

The Observer® XT is an integrated software system for collection, analysis, and management of observational data. It supports the entire research process, from the design of observational studies and coding schemes, through collection of behavioral data to the analysis and presentation of results.

SYSTEM CONFIGURATION

The Observer XT consists of modules that can be combined. The following modules are available:

- *Base Module* – For study setup, coding scheme design, live coding, offline editing, and analysis of behavioral data. The Base Module is required in any set-up of The Observer XT.
- *Video Module* – For synchronized recording of video during the observation, and offline scoring of digital media files. The Video Module allows playing and recording of two media files at the same time.
- *Multiple Video Module* – Extends the number of media files to four at a time. Larger numbers are possible with custom versions.
- *Advanced Analysis Module* – For quality control and validation of observers with reliability analysis and for finding sequential and causal relationships with lag sequential analysis.
- *External Data Module* – For synchronized recording of physiological signals on an external data acquisition system, and synchronized playback of these signals with the behavioral data and video. The External Data Module supports the import of data from a wide range of data acquisition systems.
- *Software Development Kit* – A comprehensive documentation package for connecting custom software components and data interfaces. The SDK is available on request.
- *Pocket Observer* – The compact edition of The Observer XT that runs on handheld computers and smart phones.
- *Coder License* – A limited, cost effective edition of The Observer XT, for visualization and coding only.
- observation methods
- video settings
- synchronization settings for other equipment
- what to record: independent variables, subject(s) under observation, and behaviors and modifiers.

Default terminology in The Observer XT is derived from psychology, with the terms Subject, Behavior, Modifier, and Independent Variable. You can replace them with terms that fit your own field, e.g. Test Participant, Task, Subtask, and Condition. The Observer XT supports ASCII & Unicode characters, which means you can also use for example Chinese, Japanese, and Cyrillic characters in coding scheme and comments. You can assign keys to specific subjects, behaviors, and modifiers.

Independent variables

Independent variables are descriptors of observations of which the values are constant during an observation (as opposed to the behavior, which changes during the observation). Typical examples are the name of observer, test subject, animal ID, treatment, dosage, temperature, gender, etc. They can be linked to an observation (e.g. date, location), event log (e.g. observer, origin of import data), or to a subject in an event log (e.g. name, age). You can use the values to filter data files for analysis. There can be up to 40 independent variables in a project.

Observation length

Observation length can be open ended or fixed. The length can be based on either elapsed time, or observed time. Elapsed time is the time between the start of the observation and the current clock time. Observed time is the time that the researcher has actually been observing the scene. That is the elapsed time minus any time the observation has been suspended. Observations can last up to 500 hours.

Observation methods

The Observer XT offers two different observation methods:

- continuous
- instantaneous sampling (time sampling)

Both methods can be combined within one observation.

PROGRAM STRUCTURE

1. SET UP AN OBSERVATIONAL STUDY

The first step in a study using The Observer XT is to specify the research design, including:

Launching external applications

This function gives an interface to any other Windows program. In the project setup you can define Windows commands to execute at the open, start, stop, and close

of an observation with optional execution parameters. You can use this for launching other programs to run at the same time (such as Media Recorder or an eye tracker), for backing up files after observing, and many more purposes. You can trigger multiple commands at the start and stop of observations. To adjust to the setup times of external programs you can set a wait time before the actual recording starts.

2. DESIGN A CODING SCHEME

Designing a coding scheme (ethogram) can be done before starting the first observation, but it is also possible to build the coding scheme while observing by gradually adding new elements to the coding scheme. You can even download a coding scheme from the Noldus website and modify it to your needs. You can refine your coding scheme by adding subjects, behaviors, and modifiers. They can be scored by keyboard, mouse, or pen stylus. The coding scheme can be edited any time.

Configuration checker

The coding scheme can be checked while editing for errors, such as duplicate names or key codes. It is also possible to manually start a coding scheme check and see a list with all coding scheme errors. With online checking enabled you get instant visual feedback on errors. A total check is carried out before starting an observation.

Key code settings

You can adjust your key codes to your individual preferences. You can make the following settings:

- required or not
- case sensitive or not
- key code length (1, 2, or 3 characters)
- generate automatically or not

Subjects

Subjects are the persons or animals that you want to record the behavior of. The maximum number of subjects is 250. In practice the numbers are mostly between two and ten. If you observe just one test subject per observation, there is no need to create separate subjects. Subjects-behavior combinations can easily be selected. For example, if you are interested in how long a wasp was flying you can easily select subject – wasp and behavior – fly.

Behaviors

The recording of behaviors is one of the core functions in The Observer XT. Behaviors are the basis of all analysis. There are two types of behaviors:

- State events have a frequency and a duration (e.g. Sit). This can be set per behavior. The maximum number of behaviors is 250. States within a group are mutually exclusive and exhaustive by default. You can also use start-stop states. In this case for each state the start and stop must be scored.
- Point events only have a frequency (e.g. Blink). They are also useful for marking synchronization points and other interesting moments.

The maximum number of subjects x behaviors is 5000.

Modifiers

Modifiers add extra information to behaviors. The behavior 'Write' may be extended with the modifiers 'Pen' or 'Pencil'. Apart from nominal modifiers (e.g. Slow, Medium, Fast) it is also possible to use numeric rating scales (e.g. intensity scale 1-5, speed 0-100). It is possible to connect one group of modifiers to multiple behaviors.

Modifiers can be mutually exclusive within a group (you write with pen or pencil, not both) or not (you can carry a book, a notepad, a pencil, and your phone at the same time). A modifier group can be compulsory or optional to score. Per behavior there can be up to 250 modifiers, which is the maximum number of modifiers in a coding scheme.

3. OBSERVE

An observation consists of one or more synchronized data streams. A data stream can be observational data, comment texts, automatically recorded events, digital media (so video), physiological signals, or other analog data. The Observer XT enables you to score behavior and log comment texts. For each scored event the system automatically records the time.

It is possible to code a video multiple times, and gradually build up the coding scheme e.g., you can start only logging comments, then make the subjects' column visible and log the subjects that you think are interesting, then the behaviors, and finally add modifiers.

In The Observer XT you can observe live, offline, or both. Live observations can be rescored and edited offline. You can import extra event logs or physiological data streams offline.

Video

The optional Video Module adds a range of functions to the Base Module. You can record and play two full-sized full-resolution videos with your observation. The number of concurrent video sources can be extended to four with the Multiple Video Module, and to more in custom versions.

The Observer XT offers several ways to control video playback.

- The Playback Control window allows you to operate the play, stop, pause, fast forward, etc., functions from the computer with a simple mouse click.
- All video control functions are also accessible through function keys. This means that you do not have to move your hands away from the keyboard during data entry, so you can focus on observing rather than controlling the hardware.
- Jog or shuttle through the media file forward and backwards at speeds varying from 1/25 to 16 times

normal playback speed. The speeds available depend on the video format you use.

- Quick Review function rewinds the video a user-defined number of seconds and resumes playback at a user-defined (slow-motion) speed.
- Loop function plays the video continuously until you stop it.

Screen capture

With a special device The Observer XT displays and captures the screen of a test computer. The captures are recorded as high quality media files that enable you to read exactly what a test participant has been seeing and doing. The screen capture is synchronized with the event log and other data.

Screen capture does not require the installation of software on the test PC. It can only be used in combination with the Video Module.

Automatically Start-Stop Encoding of Media Files

It is possible to start and stop the encoding of digital media files from within The Observer XT. You can record digital media files directly from a FireWire or USB camera, use Media Recorder, or start other recording software. When the observation is started, the encoding starts automatically as well. The event log is synchronized with the video, which improves timing accuracy. When you finish the observation, encoding stops automatically.

In many set-ups the digital media files are made with other tools than The Observer XT. Examples include Media Recorder, eye trackers, etc. These recordings can be integrated with live observations in The Observer XT. When the observation is finished the generated media files are automatically linked to the new observation.

Sound feedback

While you are scoring, the system can give sound feedback, so that you do not have to take your eyes off the scene. Sounds can be given upon pressing a key, finishing an item, finishing a line, or not at all. Instead of the standard system beep you can select a .WAV file to play. Each coding scheme element can get its own .WAV, or you can use one for all.

Find function

Search through all or part of your observations to find comments, subjects, behaviors, or modifiers. This function

creates a list of all the events that meet your criteria. You can either click on a result and be brought to the right observation at the exact time, or copy/paste the list to Excel.

4. DATA SELECTION

Selecting data in The Observer XT is done by building filters known as data profiles. Data profiles apply to all data in a project, including external data. In the data profile you specify what to include in the analysis. You can define an unlimited number of data profiles per project and they can be stored and re-used. New data are automatically added if they meet the criteria in the filter.

Data selection offers the following functionality:

- *Grouping* – Join observations, independent variables, and coding scheme elements. Grouping is set for all data at once. Once defined, the groups are shown as items in the profile and in the analysis results.
- *Selecting observations and event logs* – In your analysis you may not need all the data in your project. You can select subsets of event logs in various ways. Individual observations and event logs can be selected, but it is also possible to build filters based on independent variables, for instance by subject age or gender, or by treatment group.
- *Selecting events* – Filter out the relevant events by selecting individual behaviors or groups. You can also select subjects, or subject-behavior combinations. Modifiers can be used as additional selection criteria.
- *Nesting* – Select certain periods based on the recorded behavior and/or external data. You can use all behavior selection criteria for nesting too.
- *Selecting intervals* – Select free time intervals, the time from one behavior to another, or a specific period before or after a behavior or external data values. The selected intervals can be shown separately in the results.
- *Combining criteria* – It is possible to apply AND and OR relationships and combine the output of different selection statements. You can also build several queries into one filter.
- *Multiple output bins* – Define multiple independent results, known as output bins, in one selection profile.
- *Time bins* – The results of a calculation can be split over equal time bins, to enable to detect changes in time. You can use bins of a fixed time period or specify a number of equal bins to split your observations into.

- *Export data* – Direct export of event data and external data in one file.

5. VISUALIZATION

Behavioral data, external data, and videos can be shown together in one view. A horizontal time-event plot (a special type of bar graph) shows all behaviors per subject, per event log, and per observation. There are also graphs for external data. It shows how behaviors are spread over time (rhythmic or irregular) and visualizes variation in the duration of behaviors. A plot consists of a number of traces (horizontal bars). Trace colors and patterns are automatically assigned to your behaviors or can be specified by the user. Pop-up labels ('tool tips') show all related information (such as comments or modifiers) associated with events as you hover over the plot. The visualization always shows the result of the active data selection or the selected observation.

On the integrated visualization you can drag a hairline cursor to an interesting part of the observation. The video and all other data streams will then follow. Zoom in and out of the plots to see details, or get an overview.

Episode Selection

- *Presentation* – This function can be used for the tabular presentation of event data. The basis is a list of events based on a data selection, or created manually by dragging and dropping items from event logs. The list can contain events from any observation and event log, and you can add and remove events.
- *Create video highlights* – Along with the events there is a video window in which you can see the associated scene. If you press the play button on the Playback Control the video plays through the list top-down. The active event is highlighted. This way it is possible to view video highlights from all the media files in the project. It is also possible to generate a highlights clip based on the episode selection. To add subtitles and transitions of scenes and between scenes, and to change the start and end times of events.
- *Create external data highlights* – Use the list to select the appropriate time periods. In a viewer window you can see the associated external data. You can also export them, and thus get periods of external data filtered by the recorded behavior. You get them in a tabular ASCII format, fit for import in other packages.

Graphs

From behavior and numerical analysis various types of graphs may be drawn (see 6. Analysis).

6. ANALYSIS

The Observer XT quantifies behaviors in terms of frequency and duration. Statistics are calculated for individual events or for (combinations of) concurrent events and states. Which events are included in the analysis depends on the data selected, which is stored in a Data Profile.

Settings determine which independent variables and statistics are computed and how the program presents its results.

The selected independent variables are subdivided in system variables, user defined variables and intervals.

Available intervals are:

- analyzed duration
- minimum interval
- maximum interval
- number of intervals
- total interval duration

The output from running an analysis profile is saved as a statistics result. You can have as many statistics results as you require.

Available statistics are:

- minimum
- maximum
- mean duration
- total duration
- standard deviation
- standard error
- rate per minute (observation, interval, and analyzed duration)
- total number
- percentage (observation, interval and analyzed duration)
- latency

For rating scales or numerical modifiers the available statistics are:

- minimum
- maximum
- mean
- total duration
- total value
- mean (per minute)

The following statistics for external data can also be found here:

- minimum
- maximum
- mean
- number of samples

For events scored with instantaneous sampling, the available statistics are:

- proportion (all samples)
- proportion (scored samples)
- scored samples
- total number of samples
- total number of scored samples

Statistics are presented in tables on tabbed sheets. The layout can be customized completely, which means that you can make The Observer XT present its results in the way other packages need it. Results can be archived for later use or exported as text files or as Excel worksheets.

Graphs

A quick visual overview of the results of the data analysis can be made by using graphs. The Observer XT allows the use of pie charts, scatter plots, columns, and line charts. Trend lines can be included. Formats can easily be modified and previewed by using the Apply button. The charts can easily be exported as a graphic file (JPEG, PNG, BMP, or TIFF) for use in a presentation or research article.

Advanced Analysis Module

The Advanced Analysis Module contains two extra types of analysis: reliability and lag sequential analysis

7. IMPORT/EXPORT

Import functions

- *Importing projects from earlier versions of The Observer* – Data from The Observer 5.0 and The Observer XT 6.0/7.0/8.0 and 9.0 can be imported directly.
- *Import templates* – Save a project as template and open this template again. You can save and lock a coding scheme and for example define hardware settings.
- *Importing event data* – There is a flexible import function for event data. If data are in ASCII text and bear a time stamp they can be imported. For each type of input file you can build an import profile. There are predefined profiles for some file types, including earlier versions of The Observer XT.
- *Importing external data* – Import data streams (e.g. physiological signals) in a project. For more details, see section 'External Data Module'.
- *Importing Plug-in data* – Open a plug-in program which interacts with The Observer XT (e.g. GPS viewer).

Export functions

- Event logs can be exported as ASCII text Unicode or as Excel files.
- The list of independent variables, including the attributes of each variable, can be exported as an ASCII or Unicode text file.

- Analysis results can be exported as Excel worksheet, XML ('ARX'), or text files or copy/pasted into Excel or another package.
- Visualization of behaviors together with any external data graphs can be exported as picture files.
- Episode selections can be exported as ASCII or Unicode text files.
- Exporting media files from episode selection: Videos can be exported by generating a new media file based on an episode selection. All fragments can be in one media file, or separate media files can be generated for each episode.
- Raw data can be exported as XML ('ODX') or ASCII or Unicode text files.
- Exporting external data: direct export of event data and external data in one file resampled (equidistant time stamps).
- Graphs can be exported as picture files (JPEG, PNG, BMP, or TIFF) for presentational purposes.

ADD-ON MODULES

VIDEO MODULE/MULTIPLE VIDEO MODULE

The Observer XT supports various common video and media formats. Create digital media files in the formats DivX or DV-AVI directly by using a FireWire or USB camera, or use the Euresys H.264 video capture board in combination with Media Recorder to convert the output from the camera into a media file.

Supported media file formats are:

- VOB (from camcorders)
- H.264 DivX
- MPEG-4 DivX
- MPEG-1
- MPEG-2
- DV-AVI
- (uncompressed) AVI

For various other formats including QuickTime (MOV) and Windows Media (WMV) conversion tools are available from the Internet.

ADVANCED ANALYSIS MODULE

The Advanced Analysis Module contains two extra types of analysis:

- *Reliability analysis* – Calculates the Kappa, percentage agreement and disagreement, and Pearson's rho. Calculations are based on a record-by-record comparison of loggings by different researchers. Besides statistics the software produces a list of comparisons with all the agreements and disagreements of each pair of observations. It also creates a confusion matrix which is handy for finding systematic differences.
- *Lag sequential analysis* – Allows you to make transition matrixes based on the logged data. The matrixes can be based on a time lag or a state lag. You can set the length of the lag.

EXTERNAL DATA MODULE

This module adds functionality for the integration of Data Acquisition (DAQ) equipment in The Observer XT. This way it becomes possible to measure the overt behavior of a human or animal in relation to internal physiological processes such as motivation, anxiety, mental load, etc. The External Data Module allows you to visualize, calculate, analyze, and automatically synchronize multimodal data.

SYNCHRONIZING DATA STREAMS

Synchronizing data is not trivial. Different data modalities (video, events, physiology, etc.) are acquired by independent processes. Some may run on the same computer, some on a different one, and some on completely different hardware such as a disconnected camcorder or a handheld computer. It is impossible to guarantee that all processes start and stop at the same time. As a consequence the output files have to be aligned to one time axis.

To solve this issue there are a number of mechanisms in The Observer XT. Automatic mechanisms are available for a wide range of data streams including physiological data, computer log files, eye tracker output, and many more. The automatic mechanisms are based on time information within the data files, such as the time code that is generated by the External Data Module. They offer easy synchronization in almost every possible situation. For the few exceptions there is also a manual offset mechanism. So if there is anything out of sync you can always correct that manually.

CO-ACQUISITION OF EXTERNAL DATA

The Observer XT can automatically synchronize acquired data by sending out a signal to the DAQ system. This allows you to, for instance, synchronize video recording (by a video camera connected to the PC) with heart rate and body temperature measurement (by a telemetry system). In the observation settings you can define the characteristics of this sync signal. It is sent out from the COM port or a USB device, and fed into the DAQ device as an extra signal. The Observer XT recognizes it during import and uses it to synchronize the data with the rest of the observation.

Some DAQ devices do not have a vacant socket, but can be switched on and off with an electrical on/off pulse. The Observer XT can generate an on/off pulse for this purpose. It is transmitted through the COM port or a USB device. It is also possible not to use this signal and to import and synchronize external data afterwards.

SYNCBOX

A special piece of hardware called the SyncBox was designed to set and verify the synchronization of lab equipment during test runs. It receives electrical pulses from The Observer XT, and in turn sends out signals to all recording equipment. They include a light signal, a sound, a TTL pulse, and a key stroke. The pulses are also recorded in the event log. After loading the data from the recording systems, the pulses can be used to set their startup delays. The software sends out a series of pulses, allowing you to verify the synchronization in longer recordings. If there is drift between the internal clocks of various devices you will notice that the pulses get out of sync.

IMPORTING EXTERNAL DATA

You can import analog data from physiological or other continuous measurements (e.g. heart rate, galvanic skin response, room temperature, CPU load). For each type of file you can define an import profile in which you define the layout of the file. Files can be imported if they comply with the following conditions:

- ASCII text format
- columnar layout
- constant sample rate
- time reference in the data

The time reference is to ensure proper synchronization with video and behavioral data. There are various options for this:

- The recorded synchronization signal from The Observer XT (preferred).
- A timestamp column in the data.
- Sample rate or frequency plus start time in the file header. The software calculates the sample times.
- Sample rate or frequency in the file header, use the observation start time as a synchronization point. This option works well in cases where there is no further reference but the acquisition is started at the same time as the recording of video and behavior. This can be done by an electrical pulse, by a software command, or manually.

The Observer XT supports importing files from a large number of commonly used DAQ systems. For the following devices predefined file formats are supplied with the software:

- Mindware BioLab
- Biopac Acqknowledge 3.7.3
- DSI Dataquest A.R.T. 2.3
- FaceReader

- Polar Precision Performance 4.01
- Tobii Studio
- SMI BeGaze 3

POCKET OBSERVER

This add-on module can be used for mobile observations, using a handheld computer, Smart Phone, or rugged PDA. In this case The Observer XT is used for creating the coding scheme, analysis, visualization, etc, while the actual coding is done with Pocket Observer. Pocket Observer runs on any handheld with a VGA screen 640 x 480, landscape or portrait, with Windows Mobile Classic 6.x.

Pocket Observer 3.1 supports all coding features of The Observer XT, with a few limitations which stem from the fact that mobile devices have a smaller display. The main limitations are:

- Maximum of 5 modifiers can be connected to a behavior.
- Maximum length of behavioral element names is 16 characters.
- Length of start/stop codes is 3 characters.
- Number of subjects, behaviors, and modifiers is limited (maximum 100 each).

MISCELLANEOUS

HELP FEATURES

- *Online help* – A comprehensive set of help information is available throughout the program by pressing F1.
- *Documentation* – Reference Manual, Installation Guide, and Quick Reference Guide are included.
- *Technical Support* – As a registered user of The Observer XT, you are entitled to 3 years of technical support as part of the Basic service contract which is included in the license fee. Extended support is available in the form of higher level service contracts. Technical support questions can be submitted via our website, by e-mail, telephone, or fax. An archive of Frequently Asked Questions and Tips and Tricks can be found in the Technical Support Knowledgebase on our website.
- *Sample projects* – The Observer XT DVD includes 2 sample projects including media files. Open the backup file of a project of your choice and discover the possibilities The Observer XT offers you. Other

sample projects may be downloaded from www.noldus.com.

- *Sample templates* – The Observer XT DVD includes also 2 sample templates. Templates can be opened as a new project and the coding scheme can be modified to your wishes. Other templates can be found at www.noldus.com.

SYSTEM REQUIREMENTS

The system requirements for this software depend on its use. Important factors include the use of video, the amount of data, the complexity of data selections and analyses and the size of external data files. For optimal performance and functionality of The Observer XT, an up-to-date computer system is strongly recommended. The Observer XT 10 is tested with Windows XP Professional (with ServicePack 3) and Windows 7 (32 and 64 bit Professional edition) on a Dell Precision T3500.

Simple observations (maximum 200 observations and up to 5.000 event lines): a simple netbook will suffice. We recommend Dell Inspiron TM Mini 10 (or its successor). Working with video or a large number of observations in the project: a professional workstation will be necessary. We recommend Dell PrecisionTM T3500.

Codecs: A codec is software for recording or playing back a digital media file. Some codec packages can interfere with the codecs installed by The Observer XT. We advise to remove these codecs.

Software that is not delivered and installed by Noldus or according to Noldus instructions may interfere with The Observer XT or its components. Especially video related software (including older versions of The Observer), DVD burn software, and video games are common causes of technical problems.

Please visit our website for more information and contact details.

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