

Behavioral Observation Research Interactive Software (BORIS) user guide

BORIS is an easy-to-use event logging software for video/audio coding and live observations. BORIS is a free and open-source software available for GNU/Linux, Windows.

This user guide apply to the **version 8.13** of BORIS.

Since the version 8 BORIS is based on the MPV media player (see <https://mpv.io>) and allow the recording of events much more precisely. See http://www.boris.unito.it/pages/boris_v8.html for all the improvements of v. 8.

www.boris.unito.it



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Follow BORIS

BORIS web site: www.boris.unito.it

BORIS GitHub repository

Mastodon

Spoutible

BORIS twitter feed

BORIS YouTube channel

Legal

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Install BORIS

BORIS can be installed following instructions on the BORIS site at [download page](#)

All previous versions of BORIS are available in the **Releases** section of the [GitHub repository](#)

Linux

BORIS can run on various Linux distributions including Ubuntu, Debian, [Raspberry Pi OS](#), Chromebook ...).

See the [BORIS for Linux](#) page to install BORIS for Linux.

Microsoft-Windows

See the [Download BORIS for Microsoft-Windows](#) page to install BORIS for Windows.

Two versions are available: **BORIS Portable** and **BORIS Setup**

MacOS

As I have no access to a physical Mac computer the v.8 is not natively able to run under MacOS at the moment.

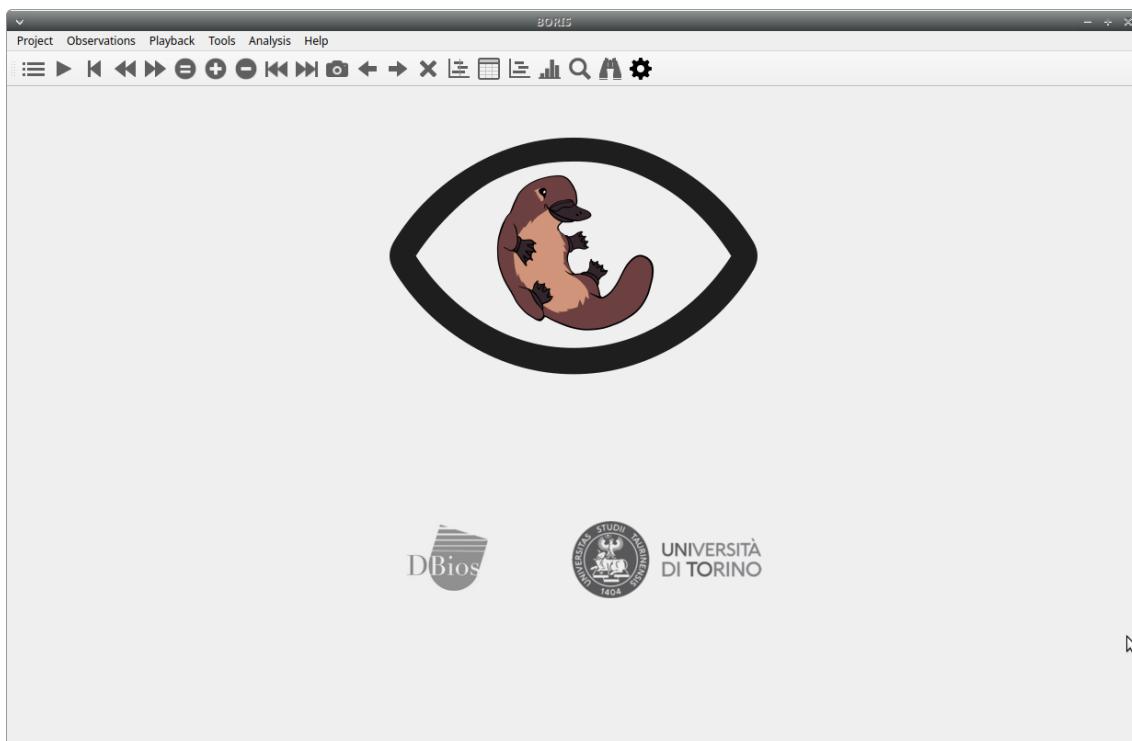
Otherwise there are various possibilities to run BORIS v. 8 on a Mac:

- Use the BORIS Docker
- Use BORIS for Windows with Boot Camp Assistant
- Use BORIS from Windows or Linux with Parallels® Desktop for Mac
- Running GUI Linux in a virtual machine on a Mac
- Switch to another OS

Launch BORIS

Start BORIS by clicking on its icon. For launching BORIS from sources see the BORIS web site. When launching BORIS for the first time it may take some time to show up. Please be patient!

The main window of BORIS will show up. The toolbar with media player commands is disabled for now.



Warning

On **Microsoft-Windows**, launching can be stopped by a *Security warning: The publisher can not be verified. Are you sure you want to run this software?* Click the *Run* button to launch BORIS.

Note

The **first launch** of BORIS can be long, so be patient. A terminal/command prompt window will show up, it is normal. Do NOT close it!

At the first launch, BORIS will ask you to allow the automatic check for new version. Internet access is required for this feature. If you choose **Yes** BORIS will check for new version about every 15 days. This option can be changed on the **Preferences** window (See [general preferences](#))

You can launch BORIS from command line by specifying the project file to open:

```
start_boris -p MY_PROJECT.boris
```

Create a new project with BORIS

The BORIS project file is the container for all information related to the project. It contains the **ethogram**, the **independent variables**, the **subjects definition**, the **behaviors coding maps**, the **converters** and all **observations** data. The save menu option (**File > Save project** or **Save project as ...**) will save the project in a path in your local file system. You can also activate the [automatic backup](#) feature (see **Preferences**).

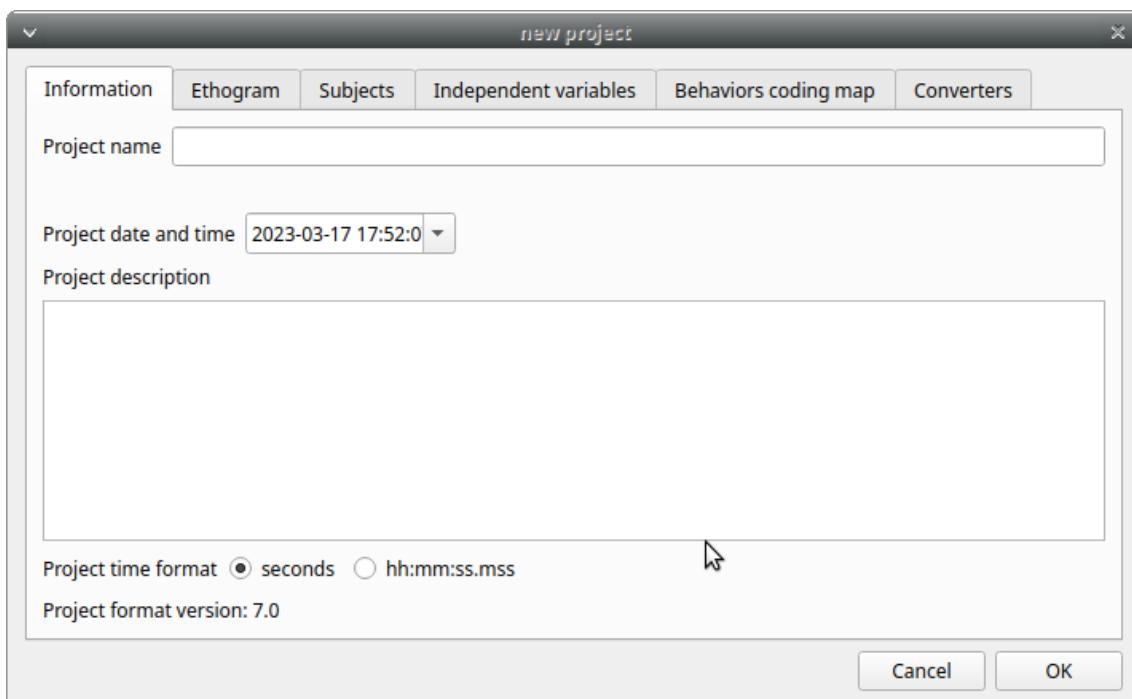
Important

It is EXTREMELY IMPORTANT to do regular backups of your project files to prevent the lost of data. Software can be reinstalled but your data could quite possibly be lost for ever. Use an external drive or/and a cloud service.

BORIS allows creating an unlimited number of projects but only one project can be opened at a time.

A video tutorial about creating a project is available at <https://www.youtube.com/watch?v=I97Dny5hFOE>

To create a new project, under the menu **File** , select **New project**. You can determine your project name by writing in the **Project name** field in the **Information** tab. Once the project will be saved, the **Project file path** will show the full path to your project file. **Date** will automatically set on the current date and time, but you can alternatively set this info on your media date and time, or whatever you prefer. **Description** can host all the relevant information about your project, can be also left empty. **Time format** can be alternatively set to **seconds** or to **hh:mm:ss.mss**. This choice can be changed at anytime under **File > Preferences** (for MacOS users, **BORIS > Preferences**) > **Default project time format**.



Set an ethogram

See <https://en.wikipedia.org/wiki/Ethogram> for ethogram definition.

Switching to the **Ethogram** tab, you can alternatively:

- set your ethogram from scratch;
- import an existing ethogram from another BORIS project;
- import an ethogram from a JWatcher global definition file (.gdf).
- import an ethogram from a plain text file

The screenshot shows the 'edit project' window with the 'Ethogram' tab selected. On the left is a table with columns: Behavior type, Key, Code, and Description. The table contains 10 rows of behavior definitions. On the right is a panel with buttons for 'Behavior', 'Import ethogram', 'Behavioral categories', 'Exclusion matrix', and 'Export ethogram'. At the bottom are 'Cancel' and 'OK' buttons.

Behavior type	Key	Code	Description
1 State event	T	Tear	Otter tears off vegetation
2 State event	C	Chase	Otter chases other animals
3 State event	I	Interact with enrichment	Otter interacts with enrichment
4 State event	R	Rub	Otter rubs and rolls itself upon a surface; may be accompanied by sniffing (Ethol, 2015)
5 State event	C	Carry objects	Otter carries objects or food by holding them against the cheek with one front paw while hobbling on three legs
6 State event	S	Sniff	Otter moves the nose and head movement back and forth while not engaged in the rub behavior (Ethol, 2015)
7 State event	L	Locomotion	Otter moves from place to place
8 State event	S	Spot keeper	Otter spots the keeper in or out the enclosure
9 State event	A	Alert	Otter is stationary and directs its attention towards something or someone (Hasenjager, 2011)
10 State event	Q	Allogroom	Otter licks or scratches with forepaws or hind-paws another river otter's fur (Ethol, 2015)

The screenshot shows the 'edit project' window with the 'Behaviors coding map' tab selected. On the left is a table with columns: Color, Category, Modifiers, and Exclusion. The table contains 10 rows of behavior definitions. On the right is a panel with buttons for 'Behavior', 'Import ethogram', 'Behavioral categories', 'Exclusion matrix', and 'Export ethogram'. At the bottom are 'Cancel' and 'OK' buttons.

Color	Category	Modifiers	Exclusion
#00aaff			Vomit
#ff007f	physiology	{"0": {"name": "", "type": 0, "values": ["Alone (1)", "In group (2)"]}, "1": {"name": "", "type": 0, ...}}	Alert,Allogroom,Breed,Carry ...
ffff00	physiology		Alert,Allogroom,Breed,Carry ...
#55ff00	physiology		Alert,Allogroom,Breed,Carry ...
#55ffff	physiology		Alert,Allogroom,Breed,Carry ...
#aaff7f	physiology		Alert,Allogroom,Breed,Carry ...
#aaaaff	physiology		Alert,Allogroom,Breed,Carry ...
#aaaa00	reproduction		Alert,Allogroom,Carry ...
	social	{"0": {"name": "", "type": 0, "values": ["Nina (N)", "Himal (H)", "Sharky (C)", "Nautilus (S)", ...]}	Alert,Allogroom,Breed,Carry ...
	social	{"0": {"name": "interaction", "type": 1, "values": ["Himal", "Nautilus", "Nina", "Sharky"]}}	Alert,Allogroom,Breed,Carry ...

Set your ethogram from scratch

Clicking on the **Behavior** > **Add behavior** button you can add a new row in the **Ethogram** table and behavior type will be automatically set to **Point event**.

The cells with gray background can not be directly edited. You must double-click on them and then select a value.

Behavior types

2 types of behaviors can be defined. Double-click on the cell and select the type of behavior:

- **Point event behavior when the behavior has no duration.**

The behavior will be coded by pressing the defined keyboard key (see below) or by double-clicking to the corresponding row in the Ethogram table.

- **State event behavior when the behavior has a duration.**

The behavior start and stop will be coded by pressing the defined keyboard key (see below) or by double-clicking to the corresponding row in the Ethogram table. These behaviors **must** have a start event and a stop event otherwise an **UNPAIRED events** warning will be reported when you will close the observation or during an analysis.

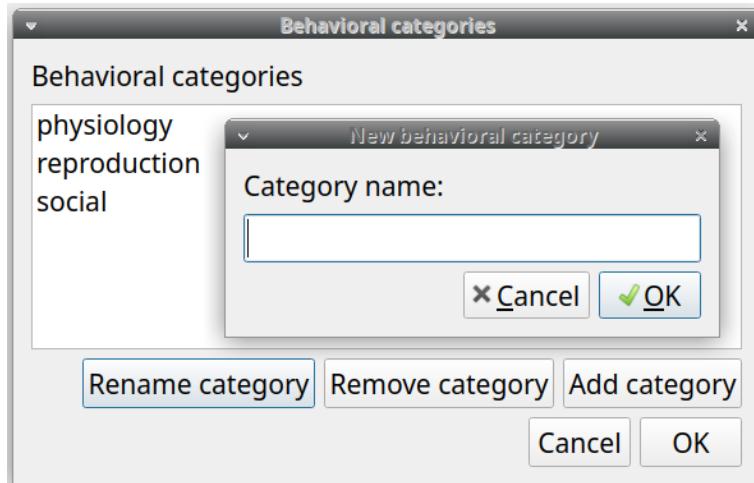
You can switch between **State event** and **Point event** at your convenience with a double-click on the **Behavior type** cell. You can also add a **Coding map** to either a **State event (State event with coding map)** or a **Point event (Point event with coding map)**; see the "Coding map" section for details).

An existing behavior can be duplicated using the **Clone behavior** button. Its code have then to be changed. On a selected behavior, click on the **Remove behavior** button to remove. The **Remove all behaviors** button will clear the **Ethogram** table. Both the above-mentioned operations must be confirmed when prompted.

Behavioral codes (**Code** column) can be sorted alphabetically by checking the **Alphabetical order** checkbox. Alternatively they can be sorted manually by using the **Move up** and **Move down** buttons.

Categories of behaviors

Defining categories of behaviors can be useful for the analysis of coded events (for example the time budget analysis). Click the **Behavioral categories** button and add the categories of behaviors. Behaviors can then be included or not in a defined category.



Set keys and codes

For each behavior you have to set a keyboard key (**Key** column) that will be then used to code the behavioral events. You can choose whether you want to set a unique key for each behavior or use the same key for more than one behavior. In the case you set the same key for more than a behavior, BORIS will pause your coding and ask which of the behavior you want to record. From version 7 the keys are **case-sensitive**.

If your project was created with a previous version of BORIS (< v.7) you can use the **Convert keys to lower case** to convert all keys to lower case otherwise you will have to code your observation using upper case key.

Important

If you open a project file created with a version older than v.7 BORIS will ask you to convert the upper case behavior and subject keys to lower case.

Important

Do not use the / and * keys! They are reserved for the frame-by-frame mode.

In the **Code** column, you have to add a unique code for each behavior. Duplicated codes are not accepted and BORIS will warn in red about duplicates on the bottom left of the *Ethogram* tab. The code can be an alphanumeric string (which must not include the pipe character |).

The **Category** column allow you to include the behavior to a predefined behavioral category.

The **Description** of your behavior is optional. The **Description** column can be useful to add information about a specific behavior, its characteristics (e.g. to standardise observation between different users) or to refer to external information (e.g. reference to a previous ethogram).

The following three columns (**Color**, **Modifiers**, **Exclusion**, **Coding map**) cannot be edited from the *Ethogram* table.

The **Color** column allow to select a color for the behavior. This color will be used for plotting events.

Set the modifiers

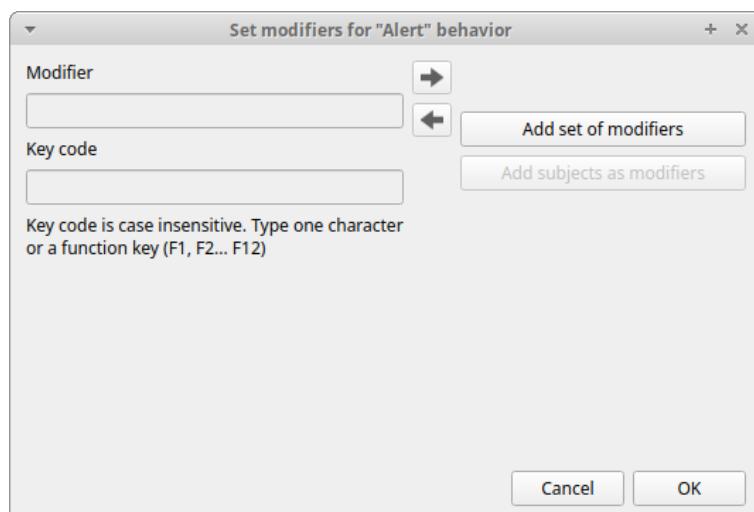
Modifiers can be used to add attributes to a behavior. A single behavior can have two or more modifiers attached (e.g. "play" may have "solitary" or "social" as modifiers). The use of modifiers can be convenient to significantly reduce the number of keys and simplify the behavioral coding.

4 types of modifiers are available: **Single selection**, **Multiple selection**, **Numeric** and **Value from external data file**:

- the **Single selection** type will allow the observer to select only **one** modifier for the current behavior.
- the **Multiple selection** type will allow the observer to select one or more modifiers for the current behavior.
- the **Numeric** type will allow the observer to input a number. For example a distance of interaction.
- the **Value from external data file** type will save the value of a variable from an external data file.

In BORIS modifiers can also be added in different modifier sets [e.g. "play, social" may have a modifier set (#1) for "brothers" and another (#2) for "sisters"]. In the case of using sets of modifiers, you can select one/more modifier for each set.

To add modifiers to a behavior, you need to double-click the **Modifiers** cell corresponding to the behavior you want to add the modifiers to. The following window will show up:



Click the **Add a set of modifiers** button:



Select the modifier type using the **Modifier type** combo box. You have to choose between **Single selection**, **Multiple selection Numeric** and **Value from external data file**.

Single selection and Multiple selection modifiers

Set a name for the new modifiers set by typing it in the **Set name** edit box. Setting a modifiers' set name is not mandatory.

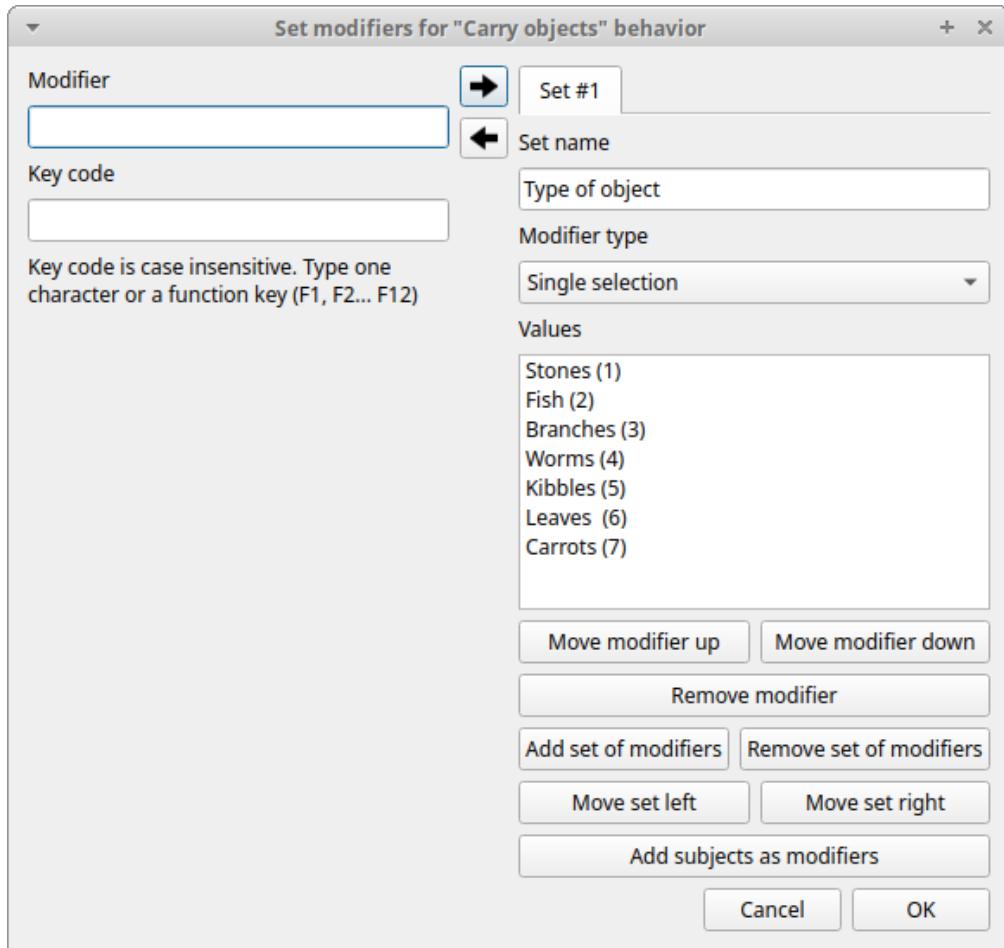
Within a set of modifiers, you can add a modifier by writing the modifier in the **Modifier** edit box. You can choose a shortcut (one character - case sensitive) to this modifier (optional). Then press the **right-arrow** button to add the new modifiers to the set.



To modify a modifier, select it and press the **left-arrow** button, edit the modifier and press the **right-arrow** button.

A modifier can be removed by pressing the **Remove modifier** button.

After adding all modifiers the window will appear like this:



All defined subjects can be added as modifiers using the **Add subjects as modifiers** button. This can help in case of coding the interactions between subjects for example.

The modifiers can be loaded from a plain text file Use the **Load modifiers from file** button.

The modifier position into the modifiers' set can be manually set using the **Move modifier up** and **Move modifier down** buttons. The modifiers can be sorted alphabetically (use the **Sort modifiers** button).

You can add and/or remove sets using the buttons **Add set of modifiers** and **Remove set of modifiers**.

The position of a modifiers' set can be customized (using the **Move set left** and **Move set right** buttons)

Modifiers can not contain the following characters: ()`~!

Example of a **multiple selection** modifiers set:



Many values can be selected together.

Example of 2 sets of modifiers:





Numeric modifier

Set a name for the new set by typing it in the **Set name** edit box. Setting a modifiers' set name is not mandatory.

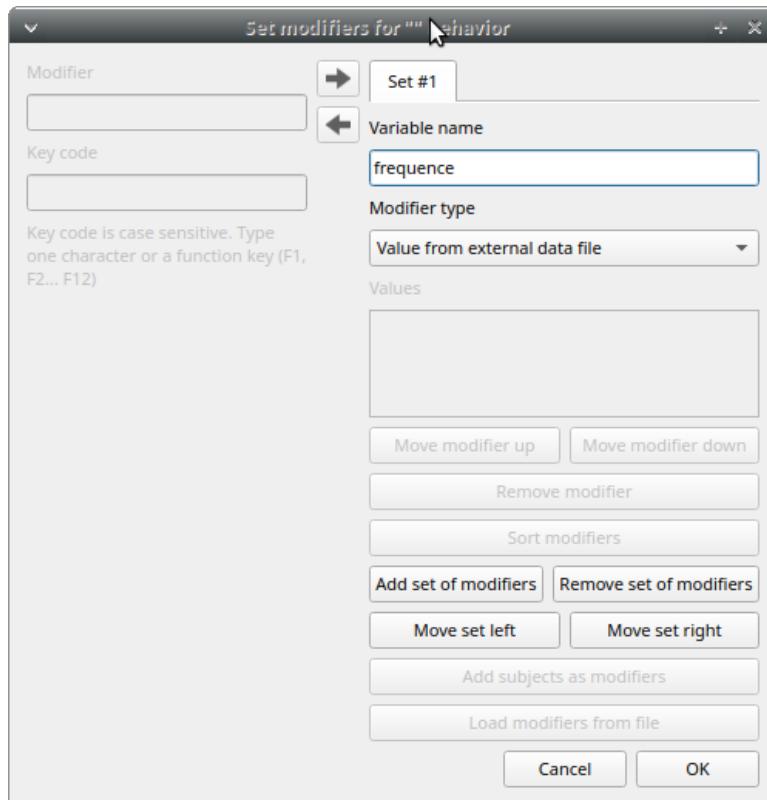
When a **Numeric** modifier will trigger, BORIS will ask the observer for a numeric value.

Value from external data file modifier

This modifier can be used to record the value of a variable coming from an external data file (defined during the creation of the observation).

You have to define the variable name in the **Variable name** edit box. This is mandatory and the name of the variable **must** be the same than the variable defined in the observation.

See [External data files](#)



Click **OK** to save modifiers in the **Ethogram** table.

Set the exclusion matrix

The occurrence of an event (State or Point) can exclude the occurrence of a state event. This can be set using the **Behaviors exclusion matrix** window, which can be opened clicking on the **Exclusion matrix** button. BORIS will ask for including **Point events** or not and a new **Exclusion matrix** window will open.

Exclusive behavior may be selected by checking on the corresponding checkbox in the automatically-generated matrix. We suggest to work on the **Exclusion matrix** when all the behaviors have been added to your ethogram.

All behaviors can be excluded by a particular behavior by selecting the corresponding entire row (click on the row header of the behavior) and by clicking on the **Check selected** button. You can also uncheck all behaviors by selecting the **Uncheck selected** button.

Example of an **exclusion matrix**:

Behavior exclusion matrix																	
Check if behaviors are mutually exclusive. The Point events (displayed on blue background) cannot be excluded)																	
	Tear	Chase	Interact with enrichment	Rub	Carry objects	Sniff	Locomotion	Spot keeper	Alert	Allgroom	Dig	Look for food	Manipulate	Roll objects	Self-groom		
Vocalize	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Yawn	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	
Tear		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Chase	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Interact with enrichment	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Rub	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Carry objects	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Sniff	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Locomotion	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Spot keeper	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Alert	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Allgroom	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Dig	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Look for food	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Manipulate	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Roll objects	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Self-groom	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Sleep	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Stomp	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Swim	✓	✓	□		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Eat	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Defecate	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Drink	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Rest	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Urinate	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Vomit	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Breed	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Play on the ground	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Play in the water	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

[Check all](#) [Uncheck all](#) [Revert check](#) [Check selected](#) [Uncheck selected](#) [Cancel](#) [OK](#)

For example in the previous figure, the **Alert** behavior will exclude the following behaviors: **Allgroom, Breed, Carry objects, Chase ...**

During the observation, the excluding event will stop all the current excluded state events one millisecond before the occurrence of the event.

Import an ethogram from an existing project

Behaviors within an ethogram can be imported from an existing BORIS project (.boris) using the **Import ethogram > from a BORIS project** button. BORIS will ask to select a BORIS project file and whether imported behaviors should replace or be appended to the **Ethogram** table. Imported behaviors will retain all the previously defined behavior parameters (namely Behavior type, Key, Code, Description, Modifiers and Exclusion information).

Import an ethogram from a JWatcher global definition file (.gdf)

Behaviors can be imported from a JWatcher global definition file (.gdf) using the **Import ethogram > from JWatcher** button. BORIS will ask to select a JWatcher file (.gdf) and whether imported behaviors should replace or be appended to the **Ethogram** table. Behavior type and exclusion information for the behaviours imported from JWatcher have to be redefined.

Import an ethogram from a plain text file

Behaviors can be imported from a plain text file using the **Import ethogram > from text file** button. The fields must be separated by TAB, comma (,) or semicolon (;). All rows must contain the same number of fields.

The fields will be interpreted as:

- 1st column: Behavior type **State event** or **Point event** (mandatory)
- 2nd column: Key (one character - case insensitive)
- 3rd column: Behavior code (must be unique)
- 4th column: behavior category (empty if no category)
- 5th column: Description of behavior(optional)

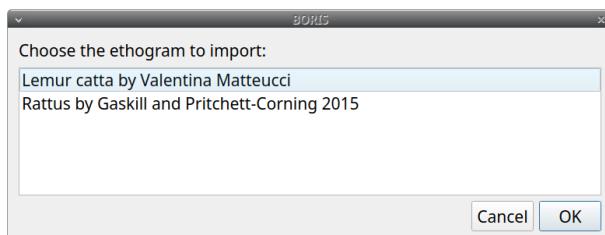
All fields after the 5th will be ignored.

BORIS will ask to select a plain text file (by default: *.txt *.csv *.tsv) and whether imported behaviors should replace or be appended to the **Ethogram** table. The missing information for the behaviours imported from text file have to be redefined.

Access to the BORIS ethogram repository

This function can be activated by clicking the **Import ethogram > from the BORIS repository** button.

A list of available ethograms will open and an ethogram can be loaded in the current project.



Export the ethogram

The entire ethogram can be exported in various formats (TSV, CSV, XLS, ODS, HTML). See **File > Edit project > Ethogram tab > Export ethogram**

Define the subjects

BORIS allow to code behaviors for different subjects within a single observation. The **Subject** table allows specifying subjects using a **Key** (e.g. the **k** on your keyboard), **Subject name** (e.g. "Kanzi"), **Description** (e.g. male, born October 28 - 1980).

In this case, pressing **n** will set "Nina" as the focal subject of the behavioural coding. Pressing **n** again will deselect "Nina" and set to "no focal subject".

The key definition is not mandatory. In this case, you will have to select the current subject from the subjects list with a double-click.

The definition of one or more subjects is not mandatory. Addition, removal and sorting of the subjects follows the same logic of the *Ethogram* table (see [Set your ethogram from scratch](#) for info).

The keys are **case-sensitive**.

If your project was created with a previous version of BORIS (< v.7) you can use the **Convert keys to lower case** to convert all keys to lower case otherwise you will have to code your observation using upper case key.

The subjects can also be imported from an existing BORIS project: use the **Import Subjects from a BORIS project** button.

Import subject from a spreadsheet

The subjects can be imported from a spreadsheet (Google spreadsheet, Microsoft-Excel, LibreOffice Calc).

The spreadsheet must contain one subject by row and have to be organized as above:

- 1st column: Subject key (One character - Case sensitive - Optional)

- 2nd column: Subject name (mandatory)
- 3rd column: Description of subject (optional)

Select all cells of your spreadsheet (CTRL + A), copy to clipboard (CTRL + C). Click the **Import from clipboard** button.

Important

If you open a project file created with a version older than v.7 BORIS will ask you to convert the upper case behavior and subject keys to lower case.

Define the Independent variables

Label	Description	Type	Predefined value	Set of values
1 Location	Location where observations where made	text	44° 55' 59" N – 7° 25' 18" E	
2 Temperature	Average temperature of the day (°C)	numeric		
3 Visitors	Visitors per day	numeric		
4 Weather	Meteorological conditions	value from set	sun	sun,rain,cloud

Label: Location
 Description: Location where observations where made
 Type: text
 Predefined value: 44° 55' 59" N – 7° 25' 18" E

Add variable
 Remove variable
 Import variables from a BORIS project

BORIS allows adding information about the observation using **Independent variables**. This can be used to specify factors that may influence the behaviors (e.g. group composition, temperature, weather conditions) but will not change during a single observation within a project. Each independent variable can be defined by a **Label** (e.g. weather), a **Description** (e.g. weather conditions), a **Type** (*text, numeric, value from set or timestamp*).

The values of a set are defined in the **Set of values** column separating the available values with a comma (,). Please note that the first value of the set will be selected by default. It should be useful to define a NA value as first value of every set.

The values for the independent variables will be asked when creating a new observation. Addition, removal and sorting of the independent variables follows the same logic of the **Ethogram** table (see **Set your ethogram from scratch** for info). The independent variables can also be imported from an existing BORIS project using the **Import Variables from a BORIS project**.

Example of independent variable defined as "set of values"



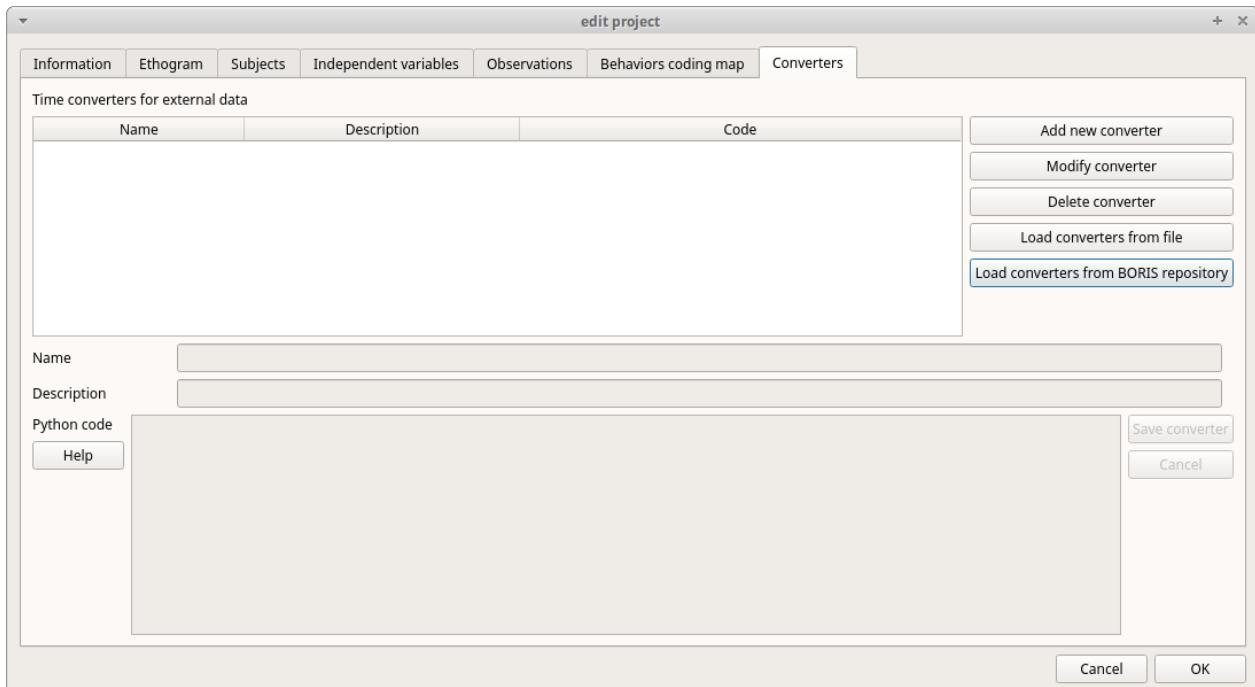
The predefined value must be contained in the set of value.

Observations' tab

The **Observations** table in BORIS shows information about all the previous observations within a project. A selected "Observation" can be removed using the "Remove observation" button (you will be prompted for confirmation). This operation cannot be undone and deleted observations cannot be recovered once the project is saved. The **Observations** table shows four columns **id Date Description Media**.

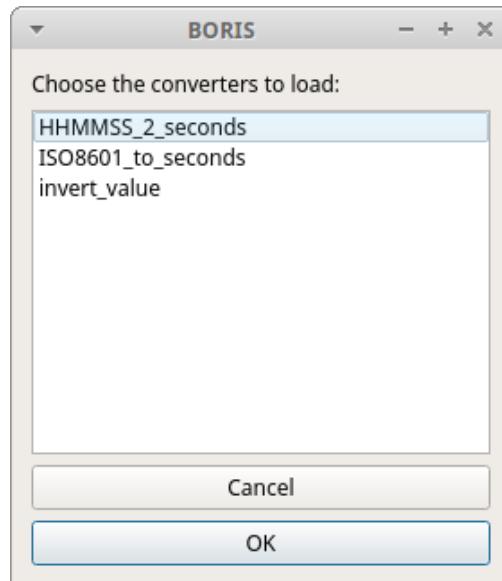
Converters' tab

Converters are used for plotting external data when the timestamp values are not expressed in seconds. Converters can be written by the user, loaded from file or loaded from the repository of the BORIS web site (<http://www.boris.unito.it/static/convertisers.json>).



Load converters from BORIS web site

Click **Load converters from BORIS repository** and select the converters to be added to your project.



The main window title is 'edit project'. The 'Converters' tab is active. A table lists 'Time converters for external data' with columns for Name, Description, and Python code. Two converters are listed:

Name	Description	Python code
1 HHMMSS_2_seconds	convert HH:MM:SS in seconds since 1970-01-01 @h, m, s = INPUT	
2 ISO8601_to_seconds	Convert ISO8601 format to seconds since 1970-01-01 Input example: "2018-01-18T12:31:40Z"	import datetime dt = datetime.datetime.strptime(INPUT, '%Y-%m-%dT%H:%M:%S%z') seconds = dt.timestamp()

To the right are buttons for managing converters: 'Add new converter', 'Modify converter', 'Delete converter', 'Load converters from file', and 'Load converters from BORIS repository'. At the bottom are 'Save converter', 'Cancel', and 'OK' buttons.

Writing a converter

See "[Converters for external data values](#)"

The converters loaded in your project can be then selected for converting timestamp (or other values) in external data file

See [Converters](#)

Open an existing project with BORIS

To open an existing BORIS project, select the menu **File > Open project**. A BORIS project file is a container for all information related to a set of observations as the ethogram, the independent variables, and the subjects. BORIS allows creating an unlimited number of projects but only one project can be opened at a time.

Import a project

You can import a project from a **Noldus The Observer XT Coding Scheme Exchange** file (.otx or .otb extensions). The Observer XT software allows you to save a project as a template (see the reference manual). This template can be imported into BORIS and then saved as a BORIS project (File > Import a project from ... > Noldus The Observer XT template)

The following information will be imported from the template file:

- Ethogram (coding scheme)
- Modifiers
- Behavioral categories
- Subjects
- Independent variables

The Observer is a registered trademark of Noldus Information Technology b.v. See the [Noldus web site](#) for details

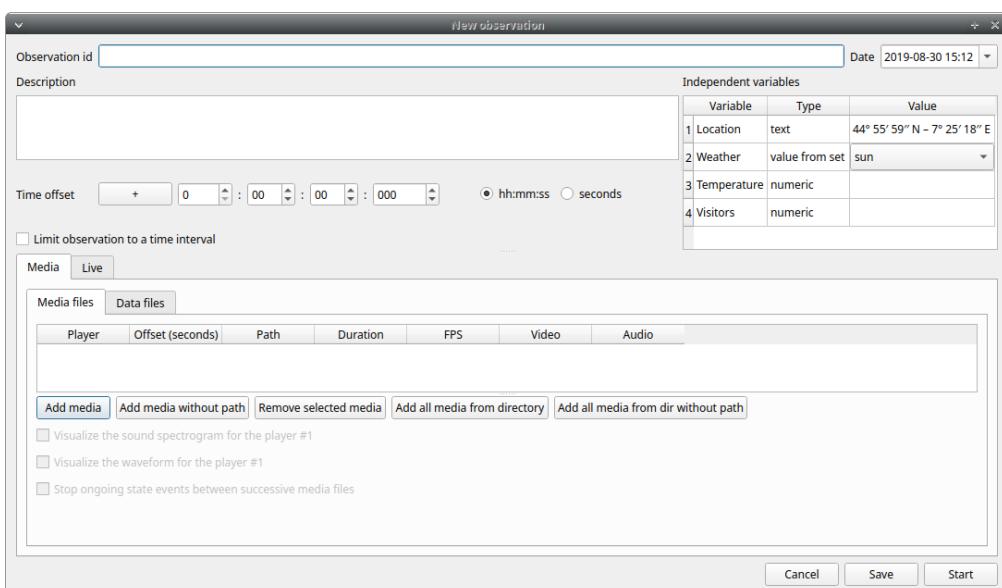
Observations

Create a new observation

A video tutorial about making an observation is available at <https://www.youtube.com/watch?v=CKeBITCICXc>

To create a new observation you must first [Create a new project with BORIS](#) or [Open an existing project with BORIS](#).

Clicking on **Observations > New observation** will show the **New observation** window.



This window allow adding various observation data:

- a mandatory **Observation id** (must be unique across all observations in the open project);

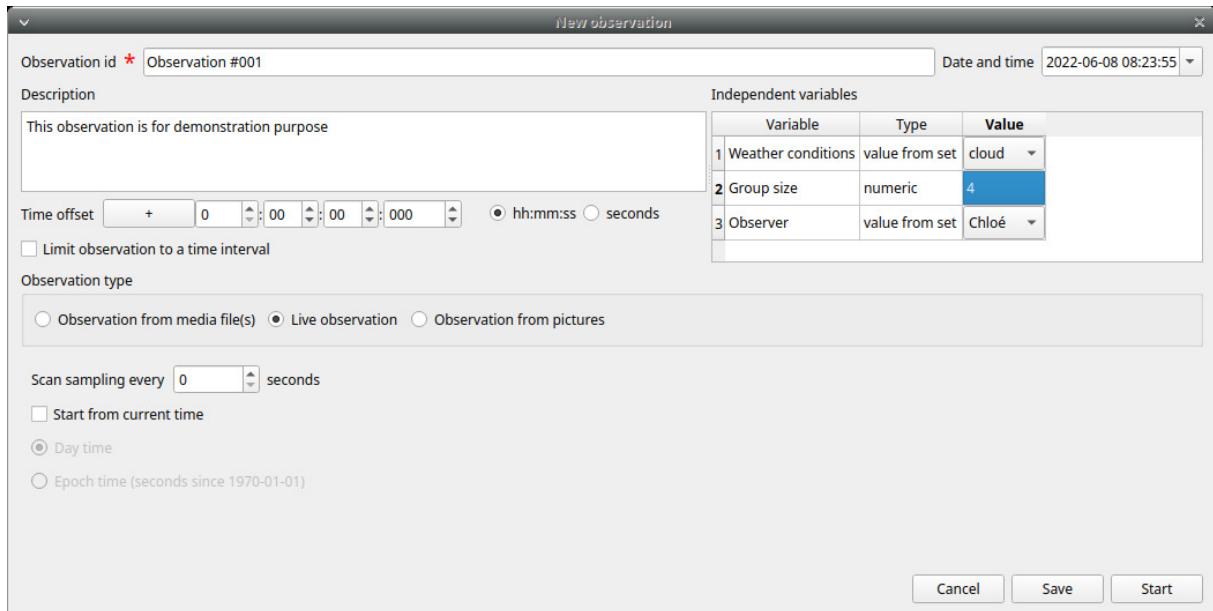
- **Date**, which will be automatically set on the current date and time, but you can alternatively set this info on your media date and time, or whatever you prefer.
- **Description**, which can host all the relevant information about your observation, but can be also left empty.
- **Independent variables** (e.g. to specify factors that may influence the behaviors but will not change during the observation within a project). See the [independent variables](#) section for details.
- **Time offset**. BORIS allow specifying a time offset that can be added or subtracted from the media timecode.
- The **Limit observation to a time interval** option can be used to limit the observation to an arbitrary time interval.

You must then indicate if you want to make an observation based on pre-recorded media (audio / video) or a live observation.

Live observation

During the live observation BORIS will show you a timer that will be used for recording time for coded events.

Click on the **Live observation** radio button to create a live observation.



Scan sampling

In the above tab you can select a time for **Scan sampling** observation. In this case the timer will stop at every time offset you indicated and all the coded events will have the same time value.

Start from current time

If you want that the time starts from the current time you can check the **Start from current time** checkbox.

Observation type
<input type="radio"/> Observation from media file(s) <input checked="" type="radio"/> Live observation <input type="radio"/> Observation from pictures
Scan sampling every <input type="text" value="0"/> seconds
<input checked="" type="checkbox"/> Start from current time
<input type="radio"/> Day time
<input type="radio"/> Epoch time (seconds since 1970-01-01)

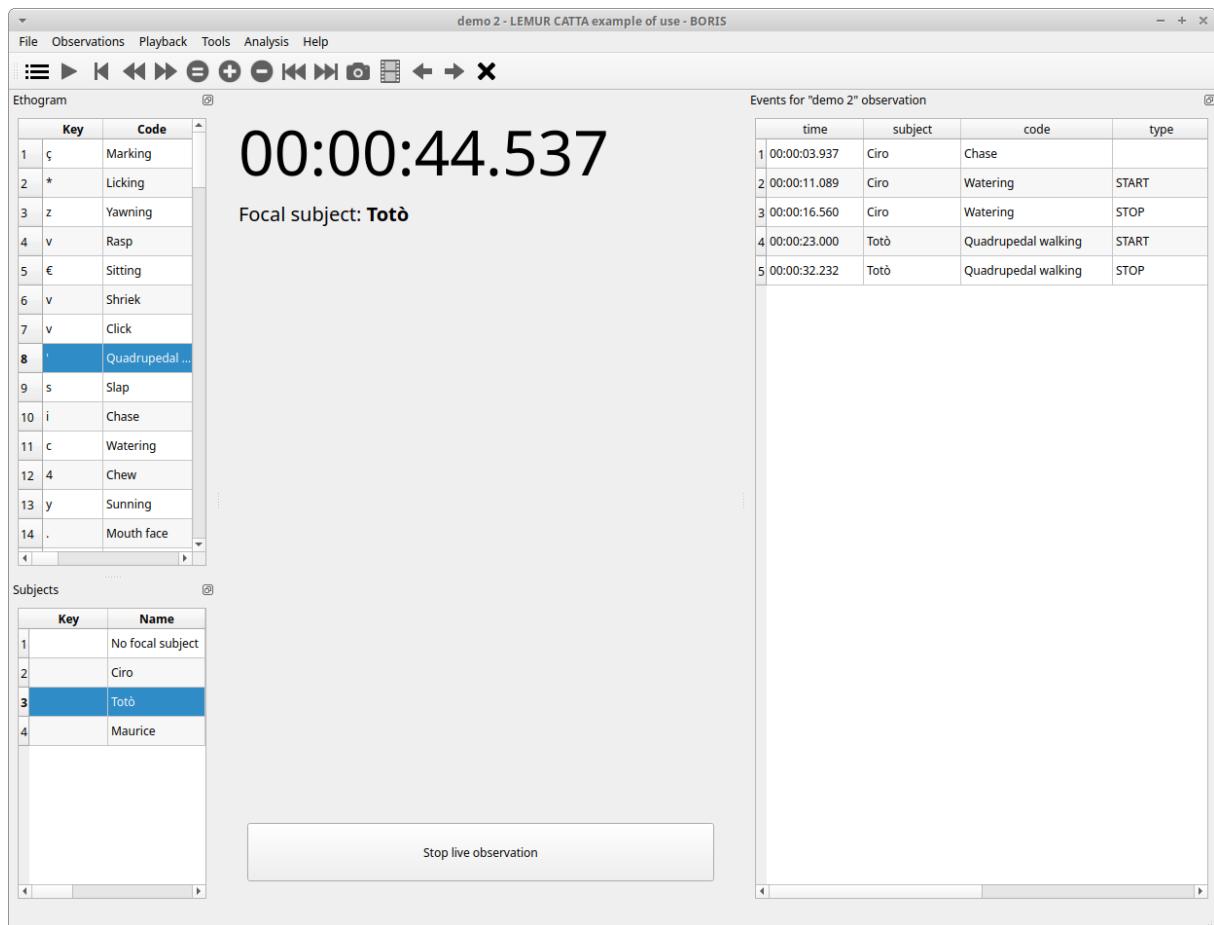
If the **Day time** option is checked the start time will be the computer current time when you will press the **Start** button.

If the **Epoch time** is checked the start time will be the number of seconds since the Jan 1st, 1970 (1970-01-01). See [Unix time](#) for details. This option is usefull for long observations (few days) or observations that start before midnight and end after.

Start the observation

Click the **Start** button to begin the live observation or **Save** to save it in the [Observations list](#).

The main window during a live observation will look like this:



See the [Live observations](#) section to start coding.

Observation from media file(s)

Click on the **Observation from media file(s)** radio button to create an observation based on one or more media files.

New observation

Observation id *	Date and time 2022-09-05 16:38:40															
Description																
Time offset 0.000	<input type="radio"/> hh:mm:ss <input checked="" type="radio"/> seconds															
<input type="checkbox"/> Limit observation to a time interval																
Independent variables																
<table border="1"> <thead> <tr> <th>Variable</th> <th>Type</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>1 Location</td> <td>text</td> <td>44° 55' 59" N – 7° 25' 18" E</td> </tr> <tr> <td>2 Weather</td> <td>value from set</td> <td>sun</td> </tr> <tr> <td>3 Temperature</td> <td>numeric</td> <td></td> </tr> <tr> <td>4 Visitors</td> <td>numeric</td> <td></td> </tr> </tbody> </table>		Variable	Type	Value	1 Location	text	44° 55' 59" N – 7° 25' 18" E	2 Weather	value from set	sun	3 Temperature	numeric		4 Visitors	numeric	
Variable	Type	Value														
1 Location	text	44° 55' 59" N – 7° 25' 18" E														
2 Weather	value from set	sun														
3 Temperature	numeric															
4 Visitors	numeric															
Observation type																
<input checked="" type="radio"/> Observation from media file(s) <input type="radio"/> Live observation <input type="radio"/> Observation from pictures																
<input checked="" type="radio"/> Media files <input type="radio"/> Data files																
<table border="1"> <thead> <tr> <th>Player</th> <th>Offset (second)</th> <th>Path</th> <th>Duration</th> <th>FPS</th> <th>Video</th> <th>Audio</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>video1.mp4</td> <td>00:02:59.960</td> <td>25</td> <td>True</td> <td>False</td> </tr> </tbody> </table>		Player	Offset (second)	Path	Duration	FPS	Video	Audio	1	1	video1.mp4	00:02:59.960	25	True	False	
Player	Offset (second)	Path	Duration	FPS	Video	Audio										
1	1	video1.mp4	00:02:59.960	25	True	False										
<input type="button"/> Add media <input type="button"/> Remove selected media <input type="checkbox"/> Use media file name as observation id <input type="checkbox"/> Visualize the sound spectrogram for the player #1 <input type="checkbox"/> Visualize the waveform for the player #1 <input type="checkbox"/> Stop ongoing state events between successive media files																
<input type="button"/> Cancel <input type="button"/> Save <input type="button"/> Start																

The **Observation from media file(s)** tab contains 2 tabs: **Media files** and **Data files**.

Click the **Media files** tab and add one or more media files using the **Add media** button. You have 3 options:

- **with absolute path:** the whole media file path will be recorded in the project
- **with relative path:** the media file path will be recorded relatively to the position of the BORIS project file (the directory of the BORIS project file must be included). This option is useful if you have to move your BORIS project file on another computer.
- **from directory with absolute path:** all the media file found in the directory will be added to the playlist (the whole media file path will be recorded in the project)
- **from directory with relative path:** all the media file found in the directory will be added to the playlist (the relative media file path will be recorded in the project)

Information about the selected media file will be extracted and displayed in the media list: media file path, media duration, number of frames by second (FPS), the presence of a video stream, the presence of an audio stream .

Media	Live														
<input checked="" type="radio"/> Media files <input type="radio"/> Data files															
<table border="1"> <thead> <tr> <th>Player</th> <th>Offset (seconds)</th> <th>Path</th> <th>Duration</th> <th>FPS</th> <th>Video</th> <th>Audio</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>video1.mp4</td> <td>00:02:59.960</td> <td>25</td> <td>True</td> <td>False</td> </tr> </tbody> </table>		Player	Offset (seconds)	Path	Duration	FPS	Video	Audio	1	1	video1.mp4	00:02:59.960	25	True	False
Player	Offset (seconds)	Path	Duration	FPS	Video	Audio									
1	1	video1.mp4	00:02:59.960	25	True	False									
<input type="button"/> Add media <input type="button"/> Add media without path <input type="button"/> Remove selected media <input type="button"/> Add all media from directory <input type="button"/> Add all media from dir without path <input type="checkbox"/> Visualize spectrogram for the player #1 <input type="checkbox"/> Stop ongoing state events between successive media files															

The dropdown list in the first column allow you to choose a player (for a maximum of 8). If you want to observe more media files simultaneously you must use consecutive players (starting from 1). See example below:

Media files		Data files					
Player	Offset (seconds)	Path	Duration	FPS	Video	Audio	
1 1	0	video1.mp4	00:02:59.960	25	True	False	
2 2	0	video2.mp4	00:02:59.960	25	True	False	
3 3	0	video3.mp4	00:02:59.960	25	True	False	

If you have to synchronize 2 (or more) videos you can use the **Offset column** to indicate when the 2nd player should start. For example if the video loaded in the second player starts 15 seconds after the first video you have to input **15** in the **Offset** cell. If the second video starts before the first player you can set a negative value in the **Offset** cell

If you have to play sequentially many videos you have to select the same player (#1) for all video you have loaded. This means that an event occurring at time t_x in the media file queued as second (e.g. second_video.mp4) in the playlist will be scored as happening at time $t_1 + t_x$ (where t_1 is the duration of the first media file, e.g. first_video.mp4).

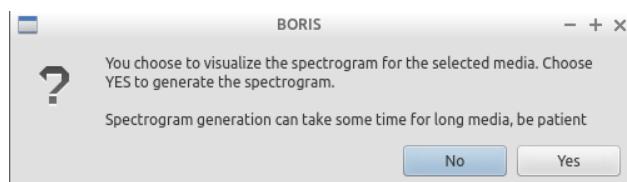
The **Remove selected media** button can be used to remove all the selected media files.

All the media types reported at <http://www.videolan.org/vlc/features.html> can be played in BORIS.

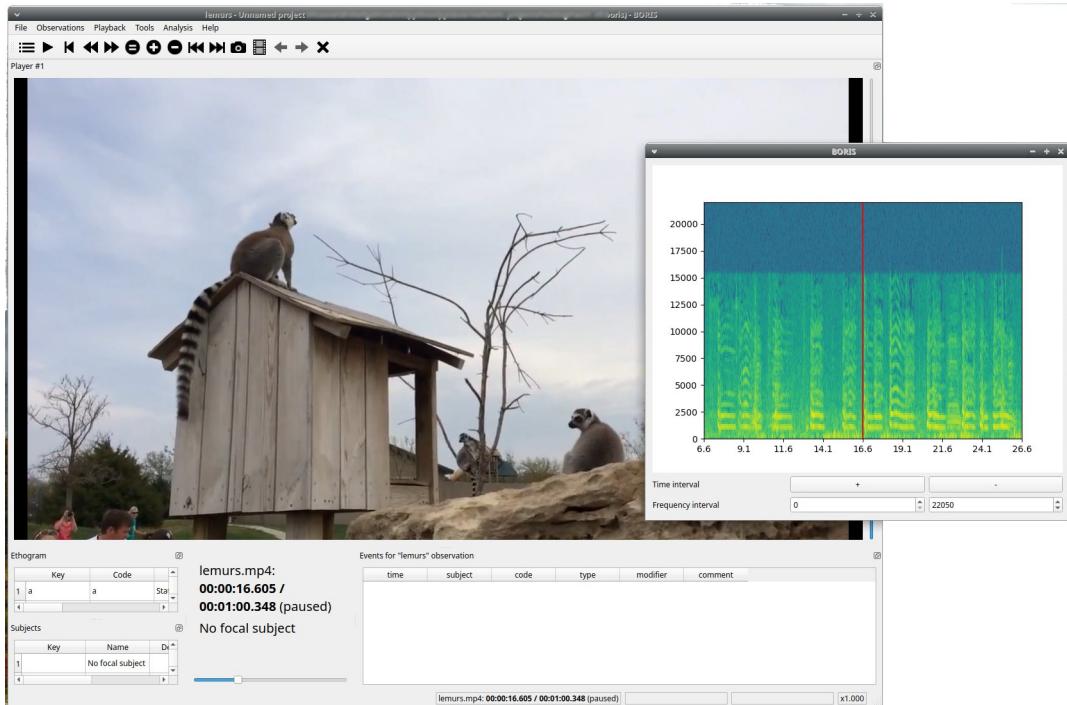
The **Use media file name as observation id** button will set the first media file name as **observation id**

Spectrogram visualization

BORIS allow you to visualize the sound spectrogram during the media observation. Activate the **Visualize spectrogram** check box. BORIS will ask you to generate the spectrograms for all media files loaded in the first player.



The spectrogram visualization will be synchronized to the media position during the observation.



Close current behavior between videos

This option is disabled for now.

External data files

Warning

At this time only 2 external data can be plotted with your media file

You can select one or more external data files to be plotted synchronously with your media. Click the **Data files** tab and use the **Add data file** button to select a data file.

Media files **Data files**

Data files to plot

Path	Columns to plot	Plot title	Variable name	Converters	Time interval (s)	Start position (s)	Subtract first value	Color

Add data file **Add data file without path** **View first rows** **Show plot** **Remove selected data file**

The data files must be plain text files with at least **2 columns** separated by comma or TAB. One column must contain a timestamp that will be used to synchronize the plot with the media. The sampling rate can be variable.

Example of a plain text data file with 5 columns separated by comma (,):

```
Display,X Pos,Y Pos,Start Time (secs),Pupil Diameter
1,864,509,549.233,0.00295773451216519
1,863,505,549.25,0.00281810853630304
```

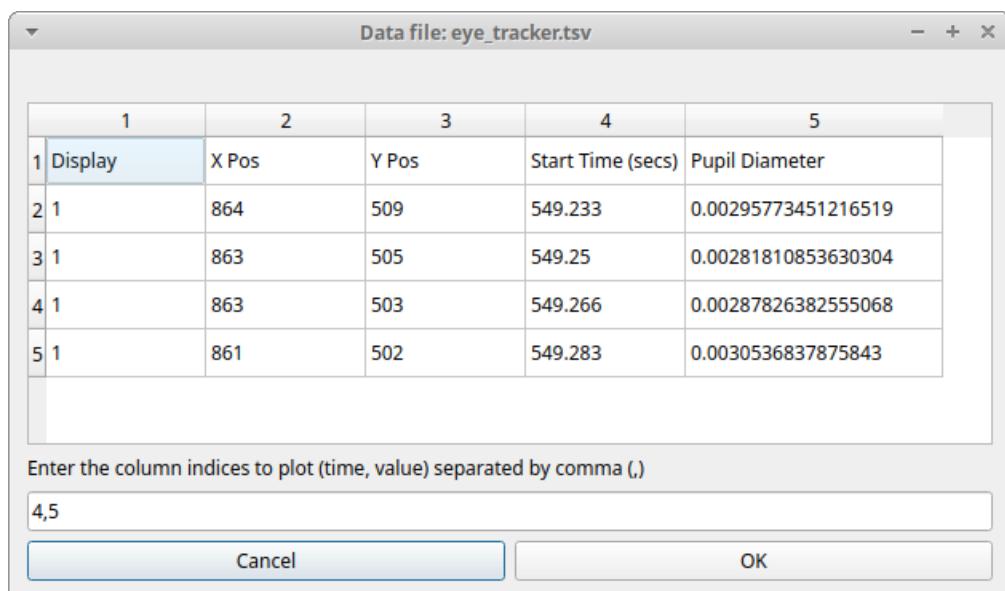
```

1,863,503,549.266,0.00287826382555068
1,861,502,549.283,0.0030536837875843
1,858,501,549.3,0.00308083021081984
1,856,499,549.316,0.00306266942061484
1,854,499,549.333,0.00305776367895305
[...]

```

In the above example the 4th column contains the timestamp and the 5th the value to be plotted.

Input the index of the column containing the timestamp and the index of the column containing the value to be plotted. The two indices must be separated by a comma (,). Click **OK** to close the window.



A new row will be added in the data files table.

Path	Columns to plot	Plot title	Variable name	Converters	Time interval (s)	Start position (s)	Subtract first value	Color

Add data file Add data file without path View first rows Show plot Remove selected data file

You can modify/complete the following parameters by directly typing in the table cells:

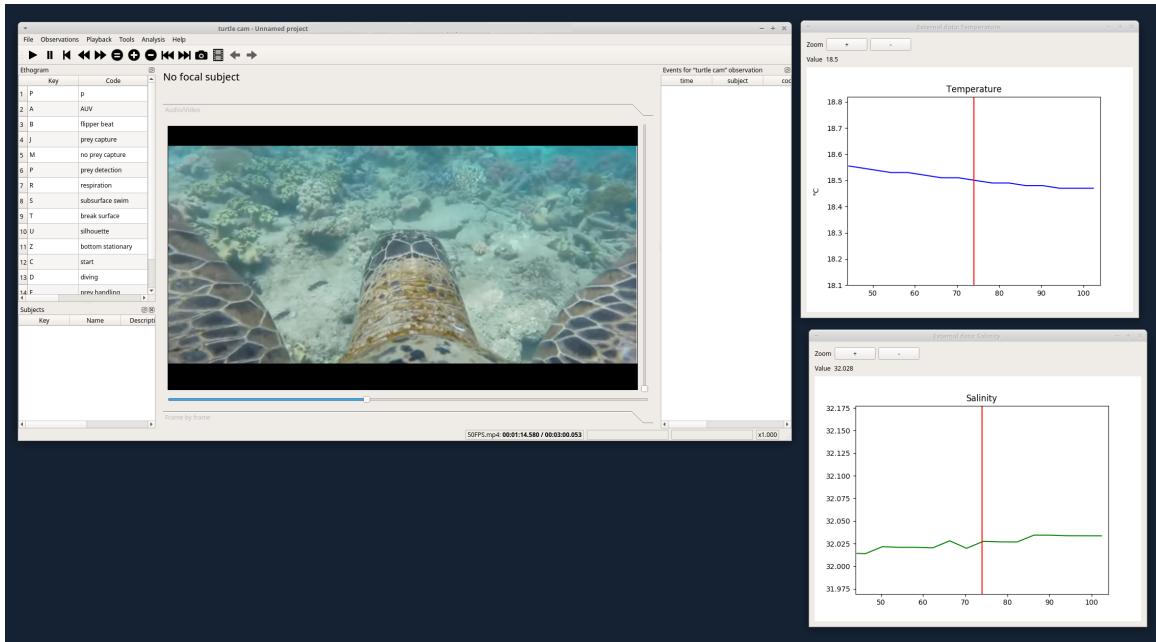
- Columns to plot
- Plot title: the title of the plot
- Variable name
- Converters: Used if the timestamp is not expressed in seconds (see below for details)
- Time interval: The time interval that will be plotted (in seconds)
- Start position: the start position of data for synchronisation with the media (in seconds)
- Subtract first value: if the timestamp does not start with a 0 value you can choose to subtract the first value to all timestamp values.
- Color: the color of the color

NOTE : if you want to record the value of the plotted variable in a modifier of a behavior (see [Value from external data file modifier](#)) the modifier must have the same **variable name**.

You can check if the data from file can be correctly plotted by using the **Show plot** button. If the data are compatible you will see a plot otherwise you will obtain a message with an explanation.

For now only 2 values can be plotted synchronously with your media file. The values can come from the same file or from two different files.

During the observation the values you have selected in external data files will be plotted synchronously with your media file.



Converters

If the values in the timestamp column are not expressed in seconds (like 12.45) but in another format (HH:MM:SS, MM:SS, ISO8601 2018-01-18T12:31:40Z ...) you must use a converter that will convert the current format in seconds.

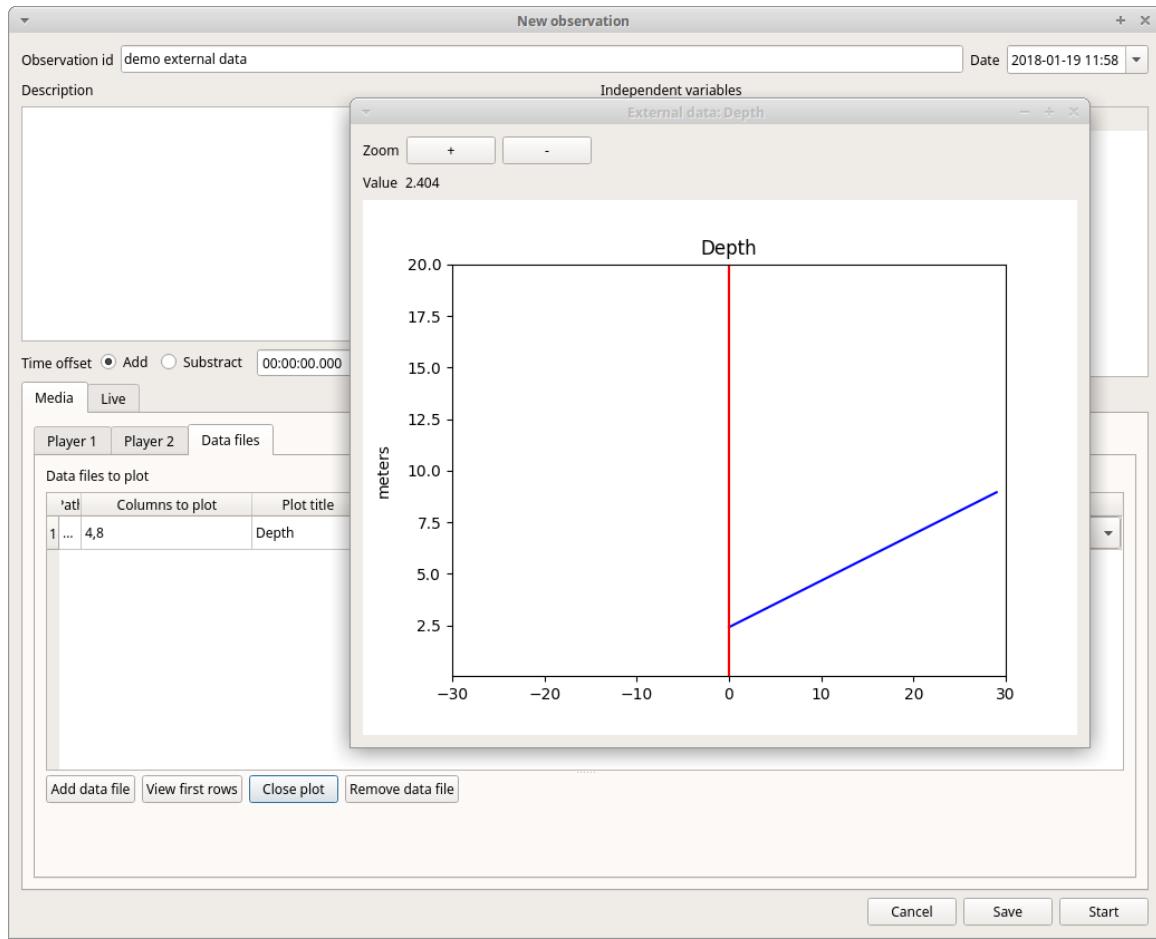
See the Converters' tab in the project configuration: [converters tab](#)

A **double-click** on the converters cell will allow you to select a converter for each column to be plotted

The figure shows the 'Converters' dialog box. It has a dropdown menu for 'Assign converter' with options: None, HHMMSS_2_seconds, ISO8601_to_seconds, and invert_value. The 'HHMMSS_2_seconds' option is highlighted. Below the dropdown, there is a table titled 'Data files to plot' with one row. The row contains columns for Path (1 /home/user/external_data2.csv), Columns to plot (4,8), Plot title (Depth), Variable name (meters), Converters ({'4': 'HHMMSS_2_seconds'}), Time interval (s) (60), and Start position (s) (0).

Data files to plot						
Path	Columns to plot	Plot title	Variable name	Converters	Time interval (s)	Start position (s)
1 /home/user/external_data2.csv	4,8	Depth	meters	{'4': 'HHMMSS_2_seconds'}	60	0

Use the **Show plot** button to verify if your external data can be plotted without problem. The **Close plot** button will close the plot window.



Converters can also be used to convert values that are not time value.

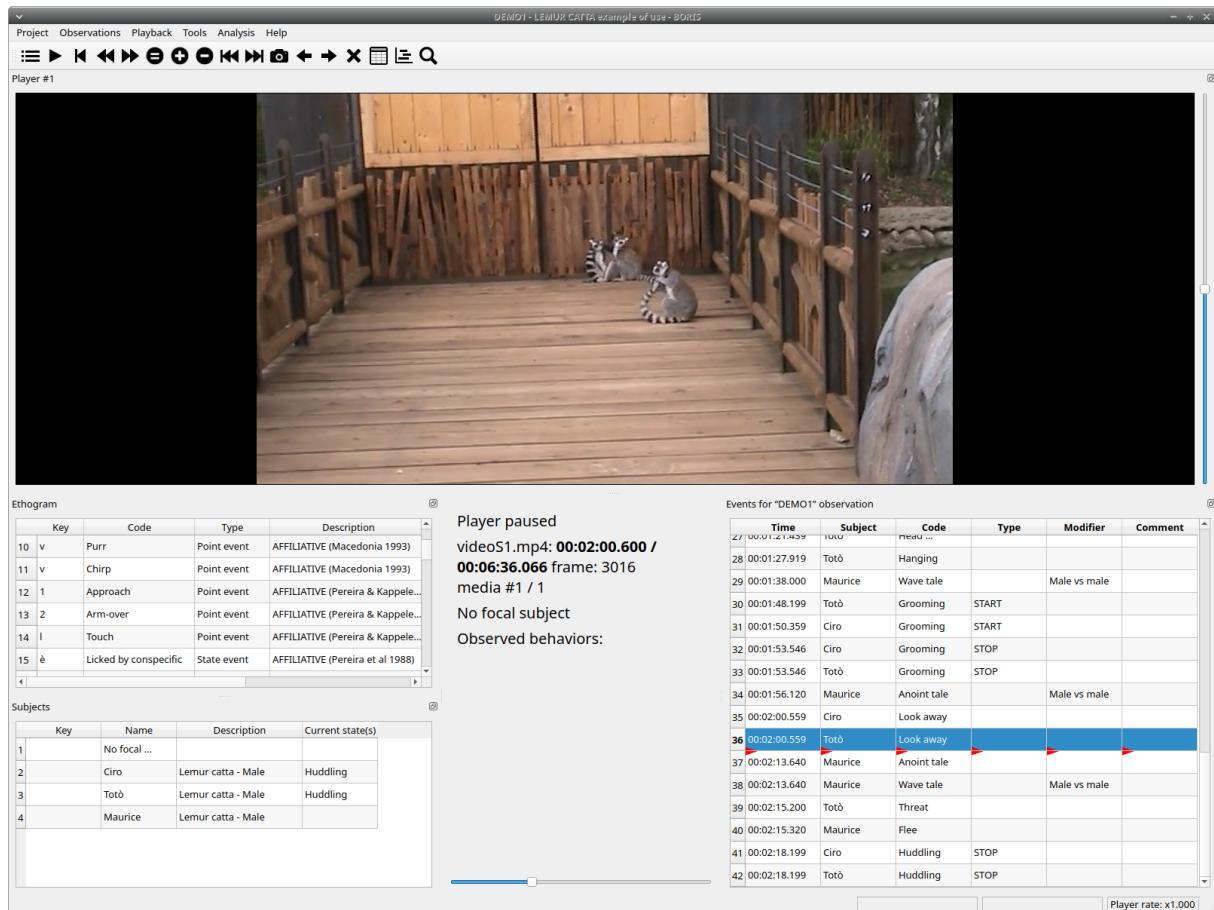
Example of a converter for inverting value:

```
OUTPUT = - float(INPUT)
```

Start the observation

Click the **Start** button to start coding. The **Observation** window will be closed and you'll be transferred to the main **BORIS** window. If you do not want to start the observation click the **Save** button. The observation will be saved in the **observations list**.

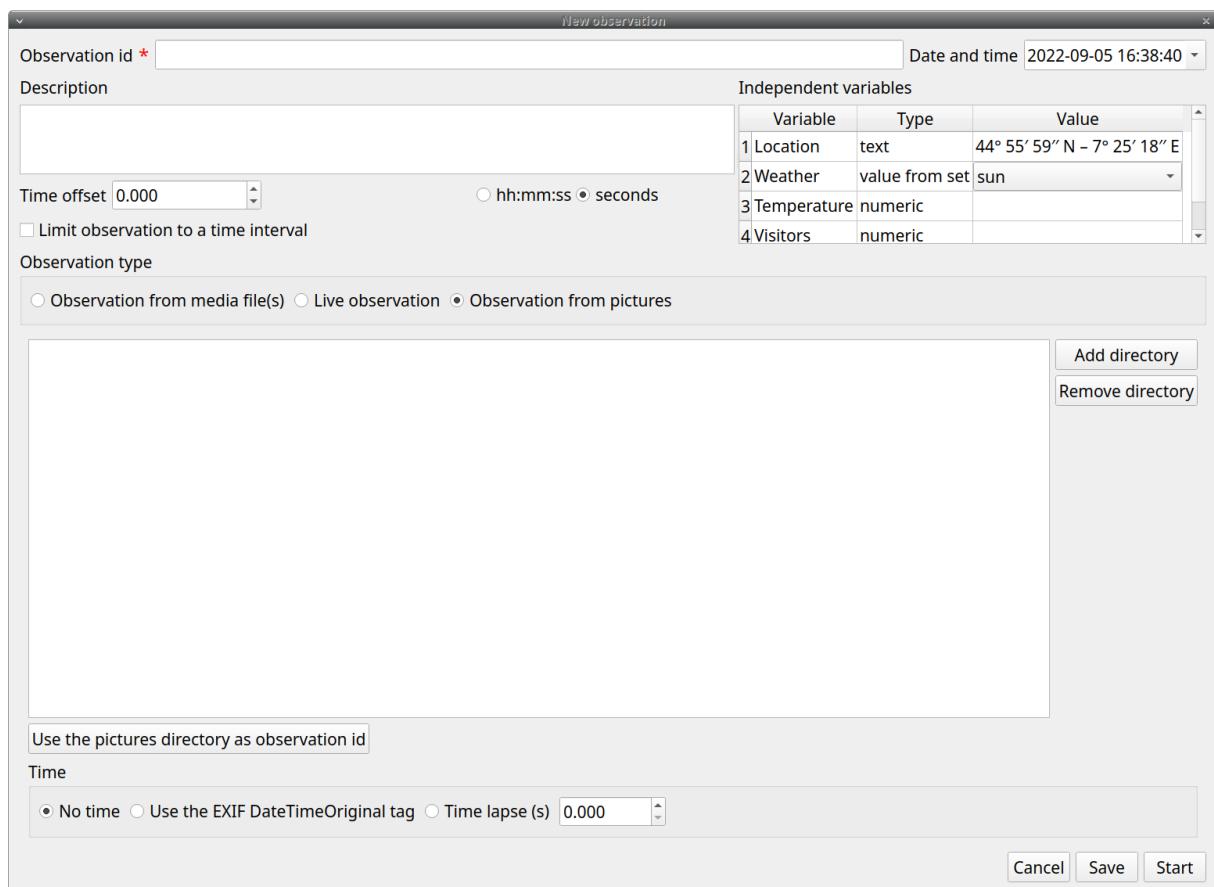
The main window during the observation of a single media file will look like this:



See the [media coding](#) section to start coding.

Observation from pictures

Click on the **Observation from pictures** radio button to create an observation based on pictures.



Use the **Add directory** to select a directory containing the pictures you want to code. You can select many directories, in this case the pictures will be browsed in the order of the directories were added.

The **Use the pictures directory as observation id** button will set the directory name as **observation id**

Time

You have 3 option for the coding time:

- No time: no time will be recorded. The image index (the position of image in the directory) and the image file path will be recorded.
- Use the EXIF DateTimeOriginal tag: the time will be extracted from the EXIF tag of the picture file (if any).
- Time lapse: this option will let you define the time interval between the pictures.

Start the observation

Click the **Start** button to start coding. The **Observation** window will be closed and you'll be transferred to the main **BORIS** window. If you do not want to start the observation click the **Save** button. The observation will be saved in the **observations list**.

The main window during the coding of a picture directory will look like this:

Events for "time lapse" observation							
time	subject	code	type	modifier	comment	image index	image path
1 20.000		Rest	START			1	/data/tmp/img/img_0001.jpg
2 100.000		Rest	STOP			5	/data/tmp/img/img_0005.jpg
3 200.000		Sleep	START			10	/data/tmp/img/img_0010.jpg

See the [media coding](#) section to start coding.

Various options

Limit observation to a time interval

This option can be used to limit the observation to a time interval for live or media based observations.



Observations list

The **Observations > Observations list** will show you all the observations contained in the current BORIS project.

The following values are displayed: the observation id, the description of observation, the coded subjects, the observation duration (as the difference between the last recorded event and the first one), the percent of exhaustivity of the coding (as the sum of the length of the coded events divided by the observation duration), the media file(s) or LIVE in case of live observation, the values of the independent variables.

Observations list - BORIS												
1442 observations												
	id	date	contains	description	subjects	observation duration	exhaustivity %	media	Location	Weather	Temperature	Visitors
1	0001_a	2016-05-17 00:00:31		Vegetation	Himal, Nautilus	32.400	100.0	#1: 20160517162539.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25	1046
2	0001_b	2016-05-17 00:00:31		Vegetation	Himal, Nautilus	32.400	98.5	#1: 20160517162539.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	26	1046
3	0002	2016-05-17 00:00:24		Vegetation	Sharky, Himal, Nautilus	34.470	89.6	#1: 20160517162540.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24	1046
4	0003	2016-05-17 00:00:05		Vegetation	Nina, Sharky, Himal, Nautilus	22.500	87.1	#1: 20160517162641.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25	1046
5	0004	2016-05-17 00:00:59		Central trunks	Nina, Sharky, Himal, Nautilus	50.697	72.9	#1: 20160517162952.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	26	1046
6	0005	2016-05-17 00:00:49		In the pool	Sharky, Nautilus	40.770	100.0	#1: 20160517163131.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24	1046
7	0006	2016-05-17 00:00:42		In the pool	Sharky, Himal, Nautilus	61.830	73.3	#1: 20160517163231.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24	1046
8	0007	2016-05-17 00:00:13		In the pool	Nina, Sharky, Himal	124.986	41.3	#1: 20160517163347.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25	1046
9	0008	2016-05-17 00:00:17		In the pool	Sharky, Himal, Nautilus	64.800	85.1	#1: 20160517163743.m2ts	44° 55' 59" N - 7° 25' 18" E			1046
10	0009	2016-05-17 00:00:10		In the pool	Nina, Sharky, Himal	46.277	84.6	#1: 20160517163927.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25	1046
11	0010	2016-05-17 00:00:57		Area near the glass window	Sharky, Himal, Nautilus	16.779	81.1	#1: 20160517164021.m2ts	44° 55' 59" N - 7° 25' 18" E			1046
12	0011	2016-05-17 00:00:50		Area near the glass window	Nina, Sharky, Himal, Nautilus	25.101	49.1	#1: 20160517164106.m2ts	44° 55' 59" N - 7° 25' 18" E			1046
13	0012	2016-05-17 00:00:45		Area near the glass window	Nina, Sharky, Nautilus	78.210	62.4	#1: 20160517164204.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	26	1046
14	0013	2016-05-17 00:00:25		Central trunks	Nina, Sharky, Himal, Nautilus	63.631	66.2	#1: 20160517164715.m2ts	44° 55' 59" N - 7° 25' 18" E			1046
15	0014	2016-05-17 00:00:52		In the pool	Nina, Sharky, Himal, Nautilus	242.596	53.5	#1: 20160517164927.m2ts	44° 55' 59" N - 7° 25' 18" E			1046
16	0015	2016-05-17 00:00:18		Central trunks		111.302	49.7					

The observations can be sorted by clicking in the desired column header (alphabetic order ascending or descending).

Checking the observations

The status of observation is displayed in the first column (**Observation id**). If the background of this column is red the observations has one or more UNPAIRED state events. These UNPAIRED observations will not be analyzed. See [Fix unpaired state events](#) for details.

Observations list - BORIS											
1443 observations											
	id	date	contains	description	subjects	observation duration	exhaustivity %				
1	0001_a	2016-05-17 00:00:31		Vegetation	Himal, Nautilus	32.400	100.0				
2	0001_b	2016-05-17 00:00:31		Vegetation	Himal, Nautilus	32.400	98.5				
3	0002	2016-05-17 00:00:24		Vegetation							
4	0003	2016-05-17 00:00:05		Vegetation	Nautilus, Himal, Sharky	34.470	89.6				
5	0004	2016-05-17 00:00:59		Central trunks	Sharky, Nina, Himal, Nautilus	22.500	87.1				
6	0005	2016-05-17 00:00:49		In the pool	Sharky, Nautilus	40.770	100.0				
7	0006	2016-05-17 00:00:42		In the pool							
8	0007	2016-05-17 00:00:13		In the pool	Nina, Himal, Sharky	124.986	43.5				
9	0008	2016-05-17 00:00:17		In the pool	Nautilus, Himal, Sharky	64.800	85.1				
10	0009	2016-05-17 00:00:10		In the pool	Nina, Himal, Sharky	46.277	84.6				
11	0010	2016-05-17 00:00:57		Area near the glass window	Nautilus, Himal, Sharky	16.779	81.1				
12	0011	2016-05-17 00:00:50		Area near the glass window	Nina, Nautilus, Himal, Sharky	25.101	49.1				
13	0012	2016-05-17 00:00:45		Area near the glass window	Nina, Nautilus, Sharky	78.210	62.4				
14	0013	2016-05-17 00:00:25		Central trunks	Sharky, Nina, Himal, Nautilus	63.631	66.2				
15	0014	2016-05-17 00:00:52		In the pool	Nina, Nautilus, Himal, Sharky	242.596	53.5				
16	0015	2016-05-17 00:00:18		Central trunks	Sharky, Nina, Himal, Nautilus	111.302	49.7				

Filtering the observations

The observations list can be filtered selecting a field and a condition in the drop-list boxes.

In the following example observations are filtered: only observations with **description** containing the **In the pool** subject are shown:

Observations list - BORIS

93 observations

description contains in the pool

id	date	description	subjects	media	Location	Weather	Temperature
1 0005	2016-05-17 00:00:49	In the pool	Sharky, Nautilus	#1: 20160517163131.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24
2 0006	2016-05-17 00:00:42	In the pool	Sharky, Nautilus, Himal	#1: 20160517163231.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24
3 0007	2016-05-17 00:00:13	In the pool	Nina, Sharky, Himal	#1: 20160517163347.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25
4 0008	2016-05-17 00:00:17	In the pool	Sharky, Nautilus, Himal	#1: 20160517163743.m2ts	44° 55' 59" N - 7° 25' 18" E		
5 0009	2016-05-17 00:00:10	In the pool	Sharky, Nina, Himal	#1: 20160517163927.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25
6 0014	2016-05-17 00:00:52	In the pool	Nina, Sharky, Nautilus, Himal	#1: 20160517164927.m2ts	44° 55' 59" N - 7° 25' 18" E		
7 0185	2016-05-28 00:00:23	In the pool	Nina, Sharky, Nautilus	#1: 20160528124413.m2ts	44° 55' 59" N - 7° 25' 18" E		
8 0212	2016-05-31 00:00:53	In the pool	Sharky	#1: 20160531104533.m2ts	44° 55' 59" N - 7° 25' 18" E		
9 0217	2016-05-31 00:00:49	In the pool	Nina, Himal	#1: 20160531145324.m2ts	44° 55' 59" N - 7° 25' 18" E		
10 0220	2016-05-31 00:00:36	In the pool	Sharky, Nina, Nautilus, Himal	#1: 20160531153747.m2ts	44° 55' 59" N - 7° 25' 18" E		
11 0359	2016-06-06 00:00:54	In the pool	Nina, Sharky, Nautilus, Himal	#1: 20160606163758.m2ts	44° 55' 59" N - 7° 25' 18" E		
12 0411	2016-06-07 00:00:53	In the pool	Nina, Nautilus	#1: 20160607103354.m2ts	44° 55' 59" N - 7° 25' 18" E		
13 0412	2016-06-07 00:00:21	In the pool	Nautilus	#1: 20160607103630.m2ts	44° 55' 59" N - 7° 25' 18" E		

Cancel Start View Edit

Observations can be filtered with **Independent variables** values.

The following example displays only the observations that do not contain "Sunny" in the **Weather** independent variable :

Observations list - BORIS

1430 observations

Weather does not contain sun

id	date	description	subjects	media	Location	Weather	Temperature
1 0008	2016-05-17 00:00:17	In the pool	Sharky, Nautilus, Himal	#1: 20160517163743.m2ts	44° 55' 59" N - 7° 25' 18" E		
2 0010	2016-05-17 00:00:57	Area near the glass window	Sharky, Nautilus, Himal	#1: 20160517164021.m2ts	44° 55' 59" N - 7° 25' 18" E		
3 0011	2016-05-17 00:00:50	Area near the glass window	Sharky, Nina, Nautilus, Himal	#1: 20160517164106.m2ts	44° 55' 59" N - 7° 25' 18" E		
4 0013	2016-05-17 00:00:25	Central trunks	Nina, Sharky, Nautilus, Himal	#1: 20160517164715.m2ts	44° 55' 59" N - 7° 25' 18" E		
5 0014	2016-05-17 00:00:52	In the pool	Nina, Sharky, Nautilus, Himal	#1: 20160517164927.m2ts	44° 55' 59" N - 7° 25' 18" E		
6 0015	2016-05-17 00:00:18	Central trunks	Nina, Sharky, Nautilus, Himal	#1: 20160517165631.m2ts	44° 55' 59" N - 7° 25' 18" E		
7 0016	2016-05-17 00:00:58	Central trunks	Nina, Sharky, Nautilus, Himal	#1: 20160517165923.m2ts	44° 55' 59" N - 7° 25' 18" E		
8 0017	2016-05-17 00:00:37	Suspended trunks	Nina, Sharky, Nautilus, Himal	#1: 20160517170018.m2ts	44° 55' 59" N - 7° 25' 18" E		
9 0018	2016-05-17 00:00:18	Central trunks	Nina, Himal	#1: 20160517170259.m2ts	44° 55' 59" N - 7° 25' 18" E		
10 0019	2016-05-17 00:00:23	Central trunks	Sharky, Nina, Nautilus, Himal	#1: 20160517170519.m2ts	44° 55' 59" N - 7° 25' 18" E		
11 0020	2016-05-25 00:00:24	Indoor entrance	Nina, Himal	#1: 20160525145403.m2ts	44° 55' 59" N - 7° 25' 18" E		
12 0021	2016-05-25 00:00:47	Indoor entrance	Sharky, Himal	#1: 20160525145814.m2ts	44° 55' 59" N - 7° 25' 18" E		
13 0022	2016-05-25 00:00:30	Indoor entrance	Nina, Himal	#1: 20160525150240.m2ts	44° 55' 59" N - 7° 25' 18" E		

Cancel Start View Edit

Observations with a value of **Temperature** independent variable between 18 and 22:

Observations list - BORIS

10 observations

Temperature	between (use and to separate terms)	24 and 26					
id	date	description	subjects	media	Location	Weather	Temperature
1 0001_a	2016-05-17 00:00:31	Vegetation	Nautilus, Himal	#1: 20160517162539.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25
2 0001_b	2016-05-17 00:00:31	Vegetation	Nautilus, Himal	#1: 20160517162539.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	26
3 0002	2016-05-17 00:00:24	Vegetation	Sharky, Nautilus, Himal	#1: 20160517162540.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24
4 0003	2016-05-17 00:00:05	Vegetation	Nina, Sharky, Nautilus, Himal	#1: 20160517162641.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25
5 0004	2016-05-17 00:00:59	Central trunks	Sharky, Nina, Nautilus, Himal	#1: 20160517162952.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	26
6 0005	2016-05-17 00:00:49	In the pool	Sharky, Nautilus	#1: 20160517163131.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24
7 0006	2016-05-17 00:00:42	In the pool	Sharky, Nautilus, Himal	#1: 20160517163231.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	24
8 0007	2016-05-17 00:00:13	In the pool	Nina, Sharky, Himal	#1: 20160517163347.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25
9 0009	2016-05-17 00:00:10	In the pool	Sharky, Nina, Himal	#1: 20160517163927.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	25
10 0012	2016-05-17 00:00:45	Area near the glass window	Sharky, Nina, Nautilus	#1: 20160517164204.m2ts	44° 55' 59" N - 7° 25' 18" E	sun	26

Cancel Start View Edit

Observations with a value of **Visitors** independent variable greater than 1000:

Observations list - BORIS

825 observations

Visitors	>	1000						
id	date	description	subjects	medi	Location	Weather	Temperature	Visitors
4 0003	2016-05-17 00:00:05	Vegetation	Nina, Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E	sun	25	1046
5 0004	2016-05-17 00:00:59	Central trunks	Sharky, Nina, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E	sun	26	1046
6 0005	2016-05-17 00:00:49	In the pool	Sharky, Nautilus	#1: ...	44° 55' 59" N - 7° 25' 18" E	sun	24	1046
7 0006	2016-05-17 00:00:42	In the pool	Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E	sun	24	1046
8 0007	2016-05-17 00:00:13	In the pool	Nina, Sharky, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E	sun	25	1046
9 0008	2016-05-17 00:00:17	In the pool	Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E			1046
10 0009	2016-05-17 00:00:10	In the pool	Sharky, Nina, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E	sun	25	1046
11 0010	2016-05-17 00:00:57	Area near the glass window	Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E			1046
12 0011	2016-05-17 00:00:50	Area near the glass window	Sharky, Nina, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E			1046
13 0012	2016-05-17 00:00:45	Area near the glass window	Sharky, Nina, Nautilus	#1: ...	44° 55' 59" N - 7° 25' 18" E	sun	26	1046
14 0013	2016-05-17 00:00:25	Central trunks	Nina, Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E			1046
15 0014	2016-05-17 00:00:52	In the pool	Nina, Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E			1046
16 0015	2016-05-17 00:00:18	Central trunks	Nina, Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E			1046
17 0016	2016-05-17 00:00:58	Central trunks	Nina, Sharky, Nautilus, Himal	#1: ...	44° 55' 59" N - 7° 25' 18" E			1046

Cancel Start View Edit

Delete observations

The observations can be deleted from the project using the following procedure: **File > Edit project > Observation's tab**

Select all observations to remove

Click the **Remove selected observations** button and confirm the deletion.

Please note that the deletion is irreversible.

Import observations from a project file

The **Observations > Import observations** option allows to import observations from a BORIS project file into the current project. Choose the project file and then the observations to import. BORIS will check if observations with same id are already existing in the current project. BORIS will also check if behaviors and/or subjects used in the imported observations are not defined in the current project.

Coding your media

When looking at the BORIS main window, the window title bar shows the **Observation id - Project name - BORIS**. The media (the first in the queue) will be loaded in the media player and paused.

Media based coding

Media controls are available in the toolbar



Key to the symbols:

- **List of observations**
- **Play** (become **Pause** when media is played)
- **Rewind** reset your media at the beginning
- **Fast backward** jumps for n seconds backward in your media (See [general preferences](#) to set n)
- **Fast forward** jumps for n seconds forward in your media (See [general preferences](#) to set n)
- **Set the playback speed to 1x**
- **Increase the playback speed** (See [general preferences](#) to set the step value)
- **Decrease the playback speed** (See [general preferences](#) to set the step value)
- **Jump to the previous media file**
- **Jump to the next media file**
- **Take a snapshot** of current video or frame
- **Move on frame back**
- **Move one frame forward**
- **Close current observation**
- **Time budget of the current observation**
- **Plot events of the current observation**
- **Find in events**

The media can be controlled by special keyboard keys:

- **Page Up** key: switch to the next media
- **Page Down** key: switch to the previous media
- **Up arrow** key: jump forward in the current media
- **Down arrow** key: jump backward in the current media
- **Home** key: Increase the playback speed (See [general preferences](#) to set the step value)
- **End** key: Decrease the playback speed (See [general preferences](#) to set the step value)
- **Backspace**: Set the playback speed to 1x
- **Left arrow** key: go to the previous frame
- **Right arrow** key: go to the next frame

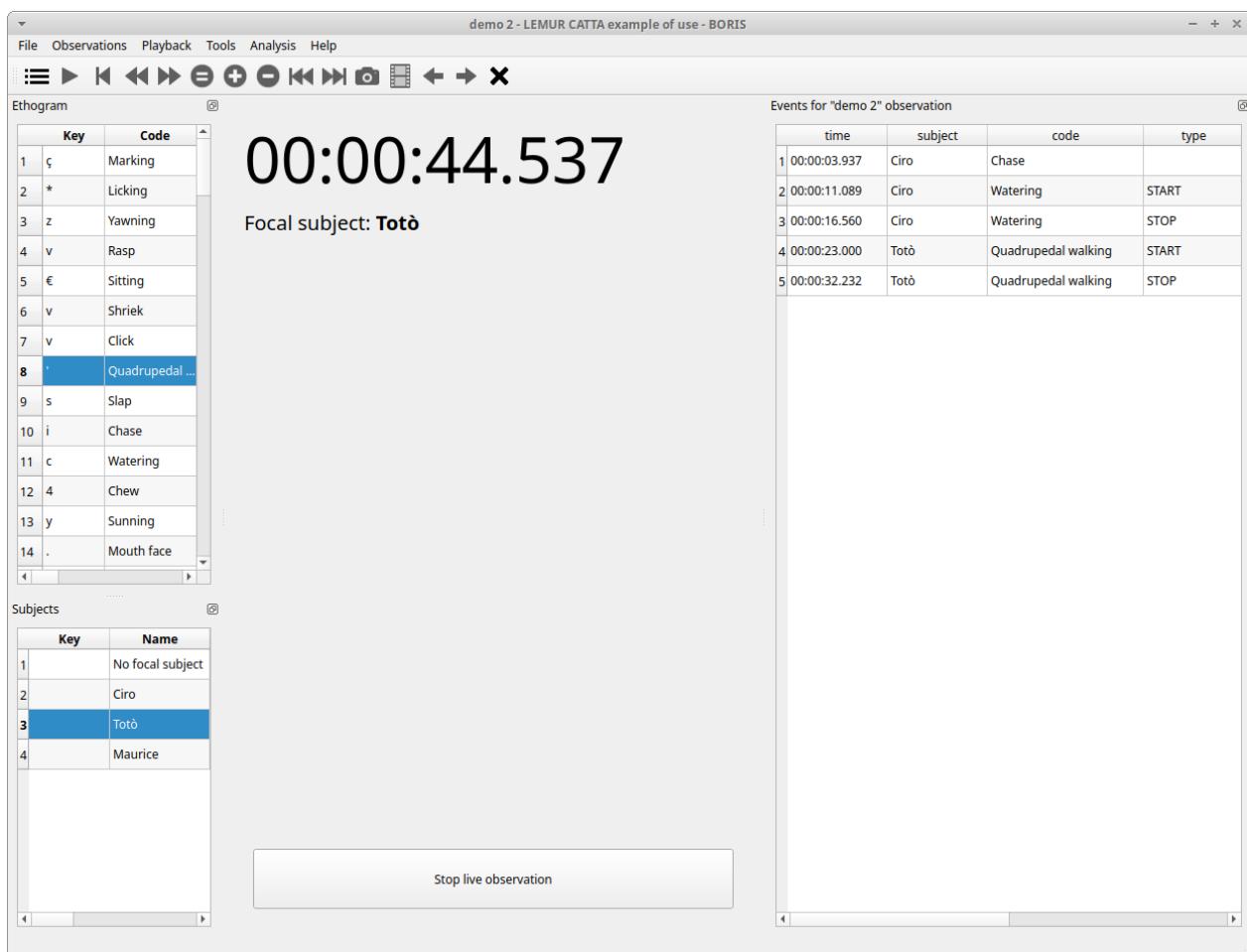
Live observations

During a live observation the media control toolbar is disabled.

Press the **Start live observation** button to start your observation. If some events are already coded BORIS will ask you for deleting them.

A timer will be displayed. The events will be recorded in the events widget.

See the following screenshot.



Ethogram widget in the main window

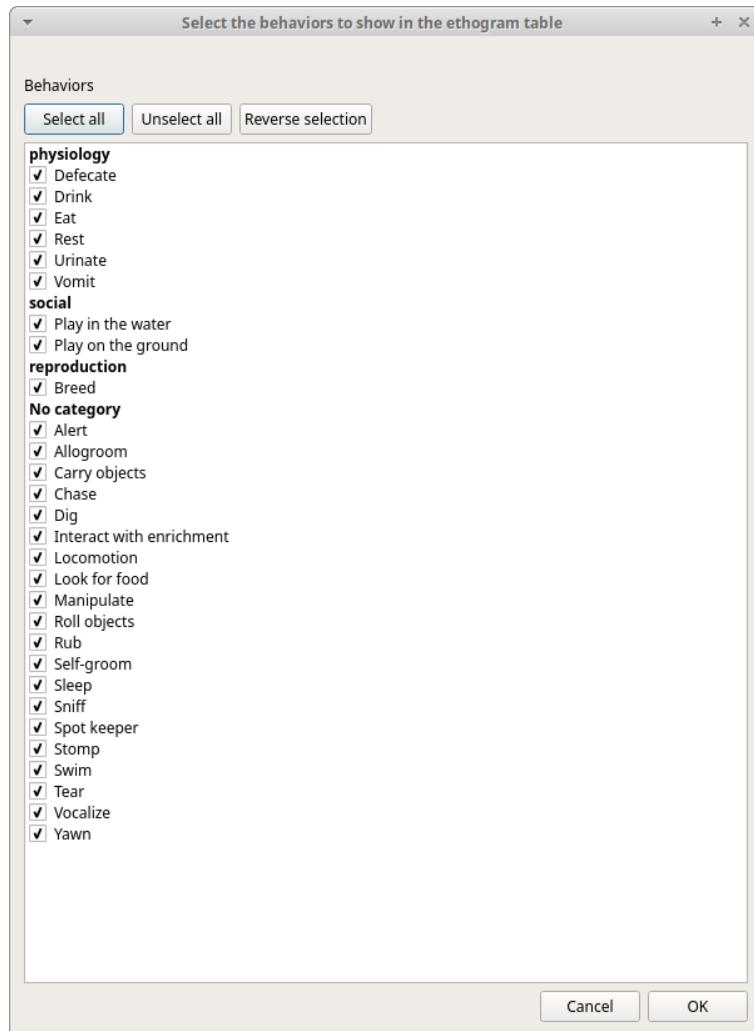
Ethogram						
Key	Code	Type	Description	Category	Modifiers	Excluded
1 A	Alert	State event	Otter is stationary and directs its attention to...		{}	Allogroom,Breed,Carry ob
2 Q	Allogroom	State event	Otter licks or scratches with forepaws or hind...		{}	Alert,Breed,Carry objects,
3 B	Breed	State event	Otters are engaged in copulatory activities (H...	reproduction	{}	Alert,Allogroom,Carry obj
4 C	Carry objects	State event	Otter carries objects or food by holding them...		{"0": {"name": "...", "...	Alert,Allogroom,Breed,Ch
5 C	Chase	State event	Otter chases other animals		{"0": {"name": "...", "...	Alert,Allogroom,Breed,Ca
6 D	Defecate	State event	Otter eliminates fecal matter (Ethol, 2015)	physiology	{}	Alert,Allogroom,Breed,Ca
7 D	Dig	State event	Otter uses front legs to move sand, stones on...		{}	Alert,Allogroom,Breed,Ca
8 D	Drink	State event	Otter consumes water found in its environme...	physiology	{}	Alert,Allogroom,Breed,Ca
9 E	Eat	State event	Otter consumes food	physiology	{"0": {"name": "...", "...	Alert,Allogroom,Breed,Ca
10 I	Interact with e...	State event	Otter interacts with enrichment		{"0": {"name": "...", "...	Alert,Allogroom,Breed,Ca
11 L	Locomotion	State event	Otter moves from place to place		{"0": {"name": "...", "...	Alert,Allogroom,Breed,Ca
12 F	Look for food	State event	Otter looks for food in the environment		{}	Alert,Allogroom,Breed,Ca

The **Ethogram** widget provide the user with the list of behaviors defined in the **Ethogram**. It can be used to record an event by double clicking on the corresponding row. The **Key** column indicates the keyboard key assigned to each behavior (if any). Pressing a key will record the corresponding behavior (that will appear in the *Events* widget).

The behaviors shown in the ethogram widget can be filtered:

Right-click on ethogram widget > **Filter behaviors**

Check/Uncheck single behaviors or double-click on the behavioral category



Subjects widget in the main window

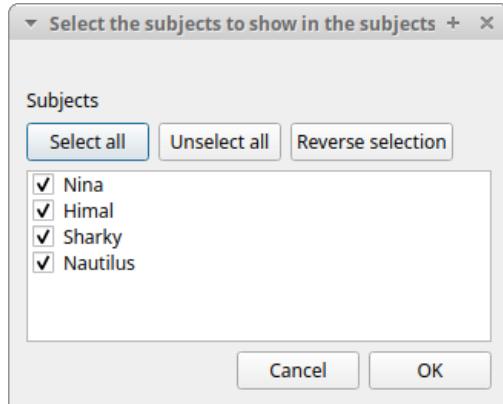
Subjects			
Key	Name	Description	Current state(s)
1	No focal subject		
2 N	Nina	Female, adult, born on 10/03/2013 i...	
3 H	Himal	Male, adult, born on 04/30/2014 in ...	
4 C	Sharky	Male, juvenile, born on 10/30/2015 i...	
5 S	Nautilus	Male, juvenile, born on 10/30/2015 i...	

The **Subjects** widget provide the user with the list of subjects defined in the **Subject** tab in the **Project** window. It can be used to add information about the focal subject on the recorded behaviors by double clicking on the corresponding row. When a subject is selected his/her name appears above the media player. The **Key** column indicates the keyboard key assigned to each subject (if any).

The subjects shown in the subjects widget can be filtered:

Right-click on subjects widget > **Filter subjects**

Check/Uncheck single subject



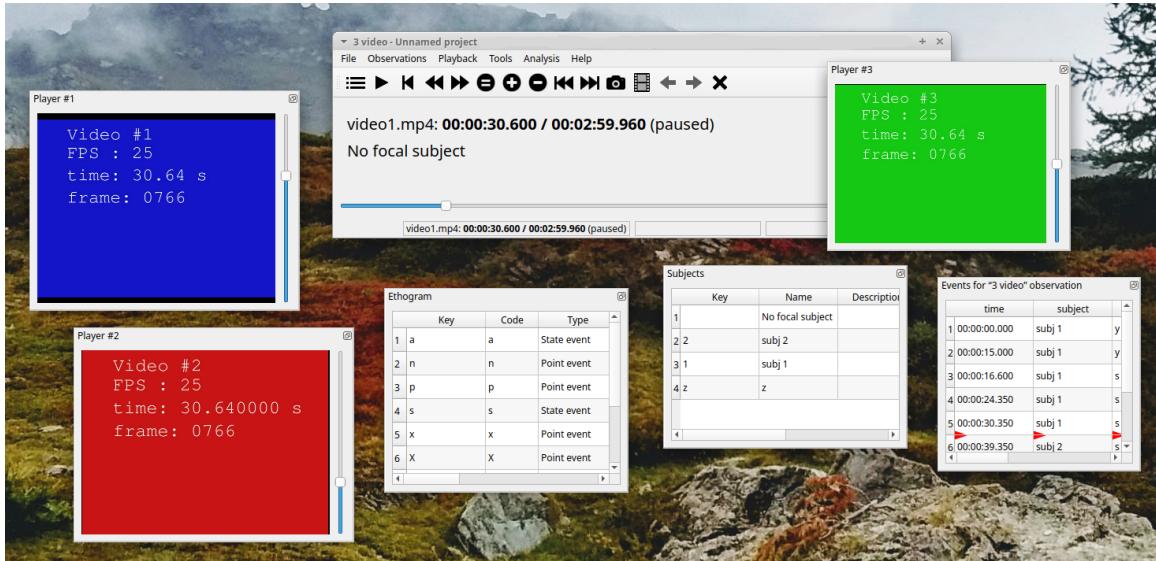
The media player widgets

Key	Code	Type
1	a	State event
2	n	Point event

time	subject	code
1 00:00:00.000	subj 1	y
2 00:00:15.000	subj 1	y
3 00:00:16.600	subj 1	s
4 00:00:24.350	subj 1	s
5 00:00:30.350	subj 1	s
6 00:00:39.350	subj 2	s
7 00:00:50.600	subj 2	s

The media position can be set using the horizontal slide bar. Each media player has its own audio volume control (the vertical slide bar on the right side of the player).

The organization of the various widget can be customized:



The Events widget

Events for "0001_a" observation					
time	subject	code	type	modifier	comment
1 0.000	Himal	Tear	START	Branches	
2 0.000	Nautilus	Tear	START	Branches	
3 30.199	Himal	Tear	STOP	Branches	
4 30.200	Himal	Locomotion	START	Walk	
5 32.400	Himal	Locomotion	STOP	Walk	
6 32.400	Nautilus	Tear	STOP	Branches	

The **Events** widget shows all the recorded behaviors (events) with the following parameters (organized in columns):

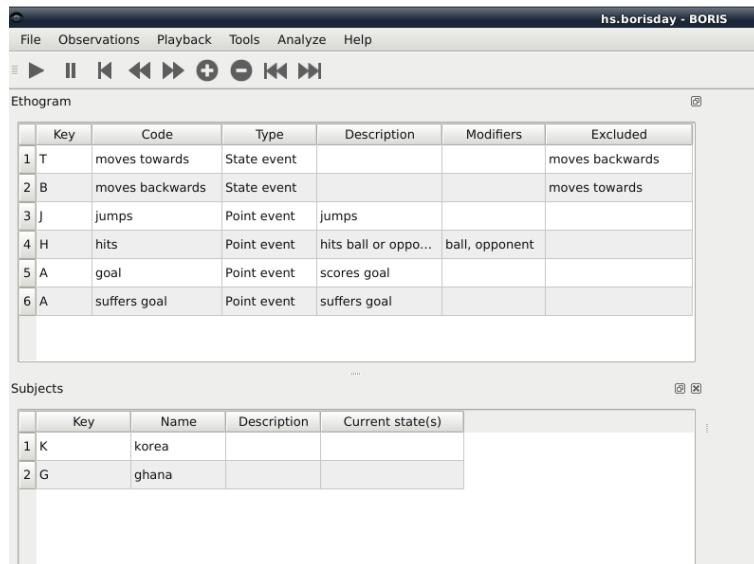
- **time**, the time at which the event occurred;
- **subject**, the focal subject (if any);
- **code**, the behavior code;
- **type**, in case of a state event indicates whether the time corresponds to the start or to the stop.
- **modifier**, indicates the modifier(s) that was(ere) selected (if any);
- **comment**, is an open field where the user can add notes.

A tracking cursor (red triangle) will show the current event. This cursor can be positioned above the current event, see [tracking cursor position](#) option in Preferences window.

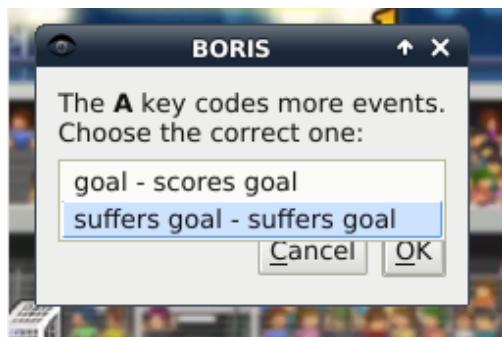
A double-click on a row will reposition the media player to the moment of the corresponding event. See [Time offset for media reposition](#) in Preferences window to customize the time offset for media repositioning.

Record an event

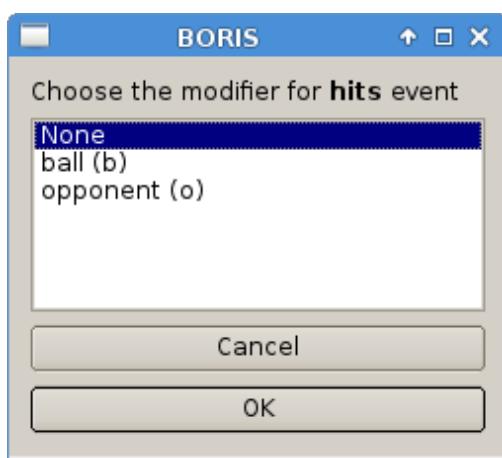
Once ready to begin your coding, you can start the media player using the **Play** button (or the **Space bar**). The behaviors can be recorded using the keyboard with the predefined keys, by double-clicking the corresponding row in the **Ethogram** table or by using the **Coding pad** (See [coding pad](#)).



If the pressed key defines a single event, the corresponding event will be recorded in the **Events** table. In the case you have specified the same key for two (or more) events (e.g. key A in the figure below), BORIS will prompt you for the desired behavior.



In the case you have specified modifiers (one or more sets), BORIS will prompt you for the desired modifier(s) if any (e.g. **ball** or **opponent** in the figure below). You can select the correct one using the mouse or the keyboard (**b** key or **o** key)



If no keys are defined for the modifier selection, you can type the first character of the modifier and use the **Up arrow** and **Down arrow** keyboard keys to select the correct modifier.

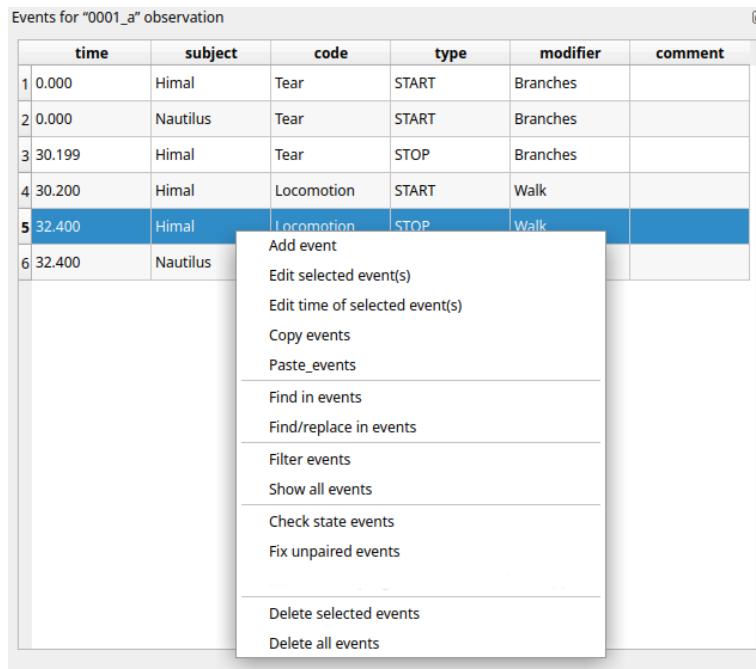
In the case your behavior type is a **Point event with coding map** or a **State event with coding map**, BORIS will show the **Coding map** window and will allow selecting the desired area(s). In case you click a part of the map in which two (or more) areas overlap, the corresponding codes will be recorded.

A recorded event can be edited (once selected) using the **Observations > Edit event** menu option. The resulting *Edit event parameters* allows modifying every parameter (e.g. time, subject, code, modifiers, and comment).

The **Observations > Add event** menu option allows adding a new event by specifying its time and the other parameters.

The Events widget context menu

Some functions are available in the Events widget context menu. Right-click on the Events widget.



Undo an even recording

A wrong event can be removed from the events list using the Undo function (CTRL + Z). You can go back till 25 events recorded events.

Add event

This option allows adding a new event by specifying its time and the other parameters.

Edit selected event(s)

This option allows to edit the selected event(s). When many events are selected you have to choose the field to edit between **Subject**, **Behavior** and **Comment**. In this case the new value will apply to all selected events.

The screenshot shows the Events widget with a context menu open over the fourth row. The menu title is "Edit selected events". It contains three radio buttons: "Subject" (selected), "Behavior", and "Comment". Below the radio buttons is a dropdown menu titled "New value" containing the options: Nina, Himal, Sharky, and Nautilus. The "Sharky" option is highlighted with a blue selection bar. At the bottom of the menu are two buttons: "Cancel" and "OK".

time	subject	code	type	modifier	comment
1 0.000	Himal	Tear	START	Branches	
2 0.000	Nautilus	Tear	START	Branches	
3 30.199	Himal	Tear	STOP	Branches	
4 30.200	Himal	Locomotion	START	Walk	
5 32.400	Himal	Locomotion	STOP	Walk	
6 32.400	Nautilus				

Edit time of selected event(s)

This option allows to add or subtract a time value (in seconds) to all selected events. For subtracting a value use a negative value.

The screenshot shows the Events widget with a context menu open over the fourth row. The menu title is "Time value". It contains a single input field labeled "Value to add or subtract (use negative value)" with the value "-10.200" entered. At the bottom are two buttons: "Cancel" and "OK".

time	subject	code	type	modifier	comment
1 0.000	Himal	Tear	START	Branches	
2 0.000	Nautilus	Tear	START	Branches	
3 30.199	Himal	Tear	STOP	Branches	
4 30.200	Himal	Locomotion	START	Walk	
5 32.400	Himal	Locomotion	STOP	Walk	
6 32.400	Nautilus	Tear	STOP	Branches	

Copy events

This option allows to copy the selected events in the clipboard. The clipboard will contain the values of the selected events (except the **type** field) separated by a <TAB> character.

Example of clipboard content:

```
0.0 Himal    Tear    Branches
0.0 Nautilus      Tear    Branches
30.199   Himal    Tear    Branches
30.2     Himal   Locomotion    Walk
32.4     Himal   Locomotion    Walk
32.4     Nautilus      Tear    Branches
```

Paste events

This option allows to paste the clipboard content into the events widget. The clipboard must respect the format described in the previous section: 5 columns separated by <TAB> character.

Find in events

This option allows to search for a string in the various field of events. Select the fields to be searched. The find/replace operation can be restricted to the selected events.

The screenshot shows a table of event data on the left and a 'Find in events' dialog box on the right. The table has columns: time, subject, code, type, modifier, and comment. The dialog box contains checkboxes for Subject, Behavior, Modifiers, and Comment, all of which are checked. A 'Find' input field contains 'Locom'. A checkbox for 'Find in selected events' is unchecked. At the bottom are 'Close' and 'Find' buttons.

	time	subject	code	type	modifier	comment
1	0.000	Himal	Tear	START	Branches	
2	0.000	Nautilus	Tear	START	Branches	
3	30.199	Himal	Tear	STOP	Branches	
4	30.200	Himal	Locomotion	START		
5	32.400	Himal	Locomotion	STOP		
6	32.400	Nautilus	Tear	STOP		

Find/Replace in events

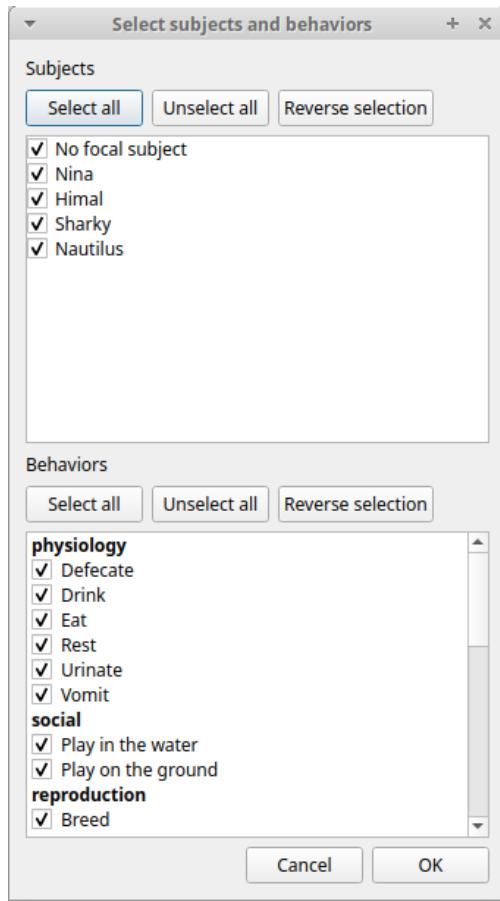
This option allows to search for a string and replace it by a new value in the various field of events. Select the fields to be searched. The find operation can be restricted to the selected events.

The screenshot shows a table of event data on the left and a 'Find/Replace events' dialog box on the right. The table is identical to the one in the previous 'Find in events' section. The dialog box contains checkboxes for Subject, Behavior, Modifiers, and Comment, with only 'Subject' checked. The 'Find' input field contains 'Himal' and the 'Replace' input field contains 'Coco'. A checkbox for 'Find/Replace in selected events' is unchecked. At the bottom are 'Cancel', 'Find and replace', and 'Find and replace all' buttons.

	time	subject	code	type	modifier	comment
1	0.000	Himal	Tear	START	Branches	
2	0.000	Nautilus	Tear	START	Branches	
3	30.199	Himal	Tear	STOP	Branches	
4	30.200	Himal	Locomotion	START	Walk	
5	32.400	Himal				
6	32.400	Nautilus				

Filter events

This option allows to filter the events by field value.



Show all events

This option reverts the previous one and allows to visualize all coded events

Check state events

This option allows to check if the **state events** are **PAIRED**, if they have a **START** and a **STOP** occurrences.

Delete selected events

This option allows to delete the selected events. This operation is irreversible!

Delete all events

This option allows to delete all then events in the current observation. This operation is irreversible!

Fix unpaired state events

You can use the "Fix unpaired events" function to fix the **state events** without a STOP event.

Observations > Fix unpaired events (keyboard shortcut: CTRL+U)

The program will ask for a time at which insert the STOP events for all unpaired **state events**

This function can be run on a set of selected observations (when no observation is open). In this case the STOP events will be inserted at the end of observation.

Explore project

You can search information in various fields in all observations in the current project (Observations > Explore project).

The searchable fields are: **subject**, **behavior**, **modifier** and **comment**.

If more than one field is searched a logic AND will apply.



The events that were found are listed in a table. By double-clicking on the row the corresponding observation will be opened and the visualization will be scrolled to the row corresponding to the event.

The screenshot shows the BORIS software interface. On the left is the Ethogram with various behavioral categories like Alert, Allogroom, Breed, Chase, Defecate, Dig, Drink, Eat, Interact with, Locomotion, Look for food, Manipulate, Play in the water, and Play on the ground. In the center, a table titled 'Events for "0004" observation' lists events with columns for time, subject, code, and type. One row is selected (Observation id: 32). On the right, a detailed view of the selected observation (0004) shows the timeline from 00:00:16.468 to 00:00:58.852, listing numerous events for subjects Himal, Nautillus, and Nina across different behaviors like Alert, Locomotion, Rest, and Drink. A small 'Warning' dialog is visible at the bottom left of the main window.

Frame-by-frame mode

You can switch between the media player and the frame-by-frame mode using the **arrow buttons** in the toolbar:

In frame-by-frame mode the video will stop playing and the user will visualize the video frame by frame.

Warning

Please note that MTS video files should be re-encoded to be used in frame-by-frame mode. Otherwise the extracted frames are not reliable.

You can move between frames by using the arrow keys in the toolbar (on the right) or by using keyboard special keys:

- **Left arrow** key: go to the previous frame
- **Right arrow** key: go to the next frame
- **Page Up** key: switch to the next media
- **Page Down** key: switch to the previous media
- **Up arrow** key: jump forward in the current media
- **Down arrow** key: jump backward in the current media

If you have a numeric keypad you can use the following keys in alternative:

- The key / will allow you to view the previous frame

- The key * will allow you to view the next frame

To return in the media player mode press the **Play** button in the toolbar.

See **File > Preferences > frame-by-frame mode**

Exporting events data

The coded events can be exported in various formats:

Export tabular events

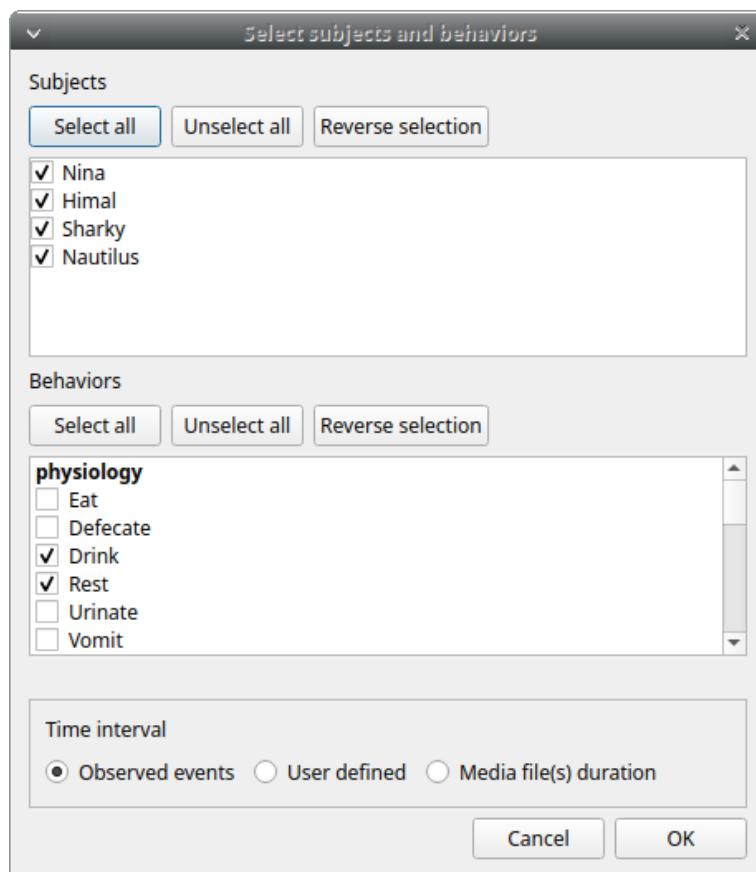
Observations > Export events > Tabular events

This function exports the events of selected observations in one or many files. Various formats are available: TSV, CSV, ODS, XLSX, XLS, HTML, Pandas dataframe and R dataframe.

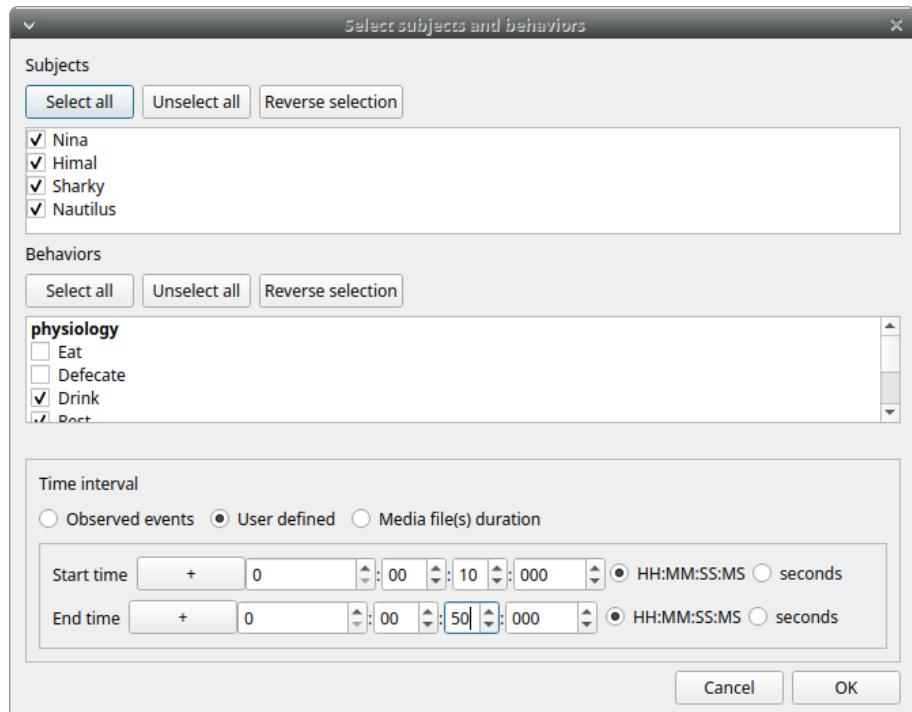
If many observations are selected BORIS will ask for a directory to save the various files. For the XLS and XLSX formats the events can be exported on various worksheet in a single workbook. These formats are suitable for further analysis.

Select the subjects, the behaviors and the time interval.

Set the time interval to the **Observed events**



Select a **User defined** time interval.



Example of output of tabular events

Subject	Behavior	Behavioral category	Modifier #1	Behavior type	Time	Media file name	Image index	Image file path	Comment
Himal	Tear		Branches	START	0.000	20160517162540.m2ts	NA	NA	
Sharky	Tear		Branches	START	0.000	20160517162540.m2ts	NA	NA	
Nautilus	Tear		Branches	START	1.359	20160517162540.m2ts	NA	NA	
Nautilus	Tear		Branches	STOP	25.776	20160517162540.m2ts	NA	NA	
Nautilus	Carry objects		Branches	START	25.777	20160517162540.m2ts	NA	NA	
Nautilus	Carry objects		Branches	STOP	27.732	20160517162540.m2ts	NA	NA	
Sharky	Tear		Branches	STOP	30.688	20160517162540.m2ts	NA	NA	
Sharky	Locomotion		Walk	START	30.689	20160517162540.m2ts	NA	NA	
Sharky	Locomotion		Walk	STOP	31.819	20160517162540.m2ts	NA	NA	
Himal	Tear		Branches	STOP	33.898	20160517162540.m2ts	NA	NA	
Himal	Locomotion		Start	START	33.899	20160517162540.m2ts	NA	NA	
Himal	Locomotion		Start	STOP	34.470	20160517162540.m2ts	NA	NA	

Export aggregated events

Observations > Export events Aggregated events

This function will export the events corresponding to the selected subjects and the selected behaviors of the selected observations.

Various formats are available:

- **table format** (TSV, CSV, XLSX, XLS, ODS, HTML)
 - **SQL** format for populating a SQL database
 - **SDIS** format for analysis with the GSEQ program available at <http://www2.gsu.edu/~psyrab/gseq>
 - **Pandas dataframe** (to be loaded in Python with the [pickle module](#))
 - **R dataframe** (to be loaded in R with [readRDS function](#))

If two or more observations are selected you can choose to group all results in one file. If you do not want to group results BORIS will ask for a directory to save the various files (the observation id will be used as file name).

The **State events** are paired and in this case the event duration is available.

An arbitrary time interval can be selected (check the **Limit to time interval** option). In this case the ongoing events will be started at start time and stopped at end time in the export file.

The following fields are available in the output:

- Observation id
 - Observation date and time
 - Observation description
 - Observation type (Media file / Live / Pictures)
 - Source (for media file and pictures)
 - Total duration (in seconds, the duration of observation in base of the selected time interval)
 - Media duration(s) (in seconds, for media file observation)
 - FPS (frame/s, for video file, number of images per second)
 - Independent variables (one column by variable9)
 - Subject name
 - Observation duration by subject
 - Behavior
 - Behavioral category (if any)
 - Modifier(s) of behavior (one column by modifier)
 - Behavior type (STATE / POINT)
 - Start (seconds)
 - Stop (seconds)
 - Duration (seconds, duration of the event for STATE events)
 - Media file name (for media file observation, media in which the event occurs)
 - Image index start (for observations from pictures, index of the image where the event starts)
 - Image index stop (for observations from pictures, index of the image where the event stops)
 - Image file path start (for observations from pictures, path of the image where the event starts)
 - Image file path stop (for observations from pictures, path of the image where the event stops)
 - Comment start
 - Comment stop

Example of table export of aggregated events (TSV, CSV, XLSX, ODS, HTML)

Subject	Observation duration by subject by observation	Behavior	Behavioral category	Modifier #1	Behavior type	Start (s)	Stop (s)	Duration (s)	Media file name	Image index start	Image index stop	Image file path start	Image file path stop	Comment start	Comment stop
Himal	47.613	Locomotion	Not defined	Run	STATE	8.253	11.779	3.526	20160517162952.m2ts	NA	NA				
Nautlius	24.431	Locomotion	Not defined	Run	STATE	8.329	13.789	5.460	20160517162952.m2ts	NA	NA				
Sharky	48.452		Swim	Not defined	STATE	10.400	58.852	48.452	20160517162952.m2ts	NA	NA				
Alie	57.431		Alert	Not defined	STATE	10.400	16.460	1.059	20160517162952.m2ts	NA	NA				
Nautlius	24.431	Locomotion	Not defined	Walk	STATE	13.790	14.465	1.075	20160517162952.m2ts	NA	NA				
Himal	47.613	Locomotion	Not defined	Jump	STATE	14.948	16.467	2.119	20160517162952.m2ts	NA	NA				
Nautlius	24.431	Locomotion	Not defined	Jump	STATE	14.948	23.600	8.752	20160517162952.m2ts	NA	NA				
Nina	27.431	Rest	physiology		STATE	15.000	40.550	25.549	20160517162952.m2ts	NA	NA				
Himal	47.613	Alert	physiology	Not defined	STATE	16.468	24.400	7.939	20160517162952.m2ts	NA	NA				
Nautlius	24.431	Rest	physiology	STATE	20.400	24.258	4.058	20160517162952.m2ts	NA	NA					
Himal	47.613	Locomotion	Not defined	Walk	STATE	20.917	44.760	15.843	20160517162952.m2ts	NA	NA				
Nautlius	24.431	Locomotion	Not defined	Run	STATE	39.983	42.313	2.330	20160517162952.m2ts	NA	NA				
Nautlius	24.431	Rest	physiology		STATE	42.314	48.219	5.905	20160517162952.m2ts	NA	NA				
Himal	47.613	Allogram	Not defined		STATE	44.761	48.364	3.603	20160517162952.m2ts	NA	NA				
Himal	47.613	Locomotion	Not defined	Walk	STATE	46.762	49.274	0.512	20160517162952.m2ts	NA	NA				
Himal	47.613	Drink	physiology		STATE	49.275	50.390	1.115	20160517162952.m2ts	NA	NA				
Himal	47.613	Swim	Not defined		STATE	50.609	58.950	8.541	20160517162952.m2ts	NA	NA				
Sharky	40.77		Manipulate	Not defined	STATE	0.000	40.770	40.770	20160517161531.m2ts	NA	NA				
Nautlius	40.77		Manipulate	Not defined	STATE	0.000	40.770	40.770	20160517161531.m2ts	NA	NA				
Himal	44.368	Manipulate	Not defined		STATE	0.000	40.760	40.760	20160517163231.m2ts	NA	NA				
Nautlius	45.037	Manipulate	Not defined		STATE	0.000	17.448	17.448	20160517163231.m2ts	NA	NA				
Sharky	46.537	Manipulate	Not defined		STATE	1.824	46.537	46.537	20160517163231.m2ts	NA	NA				

Example of SQL export of aggregated events:

```
CREATE TABLE aggregated_events (id INTEGER PRIMARY KEY ASC, observation TEXT, subject TEXT, behavior TEXT, type TEXT, modifiers TEXT, start FLOAT, stop FLOAT, comment TEXT, comment_stop TEXT, image_index_start INTEGER,image_index_stop INTEGER,image_path_start TEXT,image_path_stop TEXT);
INSERT INTO "aggregated_events" VALUES('1', '0001_a', 'Himal', 'Tear', 'STATE', 'Branches', '0.0', '30.199', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('2', '0001_a', 'Himal', 'Locomotion', 'STATE', 'Walk', '30.2', '32.4', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('3', '0001_a', 'Nautlius', 'Tear', 'STATE', 'Branches', '0.0', '32.4', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('4', '0001_b', 'Himal', 'Tear', 'STATE', 'Branches', '0.0', '30.199', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('5', '0001_b', 'Himal', 'Locomotion', 'STATE', 'Walk', '30.2', '32.4', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('6', '0001_b', 'Nautlius', 'Tear', 'STATE', 'Branches', '0.0', '33.898', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('7', '0002', 'Himal', 'Tear', 'STATE', 'Branches', '0.0', '33.898', '33.899', '34.47', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('8', '0002', 'Himal', 'Locomotion', 'STATE', 'Walk', '30.688', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('9', '0002', 'Sharky', 'Tear', 'STATE', 'Branches', '0.0', '30.688', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('10', '0002', 'Sharky', 'Locomotion', 'STATE', 'Walk', '30.689', '31.819', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('11', '0002', 'Nautlius', 'Carry objects', 'STATE', 'Branches', '1.359', '25.776', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('12', '0002', 'Nautlius', 'Carry objects', 'STATE', 'Branches', '25.777', '27.732', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('13', '0003', 'Nina', 'Locomotion', 'STATE', 'Walk', '21.626', '22.5', '', '', 'NA', 'NA', 'NULL', 'NULL');
INSERT INTO "aggregated_events" VALUES('14', '0003', 'Nina', 'Manipulate', 'STATE', '0.0', '21.625', '', '', 'NA', 'NA', 'NULL', 'NULL');
```

Export events as behavioral sequences

Observations > Export events as behavioral sequences

Behavioral strings can be used with the **Behatrix** program: **Behatrix**

Example:

```
# observation id: demo#1
# observation description:
# Media file name: video1.mp4, video2.mp4

Subject #1:
eat|jump|eat|jump

Subject #2:
eat|rest|jump|eat|jump
```

Export events as Praat TextGrid

Observations > Export events as Praat TextGrid

Example:

```
File type = "ooTextFile"
Object class = "TextGrid"

xmin = 4.3
xmax = 113.988
tiers? <exists>
size = 2
item []:
    item [1]:
        class = "IntervalTier"
        name = "Subject #1"
        xmin = 4.3
```

```

xmax = 10.0
intervals: size = 1
intervals [1]:
    xmin = 4.3
    xmax = 10.0
    text = "eat"
item [2]:
    class = "IntervalTier"
    name = "Subject #2"
    xmin = 26.6
    xmax = 113.988
    intervals: size = 1
    intervals [1]:
        xmin = 26.6
        xmax = 113.988
        text = "eat"

```

Export events for analysis with JWatcher

Observations > Export events for analysis with JWatcher

JWatcher is a powerful tool for the quantitative analysis of behavior.

The events coded with BORIS can be exported to be analyzed with JWatcher.

Click **Observations > Export events > for analysis with JWatcher** to export the coded events.

BORIS will ask for selecting a directory. After this, for each combination of selected observation and selected subject the following files will be created:

- the Focal Data File (.dat)
- the Focal Analysis Master File (.faf)
- the Focal Master File (.fmf)

These files can be used to analyze your observations with JWatcher.

Export events as Behaviors Binary Table

Observations > Export events as Behaviors Binary Table

A time interval will be asked to the user (in seconds). The observation will be checked every n seconds and the presence (1, absence: 0) of the selected behaviors will be exported in a table for each selected subjects.

Example for a time interval of 1 second:

time	Alert	Drink	Locomotion	Swim
0.0	0	1	0	0
1.0	0	1	0	0
2.0	0	1	0	0
3.0	0	1	0	0
4.0	0	1	0	0
5.0	0	1	0	0
6.0	0	1	0	0
7.0	0	1	0	0
8.0	0	1	0	0
9.0	1	0	0	0
10.0	1	0	0	0
11.0	0	0	1	0

12.0	1	0	0	0
13.0	1	0	0	0
14.0	1	0	0	0
15.0	1	0	0	0
16.0	1	0	0	0
17.0	1	0	0	0
18.0	0	0	1	0
19.0	0	0	1	0
20.0	0	0	1	0
21.0	0	0	1	0
22.0	1	0	0	0
23.0	0	0	0	0
24.0	0	0	0	0
25.0	0	0	0	0
26.0	0	0	0	0
27.0	0	0	0	0
28.0	0	0	0	0
29.0	0	0	0	0
30.0	0	0	0	0
31.0	0	0	0	0
32.0	0	0	0	0
33.0	0	0	0	1
34.0	0	0	0	1
35.0	0	0	0	1
36.0	0	0	0	1
37.0	0	0	0	1
38.0	0	0	0	1
39.0	0	0	0	1
40.0	0	0	0	1
41.0	0	0	0	1
42.0	0	0	0	1
43.0	0	0	0	1
44.0	0	0	0	1
45.0	0	0	0	1
46.0	0	0	0	1
47.0	0	0	0	1
48.0	0	0	0	1
49.0	0	0	0	1

Extract sequences from media files corresponding to coded events

Sequences of media file corresponding to coded events can be extracted from media files:

1. Click on **Observations > Extract events from media files** option.
2. Choose the observation(s).
3. Select the events to be extracted.
4. Select a destination directory that will contain the extracted sequences.
5. Select a time offset (in seconds, the default value is 0).

The time offset will be subtracted from the starting time of event and added to the stopping time. All the extracted sequences will be saved in the selected directory following the file name format:

{observation id}_{player}_{subject}_{behavior}_{start time}-{stop time}

Extract frames corresponding to coded events

The frames corresponding to coded events can be extracted and saved as images.

1. Click on **Observations > Extract frames from media files** option.
2. Choose the observation(s).
3. Select the events to be extracted.
4. Select a destination directory that will contain the extracted sequences.
5. Select a time offset (in seconds, the default value is 0).

Export transitions matrix

3 transitions matrix outputs are available: The matrix of frequencies of transitions, the matrix of frequencies of transition after each behavior and the matrix of number of transitions.

Matrix of frequencies of transitions

This matrix contains the frequencies of total transitions. The sum of all frequencies must be 1.

Example of frequencies of transitions matrix:

	eat	sleep	walk
eat	0.0	0.286	0.143
sleep	0.143	0.0	0.143
walk	0.286	0.0	0.0

In this matrix you can see that the **eat** behavior precedes the **sleep** behavior with a frequency of **0.286** of the total number of transitions.

Matrix of frequencies of transitions after behavior

This matrix contains the frequencies of transitions after each behavior. The sum of each row must be 1.

Example:

	eat	sleep	walk
eat	0.0	0.667	0.333
sleep	0.5	0.0	0.5
walk	1.0	0.0	0.0

In this example you can see that **sleep** follows **eat** with a frequency of **0.667** and **walk** follows with a frequency of **0.333**.

Matrix of number of transitions

This matrix contains the number of transitions after each behavior.

Example:

	eat	sleep	walk
eat	0	2	1
sleep	1	0	1
walk	2	0	0

Playback menu

Jump

Jump forward

Allow to jump forward in the current media file. See **File > Preferences** for setting the jump value.

Jump backward

Allow to jump backward in the current media file. See **File > Preferences** for setting the jump value.

Jump to specific time

Allow to go to a specific time in the current media file.

Zoom level

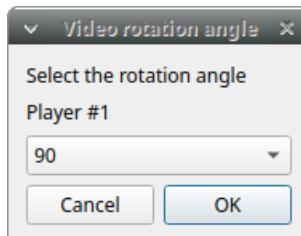
zoom in with **CTRL + +** zoom out with **CTRL + -** set no zoom with **CTRL + 0** or by clicking the mouse right button on the video

and move (pan) the picture in video using: **CTRL + LEFT ARROW**, **CTRL + RIGHT ARROW**, **CTRL + UP ARROW** and **CTRL + DOWN ARROW**,

If you have n observation with many media you will have to select the video by a left-click before.

Rotate video

Select the video rotation for each player. The available rotation values are: 0, 90, 180 and 270.



Display subtitles

Select to display or hide the subtitles. The subtitles file must have exactly the same name of the video file except for the extension and be placed in the same directory.

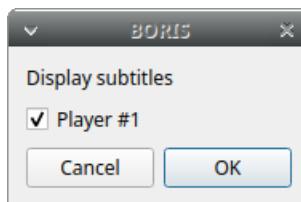
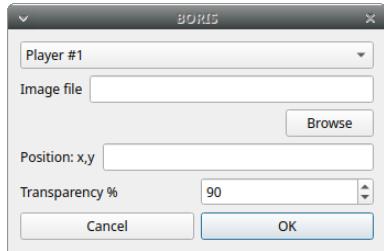


Image overlay on video

Select an image overlay to be displayed on the video. If the selected image does not have a transparent background the transparency can be set from 0 (full transparency) to 255 (no transparency).

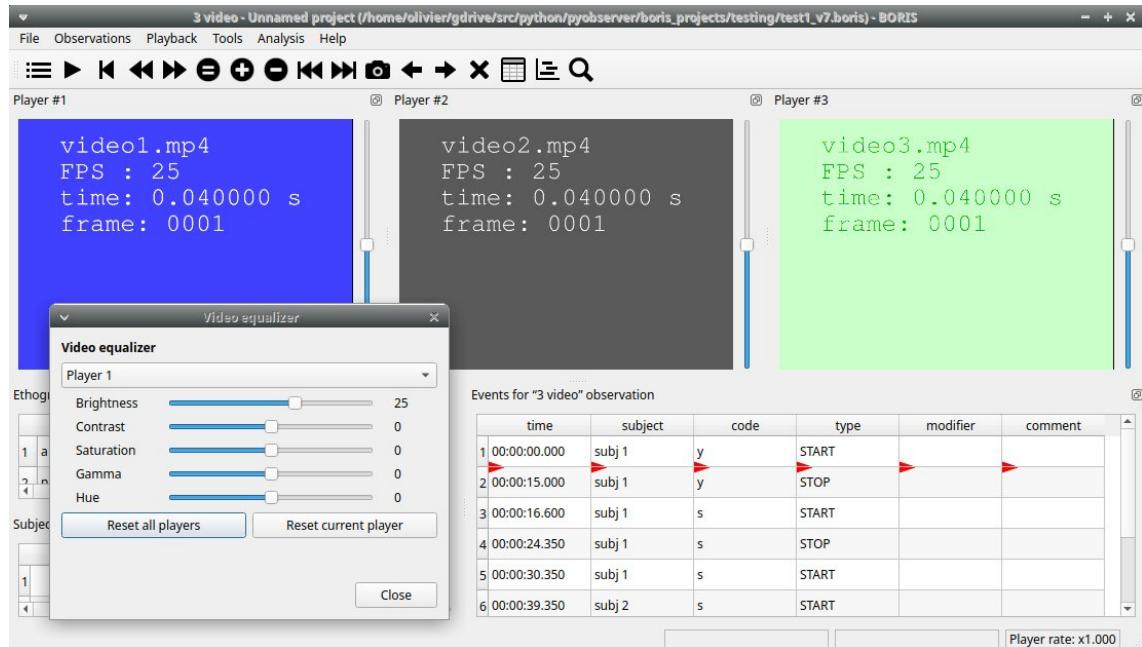
The image must be in PNG format, if the image is smaller than the video resolution the image position can be set from the top-left corner (x: horizontally, y: vertically).



Select > **Playback > Image overlay on video > Remove** to remove the image overlay.

Video equalizer

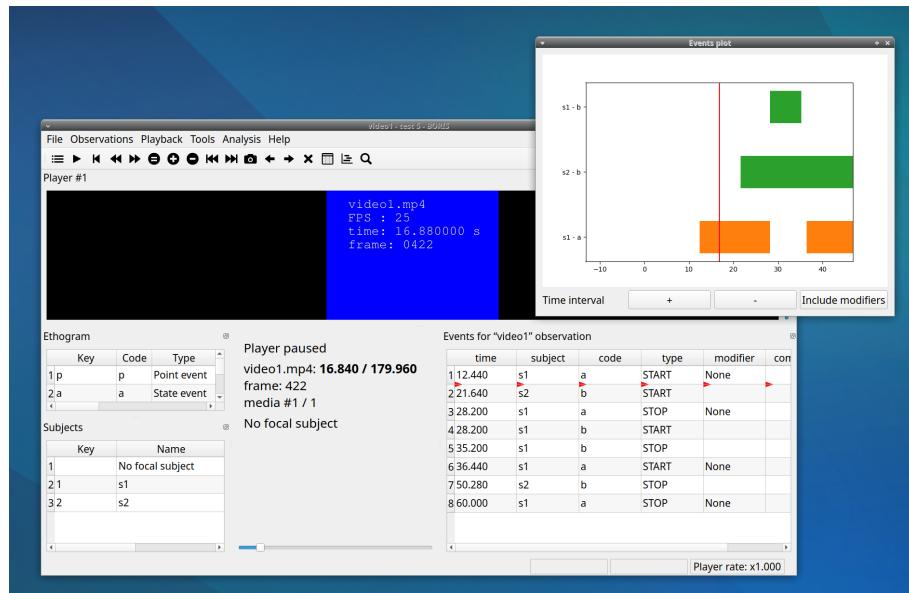
Using this function the **brightness**, the **contrast**, the **saturation**, the **gamma** and the **Hue** can be set for each player.



Tools

Plot events in real-time

This function can be activated with **Tools > Plot event in real time**.

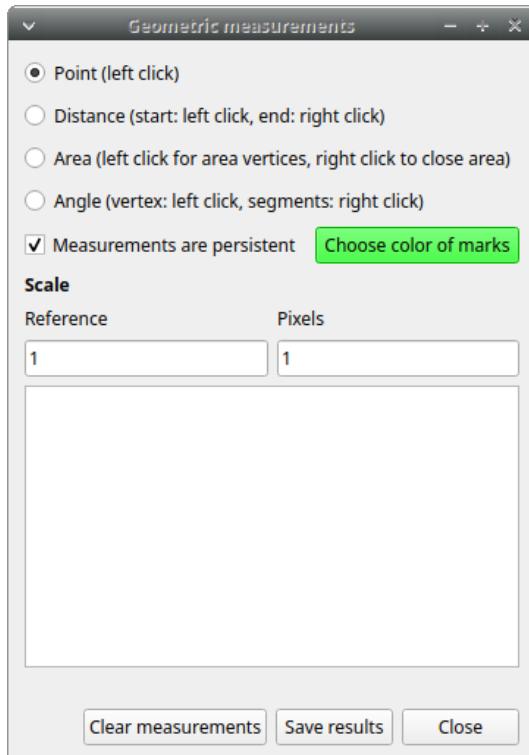


Lock the dockwidgets

The dockwidgets (except the player dockwidgets) can be locked on the main window (See **Tools > Lock dockwidgets**).

Geometric measurements

Some geometric measurements can be done: distances, areas and angles can be measured and point position recorded. Click on **Tools > Geometric measurements** to activate the measurements. The **Measurements window** will be shown:



Mark color

Use the **Choose color of marks** button to select a color. All marks will be drawn with the selected color.

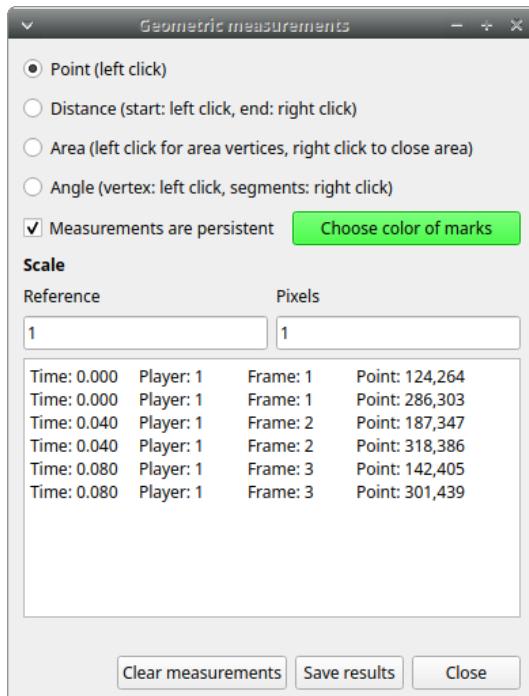
Setting the scale

For distance and area measurements you can set a scale in order to have results of measurements in a real unit (like centimeters, meters etc).

1. measure a reference object (that have a known size) on the frame (with the distance tool. See next chapter for details) and set the pixel distance in the **Pixel** text box.
2. Set the real size of the reference object in the **Reference** text box (must be a number without unit).

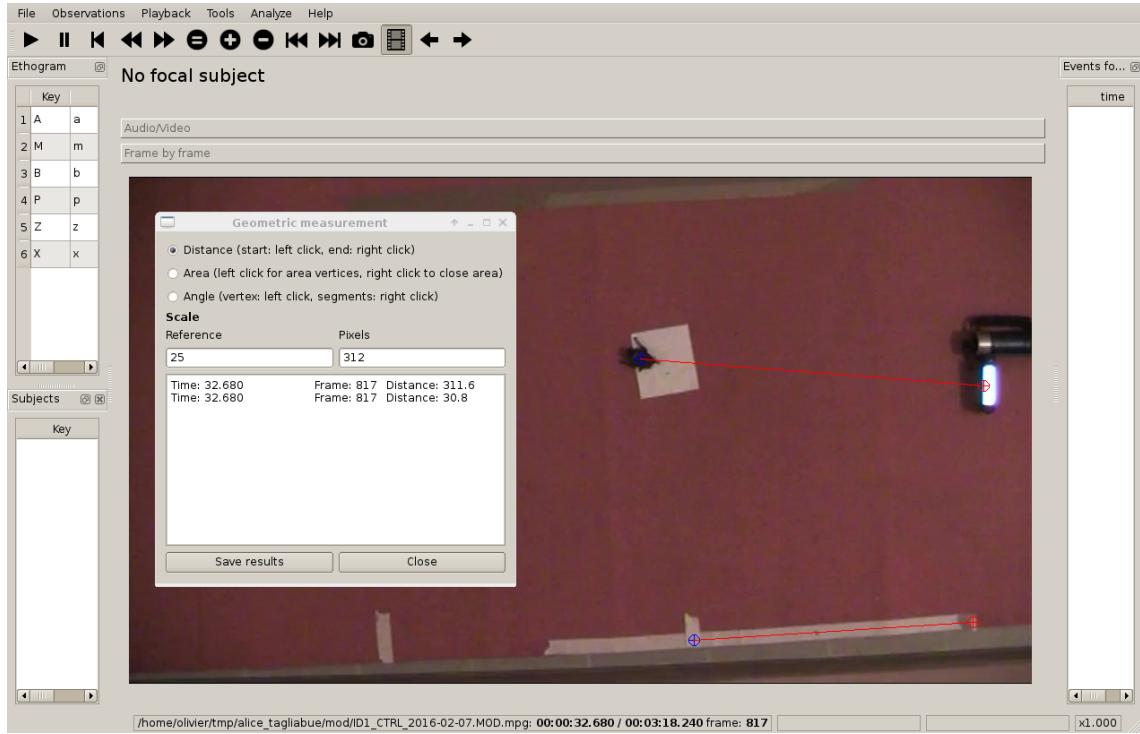
Point

Select the **Point** radio button. Click the left mouse button on the frame bitmap to record the position of the clicked position.



Distance measurements

Select the **Distance** radio button. Click the left mouse button on the frame bitmap to set the start of the segment that will be measured. A circle with a cross will be drawn. Click the right mouse button to set the end. A red circle with a cross will be drawn. The distance between the two selected points will be available in the text area of the **Measurements window**.



Area measurements

Select the **Area** radio button. Click the left mouse button on the frame bitmap to set the area vertices. Circles with a cross will be drawn. Click the right mouse button to close the area. The area of the drawn polygon will be available in the text area of the **Measurements window**.

Angle measurements

Select the **Angle** radio button. Click the left mouse button on the frame bitmap to set the angle vertex. A red circle with a cross will be drawn. Click the right mouse button to set the two segments. Circles with a cross will be drawn. The angle between the two drawn segments will be available in the text area of the **Measurements window**.

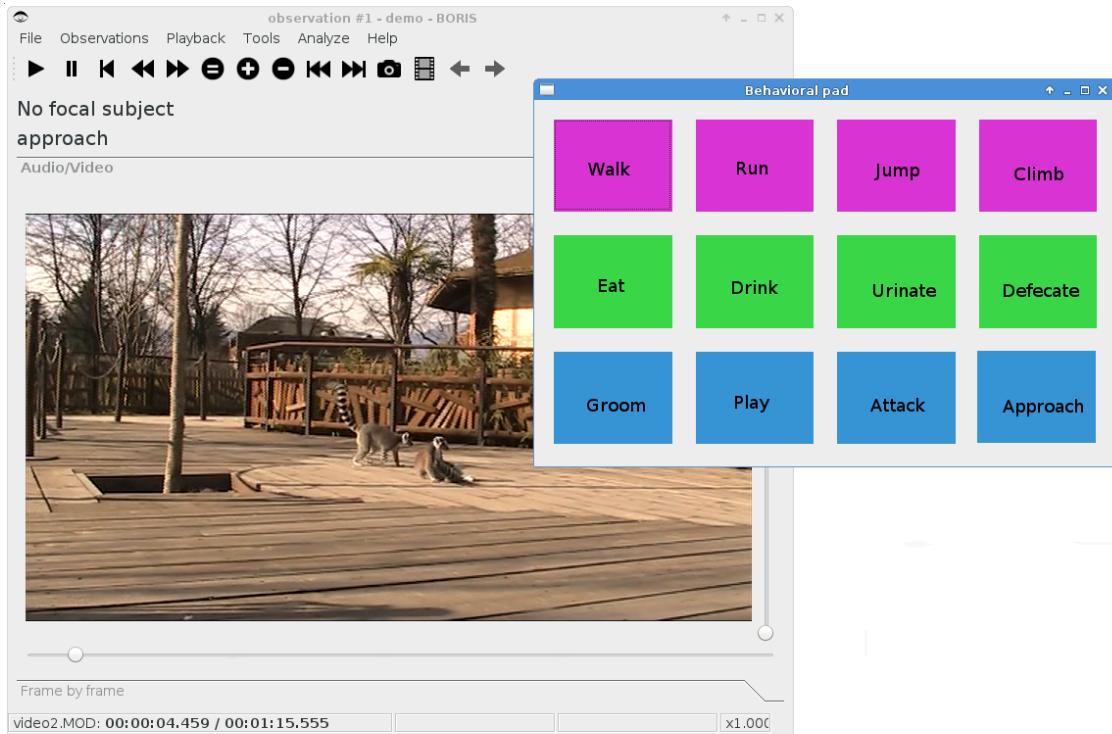
Persistent measurements

If the **Measurements are persistent** checkbox is checked the measurement schemes will be available on all frames otherwise they will be deleted between frames.

The marks selected on other frames will be drawn in red.

Coding pad

During observation a coding pad with the available behaviors can be displayed (**Tools > Coding pad**). This **Coding pad** allows the user to code using a touch-screen or by clicking on the buttons. When the **Coding pad** is displayed you can continue to code using the keyboard or the ethogram.



Subjects pad

A pad with all defined subjects (or filtered subjects) can be displayed during the observation (**Tools > Subjects pad**). This **Subjects pad** allows the user to select the focal subject using a touch-screen or by clicking on the buttons. When the **Subjects pad** is displayed you can continue to select the focal subject using the keyboard or the subjects list.



Converters for external data values

Converters can be written using the Python 3 programming language.

The **INPUT** variable will be loaded with the original value of the external data file (for example 01:22:32).

The **OUTPUT** variable must contain the converted value in seconds (the dot must be used for decimal separator).

Example of a converter for converting HH.MM:SS format in seconds:

```

h, m, s = INPUT.split(':')
OUTPUT = int(h) * 3600 + int(m) * 60 + int(s)

```

The Python function `strptime()` from the `datetime` module can be useful for converting time values:
<https://docs.python.org/3/library/datetime.html#strftime-strptime-behavior>

Example of a converter for converting ISO8601 format in seconds using the `strptime()` function:

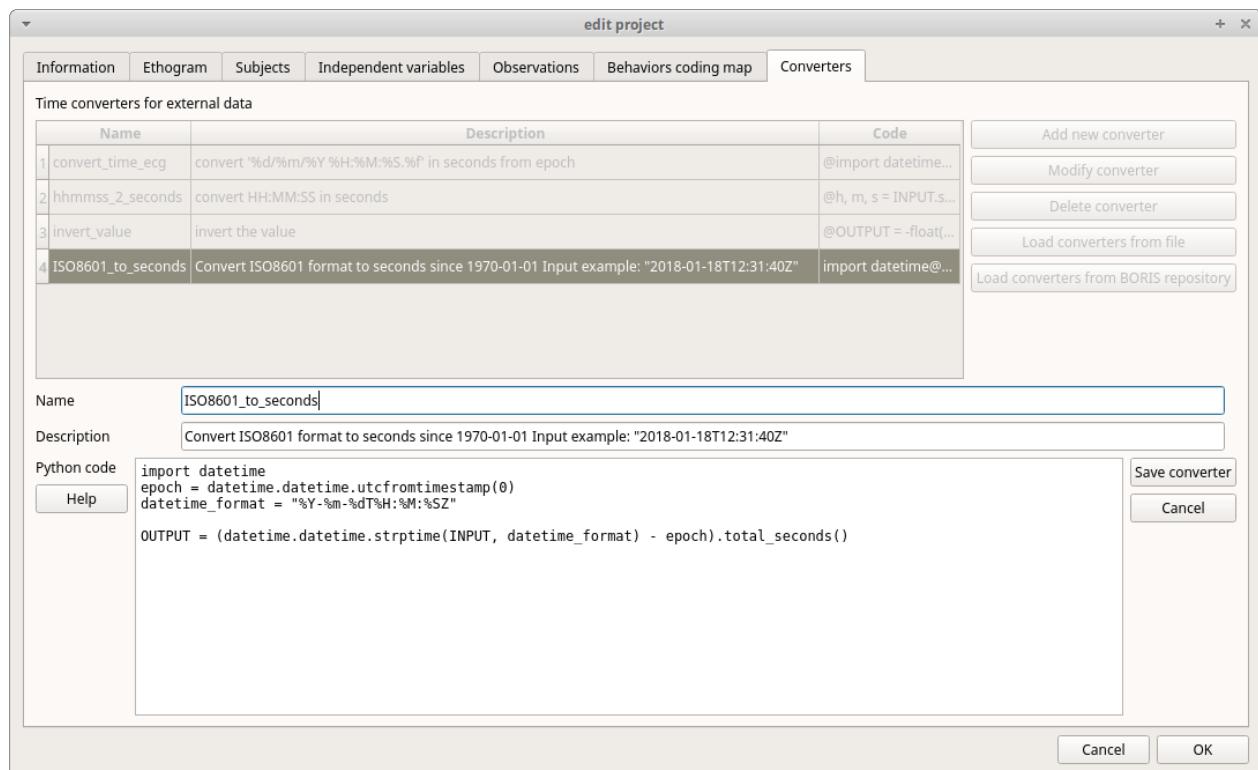
```

import datetime
epoch = datetime.datetime.utcnowtimestamp(0)
datetime_format = "%Y-%m-%dT%H:%M:%SZ"

OUTPUT = (datetime.datetime.strptime(INPUT, datetime_format) - epoch).total_seconds()

```

File > Edit project > Converters tab



Transitions flow diagram

BORIS can generate DOT scripts and flow diagrams from the transitions matrices (See Observations > Create transition matrix for obtaining the transitions matrices).

DOT script (Graphviz language)

Tools > Transitions flow diagram > Create transitions DOT script

Choose one ore more transitions matrix files and BORIS will create the relative DOT script file(s).

The DOT script files can then be used with [Graphviz](#) (Graph Visualization Software) or [WebGraphviz](#) (Graphviz in the Browser) to generate flow diagram of transitions.

See [DOT \(graph description language\)](#) for details.

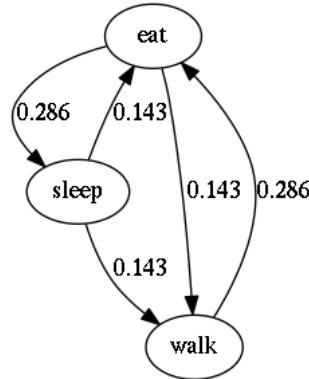
Flow diagram

If [Graphviz](#) (Graph Visualization Software) is installed on your system (and the **dot** program available in the path) BORIS can generate flow diagram (PNG format) from a transitions matrix file.

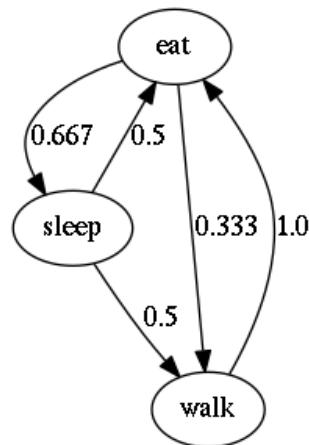
Tools > Transitions flow diagram > Create transitions flow diagram

Choose one ore more transition matrix files and BORIS will create the relative flow diagram.

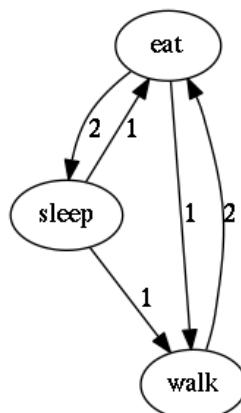
Flow diagram of frequencies of transitions



Flow diagram of frequencies of transitions after behavior



Flow diagram of number of transitions



Re-encoding and resizing a video file

BORIS can re-encode and resize your video files in order to reduce the size of the files and have a smooth coding (specially with two video files playing together). The re-encoding and resizing operations are done with the embedded ffmpeg program with high quality parameters (bitrate 2000k).

Select the files you want re-encode and resize and select the horizontal resolution in pixels (the default is 1024). The aspect ratio will be maintained.

You can continue to use BORIS during the re-encoding/resizing operation.

The re-encoded/resized video files are renamed by adding the re-encoded.avi extension to the original files.

Warning

Please note that MTS video files should be re-encoded to be used in frame-by-frame mode. Otherwise the extracted frames are not reliable.

Rotating a video file

BORIS can rotate your video files in order to code them using the right view. The rotating operation is done with the embedded ffmpeg program using the same quality parameters than the original video.

Select the files you want rotate and select the rotation between: **Rotate 90 clockwise**, **Rotate 90 counter clockwise** and **Rotate 180**.

The aspect ratio will be maintained.

You can continue to use BORIS during the rotation operation.

The rotated video files are renamed by adding the **rotated<ANGLE>** to the original file name.

Coding map

A coding map is a bitmap image with user-defined clickable areas that will help to code for behaviors or modifiers for a behavior.

2 types of coding maps are available:

- Behaviors coding map
- Modifiers coding map

The Behaviors coding map

BORIS allows creating a **Behaviors coding map** using the **Map creator** tool (**Tools > Create a coding map > for behaviors**).

A **Behaviors coding map** can be created only if you have defined behaviors in your ethogram.

Creating a Behaviors coding map

To create a new **Behaviors coding map** launch the **Behaviors coding map creator**

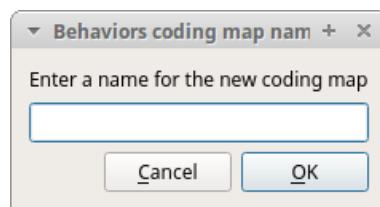
Tools > Create a coding map > for behaviors).

A new window will open



File > New behaviors coding map

Enter a name for the new **Behaviors coding map**

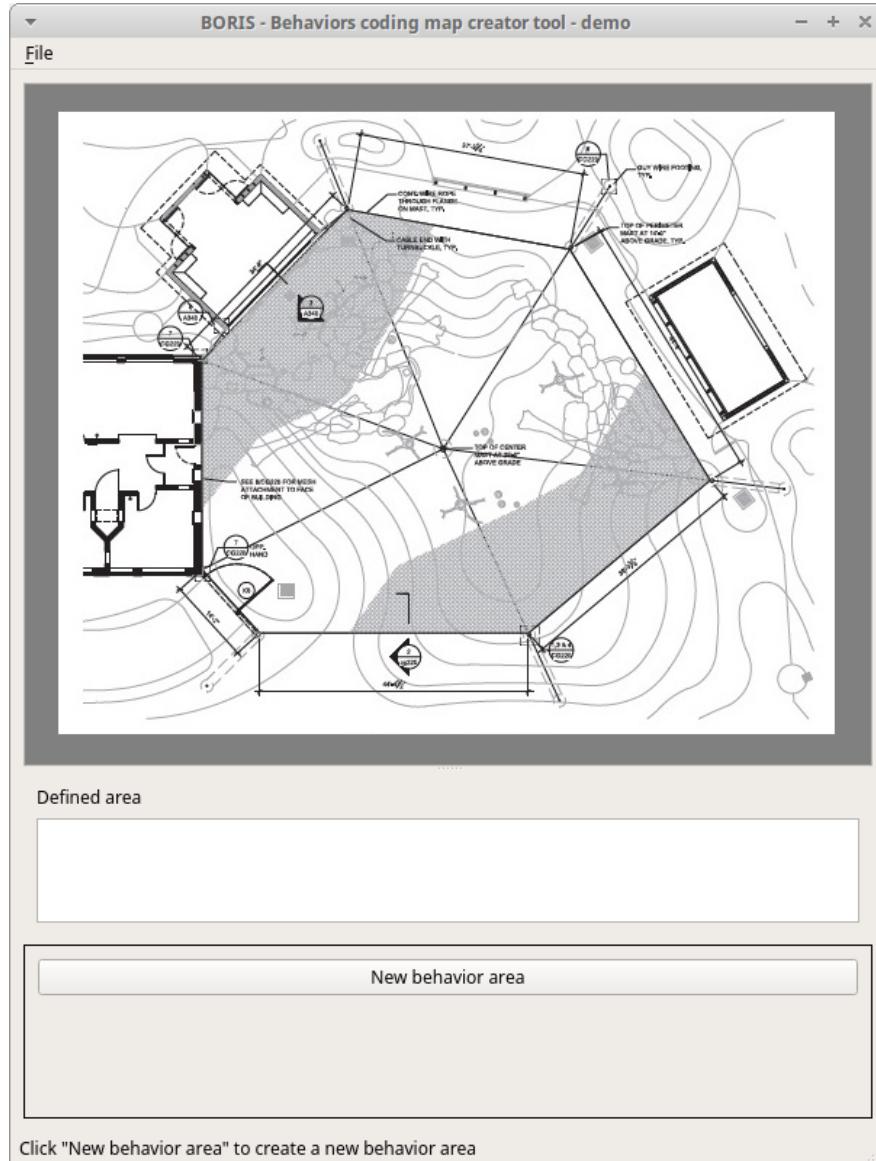


Loading a bitmap for a behaviors coding map

Click the **Load bitmap** button in the bottom of the window and select a bitmap image (PNG and JPEG formats are accepted).

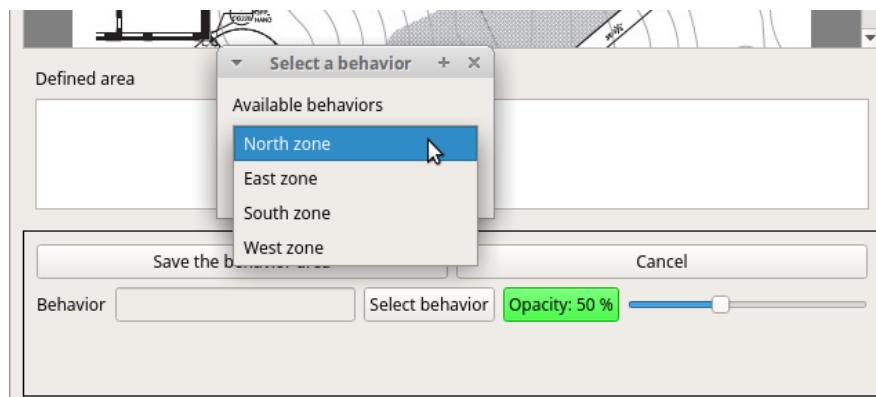
If the size of your bitmap image is bigger than 640 x 640 pixels BORIS will resize it to 640 x 640 pixels keeping the aspect ratio and store the resized version in the coding map file.

The bitmap will be displayed



Adding areas corresponding the behaviors

Click the **New behavior area** button in the bottom of the window and select a behavior by clicking on the **Select behavior** button.



The available behaviors are taken from the ethogram of the current project.

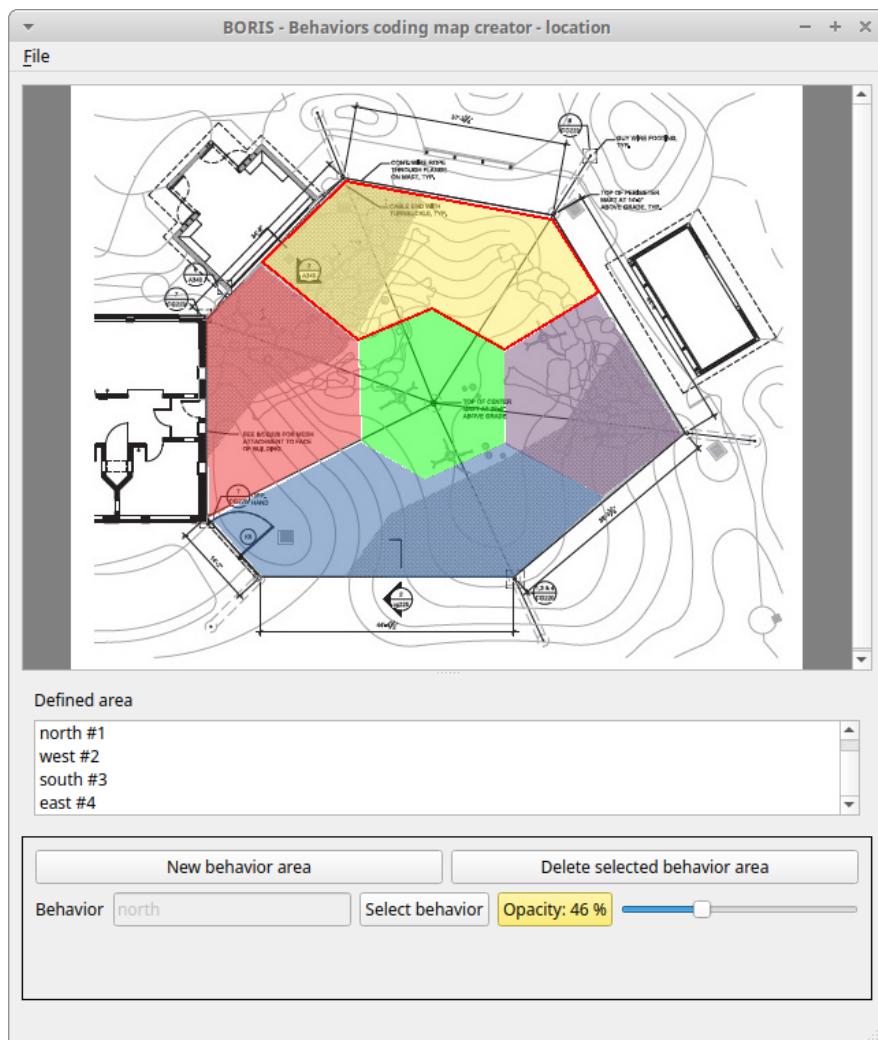
Click on the bitmap to define the vertex on the area that will code the selected behavior. Close the area by clicking again on the first point.

The color of the new area can be changed using the **Opacity** button. The opacity can be changed (from 0 to 100%) using the slider.

Save the behavior area by clicking on the **Save the behavior area** button

The area will be added to the **Defined area** list

You can add more area and also add more than one area for a same behavior. Two or more areas can overlap. In this case all corresponding behaviors will be triggered.



Add the Behaviors coding map to the current project

File > Add coding map to project

The coding map will be added to the current project

You can add a **Behaviors coding map** to the current project from a file containing the coding map:
(**File > Edit project > Behaviors coding map > Add a behaviors coding map**)

Saving the Behaviors coding map

Saving the **Behaviors coding map** will create a file containing the **Behaviors coding map** including the bitmap image.

File > Save the current Behaviors coding map

The file containing the **Behaviors coding map** can be then reloaded in the **Behaviors coding map creator** or added to a BORIS project (**File > Edit project > Behaviors coding map > Add a behaviors coding map**)

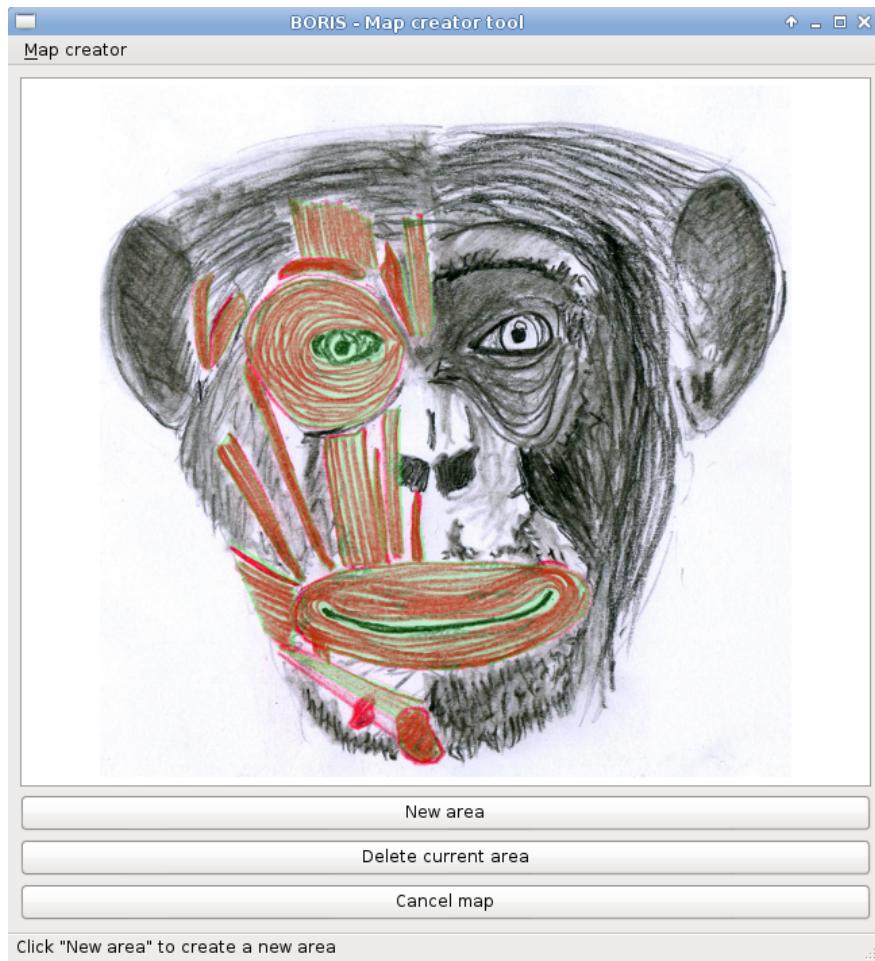
The Modifiers coding map

BORIS allows creating a modifiers coding map using the **Modifiers Map creator** tool (**Tools > Create a coding map > for modifiers.**) Clickable areas may correspond to specific modifiers that can be meaningful for the behavioral coding. Facial expression is the case we thought to when developing this function.

Creating a modifiers coding map

Loading a bitmap for a modifiers coding map

To create a new **Modifiers coding map**, launch the **Modifiers Map creator** tool (**Tools > Create a coding map > for modifiers**). The BORIS main window will be replaced by the **Modifiers Map creator** window. Click on **Modifiers Map creator > New Modifiers map** and enter a name for the new map in the edit box. You have to load a bitmap image (JPEG or PNG) using the **Load bitmap** button. The loaded image will be displayed.



If the size of your bitmap image is bigger than 640 x 640 pixels BORIS will resize it to 640 x 640 pixels keeping the aspect ratio and store the resized version in the coding map file.

Adding areas corresponding to the modifiers

To create clickable areas on a coding map, you have to click on the **New area** button and enter an **Area code** in the edit box. The new area can now be defined by clicking on the image. The drawing tool allows defining an irregular polygon (a plane shape with straight sides, which does not have all sides equal and all angles equal) by clicking to determine subsequent vertices. It can be convex or concave. Straight sides must not cross each other. Once selected an area can be deleted using the **Delete area** button. When an area is closed and its name has been defined in the **Area code** field, it can be saved by using the **Save area** button. The areas can partially overlap each other. See the **Using a Coding map** section for more details. Once all areas are added the entire map can be saved using the **Save map** option menu (**Map creator > Save map**). The map is now saved in its own file (.boris_map) which is NOT part of the BORIS project. A map can be edited at anytime by opening the map file from the **Open map** menu option (**Map creator > Open map**).

Adding a modifiers coding map to your project

Creating a Coding map is not automatically adding the map to your project. The Coding map have to be added to your project by selecting the corresponding **Behavior type (Point event with coding map, State event with coding map)**. BORIS will ask to select the file name containing the coding map (.boris_map) and load the coding map in the project. The coding map name will appear in the **Coding map** column and will be saved in the BORIS project file.

NOTE: If you later modify your coding map you must reload the new version in your BORIS project.

Analysis

Time budget analysis

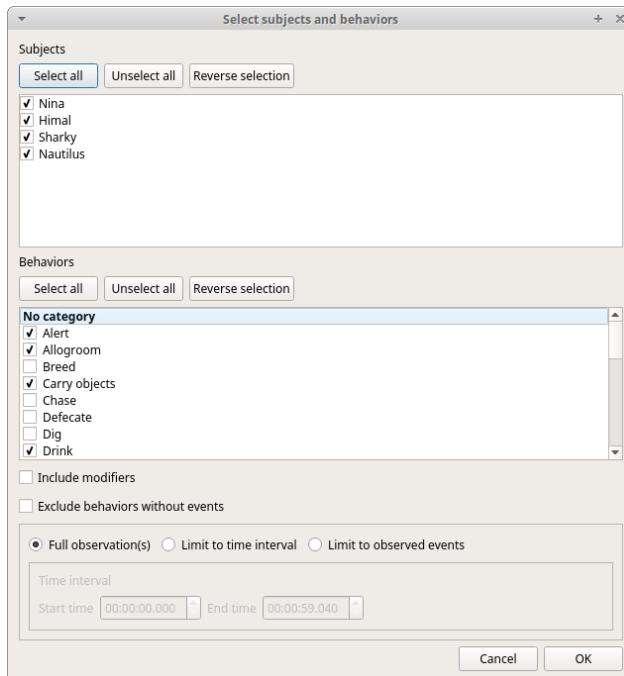
The **Time budget analysis** can be done by behavior (including or not the modifiers) or by category of behaviors. Choose the option from the **Analysis** menu.

The **Time budget analysis** can be done on one or more observations. If you select more than one observation you must then choose for a global time budget analysis that will contain all selected observations or a time budget analysis for every single observation.



Choose **Yes** to group all observations in one time budget analysis

The **Analysis > Time budget** menu option shows the time budget for the events of the selected observations. Select the subjects and behaviors you want to include in the time budget analysis:



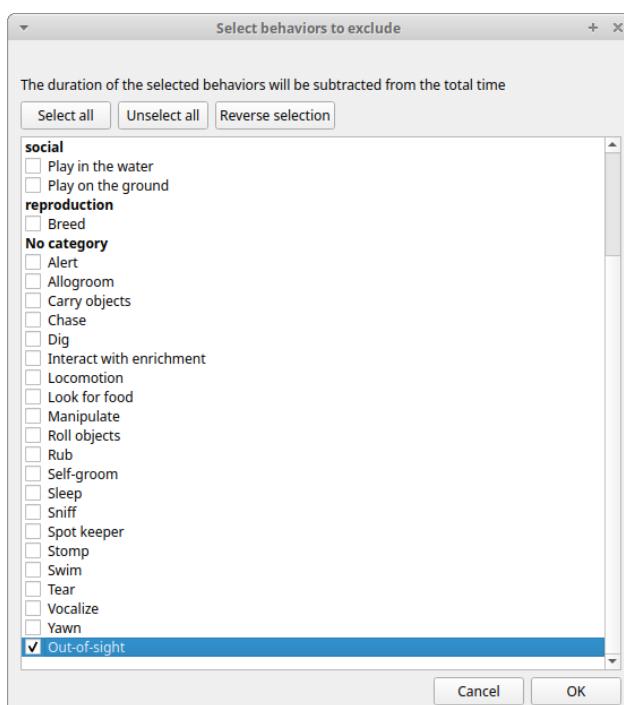
All behaviors can be selected or unselected by clicking on the Category (bold).

You can choose to include or not the behavior modifiers in the Time budget analysis and to exclude behaviors without coded events.

The Time budget analysis can be restricted to a part of the observation:

- Full observation(s): the analysis will be made on the full observation length.
- Limit to time interval: use the **Start time** and **End time** boxes to select starting time and ending time.
- Limit to observed events: the analysis will be made from the first observed event to the last observed event.

The last dialog window will allow you to subtract the duration of one or more behaviors from the total duration of the observation. This can help you if you have defined a "out-of-sight" code in your ethogram for example:



The results contain for each subject and behavior the **total number of occurrences**, the **total duration** (for the behaviors defined as state events), The **duration mean** (for the behaviors defined as state events), the **standard deviation of duration**, the **inter-events intervals duration mean**, th **standard deviation of the inter-events intervals duration** and the **percent of total duration of observation(s)**. All duration times are expressed in seconds (s).

Time budget									
Selected observations									
Total observation length: 00:07:25.680									
Subject	Behavior	Modifiers	Total number	Total duration (s)	Duration mean (s)	Duration std dev	inter-event intervals mean (s)	inter-event intervals std dev	% of total length
1 Nina	Alert	-	1	1.882	1.882	NA	NA	NA	0.4
2 Nina	Locomotion	-	2	2.913	1.457	0.824	NA	NA	0.7
3 Nina	Manipulate	-	2	65.048	32.524	15.414	NA	NA	14.6
4 Nina	Rest	-	1	25.549	25.549	NA	NA	NA	5.7
5 Himal	Alert	-	4	18.131	4.533	2.542	10.95	NA	4.1
6 Himal	Allgroom	-	1	3.603	3.603	NA	NA	NA	0.8
7 Himal	Drink	-	1	1.133	1.133	NA	NA	NA	0.3
8 Himal	Locomotion	-	10	36.633	3.663	5.777	6.124	5.88	8.2
9 Himal	Manipulate	-	3	66.702	22.234	17.18	4.723	NA	15.0
10 Himal	Play on the ground	-	1	16.46	16.46	NA	NA	NA	3.7
11 Himal	Rub	-	1	11.031	11.031	NA	NA	NA	2.5
12 Himal	Self-groom	-	1	3.571	3.571	NA	NA	NA	0.8

The time budget results can be saved in various formats for further analysis: * Plain text files: TSV, CSV or HTML * Spreadsheets: Open Document (ODS), Microsoft Excel (XLSX) and Legacy Microsoft (XLS)

Note

If a STATE behavior has an odd number of coded events, BORIS will report "UNPAIRED" instead of results"

Synthetic time budget

The synthetic time budget is similar to time budget but with fewer parameters and a different organization of results. Results of all selected observations are organized in columns on a single page. Two parameters are provided for now: **number of occurrences** and **total duration** (for the behaviors defined as state events)

A	B	C	D	E	F	G	H	I	J
1		Nina	Nina	Nina	Nina	Nina	Nina	Nina	Nina
2		Alert	Alert	Allogroom	Allogroom	Breed	Breed	Carry objects	Carry objects
3	Total length (s)	Total duration	Number of occurrences						
40	0037	32.160							
41	0038	86.880	1.675	1					
42	0039	96.960	13.471	2					
43	0040	335.520	86.615	12	15.84	2			
44	0041	130.560	9.069	2	5.85	1			
45	0042	36.960	24.298	3					
46	0043	107.040	42.928	5					
47	0044	109.920	11.769	4	12.471	2			
48	0045	102.240	72.857	6					
49	0046	84.960	44.459	6					
50	0047	77.280	68.929	2					
51	0048	23.520	3.1	1	10.797	1			
52	0049	34.080	9.897	2	8.431	1			
53	0050	23.040							
54	0051	44.160	1.079	1					
55	0052	18.240							
56	0053	39.840							
57	0054	35.040							
58	0055	256.800	61.321	15	19.73	1			
59	0056	26.400	15.241	5					
60	0057	45.120	6.887	3	10.984	2			
61	0058	45.120	2.647	1					
62	0059	41.760							
63	0060	292.800	1.543	2					
64	0061	25.920							

All duration times are expressed in seconds (s).

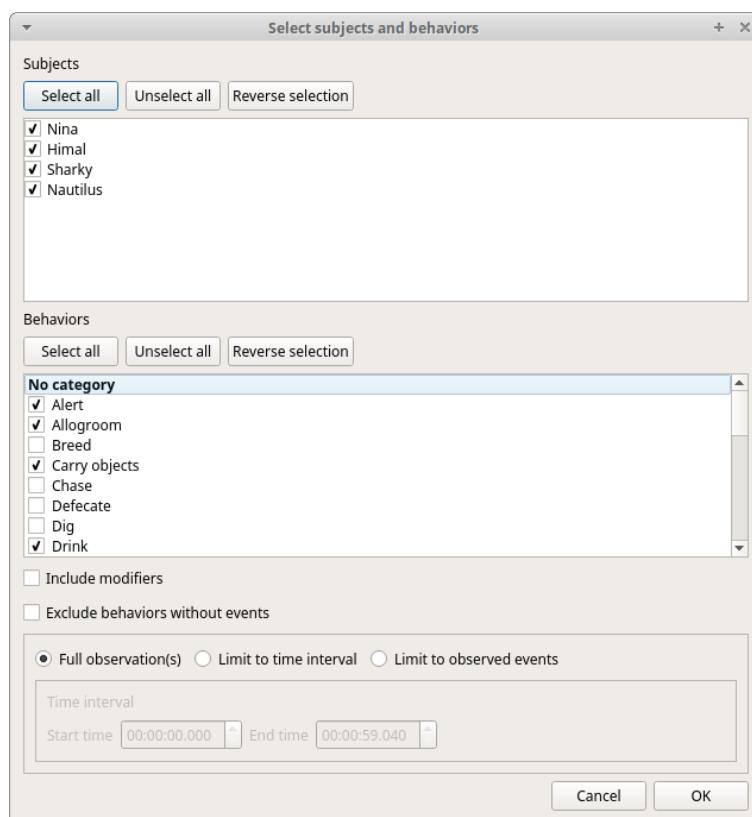
The time budget results can be saved in various formats for further analysis: * Plain text files: TSV, CSV or HTML * Spreadsheets: Open Document (ODS), Microsoft Excel (XLSX) and Legacy Microsoft (XLS)

Plot events

The coded events from many observations can be plotted along a time axis.

Analysis > Plot > Plot events

The subjects and behaviors you want to include in the plot can be selected in the following window:



You can choose to include or not the behavior modifiers (if any) and to exclude behaviors without coded events.

The time interval can be selected (See time budget)

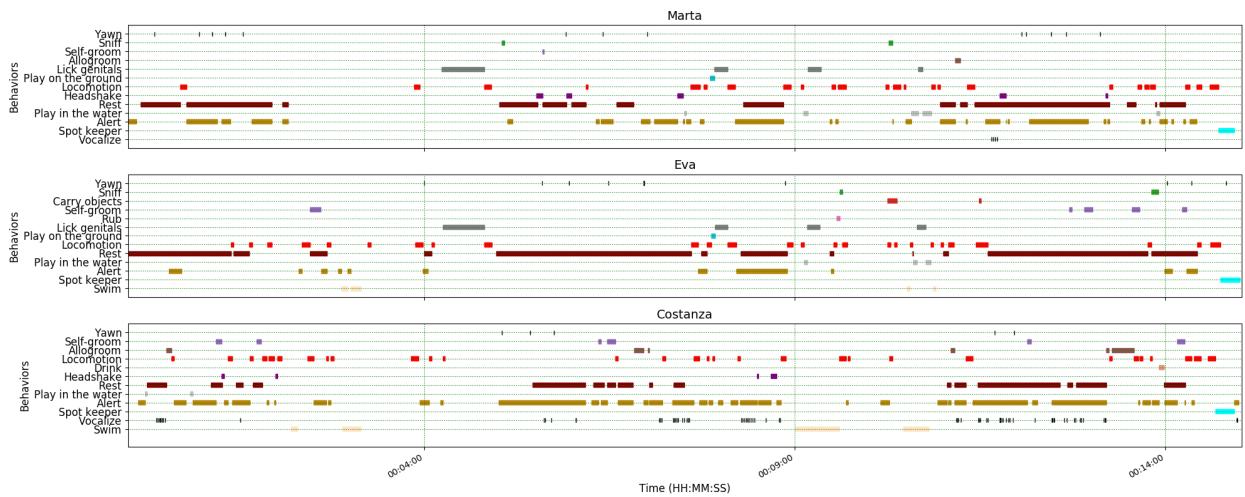
The plot can be exported in various formats like bitmap (PNG, JPG, TIFF) or vectorial graphic (SVG, PDF, EPS, PS). The SVG format can be further edited with the [Inkscape](#) vector graphics editor.

Note

If a STATE behavior has an odd number of coded events, you will see this error message: "The STATE behavior XXX is not paired"

This function creates one plot by subject on one figure.

The color of behaviors can be customized. See [plot colors](#)

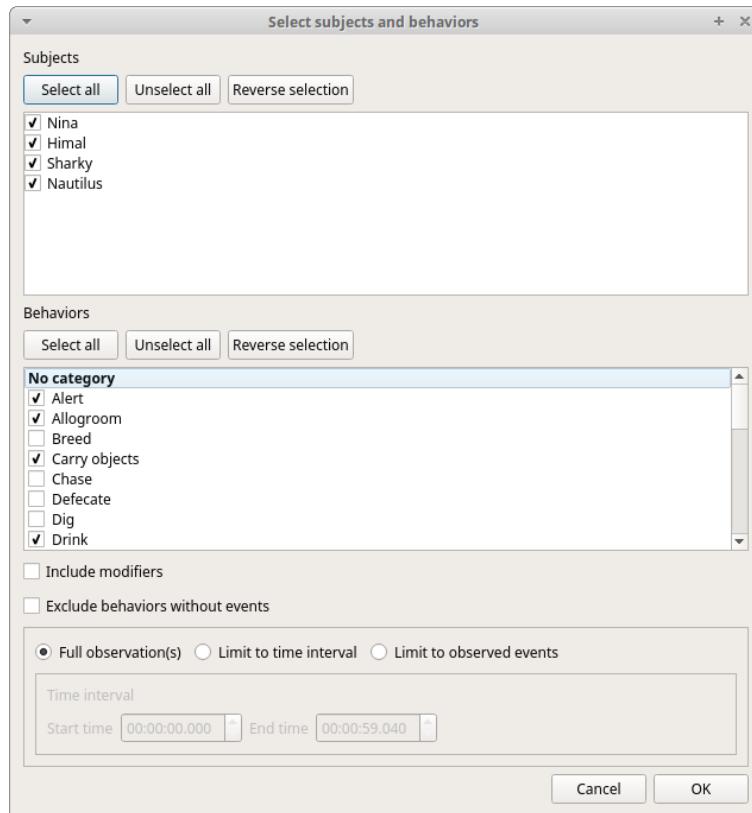


Plot time budget

The duration and number of occurrences can be plotted for each subject and behavior.

Analysis > Plot > Plot time budget

The subjects and behaviors you want to include in the plot can be selected in the following window:



The behavior modifiers can not be included in the plot for now.

The time interval can be selected (See time budget)

The plot can be exported in various formats like bitmap (PNG, JPG, TIFF) or vectorial graphic (SVG, PDF, EPS, PS). The SVG format can be further edited with the [Inkscape vector graphics editor](#).

Note

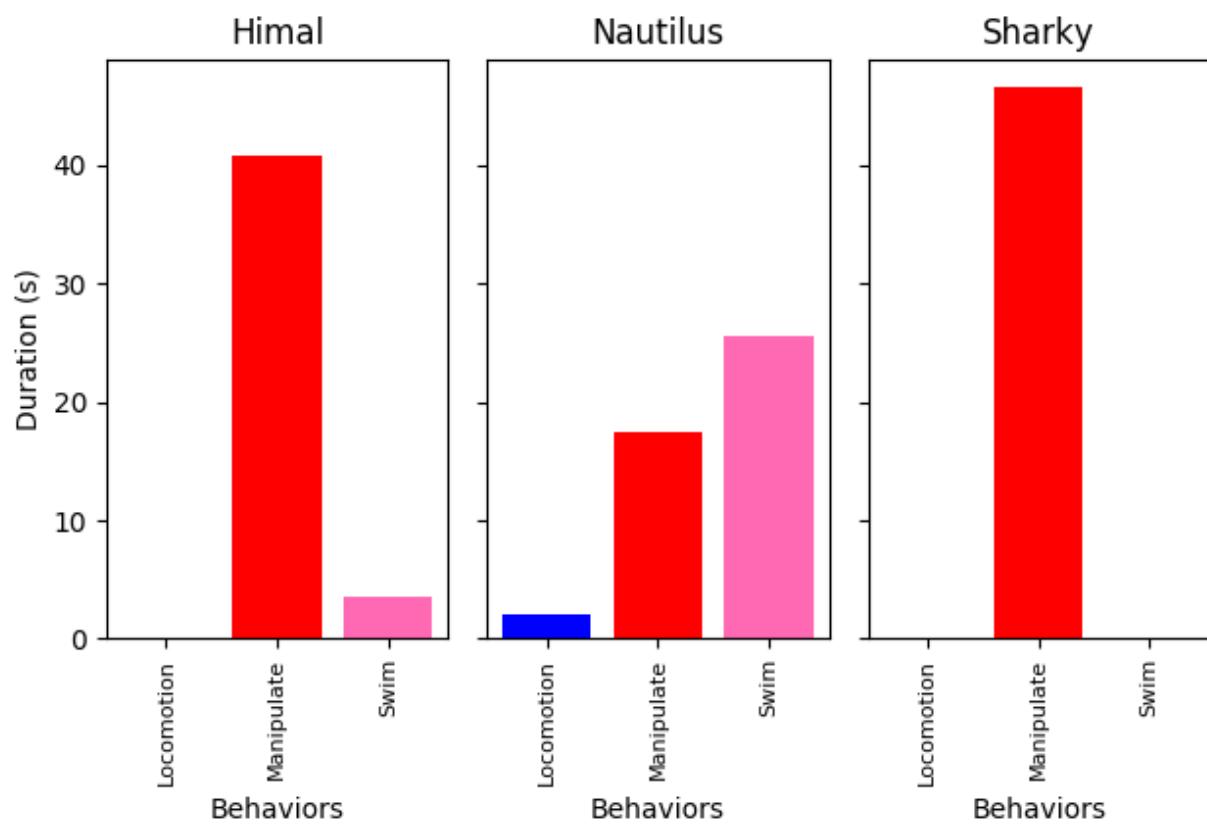
If a STATE behavior has an odd number of coded events, you will see this error message: "The STATE behavior XXX is not paired"

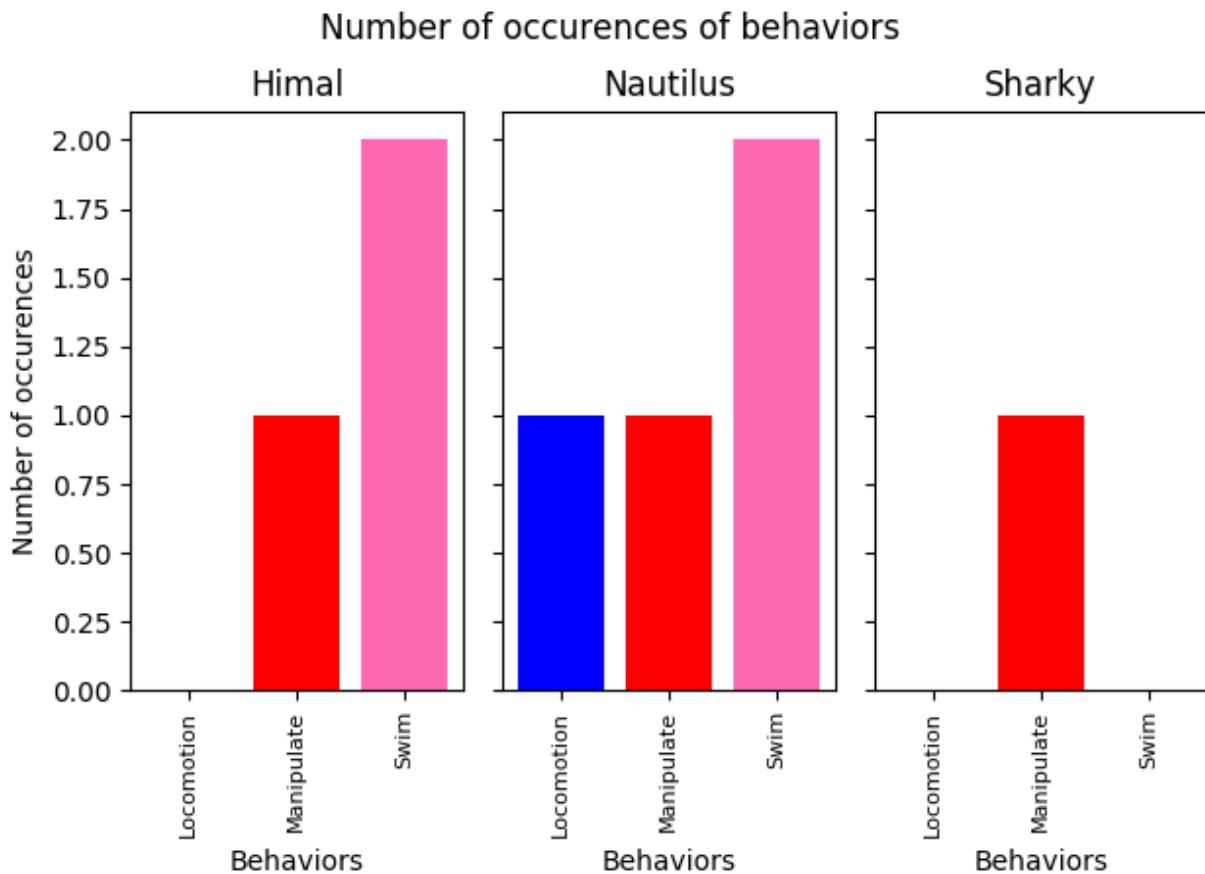
This function creates 2 plots with all subjects for each observation:

- a plot of the behavior durations for the behaviors defined as STATE event.
- a plot of the number of occurrences for all the behaviors.

The color of behaviors can be customized. See [plot colors](#)

Durations of behaviors



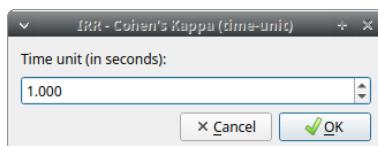


Inter-rater reliability

The Cohen's kappa coefficient can be calculated (**Analysis > Inter-rater reliability > Cohen's kappa**).

[Cohen's kappa on Wikipedia](#)

After selecting 2 observations and a time window (in seconds) for the analysis (the default value is 10 seconds) the Cohen's kappa will be displayed in the results window.



Implementation of IRR Cohen's Kappa in BORIS

If a time window of n seconds is set the 2 selected observations will be checked every n seconds for agreement/disagreement from the first event to the last event of the 2 observations . In case of a point event the presence of a corresponding event in the other observation will be verified using a time window of n seconds centered on the point event.

A IRR Cohen's Kappa analysis is available in the GSEQ program (<http://www2.gsu.edu/~psyrab/gseq>). For this the coded events can be exported as aggregated events in SDIS format. See [export aggregated events](#)

Advanced event filtering

This function allows to filter events from one or more observations by selecting subjects, behaviors and logical operators.

To use the filter, select a subject, select a behavior and click on the button with the green arrow on the side of the behaviors list. The tuple subject/behavior will be added in the **filter text edit**. A complex filter query can be constructed by adding parenthesis and logical operator (**AND & / OR |**) for combining various subjects and behaviors.

Example of a summarized output showing the occurrences of Himal resting while Nautilus in alert:

Observation id	Number of occurrences	Total duration	Mean	Std Dev
1 0015	1	3.351	3.351	NA
2 0019	2	8.581	4.29	2.461
3 0028	1	3.905	3.905	NA
4 0030	1	8.231	8.231	NA
5 0032	1	14.245	14.245	NA
6 0043	1	9.219	9.219	NA
7 0048	1	2.016	2.016	NA

Example of a detailed output showing the overlapping intervals while Himal rests and Nautilus is in alert:

Observation id	Comment	Start time	Stop time	Duration
1 0019		3.559	6.088	2.529
2 0019		14.907	17.457	2.550
3 0028		0.0	3.905	3.905
4 0048		18.333	18.627	0.294
5 0054		28.77	30.019	1.249
6 0138		174.796	178.699	3.903
7 0138		180.77	181.497	0.727

The same subject can be used many times in the query with OR or AND (in case of non exclusive behaviors):

Advanced event filtering

Filter
"Himal|Drink" | "Himal|Eat"

Summary Details

Subjects
Himal
Nautilus
Nina
Sharky

Behaviors
Carry objects
Chase
Defecate
Dig
Drink
Eat
Interact with enrichment
Locomotion
Look for food
Manipulate
Play in the water
Sleep on the ground

Logical operators
AND
OR

Results (188 events)

Observation id	Comment	Start time	Stop time	Duration
1 0004		49.275	50.408	1.133
2 0009		5.579	10.48	4.901
3 0009		18.683	40.19	21.507
4 0013		24.324	30.869	6.545
5 0055		3.65	5.326	1.676
6 0055		21.362	29.117	7.755
7 0056		22.885	26.37	3.485

Save results **Close**

An unlimited number of conditions can be used:

Advanced event filtering

Filter
"Himal|Rest" & "Nautilus|Rest" & "Nina|Rest" & "Sharky|Rest"

Summary Details

Subjects
Himal
Nautilus
Nina
Sharky

Behaviors
Rest
Roll objects
Rub
Self-groom
Sleep
Sniff
Spot keeper
Stomp
Swim
Tear
Urinate

Logical operators
AND
OR

Results (2 observations)

Observation id	Number of occurrences	Total duration	Mean	Std Dev
1 0999	1	0.403	0.403	NA
2 1000	2	2.769	1.384	1.592

Save results **Close**

Parenthesis can be used to group logical conditions into block(s):

Advanced event filtering

Filter

Summary Details

Subjects	Behaviors	Logical operators
Himal Nautilus Nina Sharky	Carry objects Chase Defecate Dig Drink Eat Interact with enrichment Locomotion Look for food Manipulate Play in the water Sleep on the ground	AND OR

Results (30 events)

Observation id	Comment	Start time	Stop time	Duration
1 0055		8.689	12.435	3.746
2 0055		19.778	21.361	1.583
3 0055		29.118	30.692	1.574
4 0055		66.079	69.591	3.512
5 0055		199.744	200.81	1.066
6 0239		149.63	152.719	3.089
7 0230		162.807	164.850	1.052

The results can be saved in a Tab Separated Values (TSV) file using the **Save results** button. Other formats will be added in future.

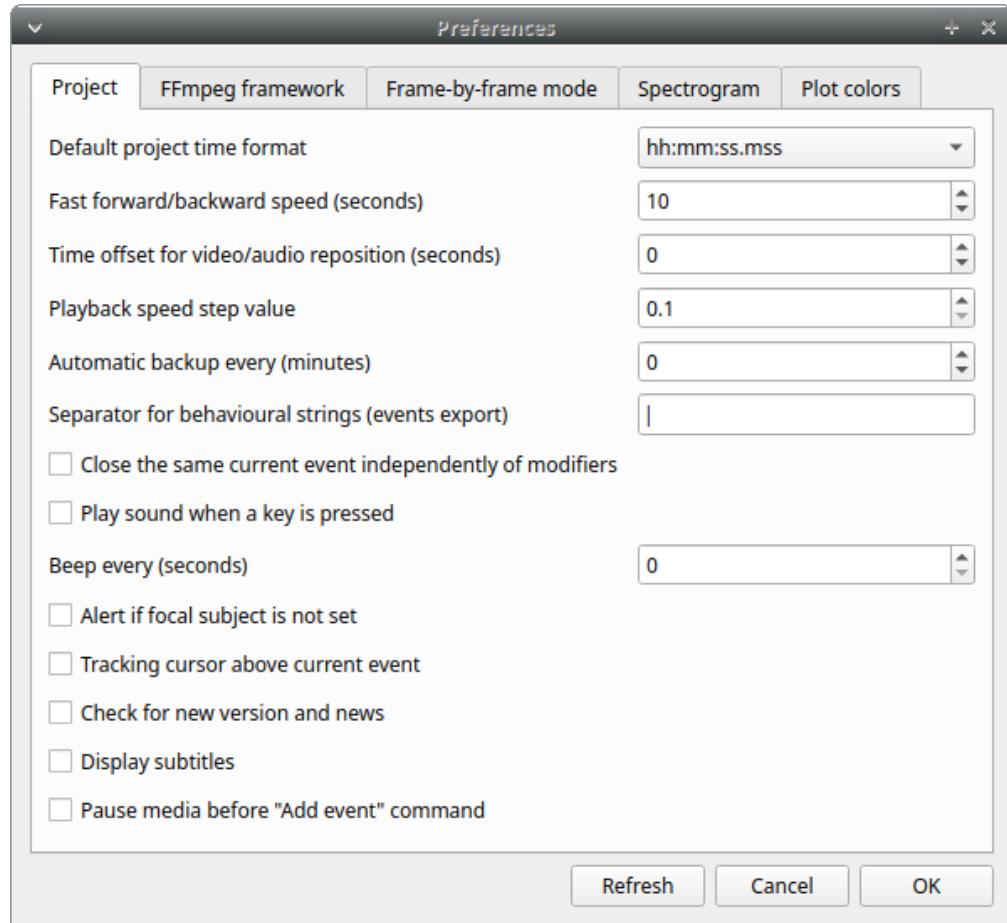
Latency

The latency will analyze the time between one or more markers (arbitrary behaviors(s)) and other behaviors.

Preferences

You can customize BORIS using the Preferences window (**File > Preferences**)

General preferences



Refresh button

Option to reinitialize the configuration to default. BORIS will be closed.

Default project time format

This option allows the user to choose the format for displaying time in the project. Please note that time is internally always saved in seconds with a precision of 3 decimal digits

Fast forward/backward speed (seconds)

This option allows the user to customize the amount of time for "jumping" forward or backward in media.

Time offset for media reposition (seconds)

This value indicates the time offset for repositioning the media after double-click on a row event of the *Events* table. 'for example -4 seconds indicates that after a double-click the media will be repositioned 4 seconds before the recorded event.'

Playback speed step value

This value indicate how much the speed will be increased or decreased after pressing the *change playback speed* buttons.

Auto-save project every (minutes)

if set BORIS will save your project automatically every n minutes. 0 indicate no automatic backup. The project will be saved if the project is already saved and an observation is open.

Separator for behavioural strings

Character (or string) used to separate behaviors when exporting events as behavioural strings. See also Behatrix

Close the same current event independently of modifiers

Option used to STOP the current behavior without regarding the modifiers

Play sound when a key is pressed

Activate a sound signal after every keypress event

Alert if focal subject is not set

If this option is activated BORIS will show an alert box if no focal subject is selected

Tracking cursor above current event

Check this box to position the tracking cursor above the current event in events list table.

Check for new version

Check for new version on BORIS web site every 15 days (internet access required)

Display subtitles

Option to display or hide the visualization of subtitles. In case of separate file, the file containing subtitles must have the same base name than the video files with a .srt extension.

Pause media before "Add event" command

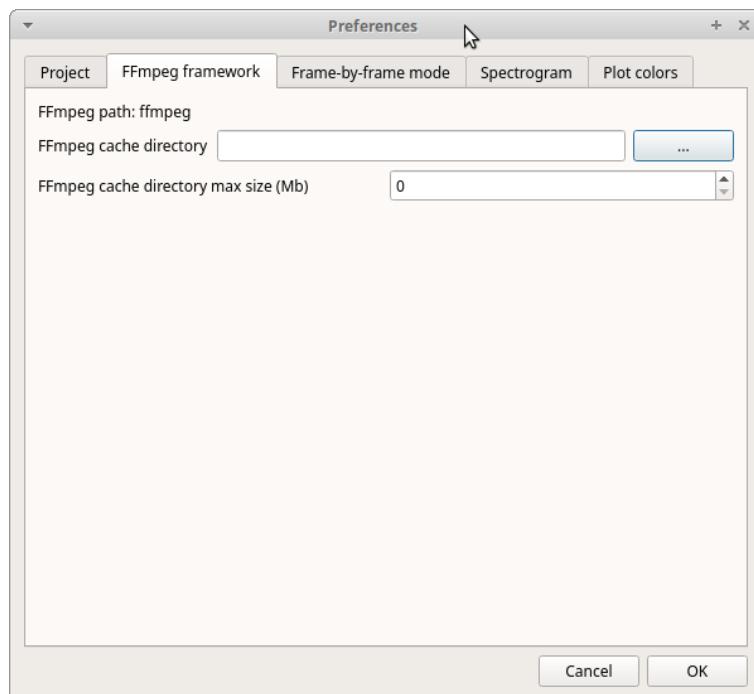
Option to pause the media before manually adding an event.

Results

Compact time budget

This option allow to produce a compact time budget with the same number of columns for each row.

FFmpeg framework



The path for the ffmpeg executable program is displayed. The FFmpeg executable is now included with BORIS in Windows and Mac OS versions.

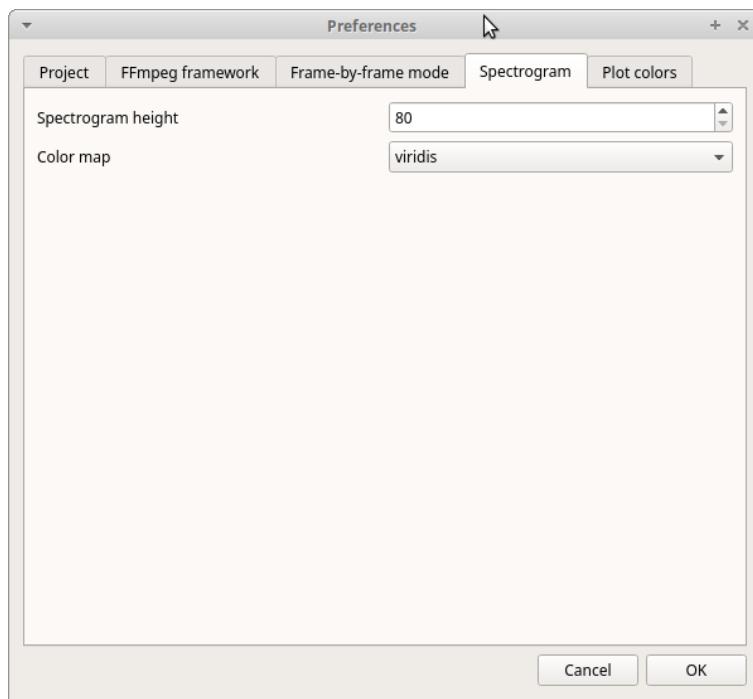
FFmpeg cache directory

This indicates the directory that will be used as image cache for frame-by-frame mode and spectrogram visualization. If you do not specify a path, BORIS will use the default temporary directory of your system.

FFmpeg cache directory max size

Indicate a size limit (in Mb) for the image caching. 0 indicates no limit

Spectrogram



Spectrogram height

Select the height of generated spectrogram (in pixels). You will need to restart the current observation to apply changes.

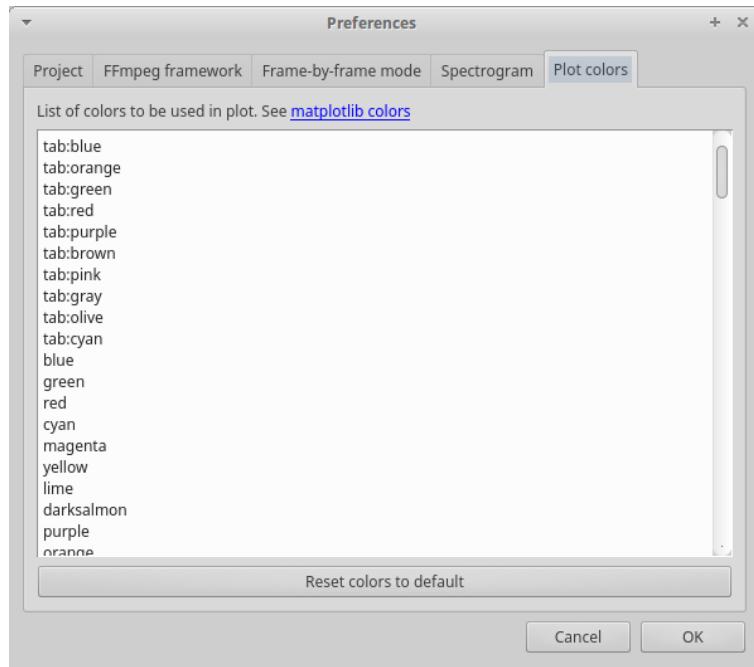
Color map

Select the color map for displaying the generated spectrogram. See [Matplotlib colormaps](#) for details.

Plot colors

The color of behaviors in the plot events functions can be customized. The first color will be associated to the first behavior in your ethogram, the second color to the second behavior and so on. Various color formats can be used to specify a color: **named color** or **hex RGB** (like #0F0F0F). See https://matplotlib.org/api/colors_api.html and https://matplotlib.org/examples/color/named_colors.html for details

The **reset colors to default** button will reload the default colors.



Various

Removing path of media files

Using BORIS you can choose to store the full path of the media/data files into the file project (for example: /home/user/Video/video_n1.mp4 or c:\Users\user\Documents\video1.avi).

If you want to move your project on a different computer or if you want to move your media/data files you may want to do not store the full path. For this you can choose to add media/data files with relative path (See **Add media files** section). You can also remove the full path of your media/data files from all observations of the current project (**File > Remove path from media files**). Please note that this operation is irreversible. After remotion the full path of your media will be lost and will not be recoverable.

If you choose to do not store the full path of media/data files the path of the media/data files must contain the path of your BORIS project file.

Example: if you BORIS project file is saved in /home/user/projects/test.project your media/data files can be saved in the /home/user/projects/videos directory but **NOT** in the /home/user/videos` directory.

Citing BORIS

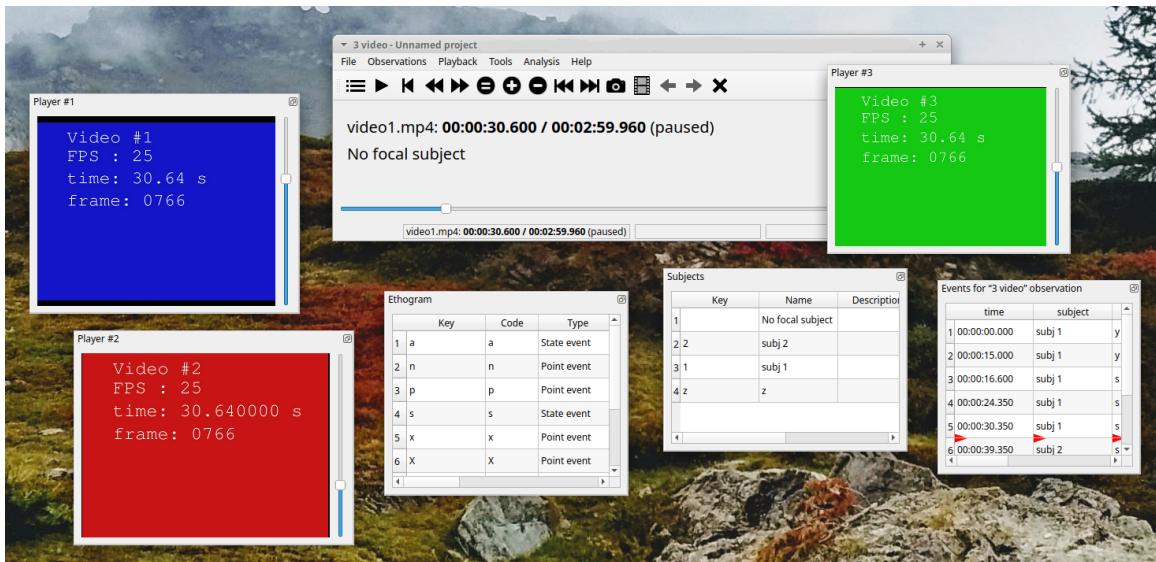
If you have used BORIS for publications, please cite:

Olivier Friard and Marco Gamba. (2016) BORIS: a free, versatile open-source event-logging software for video/audio coding and live observations. *Methods in Ecology and Evolution*, 7(11), 1324–1330
DOI: 10.1111/2041-210X.12584

Docking

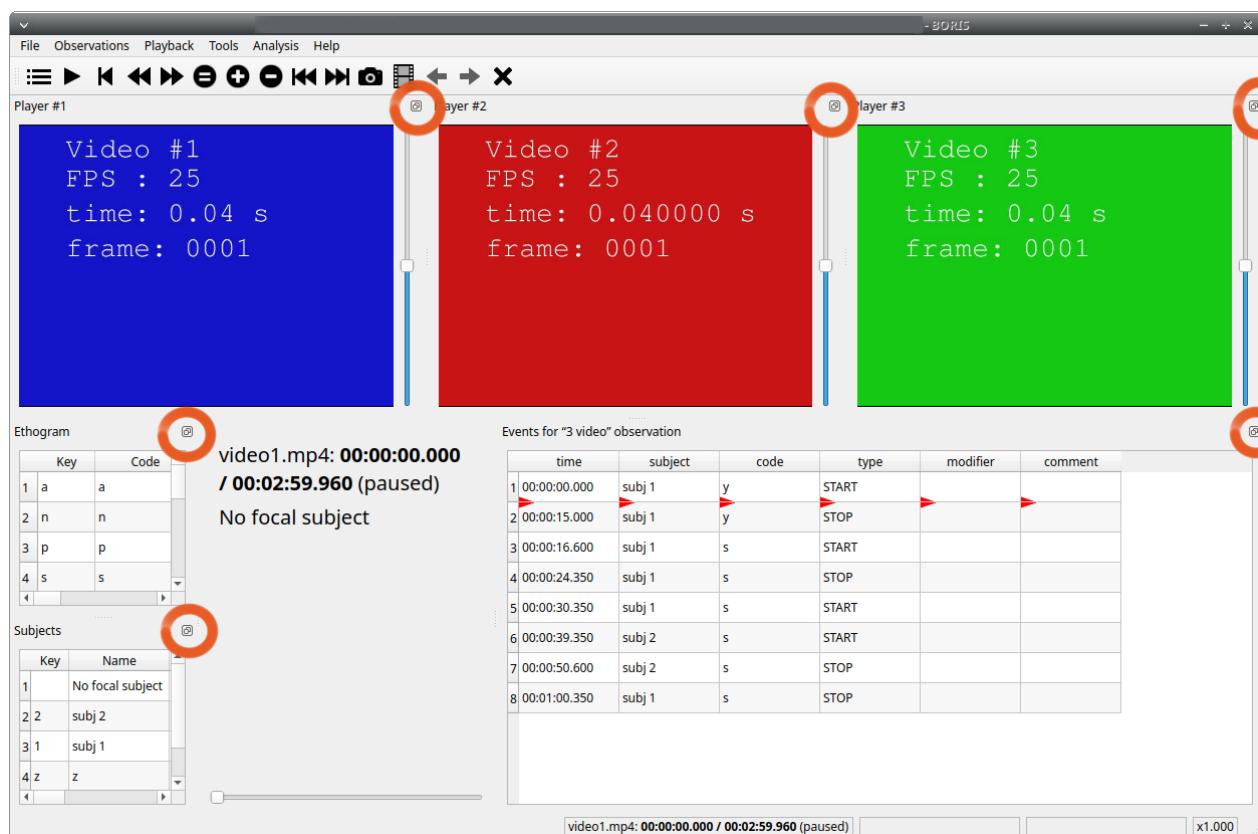
All elements, including all the media players can be undocked from the main window and positioned where you prefer (e.g. they can be on the same desktop over one or many screens).

The position of the various widgets is saved in the [configuration file](#) at the end of the work session.

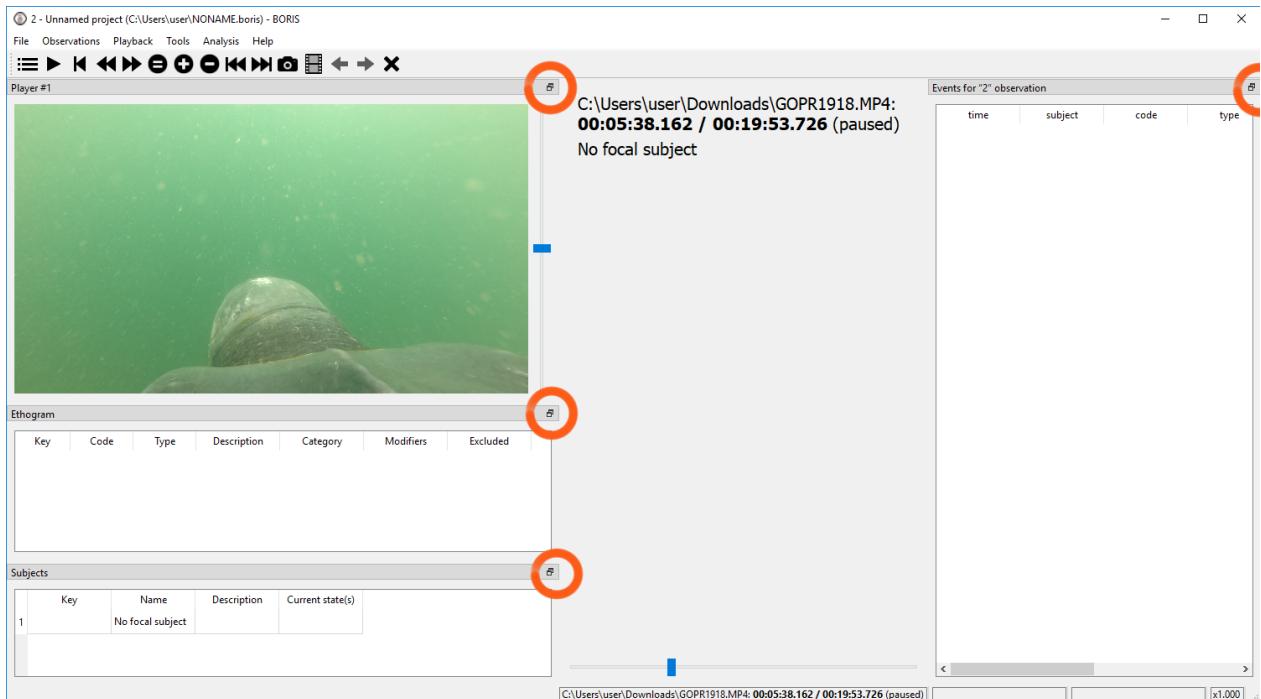


Click the icon present at the top-right corner of the widget (for MacOS the icon is located at the left-top corner) will undock the widgets that can be repositioned on another docking area or moved out of the main window. A double-click on the top bar of the widget will reposition it on the main window.

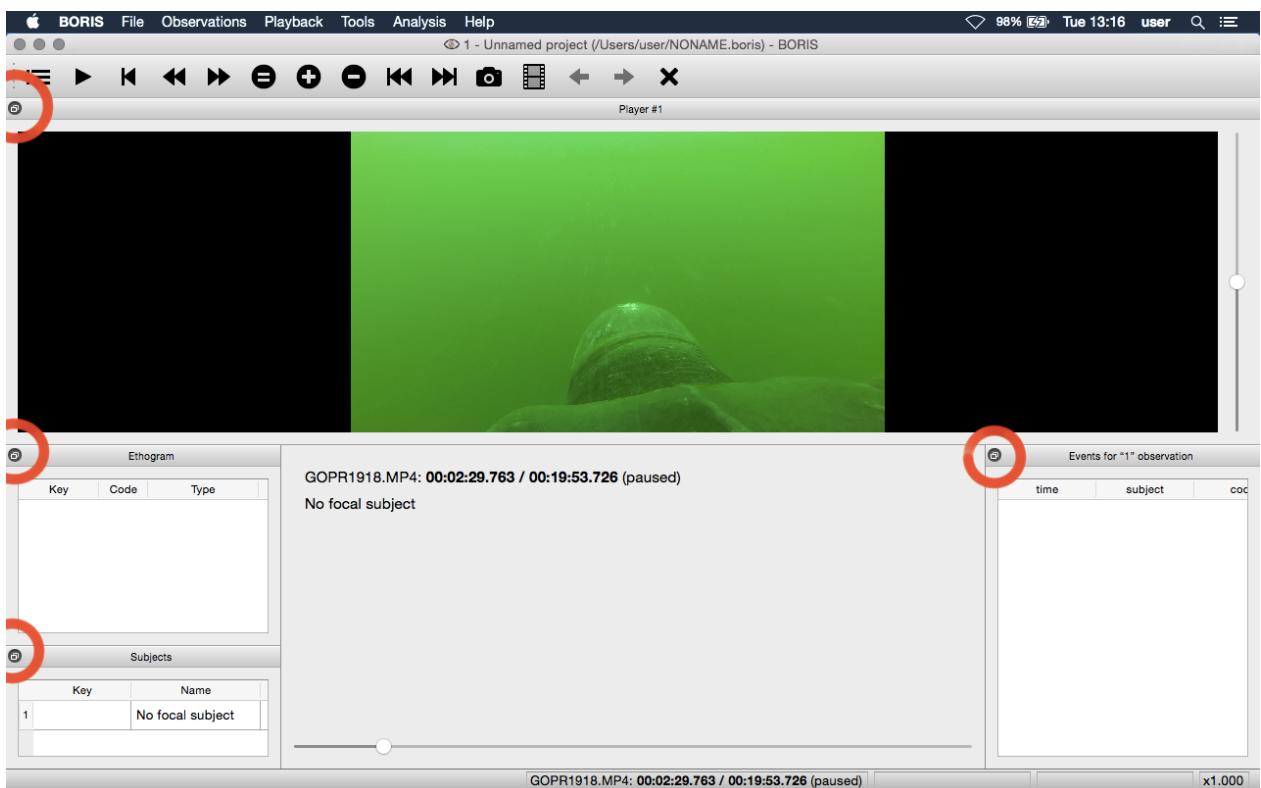
For Linux:



For Microsoft-Windows:



For Mac OS:



If you feel uncomfortable with the dockwidgets you can block them on the main window by checking the **Lock dockwidgets** option (see **Tools > Lock dockwidgets**). All the dockwidgets will be docked on the main window and locked on it except the player dockwidgets.

Configuration files

BORIS saves the configuration (user preferences, windows position, widgets position) in a configuration file. This file is named **.boris** and it is saved on the home directory of the current user:

```
for Linux:  
/home/USERNAME/.boris  
  
for Microsoft-Windows:  
C:\Users\USERNAME\.boris  
  
for MacOS:  
/Users/USERNAME/.boris
```

If you have some trouble using BORIS try to close the program, delete this file and relaunch BORIS.

The **recent projects list** is saved on the **.boris_recent_projects** file in the home directory of the current user.

Bug reports and features request

Please report any bug you will find in the latest BORIS version using the GitHub repository.

Prior to report a bug please:

- Check the Frequent Asked Question (FAQ) section
- Check if the issue was not already reported (GitHub repository)
- Delete the configuration file and try again (see [configuration file](#)).

Remember to indicate:

- your operating system
- the version of your operating system
- the computer you are using (model, RAM ...)
- the version of BORIS you are using
- Information on the mediafile you are coding (if any) See Tools > Media file information

Give all the information that will allow to reproduce the bug: a detailed procedure, a screen recording, etc.

In case of crash please send me the file boris_error.log generated in your home directory just after the crash (before relaunching BORIS):

```
Linux:  
/home/YOUR_PROFILE_NAME/boris_error.log  
  
Microsoft-Windows:  
c:\Users\YOUR_PROFILE_NAME\boris_error.log
```

If the bug is fixed remember to close the issue.

If you find BORIS useful you can give a star to the BORIS GitHub repository.

Acknowledgement

The authors would like to acknowledge Valentina Matteucci and all others users that report bugs and/or request features for their precious help.

Valid keys for triggering behavior

BORIS makes difference between lower case and upper case characters

- keys from a to z

- keys from A to Z
- keys from 0 to 9
- function keys from F1 to F12
- à é è ù ì ç
- ! " £ \$ % & / () = ? ^ [] { } @ | § ° #