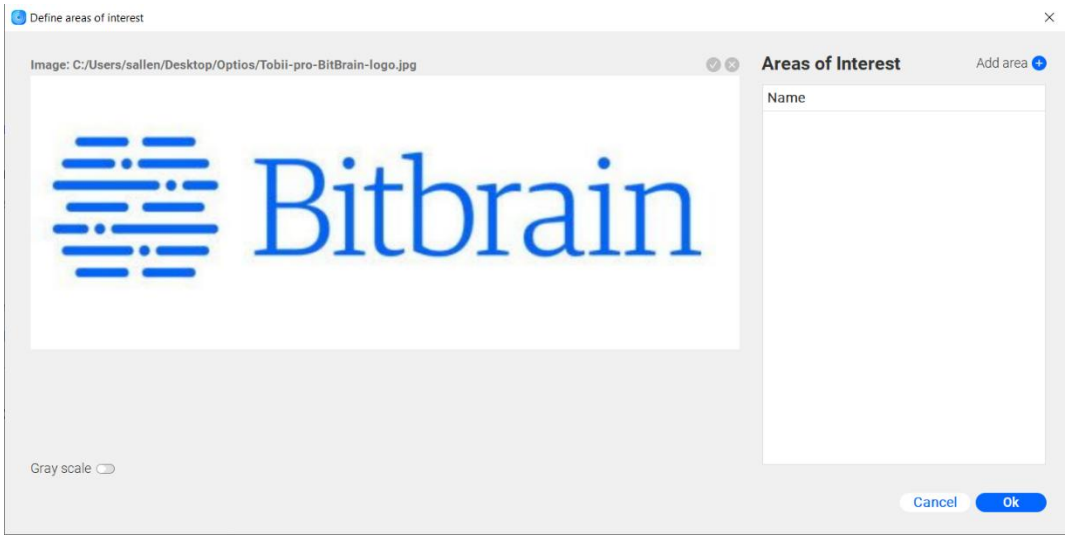


Screen 38: Materials tab

1. Click on the icon in the evaluation images.

Screen 39: Image options

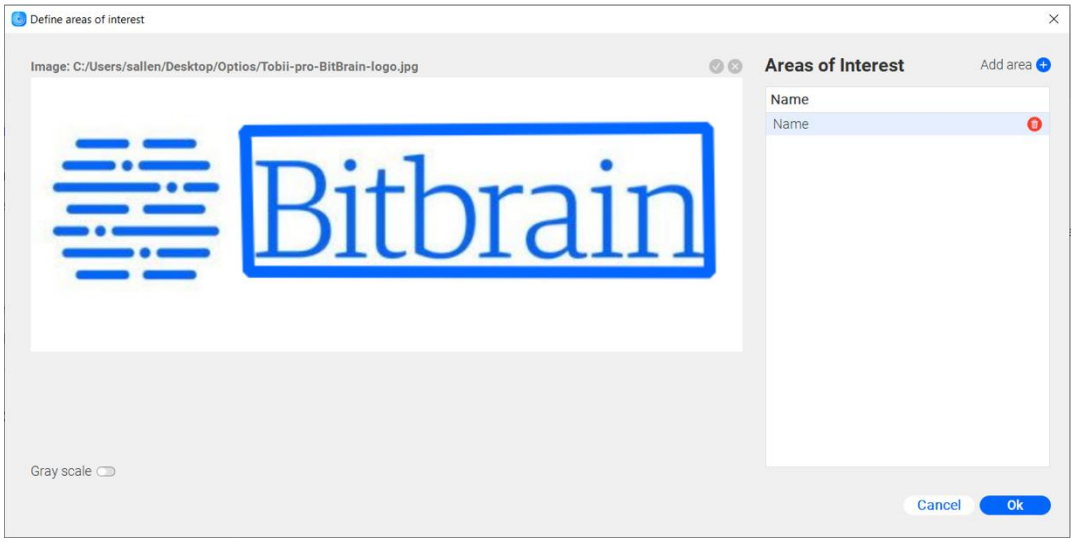
2. When clicking on this button, the following interface is displayed:



Screen 40: Edit Areas of Interest

To define the areas, click on "Add area", name and delimit the region on the image by defining the start and stop point of each 'line' in the AOI and drawing a shape around the area you want to define. To close the figure, press the button.

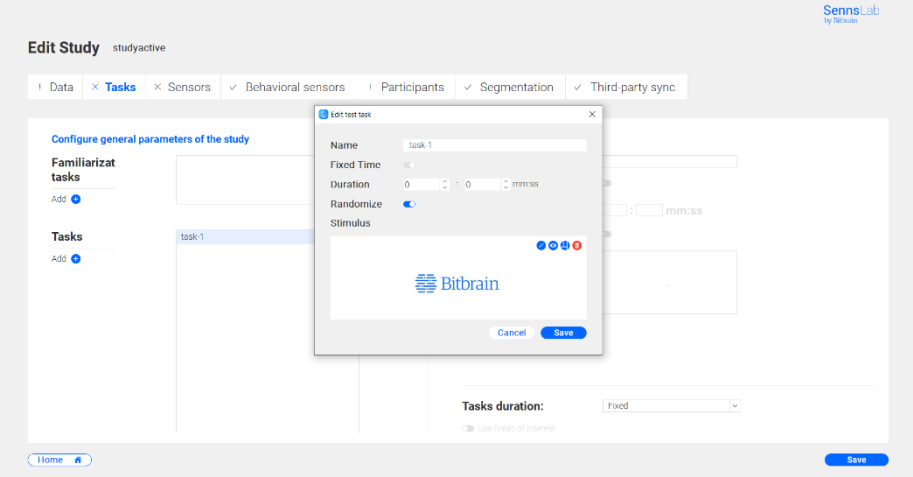
Note: The maximum number of AOI per image is 40.



Screen 41: Defining Areas of Interest

2. Active image template

The active image template is used to present images in a fixed or variable amount of time, while the participant is asked to perform some task. This template is typically used for viewing images of static web pages, apps, products on a shelf, product displays, etc.



Screen 42: Tasks Tab - Active Image Template

The same considerations should be taken as in running the Passive Image Template.

2.1 Configure the general parameters of the study:

Task duration: fixed or variable. Fixed duration can be set to anything between 15 seconds and 1 hour. Variable tasks are ended by the user or moderator, they can be finished by a key (which can be configurated in the behavioral tab) or clicking on a button on the study execution screen.

2.2 Configure task stimuli:

Familiarization tasks: This is a set of 0-3 tasks are used to adapt the participant to the context of the test. The data from familiarization tasks is *not* analyzed.

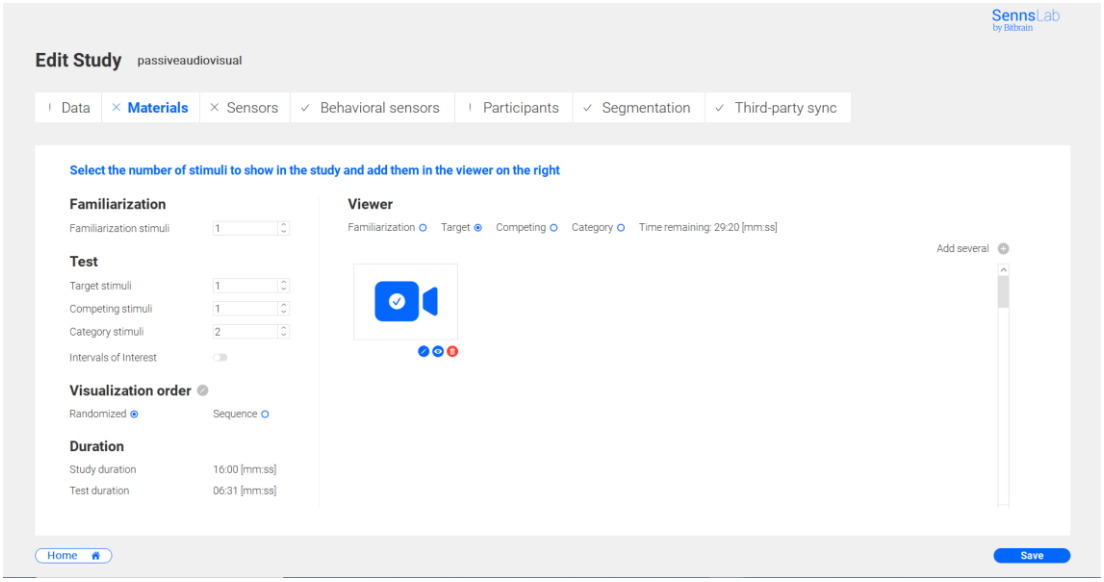
- **Tasks:** This is a set of 1-15 tasks for evaluation. Task settings include:
  - Name, used to identify the task.
  - Indicate the time (fixed or variable) in the "Task Duration" box
  - Activate order randomization if desired.
  - Stimulus, an image must be selected.

The tasks can be visualized, and you can change the order in which they are presented. Areas of Interest can be designed as it happened in the Passive Image template.

3. Passive Audiovisual Template

This template is used to present stimuli (video) while no action is requested from the participant. This template is typically used to evaluate advertisements, campaigns, etc.

This template follows the same structure as the Passive Image Template. The only thing that changes is the type of stimuli presented.



Screen 43: Tasks Tab- Passive Audiovisual

Some important considerations when designing a passive audiovisual study:

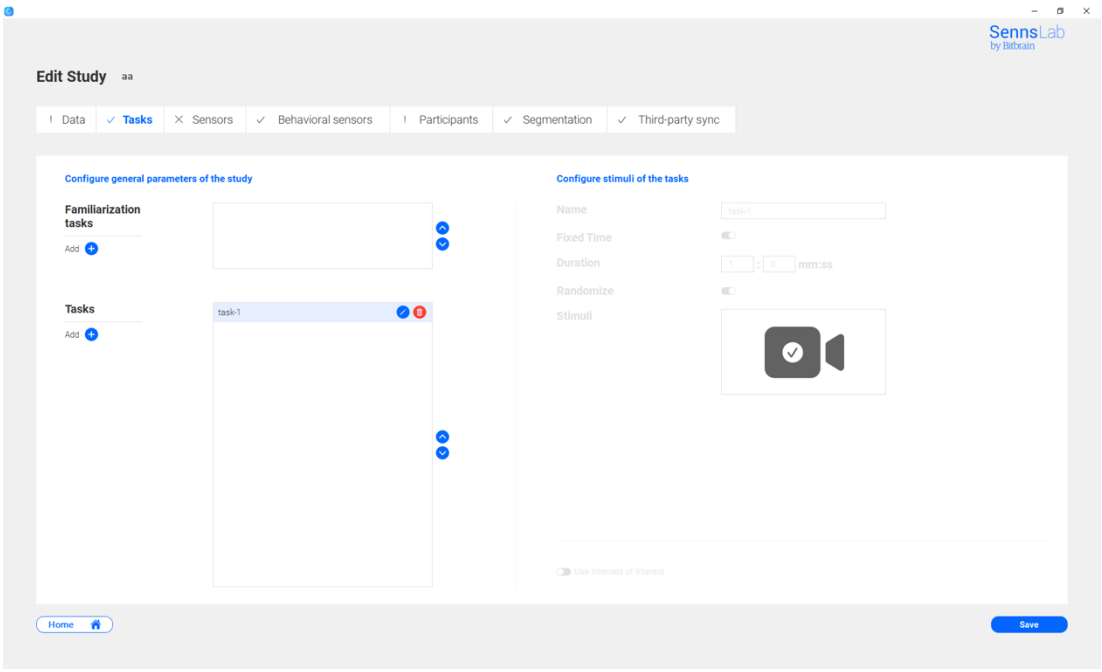
- When SennsLab presents videos, they will be resized to fit the size and resolution of the presentation screen, while maintaining the aspect ratio. If a video is too small for the monitor size, it will appear pixelated. Consider pre-formatting your videos into the proper resolution before using.
- A specific video (name) can be included only once in a study.
- Accepted file formats are: *.wmv, *.mpeg, *.avi, *.mpg, *.mp4.
- The duration of the study changes according to the number of videos added in each stimuli class.

4. Active Audiovisual Template.

The Active Audiovisual template is used to present video files while the participant is requested to do a task. This template is most often used to simulate the experience of a point-of-sale or store shelf environment.

The same considerations should be taken as in the Passive Audiovisual Template.

This template follows the same structure as the Active Image Template. The only thing that changes is the type of stimuli presented.

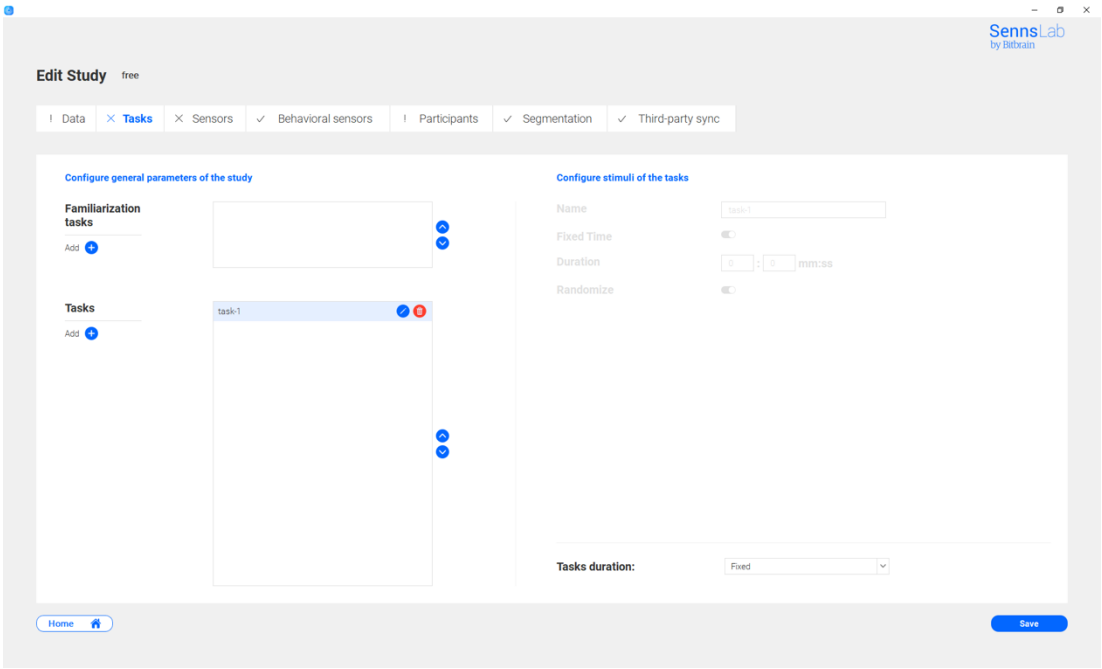


Screen 44: Tasks Tab- Active Audiovisual

5. Free Task Template

This template is used to evaluate open tasks with fixed or variable time limits and user interaction. The free task template allows for more flexibility in study design. This is typically used to evaluate interaction with websites, software, products, etc.

It follows the same structure as the Active Image Template. The only thing that changes is the type of stimuli presented. In this case, no predefined image or video will be displayed by the software. The task and stimuli in this template is provided by an external source such as a web browser or an application.



Screen 45: Tasks Tab- Active Audiovisual

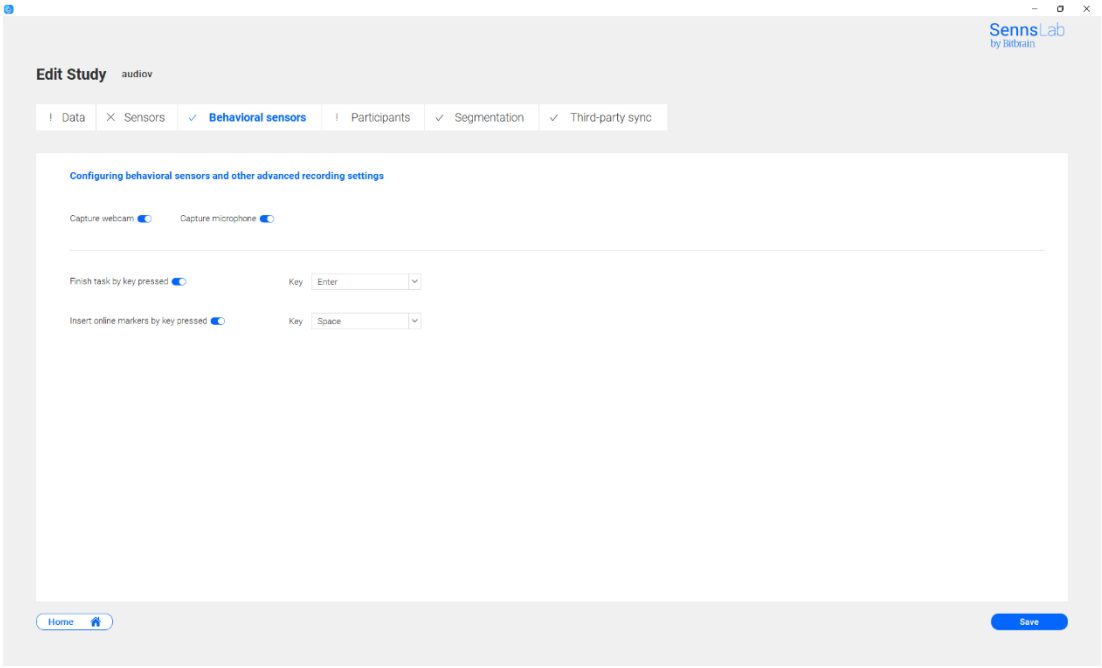
In Lab templates

1. Audiovisual recording.

The audiovisual recording template is used to record an interview with a participant while evaluating their emotional response.

This template is a variable-time recording task. There are no configurable parameters. In addition, in the behavioral sensors tab both the webcam and the micro recording are set to “on” by default.

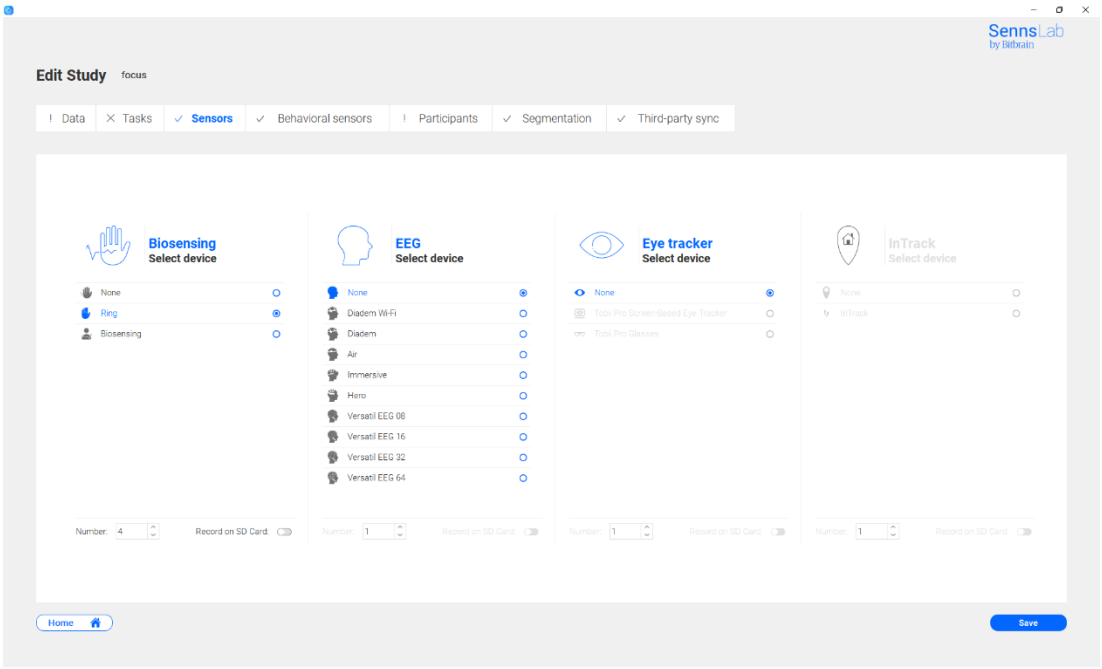
The rest of the options correspond to the common configuration steps described in section.



Screen 46: Behavioral sensors Tab- Audiovisual

2. Focus Group.

This template allows the recording of a focus group interview where the aim of the study is to evaluate the emotional response of multiple participants. Remember to select the use of multiple devices in the sensors tab. In addition, in the behavioral sensors, tab webcam and micro recording are set to “on” by default.



Screen 47: Edit study- Focus group

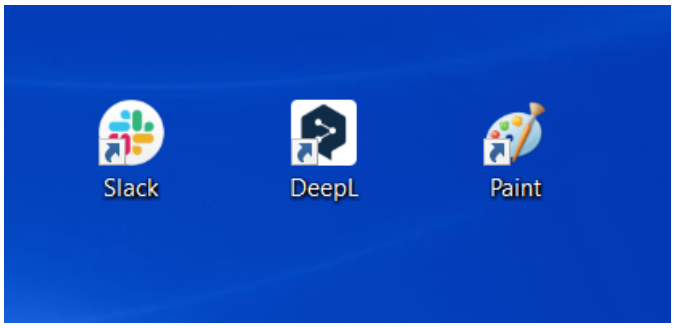
2.1 Configure task stimuli:

A task in the focus group template consists of a labeled section of time for the test moderator to start a discussion or ask questions on a particular topic. There is no defined stimulus in the focus group template, tasks are provided only for organization and analysis purposes.

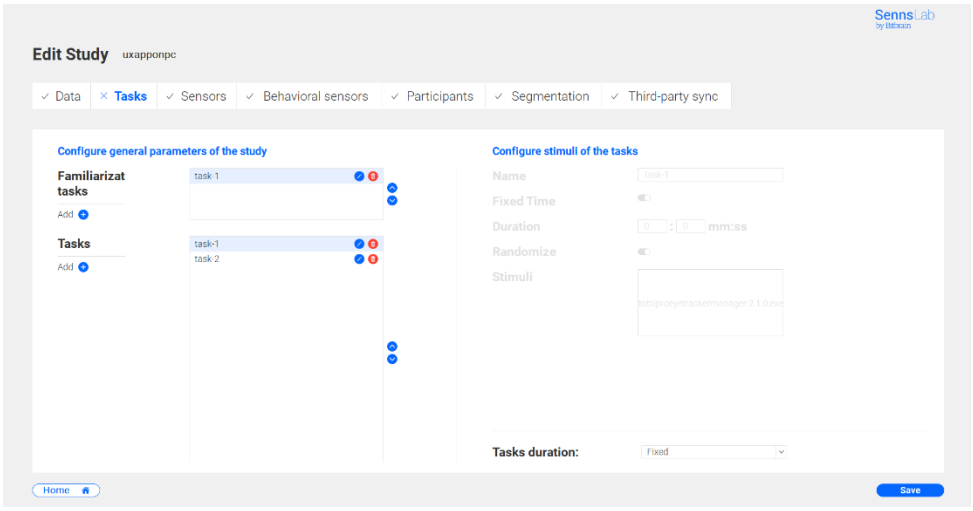
Familiarization and assessment tasks follow the same pattern as in the “Free tasks template”

3. Ux App on PC: allows the evaluation of user experience while the participant is using a PC-based application. This template can be used to evaluate the emotional response of the participant when using any app or executable.

The stimuli to be analyzed could be any application you have on your computer. The objective of this type of study is to analyze how the participant uses the application in an established period of time. The following screen shows some applications which could be evaluated.



Screen 48: Apps to study



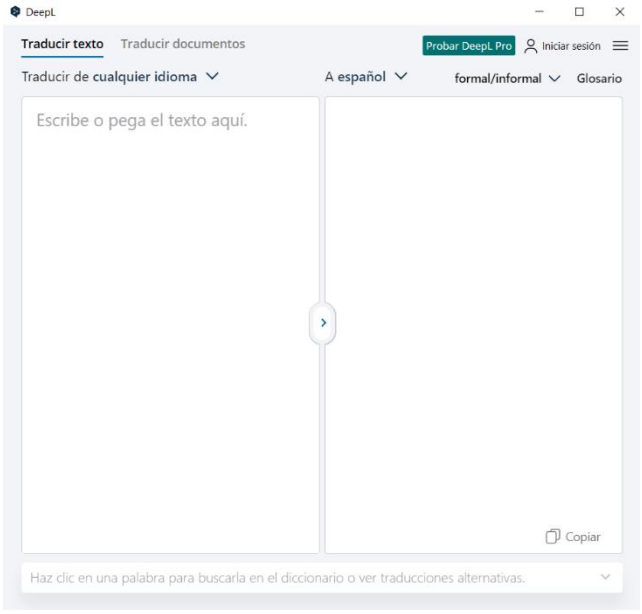
Screen 49: Tasks Tab- Ux App on PC template

- Screen, mouse position, webcam, and micro recording are set on by default.

3.1 Set up the task sequence:

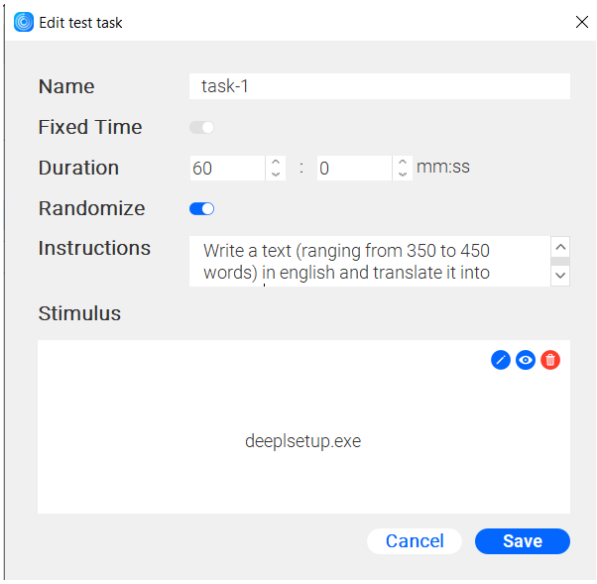
Familiarization task: This is a set of executables used to familiarize the participant with the content of the study. For further information, read “Free task template”.

Assessment tasks: This is a set of 1-15 executables for full analysis. For example, the following screen shows the application which is going to be analyzed. It is “DeepL” a translator.



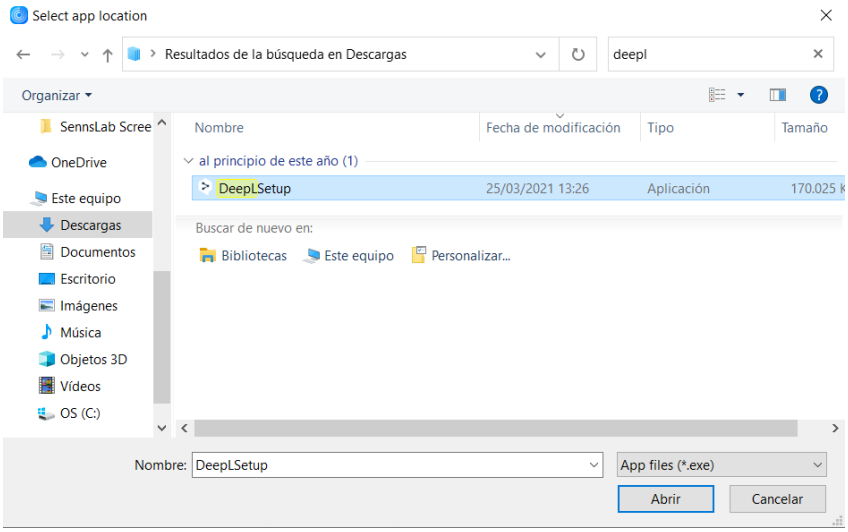
Screen 50: Assessment task (stimuli): DeepL translator

Note that the moderator can optionally add instructions to the user in order to give a proper explanation of what the user is supposed to do in each task.



Screen 51: Edit test task- Instructions

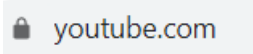
The stimuli (app) are set by clicking on the edit icon . To confirm that **SennsLab** will be able to execute the app properly, check that your stimuli will display correctly by pressing



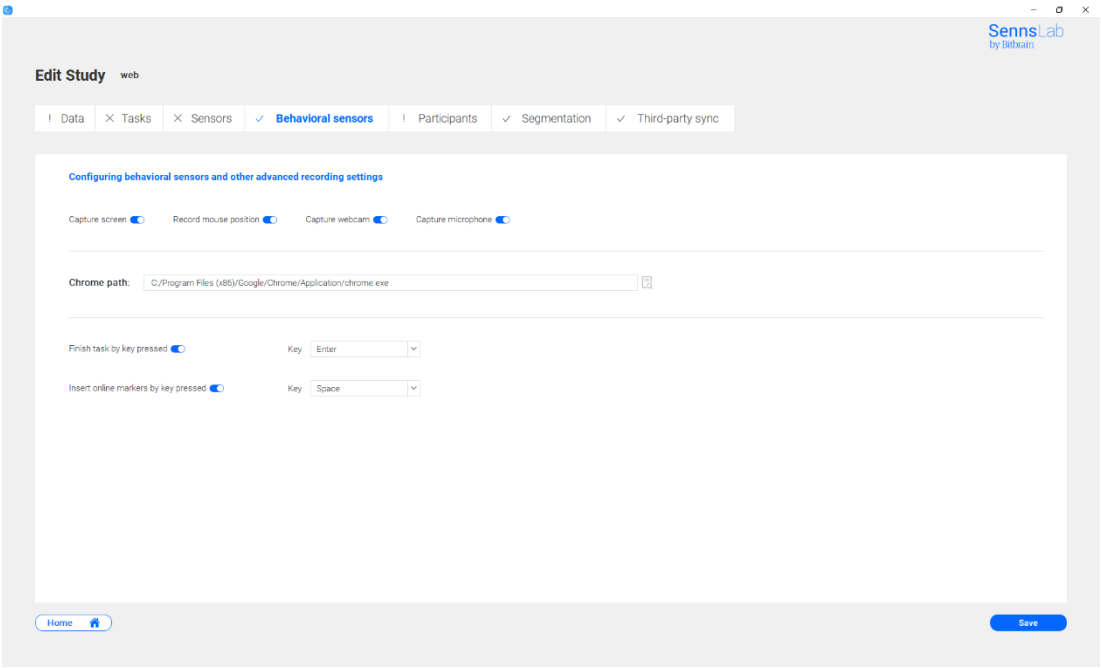
Screen 52: Selecting the executables

Note: In case that **SennsLab** cannot support the execution of the app of interest, we recommend using the free Task template as an alternative, and to launch the app manually during the test.

4. Ux Web on PC: This allows the evaluation of user experience while the participant is browsing a website. **The stimulus that will be analyzed is any website or URL you want to test.** The aim of this type of study is to analyze how the user navigates and uses the website in an established period of time.



Screen 53: Example of URL/website



Screen 54: Data Tab- Ux Web on PC template

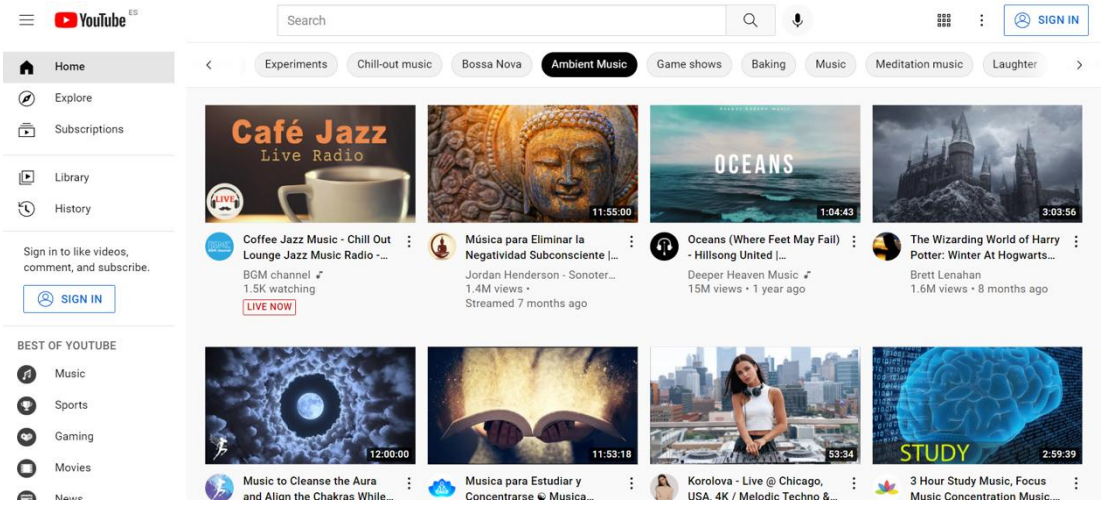
Some considerations when using a Ux Web on PC template:

- The browser used in this study template needs to be Chrome
- Screen, mouse position, webcam and micro recording are set on by default.

4.1 Set up the task sequence:

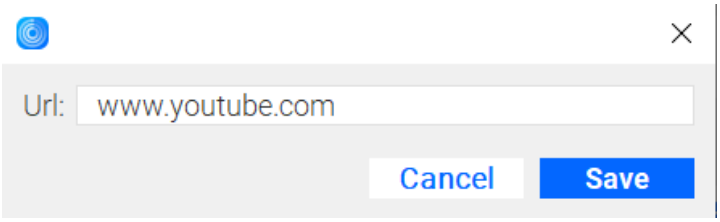
Familiarization task: This is a set of URL's/websites used to familiarize the participant with the content of the study. Read "Free Task Template" for further information.

Assessment tasks: This is a set of 1-15 URL's/websites for full analysis. The following screen will show YouTube.



Screen 55: YouTube website

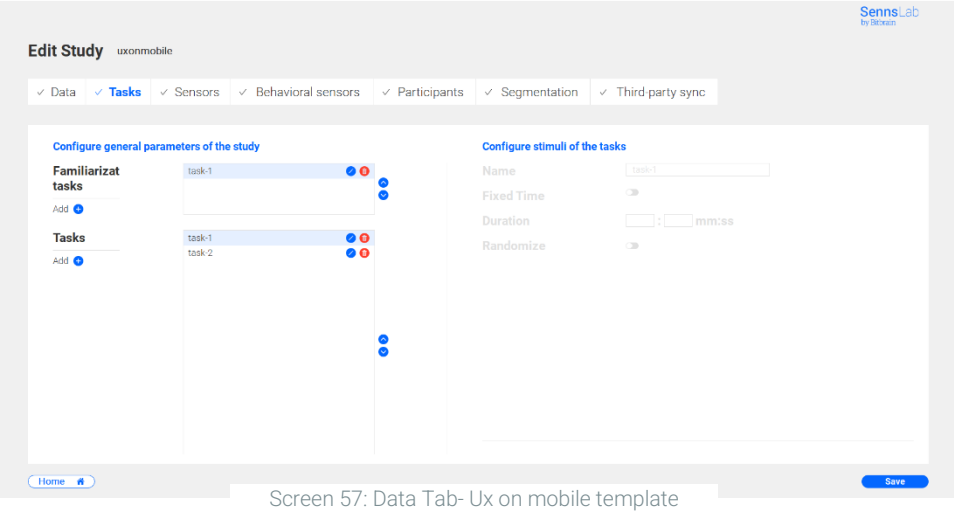
Note that instructions can be added for each website. Select the URLs that are going to be evaluated by clicking on the open and edit button.



Screen 56: Data Tab- URL

If you click on the visualization icon the URL site will be launched. We do recommend testing it before running the study.

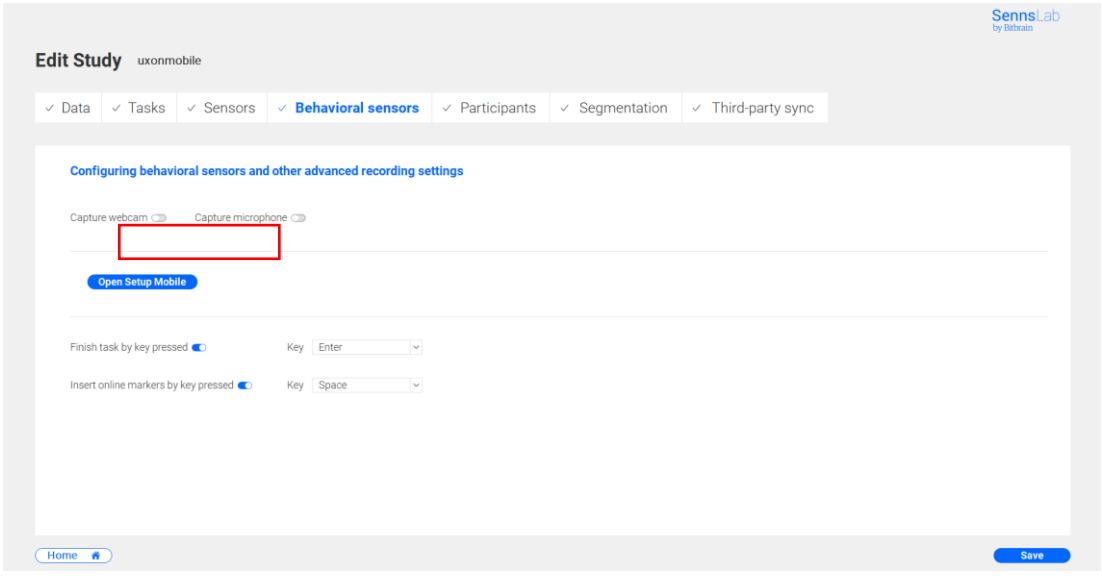
5. Ux on Mobile: allows the evaluation of user experience. The tasks are performed by the participant using an application or a website on a mobile device (only **Android mobiles are supported**). For more details, see Annex 8 "Mobile Setup".



Screen 57: Data Tab- Ux on mobile template

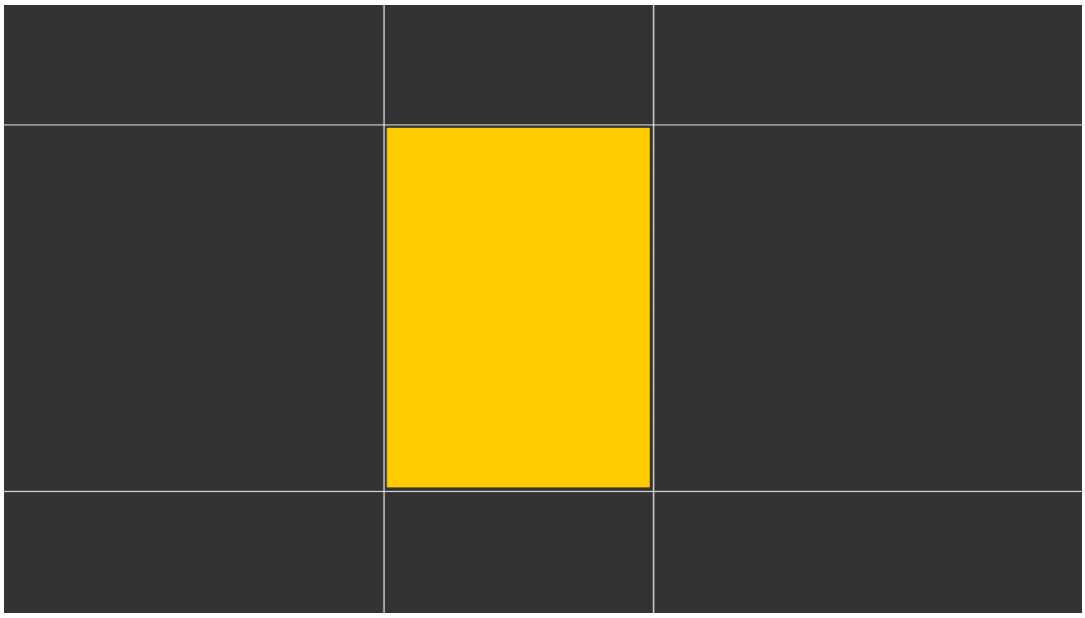
See “Free Task Template” for information regarding the configuration parameters and the tasks.

In the Behavioral Sensors tab click on the “Open Setup Mobile”



Screen 58: Data Tab- Ux on mobile template

By clicking, the following screen will appear.



Screen 59: Setup Mobile Screen

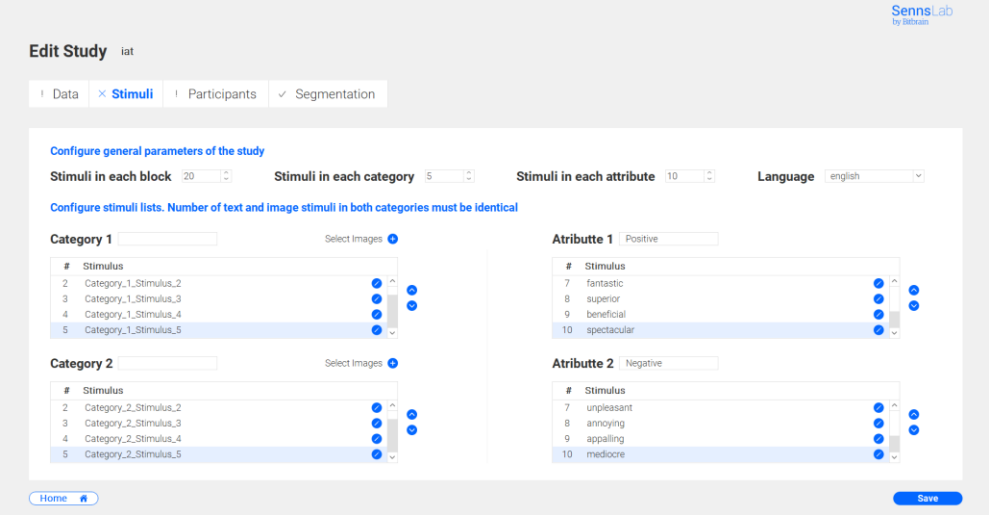
On this screen, indicate where the mobile phone will be placed.

Implicit Response Templates

1. IAT:

This template is used to measure the implicit association of a series of attributes with 2 concepts. (Brands, cultural, sociological aspects).

1.1 Set general study parameters



Screen 61: Edit study tab - IAT template

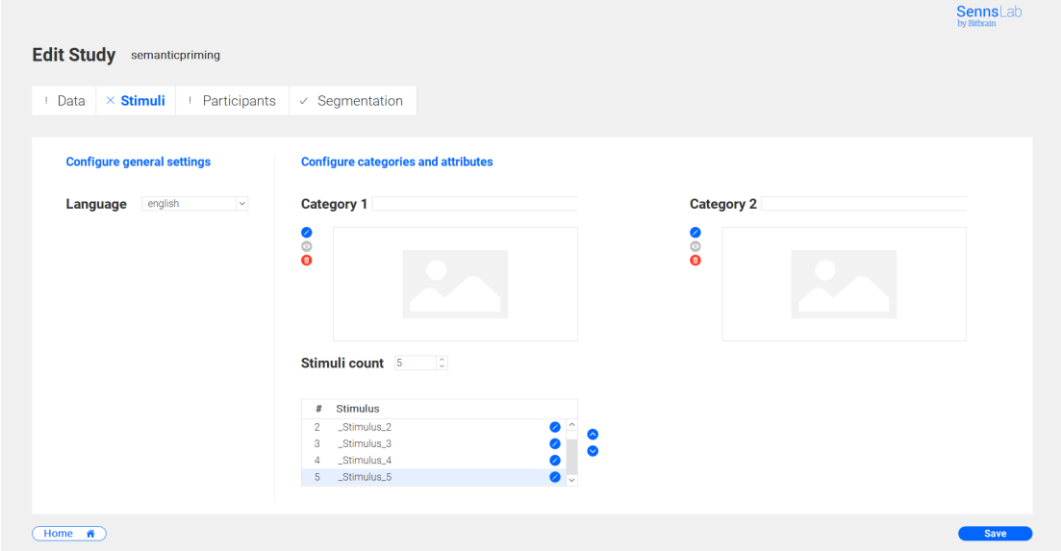
- **Stimuli in each block:** number of repetitions that will appear for each of the blocks. Minimum = 20; Maximum = 40.
- **Stimuli in each category:** number of stimuli (text or image) that will appear in each of the categories. Minimum = 2; Maximum = 20.
- **Stimuli in each attribute:** number of text attributes that will appear in each of the attribute lists. Minimum = 3; Maximum = 10.
- **Language:** available in Spanish and English.

1.2 Stimulus List

Category: brand, product, concept to be evaluated. Because it is a comparative test, two must be defined.

- **Category stimuli**: stimuli related to that category. The stimuli entered must represent characteristics or aspects linked to the selected category. Click on to edit the text or the image.

- **Attributes**: attribute 1 = Positive and attribute 2 = Negative are displayed. They are the standard attributes of the test definition but can be changed by clicking in the text box.



Screen 62: Stimuli Tab – Semantic Priming offline offline

- **Attribute stimuli** = these are the concepts associated with the attribute. They are standard positive or negative adjectives of the test definition. Click on to edit the text.

For more information, see Annex 1 “Definition and methodology of implicit response”.

2. Semantic priming:

This template is used to measure the implicit association between a series of attributes (text) used as priming stimuli and two brands / products.

2.1 Configure general settings

- **Language:** Spanish or English.

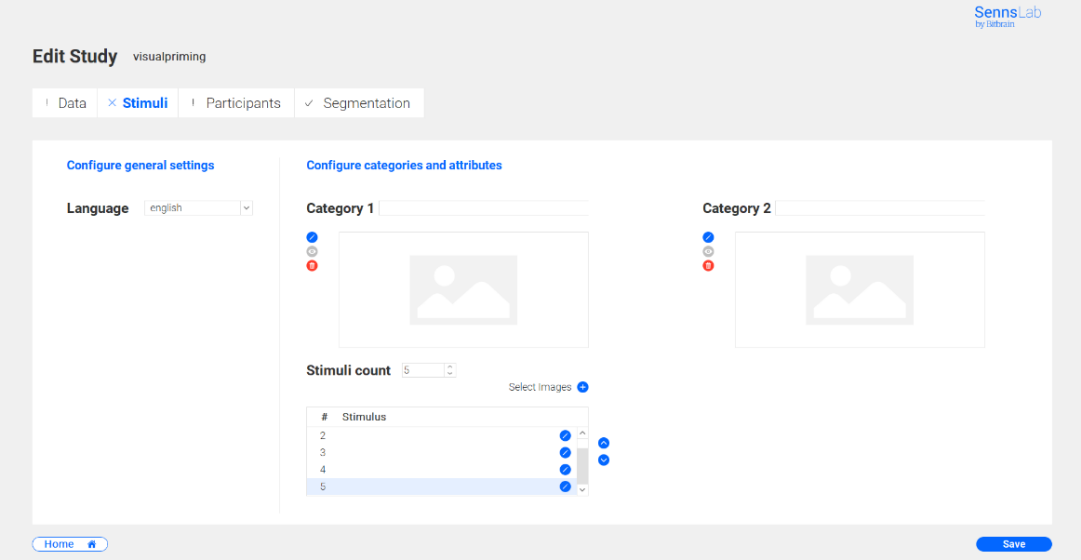
2.2 Configure categories and attributes

- **Categories:** this is the brand, product or concept that you want to evaluate. As it is a comparative test, two must be defined. Use the text box for each to define a category name, then load the image and hit save to keep the changes.
- **Attributes/Stimuli:** adjectives, characteristics, or aspects (in text format) that you want to use to evaluate in conjunction with the categories. Define the total number in the “Stimuli count” field (Minimum = 2; Maximum = 10) and edit them with the button.

For more information, see Annex 1 “Definition and methodology of implicit response”.

3. Visual Priming:

This template is used to measure the implicit association between a series of attributes (images) used as priming stimuli and two brands / products.



Screen 63: Stimuli Tab - Visual Priming offline

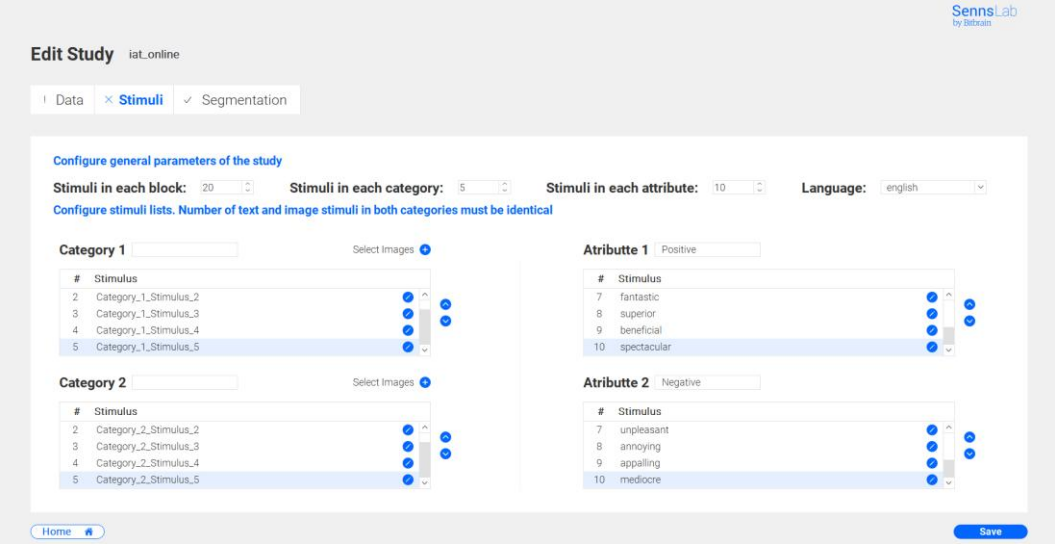
The same general settings, categories and attributes from the Semantic Priming apply to Visual Priming. The only difference is that the attributes here are images, instead of text.

For more information, see Annex 1 “Definition and methodology of implicit response”.

Online Implicit Response Templates

1. IAT online:

This template is used to measure the implicit association of a series of attributes with 2 concepts (brands, cultural, sociological aspects).



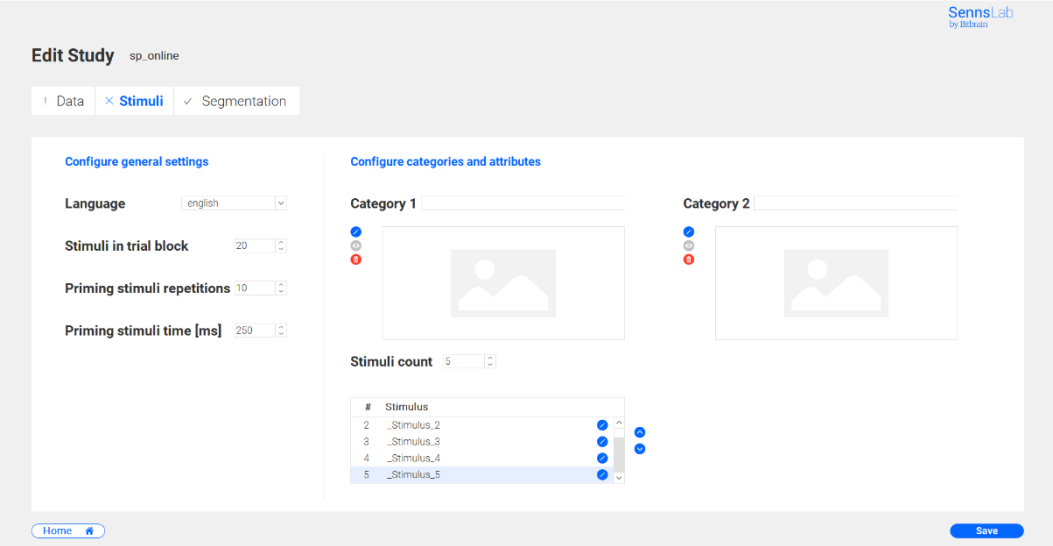
Screen 64: Edit study- IAT online

The IAT Online study is designed to run as a website so participants can take the test remotely.

The general study parameters and the stimulus list follow are the same as in the offline IAT.

Online implicit response templates are formatted and published as a URL. To get the link, once the study is defined, export it. This option will show on the manage studies window. Once you click on the ´export´ button, a zip file will be generated. Send the resulting .zip file to support@bitbrain.com. Within 24 hours, your URL will be created and can be shared with the study participants.

For more information, see Annex 1 “Definition and methodology of implicit response”.



Screen 65: Stimuli tab – Semantic priming online

2. Semantic priming online:

This template is used to measure the implicit association between a series of attributes (text) and two brands / products. The Semantic Priming Online study is designed to run as a website so participants can take the test remotely.

2.1 General parameters of the study:

- **Stimuli in trial block:** number of repetitions that will appear for each of the blocks. Minimum = 20; Maximum = 40.
- **Priming stimuli repetitions:** number of repetitions of each stimulus.
- **Priming stimulus time (ms):** time that the priming stimulus will be shown during the study.

Screen 65: Stimuli Tab - Semantic Priming online

- **Language:** Spanish and English.

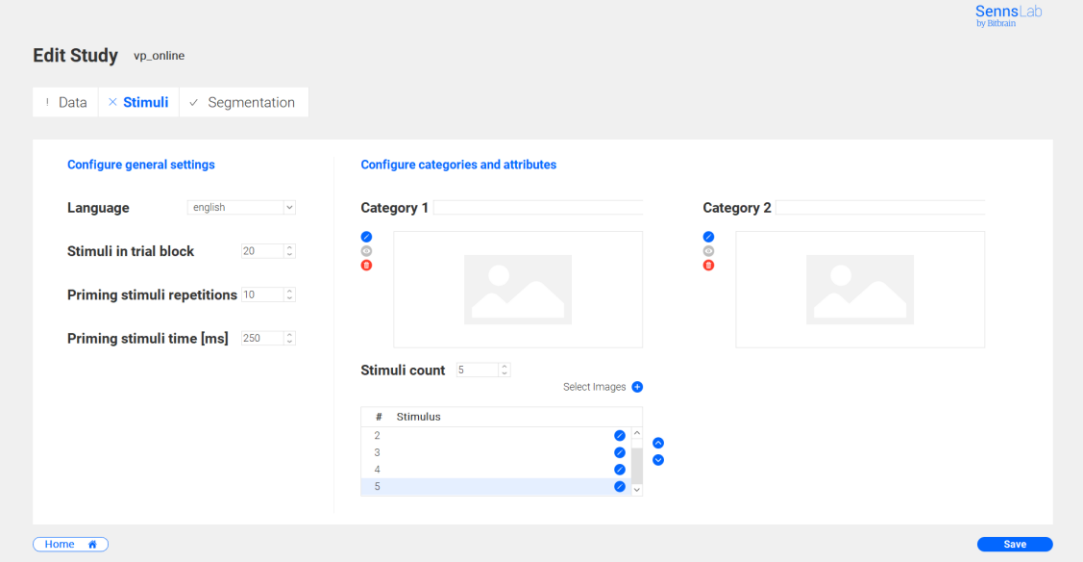
Categories and attributes are the same as in the offline Semantic Priming.

To obtain the URL link, read the instructions in the Online IAT section.

For more information, see Annex 1 “Definition and methodology of implicit response”.

3. Visual Priming Online

This template is aimed to measure the implicit association between a series of attributes (image) and two brands / products. The Visual Priming Online study is designed to run as a website so participants can take the test remotely.



Screen 66: Stimuli Tab - Visual Priming online

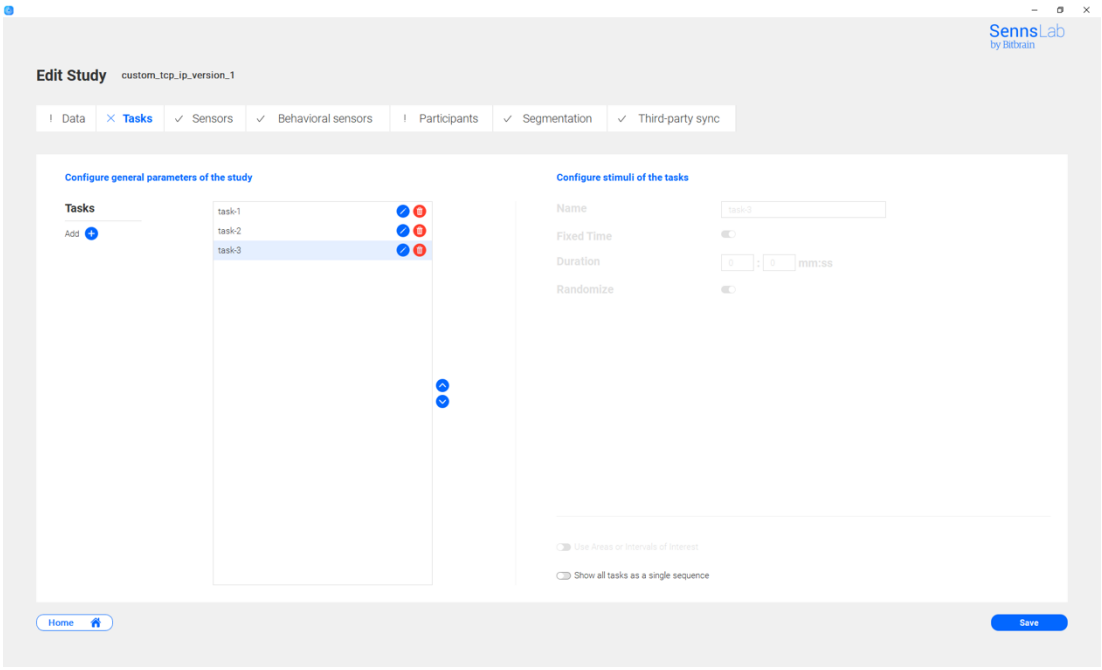
The same general parameters and stimuli from the Semantic Priming Online apply. To obtain the URL link, read the instructions in the Online IAT section.

For more information, see Annex 1 “Definition and methodology of implicit response”.

Custom Templates

1. Custom:

This template allows the creation of studies that are completely personalized by the researcher. Any stimulus and task can be added (audiovisual, images and free tasks). This template is *not* compatible either with **SennsCloud** nor with **SennsMetrics** analysis software. Custom studies produce raw data only, which can be exported to a data file and processed via third-party analysis tools. To learn more about the structure of the export file, see Annex 6 “Researchers Guide”.



Screen 67: Edit Study- Custom Template

Custom Template follows the same structure as the Free Template. The only thing that changes is the type of stimuli presented. In this case, it could be an image, an audiovisual, or even a free task. In addition, all tasks can be executed with or without a pause between them (in a sequence).

2.3 LAUNCH

In the Launch block you will find all the study execution options.

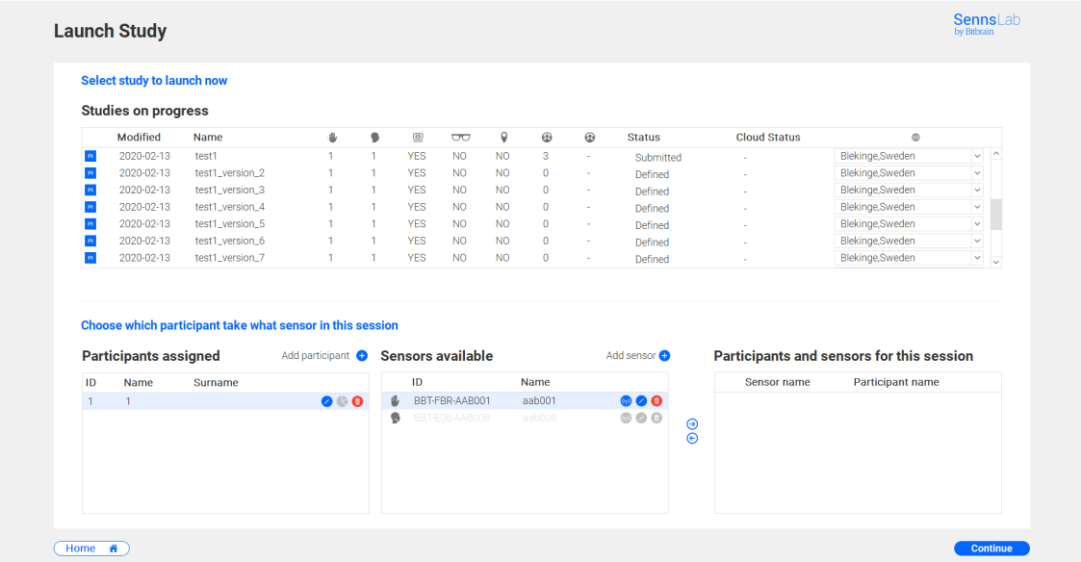
The Launch Demo option allows you to view basic signal display and test hardware performance without recording data. This is a way to test the experiment before running it.

The launch study option executes the experiment and records data.

2.3.1 Launch study

Selection of study, participants and sensors

Clicking on the launch study button will bring up the setup screen. Select the recording settings for the session.



Screen 68: Selection of study, participants and sensors

Step 1

Select the study you wish to run in the "Studies in progress" window. In this section, a brief description of the characteristics of each study is shown:

- Blue icon referring to the type of template used
- Modified: last date in which the study was modified.

- Name of the study
-  Number of associated biosensors.
-  Number of associated EEG systems.
-  Stationary (remote) eye tracking device
-  Mobile eye tracking device.
-  Indoor human tracking device.
-  Number of study sessions executed.
- Status: Reflects the current status of the study:

  - In design: Not all parameters have been completed.
  - Defined: All parameters have been completed.
  - Running: At least one study session has been run.
  - Submitted: Registered data has been uploaded for analysis (no longer used, included for retro compatibility with older data files).

- Location: Indicates the geographical region where the study will be carried out.

Step 2

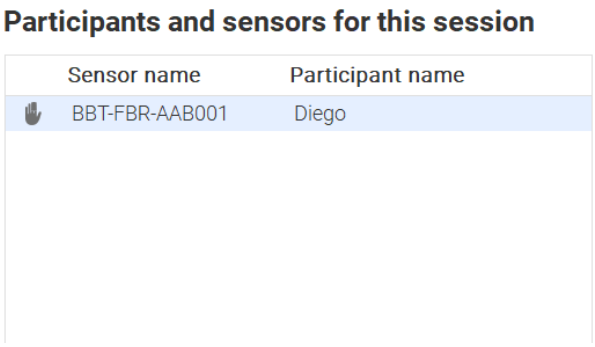
Choose the participant (s) to be recorded. There are three options for this:

- Option 1: if the participant was previously created and linked to the study, they will appear in the list in the section "Assigned participants".
- Option 2: if the participant has been previously created and has not been linked to the study, click on the "Add" button located above the "Assigned participants" section then select the participant.
- Option 3: create a new participant in the participant database. First , click on the "Add" button located above the "Assigned participants" section. Then, click on the "Add new participant" button.

Step 3

Associate the sensors to be used in the study session. In the “Available sensors” window, all the devices that are configured will be listed (see how a device is configured in section 1.3 “Install devices”). In addition, it is possible to add and pair new devices through the "Add sensor" button.

To associate the participant and sensor, mark both elements and click on the "right" arrow to add to the "participants and sensors in this session" window.



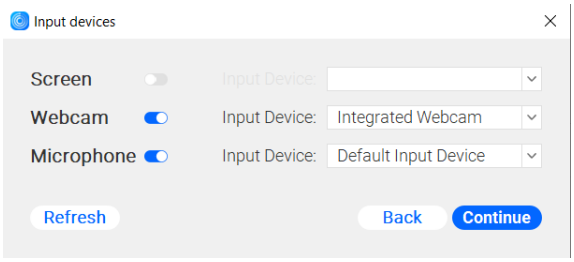
Screen 69: Participants and sensors for the session

Step 4

Click "Continue" when you have finished assigning participants and sensors for the session.

Step 5

If you have defined any behavior parameters (see section 2.1.4), select the peripherals to be used in the test through the following window:



Screen 70: Input Devices

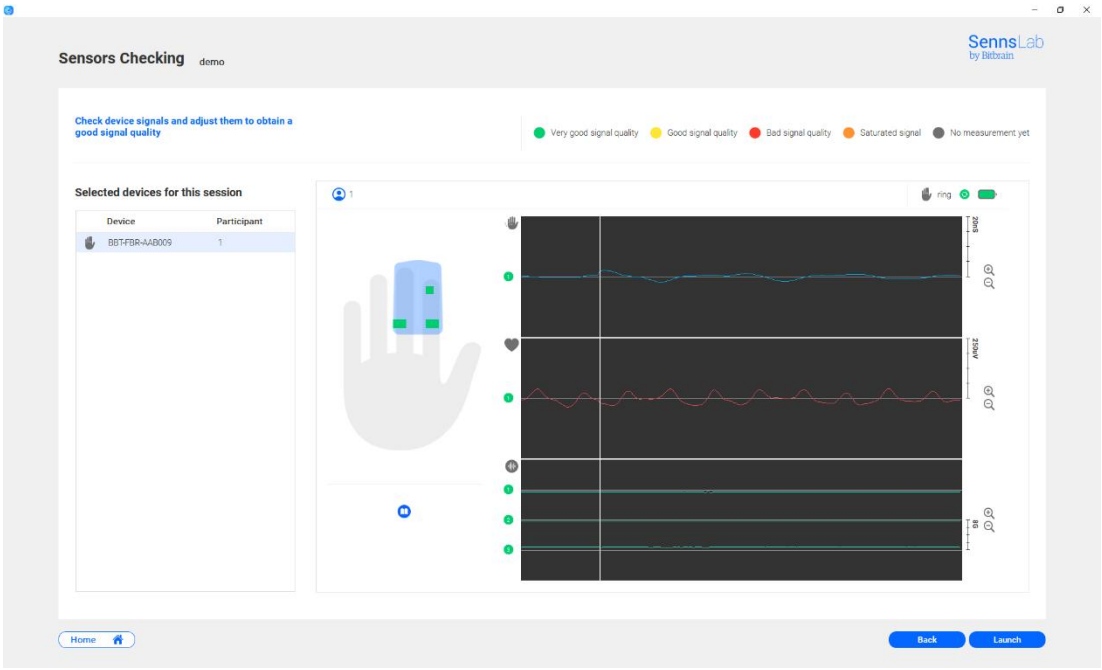
Through the check-boxes, enable or disable recording for each peripheral device. In addition, you can select which one to use through the dropdown in "input device".

To detect a new peripheral device, press refresh. Once you have finished, click "Continue".

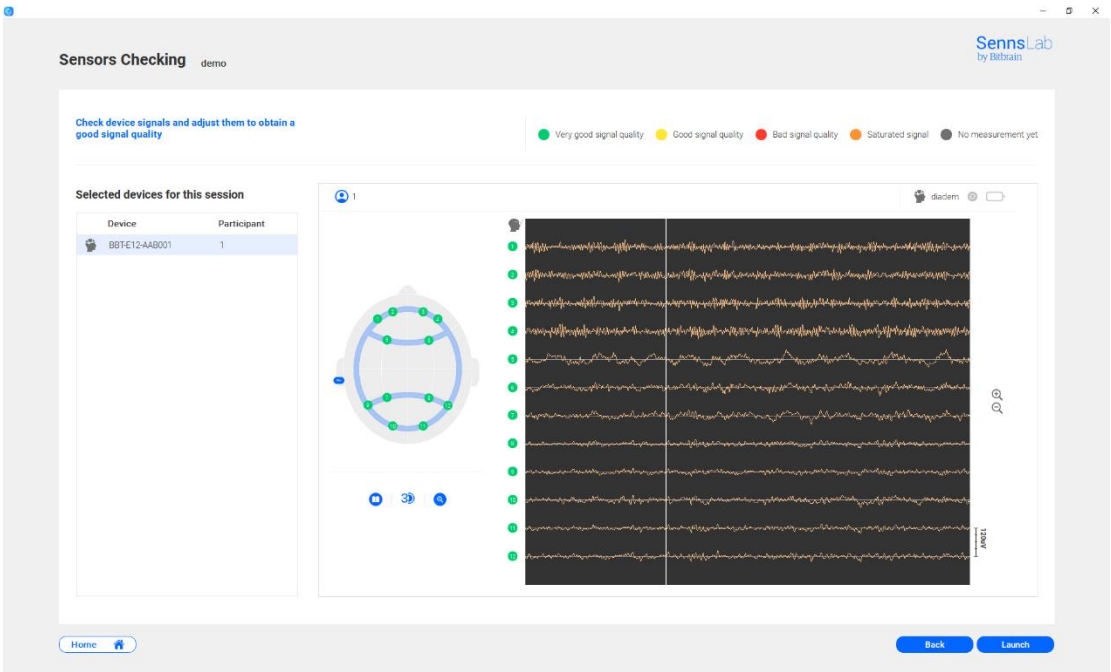
Sensor check

The first part of the window shows a list of devices that have been associated with the session in the previous step, or in the design of the experiment. By selecting each one, the real-time signal registration will be displayed.

In this screen, the position and signal quality indicators for each sensor are also represented.



Screen 71: Ring Check



Screen 72: Diadem check

The quality of the registered signal must be verified through the indicators for each type of sensor. For more information, please check the device instructions by clicking on the manual icon.

Visualization filters

While viewing the signals online, you can configure visualization filters. **The application of these filters only impacts the real time data display, exported raw data is not filtered.**

Default filters are configured for the following signals:

- **GSR Sensor** → Bandpass Filter of order 4, with frequencies from 0.5 to 2 Hz
- **BVP Sensor** → Bandpass Filter of order 4, with frequencies from 0.5 to 4 Hz
- **ExG Sensor** → Bandpass Filter of order 4, with frequencies from 0.5 to 100 Hz
- **EEG sensor** → Bandpass filter of order 4, with frequencies from 1 to 30 Hz and the notch
- **Photodiode** → Low pass filter of order 4, with cutoff frequency 10Hz

Regarding the Versatile Bio device, it is recommended to use the following configuration:

Bipolar ExG Sensors

In principle, it is not necessary to configure filters. However, it may be necessary to use the magnifying glass to reduce the scale in order to visualize the signal.

Analog

- GSR Sensor → Other; Enabled / Bandpass Max: 10, Min: 0.5
- BVP Sensor → Other; Enabled / Bandpass Max: 10, Min: 0.5
- Respiration sensor → Other; Enabled / Bandpass Max: 10, Min: 0.1
- Air flow sensor → Other; Enabled / Bandpass Max: 10, Min: 0.1
- Snoring sensor → Notch + Highpass Low: 1
- Temperature sensor → No need to configure filters.
- Photodiode sensor → No filters required

Feedback from devices

During the sensor check, the communication with the devices is verified. The pairing status is displayed in **SennsLab** on the top bar on the signal representation screen:

Waiting. When started, the device displays this status for a few seconds. If it persists please check:

- Bluetooth: The device is turned off or has not been paired correctly.
- WiFi: The device is turned off or there is a problem with the network configuration.

- **No signal is received** from the device. Bluetooth: The device is physically out of the range, or it has been turned off.
- WiFi: The device is physically out of WiFi range, or it has been disconnected from the network or turned off.

Receiving signal. Signal is being received from device correctly

Micro-SD card* recording:

Synchronizing. During this process, the device must remain within range of the computer until complete.

Note*: The fields marked with a (*) are mandatory

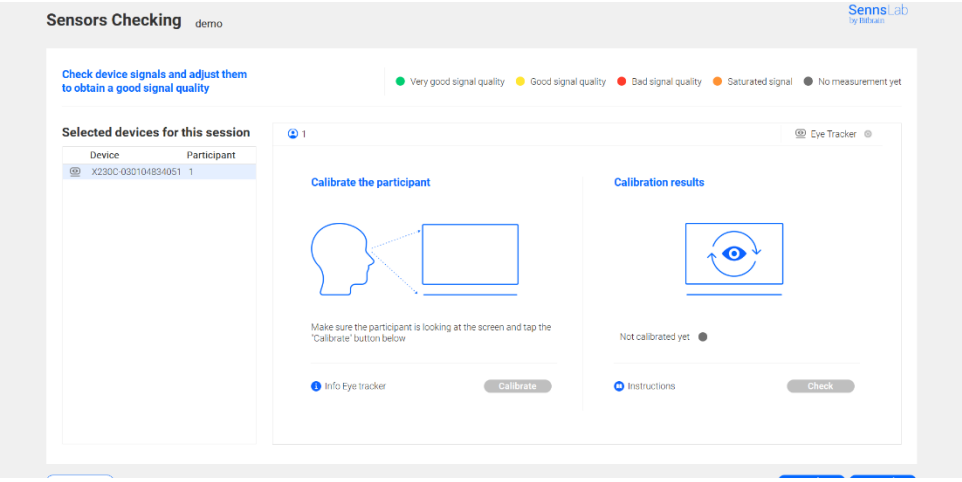
Recording in SD. The signal is being received and is being recorded to the microSD card correctly

Communication interrupted. The recording has started on the microSD card, but no signal is currently being received.

Writing error. An error has occurred, and data is not being written to the microSD card.

Screen based eye-tracking system check

One valid eye tracking calibration must be performed with the participant in order to launch the study. To do this, position the participant properly (centered in front of the stimulus presentation screen and in range of the eye tracking camera), then click on “Calibrate”.

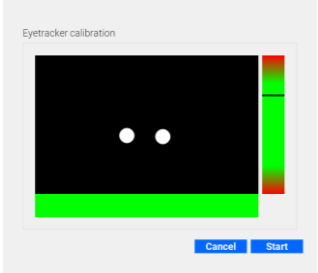


Screen 73: Eye tracking calibration

A pop-up window will appear indicating the eyes detected by the eye tracking camera and the position relative to the working range of the system.

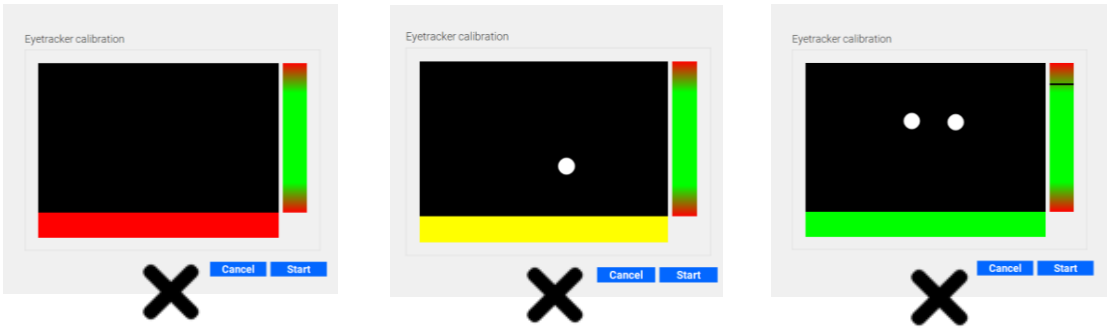
The bottom bar can be green, yellow, or red, indicating good, noisy, or poor eye detection, respectively.

The right side bar indicates the participant's distance from the eye tracking camera (i.e. how close to the camera and the screen). During the initial setup, the black indicator should be near the middle of the vertical bar. This will give you an indication of the tracking range of the system.



Screen 74: Eye tracking calibration (1)

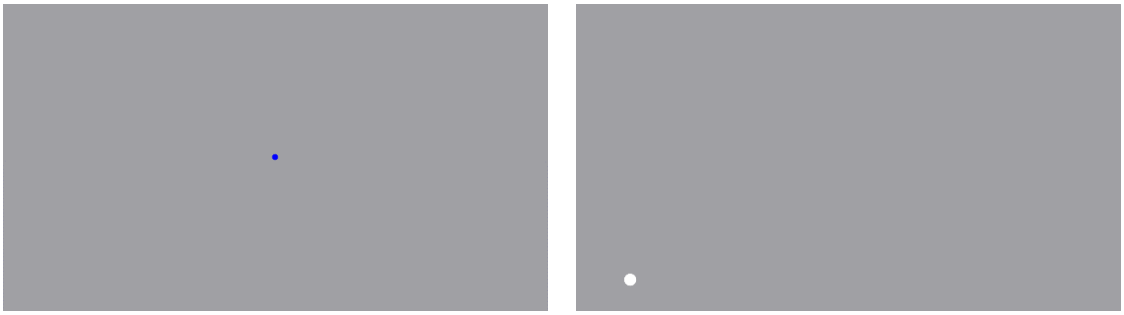
Below are several examples :ct detection types:



Screen 75: Eye tracking detection types

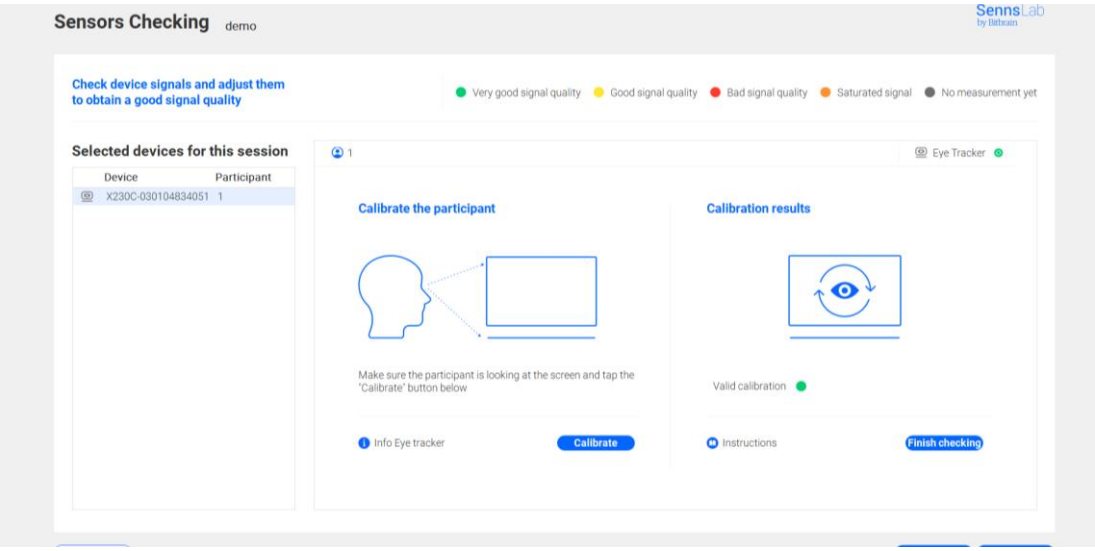
When the indicator is green, the moderator should instruct the participant to look at each circle as it appears, while minimizing head and body movement.

When the participant is ready, click on "Start".



Screen 76: Eye Tracking Calibration (2)

.



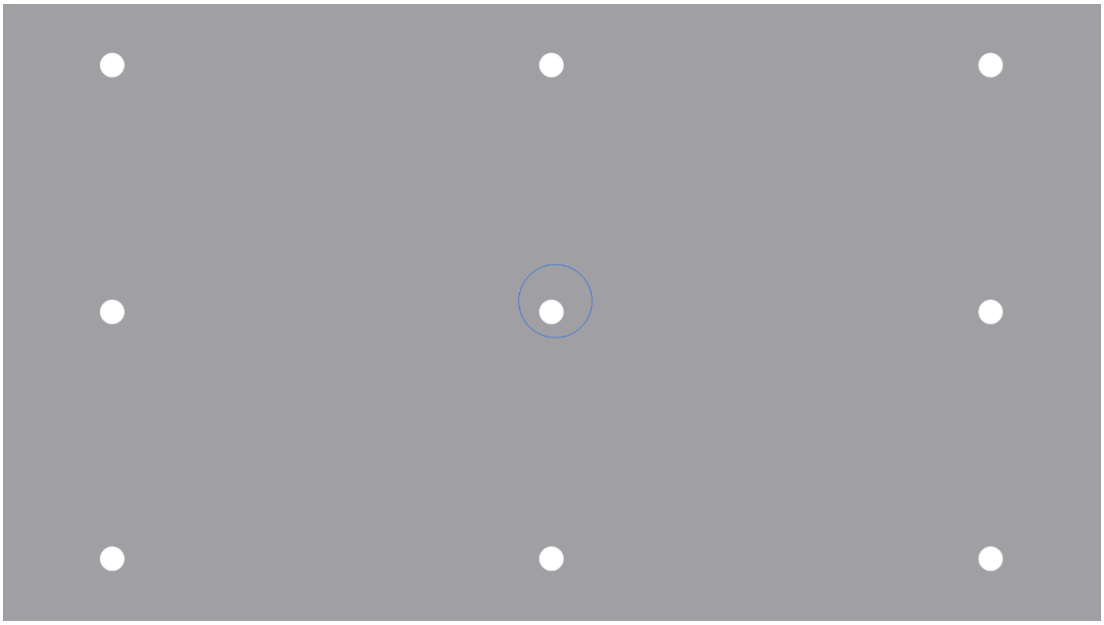
Screen 77: Sensor Check

When the calibration process is complete, the results will indicate whether the calibration was valid (green) or invalid (red).

If the calibration is not valid, repeat the process. Many participants will perform better in their second or third attempt. If a valid calibration is not possible, it may indicate that the participant has an oculomotor or ophthalmological issue, difficult corrective lenses, or another characteristic that makes them a poor candidate for an eye tracking study. The study can still be launched, but eye tracking data will be inaccurate and about it may be unclear how well the participant sees the stimulus.

- If the calibration is valid, the eye tracker verification window will automatically appear, with a display of accuracy.

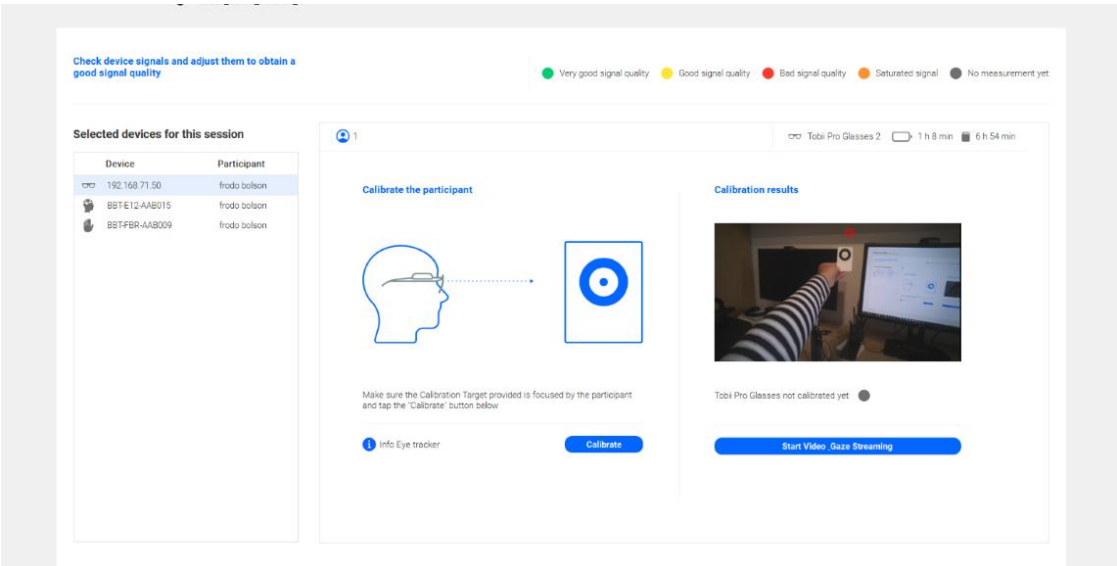
In this window, the participant is asked to focus their gaze on different points so the moderator can assess the accuracy of the calibration. When the verification is complete, press the "End verification" button in SennsLab.



Screen 78: Eye Tracking -calibration, check screen

If precision is as desired, click on "Launch" to continue. If it is not, repeat the calibration.

Tobii Pro Glasses



Screen 79: Checking Tobii Pro Glasses

Feedback on the status of Tobii Pro Glasses is displayed above the main window. Next to the battery icon is the estimated battery time of the device. Next to the SD card icon, the available recording time is reported, according to the internal storage on the data recorder.

Run the eye tracking glasses calibration for the participant before launching the study and recording data.

To start, click the button “start video and pupil transmission” to activate streaming.

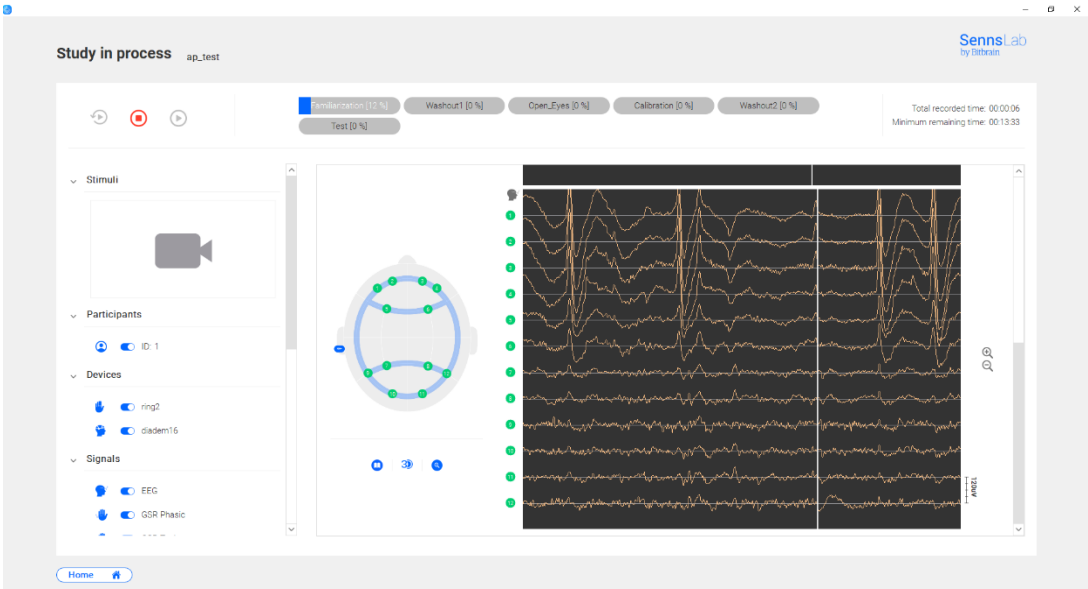
To calibrate the glasses, use the calibration card included with the Tobii Pro Glasses kit. Place it one meter from the participant, preferably on a monochrome surface, and click on the "Calibrate" button in the Glasses interface. The participant must fixate on the point on the calibration card with as little movement as possible. The calibration card itself must also be held as still as possible until the calibration is complete.

After a few seconds, SennsLab will provide feedback on the calibration process. There are two possible outcomes:

- If the calibration is *valid*, the accuracy of the data acquired should be verified in the live gaze data view. To do this, ask the participant to look at different points and assess the gaze position manually.
- If the calibration is *not valid*, the process should be repeated at least one or two times. If a valid calibration cannot be attained, the study can still be launched. However, the attention data may not be valid, either because the eye tracking system cannot acquire a good enough view of the eyes (i.e. due to strong prescription glasses) or because the participant may not be able to fixate properly.

Study in progress

This section details the options related to a study while in process. **For information related to specific task blocks and protocols see Section 3: Execution.**



Screen 80: Edit study- Focus group

General information

After launching a study, you will see the study-in-progress window.

Play: starts presentation and data recording for the next task.

Stop: interrupts recording data. A task that is interrupted can not be analyzed.

Repeat: The last executed task will be run again.

Devices and Signals: check a device or signal box to show live data from that sensor on the display.

Participants: check the participant to view live data on the display

00:00:52

Total Recorded Time: An indicator of the time that has been recorded during this session.

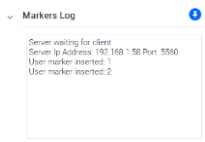
00:14:35

Minimum time remaining: an indicator of the minimum time remaining before the study is complete. This time is calculated by adding the time of the remaining stimuli blocks but does *not* consider indefinite breaks.

Percentage bar Represents the % completed of each stimulus block. If the bar is completed in blue (100%) it means that this block has been successfully completed. If it stays red, it means that the task was interrupted and the data was not correctly recorded. Click to record this section of the experiment again.

Stimuli: shows the stimulus that the participant is currently viewing. Click on to finish a non-fixed time task.

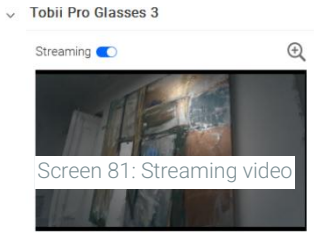
Device status: Shows the status of the sensor.



Markers Log: Show the markers or tcp/ip events received. Click on to insert a user marker.

To return to the main screen, click the home button.

The following is the feedback running Tobii Pro Glasses :



Screen 81: Streaming video

Status View: Located in the upper left corner, this displays the current status of the device. Before starting any task, check this to verify that the glasses are ready to record.

Streaming: This shows the participant's gaze position in real time. This should be used to verify the proper function of the eye tracking glasses before recording.

Regardless of whether streaming is enabled, the gaze video recording will be stored on the device.

Recommendations for use

Once each of the sections that include Tobii Pro Glasses has been defined, follow these guidelines for proper recording of eye tracking data.

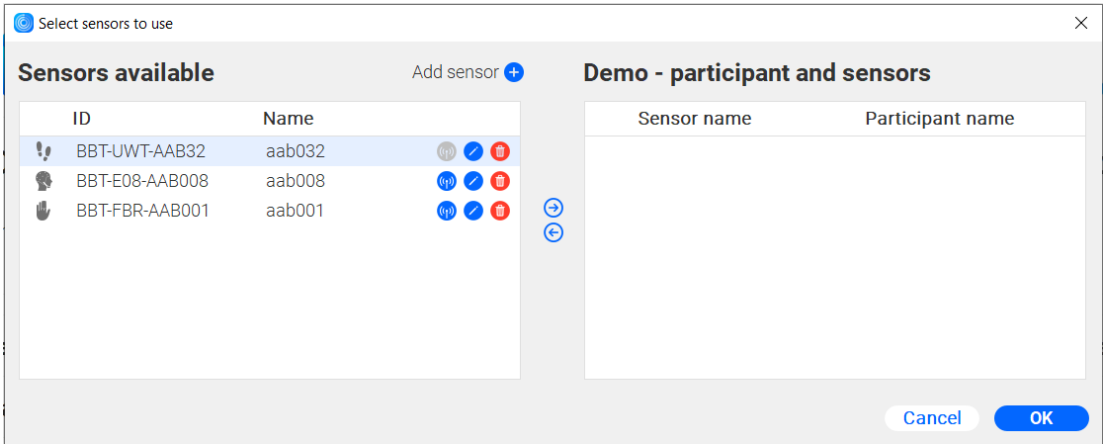
1. Verify the status of Tobii Pro Glasses through the status view. If they are ready to record, start the task via the Play button.

2. If the status view indicates that the glasses are not connected, check that the device is turned on and that there is adequate storage and battery life remaining. In addition, verify that the SennsLab computer is properly connected to the Tobii Pro Glasses network.

3. If the task fails to record, re-check the network connection and the status of the device.

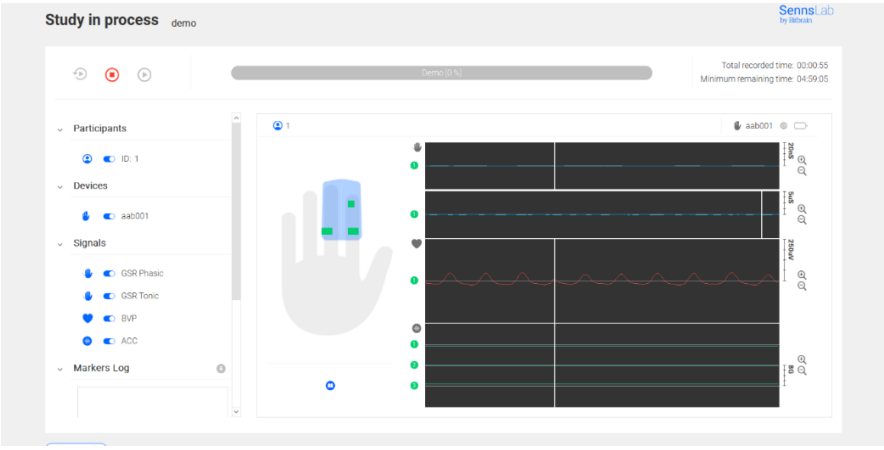
2.3.2 Launch demo

The demo mode is an easy way to view incoming signals and show the test process. Unlike a pilot test, no data is recorded in demo mode.



Screen 82: Launch demo

- Step 1: On the main screen click "Launch Demo".
- Step 2: Assign the devices to be included in the demo by selecting the relevant one on the list on the left: “Sensors Available”, and then clicking on the arrow. You can also add new devices through the "Add sensor" button. In addition, you can check the status of eye tracking devices via the "Info" buttons.
- Step 3: click on “OK” to continue
- Step 4: All screens during the test will indicate “Demo” in the upper left corner. If using a remote eye tracking system, a view of the images with gaze data will be displayed during the test. Otherwise, the window will display the selected device signal.



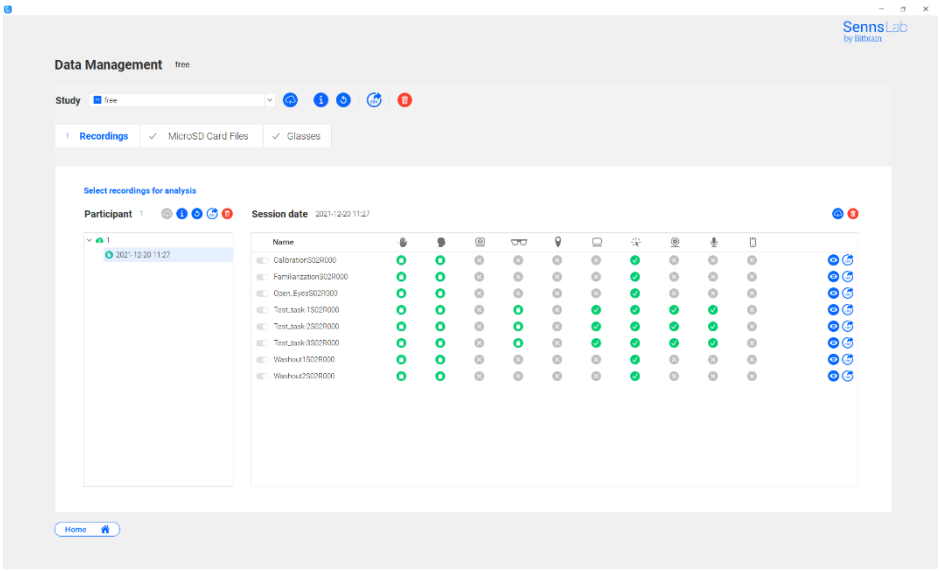
Screen 83: Demo execution

2.4 ANALYZE

This includes all options for data management. It is possible to visualize data that has been recorded and export it as raw data, or in a file to be send to our cloud service for analysis.

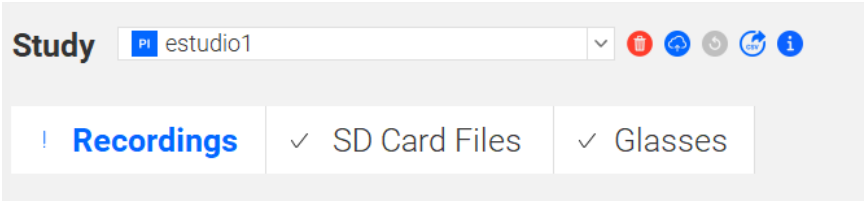
2.4.1 Data management

This screen gives the option to inspect the recorded data, export it in raw format or upload it to our cloud service for analysis.



Screen 84: Data management

On the main screen you can choose between the recorded studies, SD Card files or Glasses data.



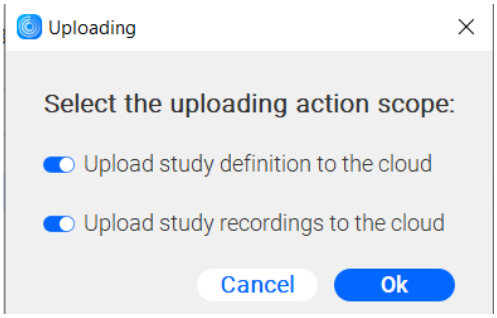
Screen 85: Data management - Options

Select a study, The first option available will be the last study you have run.

The button functionality is as follows:

Delete the sessions recorded. This option removes all the session recorded for the selected study.

Upload to the cloud. This option allows to upload the study definitions and/or all the recordings to our cloud service for analysis.



Screen 86: Upload dialog

Synchronize status with the cloud service.

Export the study definitions to csv so that you could analyze the data manually. The file will go to C:\sennsLabZipFiles\exportData.

Information about the status of the study and the recordings in the cloud.

RECORDINGS*:

Select the participant recording for analysis. Only one session per participant can be uploaded.

In the participants section (left side) the list with all the participants who took part in the study can be found. In addition, all the sessions recorded by each participant are included in that list.

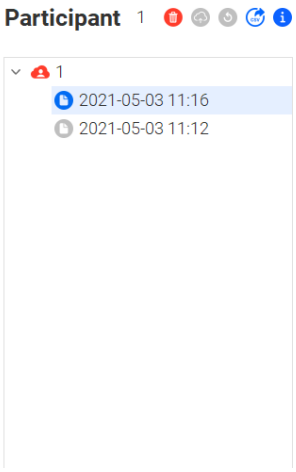
On the top of the participants section, the buttons are equivalent to the ones previously mentioned. Now the functionality is limited to the selected participant. For example, if you click on the delete button, only the selected participant will be deleted.

In the participants list, the id and the status of each participant is displayed. The status is represented by one of these icons:

The participant has already been uploaded to the cloud service to be analyzed.

All of the tasks were completed. A participant in this status is ready to be uploaded and analyzed.

Some tasks have not been recorded. A participant with this status can not be uploaded.



Screen 87: Participants List

* These actions impact the entire selected study.

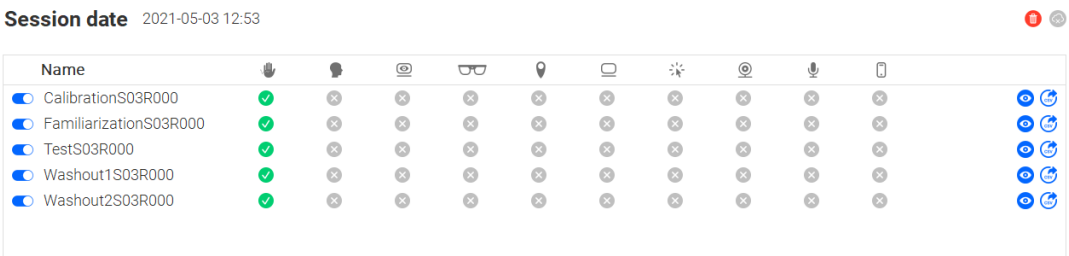
All the participant sessions are listed below the id and status information. The sessions are represented by their recorded date and time. Automatically, the software selects the session most recently recorded unless some previous session has been uploaded. The selected session will be uploaded by clicking on upload button. In addition, each session has a status, it is represented by an icon. The session status cand be:

selected session

discarded session

uploaded session

Click on a participant session (in the participant´s list) to view the details in the Session section. In this section, all the tasks recorded in the selected session are displayed, allowing also deleting or invalidate an uploaded session.



Screen 88: Session section

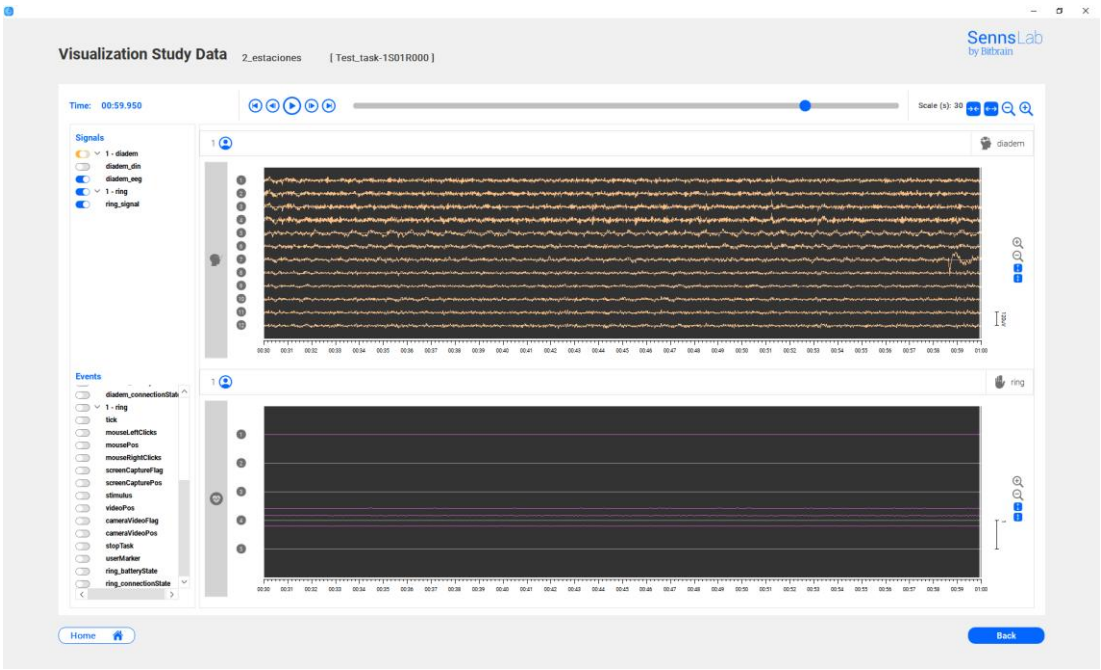
In the tasks list, choose the files to upload by clicking on the selection icon. If any task is missed (not selected or not recorded) the participant icon will appear red and can not be uploaded for analysis. You can select a task from a non-selected session in order to complete the data required.

Detailed information about the status of the sensors included in the tasks is displayed. The status depends on the type of sensor:

ICON SENSOR	SENSOR	NOT INCLUDED	RECORDED	SD CARD NOT IMPORTED YET	SD CARD IMPORTED
	Biosignal				
	EEG				
	Eyetracker screen based			--	--
	Eyectraker mobile		--		

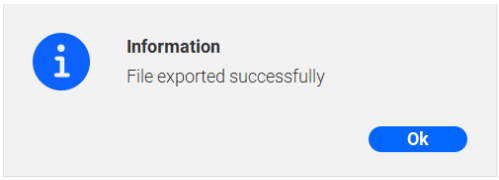
ICON SENSOR	SENSOR	NOT INCLUDED	RECORDED	NOT RECORDED
	Screen capture			
	Mouse			
	Webcam			
	Microphone			
	Mobile			

The inspect or export raw data options are available for any task. The data of each task can be visualized by clicking on the visualization icon . The following window will be displayed.

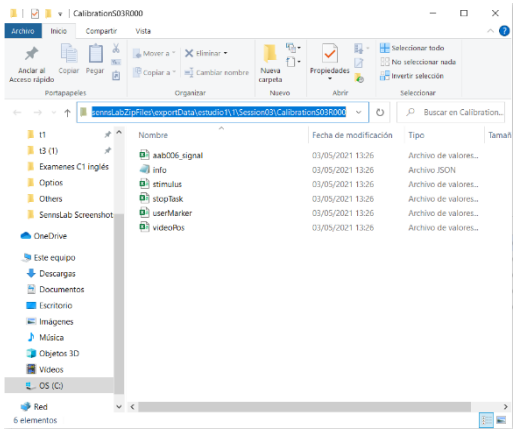


Screen 89: Visualization Study Data Tab

The “Export data” option allows recorded data to be exported for third party analysis. The data structure format is available in Annex 6 “Researchers Guide”. When clicking on the export button , a window will appear, and it will redirect you to the path where the file has been exported.



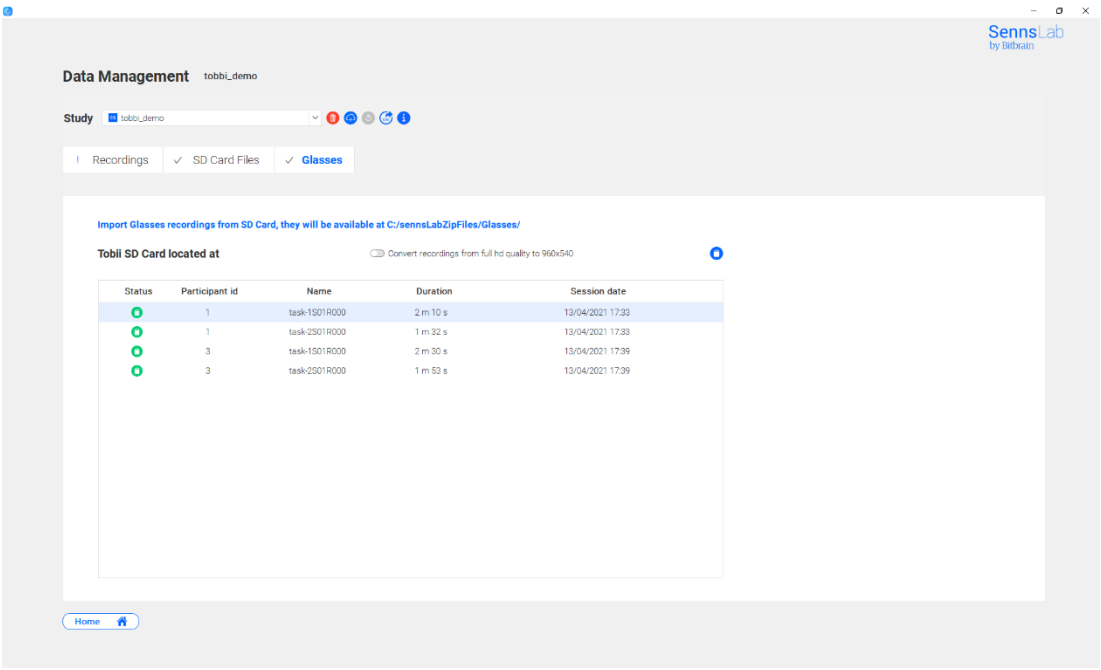
Screen 90: File exported



Screen 91: File path

MicroSD CARD FILES:

In the SD Card Files tab, data can be imported from a microSD card for analysis.



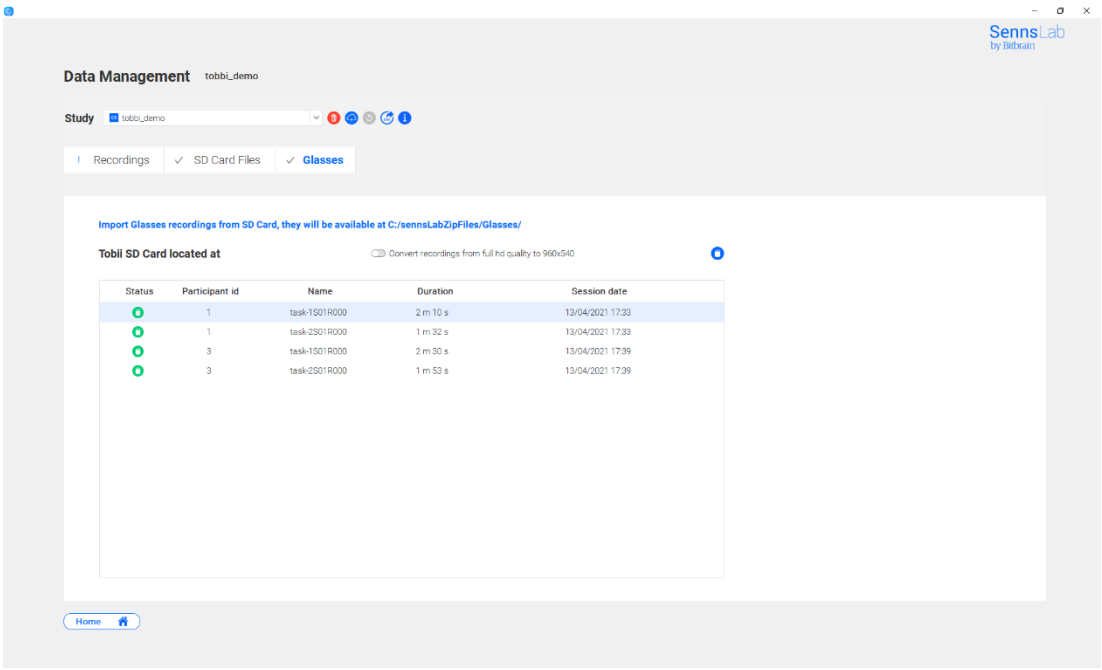
Screen 92: SD card files

At the bottom window, the status of the microSD card recordings is reported:

- the file has already been imported.
- the file has not been imported yet.
- the file has not been imported yet, but it has been located on a card plugged in the PC. Click on the import button (top right side).
- the file has not been imported because of a failure in the import process.
- Files can be imported by clicking on the button located on the right side.

GLASSES:

In the Glasses Tab recordings can be imported for analysis. In addition, data in raw format will be available. These files are fully compatible with Tobii Pro Lab software.



Screen 93: Glasses SD card files

You can see the status of the Glasses recordings in the bottom window:

the file has already been copied.

the file has not been copied yet.

the file has not been copied yet, but it has been located in a card plugged into the PC. Just click on the import button (top right side).

Files can be copied by clicking on the button located on the right side.

3. EXECUTION

This section discusses the structure of experiments for standard in-lab and outside-lab templates. This will introduce the nature of the studies that can be carried out through SennsLab.

The blocks that make up an experimental protocol are defined as:

- Familiarization (F): This is a block of stimuli chosen to familiarize the participant with the content of the test and the overall test protocol. Familiarization blocks are not analyzed and no data is collected. In some templates, familiarization content is automatically added by SennsLab - in addition to any you add yourself.
- Washout 1 (W1): The participants are instructed to close their eyes and enter a resting state. The washout block is meant to de-couple the emotional response from one block to the next and to establish a null baseline for EEG and biosensing data. This is a break where the participant clears their emotional response. W1 is positioned between the familiarization tasks and the rest of the study.
- Eyes open (OA): The participant is instructed to enter a state of rest with eyes open.
- Calibration (C): This block displays built-in stimuli to the participant as a method of determining the range of physiological responses for the individual, and normalizing across all participants. This is required for all biosensing and EEG tests. It is not to be confused with eye tracking calibration, which is done during test setup. Images and videos in this step are built into SennsLab and can not be changed.
- Washout 2 (W2): The second washout block is the same as the first, except it is positioned between the calibration and the actual test block.
- Test (T): This is the actual stimuli for evaluation and analysis
- Test survey (ST): This is a survey to have the participant evaluate the test images displayed as "Negative", "Neutral" and "Positive" in order to calibrate the valence calculation.
- Calibration Survey (TC): This is a survey to have the participant evaluate the calibration images displayed as "Negative", "Neutral" and "Positive" in order to calibrate the valence calculation.

Note that some blocks such as **Familiarization, Washout 1, Eyes open, Calibration, Washout 2, Test survey,** and **Calibration Survey** are used only for internal purposes and are not available for analysis in **SennsMetrics**.

It should be noted that, depending on the type of template and the devices to be used, the number of blocks may vary. Below are the blocks included in the experiment depending on the device:

Eye Tracker

F **T**

Ring

F **W1** **C** **W2** **T**

Diadem

F **W1** **OA** **C** **W2** **T** **ST*** **TC***

* Blocks only visible in the Passive Image template.

3.1 CALIBRATION TYPES

Depending on the type of stimulus template selected, a different type of calibration is displayed. The types of calibration are defined below:

Passive Image Calibration

The participant will visualize 12 images as defined by default in SennsLab. The images were obtained from the IAPS database and were selected based on a study carried out by Bitbrain.

"The following sequence will be displayed. First you will see a cross on the screen. Look at the target as long as it is displayed. A calibration image will then appear. Watch it in silence and try to limit body and head movement. When the word "rest" appears on the screen, relax and wait for the next cross to appear. The process will continue until all calibration images are displayed."

Passive Audiovisual Calibration

The participant will see 5 videos defined automatically in SennsLab. The selection of videos is based on a study carried out previously by Bitbrain.

"The following sequence will be displayed. First, you will see a cross on the screen. Look at the target as long as it is displayed. A calibration video will play. Watch it in silence and try to limit

head and body movement. When the word "rest" appears on the screen, relax and wait for the next cross to appear. The process will continue until all calibration videos are displayed."

Other Standard, In Lab and Out of Lab templates

In the remaining templates, two tasks are introduced before the main task is displayed.

- Familiarization (20 seconds) → The participant learns how to perform the calibration task
- Calibration (1 minute) → The participant is calibrated.

In this case, the calibration is a cognitive test with the objective of inducing controlled stress in the participant. The participant is asked to perform a math exercise. The briefing is as follows:

"Next I am going to tell you a number. When I say: "now", you will have to start subtracting from 7 in 7 as fast as you can, out loud and consecutively"

When one of these tasks is started, the participant will be asked to count backwards from a starting point, out loud, by a certain defined number. When the participant understands the task, start the countdown by pressing enter. At that time, the participant must begin performing the exercise. The time remaining will appear on the participant's screen, while a list of correct numbers will appear on the evaluator's screen.

It is very important not to intervene. There is no benefit to correcting mistakes and care must be taken to not overly frustrate the participants.

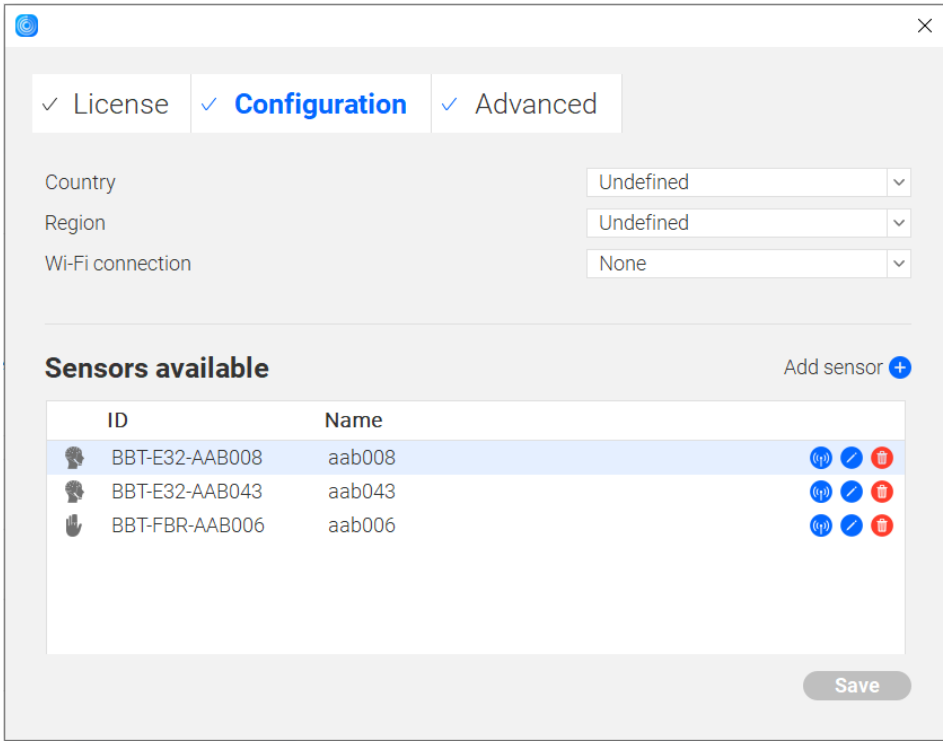
When time expires, the word "rest" will appear on the screen. At that time, the participant will be instructed to relax:

"Once the word "rest" appears on the screen, stop the math task and relax with your eyes open. Please limit head and body movement. In a few seconds, "close your eyes" will appear on the screen, when it does, please close your eyes until I tell you to open them."

4. ANNEX

4.1 ANNEX 1: DEVICES CONFIGURATION

To start the signal recording in SennsLab, the device needs to be added to the "sensors available" list. This list can be accessed on the "Launch study" screen, on the "Launch demo" dialog, and, on the Configuration tab. The configured devices will be displayed on this list. The functionalities of the available buttons are:



Screen 94: Device Configuration

Add sensor: a new device is generated to be configured.

Pair a sensor: pairing the device to the PC (required only for Bluetooth connection)

Edit a sensor.

Remove a sensor.

Save: allows to store the configuration once you have defined the devices.

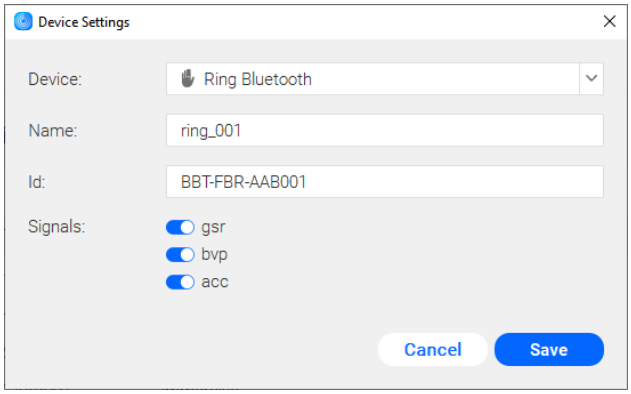
For Wi-Fi connection, there are three options:

- **Connect using virtual network:** Option that will appear selected by default. It does not require the use of an external device.
- **Connect to a network adapter:** Option to be used only if Bitbrain technical support has provided you with a WiFi router with the required configuration.
- **None:** If you select “None”, the networks for use will need to be configured manually.

Adding a new sensor.

Adding a new sensor requires entering settings such as type, name, ID/IP (info available in the device label) and the selection of the signals that will be recording.

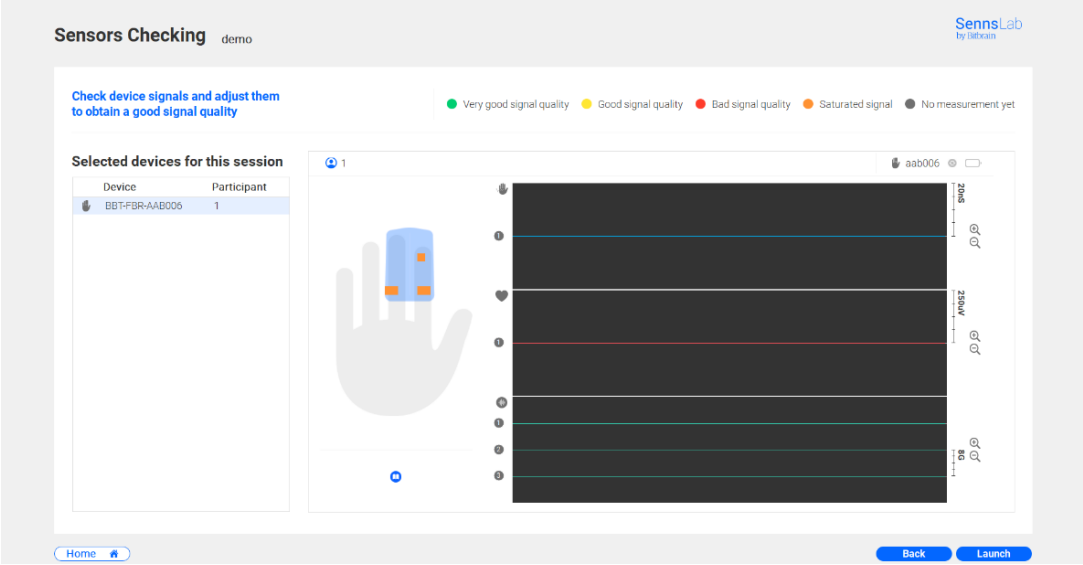
- Please consider: Unique name.
- Tobii devices should be connected in order to be configured.



Screen 95: Device Settings

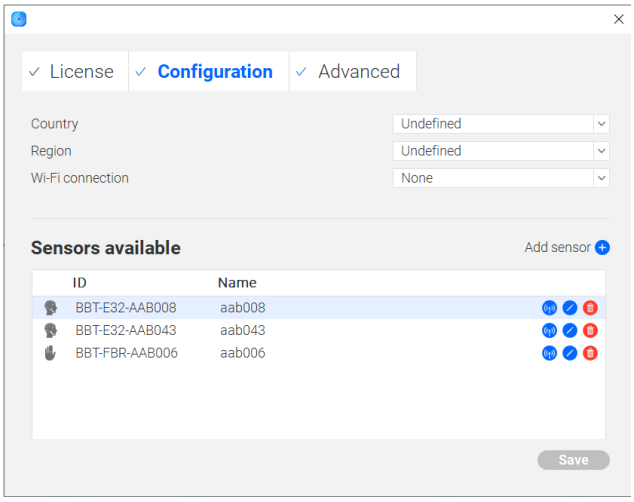
4.2 ANNEX 2: DETECTION OF MATCHING PROBLEMS WITH BLUETOOTH DEVICES

If the real-time signal is not displayed when launching a demo or study with a Bluetooth device, there may be a problem with pairing. We recommend the following process:



Screen 96: Sensors Checking – no signal

1. Go to the Configuration dialog (at the main screen) or any device list (demo or launch study) and re-pair the device in question (first turn it on) .



Screen 97: Device Configuration

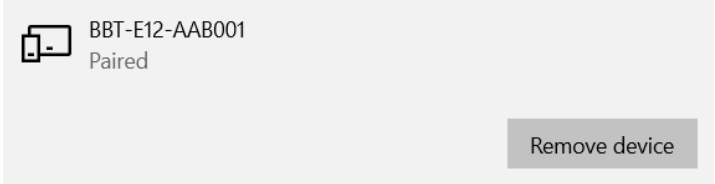
2. If “Device already paired” is shown, try to record again.

3. In case the warning displayed is “Device not found”, the problem comes from the management of Bluetooth devices in Windows. Therefore, the configuration must be done manually.

Screen 98: Bluetooth devices settings

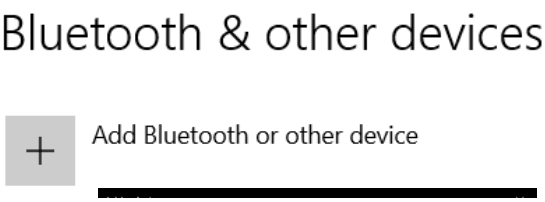
4. Access “Bluetooth and other devices settings” and identify the ID of the device that has caused problems.

5. Click on it and click on “Remove device”.



Screen 99: Bluetooth devices paired

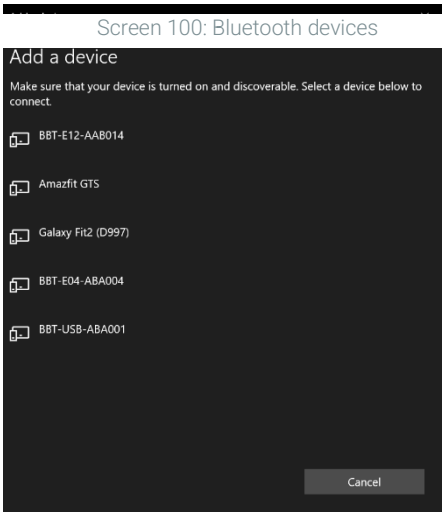
6. To add it again, turn on the device and click on “Add Bluetooth or another device”



Screen 100: Bluetooth devices

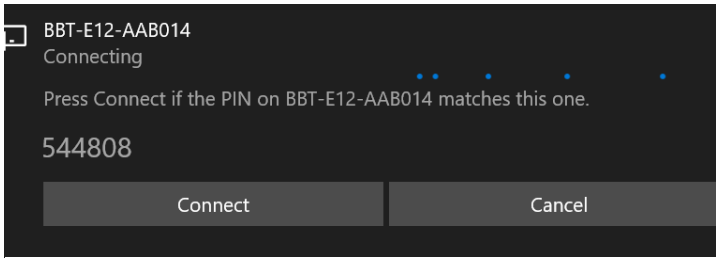
7. Select the type of device you want to add. In this case "Bluetooth".

8. A list with all the devices it finds will be displayed. Click on the device you want to add.



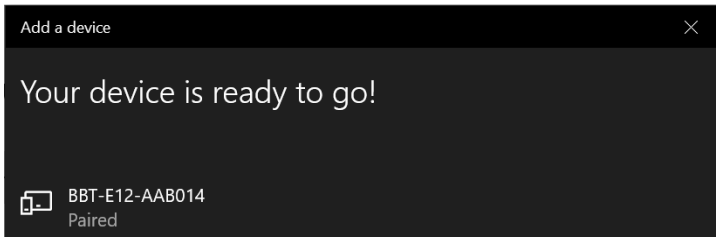
Screen 101: Device List

9. It will start the connection process. Click on "Connect". (In case no pin appears, and one is requested, put "1234")



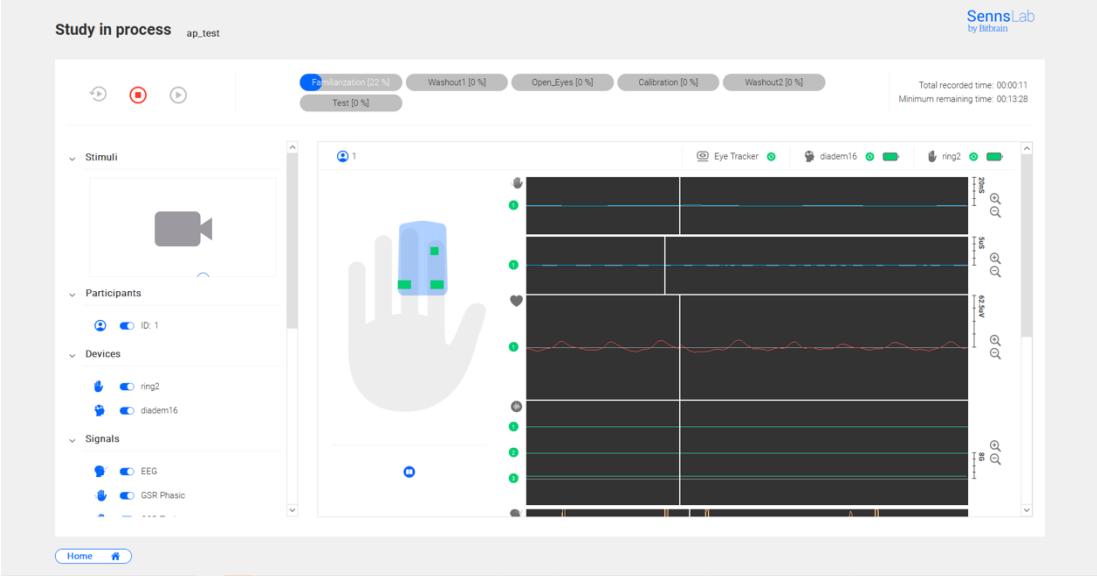
Screen 102: Connecting device

10. Once the connection is finished, the following screen will be displayed:



Screen 103: Device ready

11. Once configured,



launch **SennsLab** and check that it has been configured correctly.

Screen 104: Sensor Check - Finger

12. If **SennsLab** still does not show a signal online, please contact support@bitbrain.com.

Note: Bluetooth devices can only be paired with one computer at a time. If the device will not pair with the computer, verify that it is not already registered on a different computer in the vicinity.

4.3 ANNEX 3: TOBII GLASSES

To use Tobii Pro Glasses in SennsLab, you must connect them via Wi-Fi or Ethernet.

Wi-Fi Connection

Wi-Fi connection requires the following components:

1. SennsLab software v3.2 or higher (Tobii Pro Glasses 2) or SennsLab v7.1 or higher (Tobii Pro Glasses 3).
2. Tobii Pro Glasses 2 or 3.
3. A Wi-Fi adapter to connect to the Glasses network.

First, turn on Tobii Pro Glasses and connect the PC to its Wi-Fi network. To do this, connect to the network named TG02B-… or TG03B-… and then write the password “TobiiGlasses”.

Screen 105: Tobii Pro Glasses Wi-Fi network configuration

Ethernet Connection

Ethernet connection requires the following components:

1 PC with Windows 10 Operating System with available Ethernet port.

2 SennsLab software v6.0 or higher (Tobii Pro Glasses 2) or SennsLab v7.1 or higher (Tobii Pro Glasses 3)

3 Tobii Pro Glasses 2 or 3

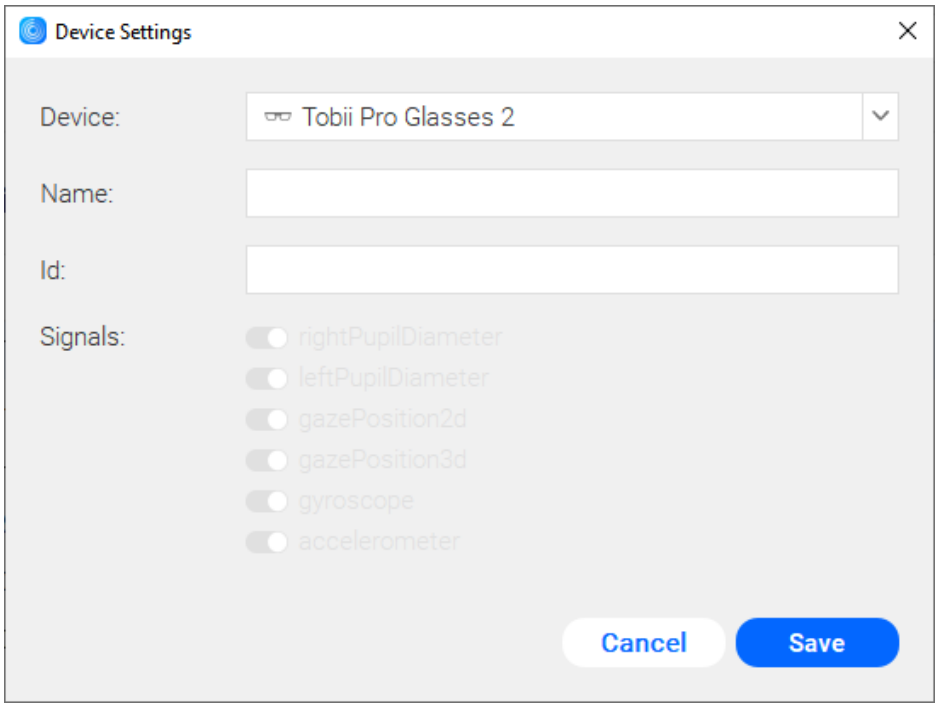
4 1 Ethernet cable

Then, turn on the Tobii Pro Glasses and connect the Ethernet cable to the SennsLab recording PC.

Add Tobii Pro Glasses to sensors available list

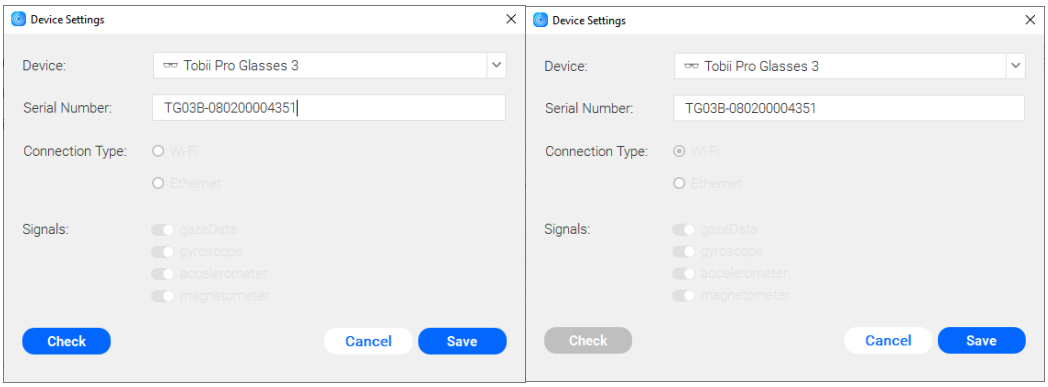
To run a study that includes **Tobii Pro Glasses**, this device needs to be added to "sensors available" list. To do that, follow these steps:

1. Connect **Tobii Pro Glasses** and **SennsLab** PC (by Wi-Fi or Ethernet)
2. Go to the "sensors available" list (Launch study, Demo or Configuration tab)
3. Click on Add new sensor
4. For Tobii Pro Glasses 2, select **Tobii Pro Glasses 2** from the device type list. The system will automatically connect to the device. The Name and Id fields will be fill out automatically.



Screen 106: Tobii Pro Glasses 2 configuration

5 For Tobii Pro Glasses 3, select **Tobii Pro Glasses 3** from the device type list. Type the serial number as the Name. Click on Check button, after that the system will check the connection automatically. If the Glasses are connected successful then the system will fill out the Connection Type field automatically.



Screen 107: Tobii Pro Glasses 3 configuration

The device will be displayed in the sensors list. Connect the device before starting any recordings.

4.4 ANNEX 4: SYNCHRONIZATION MESSAGE FORMAT

The synchronization messages interchanged (sent or received) by TCP/Ip connection must be a json with the following structure:

Input messages:

Message: Ack

- Use: During the execution of the study, the evaluation task(s) will only proceed when this message is received.
- Format: {"ack": "ack"}
- Answer: {"OPERATION": "ack", "STATUS": "Ok"}

Message: Start

- Use: Start task execution
- Format: {"start": "start"}
- Answer: {"OPERATION": "start", "STATUS": "Ok"}

Message: Repeat

- Use: Relaunches the last task execution
- Format: {"repeat": "repeat"}
- Answer: {"OPERATION": "repeat", "STATUS": "Ok"}

Message: Stop

- Use: Stop task execution
- Format: {"stop": "stop"}
- Answer: {"OPERATION": "stop", "STATUS": "Ok"}

Message: Event

- Use: Save an event in the data file, the content of the event will be an integer value
- Format: {"event": "1"}
- Answer: {"OPERATION": "event", "STATUS": "Ok"}

Output messages:

Message: Start

- Use: Message is sent when task execution begins
- Format: {"OPERATION": "start", "TASK": "task-2", "TIMESTAMP": "202968880727"}

Message: Stop

- Use: Message is sent when task execution stops
- Format: {"OPERATION": "stop", "TASK": "task-2", "TIMESTAMP": "202994599447"}

4.5 ANNEX 5: RESEARCHERS GUIDE

This guide explains how researchers can analyze the data registered using SennsLab.

SennsLab is a human behavior research software for study design and data collection with several sensor modalities. This is done in conjunction with the presentation of stimuli and the recording of behavior logs (webcam, video capture of the screen).

SennsLab supports synchronizing and exporting the data to plain text files (comma separated values, CSVs) together with metadata. Bitbrain provides import toolboxes in the most common data science programming languages to date: Matlab / EEGLAB toolbox; and Python/MNE toolbox.

This guide contains the following structure:

1. Data properties: properties of the signals (sensors data) and events (data for recovering the stimulation protocol, and synchronization with the behavior logs).
2. Export the data: synchronize and export the data in two output formats (Lite and Full).
3. Import the data: import the data in data science programming languages.
4. Sample-level sync between Bitbrain devices with TTL pulses.

Note that this does not cover signal processing methods, the researcher is directed to the official tutorials of EEGLAB and MNE.

4.5.1 Data properties

This section contains the description of the signal and event properties. The signal properties are grouped into devices sharing sensor modalities:

- Dry, Semi-dry EEG systems and Versatile Bio
- Ring device
- Tobii stationary eye-trackers
- Tobii Glasses

Signal properties of Dry, Semi-dry EEG systems and Versatile Bio

The EEG and biological signals are recorded without any filtering. [1-30] Hz filter is applied to the EEG for visualization purposes only.

The signals described in the table are recorded at 256 Hz and sent to the computer in blocks of 8 samples, except of the IMU signal (32 Hz, 1 sample per block).

SIGNAL TYPE	DESCRIPTION	DEVICE TYPE
eeg	**EEG signal** Number of channels * *The number of channels [value n] depends on the device type.	Air (n=8) Diadem (n=12) Immersive (n=10) Hero (n=10) Versatile 8 (n=8) Versatile 16 (n=16) Versatile 32 (n=32)
photodiode	**Photodiode input** Number of channels: 1	Air Diadem Immersive Hero Versatile: 8, 16, 32 Versatile Bio
din	**Digital input** Number of channels: 1* *The number of channels is 1, except for the Versatile 32 device (n=3)	Diadem Versatile: 8, 16, 32 Versatile Bio
dout	**Digital output** Number of channels: 1 This signal type generates TTL pulses that, when received in the DIN of another device, can be used to synchronize them at sample level.	Versatile Bio
imu	**Inertial measurement unit (IMU)** Number of channels: 9 - ch 1: accelerometer, x-axis - ch 2: accelerometer, y-axis - ch 3: accelerometer, z-axis - ch 4: gyroscope, x-axis - ch 5: gyroscope, y-axis - ch 6: gyroscope, z-axis - ch 7: magnetometer, y-axis - ch 8: magnetometer, x-axis - ch 9: magnetometer, x-axis	Air Diadem Immersive Hero Versatile: 8, 16, 32 Versatile Bio
analogic	**Input to record analogic signals such as GSR, respiration, temperature, etc.** The Versatile Bio has 7 analogic inputs.	Versatile Bio (n=7)
bipolar	**Input to record bipolar signals such as ECG, EMG, etc.** The number of inputs depends on the device type [value n].	Versatile 32 (n=2) Versatile Bio (n=9)

Signal properties of the Ring device

The biological signals are recorded without any filtering. [0.5-2] Hz and [0.5-4] Hz filters are applied to the GSR and BVP signals, respectively, for visualization purposes only.

The signals are recorded at 32 Hz and sent to the computer in blocks of 1 sample.

SIGNAL TYPE	DESCRIPTION	DEVICE TYPE
gsr_bvp_acc	The Ring device (either the WiFi or Bluetooth versions) provides the following signals: Number of channels: 5 - ch 1: galvanic skin response (GSR) - ch 2: blood volume pulse (BVP) - ch 3: accelerometer (ACC), x-axis - ch 4: accelerometer (ACC), y-axis - ch 5: accelerometer (ACC), z-axis Samples per block: 1 Sampling rate: 32 Hz	Ring WiFi Ring Bluetooth

Signal properties of the stationary Tobii eye-trackers

The sampling rate varies with the Eye-tracker model:

- Tobii Pro X2 (30-40Hz, depending on firmware)
- Tobii Pro Nano (60Hz), Tobii Pro X3-120 (120Hz)

We recommend consulting the manufacturer's documentation (Tobii).

SIGNAL TYPE	DESCRIPTION
tobii_fixed_signal	**Signal with the gaze properties and internal timestamp** Number of channels: 15 - ch 1: left eye, x coordinate - ch 2: left eye, y coordinate - ch 3: left eye, pupil diameter (mm) - ch 4: right eye, x coordinate - ch 5: right eye, y coordinate - ch 6: right eye, pupil diameter (mm) - ch 7: left pupil, x position - ch 8: left pupil, y position - ch 9: left pupil, z position - ch 10: right pupil, position x - ch 11: right pupil, position y - ch 12: right pupil, position z - ch 13: left pupil, validity code* - ch 14: right pupil, validity code* - ch 15: internal timestamp (us) * Validity codes are between 1 and 4, with 4 being the best value and 1 the worst value; and -1 if the pupil could not be found.

Signal properties of the Tobii Glasses 3.

The sampling rate is different for each signal (see table below).

We recommend consulting the manufacturer's documentation (Tobii).

SIGNAL TYPE	DESCRIPTION
gazeData	**Gaze data (2D & 3D)** Number of channels: 2 [50 Hz] - ch 1: gaze2d, x (mm) - ch 2: gaze2d, y (mm) - ch 3: gaze3d, x (mm) - ch 4: gaze3d, y (mm) - ch 5: gaze3d, z (mm) - ch 6: pupil diameter, left (mm) - ch 7: pupil diameter, right (mm) - ch 8: internal timestamp (us)
gyroscope	**Rotation** Number of channels: 4 [118 Hz] - ch 1: x (deg/s) - ch 2: y (deg/s) - ch 3: z (deg/s) - ch 4: internal timestamp (us)
accelerometer	**Accelerometer** Number of channels: 4 [118 Hz] - ch 1: x (m/s^2) - ch 2: y (m/s^2) - ch 3: z (m/s^2) - ch 4: internal timestamp (us)
magnetometer	**Magnetic field** Number of channels: 4 [10 Hz] - ch 1: x (uT) - ch 2: y (uT) - ch 3: z (uT) - ch 4: internal timestamp (us)

Signal properties of the Tobii Glasses 2.

The sampling rate can be 50 or 100 Hz depending on the version and firmware.

We recommend consulting the manufacturer's documentation (Tobii).

SIGNAL TYPE	DESCRIPTION
leftPupilDiameter **rightPupilDiameter**	**Diameter of the pupil (left & right)** Number of channels: 2 - ch 1: diameter (mm) - ch 2: internal timestamp (us)
gazePosition2d	**Projection of the gaze position in the video plane** Number of channels: 3 - ch 1: x (0-1) - ch 2: y (0-1) - ch 3: internal timestamp (us) The origin [0,0] is the top left corner and the bottom right corner corresponds to the point [1,1]
gazePosition3d	**Position where the gaze if focused** Number of channels: 4 - ch 1: x (mm) - ch 2: y (mm) - ch 3: z (mm)

	- ch 4: internal timestamp (us)
gyroscope	**Rotation** Number of channels: 4 - ch 1: x (deg/s) - ch 2: y (deg/s) - ch 3: z (deg/s) - ch 4: internal timestamp (us)
accelerometer	**Accelerometer** Number of channels: 4 - ch 1: x (m/s^2) - ch 2: y (m/s^2) - ch 3: z (m/s^2) - ch 4: internal timestamp (us)
sync	**Receives TTL pulses** Number of channels: 2 - ch 1: pulse (0-1) - ch 2: internal timestamp (us)

Event properties

The table shows all possible events logged by SennsLab along with a description.

EVENT	DESCRIPTION
General	
stopTask	Indicates whether the task was completed by user input (for example, by pressing the stop button) and not automatically. Values: 0 running, 1 stopped.
Stimuli	
stimulus	Stimulus presented, composed by two channels: - ch 1: Stimulus class (e.g., rest, target, familiarization, calibration, washout, attention). - ch 2: Stimulus name (e.g., image or video name).
keyMarker	Indicates the phase. Phases are defined in SennsLab, available only in Active Tasks.
videoPos	Time position of the video (in ms) being played.
Stimuli: mouse	
mousePosStimulusScreen	x-y position of the mouse pointer. The units are relative to the screen where the stimulus is displayed, in pixels. It must be enabled in SennsLab: "mouse recording" option. - ch 1: x position - ch 2: y position
mouseClickStimulusScreen	x-y position of the mouse when the user presses the left mouse button. The units are relative to the screen where the stimulus is displayed, in pixels. It must be enabled in SennsLab: "mouse recording" option. - ch 1: x position - ch 2: y position
Screen recorder	
screenCapturePos	Time position of the screen capture, composed by: - ch 1: time position (nanoseconds) where the frame was captured - ch 2: time position (nanoseconds) of the frame in the output video

Screen recorder: mouse	
mousePos	x-y position of the mouse pointer. The units are relative to the screen being recorded, in pixels. It must be enabled in SennsLab: "mouse recording" option. - ch 1: x position - ch 2: y position
Webcam recording	
cameraVideoPos	Time position of the webcam recording, composed by: - ch 1: time position (nanoseconds) where the frame was captured - ch 2: time position (nanoseconds) of the frame in the output video
TCP/IP sync	
tcpIP	Value of the event received by TCP/IP. This event corresponds to the message "Events", see "Section 5.4: Synchronization format message".
ackTcpIP	Time where the ACK event was received by TCP/IP. This event corresponds to the message "Ack", see "Section 5.4: Synchronization format message".
Tobii Glasses 3	
videoSync	Used to measure the correspondence between the glasses timestamps and the internal SD card timestamp - ch 1: pulse number (int) - ch 2: internal timestamp (us)
syncPort	Receives the TTL pulses - ch 1: direction (0:out/ 1:in) - ch 2: value (high/low) - ch 3: internal timestamp (us)
connectionState	Reflects changes in connection status - ch 1:status (0: not connected; 1: connected)
batteryState	Reflects the remaining battery time - ch 1: remaining battery time (s)
Tobii Glasses 2	
videoSync	Synchronization between Tobii Glasses signals and recorded video time. This event is emitted every second (1 Hz) and is composed by 2 channels: - ch 1: presentation time, pts (us) - ch 2: internal timestamp (us)

4.5.2 Export data

This section describes how to export the data to plain text files (comma separated values, CSVs) together with metadata, and the two available output formats (Lite and Full).

Note that, before proceeding with the data export, SD card recordings (if enabled) should be imported. If not, the exported data will contain the data received during online operation with possible missing values. To import the SD card recording in SennsLab see "2.4.1 Data management", section "MicroSD Card Files".

The export procedure performs some data synchronization steps depending on the desired output properties of the data. Two output formats are available: Lite and Full.

The researcher can select them in the configuration dialog (advanced options) on the main screen.

Lite format

Oriented to researchers. Exports the signal values along with the reception timestamps. In the case of Bitbrain devices, it also provides the sequence numbers and corrected timestamps (based on the initial timestamp estimation).

Exported files in the Lite format.

One CSV file for each signal:

- Bitbrain devices:
  - signal values
  - sequence number
  - timestamp (reception), might be null if package was lost online
  - timestamp (corrected), using the initial timestamp (t0) computation
- Tobii eye-trackers:
  - signal values (last channel is the internal eye-tracker timestamp)
  - timestamp (reception)

One CSV file for each event: timestamp and event channel values.

Metadata file (info.json)

- Initial timestamp (t0) and estimated sampling rate are computed for each signal (only applied to Bitbrain devices)

Full format

Oriented to general users. Exports the signal values aligned to a common starting point (padding) and at a fixed sampling rate. Data continuity is ensured by filling the lost data packages (if any) with null values.

There are two kind of corrections that affect the Bitbrain devices: the soft correction, which does not perform any resampling of the data (from estimated sampling rate to the nominal one); and the complete correction, which might resample the data.

Exported files in the Full format.

One CSV file for each signal: signal channel values

One CSV file for each event: timestamp and event channel values

Metadata file (info.json)

- Initial timestamp (t0) and estimated sampling rate are computed for each signal.
- Initial timestamp (t0) of the recording (all signals).

Output directory

For each task of a study recording, files are exported to the path:

C:\SennsLab ZipFiles\exportData\Study_name\Participant_Id\Session#\Task_name

Metadata description

A description of the metadata information is provided. This description is provided in the code of the importers (next section) as well and is the recommended procedure for the researchers to proceed.

Two types of timestamps are provided:

- High resolution timestamps for time-interval measurements: t0 and tn timestamps use this unit (using QueryPerformanceCounter in Windows OS).
- UTC timestamps: these timestamps measure absolute time units (using GetSystemTimePreciseAsFileTime in Windows OS) and can be used to synchronize to external events.

The metadata is provided in a file with a JSON data format with the following fields:

system

- version: version of the data exporter
- adjust: full, lite
- method: soft (no resampling), complete (resampling) (full export only)

status:

- ok: bool, indicates whether the data export and loader worked fine
- t0: float, initial timestamp (us) of the recording (full export only)
- tn: float, final timestamp (us) of the recording (full export only)
- utc: object with fields:
  - enabled: bool, indicates whether UTC timestamp could be measured
  - stable: bool, indicates whether the UTC timestamps were stable
  - t0: float, initial timestamp (us) in UTC units (when stable = true)
  - tn: float, final timestamp (us) in UTC units (when stable = true)

signals: array object of:

- id: string, id
- num_channels: int, number of channels
- num_elements: int, samples per block
- sampling rate: int, nominal sampling rate
- other information:
  - signal loc: string list, list of EEG positions (only available for EEG)

- subject name: id of the participant
- device name: id of the device
- device type: device type, see the abbreviations below

    Air: bth_diadem_b
    Diadem: bth_diadem_ec
    Immersive: bth_immersive
    Hero: bth_motor_cap
    Versatile n channels: bth_cap_{n}
    Versatile Bio: bth_biosensing
    Ring wifi: wifi_ring, Ring Bluetooth: bth_ring
    Tobii Glasses 2: et_tobii_glasses, Tobii Glasses 3: et_tobii_glasses_3
    4. stationary Tobii eye-tracker: et_tobii_fixed
- signal type: signal type

- status: status of the export procedure on this signal, object with fields:
    - enabled: bool, indicates whether the signal could be exported
    - error_flag: int, indicates the error (when enabled = false)
    - error_message: string, indicates the error (when enabled = false)
    - sd_sync_read: bool, indicates whether the sync file in Bitbrain device was read
    - sd_data_read: bool, indicates whether the data file in Bitbrain device was read
- internal: advanced metadata information, object with fields:
    - sr_no: int, nominal sampling rate
    - sr_st: double, estimated sampling rate
    - pad_ini: int, number of padding samples added to the beginning (full export only)
    - pad_end: int, number of padding samples added to the end (full export only)
    - t0: float, initial timestamp (us)
    - tn: float, initial timestamp (us)
    - utc: object (idem as utc object in status)

event: array object of:

- id: string, id
- num_channels: int, number of channels
- other information: subject name, device name, device type, config

4.5.3 Import data

Bitbrain provides a toolbox to easily load the data into Matlab and Python.

Loading the data in Matlab and EEGLAB

The function 'platform_loader' imports the data into the Matlab workspace. Check the function documentation in the code for the details of the outputs.

[PROP, SIGNALS, EVENTS, LOG] = platform_loader(folder);

In addition to this, we provide an example code to import the data into EEGLAB. Check the example scripts for the details. Note that EEGLAB expects data to present no discontinuities, thus the full format should be used.

Loading the data in Python and MNE

The 'platform_loader' module imports the data into Python. Check the module documentation in the code for the details of the outputs.

It requires Python >= 3.7, and the following packages: numpy, mne, matplotlib, PyQt5.

prop, signals, events, log = platform_loader.load (folder)

4.5.4 Sample level synchronization

Bitbrain has hardware components to allow two devices to be synchronized at the sample level. The concept is that one device (or an external component) sends a TTL pulse to the other device/s. Specifically, we support the following two cases:

- Versatile Bio has a "Digital output" signal that, when enabled, sends TTL pulses that are received in the "Digital input" of another device. This case requires a component (TTL Trigger Bio cable) to connect the digital ports.
- An external component (TTL hyper scanning) sends TTL pulses that are received in the "Digital input" of two devices.

In both cases, a TTL pulse is sent every 4 seconds encoding an 8-bytes number.

TTL pulses description:

Version 1: Hamming TTL pulses (8-bits number every 4 seconds)

- One pulse every 4 seconds.
- Each pulse is composed of two sequential bytes.
- Each byte has the following structure:
  - Bit 1 set to 1 (used to detect the onset)
  - Bits 2 to 8 encode a Hamming(7,4) code, i.e., a 4-bits number (left-msb) to detect corrupt transmissions.
- The two 4-bits numbers are interpreted as an 8-bits number.

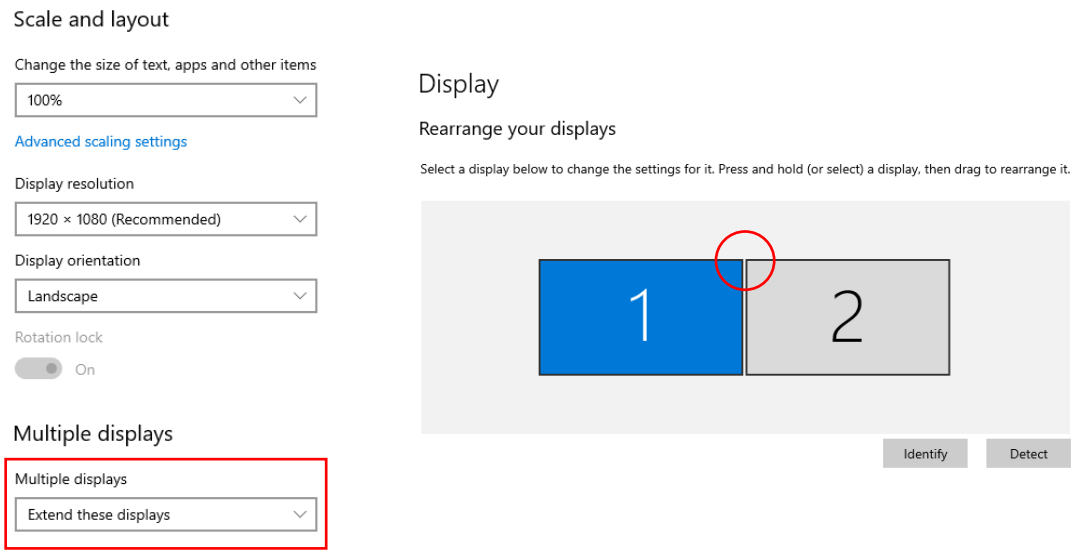
* Initial version (version 0) sent a TTL pulse every 8 seconds: only one byte (7-bits number, left-msb) with no error checking.

We provide functions in Matlab and Python ('pulse_decode') to do this decoding: they provide as output an array of (position, code) for each pulse. Check the function documentation in the code for more details.

Based on these codes, the researcher can align the recorded signals from different devices at the sample level.

4.6 ANNEX 6: POSITIONING OF SCREENS

For the stimuli to be displayed correctly on the screen that the participant has been seen, the relative the required positioning of the screens is as follows:



Screen 108: Display settings

To do this, right-click on the desktop. Choose the option "Display settings" from the menu that is displayed. Next, make sure the main screen is on the left and the secondary screen is on the right with the top edges attached as shown in the figure above. Please note that the numbers 1 and 2 do not mean primary and secondary screen, they are only an identification of the screens. The main screen is the one with the Windows start menu drawn inside, and the one without the start bar is the secondary one. In the example above the numbers match, but it is not necessary. To reposition the displays simply click on the secondary display and drag it to the indicated position.

4.7 ANNEX 7: MOBILE SETUP

Follow these instructions to configure a mobile to be used in a study based on the “Ux on Mobile” template.

Only Android is supported. The device must be set on developer mode and USB debugging option. Once the device has been set in developer mode and USB debugging mode on, plug it in the SennsLab recording PC (connect by USB). During the recording, the device needs to be placed over the screen and above any screen-based eye-tracker.

This set up will allow SennsLab to detect where the participant is looking. The participant gaze and the mobile screen recording will be shown in SennsMetrics.

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