Reference Manual

FaceReader

Version 10

Noldus

Information Technology

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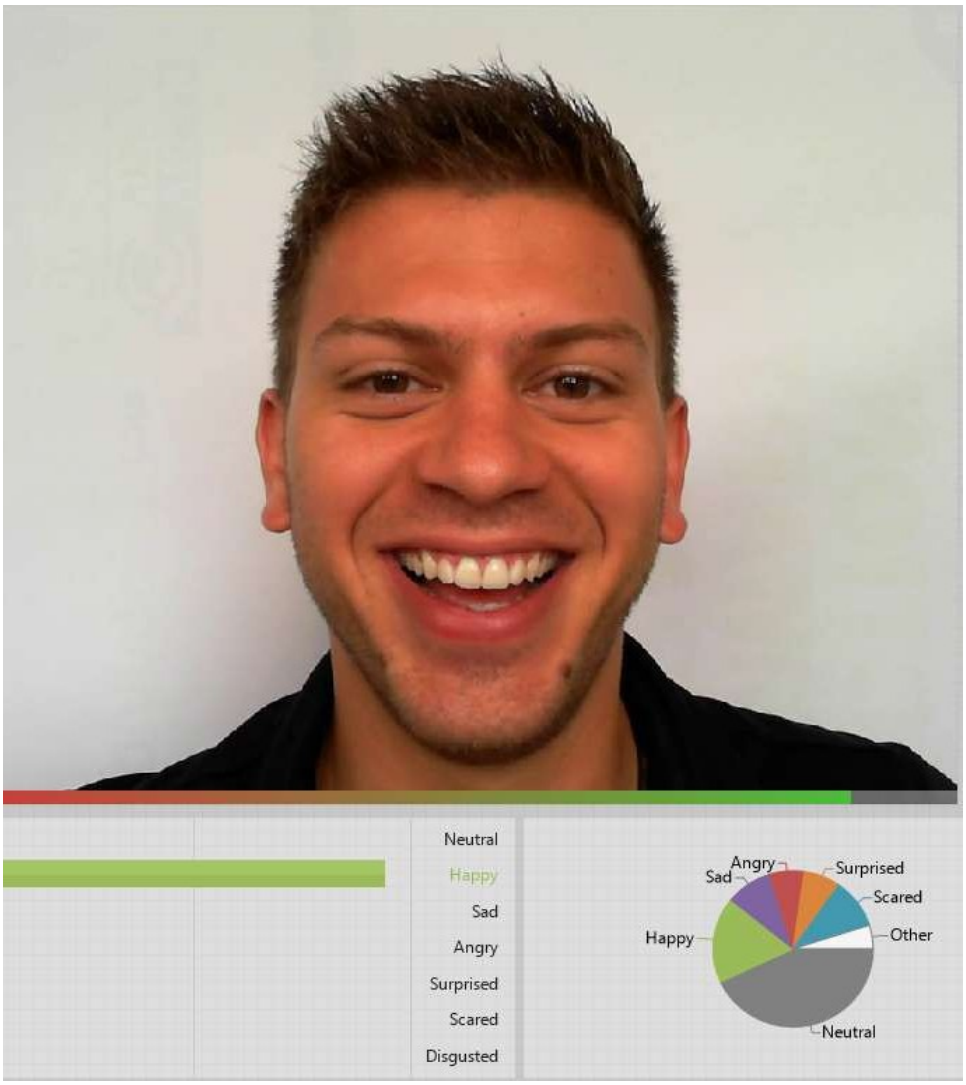
Introduction

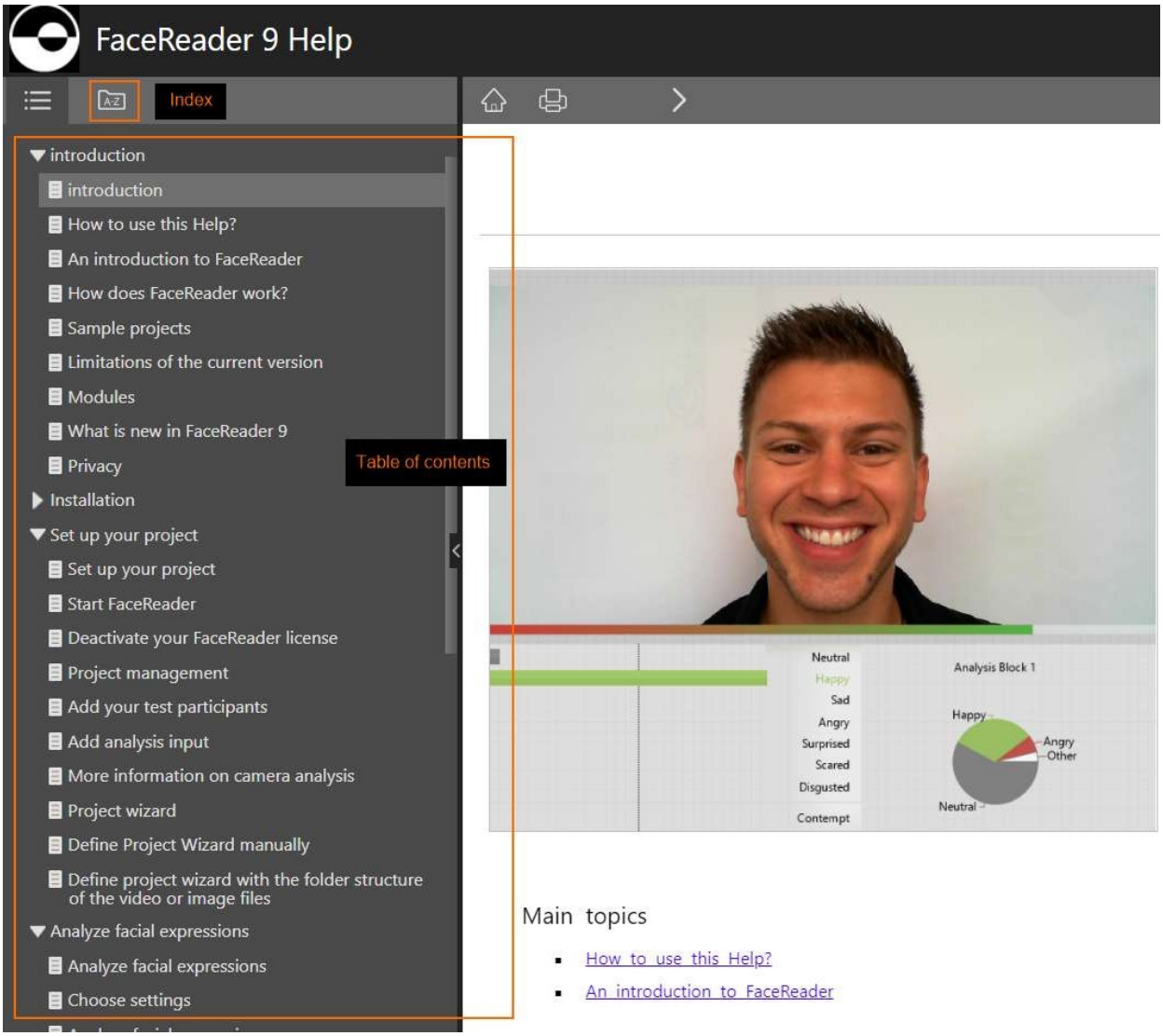


Main topics

- How to use this Help?
- An introduction to FaceReader
- How does FaceReader work?
- Sample projects
- Limitations of the current version

- Modules
- What is new in FaceReader 10

How to use this Help?



TIPS

- If you do not see the Table of Contents on the left, enlarge the Help window or zoom out the characters (**Ctrl**+mouse wheel, or **Ctrl**+**-**).
- To search for two or more adjacent words, use quotes, for example "Action Unit".
- To go back to the search results after visiting one of the result pages, click again on the magnifying glass icon in the Search field.

An introduction to FaceReader

Six basic expressions

FaceReader is a program for facial expression analysis. It can detect emotional expressions in the face. It can identify six basic expressions:

- Happy
- Sad
- Angry
- Surprised
- Scared
- Disgusted
- A Neutral state

Contempt

In addition to the six basic expressions, FaceReader can detect contempt. Contempt is an expression in which one corner of the lips is tightened and slightly raised.

Baby FaceReader

Baby FaceReader is a special version of FaceReader. It has been developed for babies and infants from 6-24 months old. Please note that Baby FaceReader analyzes Action Units, Valence and Arousal, it cannot detect the basic facial expressions. Baby FaceReader is based on the Baby FACS developed by Oster. Valence calculation in Baby FaceReader is based on Action Unit 6, 12 and 25 for positive valence. It takes the average intensity of these Action Units. Activity of Action Unit 1, 4, 7, 20, 25 and 43 results in a negative valence value.

Your Baby FaceReader license can be extended with the Vital Signs Module. Baby FaceReader cannot be combined with other modules. The Voice Analysis Module, the Advanced Research Module and the Consumption Behavior Module are not available with Baby FaceReader.

References

Messinger, D.S., Mahoor, M.H., Chow, S.M. & Cohn, J.F. (2009). Automated measurement of facial expression in infant-mother interaction: A pilot study. *Infancy* 14(3): 285-305.

Oster, H. 2003. Baby FACS: Facial Action Coding System for Infants and Young Children. Unpublished monograph and coding manual. New York University.

Oster, H. 2012. The repertoire of infant facial expressions: An ontogenetic perspective. DOI: 10.1093/acprof:oso/9780198528845.003.0010.

Rosenstein, D. & Oster, H. (1988). Differential facial responses to four basic tastes in newborns. *Child development* 59(6): 1555-1568.

Webb, R., Ayers, S. & Endress, A. (2018). The City Infant Faces Database: A validated set of infant facial expressions. *Behavior Research Methods* 50: 151-159.

Additional classifications

FaceReader can also analyze:

- Facial states — Left and right eye open or closed, mouth open or closed and eyebrows raised, neutral or lowered
- Global gaze direction — The gaze direction of the eyes, to the left, left-up and left-down, to the right, right-up and right-down and straight forward, up and down.
- Gaze Type — Fixation or saccade.
- Gaze angles — Horizontal and vertical gaze angle (in degrees).
- Gaze location — The participant's gaze location on the screen/stimulus. This option is available with the Advanced Research Module.
- Head orientation — The orientation of the head (pitch, yaw and roll, in degrees deviating from looking straight forward).
- Head position — Horizontal, vertical and depth position relative to the camera.
- Valence — Which indicates whether the person's emotional status is positive, negative or neutral.
- Arousal — Which indicates how active the person is.
- Subject characteristics — The estimation of the test participant's gender and age, and whether the person is wearing glasses or not. Subject characteristics are not available in Baby FaceReader.
- Action Units — FaceReader can analyze the 20 most common Action Units in the face. In addition, there are a number of Action Units available as Custom Expressions. FaceReader analyzes Action Units in the left and right part of the face. Action Units are available with the Action Unit Module. For Baby FaceReader you do not need the Action Unit Module as extra module. Action Unit analysis is an integral part of Baby FaceReader.

  See The Action Unit Module

- Custom expressions — FaceReader comes with a library of expressions like Interest, Attention, Confusion and Boredom. It is also possible to define your own Custom Expressions, based on Action Units, facial expressions, valence, arousal, and other parameters. Custom Expressions are available with the Action Unit Module.
- Vital signs — This option is available with the Vital Signs Module. FaceReader can estimate the test participant's heart rate and heart rate variability and respiratory (breathing) rate from the camera or video images of their face.

  See The Vital Signs Module
- Expressions in the voice — This option is available with the Voice Analysis Module. FaceReader can detect Neutral, Happy, Sad and Angry in the participant's voice.
- Consumption Behavior — This option is available with the Consumption Behavior Module. FaceReader can analyze chewing behavior and count the number of intake events (bites/sips). Consumption Behavior analysis is not available in Baby FaceReader.

  See The Consumption Behavior Module

FaceReader and The Observer XT

FaceReader data can be imported into The Observer XT, the leading software package for the collection, analysis and presentation of observational data. This enables you to integrate FaceReader data with other data, such as manually logged events, physiological data and eye tracker data and to analyze the full context. For instance, what is the test participant watching on the screen and what emotion does that trigger.

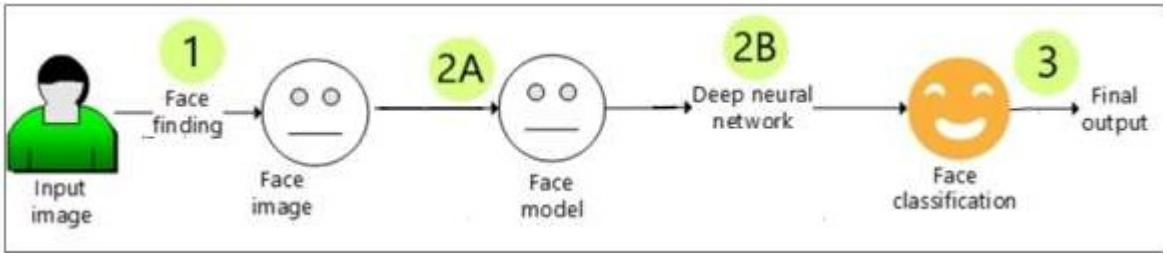
FaceReader can be used in a wide range of research areas:

- Psychology — How do people respond to particular stimuli, e.g. in cognitive research.
- Education — Observing students' facial expressions can support the development of educational tools.
- Human-computer interaction — Facial expressions can provide valuable information about user experience.
- Usability testing — Emotional expressions can indicate the ease of use and efficiency of user interfaces.
- Market research — How do people respond to a new commercial's design?
- Consumer behavior — How do participants in a sensory panel react to a new product?

How does FaceReader work?

FaceReader classifies facial expressions in several steps which is explained in the figure below. Please see [1] - [3] and the references mentioned in the text below for more information. FaceReader 10 uses new methods that are different from the ones used in previous versions of the software. We recommend using the same FaceReader version within one project.

1. **Face finding** — The position of the face in an image is found using a deep learning based face finding algorithm [1], which searches for areas in the image having the appearance of a face.
2. **Face modeling** — FaceReader uses a facial modeling technique based on deep neural networks [2]. It synthesizes an artificial face model, which describes the location of almost 500 key points in the face. The predicted key points of such a model are learned from a database of annotated images. It is a single pass quick method to directly estimate the full collection of landmarks in the face. After the initial estimation, the key points are compressed using Principal Component Analysis. This leads to a highly compressed vector representation describing the state of the face.
3. **Facial expression classification** — Classification of the facial expressions is done by a trained deep artificial neural network to recognize patterns in the face [3]. FaceReader directly classifies the facial expressions from image pixels. Over 100,000 images of people faces from all over the world, that were manually annotated, were used to train the artificial neural network. The network was trained to classify the six basic or universal emotions described by Ekman [4]: happy, sad, angry, surprised, scared, disgusted and a neutral state. Additionally, the network was trained to classify the set of facial Action Units available in FaceReader, as well as to estimate other facial attributes such as age, gender, and the presence of glasses.



Validation

Facial expression analysis of FaceReader 10 is validated using the Amsterdam Dynamic Facial Expression Set (ADFES) [5] and the Warsaw Set of Emotional Facial Expression Pictures (WSEFEP) [6], wherein expressions are manually scored by FACS certified annotators. In addition, relevant validation was also performed on other

datasets including Baby FACS manual dataset [7] and Taiwanese Facial Expression Image Database (TFEID) [8].

1. For facial expression classification on ADFES and WSEFEP FaceReader 10 has an accuracy of 98.7% and 97.2%, respectively. For FaceReader 9 these values were 99.3% and 95.7%, resp. That means that facial expression estimation under ideal conditions is improved in FaceReader 10. For Action Unit classification on ADFES and WSEFEP FaceReader 10 has an F1 score* of 0.83 and 0.80, resp. For FaceReader 9 these values were ~0.78 and ~0.76, resp. That means that facial expression estimation under ideal conditions is improved in FaceReader 10.
2. For Action Unit estimation using the baby model, FaceReader 10 has an F1 score of 0.69 on the Baby FACS Manual dataset [7]. FaceReader 9 also had a score of 0.63. This means that the baby model in FaceReader 10 performs even better on baby faces compared to FaceReader 9.
3. The East Asian model on average performed approximately 10% better on Asian faces of our internal test data set (1200 East Asian faces) than the General model. The East Asian model and General model had an accuracy of 93% and 91%, resp. when the Taiwanese Facial Expression Image Database (TFEID, 268 images, [7]) was tested.
4. Gender classification in FaceReader 10 achieves and accuracy of 94% on an internal test set.
5. The detection of (eye) glasses on faces achieves an accuracy of 99.2% on an internal test set.

* The F1 score is the weighted average of precision and recall. This score takes both false positives and false negatives into account.

References

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2. Bulat, A.; Tzimiropoulos, G. (2017) How far are we from solving the 2D & 3D face alignment problem? (and a dataset of 230,000 3D facial landmarks). Proceedings of the IEEE International Conference on Computer Vision, pp. 1021-1030.
3. Gudi, A.; Tasli, H.E.; den Uyl, T.M.; Maroulis, A. (2015) Deep learning based FACS action unit occurrence and intensity estimation. International Conference and Workshops on automatic face and gesture recognition (FG), 6: 1-5.
4. P. Ekman. Universal facial expressions of emotion. California Mental Health Research Digest, 8: 151-158, 1970.

5. Van der Schalk, J., Hawk, S. T., Fischer, A. H., & Doosje, B. J. (2011). Moving faces, looking places: The Amsterdam Dynamic Facial Expressions Set (ADFES), *Emotion*, 11, 907-920. DOI: 10.1037/a0023853
6. Olszanowski, M.; Pochwatko, G.; Kuklinski, K.; Scibor-Rylski, M.; Lewinski, P.; Ohme, R.K. (2014) Warsaw Set of Emotional Facial Expression Pictures: A validation study of facial display photographs. F*rontiers in Psychology* 5, DOI: 10.3389/fpsyg.2014.01516.
7. Oster, H. (2016). Baby FACS: Facial Action Coding System for infants and young children. Unpublished monograph and coding manual. New York University.
8. Chen, L.F.; Yen, Y.S. (2007) Taiwanese facial expression image database. Ph.D. dissertation, Brain Mapping Lab, Inst. Brain Sci., Nat. Yang-Ming Univ., Taipei, Taiwan.

To cite the use of FaceReader in publications you can use the following reference:

Noldus (2021). FaceReader: Tool for automatic analysis of facial expressions: Version 10 [Software]. Wageningen, The Netherlands: Noldus Information Technology B.V.

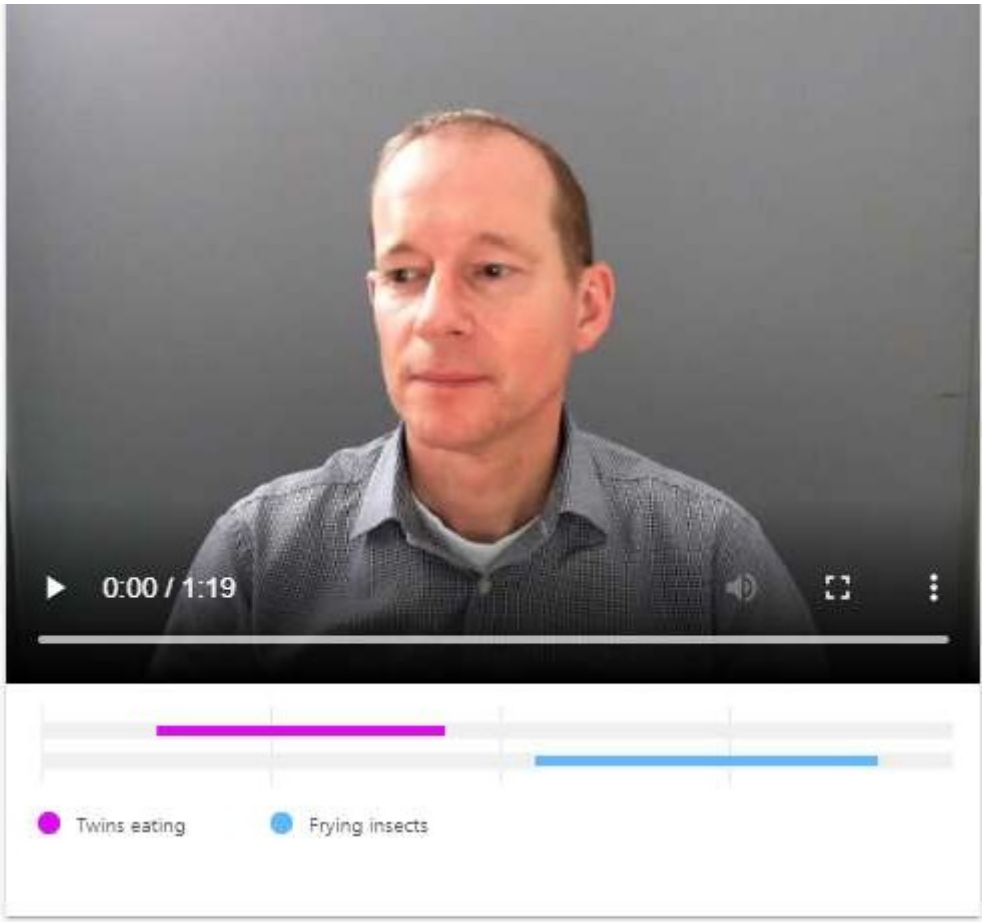
It is important to include the version number of the software in the reference since FaceReader's algorithms are improved with every upgrade.

Sample projects

You can download two example projects from your MyNoldus account: https://my.noldus.com

Sample Project - Two stimuli

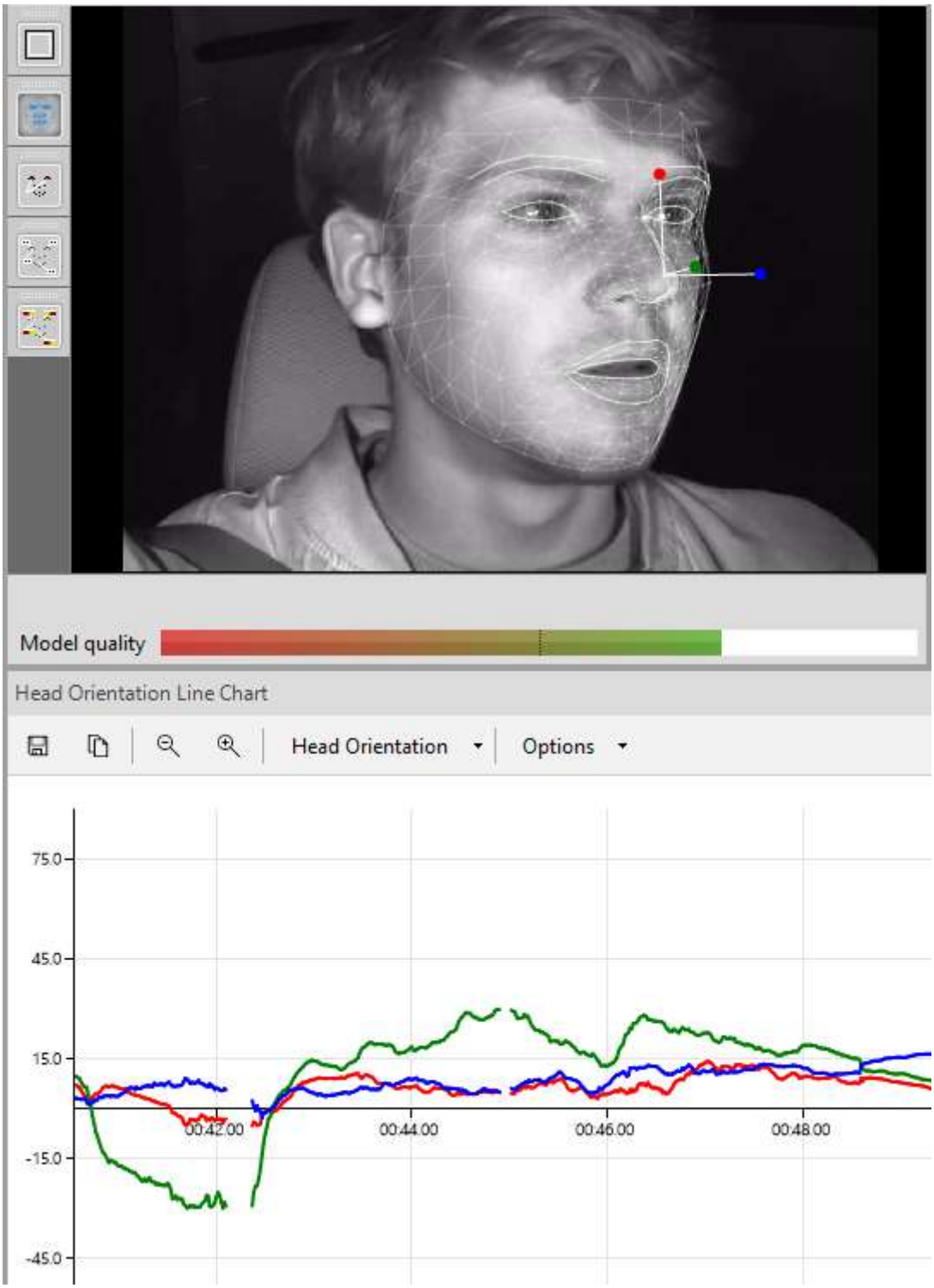
Five test participants watch two videos, one with baby twins that feed each other and one in which strange food is being prepared. Compare the facial expressions of the test participants while watching the two videos.



Frying insects

Participant	Neutral	Happy	Sad	Angry	Surprised	Scared	Disgusted
	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Mean	0.4266	0.1581	0.3243	0.0421	0.0209	0.0118	0.0754

Sample Project - Infrared recording



In this sample project we filmed a driver in a car driving in the near-dark to illustrate that FaceReader can analyze infrared recordings. In this project you can see what head rotations FaceReader can deal with. You can visualize Head orientation, Head position and Gaze angle.

Read the PDF file **Description of FaceReader 10 sample projects,** to see all the features that you can view in the projects. You can download this PDF file from the MyNoldus portal on the Noldus website (my.noldus.com).

Limitations of the current version

The current FaceReader version has a number of limitations. It is good to keep these in mind when you start working with FaceReader.

- Glasses may hinder classification. Especially thick and dark frames can reduce performance significantly. It may be useful to have a number of rimless reading glasses available in a few strengths when you carry out a test. A polarization filter on the camera can help to avoid reflections in the glasses.
- Pose, movement and rotation of the test person are limited. The test person should stand or sit and look frontally into the camera (angle < 30°). That means that you should sit opposite of the test participant and not next to him/her if you want to ask questions during the test. In a social interaction setting (medical student - patient or consultant-client interaction) you would ideally position the camera on the conversation partner's shoulder. With this set-up people look almost straight into the camera when they talk to their partner. In practice this may not be possible but if you put the camera a short distance away, at the same height, with direct sight line to the participant's face, you have a working solution.

  In a consumer study you can use a cup or bowl holder so the dish is closer to the face and the test participant does not need to tilt his/her head downwards.

  If your test participants need to read instructions or fill in a questionnaire, you can present this information on a screen and attach the camera to the screen.

- FaceReader requires strict light conditions. See Lighting setup

  You can use (near) infrared light with a camera that is sensitive for this type of light. FaceReader 10 supports (near) infrared recordings. Please note that it is not possible to measure heart rate, heart rate variability and respiratory rate with infrared recordings.

- Factors that partially hide the face, like a hat, hair that covers the forehead, or very heavy facial hair may hinder the analysis.

  Hands in front of the face should also be avoided. You may normally offer your test participants something to eat or drink during the test to make them feel more comfortable. However, when eating or drinking the test participant blocks part of the face with his/her hand and the cup/glass/ cutlery. Make sure the test participant finishes his/her cup of coffee before you start the test unless, of course, the purpose of the test is to see the reaction to a new food product or beverage.

Some people have the natural tendency to touch their face without realizing is. You may want to warn your test participant to keep their arms on the table throughout the test in order to get the best possible results.

- With the base functionality of FaceReader can analyze one face at once. If there are more faces in an image, you can select one of the faces by dragging the borders in the preview window and analyze that face. Then do the same with the other faces. Of course, the positions of the faces must not change significantly. See also the notes in Analyze facial expressions.

  If your FaceReader license included the Advanced Research Module you can analyze up to eight faces in a video simultaneously. See The Advanced Research Module.

- For FaceReader to analyze facial expressions, emotions must be visible in the face. "All my test participants looked neutral throughout the test" is an often heard complaint. It may help to test people in their natural environment, at home or in another familiar environment (restaurant, school, office, etc.). Running your tests in the test facilities in your office has the obvious advantage that you can control the test conditions much better than out in the field. The downside, however, is that people may react differently to your stimuli or not at all.
- Please contact us if any of the limitations above impede your research.

Improving FaceReader's performance

The following tips to improve FaceReader's performance apply to all analyses done in FaceReader and are especially important when using batch analysis of videos.

- Length of videos - Although there are no built-in limitations regarding the length of videos, it is good to keep in mind that the longer the video, the more data needs to be saved in the computer's internal memory. Data is only saved to the hard disk after every analysis. We recommend to use videos that have a maximum duration of two hours (if 15 fps) or one hour (if 30 fps).
- Resolution of videos - Higher resolution does not mean better facial expression analysis with FaceReader. High resolutions are scaled down to a maximum of 1280x1280 pixels while keeping the original video aspect ratio. Keep in mind that the scaling costs processing power and other resources which do have an influence on the performance. The minimum video resolution is 640x480.
- Analysis options - In the FaceReader Settings you can select what optional classifications you want to analyze. Select only those options that you need. Selecting more options requires more processor capacity.

- Visualizations - Graphical presentations cost a huge amount of processing power and other resources (e.g. memory). For best performance you can best close the visualizations during analysis.
- Processing unit - A powerful processor and sufficient internal memory is a prerequisite. Please see the System requirements.
- Applications running in the background - Make sure that no other applications are running.
- Test real products - You can show test participants pictures of your product, videos/commercials featuring your product, or you can give them the real product. Generally real products elicit greater responses. While having the real product to view is preferable to seeing a photo, real-life use is even more preferred. So, if you want to know whether your test participants like your new healthy flour mix, for example, you can ask them to bake pancakes in a test kitchen, and observe the displayed reactions during the baking process and the consumption phase.
- Present more than one stimulus - If you want to test your new product (commercial, beverage, etc.) it is best to embed it in a series of other products. In this way the test participants do not concentrate fully on the focus product and will respond in a more natural way. This also allows the participants to compare your product with similar ones. Be sure to randomize the order in which you present the products.

Mouse control

Some features of FaceReader are controlled with mouse clicks. If you do not have a mouse, you can use a mouse-emulator like NeatMouse to use those FaceReader functions. You can download NeatMouse for free.

http://neatdecisions.com/products/neatmouse/

Modules

You can extend the base functionality of FaceReader with modules. Your license determines which modules you can use. For Baby FaceReader only the Vital Signs Module is available. You can check what modules have been enabled on your license. From the **Help** menu select **About** and in the window that opens under **Modules** click **Enabled modules**.

Action Unit Module

With the Action Unit Module you can analyze the intensity of a number of Action Units from the Facial Action Coding System (FACS). FaceReader can analyze 20 Action Units, that are most common in facial expressions. With the Action Unit Module you can also define your own expressions (Custom Expressions). You can, for instance, combine 'Happy' and 'Arousal' to assess what commercial makes your test participants happily aroused. Interest, Boredom and Confusion which were called Affective Attitudes in FaceReader 7.1, are now available as Custom Expressions.

See The Action Unit Module

Vital Signs Module

With the Vital Signs Module you can analyze the heart rate and heart rate variability of the test participant by means of remote photoplethysmography. In FaceReader 10 you can also analyze the participant's respiratory (breathing) rate.

See The Vital Signs Module

Voice Analysis Module

With the Voice Analysis Module FaceReader can recognize emotions in the voice (Neutral, Happy, Sad and Angry) and Valence and Arousal. In addition, the software can assess the Loudness and Speech rate.

See The Voice Analysis Module

Advanced Research Module

This module allows you to analyze multiple faces in a video. With this module and the Stimulus Presentation Tool you can also track the gaze of the test participant to assess what he/she is looking at when you present stimuli.

See The Advanced Research Module and Stimulus Presentation Tool.

Consumption Behavior Module

With the Consumption Behavior Module you can determine whether your test participants show chewing behavior, take a bite when testing a food item or take a sip when testing drinks. Bites and sips are called ‘intake events’ in FaceReader.

See The Consumption Behavior Module.

What is new in FaceReader 10

Customers that upgrade FaceReader from a previous version should read this section carefully to get an impression of the new features in FaceReader 10 ~~9.1~~.

If you upgraded from FaceReader 9.1

Voice Analysis Module

FaceReader 10 comes with the Voice Analysis Module which allows you to detect emotions in the voice (Neutral, Happy, Sad and Angry), Valence and Arousal in the voice, Loudness and Speech rate.

New vital sign: breathing rate

FaceReader 10 allows you to measure three vital signs. The RPPG Module in previous FaceReader versions made it possible to measure heart rate and heart rate variability. In FaceReader 10 it is possible to measure respiratory (breathing) rate as well. The RPPG Module has, therefore, been renamed and is now called the Vital Signs Module.

Advanced Research Module

This module allows you to analyze multiple faces in a video. With this module and the Stimulus Presentation Tool you can also track the gaze of the test participant to assess what he/she is looking at when you present stimuli.

See The Advanced Research Module and Stimulus Presentation Tool

Project Analysis Module

The Project Analysis Module is now part of the basic FaceReader functionality.

Improved accuracy

The accuracy of basic facial expression analysis, analysis of Action Units, baby Action Units and the subject characteristics estimation has improved, including a relatively better estimation of contempt. In addition, there are significant improvements in facial state estimations (mouth and eyes open/close) and in left/right unilateral Action Unit activations.

If you upgraded from FaceReader 9.0

Improved Action Unit classification

In FaceReader 9.1.8 and higher the classification of Action Units gives slightly lower intensities than in older versions of the software. In older versions non-active Action

Units could be classified with intensity level A, A-level Action Unit activations with level B, etc. The values of Contempt, Arousal, facial states (except Gaze direction), most custom expressions and Valence in Baby FaceReader are also affected as these parameters are based on Action Units. For the most accurate Action Unit estimation it is important to use the latest version of the software. See Introduction to Action Unit classification for more information.

Improved face modeling

In FaceReader 10 the face modeling has been improved. The new model is just as fast as the model in FaceReader 9.0 but the modeling of the mouth, the eyes and the eyebrows is much better. This is important in situations in which the test participant talks (for instance, when using a think aloud protocol in a usability test) or eats.

Improved Project Analysis functionality

The Project Analysis now shows a default layout upon opening. The data selection window has been re-arranged to make it easier to use. Charts and tables have more extensive headers which can be adjusted.

New custom expressions

New custom expressions have been added to FaceReader 10, including 'Spontaneous laughter', 'Talking', Frowning and 'Raising Eyebrows'. FaceReader 10 also has extra processors to define custom expressions.

If you upgraded from FaceReader 8.1

New face finding and modeling technique

FaceReader 10 uses a new and improved face finding and face modeling technique. It is more accurate and much faster and can better deal with rotations. See How does FaceReader work? for more information. As a result there are only three face models available now (the 'General' model, 'East-Asian' model and if you have Baby FaceReader, the 'Baby' model). The 'Children' model and the 'Elderly' model have become obsolete.

Renewed Project Analysis design

The Project Analysis section has been re-designed. In addition to the basic facial expressions you can now also analyze Action Units, Custom Expressions, Heart rate, Heart rate variability, Respiration rate, and Expressions in the voice. See Project Analysis for more information. Please note that you need the Action Unit Module to measure Action Units and Custom Expressions, the Vital Signs Module to measure heart rate, heart rate variability, Respiration rate, and the Voice Analysis Module to measure expressions in the voice.

Project Analysis is now also available for Baby FaceReader.

Improved East Asian model

The East Asian face model has been improved. A validation set of images of East Asian faces has been created and a study has been carried out to validate the enhancements and to further improve the East Asian model.

Improved gaze direction measurement

Previous versions of FaceReader could track the test participant's gaze in three directions (Left, Right and Forward). In FaceReader the gaze direction can be tracked more accurately, in nine directions (Left, Left-Up, Left_Down, Right, Right-Up, Right-Down, Up, Down and Forward). FaceReader can also determine the gaze angle now (Horizontal gaze angle and Vertical gaze angle).

New custom expressions

FaceReader 10 comes with a number of new custom expressions, including: Attention, Laughing, Smiling, Spontaneous laughter, Talking, Blinking, Frowning, and Raising Eyebrows. See Custom Expressions for more information.

More functionality in Stimulus Presentation Tool

A new version of the Stimulus Presentation Tool allows you to display your stimuli full-screen. It is also possible now to define the length of the pause between stimuli and to track the test participant's gaze. See The Stimulus Presentation Tool for more information.

Software activation code instead of hardware key

FaceReader 10 comes with a software activation code as the license which makes it easier to work with the software. For existing customers it is still possible to upgrade their hardware key.

If you upgraded from FaceReader 8.0

Reporting display

FaceReader now has a a fully customizable visualization of its analysis output. You can use it on a second monitor, or to create visuals in a report or presentation. The Reporting Client has been removed, its Valence Monitor and Smiley windows are available in the Reporting Display.

See Reporting Display in FaceReader's output

Consumption Behavior Module

The Consumption Behavior Module lets you determine whether your test participant shows chewing behavior, takes a bite of the food item you are testing or takes a sip of the drinks you offer.

See The Consumption Behavior Module

If you upgraded from FaceReader 7

Baby FaceReader

Depending on your FaceReader license you have the regular version of FaceReader, Baby FaceReader or both. With Baby FaceReader you can analyze faces of babies from the age of 6 months and infants up to the age of 2 years. Baby FaceReader can analyze 20 Action Units, Valence and Arousal. You can extend Baby FaceReader with the Vital Signs Module.

Custom Expressions

FaceReader 10 lets you define your own expressions based on the default facial expressions, Valence, Arousal, Action Units and other parameters. The Affective Attitudes Boredom, Confusion and Interest are now part of the Custom Expressions and a large number of other custom expressions are available in FaceReader's Custom Expression Library . To define Custom Expressions you need the Action Unit Module. For more information see Custom Expressions.

Audio recording

If you use FaceReader with a webcam, you can now record audio with your videos. This is important in focus group tests, interviews and usability tests.

Left and right Action Units

The Action Unit Module now tells you not only whether Action Units are active in the face but also whether they are active on the left side or right side of the face. 11 out of the 20 Action Units that FaceReader can analyze, are unilateral. This functionality is especially useful if you work with patients that are semi-paralyzed, subjects that have had a stroke or people suffering from Parkinson's disease. For more information see Unilateral Action Units.

Infrared recordings

If you want to film your test participants in the (near) dark, for instance, when analyzing people's facial expressions in a cinema, you can use (near) infrared light with a camera that is sensitive for this type of light. FaceReader 10 supports (near) infrared recordings. Please note that it is not possible to measure heart rate, heart rate variability, and breathing rate with infrared recordings.

Export improvements

You now have more options to choose from when you export your data. This way it is easier to adjust the format of the export file to the requirements of analysis programs like SPSS.

New camera

Besides the Microsoft LifeCam Studio that was already supported in previous versions, FaceReader 10 now also supports the Logitech BRIO webcam.

Privacy

Privacy-by-design

FaceReader is installed on-site and adheres to strict privacy-by-design protocols. For example, the software offers the option not to record the test participant's face during the analysis. In this case only meta data are acquired that cannot be related to an identifiable person. Examples of meta data are facial expressions, head pose, age and gender.

FaceReader is a software tool for scientific research. FaceReader is not capable of recognizing or identifying faces or people, and therefore unsuitable for surveillance purposes. For more details about applications please refer to our ethics statement on the following web page:

https://www.noldus.com/about-noldus/ethics-face-reading

GDPR and HIPAA compliance

FaceReader analyzes your participant's face while interacting with the digital content on their screen. When you analyze or record the participant's face, please be aware of requirements for storing personal data. Video and audio of the participant are personally identifiable information and are, therefore, subject to GDPR regulations in Europe and HIPAA regulations in the USA. Facial expressions, video recordings with the test participant's voice, heart rate, breathing rate data are sensitive data. With the correct procedure you can make sure that you comply with privacy regulations.

To comply with GDPR or HIPAA regulations, take notice of the following:

When you record the participant, or share these recordings, make sure you ask the participant consent for video recording and let him or her sign a consent form. This informed consent form should include:

- The purpose of the recordings. If there is a possibility that the recordings will be reused for other studies, describe this explicitly.
- Which personally identifiable information is stored.

  When you do a camera analysis, by default the video is stored, which is personally identifiable information. To switch off video recording, deselect the **Record** option in the window in which you select your camera.

  If you enter participant details like their name, age or gender this is also personally identifiable information. We recommend to use generic names, like participant 1, and to use age classes instead of specific ages.

  Facial expressions, video recordings with the test participant's voice, heart rate, and breathing rate data are sensitive data.

Export files may also contain personally identifiable information or sensitive data.

- Who will have access to the personally identifiable information. Think of authorized staff directly involved in the study, but also of Noldus support staff in case support is needed.
- The retention policy, when the personally identifiable information will be deleted.
- The right of subjects to withdraw permission for the use of the personally identifiable information and instructions for the participant to withdraw permission.
- The right to data portability and instructions for the participant how to receive their data.
- Security and privacy measures taken.

  In FaceReader, video and data are stored locally on the computer. Take security measurements for the stored videos and describe this in the consent form.

For information about Noldus' Privacy Policy with regard to your data, see:

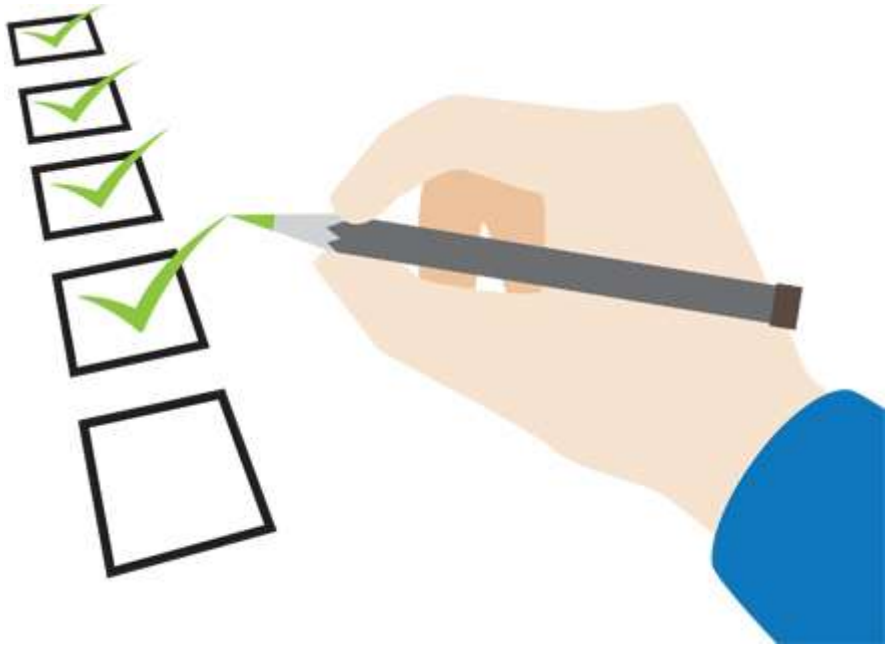
https://www.noldus.com/legal/privacy-policy

Installation

Main topics

- System requirements
- Software license key or hardware key
- The steps to install FaceReader
- Upgrade to FaceReader 10
- FaceReader trial version
- Camera and accessories

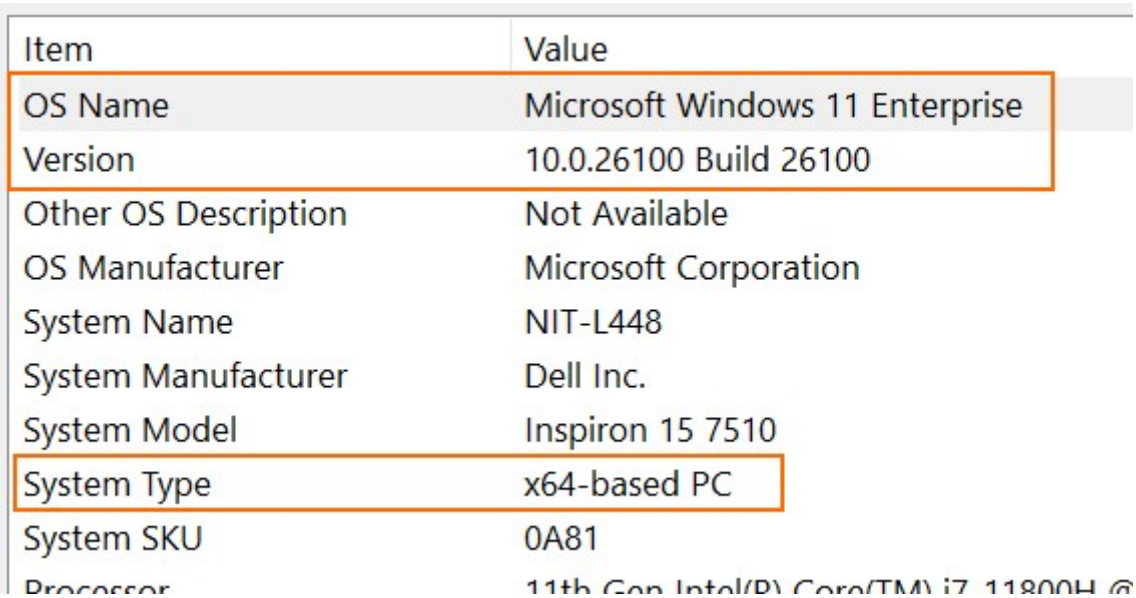
System requirements



Operating system

FaceReader has been thoroughly tested using a US English version of Windows 11 (64 bit Professional edition).

To check which version you have, type **System information** in the App window. Note the information in the **OS Name**, **Version**, and **System Type** fields.



Item	Value
OS Name	Microsoft Windows 11 Enterprise
Version	10.0.26100 Build 26100
Other OS Description	Not Available
OS Manufacturer	Microsoft Corporation
System Name	NIT-L448
System Manufacturer	Dell Inc.
System Model	Inspiron 15 7510
System Type	x64-based PC
System SKU	0A81
Processor	11th Gen Intel(R) Core(TM) i7-11800H @

Language support

Like any software package, it remains possible that minor differences in the operating systems of certain local language versions may affect how well the program runs. If you encounter a problem of this sort, please contact Noldus Technical Support.

Computer

If you order a complete solution from Noldus Information Technology, you will obtain a Dell Precision™ T3680 Workstation (or its successor), or a Dell Precision™ 3591 mobile workstation (or its successor) with the FaceReader software installed and ready to use.

Technical specifications Dell Precision T3680

- Processor: Intel Core i7 14700
- Internal memory: 32 GB or more
- Hard disk: 1 TB
- Graphics card: 8 GB NVIDIA Quadro T1000 or better

Technical specifications Dell Precision 3591 mobile workstation:

- Processor Intel Core Ultra 7 155H
- Memory: 16 GB
- 1st Hard-disk: M.2 512 GB PCIe

- Graphics card: RTX 1000 Ada

Other computers

If you choose to order a PC from another supplier, you can use the above specifications as a guideline.

We recommend that you use a professional workstation. It is possible to buy consumer-range computers with a high processor speed and plenty of memory, but in order to remain competitive regarding price, the manufacturers often economize on the underlying system architecture. That means those computers are suitable for home use, but not for running professional scientific software. You should select a computer which is intended for professional use or labeled by the manufacturer as a workstation. We, therefore, recommend to use the specifications of the Dell Precision 3591 mobile workstation that are mentioned above if you prefer to use FaceReader on a notebook.

A CPU with AVX is required when using the Consumption Behavior Module.

Camera

Supported cameras

We tested FaceReader with the following cameras:

- Logitech BRIO (USB3)
- Microsoft LifeCam Studio (USB2)
- Axis M1065-L (IP-camera)
- Logitech C920, C922, C925e, C930e

See also Camera and accessories

The Logitech BRIO is not suitable for measuring heart rate and heart rate variability. Use a Logitech C920, C922, C925e or C930e with the Vital Signs module.

Internet connection

If you are using an IP camera, you need a fast Internet connection for this set-up to work.

Software license key or hardware key

A license for FaceReader comes with either a software license key or a hardware key. The license determines which options are available to you.

See Modules

Software license key

Your software license key makes either one or multiple activations of the software possible, depending on the number of licenses that you purchased and the type of activation that you choose. For information on how to activate your license see Activate FaceReader with a software license key.

Hardware key

A hardware key is a very important piece of equipment, as it represents the full value of your license and cannot be replaced if lost. You can install FaceReader on more than one computer. However, to work with the program you need to insert the hardware key into one of the computer's USB ports.

IMPORTANT Please make sure that you do not lose the key! You will need to pay for a new license if so. Also be careful with it, because it is sensitive and can be easily damaged.

The drivers for the hardware key are installed together with FaceReader. First install FaceReader with the drivers for the hardware key, then connect the hardware key to the computer. If you connect the hardware key first, other drivers are automatically installed which may lead to incorrect functioning of the hardware key. When the hardware key is installed and connected properly, a red light glows inside it.

The steps to install FaceReader

Aim

To set up the computer to work with FaceReader.

Prerequisites.

- You have a license for FaceReader. This can be a software license key or a hardware key.

  See Start FaceReader

- You downloaded the FaceReader installation file from the MyNoldus portal (my.noldus.com).
- You did not order a computer with FaceReader from Noldus IT. If you did, all your software and any internal hardware is already installed and tested and you can skip this topic.
- You have administrator rights on the computer for FaceReader. This means you either are the system administrator or a member of the Windows group Administrators and have been assigned administrator rights.
- You checked the packing list to make sure all the components are present. If any of the components listed is missing or damaged, please report this to Noldus IT immediately.
- Your computer meets the System requirements needed for FaceReader 10.

Procedure

Carry out the following steps:

- Turn off automatic device driver installation and automatic updates
- Select correct power options in Windows 10
- Install FaceReader

Turn off automatic device driver installation and automatic updates

Aim

To make sure the cameras use the drivers that were tested with FaceReader and to prevent automatic system restarts that cannot be controlled.

Background information

The general recommendation from Microsoft to use automatic updates is good, especially for security updates. However, automatic updates of hardware device drives can sometimes give problems. FaceReader is tested with the device drivers that are available at the moment of the release. If device drivers are updated afterwards, we cannot guarantee that they work properly with FaceReader. Therefore we recommend to switch off automatic updates of device drivers.

If you ordered a computer with FaceReader from Noldus IT, the automatic device driver installation and automatic updates have already been turned off and you can skip this topic.

- Procedure for Windows 11 and Windows 10 from version 1809 onwards
- Procedure for Windows 10 up till version 1803

Procedure for Windows 11 and Windows 10 from version 1809 onwards

As of Windows 10 version 1809 please use the Group Policy Settings to prevent automatic device driver installation:

1. Click on the Windows icon in the taskbar and then type **Edit group policy**. The **Local Group Policy Editor** window opens.
2. Under **Computer Configuration** select **Administrative Templates**, **System**, **Device Installation** and then **Device Installation Restrictions**.
3. Check whether the appropriate settings are configured.

Tip: Click on a setting to get additional information. If you are unsure what settings should be configured, ask your system administrator for help.

Also check that your computer has the appropriate settings to prevent automatic updates:

1. Click on the Windows icon in the taskbar and then type **Edit group policy**. The **Local Group Policy Editor** window opens.
2. Under **Computer Configuration** select **Administrative Templates**, **Windows Components** and then **Windows Update**.

   Manage updates offered from Windows Server Update Service

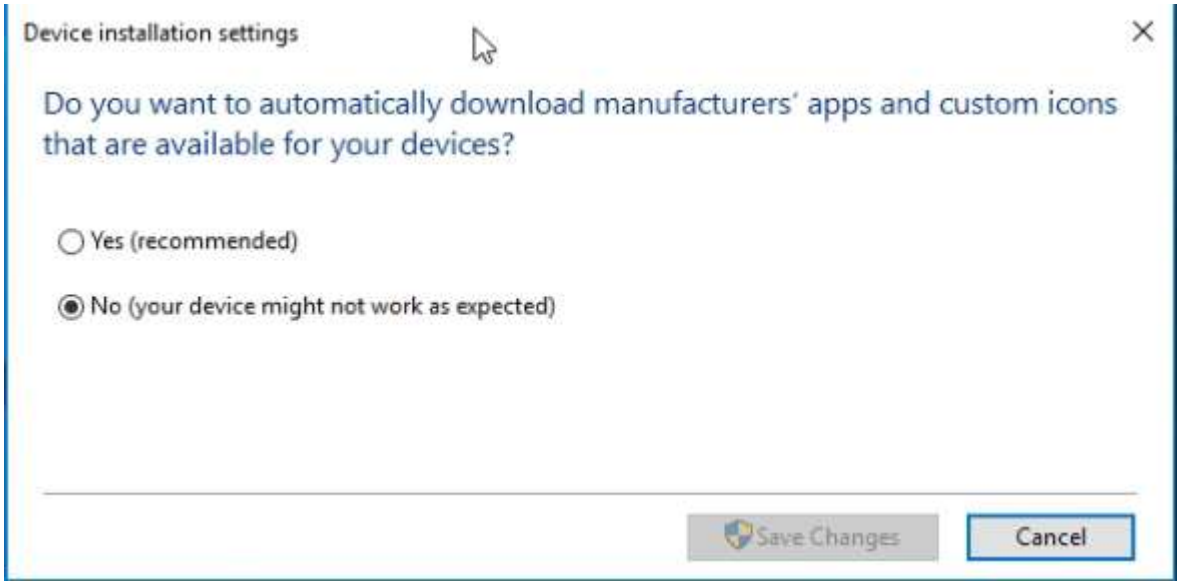
   Manage updates offered from Windows Update
3. Check whether the appropriate settings are configured.

Tip: Click on a setting to get additional information. If you are unsure what settings should be configured, ask your system administrator for help.

Procedure for Windows 10 up till version 1803

1. Click the Windows icon on your desktop and type *Change device*.
2. Click **Change Device Installation Settings**.

3. In the window that appears, select **No (your devices might not work as expected)**. Then click **Save Changes**.



Select correct power options in Windows 10

Aim

To make sure the computer shuts down properly. This step is needed for Windows 10 computers only.

Background information

On computers with Windows 10, by default the computer resumes rather than restarts after shutdown. This can cause problems with FaceReader and associated software like MediaRecorder, and The Observer XT. Therefore, we recommend to make sure that the computer really shuts down.

Procedure

1. Click the Windows icon on your desktop or keyboard and type **Control Panel**. Then click **Power options**.

2. Click **Choose what the power buttons do**.
3. Click **Change settings that are currently unavailable**.

4. Select the following options (both for **On battery** and **Plugged in**):

   - When I press the power button – Shut down.

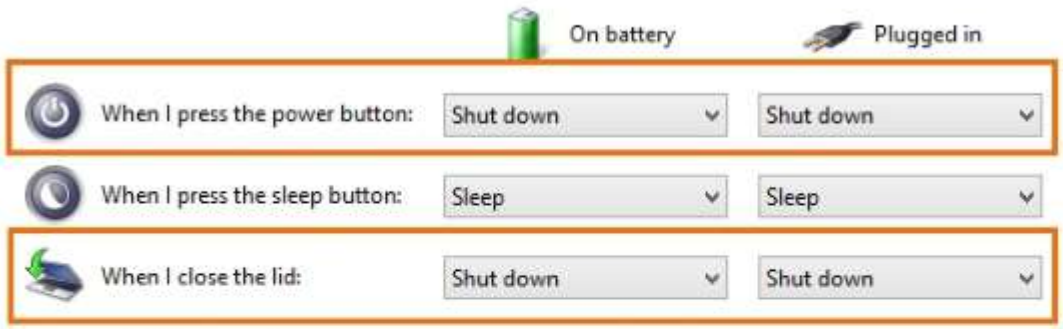
   - When I close the lid – Shut down.

   - Under Shutdown settings deselect the checkboxes **Sleep**, **Hibernate**, and **Turn on fast startup (recommended).**

Define power buttons and turn on password protection

Choose the power settings that you want for your computer. The changes you make to the settings on this page apply to all of your power plans.

Power and sleep buttons and lid settings

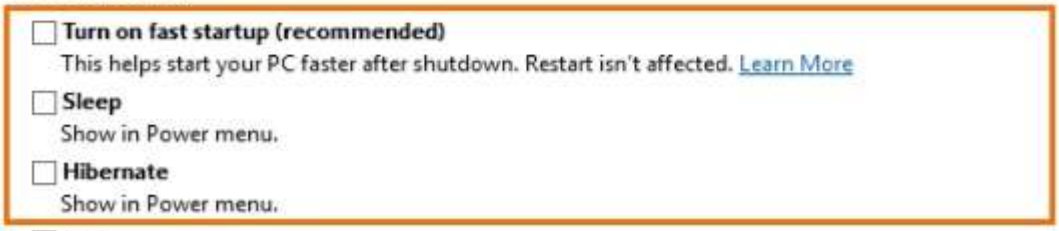


Password protection on wakeup

(•) Require a password (recommended)
When your computer wakes from sleep, no one can access your data without entering the correct password to unlock the computer. Create or change your user account password

( ) Don't require a password
When your computer wakes from sleep, anyone can access your data because the computer isn't locked.

Shutdown settings



☑ **Lock**
Show in account picture menu.

Install FaceReader

IMPORTANT If your FaceReader license comes with a hardware key, first install FaceReader and then connect the hardware key to your computer, not the other way around.

Procedure

1. Download the installation file (FaceReader 10 Setup.exe) from the MyNoldus portal of the Noldus website (my.noldus.com).

   If you do not have a MyNoldus account yet, you can create one.
2. Double-click the file. If a security message appears, click **Run**.
3. We recommend to choose **Standard** as Installation type. Choose **Custom** if you want to change the folder into which FaceReader is installed, or if you do not want shortcuts on the desktop to the program and the FaceReader Help.
4. Click **Next**, read the End-User License Agreement carefully, Select **I agree**, and click **Install** and then **Yes**. The installation of FaceReader starts.
5. When the installation of FaceReader is finished, a message appears informing you that installation is complete. Click **Launch** to start FaceReader, or **Close** to exit.

Notes

- **IMPORTANT** Projects saved in FaceReader 10 cannot be opened in earlier versions anymore.
- FaceReader is installed in C:\Program Files\Noldus\FaceReader 10\
- You can install FaceReader 10 next to older versions of FaceReader but we advise to not combine data from projects made in different versions.
- A number of sample images and video files is installed in C:\Users\Public\Public Documents\Noldus\FaceReader 10\Examples.
- To install the Stimulus Presentation Tool, see To install the Stimulus Presentation Tool
- It is not possible to install FaceReader on one computer and access it from another across a network. The program must be installed on the computer where it will be used.

End-user license agreement

IMPORTANT – READ CAREFULLY. Please read this End-User License Agreement ("**EULA**" or "**Agreement**") carefully before checking the "accept" checkbox, downloading or using the Software (as defined below). By checking the "accept" checkbox, downloading, installing or otherwise using the Software, End-User agrees to be bound by the terms and conditions in this EULA. If you do not agree to the terms and conditions of this EULA, do not check the "accept" checkbox and do not download, install or use the Software.

The Software is protected by copyright laws and international copyright treaties, as well as other intellectual property laws and treaties. The Software is licensed, not sold.

1. DEFINITIONS

Terms used in this EULA but not otherwise defined shall have the meaning assigned to them below:

1.1. **Authorized Partner**: the individual or legal entity that has been granted permission by Noldus to promote, sell or otherwise distribute the Software on behalf of Noldus.

1.2. **End-User**: the individual or legal entity that has acquired or uses the Software under the terms and conditions of this EULA.

1.3. **EULA**: this End-User License Agreement.

1.4. **Indirect Losses**: any indirect loss, claim, damage, liability, or expenses (including reasonable attorney's fees), including lost profits, and damage due to the stagnation of business operations.

1.5. **Network License**: a licensing mechanism comprising a license file and accompanying software managing the number of concurrent users of the Software.

1.6. **Noldus**: Noldus Information Technology BV, with registered office at Nieuwe Kanaal 5, 6709 PA Wageningen, The Netherlands, listed in the Trade Register under Chamber of Commerce number 09094422, or its subsidiaries listed in the document

https://www.noldus.com/legal/noldus_corporate.pdf

1.7. **Security System**: a system of software protection to limit installation and use of the Software to the authorized End-Users and computers.

1.8. **Security Device**: a device that forms part of or is attached to the computer, and is used as part of the Security System to control access to the Software.

1.9. **Software**: the software (including, but not limited to, any updates, upgrades and associated media, printed or electronic documentation and online services)

provided to the End-User by Noldus or an Authorized Partner together with this EULA, that is not covered by third party terms and conditions and is included in the list under “Noldus software” in the Annex to the General Terms and Conditions

(https://www.noldus.com/legal/noldus_gtc.pdf).

2. LICENSE

2.1. Upon payment by the End-User of the license fees for the Software, Noldus grants End-User a revocable, non-exclusive license to download, install and use the Software in accordance with the terms and conditions of this EULA. This EULA does not grant any rights to obtaining future upgrades, updates or supplements of the Software. If upgrades, updates or supplements of the Software are obtained, however, the use of such upgrades or updates is governed by this EULA and the amendments that may accompany them and may be subject to additional payments and conditions.

2.2. The End-User may download, install and use the Software on as many computers as is reasonably necessary, however the Software may not be shared or used concurrently on more computers than for which EULA’s are granted. End-User shall take all reasonably required steps to ensure that this number is not exceeded.

2.3. End-User is allowed to store or install a copy of the Software for back-up or archival purposes.

2.4. End-User shall not (i) modify, alter, adapt, merge, decompile or reverse-engineer the Software or any part thereof nor create any derivative works based on all or any part of the Software, or (ii) remove or obscure any copyright, trademark or other ownership notices from the Software, or (iii) sub-license, sell, rent, lease, hire, loan, assign or otherwise transfer the Software or your rights in the Software or any part thereof, except as provided for in this EULA.

2.5. The Software may be protected by a Security System, including but not limited to the use of expiry dates, time-limited or feature-limited licenses, authorization codes, Security Devices and Network Licensing. End-User is prohibited to (attempt to) remove, alter or circumvent in any way any part of such Security System.

2.6. End-User is responsible for regular, frequent and effective backups of all files produced or modified while working with the Software.

3. INTELLECTUAL PROPERTY

3.1. All title, copyright and other industrial, intellectual or proprietary rights in and to the Software (including but not limited to any images, photographs, animations, video, audio, music, and text incorporated into the Software), the accompanying printed materials, and any copies of the Software are owned by Noldus or its Authorized Partners. All rights not expressly granted are reserved by Noldus.

3.2. The Software may include or make use of third party software, including open source software. Such third party software may be subject to the third party's terms and conditions provided in the documentation accompanying the Software and may contain copyright or other industrial, intellectual or proprietary rights of such third party software. End-User hereby agrees to the terms and conditions for such third party software. In the absence of any third party terms and conditions, this EULA will govern the third party software in the Software.

3.3. End-User may, from time to time, provide Noldus with comments, suggestions, data, information or feedback ("**Feedback**") on the Software. End-User acknowledges and agrees that such Feedback may be freely used by Noldus, at its sole discretion, for the design, development, improvement, marketing and commercialization of its products and services, without any restrictions based on confidentiality or intellectual property rights.

4. TRANSFER

4.1. End-User is entitled to make a one-time, permanent transfer of this EULA and Software only directly to one other End-User. This transfer must include all of the Software (including all component parts, the media and printed materials, any upgrades and this EULA). Such transfer may not be by way of consignment or any other indirect transfer and shall be subject to the following provisions:

a. End-User will provide to Noldus prior to any such transfer the full name and address details of the new End-User and the expected date of transfer in writing;

b. The new End-User understands and agrees to all the terms and conditions of this EULA in the same way as if the new End-User had obtained the Software from Noldus or an Authorized Partner;

c. End-User will destroy all (partial) copies of the Software and all accompanying materials, including but not limited to installed copies and any backup copies on data storage devices and guarantee to Noldus in writing that this has been done. If the Software is an upgrade, any transfer must include all prior versions of the Software;

d. Noldus reserves the right to levy an administrative charge upon the End-User and/or the new End-User in relation to transfer of the Software to an End-User.

4.2. Any attempted transfer without prior written permission from Noldus shall constitute a material breach of this Agreement and shall be deemed null and void.

5. TERM; TERMINATION

5.1. The EULA shall enter into force on the date of acceptance by the End-User and continue until terminated in accordance with this Section 5.

5.2. If the Software is licensed on a subscription basis, the EULA shall continue until the end of the current subscription period.

5.3. Noldus is entitled to terminate the EULA immediately upon prior written notice upon:

a. the breach of any material provision of this Agreement by the End-User if (i) such breach is not curable or (ii) if curable, the End-User has not cured such breach within 30 (thirty) day period following receipt of a written notice by Noldus substantiating such breach ("*ingebrekestelling*");

b. the filing or institution of bankruptcy, liquidation or receivership proceedings of the End-User or in the event a receiver or custodian is appointed for the End-User's business, or if its business is discontinued or if it has a petition presented by a creditor for its winding up or if the End-User enters into any liquidation (other than for purpose of reconstruction or amalgamation).

5.4. Upon termination of the EULA, the End-User shall immediately discontinue the use of the Software and remove the software of all computers, destroy all (partial) copies of the Software from all storage media and return the documentation and materials relating to the Software to Noldus or its Authorized Partner.

5.5. Termination of this Agreement does not remove or reduce End-User's obligation to pay any outstanding license fees or other monies, all of which shall be due for payment immediately on termination of the EULA.

5.6. The following provisions shall survive termination of this EULA: Sections 3, 7, 9, 10 and this Section 5.6. In addition, any other provisions which are required to interpret and enforce the Parties' rights and obligations under the EULA shall also survive any termination or expiration of this EULA, but only to the extent required for the full observation and performance of the EULA.

6. WARRANTY

6.1. Noldus warrants that the Software as of the date of delivery to the End-User by Noldus or its Authorized Partner, the Software will, for a period of 90 days ("**Warranty Period**") materially conform to the specifications set out in the user documentation accompanying the Software ("**Specifications**"), provided that:

a. the Software is properly installed on a supported computer platform (as defined in documents that can be accessed on

https://my.noldus.com)

and used in accordance with the provisions of the accompanying user documentation and/or any Noldus-approved training course;

b. Noldus is notified in writing within 14 days after any non-conformity of the Software was known or should reasonably have been known to End-User and the End-User has made available all the information that might reasonably be required to allow Noldus to investigate, recreate and where possible remedy a non-conformity;

c. the Software has not been (a) altered, repaired or modified by any party other than Noldus or a third party provider approved by Noldus; or (b) used with software or a computer platform other than set out in the documents that can be accessed on

https://my.noldus.com

or have been subjected to negligence, or computer or electrical malfunction; or (c) were used, adjusted, or installed other than in accordance with instructions by Noldus.

6.2. Other than set out in Section 6.1, no warranties are expressed or implied with respect to Software or any element thereof, including without limitation its quality, performance, accuracy, merchantability or suitability or fitness for any purpose, whether or not that purpose has been communicated by End-User to Noldus. The Software is a general product developed by Noldus for a wide range of solutions, requirements and situations and End-User is responsible for purchasing the Software required for his needs. Noldus explicitly does not warrant that the Software shall be entirely without error or fault nor that it will operate without interruption. End-User agrees that such errors, faults or interruptions shall not be deemed material and cause to terminate this EULA.

6.3. The warranty by Noldus set out in Section 6.1 applies only to the first installation of the Software and will not apply, resume or renew upon delivery or installation of any subsequent update or upgrade to the Software, alteration in the number of EULA's granted for use of the Software, or any other extensions, upgrades or alterations to the Software where the Software has previously been delivered to or installed by the End-User.

6.4. The warranty by Noldus set out in Section 6.1 shall further not apply to Software that is licensed or otherwise made available at no cost, or Software that is designated as 'prototype', 'alpha' or 'beta' code, all of which are provided 'as is' and without warranty, representation or liability.

6.5. Upon receipt of an End-User's written notice of the Software not conforming to the Specifications during the Warranty Period, Noldus shall at its option and in its sole discretion (i) assist the Customer in correcting or replacing the non-conforming Software or, (ii) terminate the EULA immediately and refund the purchase price paid by the End-User. The remedies described above shall be End-User's sole and exclusive remedies. Upon expiration of the Warranty Period, Noldus shall have no obligation to provide such remedies.

6.6. Noldus and Authorized Partners, are not responsible for maintaining or supporting use of the Software or obligated to provide any updates, fixes or support to the Software unless otherwise expressly agreed in writing between End-User and Noldus or the Authorized Partners.

7. USE LIMITATIONS; LIABILITY; INDEMNIFICATION

7.1. End-User acknowledges that the Software is intended for research or training purposes only and agrees not to use the Software for diagnosis or treatment of disease in human subjects. End-User agrees not to use the Software in any application where the failure, malfunction or inaccuracy of the Software carries the risk of death or bodily injury.

7.2. Noldus Software shall not be used for collection of biometric data from human subjects without prior informed consent from the person whose data is being captured.

7.3. Noldus does not allow the use of its Software for the following applications:

a. Active defense, i.e. embedding Noldus Software in a weapon system.

b. Biometric data collection in a judicial context with the aim to use such data as evidence in court. Noldus Software cannot and shall not be used as a lie detector.

c. Surveillance of people in public spaces for security purposes.

d. Any other use that may potentially violate fundamental human rights.

7.4 If Noldus notices that its Software is used for applications that it does not approve, this may lead to discontinuation of customer support and termination of the EULA.

7.5. To the fullest extent permitted by law, and not withstanding any other provision of this EULA to the contrary:

In no event will Noldus or the Authorized Partners be liable to the End-User for Indirect Losses or for special, incidental, consequential, exemplary, enhanced, or punitive damages, including without limitation, any damages resulting from interruption of business, loss of use, loss of profits or revenue, or loss of business, arising out of or in connection with this EULA, the Software, or the performance of Noldus, the Authorized Partners, or third parties engaged by Noldus in the performance of this EULA, regardless of whether Noldus, the Authorized Partners, End-User, or any other person or entity has been advised of (or could have reasonably foreseen) the possibility of such damages or Indirect Losses. If, despite the provisions in this EULA, liability exists anyway, only direct damage will be eligible for reimbursement.

7.6. Noldus' and Authorized Partners' liability shall also be excluded, and Noldus and the Authorized Partners shall not have any liability under this EULA in the event of:

a. End-User's use of the Software other than in accordance with Section 7.1;

b. in the event of direct and indirect consequences of the End-User's failing to adhere strictly to the user documentation provided or made available by Noldus or the Authorized Partner; or

c. any loss of or damage to files or data howsoever caused.

7.7. A liability claim will be unenforceable and lapse unless Noldus or the Authorized Partner receives a written notice thereof no later than 6 months after the discovery of an event or circumstance that gives or may give rise to that claim.

7.8. Noldus will hold harmless, defend, and indemnify End-User from and against all losses, damages, claims, liabilities, and expenses incurred by End-User that arise out of, relate to, or are caused by any third party claim that End-User's use of the Software, pursuant to the terms of this EULA, infringes the intellectual property rights of such third party. If such a claim is made or appears likely to be made, Noldus, at its option, will have the right to either (i) procure for the End-User the right to continue to use the Software, (ii) modify or replace the Software so that it is no longer infringing (in a manner that substantially retains its functionality and quality), or (iii) require End-User to terminate the use of and return the Software and refund a pro rata portion, if any, of the amount paid by End-User to Noldus for the infringing Software. Notwithstanding the foregoing, Noldus will have no liability to End-User if the infringement results from use of the Software in combination with software not provided by Noldus or from modifications made by Noldus to conform to specifications provided by End-User. The indemnification obligations in this section are subject to: (i) End-User giving Noldus prompt written notice of any claim (provided that End-User's failure to provide prompt written notice will only relieve Noldus of its obligations under this Section to the extent such failure materially limits or prejudices Noldus' ability to defend or settle such claim); (ii) the transfer of sole control of the defense and any related settlement negotiations to Noldus; and (iii) End-User's cooperation, at Noldus' expense, in the defense of such claim. THIS SECTION STATES END-USER'S SOLE AND EXCLUSIVE REMEDIES FOR THIRD PARTY INTELLECTUAL PROPERTY INFRINGEMENT CLAIMS.

7.9. End-User shall indemnify and hold harmless Noldus, the Authorized Partners, and the third parties engaged by Noldus from and against any and all losses (including Indirect Losses and special, incidental, consequential, exemplary, enhanced, or punitive damages) arising out of or caused by (i) any failure in the performance of the obligations of the End-User under the law, this EULA, or Noldus' General Terms and Conditions, or (ii) any and all third party claims on any grounds whatsoever, directly or indirectly related to the End-User's use of the Software, the contents thereof, or any results or materials generated by the Software.

7.10. THE LIMITATION OF LIABILITY PROVISIONS SET FORTH IN THIS SECTION 7 SHALL APPLY EVEN IF END-USER'S REMEDIES UNDER THIS EULA FAIL OF THEIR ESSENTIAL PURPOSE.

7.11. Noldus and End-User acknowledge and agree that the parties entered into this EULA in reliance upon the limitations of liability set forth in this Section 7, that the same reflect an allocation of risk between the parties (including the risk that a contract remedy may fail of its essential purpose and cause consequential loss), and that the same form an essential basis of the bargain between the parties.

8. MISCELLANEOUS

8.1. Parties may communicate with each other by electronic mail. Parties recognize the risks associated with electronic mail and declare that they shall not hold each other liable for any damage incurred by either of them as a result of the use of electronic mail. If a Party is in doubt as to the content of an electronic message received, the content of the message originating with the sender shall be decisive.

8.2. The invalidity or unenforceability of any provision this EULA shall not affect or limit the validity or enforceability of any other provisions thereof. Any such invalid or unenforceable provision shall be deemed to be substituted by a provision that is considered to be valid and enforceable. The interpretation of the substituting provision shall be as close as possible to the economic, legal and commercial objectives of the severed provision.

8.3. Failure by Noldus or the Authorized Partner to enforce any of its rights under the EULA shall not constitute a waiver of such rights thereunder and shall not relieve End-User of its obligation to comply with such provisions. No waiver or amendment of any provisions therein shall be effective unless signed in writing by a Noldus representative. Any such written waiver shall only be applicable to the specific instance to which it relates and shall not be deemed to be a continuing or future waiver.

8.4. Amendments or changes to this EULA can only be agreed upon in writing between the Parties.

8.5. The EULA shall be binding upon the Parties thereto, their legal representatives, successors and assigns. End-User shall not assign any right or obligation arising out of this EULA without the prior written consent of Noldus. Any attempt by End-User to assign or delegate any obligation hereunder shall be deemed null and void.

9. GOVERNING LAW: END-USERS USA OR CANADA

9.1. If End-User is a legal entity and its principal place of business is located in the United States of America or Canada, or if End-User is an individual whose primary residence is located in the United States of America or Canada:

> a. This EULA is exclusively governed by the laws of the Commonwealth of Virginia and the applicable federal laws of the United States of America,

without regard to the conflicts of law provisions of any jurisdiction. Without limiting the previous sentence, End-User and Noldus expressly agree: (i) that the Virginia Uniform Computer Information Transactions Act, Virginia Code §§ 59.1-501.1 *et seq*. ("UCITA"), and the United Nations Convention on Contracts for the International Sale of Goods ("CISG") are expressly excluded from this EULA, (ii) that any and all terms contained in UCITA or CISG will have no force or effect on any portion of this EULA, and (iii) that UCITA and CISG do not apply to this EULA or the Software.

b. Any and all claims and disputes arising out of or in connection with this EULA, the Software, or the performance or non-performance by either party of any of its obligations under this EULA, which End-User and Noldus cannot resolve amicably within a reasonable period of time, will be commenced and maintained only in a state or federal court of competent subject matter jurisdiction situated or located in the United States of America. Noldus and End-User consent to the exclusive personal jurisdiction of and venue in any such court.

c. To the extent permitted by law: End-User must commence or file any claim or action arising out of or relating to this EULA or the Software within six months after the cause of action accrues, otherwise, such claim or cause of action is permanently barred. To the extent permitted by law, End-User expressly waives the right to commence or file any such claim or action under any longer statute of limitations.

10. GOVERNING LAW: END-USERS OTHER COUNTRIES

10.1. If End-User is a legal entity and its principal place of business is located in any country other than the United States of America or Canada, or if End-User is an individual whose primary residence is located in any country other than the United States of America or Canada:

a. This EULA is exclusively governed by the laws of The Netherlands. The United National Convention for Contracts on the International Sale of Goods is expressly excluded.

b. Any disputes arising out or in connection with this EULA that cannot be solved amicably within a reasonable period of time will be submitted to the competent court in Arnhem, The Netherlands, for any dispute with End-Users having their principal place of business in the European Union. In the event that an End-User has its principal place of business outside the European Union, the United States of America or Canada, any dispute shall be finally settled in accordance with the Arbitration Rules of the Netherlands Arbitration Institute. Location shall be Arnhem, The Netherlands. The arbitration procedure shall be conducted by one (1) arbiter in the English language.

REVISED JULY 21, 2022

NOTE A PDF copy of this End-User License Agreement can be found in the folder Documentation\Legal, located in your application folder (default: C:\Program Files\Noldus\FaceReader 10.

Acknowledgments and copyright notices

FaceReader™ is a trademark of Vicarious Perception Technologies BV but the End-user license agreement for products from Noldus Information Technology BV- applies. FaceReader would not be what it is without the use of third-party software. This page lists software libraries and other software products used in FaceReader and where you can find license and compliance information and/or acknowledgments for that product.

For the complete terms and conditions in PDF format, see the PDF files in the folder Documentation\Legal**Acknowledgements**, located in your application folder (default: C:\Program Files\Noldus\FaceReader 10).

Name	**Description**	**Link/ License**
Boost	Open source (Boost community) software library, C++ templates	Boost software license http://www.boost.org/users/license.html
IPP, MKL, TBB	Software library for signal, image, speech and audio processing (Intel Corporation)	Intel Composer XE https://software.intel.com/en-us/license/intel-simplified-software-license
OpenCV	Software library, collection of algorithms and sample code for various computer vision problems	OpenCV http://www.intel.com/content/www/us/en/research/intel-research.html 3-clause BSD License http://opencv.org/license.html

HASP	Library for software protection	Safenet EULA https://safenet.gemalto.com/DownloadNotice.aspx?dID=8589947119 Sentinel Gemalto https://sentinel.gemalto.com/
Wix Toolset	Tools to author software installers	Wix Toolset http://wixtoolset.org/ .NET Foundation https://dotnetfoundation.org/ Microsoft Reciprocal License (MS-RL) http://wixtoolset.org/about/license/
Emgu CV	.Net wrapper to Open Source Computer Vision Library	FaceReader contains Emgu CV components under a commercial license. http://www.emgu.com
FFmpeg	Video file decoding and encoding	GNU Lesser General Public License http://www.gnu.org/licenses/lgpl-3.0.txt Source code is available at https://ffmpeg.org/

NAudio	NAudio is used for audio playback of stimulus videos	Microsoft Public License (Ms-PL) http://naudio.codeplex.com/license Source code is available at http://naudio.codeplex.com/
Caffe	Caffe is a deep learning framework	BSD 2-Clause license https://github.com/BVLC/caffe/blob/master/LICENSE Source code is available at https://github.com/BVLC/caffe
Tensorflow Lite	Tensorflow Lite is used for multiple deep learning models within FaceReader	Apache License Version 2.0 https://github.com/tensorflow/tensorflow/blob/master/LICEN Source code available at: https://github.com/tensorflow/tensorflow
OpenVino	OpenVino is used for multiple deep learning models within FaceReader	Apache License Version 2.0 https://github.com/openvinotoolkit/openvino/blo master/LICENSE Source code available at: https://github.com/openvinotoolkit/openvino

MediaPipe	MediaPipe offers open source cross-platform, customizable ML solutions	Apache License Version 2.0 https://github.com/google/mediapipe/blob/master/LICENSE Source code available at: https://github.com/google/mediapipe

Upgrade to FaceReader 10

To upgrade a previous FaceReader version to version 10, carry out the following steps:

- Install FaceReader.

  Carry out all steps in The steps to install FaceReader.

- Upgrade the license

  See Upgrade the license

- Upgrade the Stimulus Presentation Tool.

  See To upgrade the Stimulus Presentation Tool in Project Analysis

Notes

- You can install FaceReader 10 9 next to older versions of the software.
- If you open a project that was created in an older version, it is converted to a FaceReader 10 project and cannot be opened in the older FaceReader version anymore. To work with that project in older versions first create a backup in an older version.

  See Back up a project

- We recommend to use the same FaceReader version within one project.

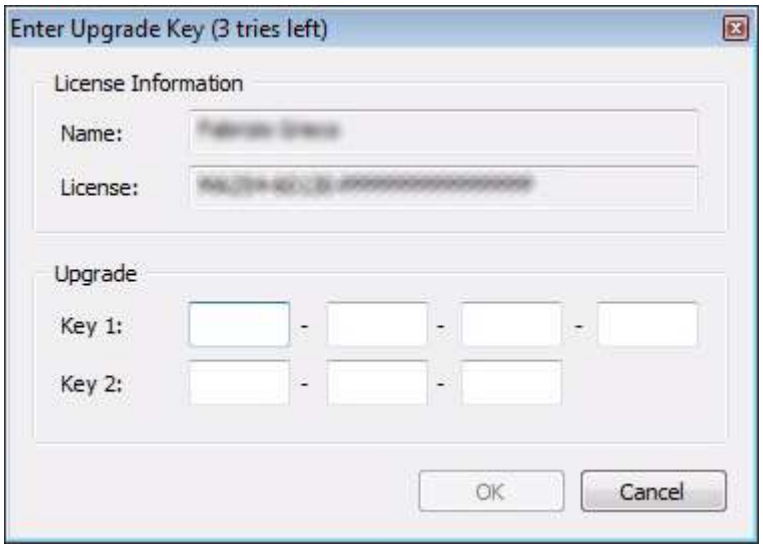
Upgrade the license

If you have a software license key

Start FaceReader and activate your new license with your software license key following the procedure in Activate FaceReader with a software license key.

If you have a hardware key

1. Insert the hardware key into your computer and start FaceReader.
2. The system automatically detects the old license on the hardware key and the **Enter Upgrade Key** window appears. Enter the key code that was supplied to you by Noldus IT. These numbers are normally sent by e-mail or are written in your welcome letter.

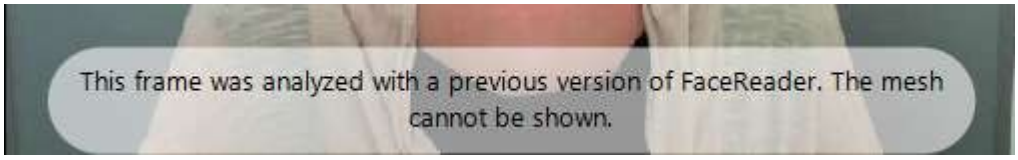


If you bought an extra module

When you already have FaceReader and bought an extra module, for example the Action Unit Module, you also need to upgrade your license. Open FaceReader and choose **Help** > **Upgrade**. Then enter the upgrade key that was supplied to you by Noldus IT.

Opening an analysis made in a previous version of FaceReader

When you open an analysis in a project that has been made in version 8 or lower of FaceReader, a message will appear in the **Analysis Visualization** window that, for instance, the mesh and the gaze cannot be shown. You will have to re-analyze the video to see these visualizations.



If the analysis was done with the **Children** model or the **Elderly** face model that have become obsolete in FaceReader 10, then a message will pop up asking you whether you would like to switch to the **General** model. If you select 'Yes' you will see 'General' as the face model in the current settings. The analysis results remain intact.

FaceReader trial version

Aim

To try FaceReader for free for a limited period.

Restrictions

- Valid for 14 days (from the day of activation).

Prerequisite

- You received a link to download the setup file.
- You received a software license key.
- Your computer meets the System requirements

Procedure

1. Open the FaceReader trial download page and download the setup file.
2. Double-click the setup file that you downloaded and follow the instructions on your screen.
3. Start FaceReader.
4. A window opens, choose **Activate software license key**.
5. In the following window select either **Floating** or **Fixed**. See What is the difference between a Floating and a Fixed activation?
6. In the window that appears, enter the software license key.
7. Click **OK**.

Notes

- To see how many days are left in your trial, choose **Help** > **About**.
- When the trial period expires, a message is shown at start up.
- The Action Unit Module, The Vital Signs Module, The Advanced Research Module, and The Consumption Behavior Module are enabled in the trial version. With the Trial version you can use the regular FaceReader functionality and Baby FaceReader.

Camera and accessories

Supported cameras

FaceReader can only classify facial expressions correctly if it gets a good image. Both the placement of the camera and the lighting of the subject's face are of crucial importance in obtaining reliable classification results. Also the quality of the camera is crucial. The following cameras are supported.

USB cameras

FaceReader is supported with current generation CCD webcams with a resolution of at least 640 x 480 pixels. FaceReader and all its modules has been tested with the following USB cameras:

- Logitech C920, C922, C925e, C930e
- Logitech Brio
- Microsoft Lifecam Studio

Do note that the Logitech Brio and Microsoft LifeCam Studio are not suitable for the Vital Signs Module due to internal image processing (see Introduction to Vital Signs).

You can purchase these cameras from us or use another current generation high quality webcam with a resolution of at least 640 x 480 pixels.

IP cameras

An IP camera is connected with the FaceReader PC via Internet, and enables you to do tests with test participants at another location or at the test participant’s home.

FaceReader works with IP camera that support MJPEG or JPEG output. FaceReader cannot import RTSP output of IP cameras.

Compared to webcams such as the Microsoft LifeCam Studio, IP camera signals are processed slower. This is caused by the fact that IP cameras need time to encode video. Also sending videos over a network takes time. This means that the IP camera video signals received by FaceReader are analyzed with a delay. This effect is also seen when The Stimulus Presentation Tool is used. The delay is in the order of magnitude of 0.1 - 0.3 seconds if you use the FaceReader setup in a company network. If you use a dedicated local network for the FaceReader setup, which is recommended, the delay is less and in the order of magnitude of 0.1-0.2 seconds.

If this delay is too large for your experiment's accuracy, record with a USB camera instead.

Infrared cameras

You can also use a camera that is sensitive to (near) infrared light, in combination with lights of this type, for instance, if you want to analyze people's facial expressions in a cinema or other (near)-dark environments. Please note that such cameras are not suitable for vital signs measurements and it is not possible to measure heart rate, heart rate variability, and breathing rate with infrared recordings.

To get started with the Microsoft LifeCam Studio

Download the drivers (**Microsoft LifeCam 5.20.msi**) from the MyNoldus portal (my.noldus.com).

IMPORTANT If you upgrade an older version of the Microsoft LifeCam Studio driver to the driver that comes with FaceReader 10, you cannot downgrade it to the old driver anymore.

To get started with the Logitech BRIO, C920, C922, C925e and C930e

The Logitech BRIO, C920, C922, C925ed and C930e do not require driver installation.

See also

- Camera frame rate and samples in FaceReader
- Camera resolution and analysis in FaceReader

Camera position

It is important to place the camera at a location that will give the most steady frontal view of the subject's face throughout the experiment. The ideal position for the camera is directly in front of the test participant. If the subject faces a computer screen, the camera can be placed either directly above or directly below the screen. When placing the camera on top of the monitor, try to position it slightly below eye level, either by raising the chair and/or by lowering the monitor. When placing the camera below the monitor, lower the chair to position the camera slightly below eye level. The classification output may have a small bias towards 'angry' when the camera is placed on top of the monitor and a small bias towards 'surprised' when the camera is placed below the monitor. This is due to the fact that people tend to tilt their head when showing these emotions. If that is a problem, you can compensate for it by calibration.

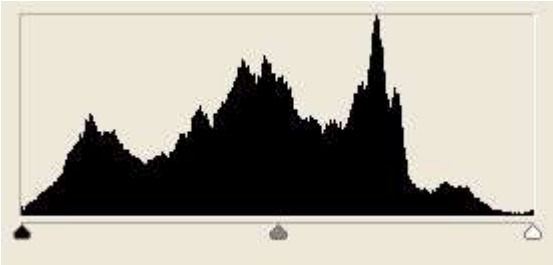
See Calibrate FaceReader

Image brightness and contrast

It is important to adjust your camera to provide images with a good contrast and brightness. You can adjust the contrast and brightness by adjusting the hardware settings using the software provided by the manufacturer of your camera. When adjusting your hardware settings, do not pay attention to the lighting of the background. Focus only on the face area of the image and ignore a very light or very dark background.

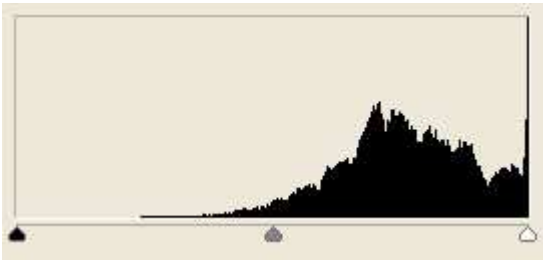
Do note that for the Vital Signs Module, slightly different camera capture settings apply. See Introduction to Vital Signs for more information.

The picture above is an example of a face image showing a good contrast and lighting. Dark areas of the face (such as the eyebrows and the pupils) are near-black and the lightest part of the face (the eye whites) are nearly white. The intensity histogram (made of the face area only) shows how the intensity values fill the whole spectrum.



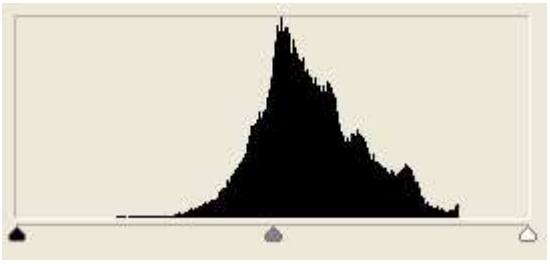
The face area of the image below is overexposed. The forehead and cheekbones are nearly white and show very little texture.

The histogram shows how only the high intensity part of the spectrum is filled. Decrease the brightness by adjusting the hardware settings of your digital camera or decrease the aperture size of your analog camera to correct this problem.

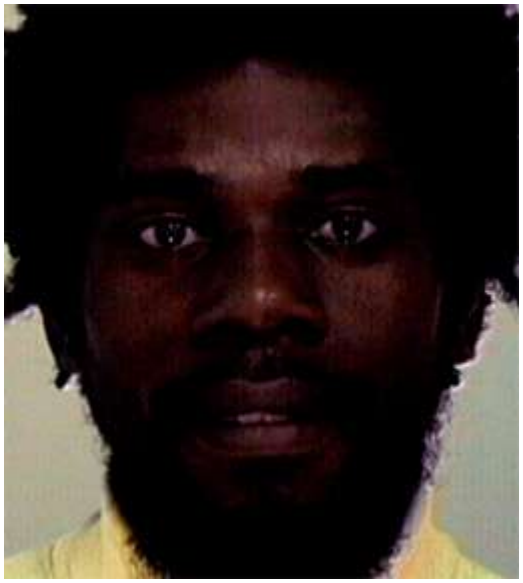


A very common problem is that the image has too little contrast.

Especially when the background is very dark or very light and the camera is set to 'automatic', the face area of the image will have a very low variability in intensity (a low contrast). The contrast is too low when the face area of the image contains no bright white and no deep black pixels. The intensity histogram shows that only the middle section of the spectrum is filled. Correct this problem by adjusting your camera (increase the contrast).



When working with a person with a dark or very pale skin color, you may need to make some extra adjustments. The default settings will often yield an image as shown below. Although there are both dark areas and white areas (the eyes) in the face, the skin itself shows too little variations in intensity. By increasing the brightness (to make the face lighter) and increasing the contrast (to increase the variation in skin tones) you can correct this problem. For people with a very pale skin, decrease the brightness and contrast.



The corrected image should look similar to the image below. Pay special attention to the skin tones.

Notes

- **IMPORTANT** Changing the brightness and/or contrast of an already recorded video or an image will have little or no effect on the quality of the analysis. The procedure above can only improve FaceReader's performance when applied at the moment the video is made.
- It is not possible to view intensity histograms in FaceReader. To view such plots, use graphics software like Paint.NET or Photoshop. To analyze video images, first make a screenshot of the image of interest.
- To assess the quality of your (video) image, view FaceReader's model quality bar.

  See one of the following:

  - Step 3 in Manual procedure image analysis in Analyze facial expressions

  - Step 3 in Manual procedure video and camera analysis in Analyze facial expressions

See also

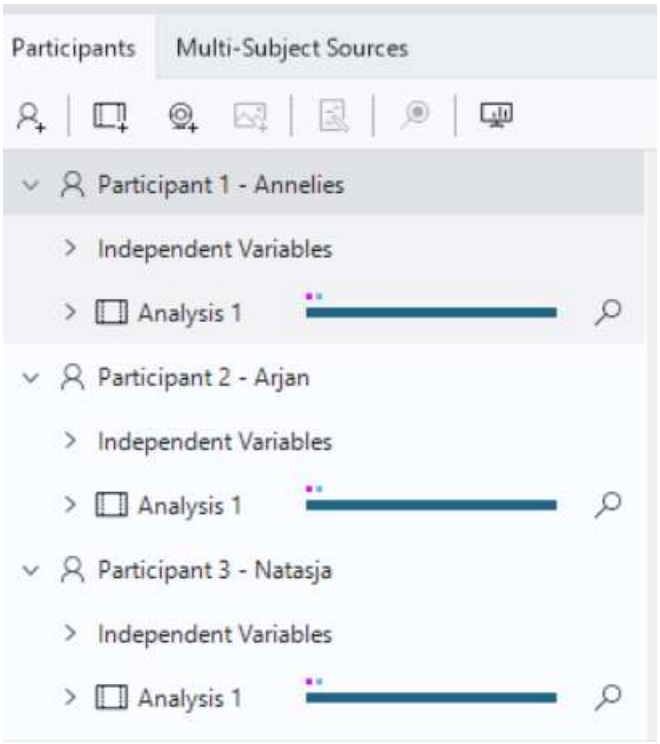
- Camera frame rate and samples in FaceReader
- Camera resolution and analysis in FaceReader

Lighting setup

A good lighting setup is vital to get a good image. Diffuse frontal and natural lighting is desirable. The light intensity or color is less relevant. Strong shadows or reflections should be avoided. If possible, place the FaceReader setup in front of a

window. Make sure that any windows to the sides of the subject are blinded. Lights from the ceiling, common in most buildings, will produce shadows below the eyebrows and nose. In situations where interior lighting cannot be controlled, stronger lights (e.g., professional photo lights) can be used to negate the effect of other, undesirable, light sources. You can purchase such lights from Noldus IT. You can also use (near) infrared light, in combination with a camera that is sensitive to this type of light.

Set up your project



Main topics

- Start FaceReader
- Project management
- Add your test participants
- Add analysis input
- Project wizard

Start FaceReader

Aim

To start working with FaceReader.

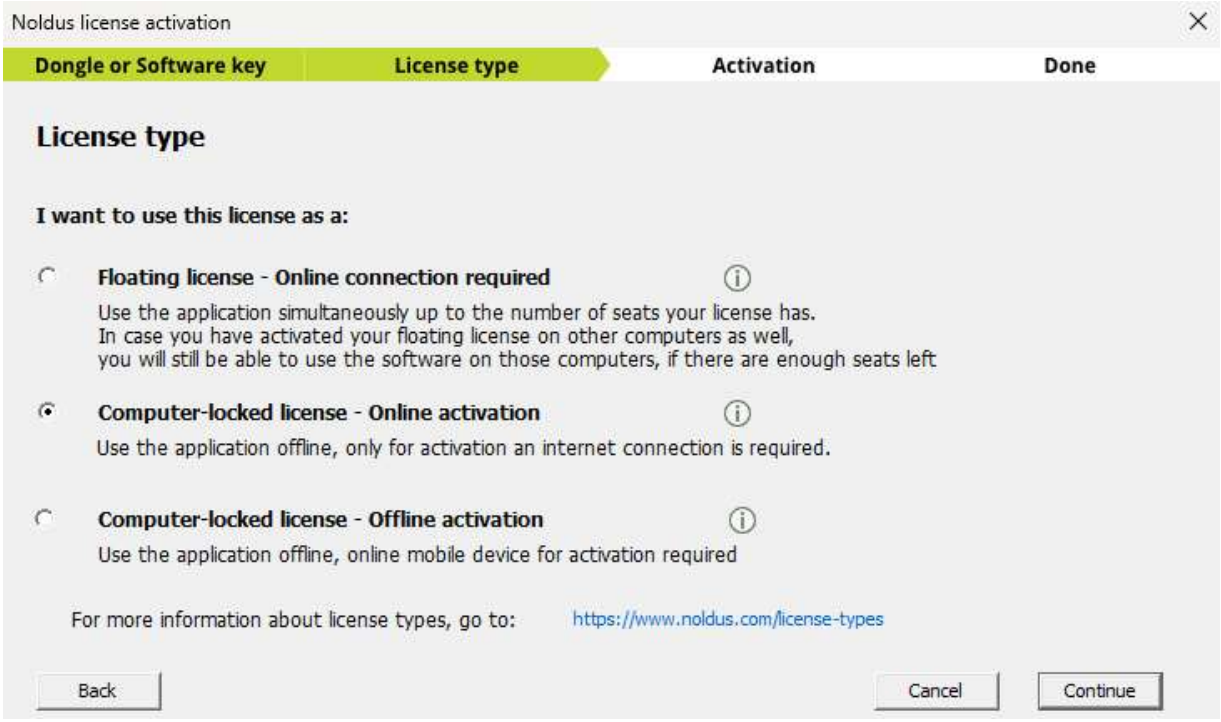
Procedure

The procedure depends on your license type. You may either have:

- A software license key.
- One or more hardware keys.

Activate FaceReader with a software license key

1. Start FaceReader, select the option **Activate software license key** and click **OK**.
2. Select either **Floating** or **Fixed** and click **OK**.



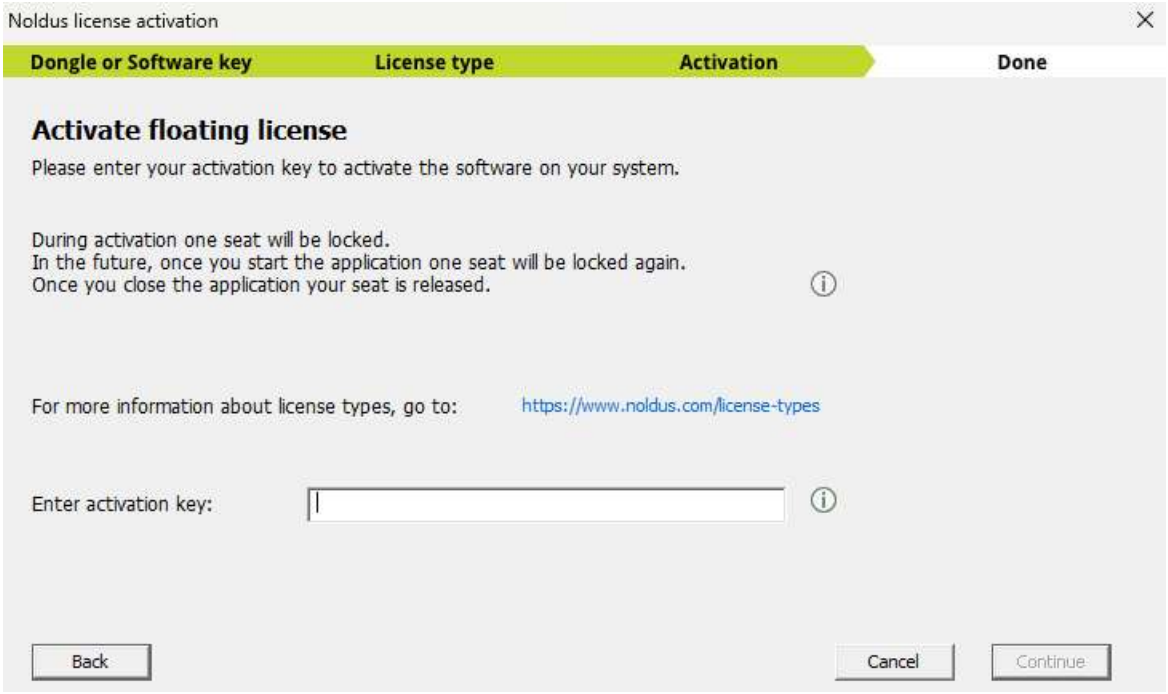
What is the difference between a Floating and a Fixed activation?

When you have a software license key you can choose between a Floating and a Fixed activation.

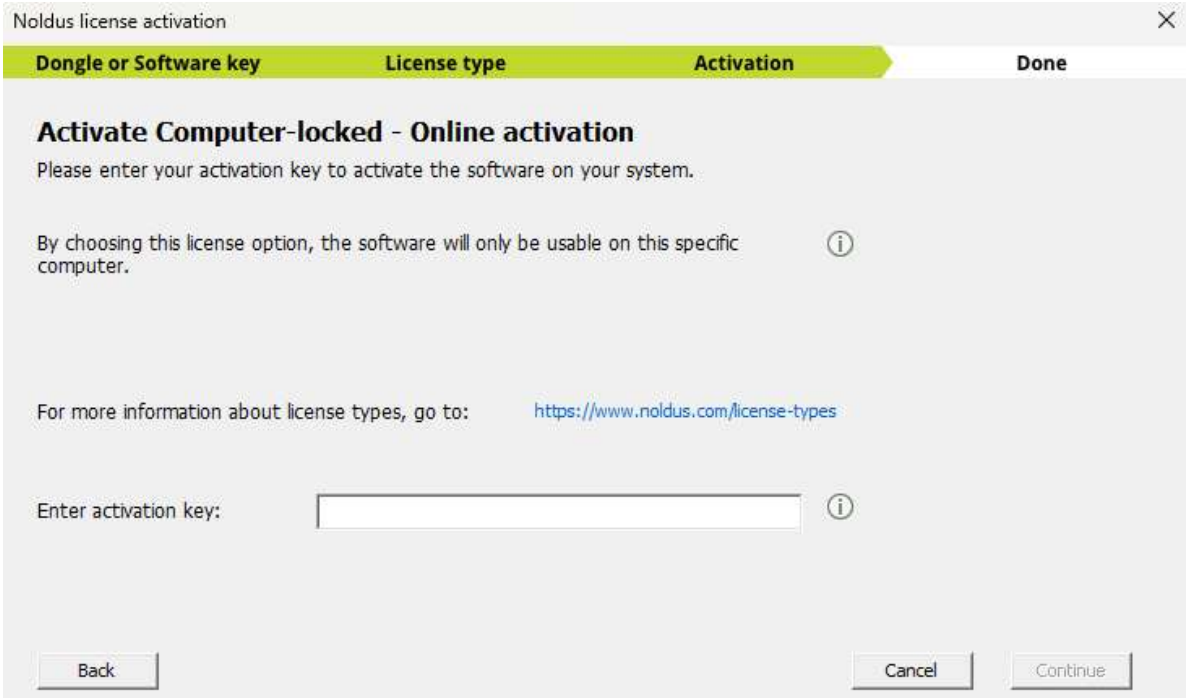
- **Floating activation** — Choose this option if you want to be flexible on which computer you use FaceReader. If you bought, for instance, a software key with two licenses, you can simultaneously use the software on, for instance, the FaceReader computer in your lab and on the computer in your office. If your student wants to use FaceReader as well (on his/her personal laptop) then this is possible. You can install and activate FaceReader on as many computers as you want but with two licenses you can use the software only on two PCs at a time. If you want to use FaceReader on a third PC the software should not be running on one of the other two PCs. Please note that a computer must have an internet connection to activate and work with a Floating license.
- **Fixed activation** — A Fixed activation is linked to one computer. The advantage of having a Fixed activation is that you do not need an internet connection to work with the software. If you bought a software key with, for instance, two licenses, you can activate FaceReader on two computers (if you choose 'Fixed' for both licenses). If you want to use FaceReader on a third computer, you have to deactivate one of the licenses and activate it on the new computer (either as Fixed or as Floating). See Deactivate your FaceReader license for more information. Please note that a computer must have an internet connection to activate/deactivate a Fixed license. After you have activated the license you can use FaceReader without internet. Alternatively, you can activate/deactivate your license using your smartphone.

Activate your floating license

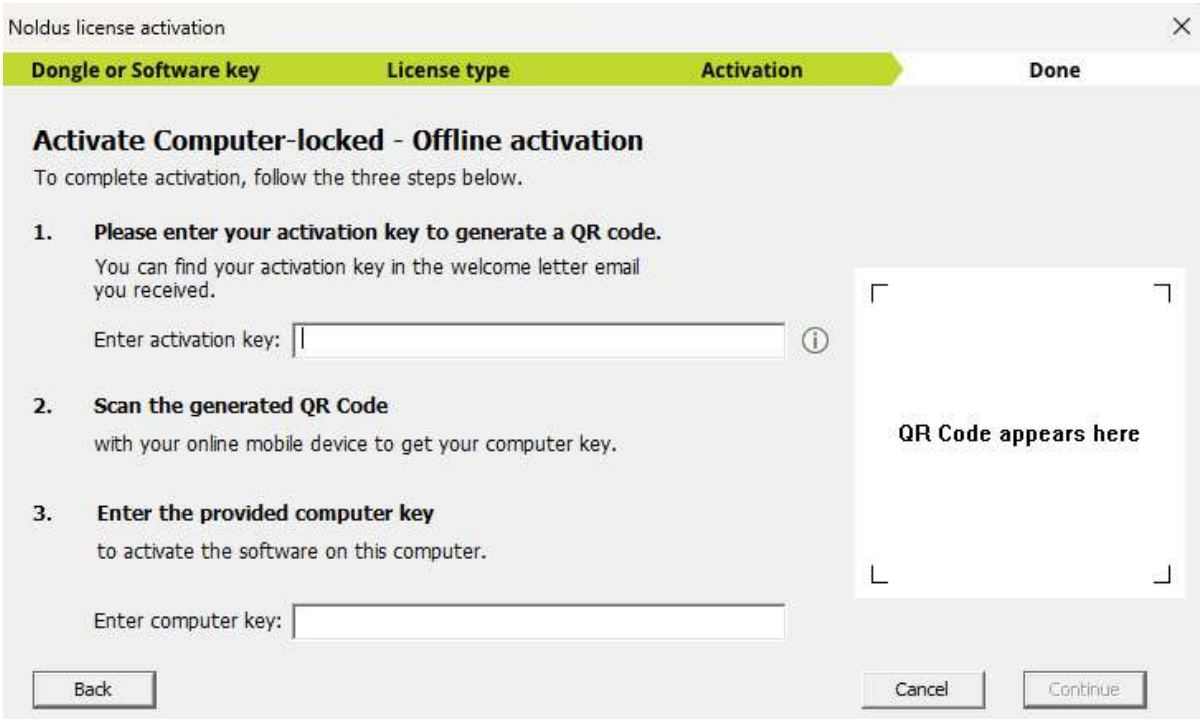
Enter your Activation key and click **OK**. The software now opens.



Activate your fixed license in an online mode



Activate your fixed license in an offline mode



Enter the Activation key that you received with the software and select

- **Activate Online** if the PC is connected to the internet. When you click **OK** the FaceReader software opens.
- **Activate Offline** if the PC does not have an internet connection. Scan the QR code with your smartphone and click **WEB**. Copy the **Computer key** shown on your smartphone to the **Computer key** field on the FaceReader PC and click **OK**. The FaceReader software opens.

If you have a hardware key

1. Plug the key into a USB port on your computer. If the hardware key is correctly connected, a red light is visible inside the key.

2. Now start FaceReader. Keep the key inserted in your computer while you work with FaceReader.

IMPORTANT The hardware key is your FaceReader license. This is an important piece of equipment. It is sensitive and can be easily damaged. Please be careful with the hardware key and make sure you do not lose it. You will need to pay for a new license if you do so.

Deactivate your FaceReader license

Aim

- To use your Fixed FaceReader license on another computer.
- To change a Fixed FaceReader license into a Floating license.
- To make sure that FaceReader cannot be used on a certain computer.

IMPORTANT If you want to uninstall FaceReader, first deactivate the license otherwise you will lose it. Please contact Noldus Technical Support if this happened.

Procedure

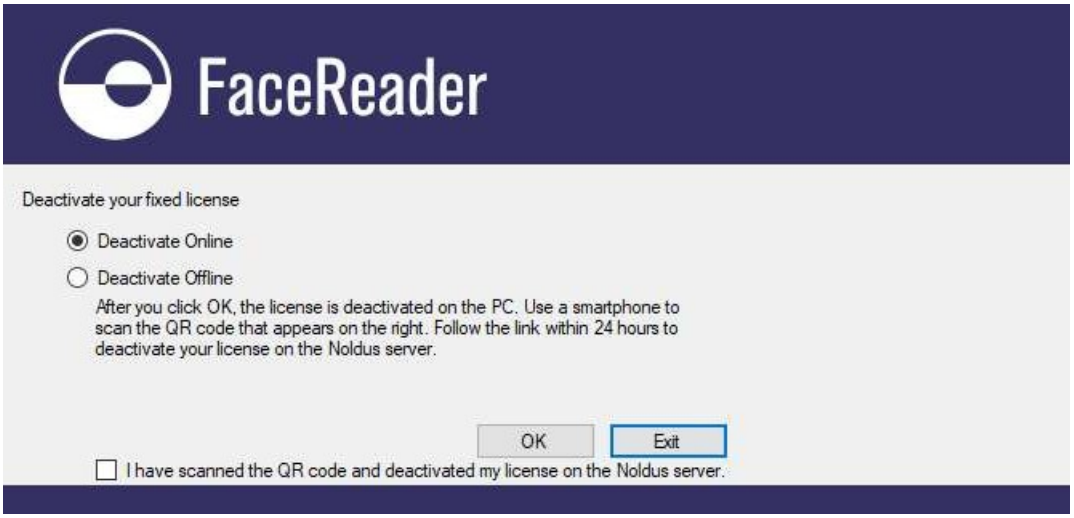
Deactivate your floating license

1. From the **Help** menu select **License** and then **Deactivate**.
2. You will get a message that your license key was successfully removed and that FaceReader will exit. Click **OK** to close the software.

Deactivate your fixed license

From the **Help** menu select **License** and then **Deactivate** and select

- **Deactivate Online** if the computer is connected to the internet. You will get a message that your license key was successfully removed and that FaceReader will exit. Click **OK** to close the software.
- **Deactivate offline** if the computer does not have internet connection. Scan the QR code with your smartphone. Click **OK** to deactivate the license on the PC. You will get a message that your license key was successfully removed and that FaceReader will exit. Click **OK** to close the software. Follow the QR code link on your smartphone within 24 hours to deactivate your license on the Noldus server.You can also first deactivate your license on the Noldus server and then select the checkbox in the window on your PC to deactivate the license on your PC.


FaceReader
Deactivate your fixed license
Deactivate Online
Deactivate Offline
After you click OK, the license is deactivated on the PC. Use a smartphone to scan the QR code that appears on the right. Follow the link within 24 hours to deactivate your license on the Noldus server.
OK
Exit
I have scanned the QR code and deactivated my license on the Noldus server.

Project management

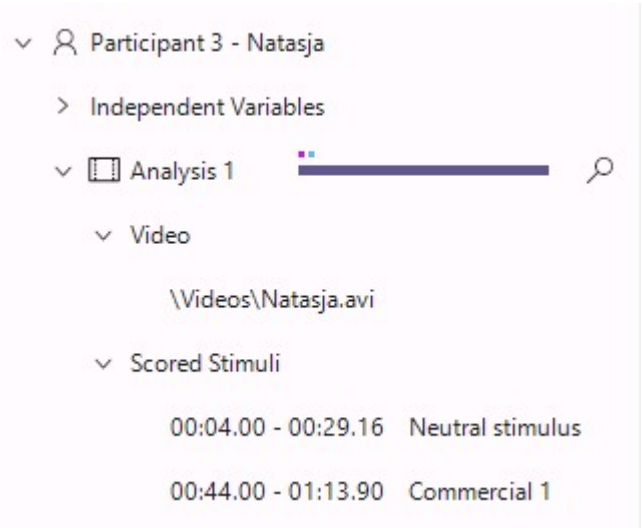
What do you want to do?

- Read about Projects
- Create a project
- Save a project
- Back up a project
- Read about The Project Explorer

Projects

A project groups all the data belonging to one experimental set-up. Your project contains the persons who participated in the experiment, their personal details (name, gender and age and other characteristics that are important for your research), the videos, and the analysis results.

The project may also contain Stimuli, Event Markers, Tests and Independent Variables.



Create a project

1. Do one of the following:
   - Choose **File** > **New** > **Project**.

- In the startup window, under **Create a new project**, choose **New project**.

2. Give the project a name and select a location to store it, or accept the default location.
3. Continue with Add your test participants

Save a project

- To save a project, choose **File** > **Save** or press **Ctrl**+**S**.
- To save a copy of the project with a different name, choose **File** > **Save As** or press **Ctrl**+**Shift**+**S**.

  IMPORTANT This does not make a copy of the video files and the saved log files. To create a copy of the project with all the videos and log files, see Back up a project

Note

IMPORTANT Never shut down the computer by pressing the power button, or cutting off the electricity. Your project data may become lost, even after you saved your project. Always use the Windows shut down feature to close your computer.

Back up a project

IMPORTANT If you use the **Save As** option, the video files and the saved log files are not copied. To create a copy of the project with all the videos and log files:

1. Choose **File** > **Project Backup** > **Copy Media to Project Folder**.

   This makes all the paths in the project relative, so you can copy the entire project to another location.

   Copy the Stimulus videos to the project folder as well. Choose **File** > **Project Backup** > **Copy Stimuli to Project Folder**.

2. Choose **File** > **Open Project Folder**. This opens the project folder in Windows Explorer.
3. Select the contents of this folder and copy it.
4. Paste this to the backup location, for example a network drive or an external harddisk.

Notes

- Please be aware that video files are generally very large, so make sure the computer with the project folder has enough disk space.

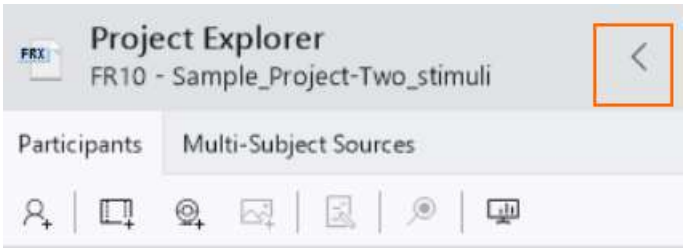
- Create a backup of your project at least once a day and store it in a safe location, for example on a network, or an external hard drive in another building. If you record videos from the test participants' faces, create backups of these videos as well.

The Project Explorer

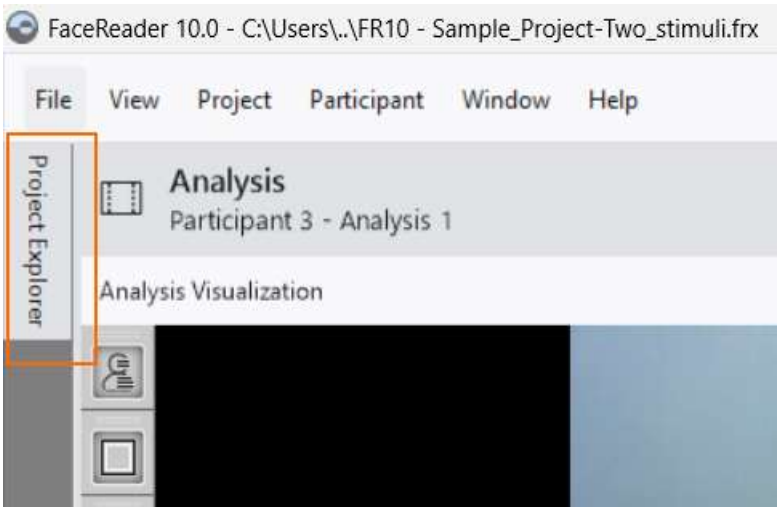
The Project Explorer is present on the left side of your screen. It displays the test participants and analyses currently in the project. Expand or double-click elements to view more details. The **Multi-Subject Sources** tab is only visible if your license includes the Advanced Research Module.

Show/hide the Project Explorer

To create more space on your screen for the analysis, you may want to hide the Project Explorer. To do so, click the **Hide** button in the top-right corner of the Project Explorer.



To restore the Project Explorer, click the **Project Explorer** button.



The Project Explorer has a window with four tabs at the bottom of your screen:

- Stimuli – See Define Stimuli in Project Analysis
- Event Markers – See Define Event markers in Project Analysis
- Independent variables – See Define Independent Variables in Project Analysis
- Tests – See Define a test in Project Analysis

Add your test participants

Aim

To define the test participants in your study. FaceReader organizes the data per test participant. You can enter participants automatically, or manually.

Add participants automatically

With a basic FaceReader license

If you know before you create your project how many participants and analyses per participant your project will contain, you do not need to enter them manually. Use the Project wizard instead.

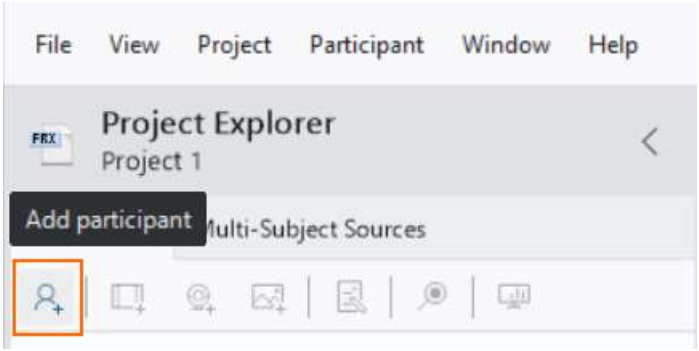
With the Stimulus Presentation Tool

With Project Analysis and The Stimulus Presentation Tool, each participant is added automatically to the project when he/she starts a test. You do not have to add participants manually.

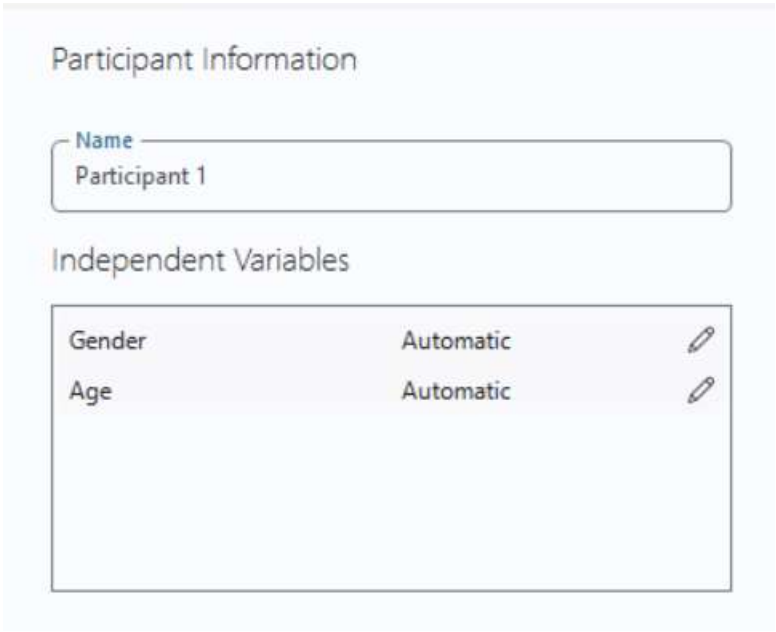
See Carry out a test with the Stimulus Presentation Tool

Add participants manually

1. Do one of the following for each test participant in your study:
   - Choose **Participant** > **Add Participant**.
   - Click the **Add Participant** button on the toolbar.



2. In the **Name** field, enter the participant's name or, for example, a number.

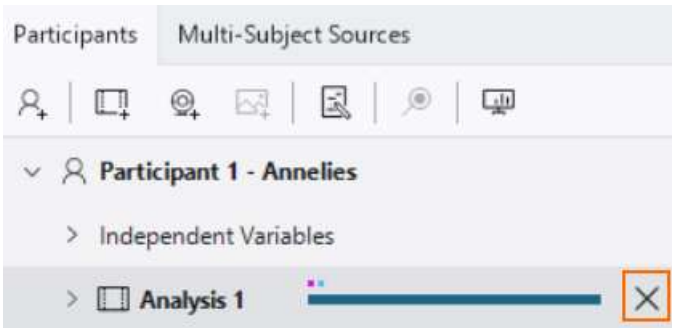


3. Two Independent Variables, *Age* and *Gender*, are present by default. FaceReader automatically estimates the age and gender of the participant from the video, camera input or image.

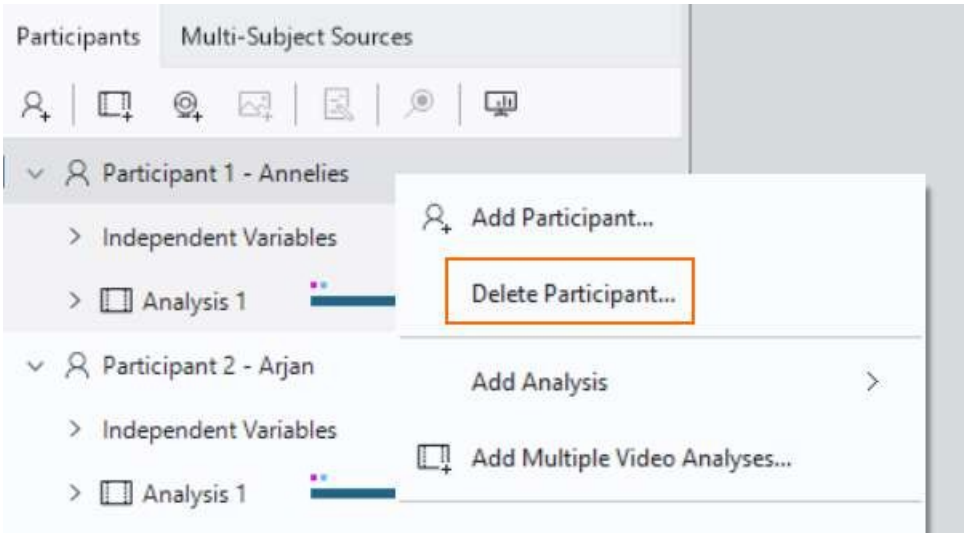
   To set the age or gender manually, click the pencil button and enter the correct value. Enter integer values for age, for example 40, not 40.5.

Notes

- To edit a participant, double-click its name and edit the details.
- To delete a participant, make sure all its analyses are closed. To close an open analysis, click the button next to it.



Right-click the participant's name and select **Delete Participant**.



- You can define extra Independent Variables. If you do so, also enter the values for these variables in step 3.

  See Define Independent Variables

- If you set the participant's gender or age manually, these are fixed with these values in the Circumplex Model of Affect and are not estimated by FaceReader.

Subject Characteristics

	Result	Amount	Certainty
Gender (fixed)	Female		100%
Age (fixed)	27		
Glasses	No		100%

Add analysis input

Aim

To define the videos, camera output, or images that FaceReader must analyze for each participant.

Prerequisite

You added at least one participant.

See Add your test participants

Before you start

If you want to use Settings other than the default ones for your analyses, choose them before you add all analyses. If you, for example, work with Asian test participants, change the default face model to EastAsian before you add the analyses.

See Choose settings

Add analysis input

With the Project Wizard

If you know before you create your project how many participants and analyses per participant your project will contain, you do not need to enter them manually. Use the Project wizard instead. See Project wizard for more information.

With the Stimulus Presentation Tool

With The Stimulus Presentation Tool, the analysis is added automatically to the project when a participant starts a test.

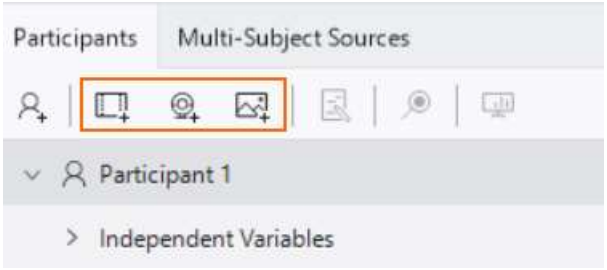
See Carry out a test with the Stimulus Presentation Tool

Add analysis input manually

1. Do one of the following:

   - Right-click a participant name and choose **Add Analysis** > **Video**, **Camera**, or **Image**.

- Select the participant for which you want to add an analysis. Click the **Video**, **Camera** or **Image** button on the toolbar to add a video file, a live video source or images.



2. Select and open the input source.

   If you carry out camera analysis, select the **Resolution** and the **Frame rate**.

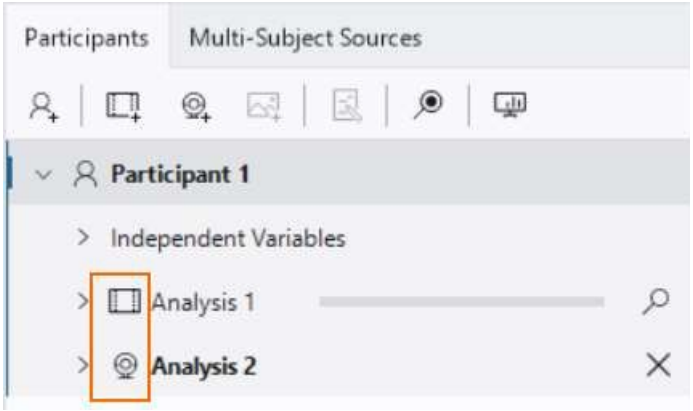
   See also:

   - More information on camera analysis

   - Camera resolution and analysis in FaceReader

   Select the **Use as Default Camera** check box if you want FaceReader to automatically select the current camera for future camera analysis sessions.

   A new analysis is added to the Project Explorer. The video, camera or images icon indicates what type of analysis it is.



3. Repeat steps 1 and 2 to add more video files, images or live video sources.

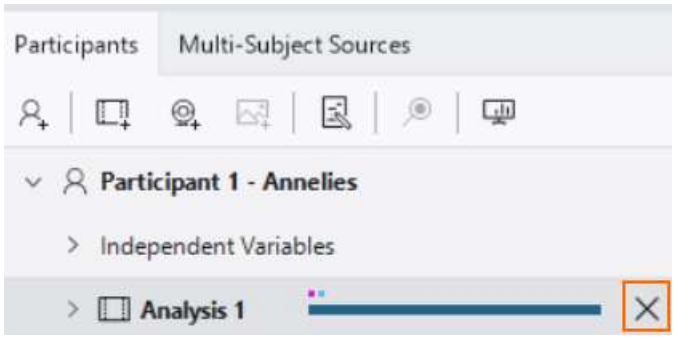
You are now ready to start an analysis.

See Analyze facial expressions

See also More information on camera analysis

Notes

- To edit an analysis, right-click the analysis and select **Edit Analysis** and make your choice.
- To delete an analysis, make sure it is closed. To close an analysis, click the button next to it.



Right-click the analysis and choose **Delete analysis**.

- To add multiple video files to your project, right-click the participant name in the Project Explorer and select **Add Multiple Video Analyses**.
- If your project contains image analyses you cannot add video or camera analyses and if your project contains video or camera analyses you cannot add an image analysis.
- If you carry out a camera analysis, or video analysis, do not carry out very long analyses/use long recordings. Especially if you export many different data, like facial states, Action Units, Stimuli and Event markers, these files get very large, which may cause performance problems. FaceReader has been tested and works well with camera analyses of two hours and video analyses of two hours with 15 fps and one hour with 30 fps. When you open a video that is longer than one hour, FaceReader shows a warning.

More information on camera analysis

What information are you looking for?

- Supported cameras
- Default camera
- Camera frame rate and samples in FaceReader
- Camera resolution and analysis in FaceReader
- Video format
- Camera analysis with an IP camera

Supported cameras

See Camera and accessories in Installation

Please also read the sections below about video frame rate and resolution.

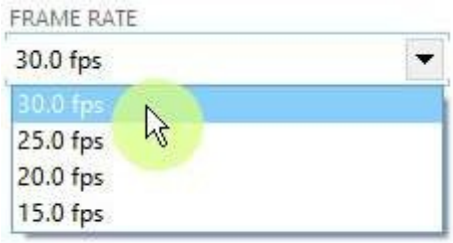
Default camera

If you always use the same camera for camera analysis, set this camera as the default one.

1. Choose **File** > **Set Default Camera**.
2. Select your camera. This camera will be automatically selected in future analyses.

Camera frame rate and samples in FaceReader

When you record video from a live camera image, the resulting frame rate of the video file is the chosen camera frame rate. See step 2 in Add analysis input manually.



Camera resolution and analysis in FaceReader

FaceReader analyzes (video/camera) images with a maximum resolution of 1280 x 1280. If the resolution of your video file, camera, or images is higher than 1280 x 1280, FaceReader scales it down while maintaining the aspect ratio. Using a higher resolution than 1280 x 1280, therefore, does not improve analysis. Also, using a higher resolution slows down the analysis.

Video format

The video file format of the recorded video is DivX/MP4V. This format is compatible with The Observer XT.

To play back a DivX video on a computer without FaceReader or The Observer XT, it may be necessary to install a DivX player.

Camera analysis with an IP camera

IMPORTANT FaceReader works with IP cameras that create MJPEG or JPEG output. FaceReader does not work with RTSP output of IP cameras.

To select an IP camera, follow the steps below:

1. In the **Select Camera** window, under **Select Camera**, choose **IP Camera**.
2. Under **Source URL**, enter the source URL of your camera.

   Check the documentation of your camera or contact the service department of your camera brand for the correct URL.

   For Axis IP cameras, enter one of the following:

   - http://*IP address camera*/mjpg/video.mjpg

   - http://*IP address camera*/axis-cgi/mjpg/video.cgi
3. Under **Frame rate**, select the frame rate (default: 5 fps).
4. If your camera is password-protected, select **Secured** and enter the **Username** and the **Password**.

   For Axis IP cameras supplied by Noldus, enter *root* and *Noldus*, respectively.
5. Select either **JPEG** or **MJPEG**.

   Check in the documentation of the camera what type of stream the camera produces (JPEG or MJPEG).

   Choose **MJPEG** for Axis IP cameras.

6. Select **Use as Default Camera** if you want FaceReader to automatically select the current camera for future camera analyses.

The camera view appears in the **Preview image** window.

Project wizard

Why a project wizard?

If you know before you create your project how many participants and analyses per participant your project will contain, you can automate adding them.

Also use the project wizard if you created many videos, or images and stored them in a structured way. For example, you created a folder per participant and each participant folder contains a number of folders and subfolders that contain the videos or images to analyze. You can use this folder and file structure to make a template and create the participants and analyses automatically.

With a project wizard template it is also possible to read the age and gender from the file names and enter these values as independent variables for the participants.

See Video and image formats which file formats can be used with the project wizard.

See:

- Define Project Wizard manually
- Define project wizard with the folder structure of the video or image files

Define Project Wizard manually

Aim

To automate adding a large number of participants or analyses. You define how analyses are organized in the Project Explorer. To assign videos to analyses automatically, follow the topic Define project wizard with the folder structure of the video or image files instead.

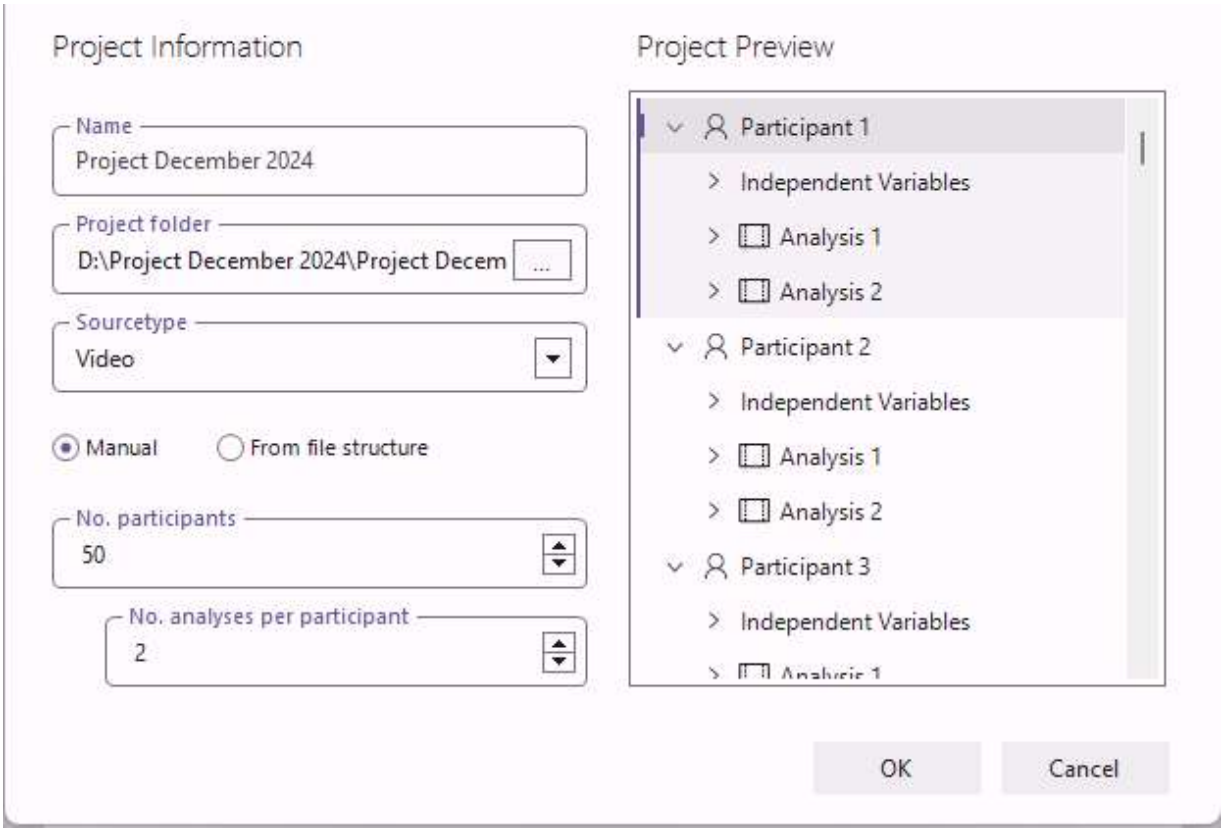
Prerequisite

You have a large number of participants, or analyses.

Procedure

1. Choose **File** > **New** > **Project Wizard**.
2. Give the project a name, select the location to store it, and select whether you want to carry out video, camera or image analysis from the **Source type** list.
3. Select **Manual**.
4. Select the **No. of participants** and the **No. of Analyses** per participant.
5. If you have chosen **Camera** as **Source type**, also select the camera under **Default camera**.

   The Project Preview on the right displays the project structure.



6. Click **OK**.
7. Open each analysis to browse to the video, or image, or select the camera and carry out analysis.

Define project wizard with the folder structure of the video or image files

Aim

To automate adding a large number of participants or analyses. The videos or images are automatically assigned to analyses.

Prerequisites

- You have a large number of participants, or analyses.
- You want to analyze videos or images.
- The videos or images of the test participants are stored in a structured way. For example, the videos of the different participants are stored in separate folders.

Procedure

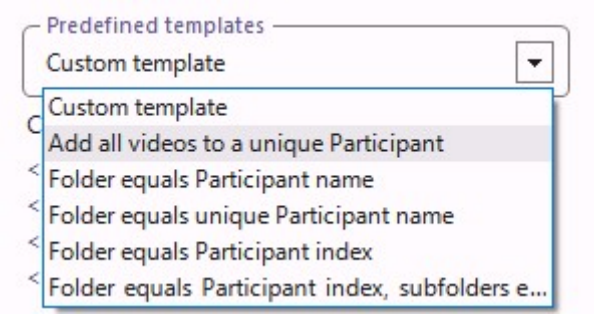
1. Choose **File** > **New** > **Project Wizard**.
2. Give the project a name, select the location to store it and select **Video**, or **Images** from the **Source type** list.
3. Select **From file structure**.

   The **Project Preview** window displays the project structure with the selected options.
4. Under **Path**, select the root of the folders where your videos or images are stored.
5. Under **Predefined Templates**, select one of the following:

   - one of the Predefined templates

   - **Custom template** — Use the building blocks under **Choose File Template Parts** to create your custom structure. See Custom template
6. Click **OK** when ready.

Predefined templates



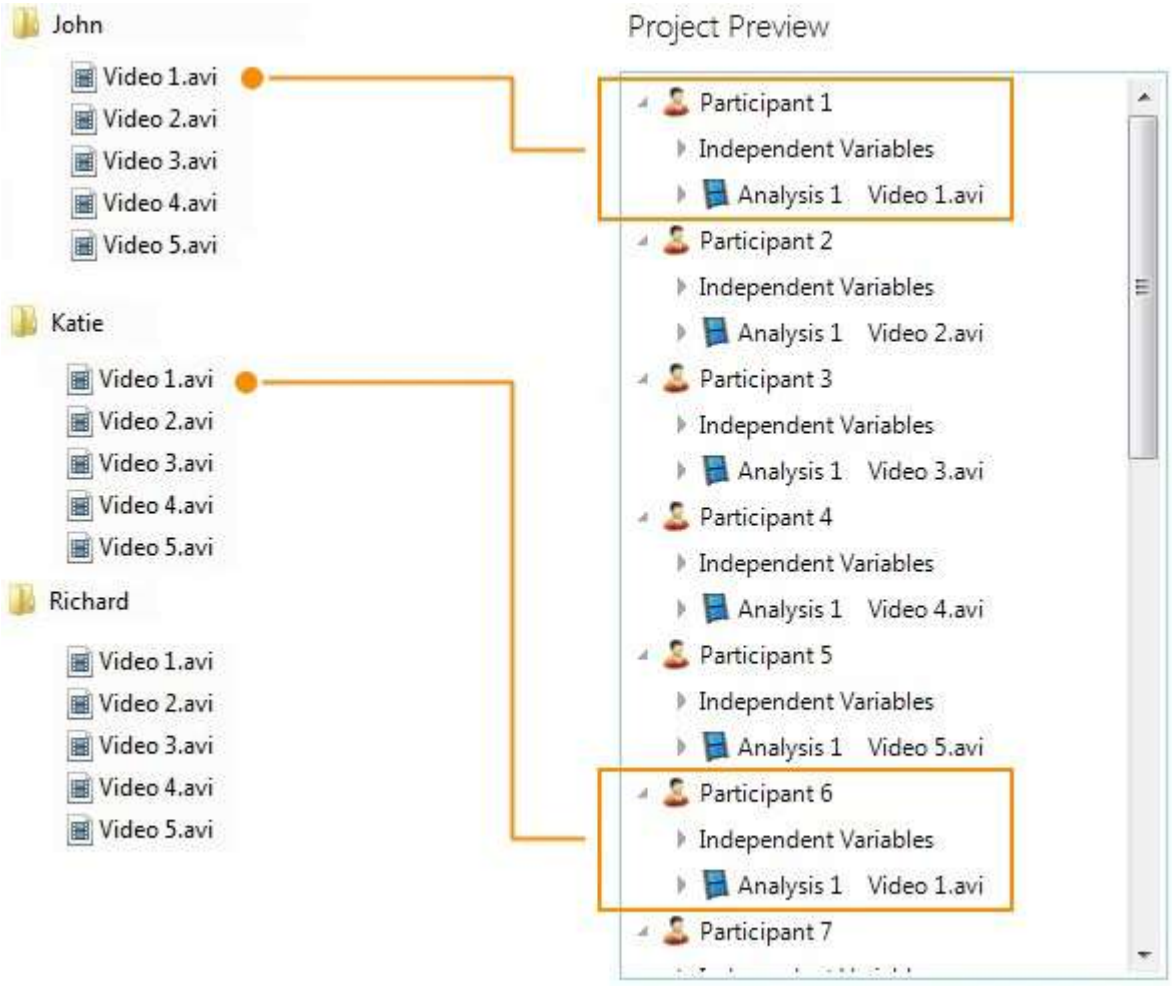
The **File template** field shows the building blocks used for this template. For an explanation of the building blocks, see Custom template.

Add all videos to a unique participant

File template <WildCard>.<WildCard>

Each video found in the folders and subfolders will be added as analysis to a separate participant. Participants will be named Participant 1, Participant 2, etc. The analyses will be named Analysis 1. Video location plays no role here.

Example:

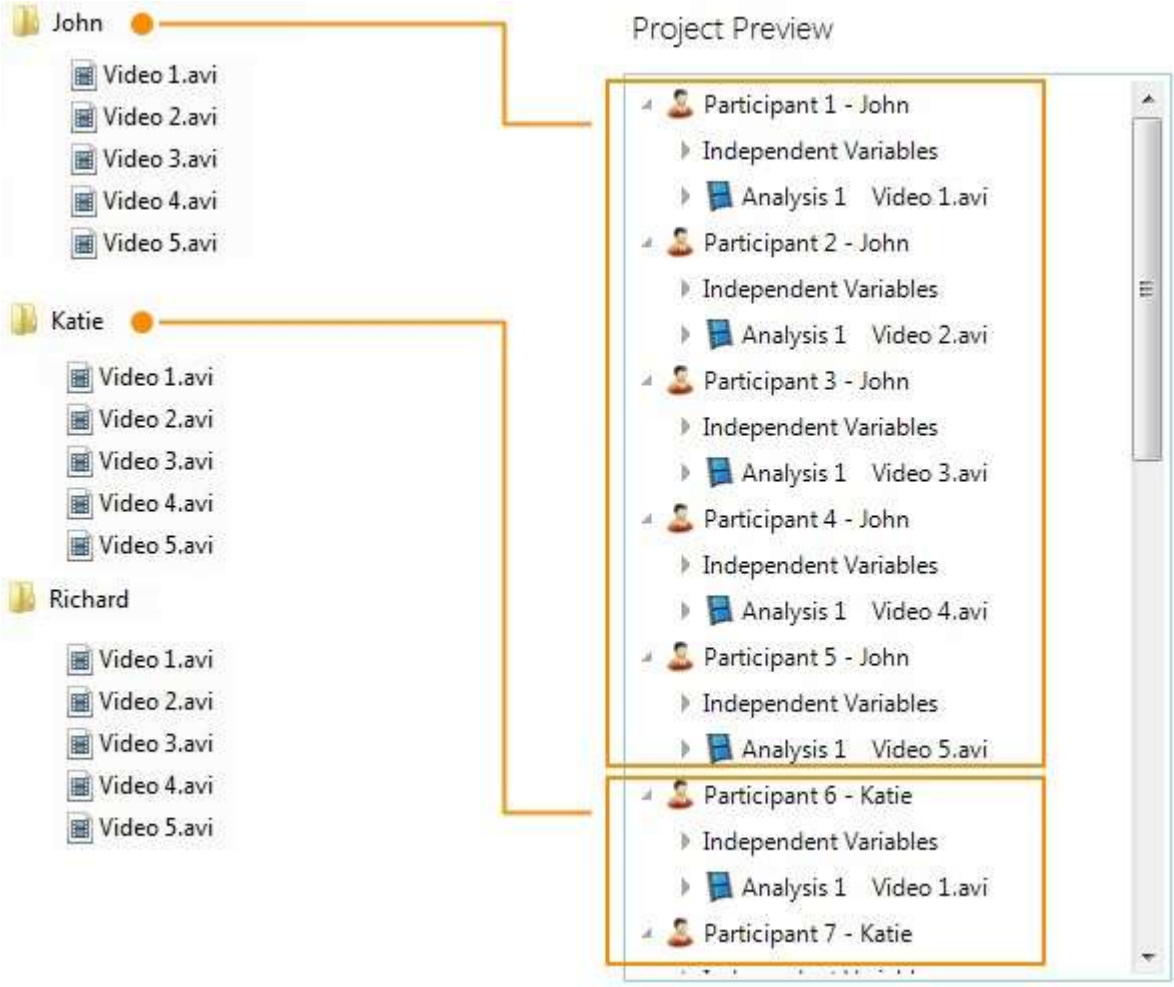


Folder equals participant name

File template <ParticipantName>\<WildCard>.<WildCard>

Each video found in the folders and subfolders will be assigned as analysis to a separate participant. Each participant will get the name of the folder where the video was found. Note that this results in the same person being represented by several "participants" in FaceReader. All analyses will be named Analysis 1.

Example



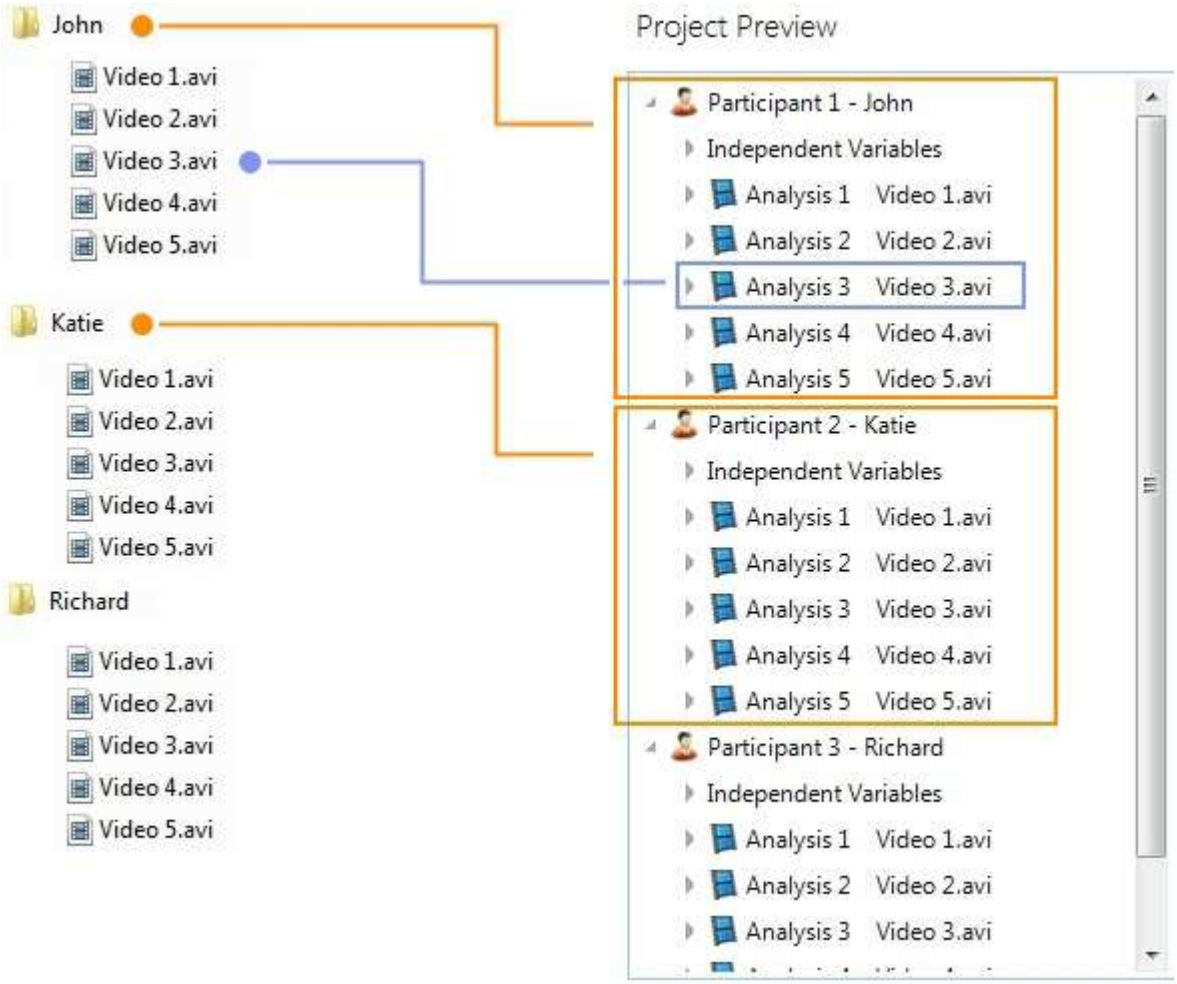
Folder equals unique participant name

File template <UniqueParticipantName>\<WildCard>.<WildCard>

Each participant will get the name of the folders found in the root folder. Each participant name will only be used once.

If more videos are found in the same folder, these will be added as analyses to the same participant. The analyses will be named Analysis 1, Analysis 2, ...etc.

Example (different colors represent different levels of organization):

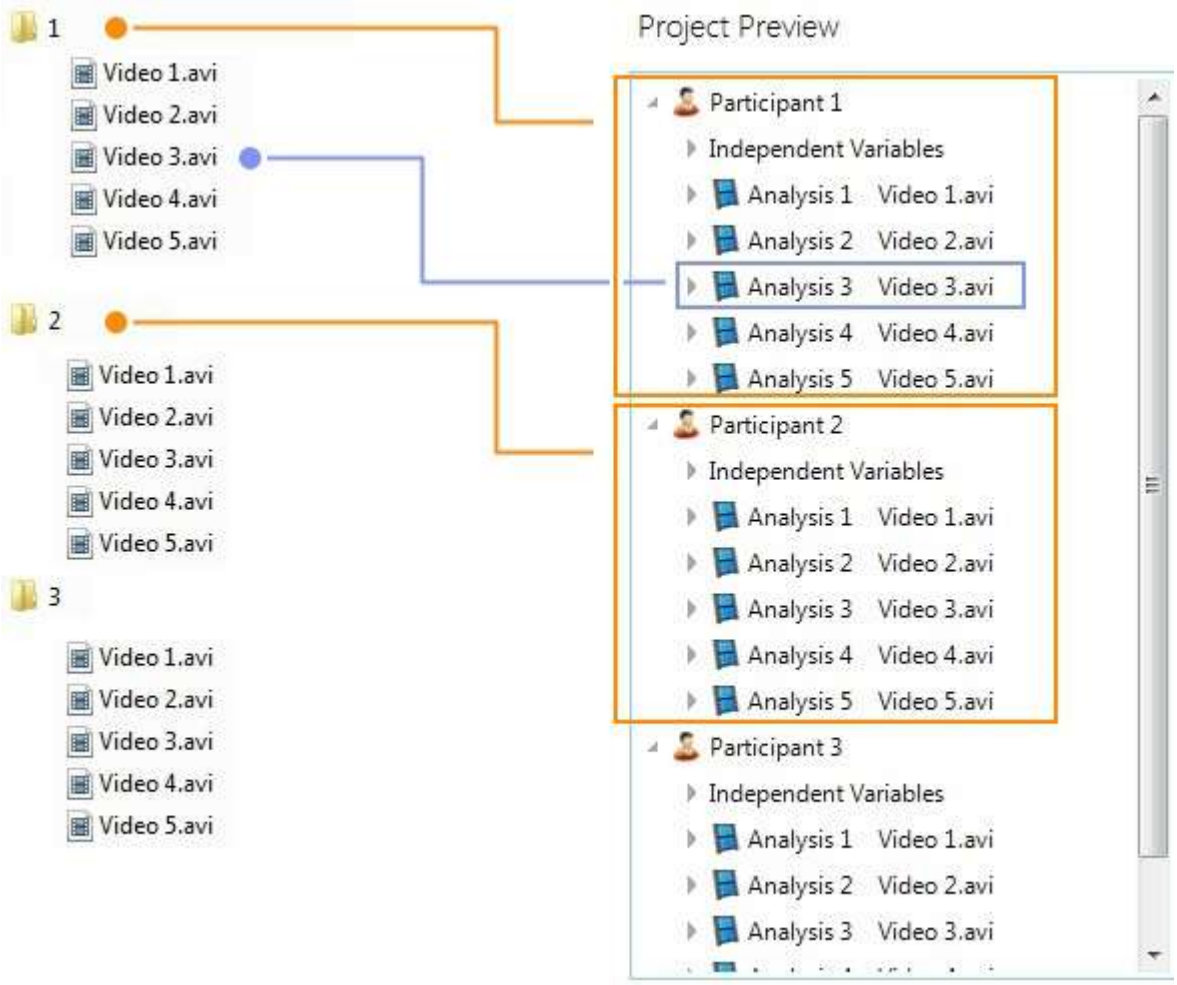


Folder equals participant index

File template<ParticipantIndex>\<WildCard>.<WildCard>

In case your folders have numbers instead of letters. Each participant will get the folder number and the videos in this folder or subfolders are assigned as analyses to this participant. The analyses will be named Analysis 1, Analysis 2, ...etc

Example (different colors represent different levels of organization):

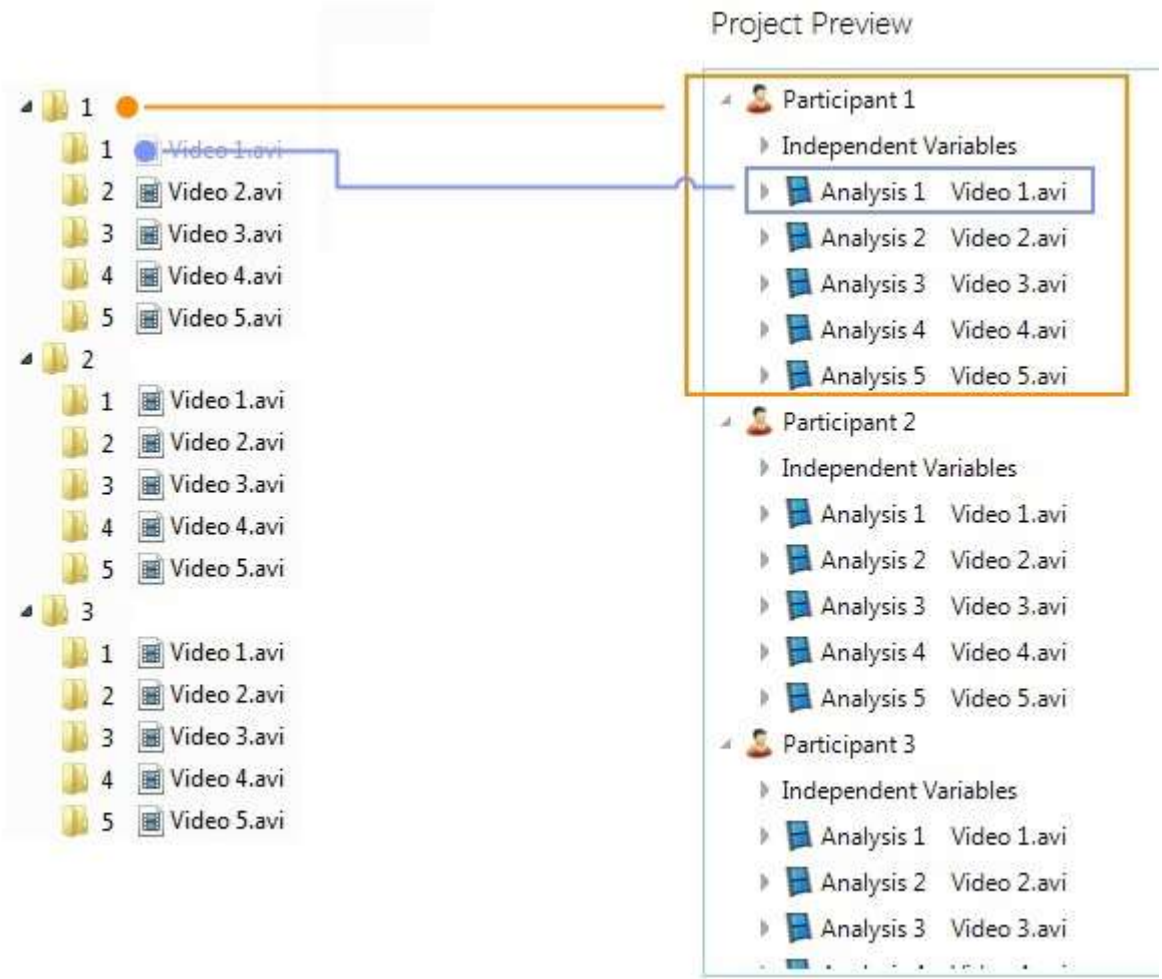


Folder equals participant index, subfolders equal analysis index

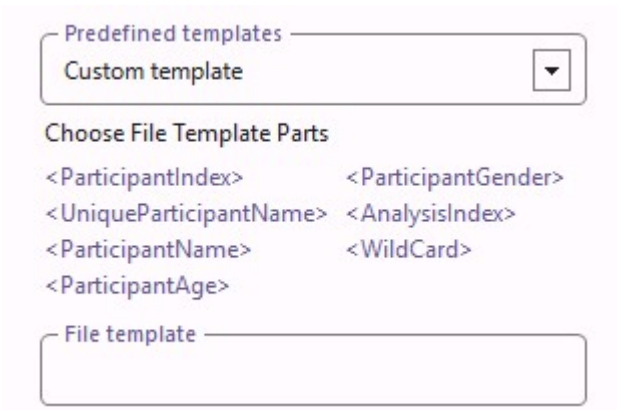
File template <ParticipantIndex>\<AnalysisIndex>\<WildCard>.<WildCard>

Use this template when your folders and subfolders have numbers instead of letters. Each subfolder may contain only one video file. Each participant will get the number of the folder directly under the root folder specified in the Path field. Each analysis will get the number of the subfolder and the name of the file.

Example (different colors represent different levels of organization):



Custom template



To create your structure, click one or more items under **Choose File Template Parts**.

- Use a slash (\) to indicate a new folder.
- Use a dot (.) to separate the filename from the extension.

ParticipantIndex

For folders and files with numerical names. Uses the folder numbers for the participants numbers.

UniqueParticipantName

Uses the folder or file names for the participant names. Each participant name will be used once.

ParticipantName

Uses the folder or file names for the participant names. Different participants can have the same name.

ParticipantAge

Reads the participant age from the file name and enters this as category for the independent variable Age.

Example: file name is 32_male_commercial 1.avi

Use building blocks <ParticipantAge>_<Wildcard>.<Wildcard>

ParticipantGender

Reads the gender from the file name and enters this as category for the independent variable Gender.

Example: file name is 32_male_commercial 1.avi

Use building blocks: <Wildcard>_<ParticipantGender>_<Wildcard>.<Wildcard>

You can also combine ParticipantAge and ParticipantGender in the following way:

<ParticipantAge>_<ParticipantGender>_<Wildcard>.<Wildcard>

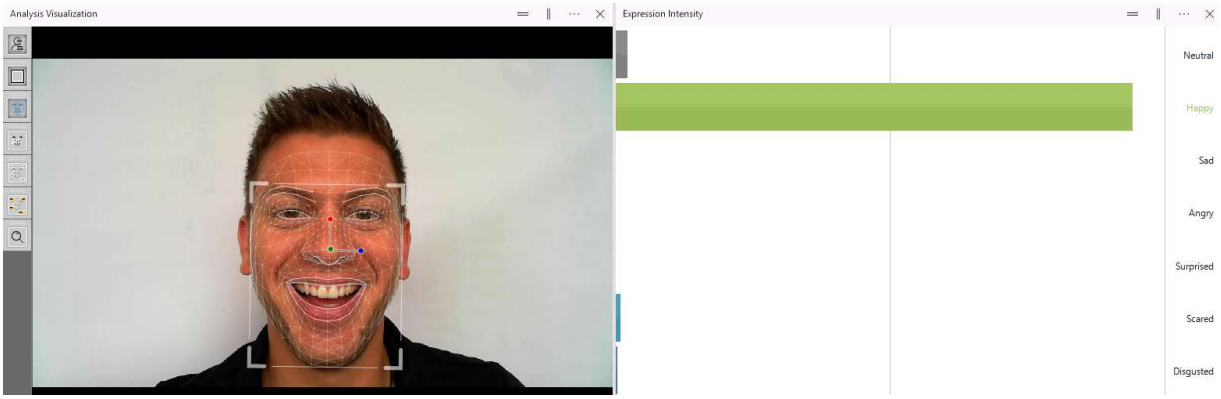
AnalysisIndex

For subfolders or files with numerical names. Each subfolder may contain only one video file. Uses the folder numbers for the analysis names.

Wildcard

Allows any character.

Analyze facial expressions



Main topics

- Choose settings
- Analyze facial expressions
- Calibrate FaceReader
- Additional options

Choose settings

Aim

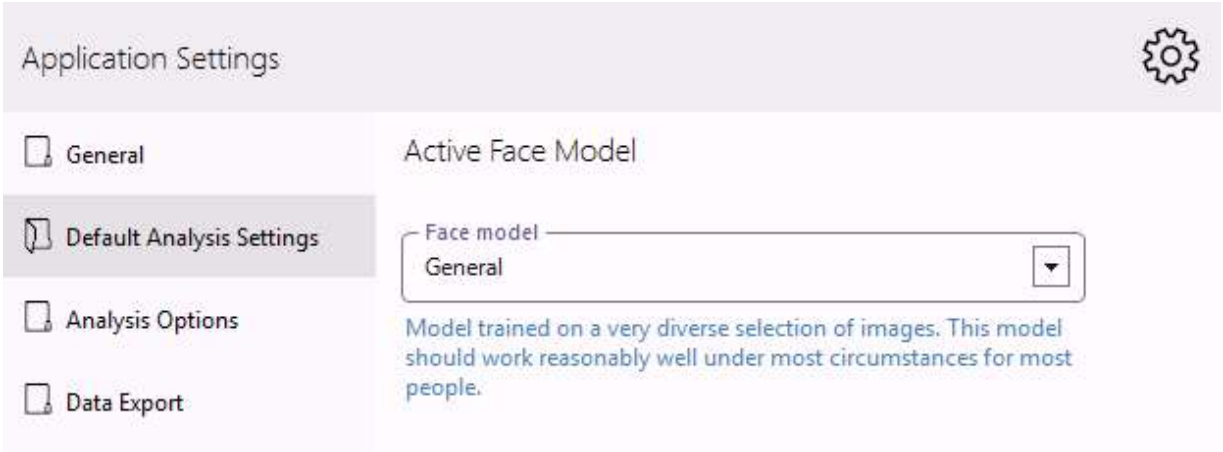
- To choose settings that are valid for all future analyses, for example to choose the Video frame rate — See Settings for all future analyses
- To adjust some settings for the analysis that is open on your screen, for example to choose the Active Face Model — See Settings for the current analysis

Set default or current analysis settings for the following:

- Face model – see Active Face Model
- Calibration – see Calibrate FaceReader
- Smoothen classifications – see Classification
- Image rotation – see Rotation
- Video sample rate – see Video

Settings for all future analyses

1. Choose **File** > **Settings** >**Default Analysis Settings**.



2. Specify the settings.

   See Default Analysis Settings for an explanation of the options.

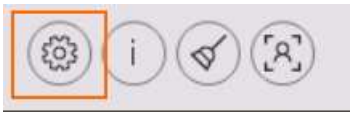
Note

The Default Analysis Settings do not apply to already existing analyses. To apply the new settings to an existing analysis, select Settings for the current analysis and redo the analysis.

Settings for the current analysis

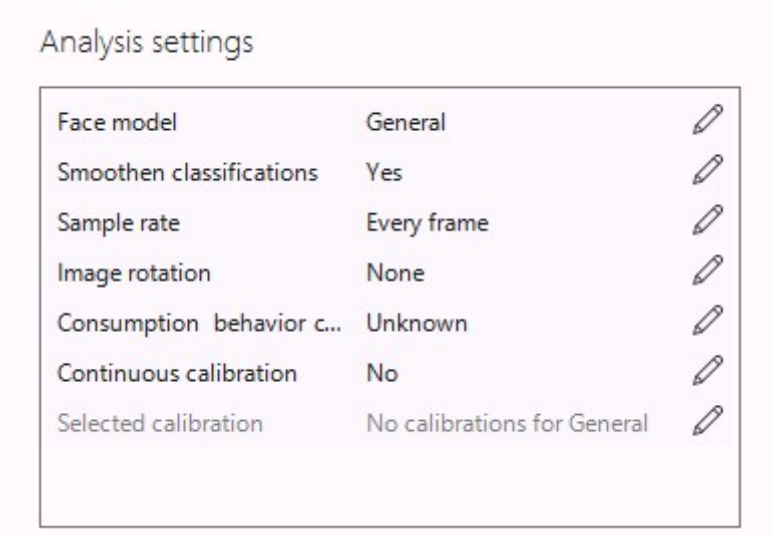
1. Open the analysis by double-clicking it in the Project Explorer or clicking the magnifying glass button next to it.

2. Select the **Analysis Settings** by clicking the **Settings** button on the bottom of your screen.



3. Click the pencil next to a setting to edit it.

   See Default Analysis Settings for an explanation of the options.



Note

You can only select **Continuous calibration** if you first set the **Selected calibration** to **None**.

Analyze facial expressions

Aim

To carry out the FaceReader analyses.

Prerequisite

You checked the **Analysis settings** by clicking the **Settings** button on the bottom of your screen. Make sure you selected the correct Face Model. See Active Face Model

See Choose settings

Which procedure are you looking for?

- Automatic analysis procedure
- Manual procedure image analysis
- Manual procedure video and camera analysis
- Optional classifications

With the Advanced Research Module you can analyze multiple faces in a video simultaneously. See Analyze multiple subjects per video.

Automatic analysis procedure

With the Project Analysis and The Stimulus Presentation Tool, analysis is carried out automatically when the participant starts a test. You do not have to start and stop analysis manually.

See Carry out a test with the Stimulus Presentation Tool in Project Analysis

Manual procedure image analysis

Aim

To analyze facial expressions from images.

Prerequisites

- You created a participant for each person.

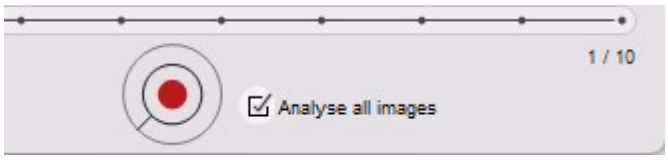
  See Add your test participants

- You created at least one image analysis for every participant.

  See Add analysis input

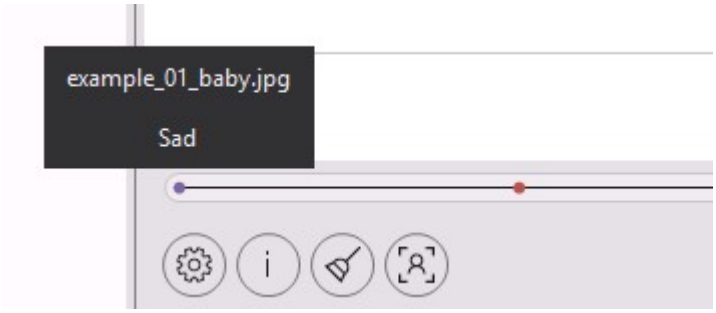
Procedure

1. Optionally, select more than one image in an analysis and select **Analyse all images** to analyze all images of the participant at once.

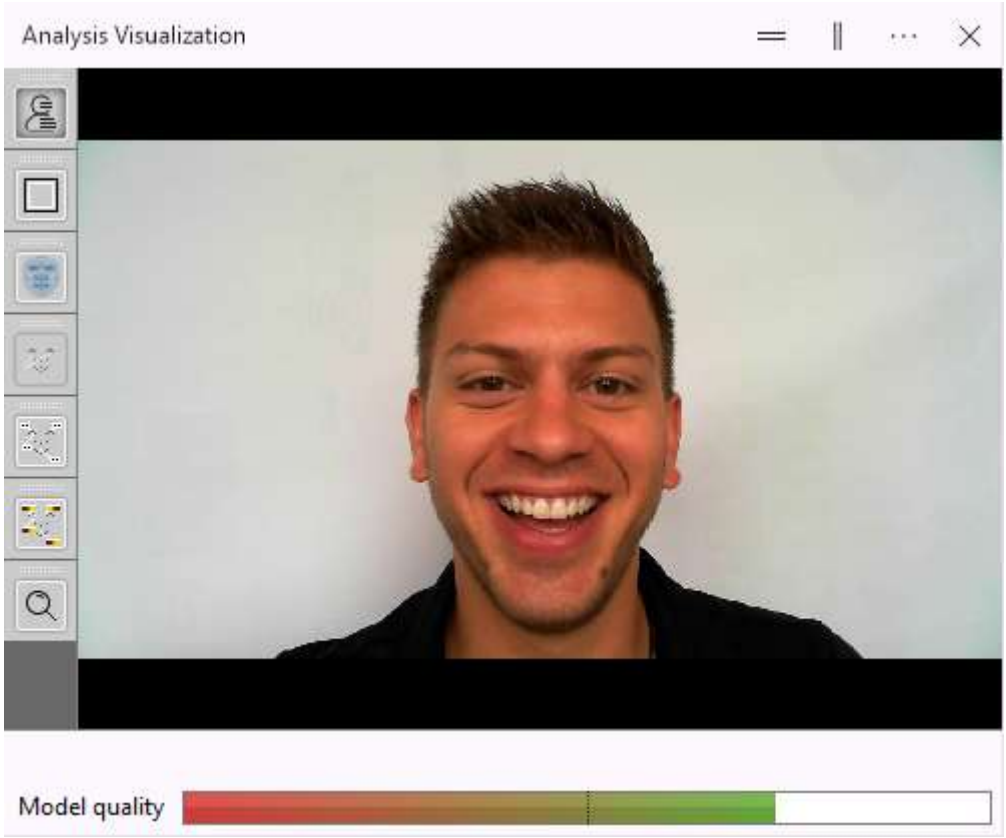


2. Click the **Start analysis** button.

   The track bar shows a dot in the color of the dominant expression for each image. When you hover with your mouse over the dot, the filename of the image and the dominant facial expression are shown.



Check the **Model quality** bar for the analysis quality. The green bar should cross the dashed line.



3. To export analysis results, choose **File** > **Export** and select to export the results of the analysis, participant, or the entire project.

   See Export analysis results

Manual procedure video and camera analysis

Aim

To analyze facial expressions from video, or live from camera images.

Prerequisites

- You do not carry out analysis with The Stimulus Presentation Tool. When you use the Stimulus Presentation Tool, the analysis starts when the participants starts a test.
- You created at least one participant.

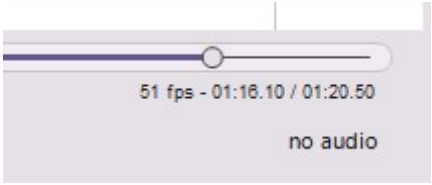
  See Add your test participants
- You created at least one video or camera analysis for every participant.

  See Add analysis input

Procedure

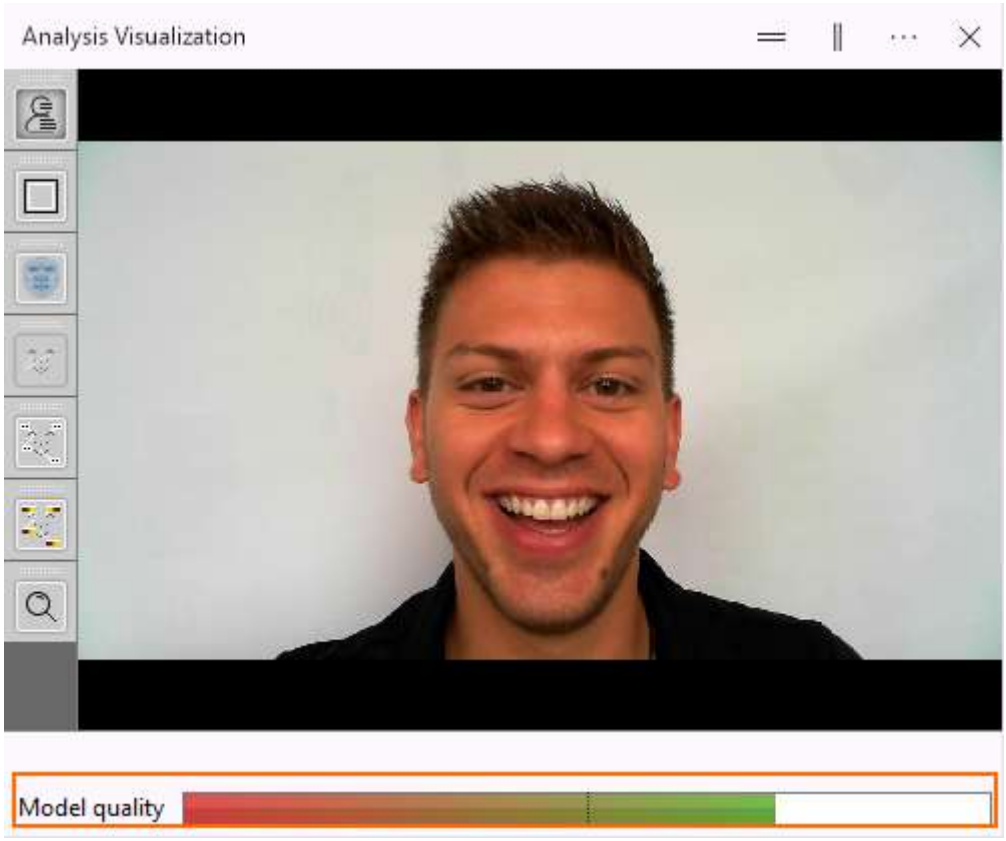
1. For Video analysis – Position the video to where you want to start the analysis.
2. Click the **Start analysis** button at the bottom of your screen.

The track bar shows the progress of the analysis, the analysis speed (in fps), the running end time of the analysis, the end time of the video and whether the video has audio.



3. During analysis, check the **Model quality** bar in the **Analysis Visualization** window. It should look like the one below, the colored bar must cross the dashed line.

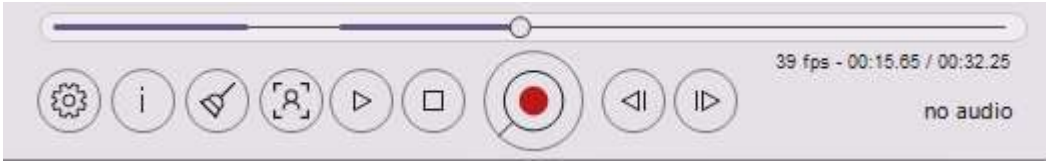
   You can adjust the model quality, see Minimum model quality



   If the quality of your camera image is not good enough, the text **Could not find a face** or **Could not classify the face** (FaceReader cannot model the face) will appear in the **Analysis Visualization** window. Probably either the lighting of the test person's face or the position of the camera is not optimal.

   See Camera and accessories how to improve your setup.

4. Click the **Stop Analysis** button to stop the analysis.
5. Video analysis – to analyze more episodes, move the video to a new position and click the **Start analysis** button again. The analyzed episodes are shown on the track bar.



IMPORTANT The data of all the analysis intervals are saved in one log file. The text **Not Analyzed** will appear in the log file for the time points that were not analyzed. This can result in very big files.

6. To export analysis results, choose **File** > **Export** and select to export the results of the analysis, participant, or the entire project.

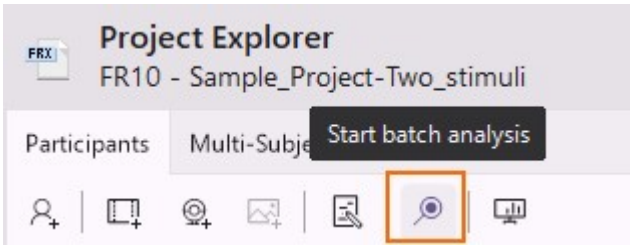
   See Export analysis results

Notes

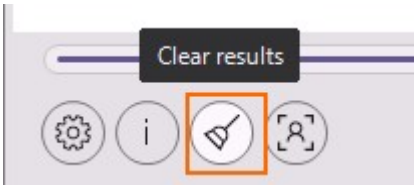
- By default, videos are processed frame-by-frame. To speed up the analysis, change the sample rate.

  See Video

- To carry out all video analyses at once, press the **Start batch analysis** button on the toolbar of the project explorer. Please see the tips on Improving FaceReader's performance which are especially important when using batch analysis.



- To redo an analysis, click the **Clear results** button and start the analysis again.



Exported log files will not be deleted.

- When you run a camera analysis, a new video frame is analyzed when the analysis of the previous frame is finished. If detection is demanding, the number of frames being analyzed per second may be lower than the camera frame rate. In this case FaceReader skips a frame to keep up with the camera frame rate. After the analysis is finished, FaceReader interpolates the results in the skipped frames to the frame rate of the recorded video.

  See also Camera frame rate and samples in FaceReader in Set up your project

- When you run a video analysis, the average frame rate may be lower than that expected from the frame rate of the video file. For example 27 fps when the video frame rate is 30 fps and you set to analyze every frame. In that case video plays slower than 1x during analysis, but all frames are analyzed.

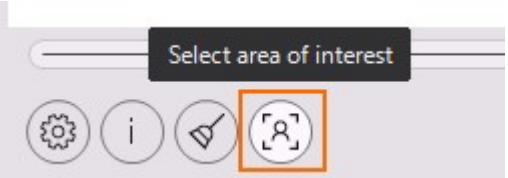
  See also:

  - Speed up analysis

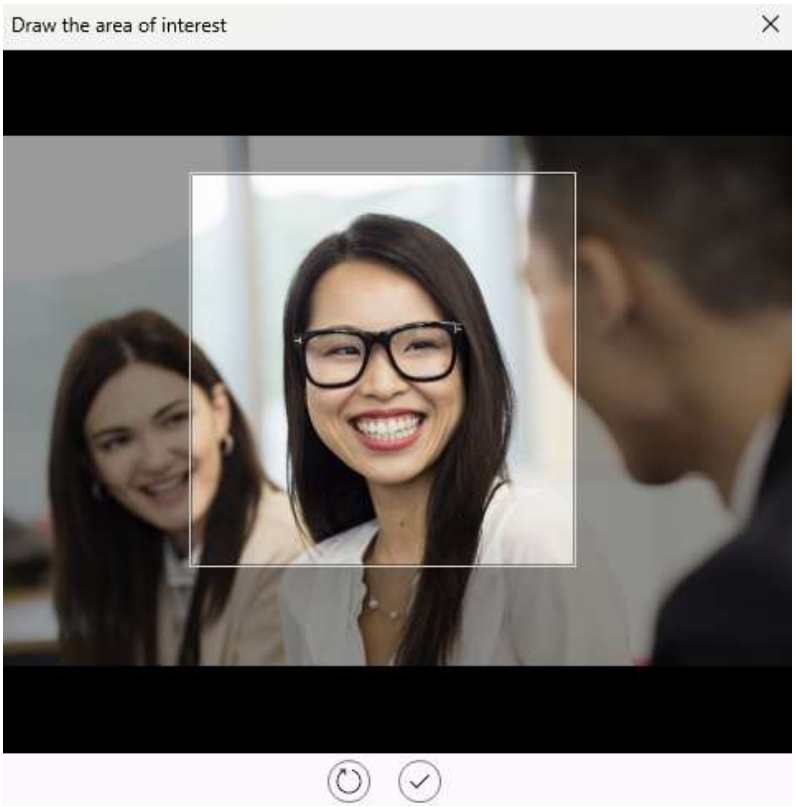
  - Video in Settings

  - Sample rate in Settings

- To analyze part of the video image, for example because your video contains multiple faces and you only want to analyze one of them, click the **Select area of interest** button.



  The **Draw the selected area** window opens. Drag a window around the face that you want to analyze.



Either click the Apply button to start analyzing the selected face or the Reset selected area button to delete the selected area and draw a new one.

- You can analyze multiple faces in a video with the Advanced Research Module.
- To increase the speed and the accuracy of analysis, FaceReader uses information from previous frames to analyze the current frame. For instance, if in the previous frame FaceReader could correctly model the face, a re-detection is not required, because FaceReader already knows the location of the face. Information about previous frames is also used to smooth the output of FaceReader. These enhancements lead to much faster analysis, and it also allows the face modeling algorithm to better fit the face in the image. A side effect of this is that results depend on the start position used.
- If you re-analyze the video of a camera analysis and notice that the video is not analyzed.

Optional classifications

Aim

To select other analyses in addition to facial expressions.

FaceReader can, optionally, analyze the following:

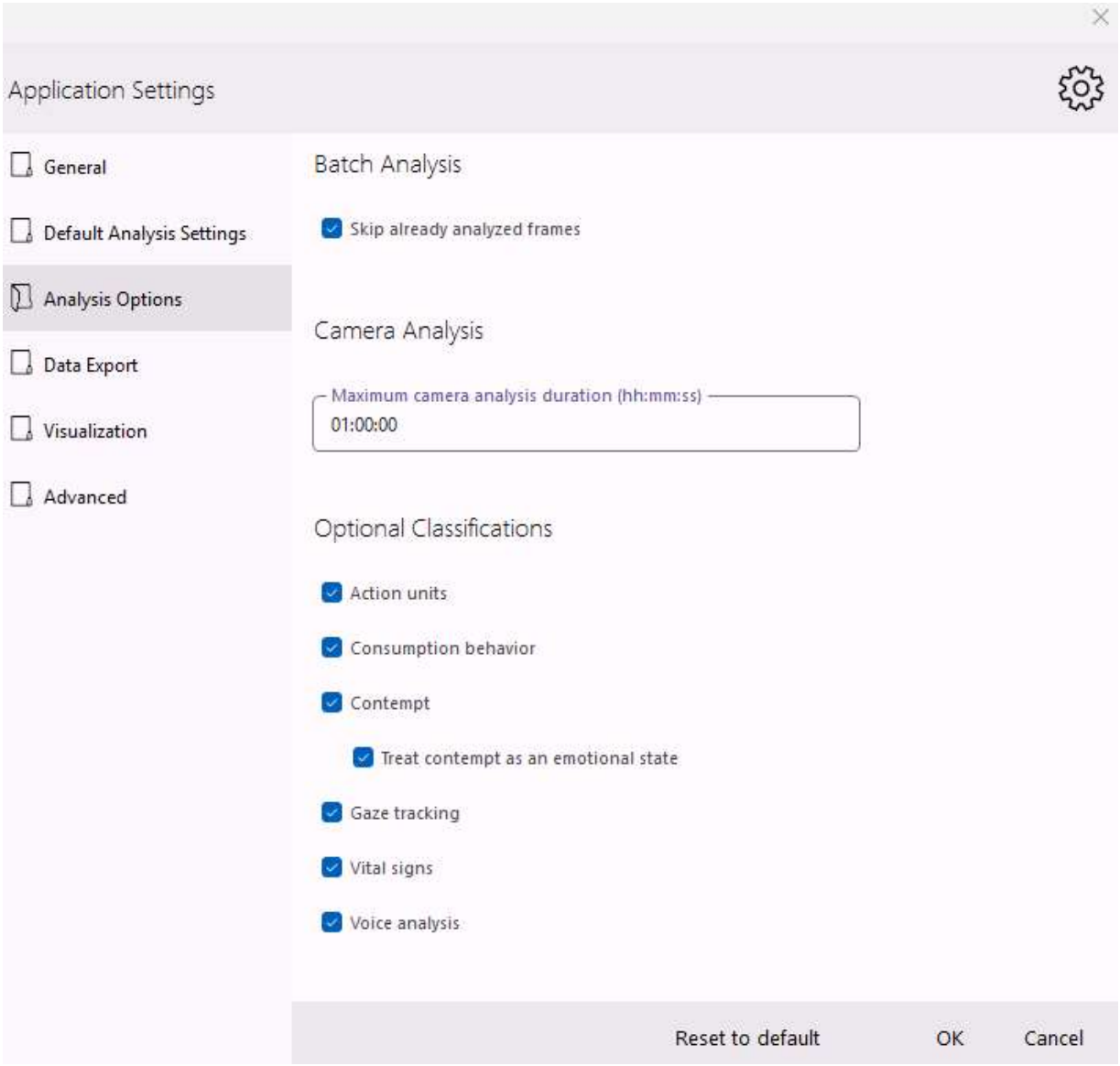
- Contempt
- Facial states
- Gaze tracking
- Action Units (if you have The Action Unit Module or you have Baby FaceReader)
- Custom Expressions (if you have the Action Unit Module or you have Baby FaceReader)
- Heart rate, heart rate variability (by means of Remote PPG), and breathing rate (if your license includes The Vital Signs Module)
- Consumption Behavior (if you have The Consumption Behavior Module, not available with Baby FaceReader)
- Expressions in the voice (if your license includes the Voice Analysis Module. Note this feature is not available with Baby FaceReader)

Note

Each optional classification decreases analysis speed, so only select the options you require.

Procedure

To select these optional classifications, choose **File** > **Settings**. Click the **Analysis Options** tab, and make your selection under **Optional Classifications**.



Contempt

Contempt is an expression in which one corner of the lips is tightened and slightly raised. It can be classified reliably in different cultures [1]. Some authors state that it should be added to the six basic emotions defined by Paul Ekman [2]. However, other authors disagree with this [3].

To add contempt to the expression states, select the option **Treat contempt as an emotional state**. This adds contempt to the State Log and Timeline and makes contempt mutually exclusive with the other emotions in the State Log and Timeline, meaning that only one emotional state can be active at any given time.

References

1. Ekman, P., & Friesen, W. V. (1986). A new pan-cultural facial expression of emotion. Motivation and emotion, 10(2), 159-168.
2. P. Ekman. Universal facial expressions of emotion. California Mental Health Research Digest, 8: 151-158, 1970.
3. Ekman, P. (1992). An argument for basic emotions. Cognition & Emotion, 6(3-4), 169-200.

Facial states

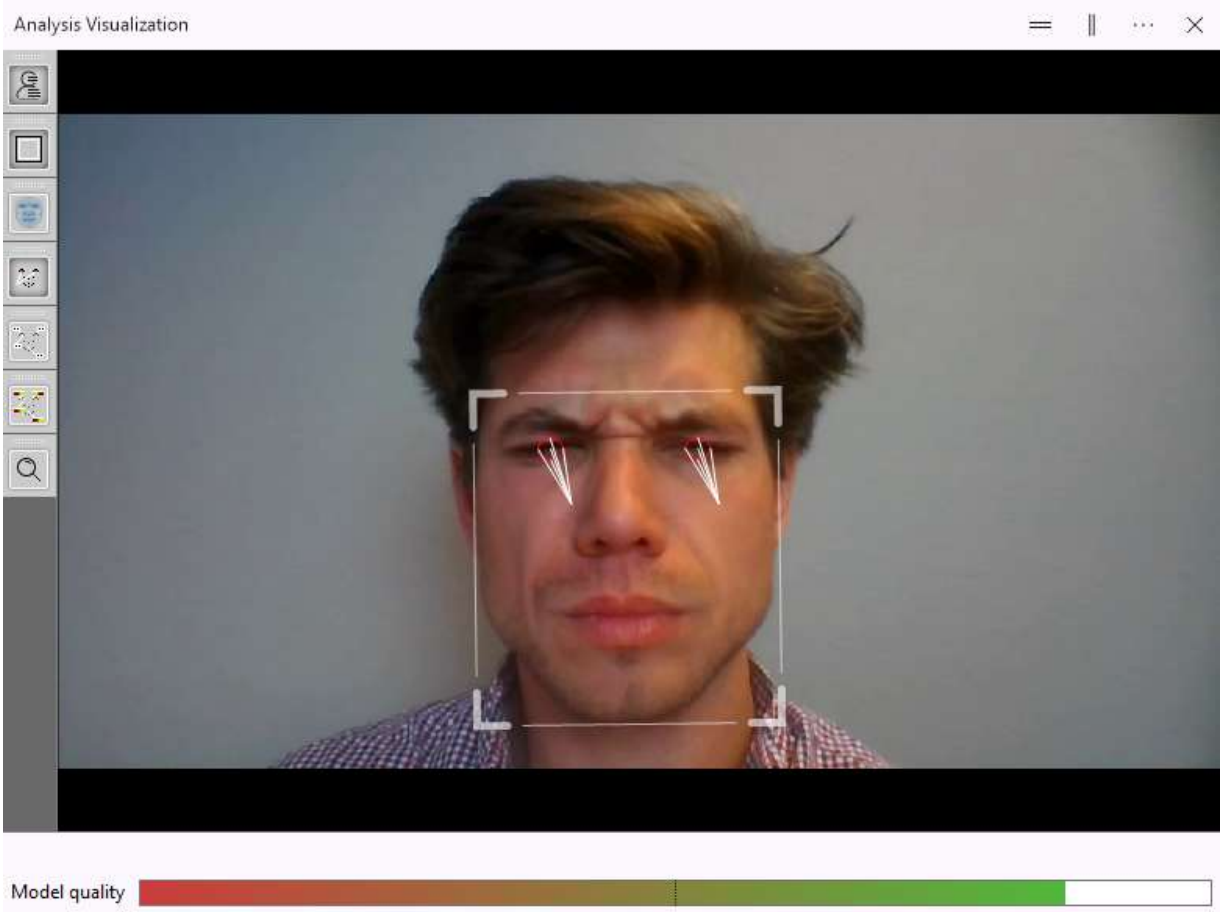
FaceReader can detect whether the left and right eye is open or closed, whether the mouth is open or closed and whether the eyebrows are raised, neutral or lowered. These states are shown in the **Facial States** window. They are also visualized in the Analysis visualization window, when the option **Show facial states** is selected.

Gaze tracking

FaceReader can detect the test participant's **Gaze Direction**, **Gaze Type** and **Gaze angles**. **Gaze direction** indicates whether the participant looks to the left, left-up, left-down, or to the right, right-up or right-down, Up, Down or Forward. **Gaze Type** indicates whether the test participant's eyes fixate on something (that is, the eyes are still and looking at, for instance, the eyes in a face) or whether there is movement of the eyes when the test participant shifts his/her focus of vision (a saccade). In addition, FaceReader measures the horizontal and vertical **Gaze angle** over time.

If your license includes the Advanced Research Module you can view the test participant's gaze overlay on the stimuli that you present with the Stimulus Presentation Tool. See Run a test in Project Analysis.

Gaze direction, **Gaze Type** and **Gaze angles** are shown on the Timeline. **Gaze Direction** is also visualized in the **Analysis Visualization** window, when the option **Show global gaze direction** is selected.



If the **Show global gaze direction** button is not active, select **File** > **Settings** > **Analysis Options** and under **Optional Classifications** select **Gaze tracking**.

Action Units

FaceReader can analyze Action Units from the Facial Action Coding System (FACS) published by Ekman and Friesen (1978), if you have The Action Unit Module or you have Baby FaceReader. The Affective Attitudes Interest, Boredom and Confusion that were called Affective Attitudes in FaceReader 7.1, are now available as Custom Expressions. You can also define your own Custom Expressions.

Heart rate, heart rate variability, and breathing rate

FaceReader can analyze the heart rate, heart rate variability and breathing rate of the test participants, if your license includes The Vital Signs Module.

Consumption Behavior

With the Consumption Behavior Module you can determine whether your test participants are chewing or taking a bite or sip. This option is not available with Baby FaceReader.

See The Consumption Behavior Module

Expressions in the voice

With the Voice Analysis Module you can analyze emotions in the voice (Neutral, Happy, Sad and Angry), and Valence and Arousal from the voice. FaceReader can also assess the Loudness and Speech rate. Voice analysis is not available with Baby FaceReader.

Calibrate FaceReader

Aim

To correct for person-specific biases in facial expressions, for example if someone looks angry or sad by nature. Instead of calibration you can also use a Stimulus to score an episode in which your test participants have a neutral expression and carry out relative analysis. See Select absolute or relative values for your parameters.

Prerequisites

- You have the regular version of FaceReader. Calibration is not available in Baby FaceReader.
- You notice a person-specific bias in facial expressions. If there is no such bias, we recommend not to use calibration since it may then decrease analysis accuracy.
- You first checked whether changing the camera, or lighting conditions removes the bias.

Two calibration methods

FaceReader has two calibration methods

- Participant calibration — Use this method if you analyze videos or images. Also use this method if you do camera analysis and the experimental setup allows capturing a neutral phase before the experiment starts.

  See Participant calibration

- Continuous calibration — Use this method if you carry out camera analysis and the experimental setup does not allow capturing a neutral phase before the experiment starts. This is for example the case if you start FaceReader automatically with another program.

  See Continuous calibration

Participant calibration

Aim

To correct for person-specific biases in facial expressions.

Prerequisite

You have a video fragment, or images in which the expression of the test participant was neutral. Alternatively, if you carry out camera analysis, you are able to record a scene during which the test participant looks neutral. Please note that you need at least 100 images for the calibration.

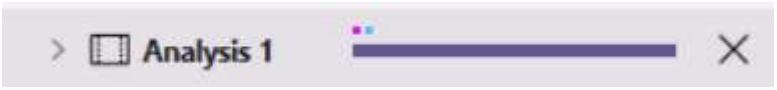
See also How participant calibration works

Procedure

1. Create a participant calibration
2. Select a participant calibration

Create a participant calibration

1. Make sure all analyses of the participant are closed. To close an open analysis, click the button next to it.



2. Do one of the following:

   - Choose **Participant** > **Calibrate Participant**.

   - Right-click the participant and choose **Calibrate Participant**.

3. Select the Face Model.

   See Active Face Model

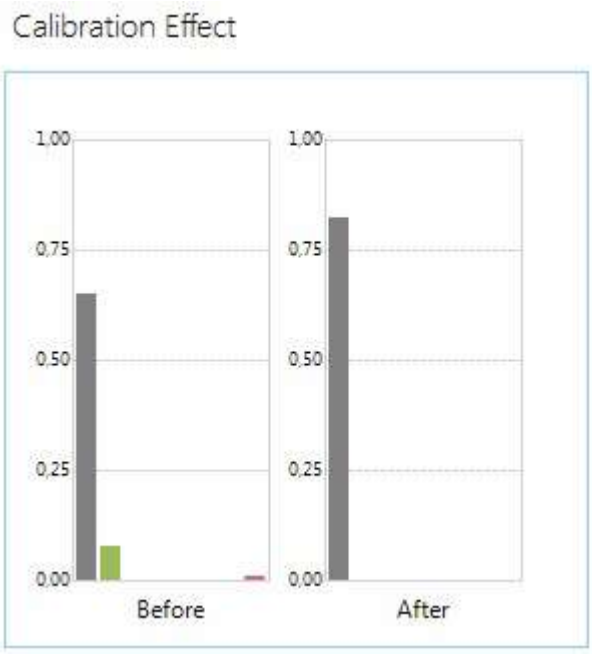
4. Choose the calibration source:

   Images – Select the files in which the participant looks neutral.

   Video – Select the video file and scroll to the part where the test participant looks neutral.

Camera – Ask the test participant to look neutral.

5. Click the **Start analysis** button. When the calibration is created, the **Calibration Effect** field shows the facial expressions before and after calibration.



6. When you are satisfied with the calibration, give it a name and click **OK**. FaceReader asks whether you want to use this calibration for all future analyses of this participant. Choose **Yes** if you want this.

   If you are not satisfied with the calibration, click the **Retry with same source** button and repeat step 5.

Notes

- If you chose to use the calibration for all new analyses of this participant in step 6, the calibration is selected automatically in all new analyses of that participant. For the already created analyses you must select the calibration manually and redo the analysis.
- To change a calibration for a participant, select the new one, choose **Participant** > **Set calibration as default**.
- To delete a participant calibration do one of the following:

  - Choose **Participant** > **Delete calibration**.

  - Unfold the participant item in the Project Explorer. Then right-click the calibration and choose **Delete calibration**.

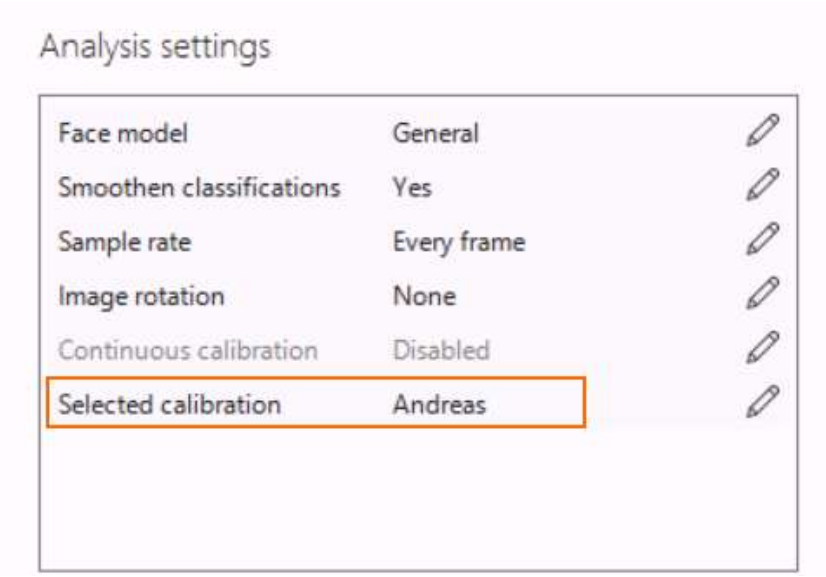
Select a participant calibration

IMPORTANT Use the same Face model (see Active Face Model) in the analysis, as was used to create the calibration. To use another face model, first create a new calibration with this model. Then do one of the following:

- Select the calibration for a specific analysis
- Select the calibration automatically for all future analyses of a participant

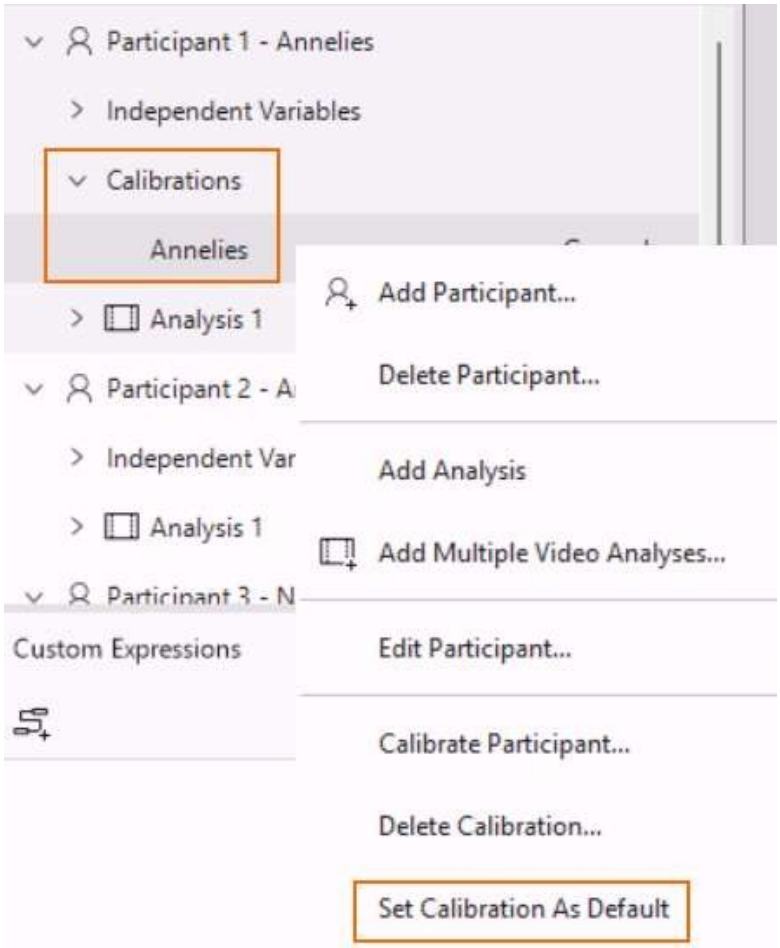
Select the calibration for a specific analysis

1. Make sure that continuous calibration is set to **No** in the **Analysis settings** window on the bottom-left of the analysis part on your screen.
2. Click the pencil button next to **Selected calibration** and select the calibration from the list.



Select the calibration automatically for all future analyses of a participant

1. Open the **Participant** item and then the **Calibrations** item in the Project Explorer.
2. Right-click the calibration and select **Set Calibration as Default**.


Participant 1 - Annelies
Independent Variables
Calibrations
Annelies
Analysis 1
Participant 2 - A
Independent Var
Analysis 1
Custom Expressions
Add Participant...
Delete Participant...
Add Analysis
Add Multiple Video Analyses...
Edit Participant...
Calibrate Participant...
Delete Calibration...
Set Calibration As Default

How participant calibration works

If you use images for calibration, FaceReader searches for the image with the lowest model error. If you use camera or video analysis, FaceReader analyzes two seconds and uses the image with the lowest model error for calibration.

Correcting expression intensities

FaceReader corrects each expression other than neutral in the following way:

Corrected Expression intensity = max (0, (I_a - I_c))/ (1-I_c)

Where I_a is the intensity of that expression in the analysis and I_c is the intensity of that expression found in the calibration. If *(I_a - I_c)/ (1-I_c)* is lower than zero, the calculated expression intensity will be zero.

You can find the I_c values in the header of the Detailed log file.

Correcting the intensity of Neutral

The intensity of Neutral is calculated in the following way:

Corrected Intensity Neutral = (N_a + (1- I_{max}))/2

Where N_a is the intensity of Neutral classified by FaceReader and I_{max} is the intensity of the expression with the highest intensity, excluding Neutral and Contempt.

Example

Consider the following expression intensities:

- Neutral = 0.6
- Happy = 0.9
- Sad = 0.1
- Angry = 0
- Surprised = 0
- Scared = 0
- Disgusted = 0

This gives an I_{max} of 0.9

And a corrected intensity of Neutral of:

Corrected Intensity Neutral = (0.6 + (1 - 0.9)) / 2 = 0.35

Continuous calibration

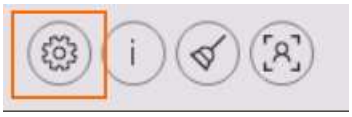
Aim

To correct for person-specific biases in facial expressions if you do not have images during which the test participant looks neutral.

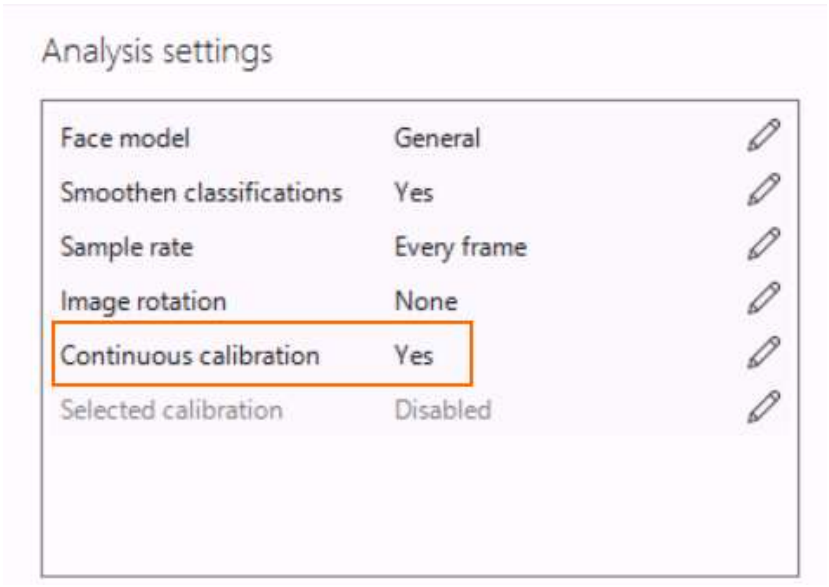
Procedure

1. Open the analysis for which you want to use continuous calibration. To open an analysis, double-click it in the Project Explorer, or click the magnifying glass button next to it.

2. Click the **Analysis settings** button at the bottom of your screen to open the **Analysis settings** window.



3. Click the pencil button next to **Selected calibration** and select **None**.
4. In the same window, click the pencil button next to **Continuous calibration** and select **Yes**. This sets the **Selected calibration** field to **Disabled**.



How continuous calibration works

FaceReader continuously averages the facial expression intensities in the analysis.

Correcting expression intensities

With Continuous calibration, Facereader corrects each expression intensity other than neutral in the following way:

Corrected expression intensity = max (0, (I_a - I_m))/ (1-I_m).

Where I_a is the intensity of that expression in the current frame and I_m is the average intensity of that expression over all frames before the current frame. If (I_a - I_m)/ (1-I_m) is lower than zero, the calculated expression intensity will be zero.

Correcting intensity of Neutral

The intensity of Neutral is calculated in the following way:

Corrected Intensity Neutral = (N_a + (1- I_{maxm}))/2

Where N_a is the intensity of Neutral classified by FaceReader in the current frame and I_{maxm} is the average intensity of the expression with the highest average intensity in all the frames before the current one, excluding Neutral and Contempt.

Example

Consider the following average expression intensities:

- Neutral = 0.6
- Happy = 0.9
- Sad = 0.1
- Angry = 0
- Surprised = 0
- Scared = 0
- Disgusted = 0

This gives an I_{maxm} of 0.9

And a corrected intensity of Neutral of:

Corrected Intensity Neutral = (0.6 + (1 - 0.9)) / 2 = 0.35

Additional options

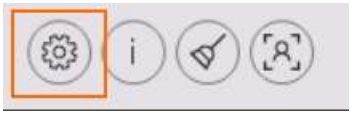
What do you want to do?

- Look for analysis information
- Recover analyses after an interrupted batch analysis
- Speed up analysis
- Move an analysis to another participant

Look for analysis information

Open the analysis.

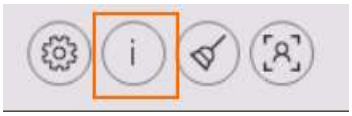
Settings



Click the **Analysis settings** button to view the settings for the current analysis. Most fields are editable.

See Settings for the current analysis

Source Details

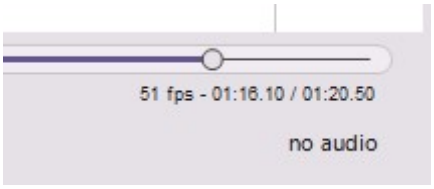


Click the **Source details** button to view information on the source of analysis, that is, the video file name, its location, duration, number of frames, frame rate, resolution and bitrate or in case of a camera analysis the camera name, its frame rate and resolution.

Track bar

The Track bar at the bottom of the screen shows the following information:

- Video analysis — Progress of the analysis, the analysis speed (in fps), the running end time of the analysis, the end time of the video and whether the video has audio.



- Camera analysis — The analysis speed (in fps), the recording time left and whether audio is recorded. The maximum camera analysis duration is one hour. Please note that it is possible to run a camera analysis without recording video/audio.

Recover analyses after an interrupted batch analysis

An autosave file is created after each analysis. This is particularly important during batch analysis. If, for any reason, batch analysis is interrupted (for example after a power failure), you can recover the autosave file by renaming it to the original project file name. To do so:

1. Make sure FaceReader is closed.
2. Browse to the project folder and locate the file ~[project name]_Autosave (with no extension).
3. Rename the original project file to **[project name]_backup.frx**.
4. Rename the autosave file to the original project name.
5. Open the project again in FaceReader. There you should find all analyses completed before the interruption.

Speed up analysis

Carry out one or more options below to increase analysis speed.

- Select only the option **Framing** in the Analysis visualization window, or close the entire **Analysis Visualization** window.
- Close all visualization windows that you are not looking at. Each visualization slows down the analysis.
- Analyze every 2nd or 3rd frame instead of every frame. To do so, choose **File** > **Settings** > **Default Analysis Settings**. Choose one of the options under **Video**.
- Carry out only the analyses you require. Selecting Optional classifications decreases analysis speed.
- Do not keep other programs running in the background.

Move an analysis to another participant

If you have multiple videos of the same participant and you accidentally added another participant to the project and added the second, third etc. analysis to the new participant, you can combine all the analyses of one participant. Right-click the appropriate analysis in the Project Explorer, click **Analysis** and then **Move Analysis To Other Participant**. Select the target participant and then **Yes** to confirm the move.

FaceReader's output

Main topics

- Manage analysis windows
- Reporting Display
- Export analysis results

Manage analysis windows

Aim

To change the windows displayed on your screen.

Prerequisite

You opened an analysis. To do so, click the magnifying glass button next to it.

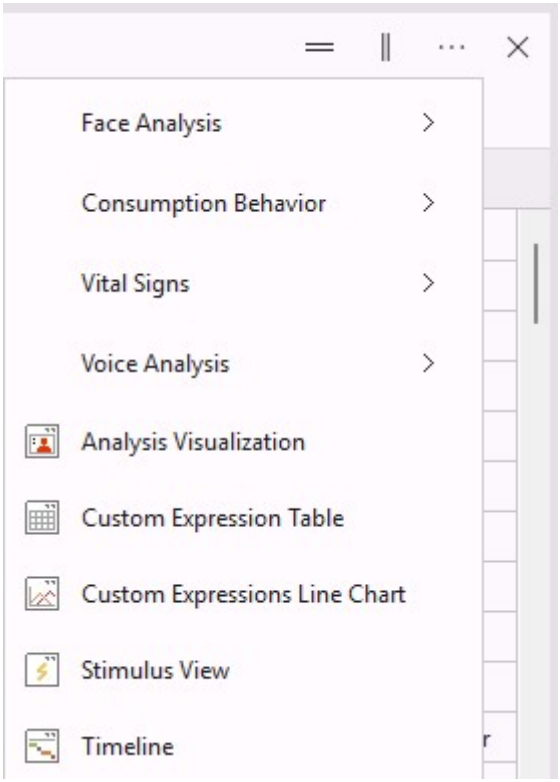
What do you want to do?

- Select analysis windows
- Add more analysis windows
- Merge analysis windows
- Reset the analysis window layout
- Read about Common options
- Create a custom visualization with the Reporting Display

Select analysis windows

1. Click the **Select window** button in the right-corner of one of the analysis windows.

2. Select one of the options.



Face Analysis

You can choose between:

- Action Unit Intensity*
- Circumplex Model of Affect$^{\Delta\Delta}$
- Expression Intensity$^{\Delta\Delta}$
- Expression Line Chart$^{\Delta\Delta}$
- Expression Summary$^{\Delta\Delta}$
- Facial States
- Gaze Angles Line Chart
- Head Orientation Line Chart
- Head Position Line Chart
- Subject Characteristics$^{\Delta\Delta}$
- Valence and Arousal Line Chart

Consumption Behavior

- Consumption Behavior Statistics**ΔΔ

Vital Signs

- Heart Beat Chart***
- Vital Signs***
- Vital Signs Line Chart***

Voice Analysis

- Voice Expression Intensity$^{\Delta}$
- Voice Expression Line Chart$^{\Delta}$
- Voice Valence and Arousal Line Chart$^{\Delta}$
- Voice View$^{\Delta}$

Analysis Visualization

*Custom Expressions Table**

*Custom Expressions Line Chart**

Stimulus View

Timeline

* This window is available if you have The Action Unit Module or Baby FaceReader

** This window is available if you have The Consumption Behavior Module

*** This window is available if you have The Vital Signs Module

$^{\Delta}$ This window is available if you have The Voice Analysis Module

$^{\Delta\Delta}$ Not available with Baby FaceReader

Notes

- When you choose a visualization that is already open in another window, the other window closes.
- Each facial expression has a fixed color which is the same in all the charts. It is not possible to change the colors of the expressions.

Add more analysis windows

1. Click one of the **Split/Unsplit** buttons in an analysis window. This will split the window either horizontally or vertically.
2. Click the **Select window** icon, select either **Face**, **Consumer Behavior**, **Vital Signs**, **Voice** or **Timeline** and then select a window from the list that appears.

Merge analysis windows

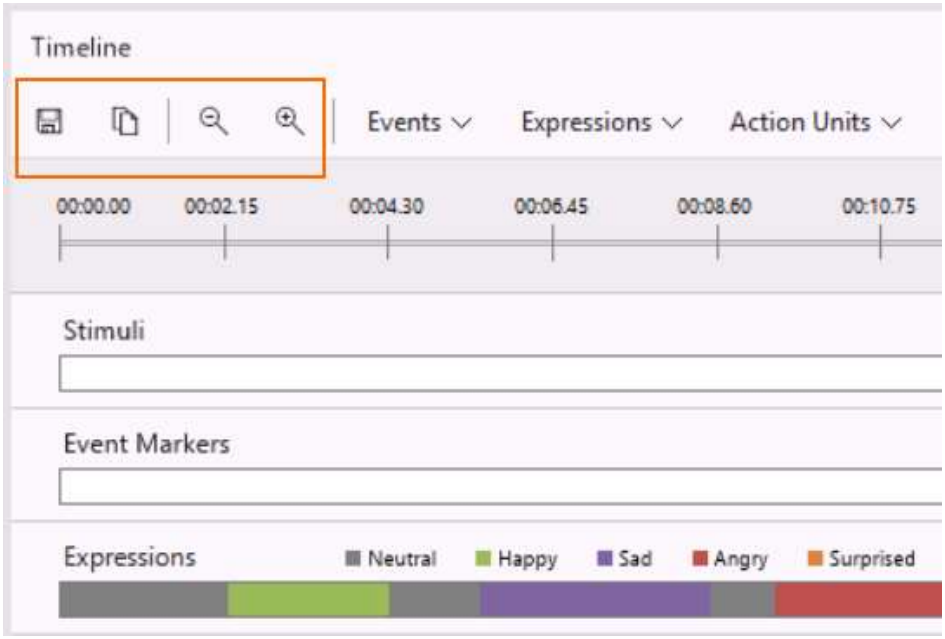
To merge the windows again, click the **Close** button in the window that you want to delete.

Reset the analysis window layout

To close any extra windows that you opened and to reset the position of your windows, choose **Window** > **Reset Analysis Window Layout**.

Common options

Most windows and charts can be exported or copied to the clipboard, and zoomed in/out.

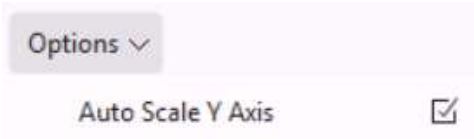


- Export the window/chart as a *.PNG, *.JPG, *.BMP, *.GIF, *.TIF or *.EMF image. An EMF image is a vector image and therefore scalable.
- Copy the window/chart to the clipboard, to paste it in another program like Word or PowerPoint.
- Use the **Zoom In** and **Zoom Out** buttons to change the level of detail.

Common options for line charts

If you analyzed multiple intervals in one video, the windows with data over time show gaps.

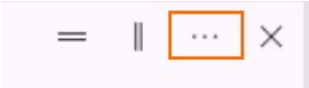
Click **Options** and then select **Auto Scale Y axis** to adjust the Y axis to the maximum value.



Analysis visualization window

To access this option

Click one of the **Select window** buttons, select **Face Analysis** and then **Analysis Visualization**.



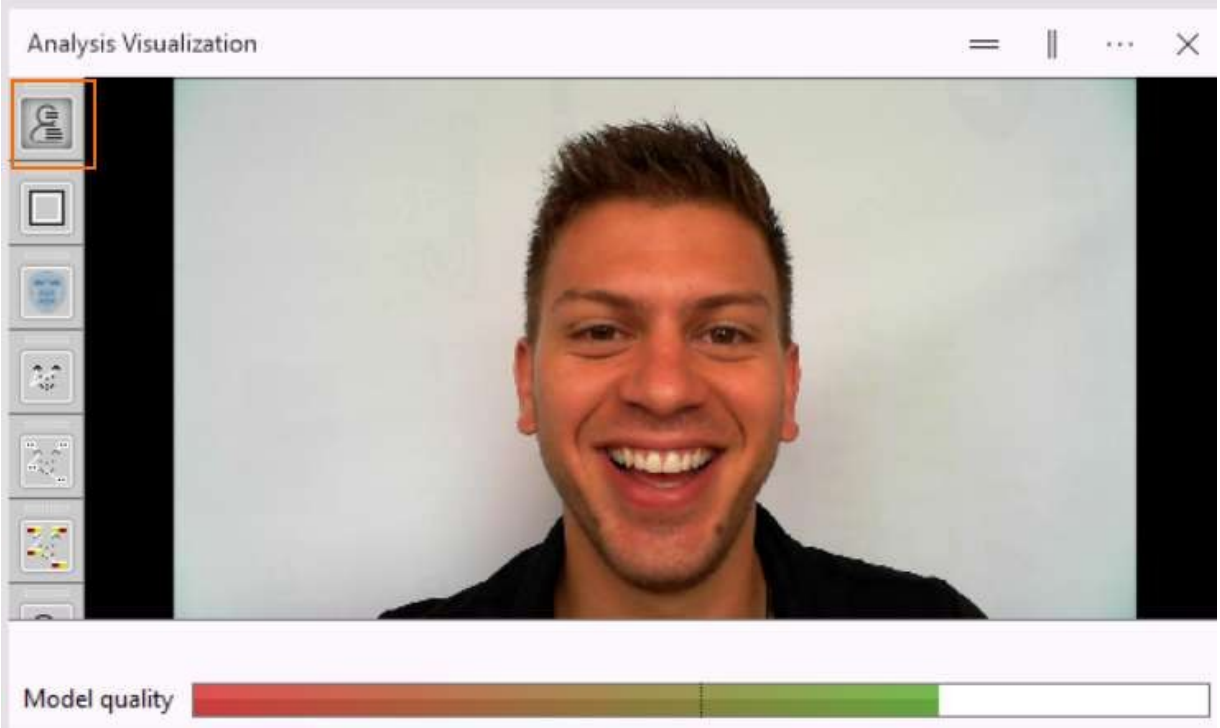
Analysis Visualization

The Analysis Visualization window shows how FaceReader analyzes your images. Click the icons on the left of this window to select one or more of the options.

In previous versions of FaceReader it was possible to view the texture model, the model constructed by the face modeling algorithm. In FaceReader 10 ~~9~~ this option is no longer available.

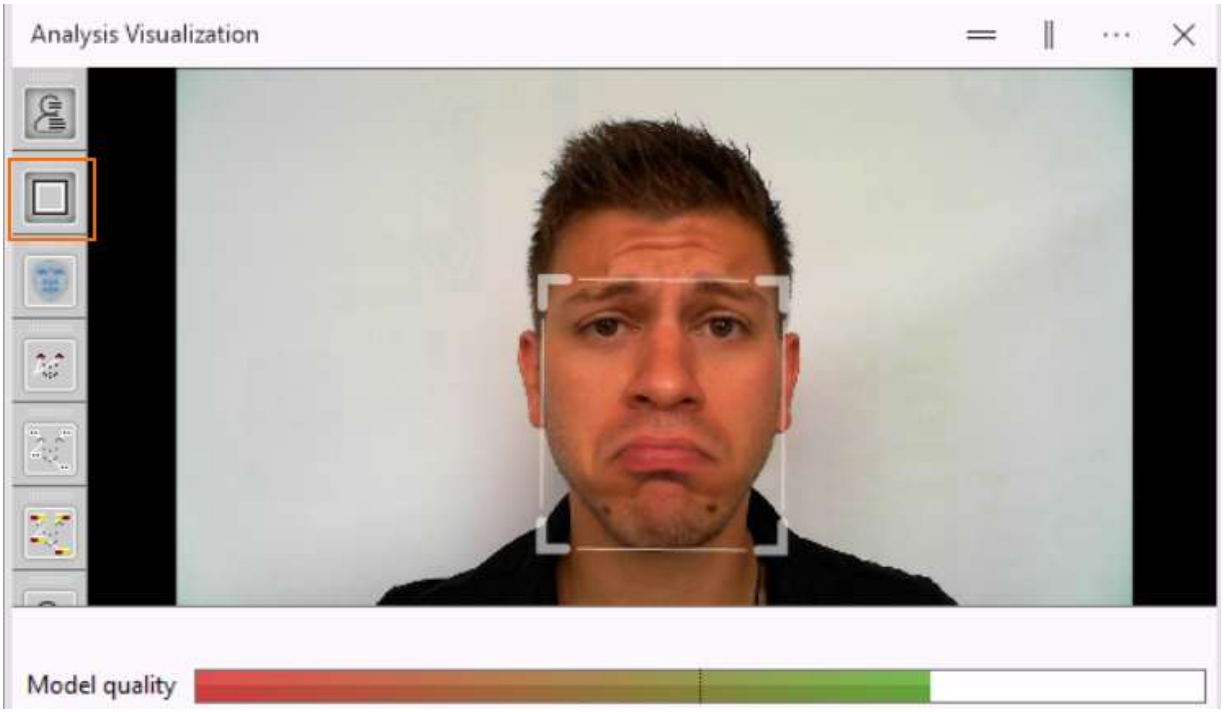
Show image

Shows the face in the video or camera image. You may want to hide the face for privacy reasons.



Show framing

Draws a white box around the face at the location where the face was found.

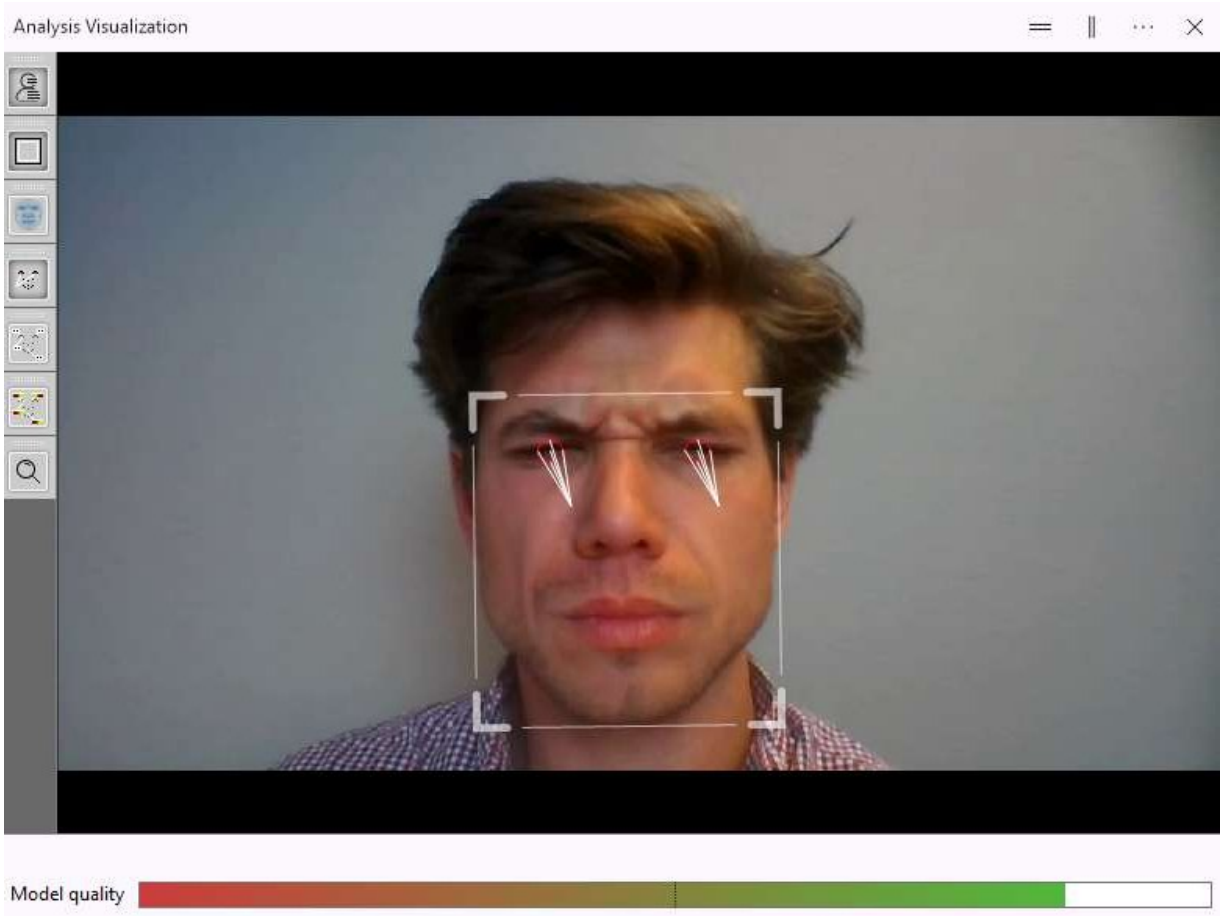


Show Mesh

Shows the positions of the 468 key points used by the face modeling algorithm. The axes on the nose indicate the head orientation.

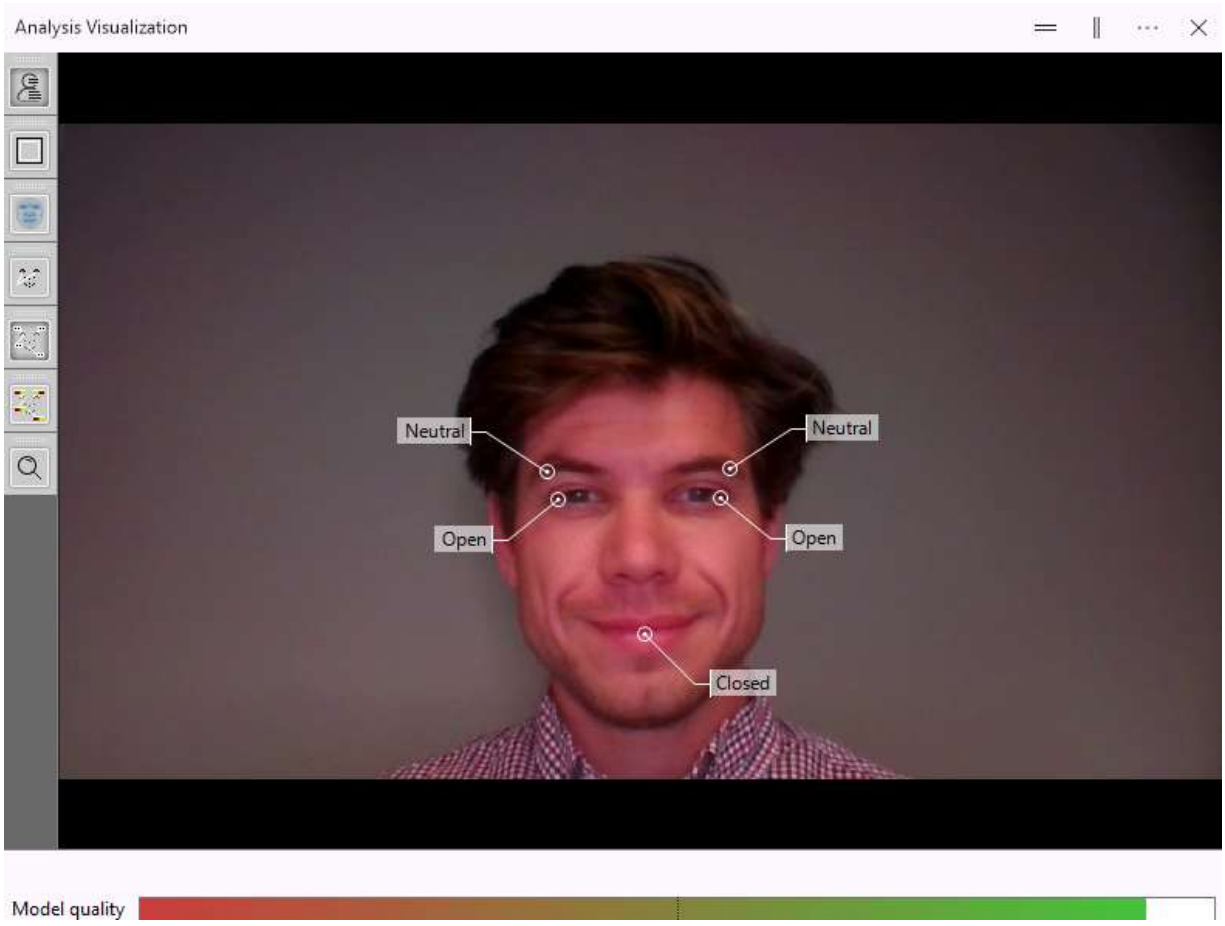
Show Global Gaze Direction

Shows the gaze direction of both eyes. The button **Show Global Gaze Direction** is not available when in the **Analysis Settings** under **Optional Classifications**, **Gaze tracking** is deselected.



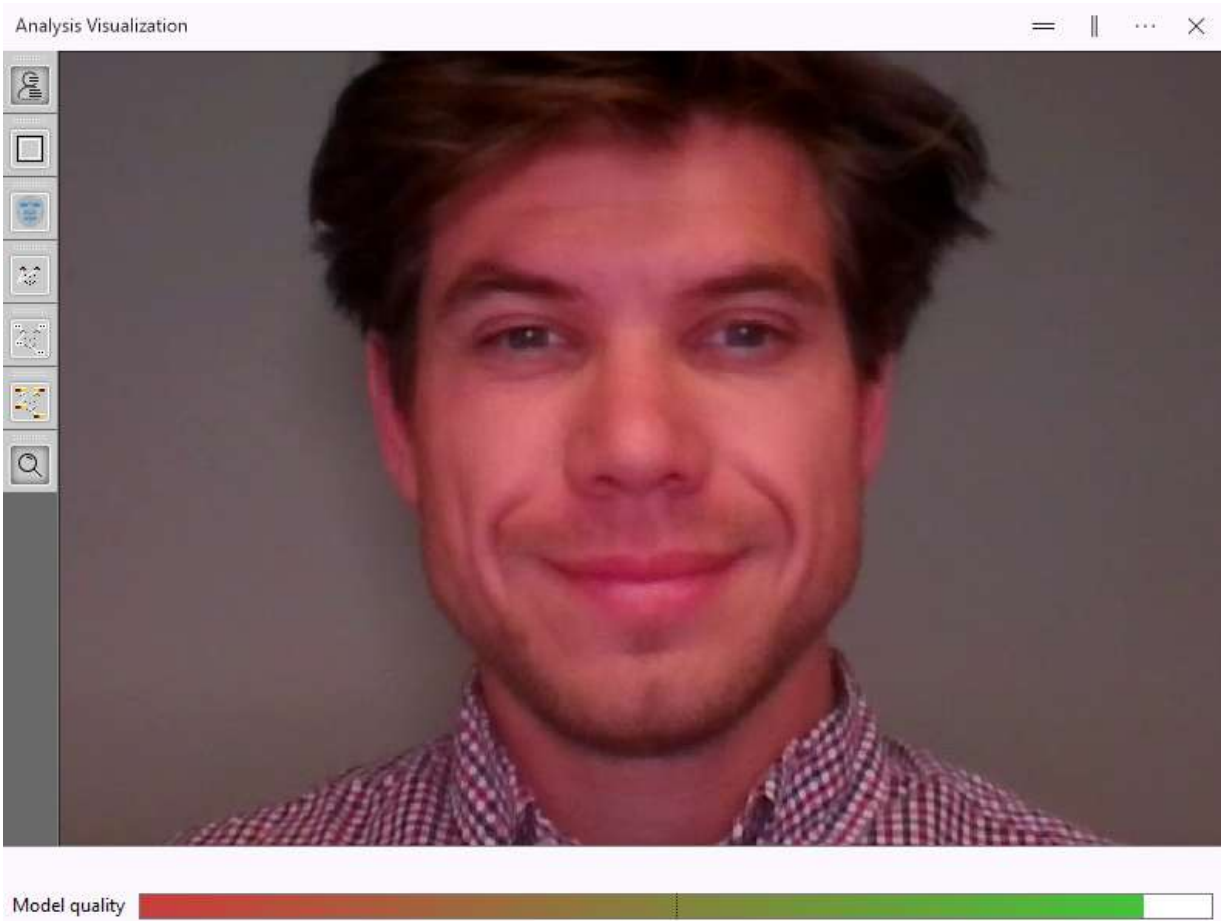
Show Facial States

Shows the Facial States: whether the left and right eye is open or closed, whether the mouth is open or closed and whether the eyebrows are raised, neutral or lowered.



Zoom on face

Zooms in on the face (if the face can be modeled). The model quality does not change when you zoom in on the face.

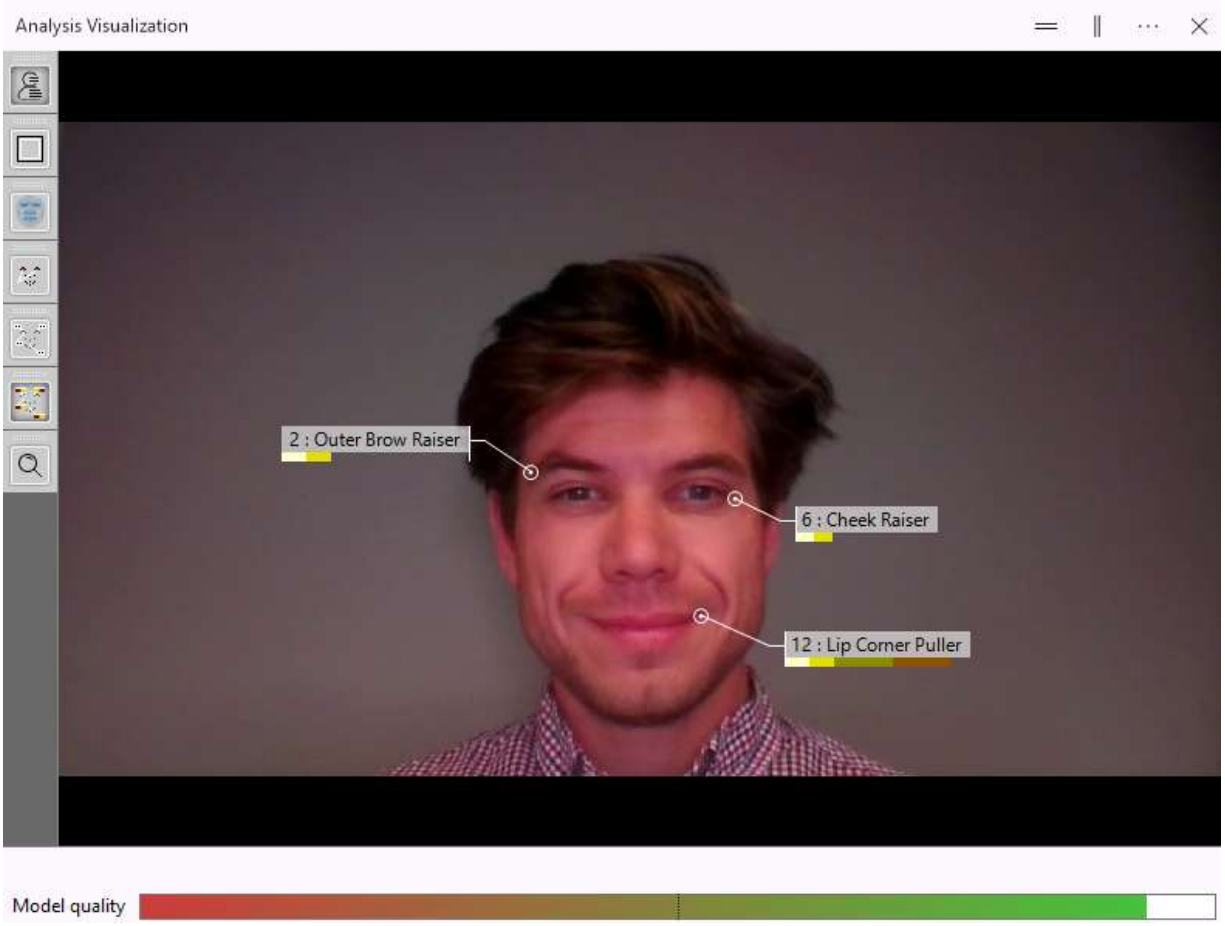


Notes

- After the analysis, you can play back the visualizations together with the video.

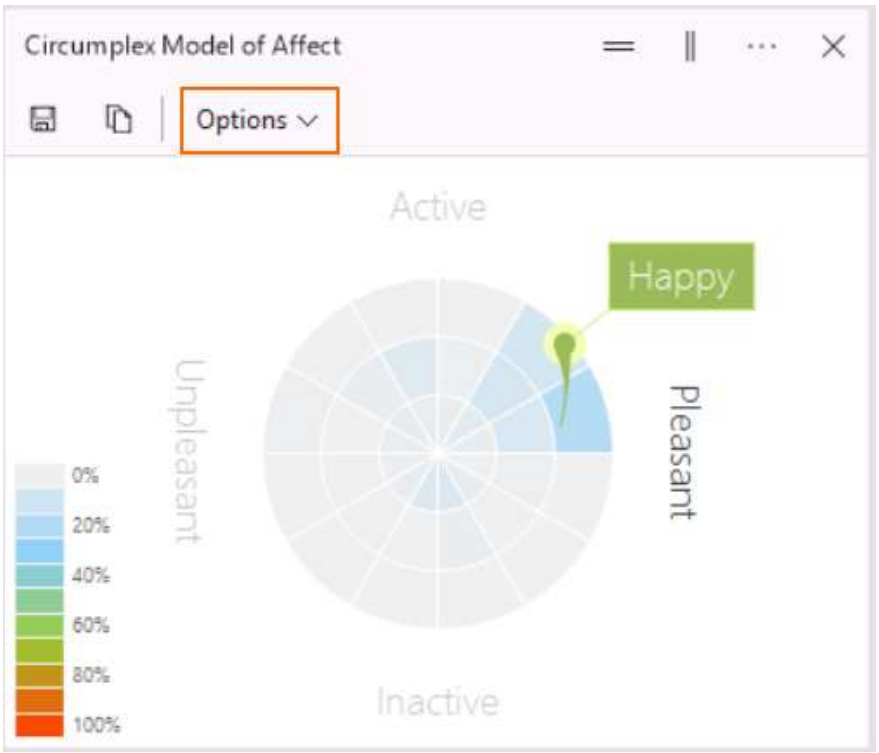
If you have The Action Unit Module, you can also display Action Units in the **Analysis Visualization** window. You can see what Action Units are active in the face and how active they are (Trace activation, Slight, Pronounced, Severe or Max). This option is available if you selected **Action Units** in the **Settings** (**Settings** -> **Analysis Options** -> **Optional Classifications**).

See Visualize Action Units


Analysis Visualization
2 : Outer Brow Raiser
6 : Cheek Raiser
12 : Lip Corner Puller
Model quality

Circumplex Model of Affect

The Circumplex Model of Affect describes emotions in a two-dimensional circular space, containing arousal on the vertical axis and valence on the horizontal axis. The center of the circle represents a neutral valence and a medium level of arousal. The Circumplex Model of Affect in FaceReader is based on the model described by Russel (1980).



Options

The following additional options can be selected with the **Options** button on the toolbar:

Show current position

Shows a circle around the affect, with the color of the current expression state.

Show history

If you carried out video analysis or camera analysis, the affect found in previous images is shown when playing back the analysis.

Show expression label

Shows the expression state found in the image selected in the **Analysis View** window. This option is not available with Baby FaceReader.

Show heatmap

This option is only available for camera and video analyses. It displays a heatmap of the affect found in the analysis.

- Based on absolute percentage – The color of the heatmap is based on the percentage of time a certain affect was found in a video or camera analysis. The maximum is 100%.
- Based on maximum percentage – The color of the heatmap is based on the percentage of time the affect that was most present occurred. This percentage of time is set as the maximum and is colored red.

References

Russell, James (1980). A circumplex model of affect. Journal of Personality and Social Psychology 39: 1161–1178.

http://en.wikipedia.org/wiki/Emotion_classification#Circumplex_model

Expression intensity chart

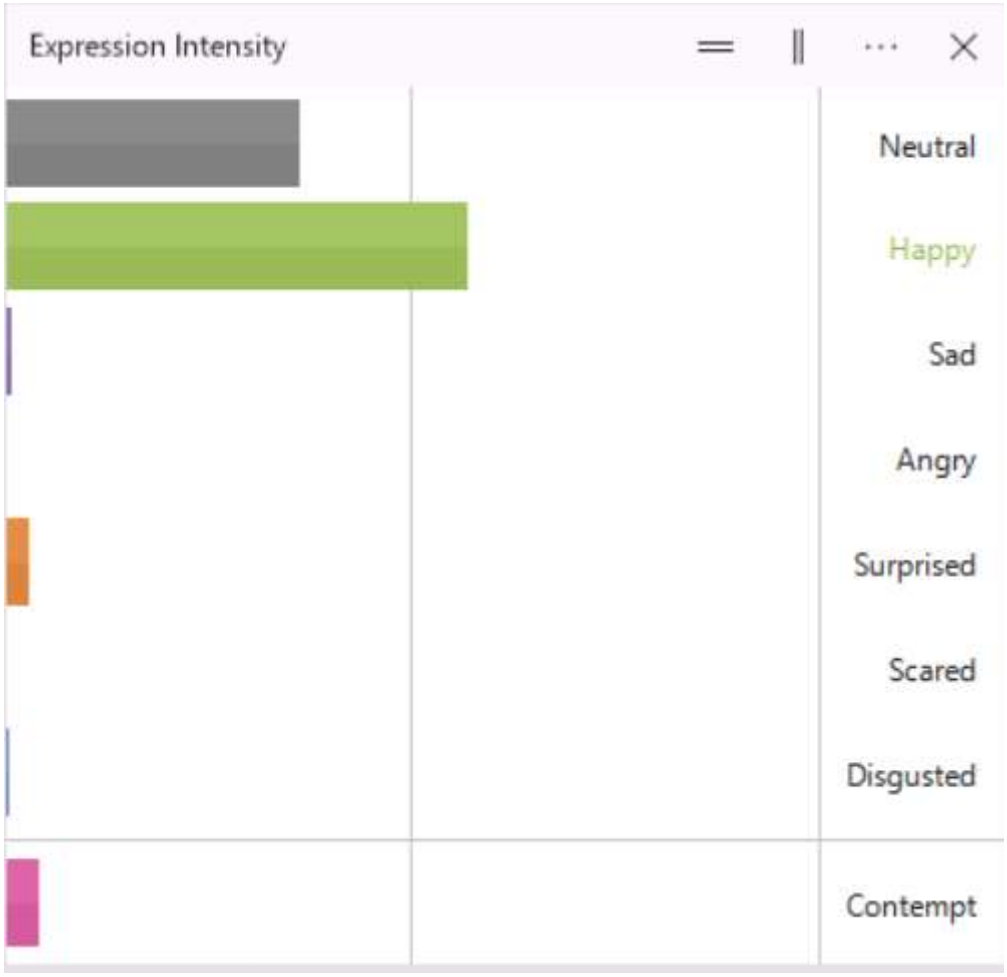
This option is not available with Baby FaceReader.

To access this option

Click the **Select window** button in one of the visualization windows, select **Face Analysis**, and then **Expression Intensity**.

Expression Intensity

The **Expression Intensity** chart displays the intensity of the six basic emotions, the neutral state and, optionally, Contempt. When your input is a live video stream or a video file, you will see the bars change over time, reflecting the changes in expressions on the face.



See Expression states explained when dominant expressions appear in the Timeline and State log.

Expression Line Chart

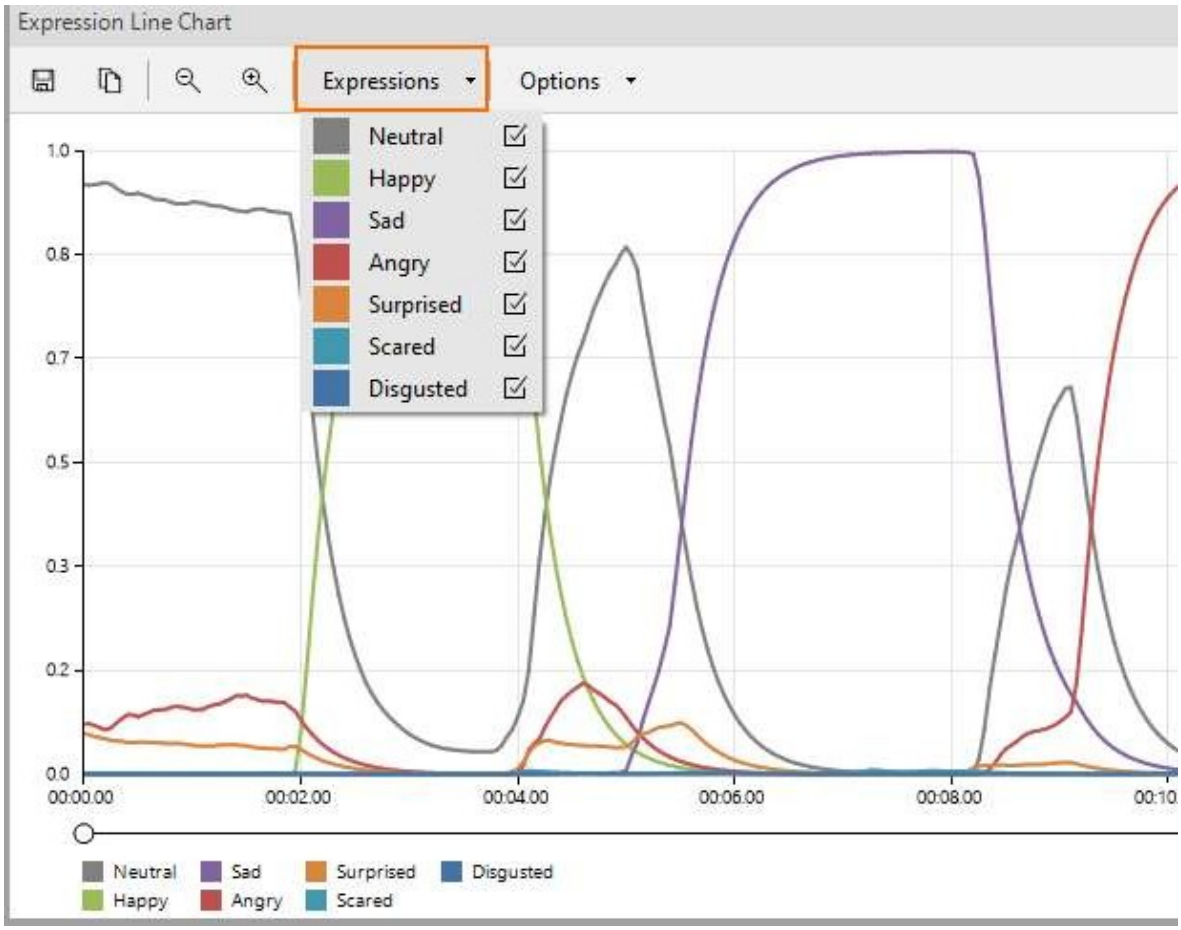
This option is not available with Baby FaceReader.

To access this option

Click the **Select window** button in one of the visualization windows, select **Face Analysis,** and then **Expression Line Chart**.

Expression Line Chart

The Expression Line Chart displays facial expressions over time. Each expression is plotted in a different color. When you play back the video, a hairline shows the time in the video.



Expressions

From the **Expressions** list choose the emotions you want to view.

Expression Summary

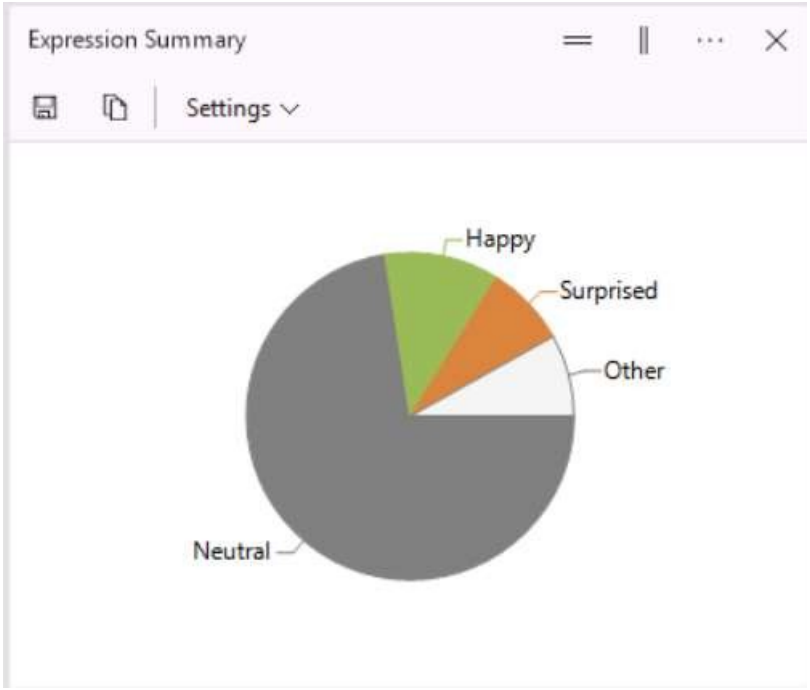
This option is not available with Baby FaceReader.

To access this option

Click the **Select window** button in one of the visualization windows, select **Face Analysis**, and then **Expression Summary**.

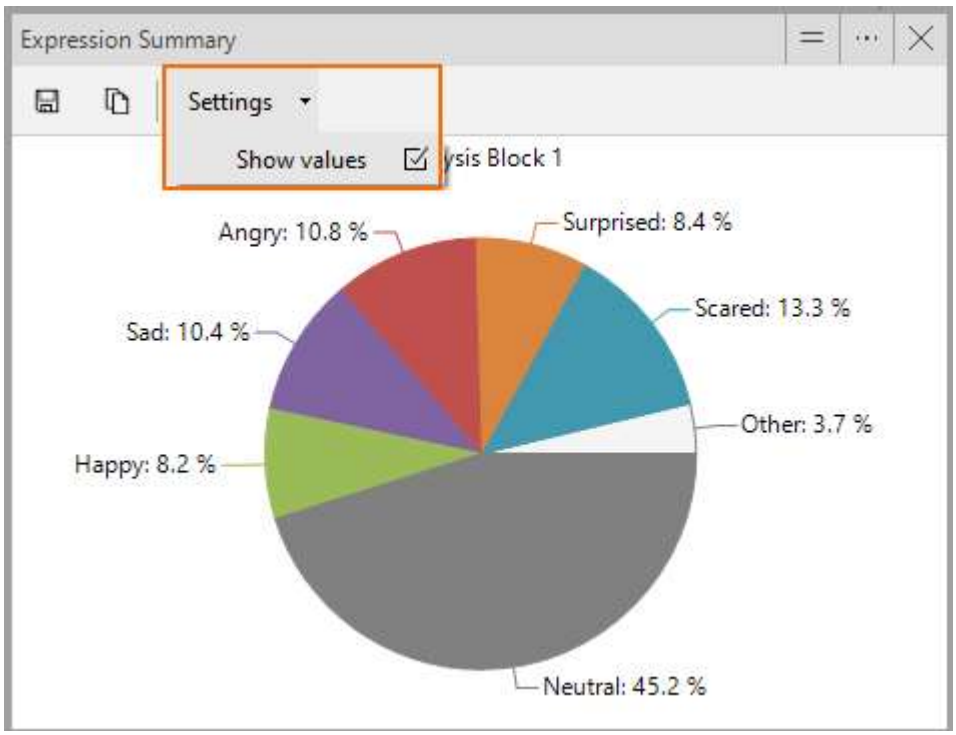
Expression summary

The chart shows the distribution of facial expressions for the complete analysis. If you analyzed multiple intervals in one video all the intervals are taken into account in the Expression Summary chart.



Options

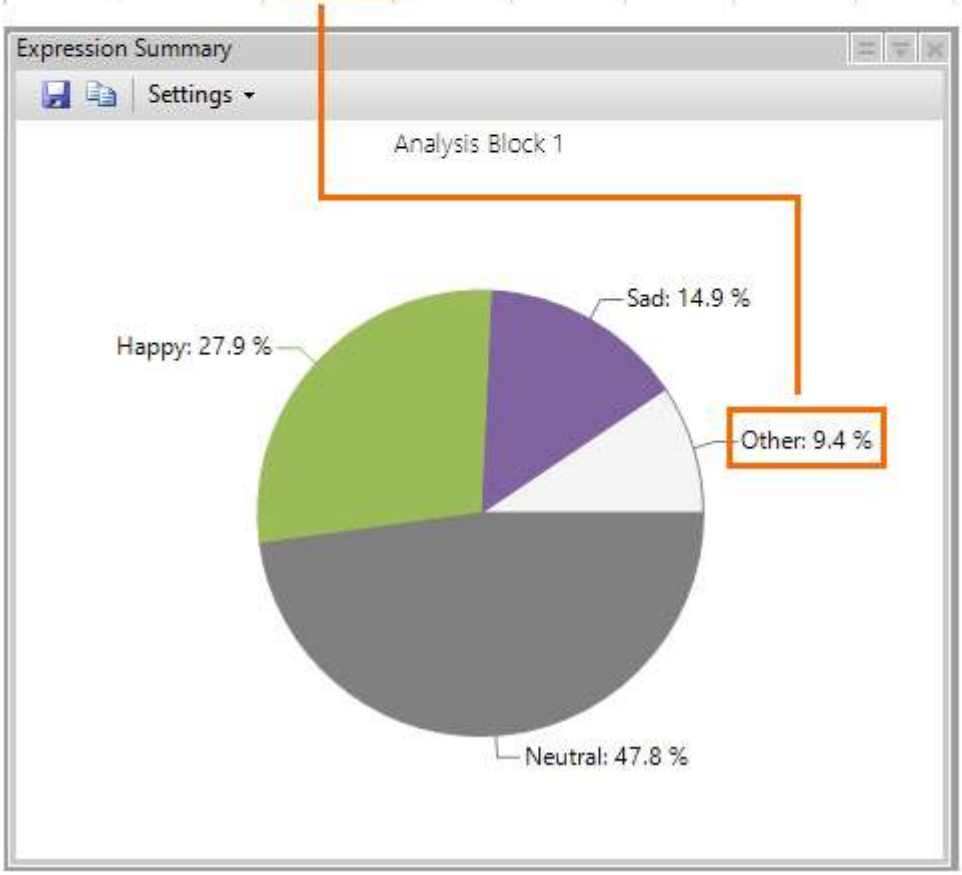
Click **Settings** and select **Show Values** to view the subdivision of emotions in percentages.



What does *Other* mean?

Expressions that make up less than 5% of the sum of all expression intensities are included in the category **Other**. The example below shows part of the detailed log of an analysis. For each expression, the total intensity is calculated. Angry, Surprised, Scared and Disgusted each have a total intensity of less than 5% of the sum of all intensities. The sum of these four expressions is displayed as *Other* in the Expression summary.

01:21.8	0.778516	0.04673	0.1358	0.01906	0.003087	0.0198	0.0147
01:21.8	0.783598	0.04556	0.13247	0.01906	0.003119	0.0197	0.01421
01:21.9	0.788584	0.0444	0.12915	0.01906	0.00314	0.0196	0.01374
01:21.9	0.792583	0.04336	0.12619	0.01903	0.003187	0.0196	0.01331
01:21.9	0.795877	0.04243	0.12346	0.01902	0.003256	0.0197	0.0129
01:22.0	0.799617	0.04167	0.12055	0.01898	0.003296	0.0198	0.01249
01:22.0	0.803244	0.0411	0.1178	0.01891	0.003344	0.0198	0.01207
01:22.0	0.805547	0.04058	0.11566	0.01889	0.00341	0.0201	0.01169
01:22.1	0.806225	0.04039	0.1141	0.01892	0.003528	0.0205	0.01135
	Neutral	**Happy**	**Sad**	**Angry**	**Surprised**	**Scared**	**Disgusted**
Total per expression	1185.159	692.169	368.161	114.464	17.74232	53.729	47.7422
Percentage	47.8	27.9	14.9	4.6	0.7	2.2	1.9
Total all expressions	2479.166						
Percentage other	9.4						



Facial States

To access this option

Click the **Select window** button in one of the visualization windows, select **Face Analysis**, and then **Facial States**.

Facial States

The Facial States table gives a dynamic overview of the following states:

- Gaze Direction (Left, Left-Up, Left-Down, Forward, Up, Down or Right, Right-Up, Right-Down) (only available if you selected **Gaze tracking** in the **Settings** > **Analysis Options**).
- Gaze Type (Fixation or Saccade) (only available if you selected **Gaze tracking** in the **Settings** > **Analysis Options**).
- Mouth (open or closed)
- Eyes (open or closed)
- Eyebrows (raised, neutral or lowered)

Facial States

	State
Gaze Direction	Down
Gaze Type	Fixation
Mouth	Closed
Left Eye	Open
Right Eye	Open
Left Eyebrow	Neutral
Right Eyebrow	Neutral

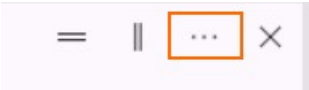
Note

If the table shows **Disabled** behind all the states and you want to view the Facial States, choose **File** > **Settings**. On the tab **Analysis Options**, under **Optional Classifications** select **Facial States**.

Gaze Angles Line Chart

To access this option

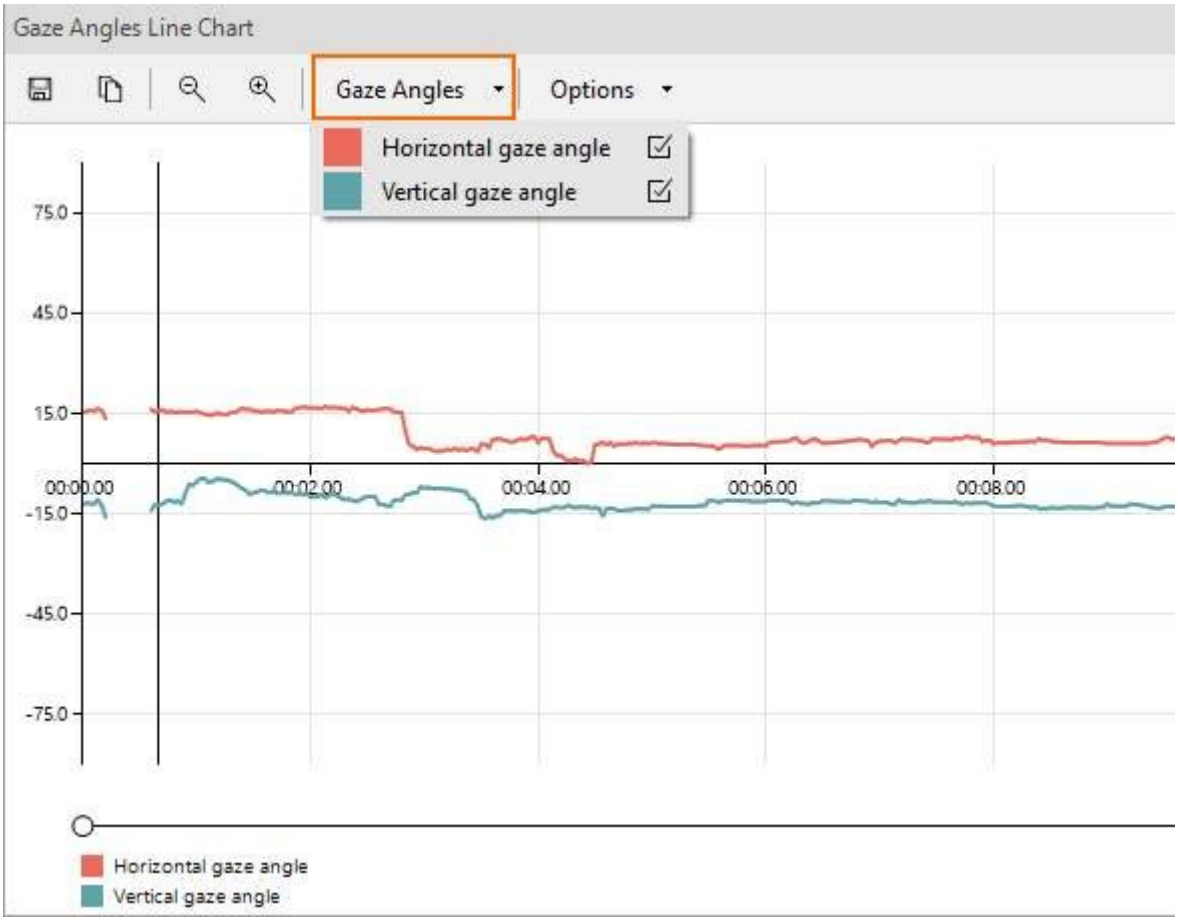
Click the **Select window** button in one of the visualization windows, select **Face Analysis,** and then **Gaze Angles Line Chart**. The **Gaze Angles Line Chart** is only available if you selected **Gaze tracking** in the **Settings** > **Analysis Options**.



Gaze Angles Line Chart

The Gaze Angles Line Chart displays the Horizontal and Vertical gaze angle over time (in degrees). When you play back the video, a hairline shows the time in the video.

Click **Gaze Angles** to select what gaze angle you want to view over time (Horizontal gaze angle and/or Vertical gaze angle).


Gaze Angles Line Chart
Gaze Angles
Options
Horizontal gaze angle
Vertical gaze angle
75.0
45.0
15.0
-15.0
-45.0
-75.0
00:00.00
00:02.00
00:04.00
00:06.00
00:08.00
Horizontal gaze angle
Vertical gaze angle

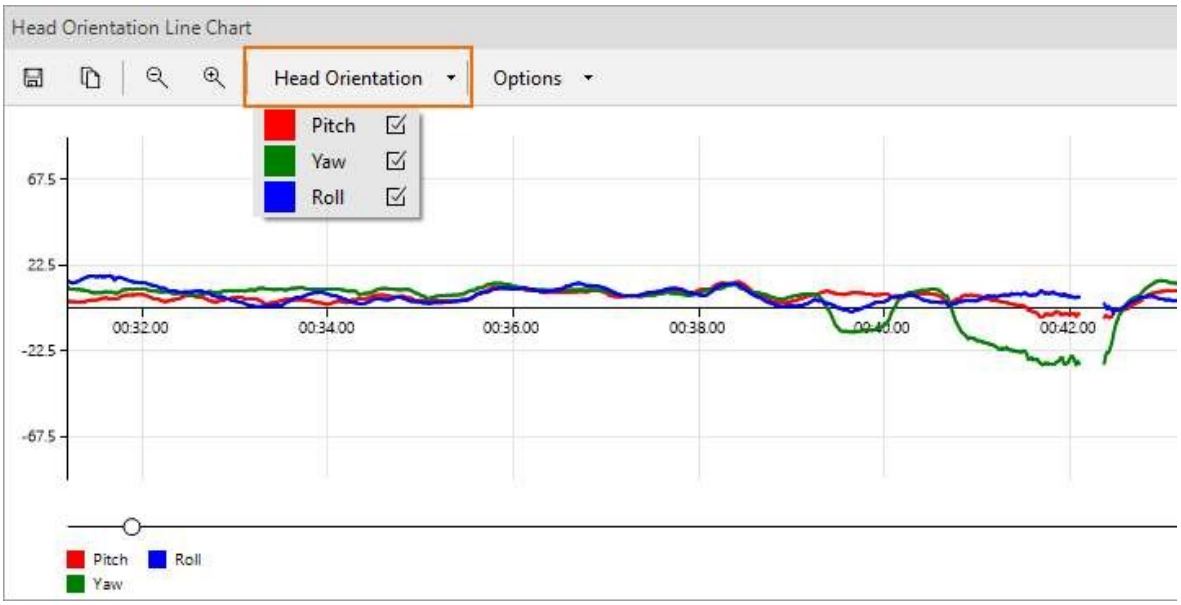
Head Orientation Line Chart

To access this option

Click the **Select window** button in one of the visualization windows, select **Face Analysis,** and then **Head Orientation Line Chart**.

Head Orientation Line Chart

The Head Orientation Line Chart displays the head orientation as the Pitch, Yaw and Roll over time. It is displayed in degrees deviating from looking straight forward. When you play back the video, a hairline shows the time in the video.



Head orientations

Click **Head Orientation** to select whether you want to view the Pitch, Yaw or Roll.

Head Position Line Chart

To access this option

Click the **Select window** button in one of the visualization windows, select **Face**, and then **Head Position Line Chart**.

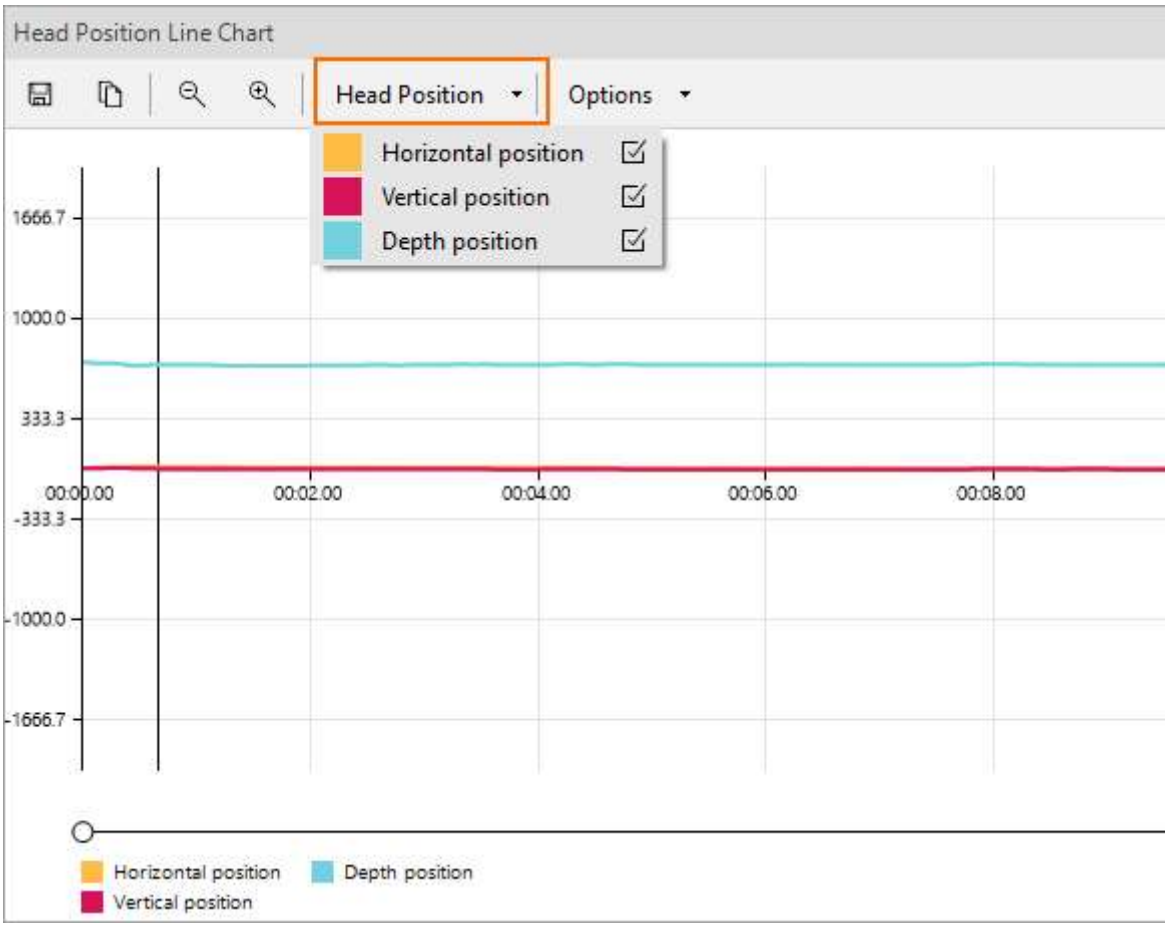
Head Position Line Chart

The Head Position Line Chart displays the head position relative to the camera over time (Horizontal, Vertical and Depth position, in millimeters). When you play back the video, a hairline shows the time in the video.

FaceReader's face model is defined in millimeters. By a projection of the 3D model to the 2D image FaceReader can derive where in real world coordinates the face is in the 2D image (and an estimated camera projection matrix). FaceReader's 3D coordinates are centered around the camera, the camera is at (0,0,0). Therefore, the 3D coordinates of the fitted model will tell you where the face is relative to the camera.

Head positions

Click **Head Position** to select what head position you want to view over time (Horizontal position, Vertical position and/or Depth position).


Head Position Line Chart
Head Position
Options
Horizontal position
Vertical position
Depth position
1666.7
1000.0
333.3
00:00.00
00:02.00
00:04.00
00:06.00
00:08.00
-333.3
-1000.0
-1666.7
Horizontal position
Depth position
Vertical position

Subject Characteristics

This option is not available with Baby FaceReader.

To access this option

Click the **Select window** button in one of the visualization windows, select **Face Analysis,** and then **Subject Characteristics**.

Subject Characteristics

The Subject Characteristics table displays the following:

- Gender – A range is given with a certainty value. If the gender is entered manually in the Independent Variables, the value is fixed and the certainty is 100%.
- Age – A range is given with a certainty value. If the age is entered manually in the Independent Variables, the value is fixed and there is no certainty displayed in the table.
- Presence of glasses – A certainty value is given.

Subject Characteristics

	Result	Amount	Certainty
Gender (fixed)	Female		100%
Age (fixed)	31		
Glasses	No		100%

Note

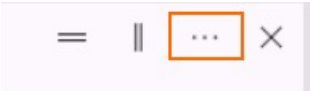
The **Subject Characteristics** table also gives you an indication of the quality of the image. If the quality of your image is poor, the information will not be correct. For instance, if FaceReader reports that a female test person is male, then the modeling

is not correct, most probably because the image is of poor quality or the lighting conditions are bad.

Valence and Arousal Line Chart

To access this option

Click the **Select window** button in one of the ~~lower~~ visualization windows, ~~and~~ select **Face Analysis** and then **Valence and Arousal Line Chart**.



Valence

Valence indicates whether the facial expressions display a positive or negative emotion.

See the figure below for an example. When you play back the video, a hairline shows the time in the video.

How valence is calculated

The valence indicates whether the emotional status of the subject is positive or negative. 'Happy' is the only positive emotion, 'Sad', 'Angry', 'Scared' and 'Disgusted' are considered to be negative emotions. 'Surprised' can be either positive or negative and is, therefore, not included in the calculation of valence. Contempt is also not included in the calculation of Valence.

Valence is calculated as the intensity of 'Happy' minus the intensity of the negative emotion with the highest intensity.

If you have Baby FaceReader, Valence is based on Action Units.

Example

Consider the following expression intensities:

- Happy – 0.8
- Sad – 0.1
- Angry – 0.0
- Scared – 0.05
- Disgusted – 0.05

In this case Valence is 0.8 - 0.1 = 0.7.

Arousal

Arousal indicates whether the test participant's face is active (+1) or not active (0). Arousal is based on the activation of 20 Action Units (AUs) of the Facial Action Coding System (FACS).

See the figure above for an example. When you play back the video, a hairline shows the time in the video.

How Arousal is calculated

1. The activation values (AV) of 20 AUs are taken as input. These are AU 1, 2, 4, 5, 6, 7, 9, 10, 12, 14, 15, 17, 18, 20, 23, 24, 25, 26, 27, and the inverse of 43. The value of AU43 (eyes closed) is inverted because it indicates low arousal instead of high arousal like the other AUs.
2. The arousal is calculated by taking the mean of the three highest values.

Note

- Contempt is not included in the calculation of Arousal.

Stimulus View

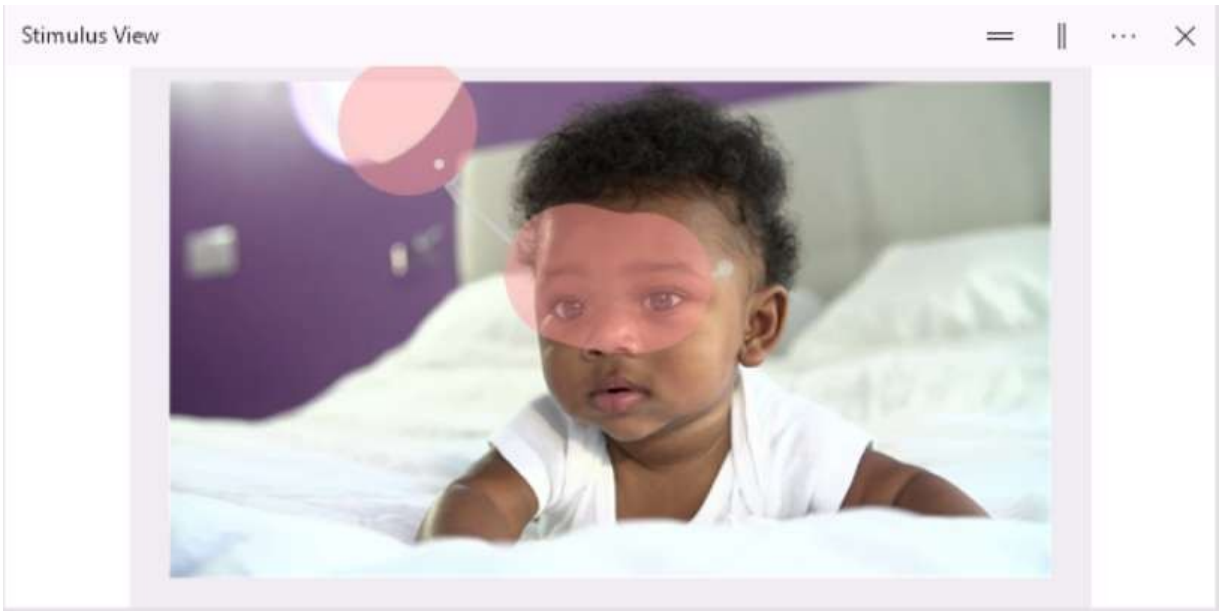
To access this option

Click the **Select window** button in one of the visualization windows, select **Face Analysis**, and then **Stimulus View**.

Stimulus View

FaceReader comes with the Stimulus Presentation tool which allows you to present stimuli to your test participants during the test. The **Stimulus View** window displays the stimulus video or image. In addition to the **Stimulus View** window you can, for instance, visualize the participant's **Expression Intensity** chart, play back the analysis and assess what facial expressions the stimuli induced.

If your FaceReader license includes the Advanced Research Module and you selected **Perform gaze calibration** when you defined the test, the window also shows the participant's gaze overlay.



Timeline

To access this option

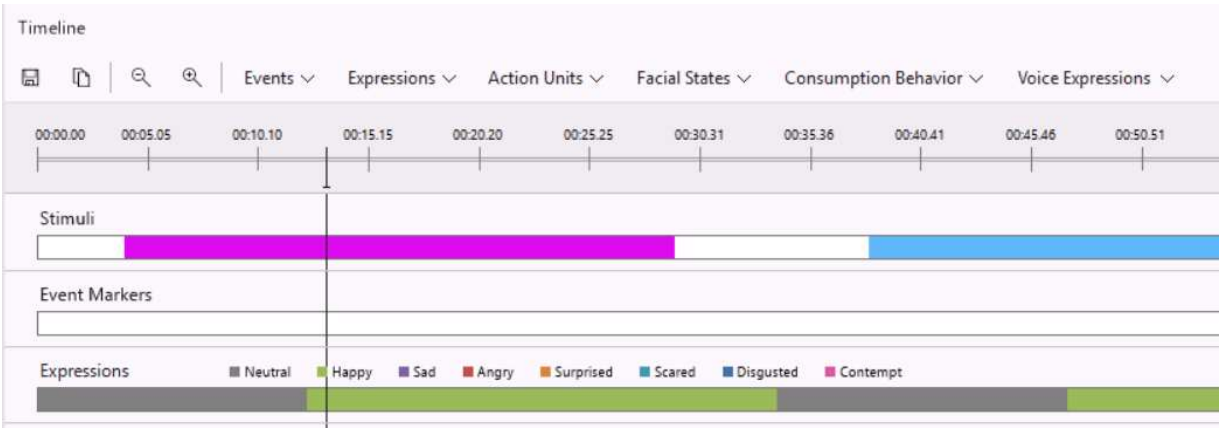
Click the **Select window** button in one of the visualization windows and select **Timeline**.

Timeline

The Timeline gives an overview of the Facial Expressions, Facial States, Stimuli, Event markers and Optional classifications on a timeline.

- If your license includes The Action Unit Module, the Timeline also displays Action Units.
- If you selected Gaze tracking in the **Settings** > **Analysis Options**, the Timeline also displays Gaze Direction and Gaze Type (saccades/fixations).
- If you have the Consumption Behavior Module, the Timeline also displays the behaviors 'Intake event', 'Chewing' and 'Chew motion' on a timeline.
- If your license includes the Voice Analysis Module, the Timeline also displays the dominant emotions recognized in the participant's voice.
- If you have Baby FaceReader, the Timeline only shows Action Units and Facial States.

You can play back through the timeline together with playing back the analyzed/ recorded video.

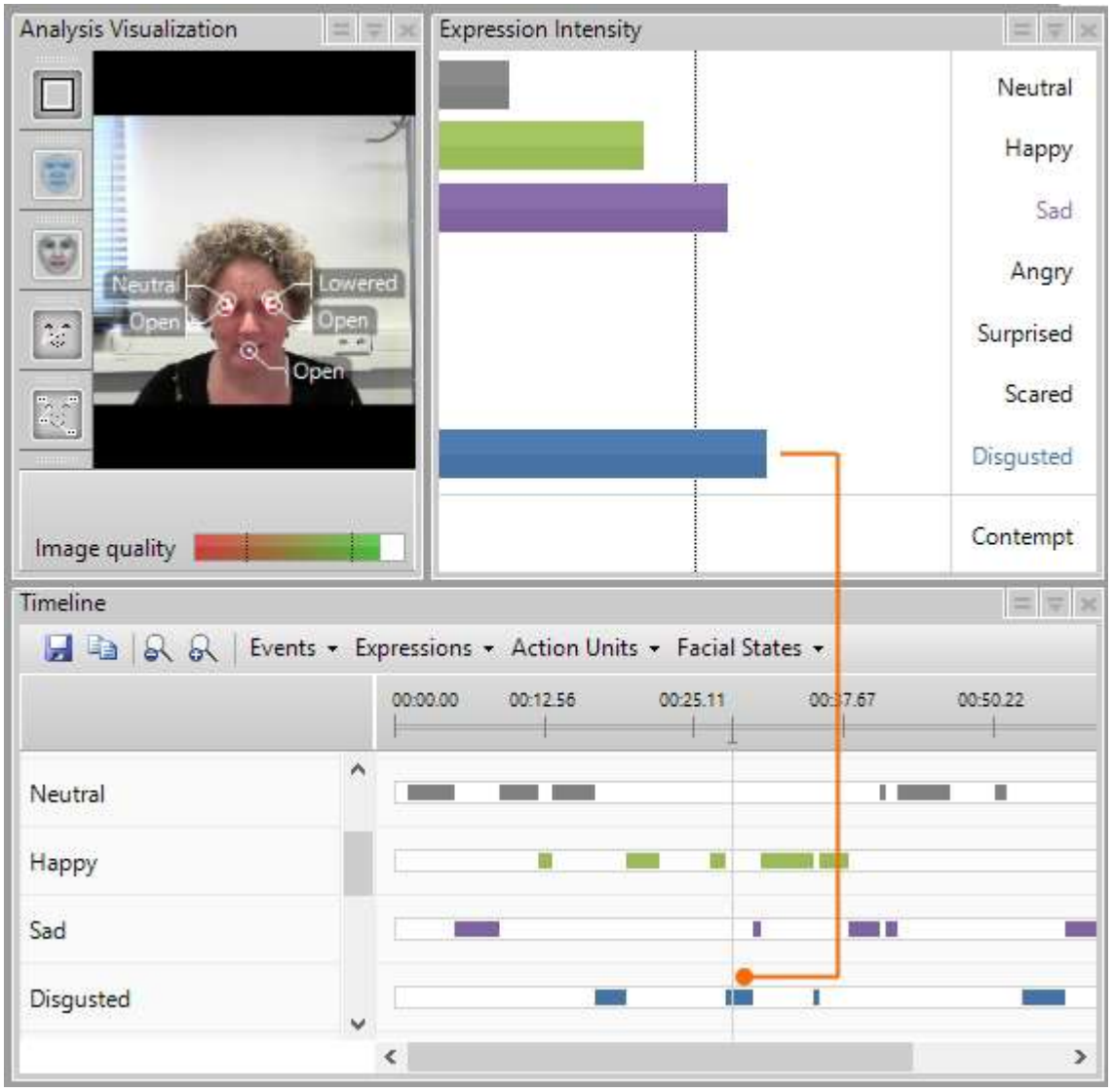


Unknown means that no face is found or the face cannot be modeled (for instance, because the quality of the video is poor or a hand partly hides the face). For video analysis, **Not Analyzed** indicates what part of the video has not yet been analyzed.

Expression states explained

An expression is dominant when its intensity is higher than that of all others. Each time the dominant facial expression changes and is active for at least 0.5 seconds, this expression is scored as a state. This state appears in the Timeline and is also scored with its time stamp in the State log.

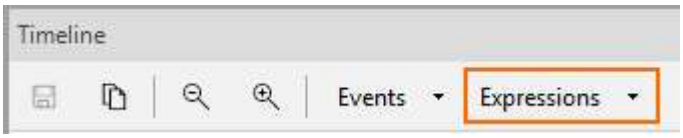
Note that if the intensity, as displayed in the Head Orientation Line Chart, exceeds 0.5, this does not necessarily mean that an expression state is scored. In the following example the Expression Intensity is compared with the Expression states. *Sad* and *Disgusted* exceed 0.5, but only *Disgusted* is scored at that time, because its intensity is higher than that of *Sad* and was dominant for at least 0.5 seconds. (see the blue bar on the timeline).



Options

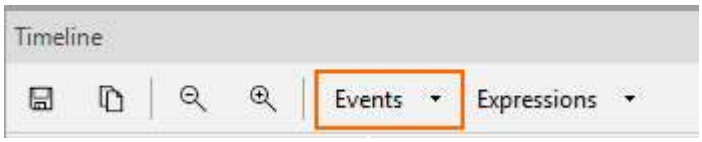
Expressions

Click **Expressions** and choose which expressions you want to view. By default all expressions are selected.



Events

The timeline also shows the Stimuli and Event Markers in your project. Optionally deselect either the Stimuli, Event Markers, or both using the Events button.

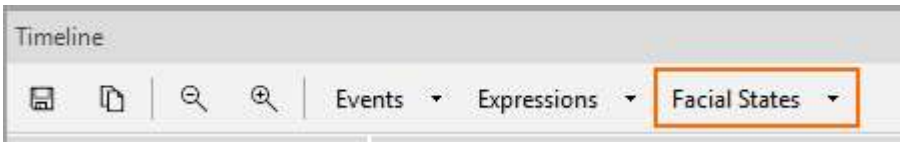


Expressions

Deselect Expressions if you do not want to see them on the Timeline.

Facial States

With **Facial States**, choose whether you want to display the Facial States (Left Eye, Right Eye, Left Eyebrow, Right eyebrow, Mouth). By default, all these options are selected.



Gaze tracking

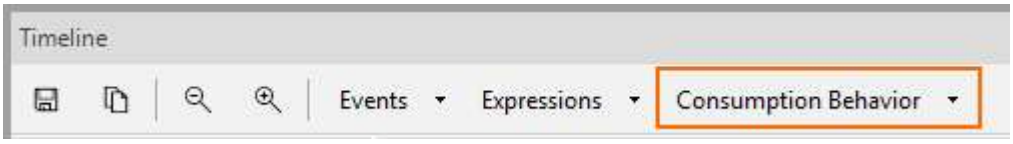
If you selected Gaze tracking in the **Settings** you can visualize the **Gaze Direction** and **Gaze Type** on the Timeline.

Action Units

If you have the The Action Unit Module, the timeline also shows the intensity of the Action Units. Optionally, deselect some Action Units, using the **Action Units** button.

Consumption Behavior

If you have The Consumption Behavior Module, the timeline also shows the behaviors 'Intake event', 'Chewing' and 'Chew motion'. Optionally, deselect some from the **Consumption Behavior** drop-down list.



Voice Expressions

If you have the Voice Analysis Module the Timeline also displays the dominant emotions recognized in the participant's voice.

Notes

- For more information about the State log, see Export analysis results.
- If you want to use other criteria to define a state, for example when the intensity of an expression is above 0.5, export the detailed log. Then calculate the states in another program, like Excel.

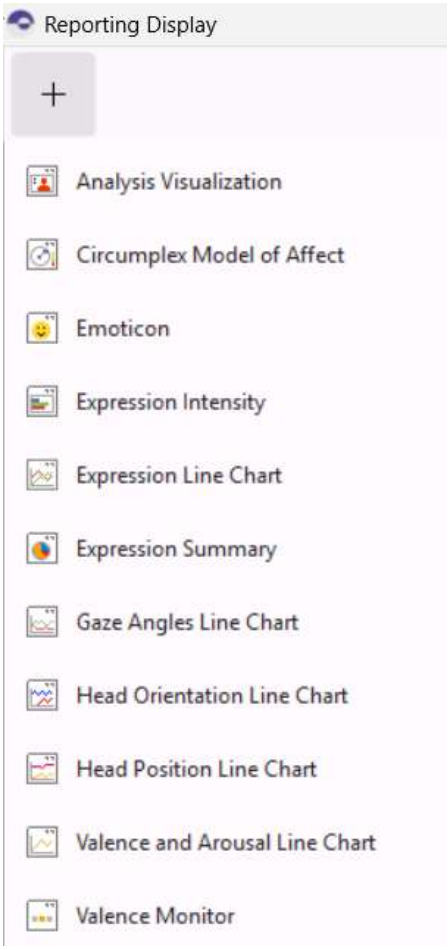
  See Export analysis results

Reporting Display

The reporting display is a fully customizable visualization of FaceReader's output. You can use it on a second monitor, or to create visuals in a report or presentation.

To access this option

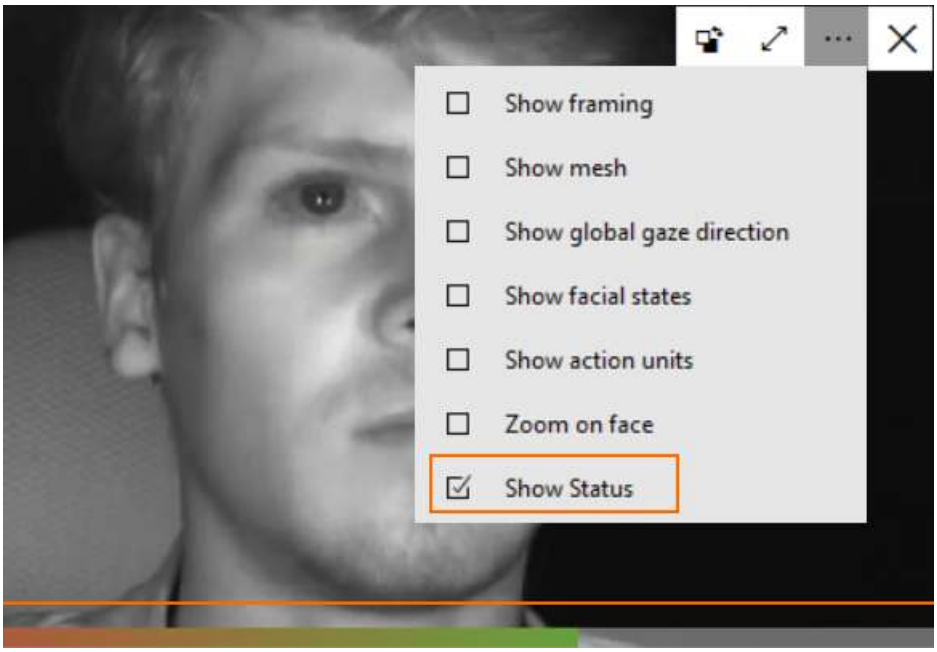
1. Choose **View** > **Reporting Display**.
2. Click the plus sign and choose one of the available windows.



For more information on the output in these windows see the links below.

- Analysis Visualization

  Click on the Ellipsis button (...) for visualization options. The same options are available as in the regular output of Facereader. The additional option **Show status** displays the Model Quality Bar.



- Circumplex Model of Affect

  Click on the Ellipsis button (...) for visualization options. The same options are available as in the regular output of Facereader.

- Custom expressions line chart

  See **Visualize Custom Expressions** in **The Action Unit Module**. This option is available when you have the Action Unit Module and added a Custom Expression to your project.

  Click on the Ellipsis button (...) to select which custom expression to display.

- Emoticon

  The emoticon dynamically visualizes the test participant's facial expressions. Each expression has a number of features (except 'scared'):

  Happy — Smiling mouth.

  Sad — Corners of the mouth down and tears dropping from the eyes.

  Angry — Red face, eyebrows lowered.

  Surprised — Big eyes, raised eyebrows.

  Disgusted — Tongue sticking out.

- Expression Intensity
- Expression Line Chart

  Click on the Ellipsis button (...) to select the expressions to display in the chart.

- Expression summary

  Click on the Ellipsis button (...) and choose **Show values** to display percentages for the facial expressions.

- Gaze Angles Line Chart

  Click on the Ellipsis button (...) to select whether you want to view the changes in the Horizontal or Vertical gaze angle.

- Head Orientation Line Chart

  Click on the Ellipsis button (...) to select whether you want to view the changes in Pitch, Yaw or Roll.

- Head Position Line Chart

  Click on the Ellipsis button (...) to select whether you want to view the changes in the Horizontal, Vertical or Depth position.

- Valence and Arousal Line Chart

  Click on the Ellipsis button (...) to select whether you want to view the Valence or the Arousal or both parameters.

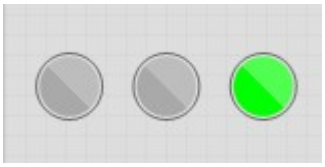
- Valence Monitor

  The Valence Monitor is a three-light indicator. The light is

  Green — The valence of the analyzed frame is above 0.33.

  Orange — The valence is between -0.33 and +0.33.

Red — The valence is below -0.33.



- Vital signs

  This option is available if you have the Vital Signs Module. See Vital Signs window in The Vital Signs Module.

- Voice Expression Intensity

  This option is available if your FaceReader license includes the Voice Analysis Module. See Voice Expression Intensity in The Voice Analysis Module.

- Voice Expression Line Chart

  Click on the Ellipsis button (...) to select the expressions to display in the chart. This option is available if your FaceReader license includes the Voice Analysis Module. See Voice Expression Line Chart in The Voice Analysis Module.

- Voice Valence and Arousal Line Chart

  Click on the Ellipsis button (...) to select whether you want to view the Valence or the Arousal or both parameters. This option is available if your FaceReader license includes the Voice Analysis Module. See Voice Valence and Arousal Line Chart in The Voice Analysis Module.

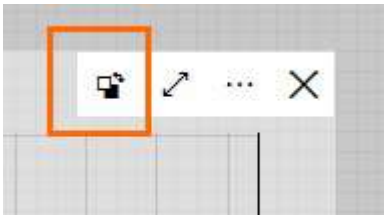
- Voice View

  This option is available if your FaceReader license includes the Voice Analysis Module. See Voice View in The Voice Analysis Module.

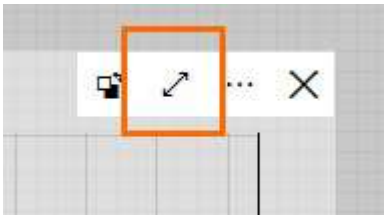
General options

All charts

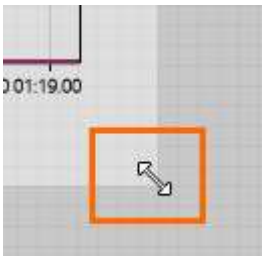
- To position a window in front of or behind another window, click on the **Toggle Back/Front** icon on the chart.



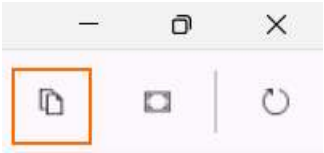
- To Maximize a window, click on the **Maximize** icon on the chart.



- To scale a window, drag the border of the window.



- To copy the presentation view, for example to paste it in a report or presentation, click on the **Copy** icon.



- To maximize the entire reporting display, click on the **Toggle full screen** icon in the upper-right corner of the window.

- To remove all windows, click on the **Reset** icon.

Line charts

To adjust the Y axis to the maximum value, click on the Ellipsis button (...) and choose **Auto scale Y axis**.

Note

The Reporting display is persistent. When you open a new project, the reporting display will open with the windows and layout that you selected in your last project.

Export analysis results

Aim

To save your analysis results as text file, Excel file or The Observer XT format file (.odx) for further analysis in another program.

Prerequisites

- You carried out analyses.
- The values of all independent variables have been scored for all participants. Analyses of participants with unscored independent variables cannot be exported. This is indicated with a warning icon in front of the participant name. Score the independent variable values for those participants.

Procedure

Exporting analysis results consists of the following steps:

1. Choose what to export
2. Export the data

Choose what to export

1. Choose **File** > **Settings** > **Data Export**.
2. Under **Export (Detailed log, ODX, N-Linx and API)** choose the data to export.

Export the data

1. Choose **File** > **Export** > and choose one of the following:

   Export Analysis Results— To export the results of the analysis currently open.

   Export Participant Analysis Results — To export the results of all analyses related to the participant currently selected.

   Export Project Results — To export the results of the entire project.

2. Browse to the location on your computer where you want to store your log files and click **OK**. The default location is:

C:\Users\<your username>\Documents\Noldus\FaceReader 10 ~~9~~\Projects\<Project Name>\Logs.

3. If you chose **Export Analysis Result** in step 1, give the export file a name. A suffix with the export type, like detailed or state, will be added to the export name.

   If you chose **Export Participant Analysis Result** or **Export Project Result,** the export files are named automatically.

4. Choose one of the following:

- Export to text files or Excel files — There are four options to select from:

  - Text files (tab delimited) - 1 file per participant/analysis

  - Excel files - 1 file per participant/analysis)

  - Combined Excel files (one sheet per analysis) - 1 file, analyses on sheets

  - Combined Excel files (all analyses in one sheet) - 1 file, all data on 1 sheet

- Export to The Observer XT (.odx)

Export to text files or Excel files

Choose to export the State log, Detailed log or Heart beat log. The Heart beat log option is available if you have the Vital Signs Module. For more information see Export heart beat log.

State log

The State log shows the expression state the test person displays (see the figure below for an example). A record is added to the log each time the dominant expression changes and is active for at least 0.5 seconds. If no face is found or the face cannot be modeled, for instance because the quality of the video is poor, a record with **Unknown** is added to the State log.

You can export State logs as text files with the data separated by tabs or as Excel files.

Participant 1_Annelies_Analysis 1_video_20210517_123200_state.txt - Notepad

File Edit Format View Help

```
Video analysis state log

Face Model      General
Calibration     -
Start time      7/19/2019 14:38:43.547
Filename        \Videos\Annelies.avi
Frame rate      30.000030000

Age     Gender
29.000000000    Female


Video Time      Dominant Expression
00:00:00.000    Unknown
00:00:01.099    Neutral
00:00:12.766    Happy
00:00:34.299    Neutral
00:00:47.133    Happy
00:00:57.899    Neutral
00:00:58.466    Happy
00:01:11.566    Neutral
00:01:14.133    Happy
00:01:15.766    END
```

NOTE To change the word 'Unknown' in the State log, see Export (Detailed log and API) in Settings

NOTE If you want to use other criteria to define a state, for example when the intensity of an emotion is above 0.5, export the detailed log. Then calculate the states in another program, like Excel.

Detailed log

The Detailed log (see the figure below for an example) contains all the expression classifier outputs and the other data you selected for export. Each expression has a value between 0 and 1, indicating the intensity of the expression. '0' means that the expression is not visible, '1' means that it is fully present. You can export the Detailed logs as text files with the data separated by tabs or as Excel files.

When no face is found or the face cannot be modeled (e.g. because the quality of the video is poor), a record with FIND_FAILED or FIT_FAILED is added. If you work live (using a camera) and your computer cannot process the incoming images fast enough, frames will be skipped and a record with MISSING will be added to the Detailed log.

NOTE To change the words FIND_FAILED, FIT_FAILED, or Unknown in the Detailed log, see Export (Detailed log and API) in Settings

If you analyze a video file and skip frames (that is, you set the Sample rate to Every 2nd frame or Every 3rd frame), the logging frequency changes accordingly.

	A	B	C	D	E	F	G	H
1	Video analysis detailed log							
2								
3	Face Model	General						
4	Calibration	Calibration Natasja (0.89275, 0.00008, 0.03040, 0.00714, 0.18510, 0.00324, 0.0						
5	Start time	2/13/2023 16:37:29.292						
6	Filename	\Videos\Natasja.avi						
7	Frame rate	30.00003						
8								
9	Age	Gender						
10	31	Female						
11								
12								
13	Video Time	Neutral	Happy	Sad	Angry	Surprised	Scared	Disgusted
14	00:00:00.000	0.793276	0	0.063159	0.001543	0	0	0.011708
15	00:00:00.033	0.781543	4.32E-05	0.062521	0.00152	0	0	0.014003
16	00:00:00.066	0.782483	9.56E-05	0.058906	0.001443	0	0	0.016457
17	00:00:00.099	0.788544	0.000146	0.053308	0.006592	0.01243	0	0.015589
18	00:00:00.133	0.802235	0.000187	0.048242	0.008155	0.019689	0	0.01413
19	00:00:00.166	0.812937	0.000247	0.043658	0.010686	0.028313	0	0.012795
20	00:00:00.199	0.823353	0.000246	0.039509	0.009715	0.032899	0	0.011579
21	00:00:00.233	0.837954	0.000233	0.035754	0.008791	0.031213	0	0.010638
22	00:00:00.266	0.852007	0.000234	0.033131	0.007956	0.028246	0	0.00963
23	00:00:00.299	0.863407	0.000227	0.033222	0.0072	0.025562	0	0.008715
24	00:00:00.333	0.869527	0.00021	0.039441	0.006516	0.023133	0	0.007965

For the Detailed log you have the following options:

- **Adjust the export sample rate** – To create a log file with a lower sample rate than the FaceReader analysis. You can choose a value between 1 and 15 frames per second. FaceReader interpolates the analysis results if the chosen sample rate results in interpolated timestamps.

  You can also choose to adjust the export sample rate to a value between 1 and 60 frames per minute. Note that this is averaging the results towards the new time base, centered at the time logged. So if you log 1 frame per

minute, the result at the 1th minute will be the average of 0.00.30.000 to 0.01.30.000.

- **Include file header** – To include the following information as header in the export file:

  - Face Model

  - Calibration – calibration name and calibration values (the average intensity values of Neutral, Happy, Sad, etc. that are found during the calibration, that is, I_C in the formula used to calculate the corrected expression intensities. See How participant calibration works).

  - Start date and time

  - Video filename

  - Analysis frame rate

  - Independent variables

- **Include column header** – To include column details in the export file.

Note

If you analyzed from video and your video was not recorded with exactly the frame rate you selected, for example 29.9 fps instead of 30 fps, the timestamps may be slightly different from what you may have expected.

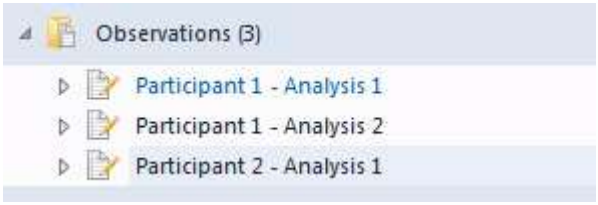
Export to The Observer XT (.odx)

The Observer log contains the analysis results, in XML format. Select this output format if you want to import your data for further analysis in The Observer XT, our software package for collecting observational data. You have the following options:

- **Include detailed values** – To save both the Detailed log as the State log in the export file. Choose this option if your license for The Observer XT does not include the External Data Module. The Detailed log data will be imported as numerical modifiers. If you have the External Data Module, select **Save Detailed log**. The Detailed log data will then be imported as external (continuous) data into The Observer XT. See How FaceReader data are imported into The Observer XT.
- **Save all analyses to a single The Observer XT log** – This option is available when you export the results of a participant, or an entire project. This option allows you to import all analyses results at once into The Observer XT. The different participants and analyses are imported into separate observations. Since FaceReader export files can be very large, we

recommend to create a FaceReader export file for each analysis and import them one by one in The Observer XT.

Each observation in The Observer XT contains the name of the imported participant and analysis.



File name

The default name for the export log files is:

[Participant number]_[Participant name]_[Analysis name]_[Analysis type]_ YYYYMMDD_hhmmss_[Export file type]

Where:

- [Participant number] is the number given automatically (Participant 1, 2 etc.)
- [Participant name] is the name entered under **Name** when adding that participant
- [Analysis name] the name of the selected analysis
- [Analysis type] specifies whether an image, video, or camera analysis has been carried out.
- YYYYMMDD_hhmmss is the date/time code of the start of the analysis.

  YYYY = year including the century.

  MM = month with leading zero.

  DD = day with leading zero.

  hh = hours, 12-hour format with leading zero.

  mm = minutes with leading zero.

  ss = seconds with leading zero.

Note

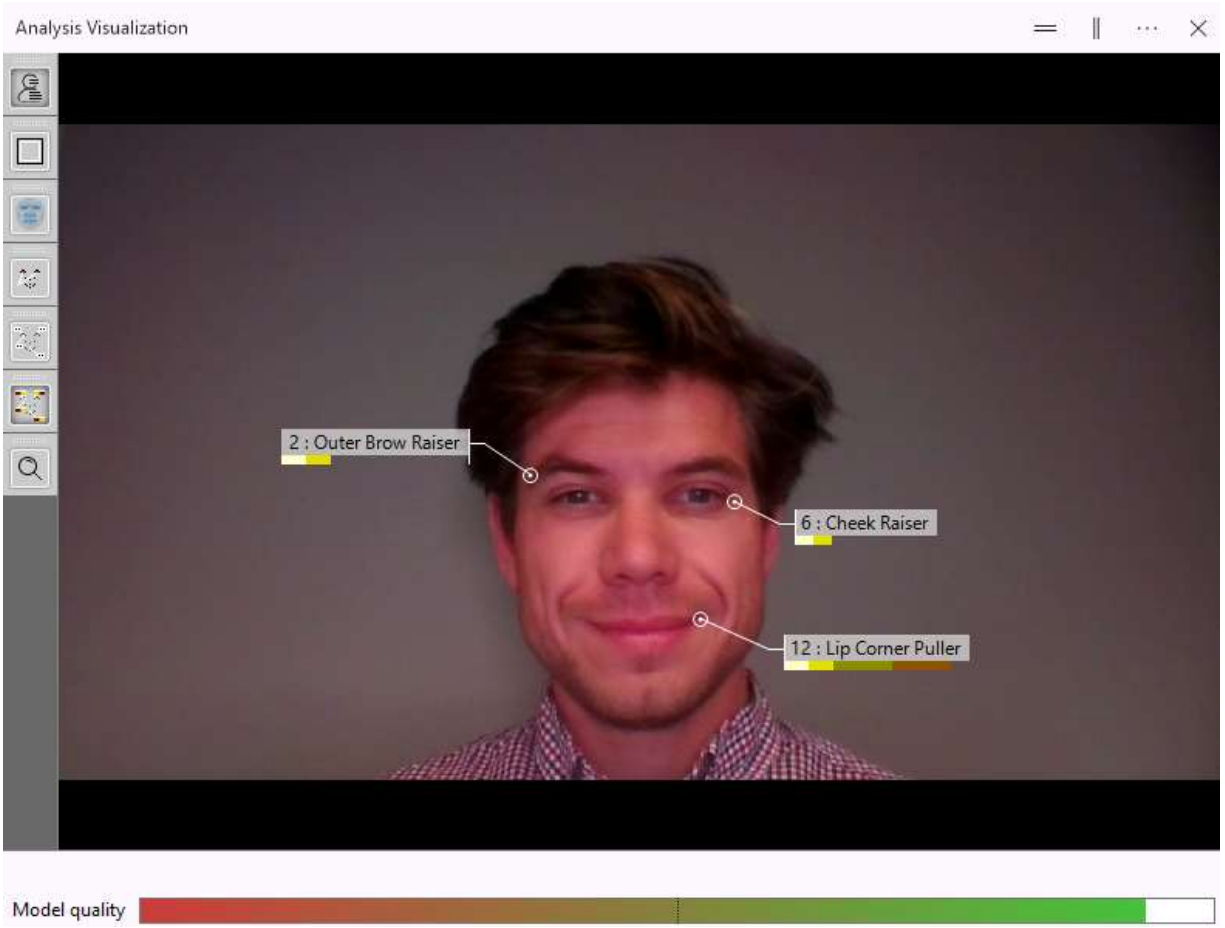
If you want to import the detailed log as external data into The Observer XT, export the detailed log as text file and select the options **Include file header** and **Include column header**. Otherwise the import profile **FaceReader 10 detailed log as external** data does not work.

If you have additional modules and selected additional data when you exported the Detailed log data (like Action Units or Expressions from voice) you need to make a new import profile. See **External Data** in The Observer XT Help how to do so, or contact Noldus Support.

See:

- Export to text files or Excel files
- Import the detailed logs as external data in FaceReader with The Observer XT

The Action Unit Module



Main topics

- Introduction to Action Unit classification
- Analyze Action Units
- Visualize Action Units
- Action Units in the log files
- Custom Expressions

Introduction to Action Unit classification

Action Units are muscles or muscle groups in the face that are responsible for facial expressions. The Action Units are described in the Facial Action Coding System (FACS) published by Ekman and Friesen (1978).

FaceReader can analyze Action Units with the Action Unit Module. The following Action Units are analyzed:

Action Unit	FACS Name
1	Inner Brow Raiser
2	Outer Brow Raiser
4	Brow Lowerer
5	Upper Lid Raiser
6	Cheek Raiser
7	Lid Tightener
9	Nose Wrinkler
10	Upper Lid Raiser
12	Lip Corner Puller
14	Dimpler
15	Lip Corner Depressor
17	Chin Raiser
18	Lip Pucker
20	Lip Stretcher
23	Lip Tightener
24	Lip Pressor
25	Lips Part
26	Jaw Drop
27	Mouth Stretch
43	Eyes Closed

If you have Baby FaceReader, you can analyze the combined activation of Action Unit 3 and 4 (Brow Knitting and Knotting).

Intensities are annotated by appending letters:

- A - trace.
- B - slight.
- C - pronounced.
- D - severe.
- E - max.

These intensities follow the classification as described in Ekman et al. (2002).

In FaceReader 9.1.8 and higher the classification of Action Units gives slightly lower intensities than in older versions of the software. In older versions non-active Action Units could be classified with intensity level A, A-level Action Unit activations with level B, etc. The reason for this difference is an error in the conversion script of the underlying deep neural network that has been corrected in FaceReader 9.1.8.

The values of Contempt, Arousal, facial states (except Gaze direction) and Valence in Baby FaceReader are also affected as these parameters are based on Action Units. Valence in the regular version of FaceReader is based on facial expressions only and is, therefore, not affected. The calculation of most custom expressions is also based on Action Units and the intensities of these custom expressions are, thus, also different. For the most accurate Action Unit estimation it is important to use the latest version of the software and re-analyze old videos if you want to compare the data with those obtained with the new FaceReader version.

References

- Ekman P. and W. V. Friesen (1978). *Facial Action Coding System: A Technique for the Measurement of Facial Movement*. Consulting Psychologists Press, Palo Alto.
- Ekman P., W. V. Friesen, and J. C. Hager (2002). *The Facial Action Coding System. Second edition*. Salt Lake City: Research Nexus eBook. London: Weidenfeld & Nicolson (world).

Analyze Action Units

Aim

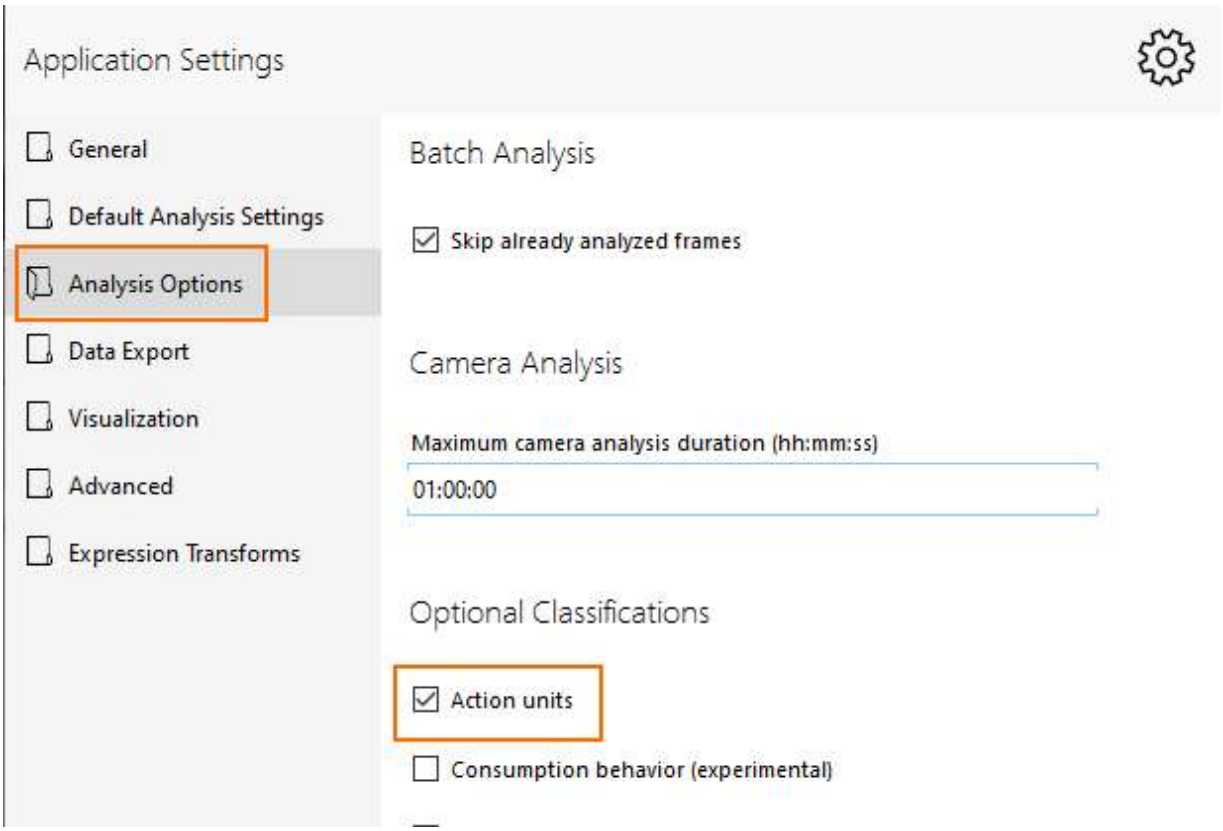
To quantify activation of Action Units in the test participant's face.

Prerequisite

Your FaceReader license includes the Action Unit Module.

Procedure

1. Choose **File** > **Settings** > **Analysis options**.
2. Under **Optional Classifications**, select **Action units**.



Action Unit Analysis is by default switched on if your FaceReader license includes the Action Unit Module.

Visualize Action Units

Aim

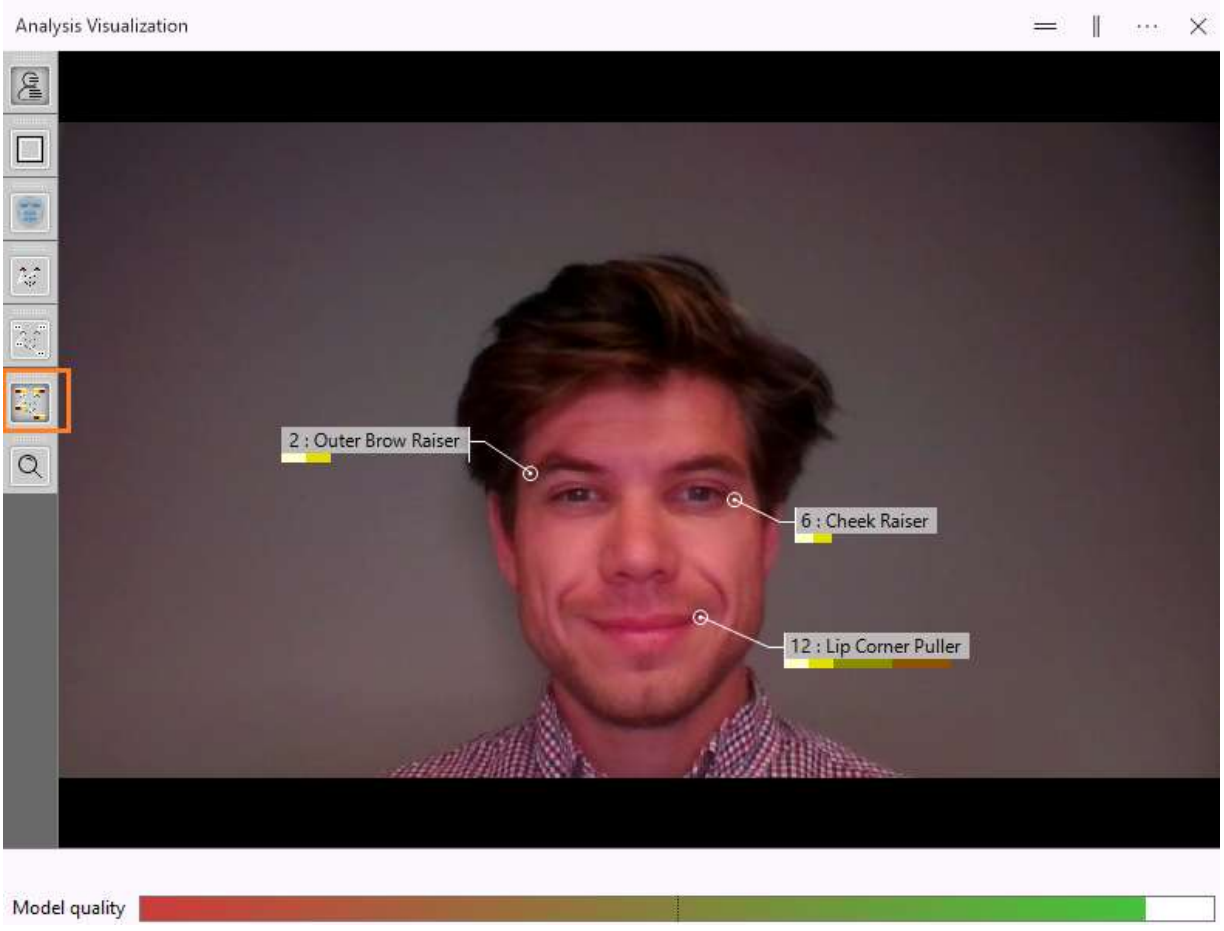
To display Action Units during or after the analysis.

Prerequisites

- Your FaceReader license includes the Action Unit Module or you have Baby FaceReader.
- You are running an analysis, or viewing the analysis afterwards.

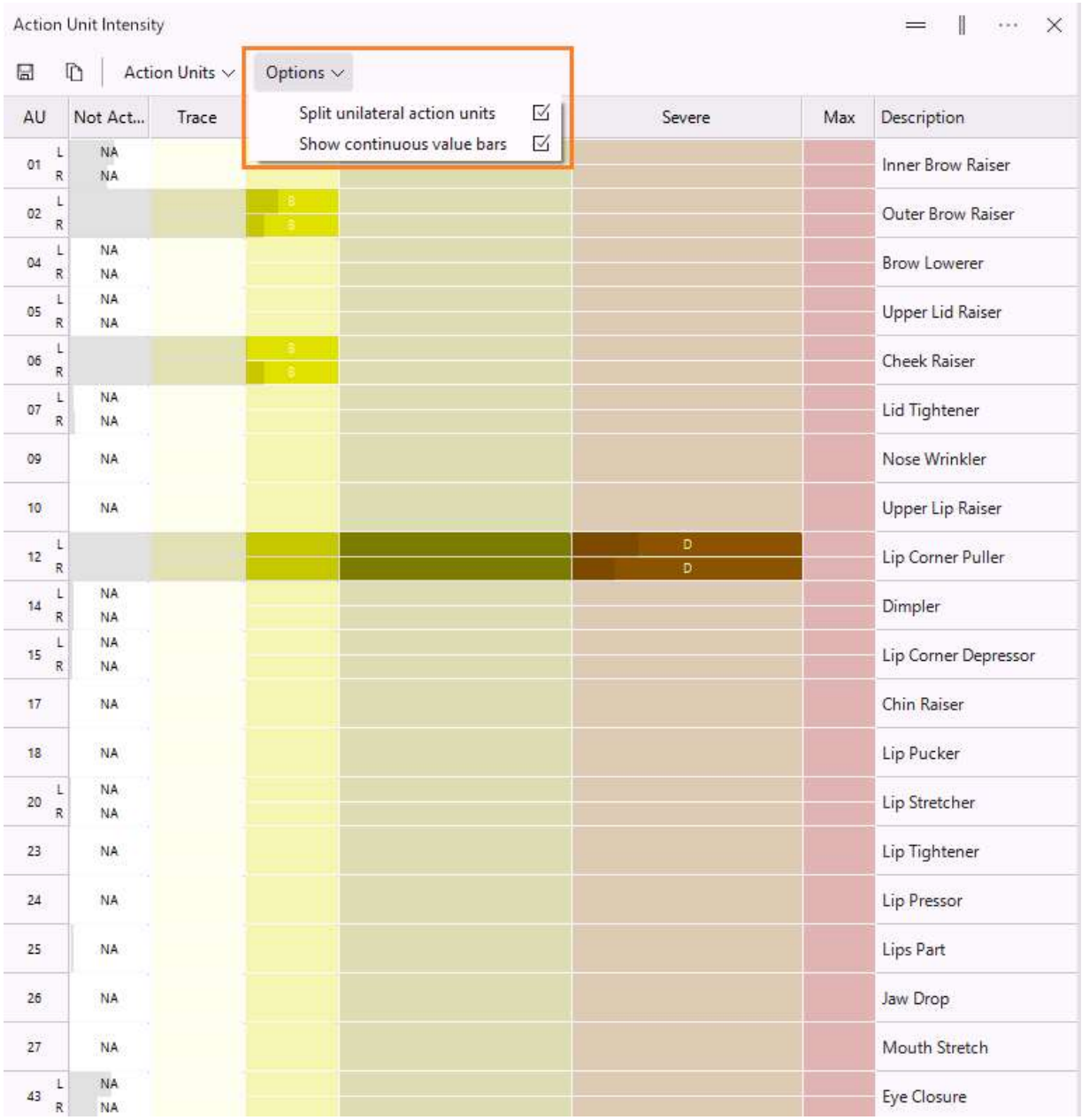
Action Units in the Analysis Visualization window

Click the **Show action units** button on the left side of this window. Action Units appear in the **Analysis Visualization** when the activity is Trace or higher. The colors under the name represent the activity of this Action Unit.



Action Unit Intensity

Select the **Action Unit Intensity** window from one of the visualization windows (see Manage analysis windows). It shows the intensity of 20 Action Units, divided into the classes Trace, Slight, Pronounced, Severe, and Max. These intensities are shown by consecutive letters from A to E. From the **Action Units** list, choose which ones to display.



Unilateral Action Units

Most Action Units are unilateral, that is, they can be visible in the left and/or right part of the face. To assess the intensity of the left and right part independently, select **Options** and then **Split unilateral action units**.

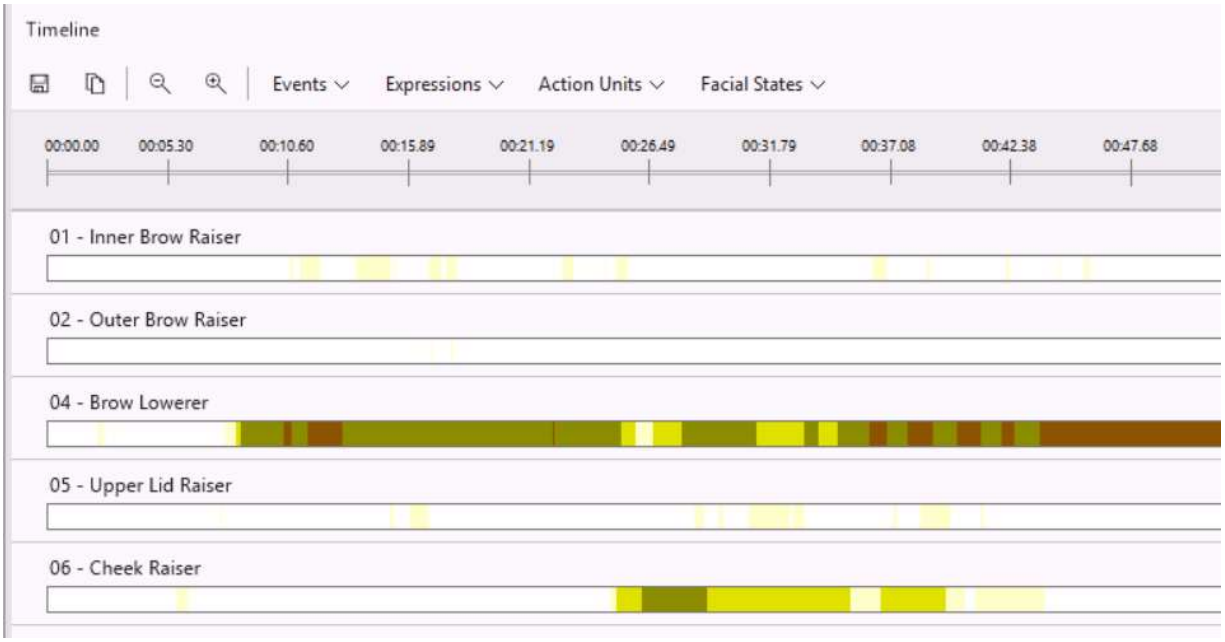
Please note that the unilateral Action Units have been evaluated only qualitatively, but not validated quantitatively. This is mainly due to unavailability of data: images of unilateral AU activation examples are rare in current datasets and hard to produce in general.

Continuous value bars

Select **Options** and then **Show continuous value bars** to visualize the intensity of the Action Units on a continuous scale.

Action Unit states

The intensity of the Action Units is displayed on the Timeline. Select **Timeline** in one of the windows (see Manage analysis windows). Choose which Action Units to display from the **Action Units** list on the toolbar. By default all Action Units are selected.



Note

To copy, save, or zoom in this window, see Common options in FaceReader's output

Action Units in the log files

Aim

To export the Action Units to a text file, Excel file or The Observer XT format file.

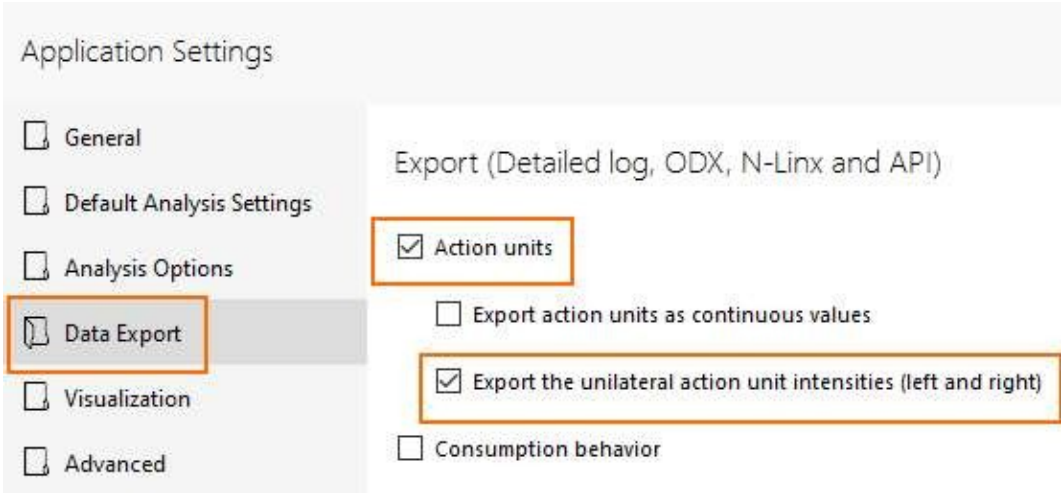
Prerequisites

- Your FaceReader license includes the Action Unit Module.
- Action Unit analysis is switched on in the Settings.

  See Analyze Action Units
- You carried out an analysis.

Export Action Units as States

1. Choose **File** > **Settings** and then click the **Data Export** tab.
2. Under **Export (Detailed log, ODX, N-Linx and API)**, select **Action units**. Do not select **Export Action Units as continuous values**. To export the unilateral Action Unit intensities, select the corresponding checkbox.



3. Choose **File** > **Export** and select one of the options.

   See Export the data in FaceReader's output

The intensities are exported as letters to the detailed log.

Action Unit 27 - Mouth Stretch	Action Unit 43 - Eyes Closed
NotActive	C
NotActive	C
NotActive	C
NotActive	B
NotActive	B
NotActive	B
NotActive	B
NotActive	B
NotActive	C
NotActive	C
NotActive	C

The letters correspond to the following Action Unit intensities:

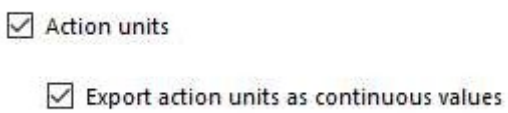
- **Not active** – [0.00 - 0.100]
- **A** – [0.100 - 0.217]
- **B** – [0.217 - 0.334]
- **C** – [0.334 - 0.622]
- **D** – [0.622 - 0.910]
- **E** – [0.910 - 1.000]

If you selected to export the unilateral Action Unit intensities, the Detailed log contains three columns for each Action Unit (the intensity on the left side of the face, on the right side and combined). The combined value is the maximum of the two.

Export Action Units as continuous values

You can also export Action Unit intensities as continuous values. To do so:

1. Choose **File** > **Settings** > **Data export**
2. Under **Export (Detailed log, ODX, N-Linx and API)** select **Action Units** and **Export Action Units as continuous values**.



3. Choose **File** > **Export** and select one of the options.

See Export the data in FaceReader's output

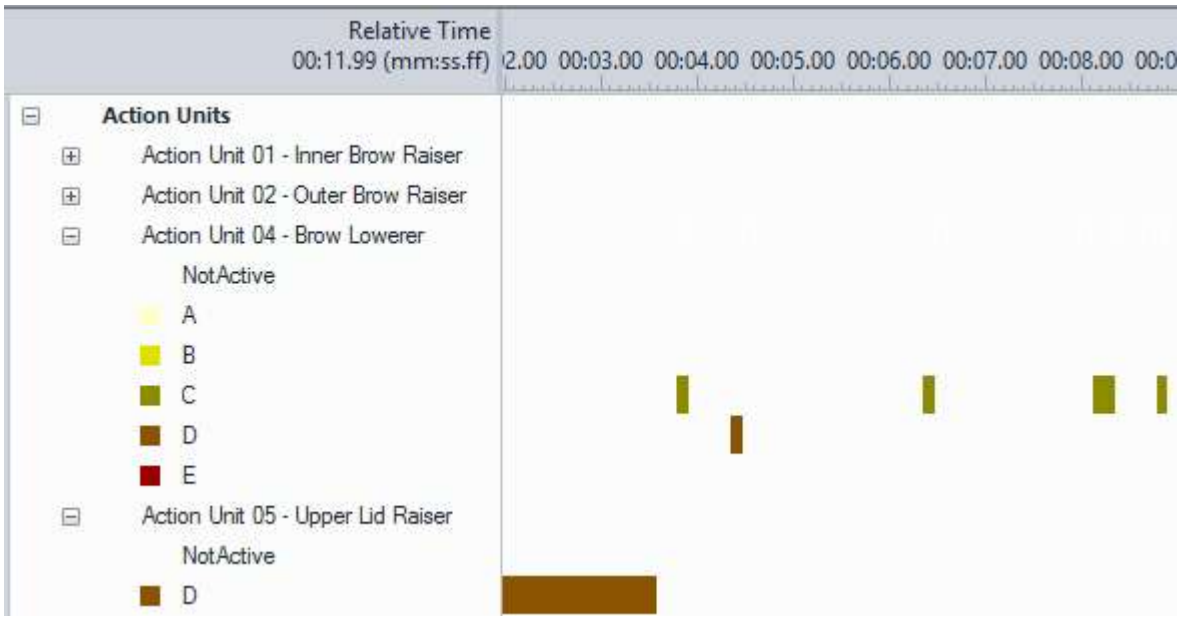
Action Unit 27 - Mouth Stretch	Action Unit 43 - Eyes Closed
0	0.289246
0	0.2892319
0	0.2609951
0	0.233869
0	0.2360564
0	0.2381264
0	0.2401302
0	0.2421434
0	0.2689239
0	0.2946268
0	0.3193725
0	0.343138
0	0.3658572
0	0.3875908
0	0.4083547
0	0.4283074

If you selected to export the unilateral Action Unit intensities, the Detailed log contains three columns for each Action Unit (the intensity on the left side of the face, on the right side and combined). The combined value is the maximum of the two.

Action Unit intensities in The Observer XT

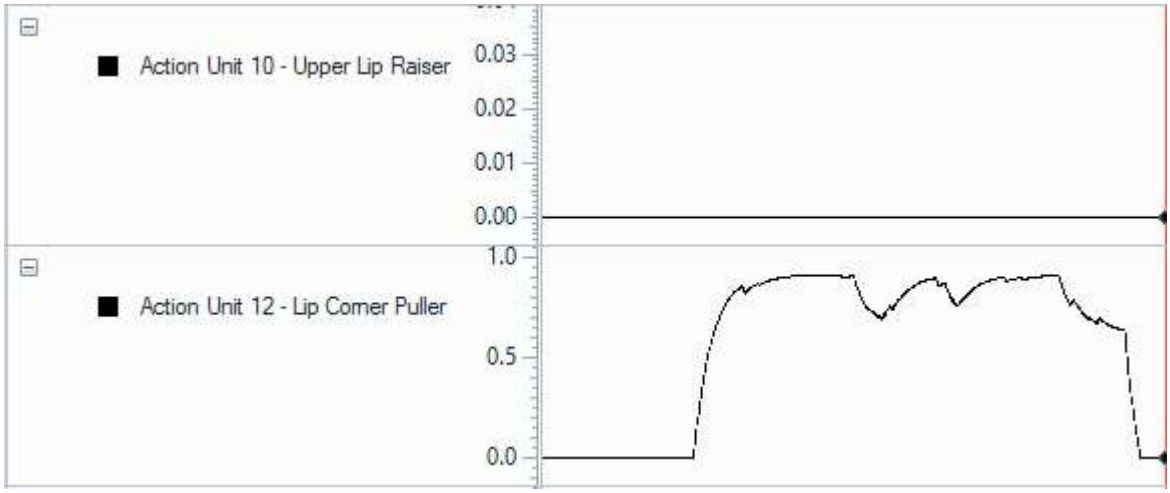
If you send FaceReader data to The Observer XT 13 or higher versions using the N-Linx network communication protocol, Action Unit intensities are not transferred to The Observer XT as numerical values but as intensity classes.

See FaceReader with The Observer XT



If you want to import the intensities as continuous values:

1. Select to **Export action units as continuous values**
2. Export FaceReader log files, export the data as Detailed log
3. Import the detailed logs as external data



Custom Expressions

Custom Expressions are facial expressions/states that you can define yourself by combining the facial expressions and Action Units that FaceReader can recognize by default (Neutral, Happy, Sad, Angry, Surprised, Scared, Disgusted and Contempt and the 20 Action Units). You can, for instance, define 'Duchenne smile' as a Custom Expression by combining Action Unit 6 and 12. You can also use Valence, Arousal, Head Orientation, Head Position, Gaze Angles, Landmarks, Heart Rate, Heart Rate Variability, Expressions in the voice, and Model quality in your definition of a Custom Expression.

If you have Baby FaceReader you can base your Custom Expressions on Valence and Arousal, the 20 Actions Units that FaceReader can recognize in baby faces, Head Orientation, Head Position, Gaze Angles, Heart Rate and Heart Rate Variability.

If you have the regular version of FaceReader, you need the Action Unit Module to be able to define Custom Expressions. If you have Baby FaceReader you do not need an extra module.

Types of Custom Expressions

There are three types of Custom Expressions:

- **Project Custom Expressions** - These Custom Expressions are available in the project that is currently open.
- **My Custom Expressions** - These Custom Expressions are available on your PC to be used in the project that is currently open and in all existing and future projects.
- **Remote Custom Expression Library** - These expressions come with your FaceReader license. You can copy and edit them and use them in your projects. They are stored in an online library and are curated by Noldus IT.

Your FaceReader license comes with the following Custom Expressions in the Remote Custom Expression Library:

Additional Action Units

- Blink (AU45) — Eyes closing and opening (>0.5 difference in the intensity of AU43) within 200 milliseconds
- Head Turn Left (AU51) — This Custom Expression/Action Unit is based on the head orientation (Yaw).
- Head Turn Right (AU52) — This Custom Expression/Action Unit is based on the head orientation (Yaw).
- Head Up (AU53) — This Custom Expression/Action Unit is based on the head orientation (Pitch).
- Head Down (AU54) — This Custom Expression/Action Unit is based on the head orientation (Pitch).
- Eyes Turn Left (AU61) — Only for central head position.
- Eyes Turn Right (AU62) — Only for central head position.
- Eyes Up (AU63) — Only for central head position.
- Eyes Down (AU64) — Only for central head position.

Baby Expressions

- Baby Cry — This Custom Expression is based on Action Unit 12 (Lip Corner Puller), 20 (Lip Stretcher), 25 (Lips Part), 26 (Jaw Drop) and 27 (Mouth Stretch).
- Baby Smile — This Custom Expression is based on Action Unit 12 (Lip Corner Puller), 20 (Lip Stretcher), 25 (Lips Part), 26 (Jaw Drop) and 27 (Mouth Stretch).

Behavioral States

- Attention — Indicates whether the test participant is centrally focussed based on the head orientation (Pitch and Yaw) and head position (Depth position). This custom expression does not include emotion.
- Attention (binary) — Takes the head orientation into account (Pitch and Yaw). Attention is 1 if the pitch and yaw are 0, otherwise attention is 0. This Custom Expression is validated (median accuracy: 0.87). For more information see the 'Validating FaceReader's attention detection: a reliable measure using gaze and head pose' blog post on the Noldus website.
- Blink Rate — Calculates the number of blinks per minute over a 10 second window.
- Leaning Backward
- Leaning Forward
- Talking — Talking is classified by looking at the rate of Action Unit 25 (parting lips) over a typical frequency (e.g. two words per second). Action Unit 25 is also important in other expressions (e.g. smiling, spontaneous laughter). You may find false positive events when the lips part and close with a similar frequency in other expressions. The value of Talking can either be 1 (talking) or 0 (no talking).

Complex Expressions

- Boredom — See below for more information.
- Confusion — See below for more information.
- Interest — See below for more information.
- Spontaneous Laughter — Laughing out loud. Takes into account Action Unit 6 and 12 and 25 and 26. Lower activation of spontaneous laughter can indicate regular laughing or in rare cases a strong smile.

Facial Gestures

- Frowning — AU4 is a frown but often people also tighten their eyelids (AU7). AU4 contributes most to this custom expression, AU7 only max 50%.
- Laughing — Laughing with mouth open. Takes into account Action Unit 6 and 12 and 25, and 26.
- Mouth opening — Any form of mouth opening.
- Mouth tightening — Any Action Unit activity that puts tension on the mouth (Action Unit 10, 15, 18, 23, 24).
- Moving Eyes — General eye movement, away from the center. A higher value indicates more movement.

- Moving head — General head movement, away from the center. A higher value indicates more movement.
- Raising eyebrows — Upward movement of the eyebrows irrespective of the inner and outer brow.
- Smiling — Mouth is closed. Takes into account Action Unit 6, 12, 25, and 26.

Baby Cry and Baby Smile come with Baby FaceReader.

Boredom, Confusion and Interest come with the regular version of FaceReader. These expressions were called Affective Attitudes in FaceReader 7.

Boredom, Confusion and Interest are estimated using all frames in a time interval. Therefore, the analysis of these Custom Expressions can only be done with video and camera analyses. For each frame, the estimate of the Custom Expression is calculated using the current frame and all the previous frames in the time interval.

To calculate Interest, Boredom and Confusion the following time intervals are used:

- Interest – 2 seconds.
- Boredom – 5 seconds.
- Confusion – 2 seconds.

At the start of the analysis, there is no time interval yet to analyze these Custom Expressions. Therefore the visualization will display no data. FaceReader starts the analysis when half the time interval has been reached. This means that the analysis of Interest and Confusion starts 1 second after the start of the analysis. The analysis of Boredom starts 2.5 seconds after start of the analysis.

The analysis of Interest, Boredom and Confusion is based on references 1, 2 and 3.

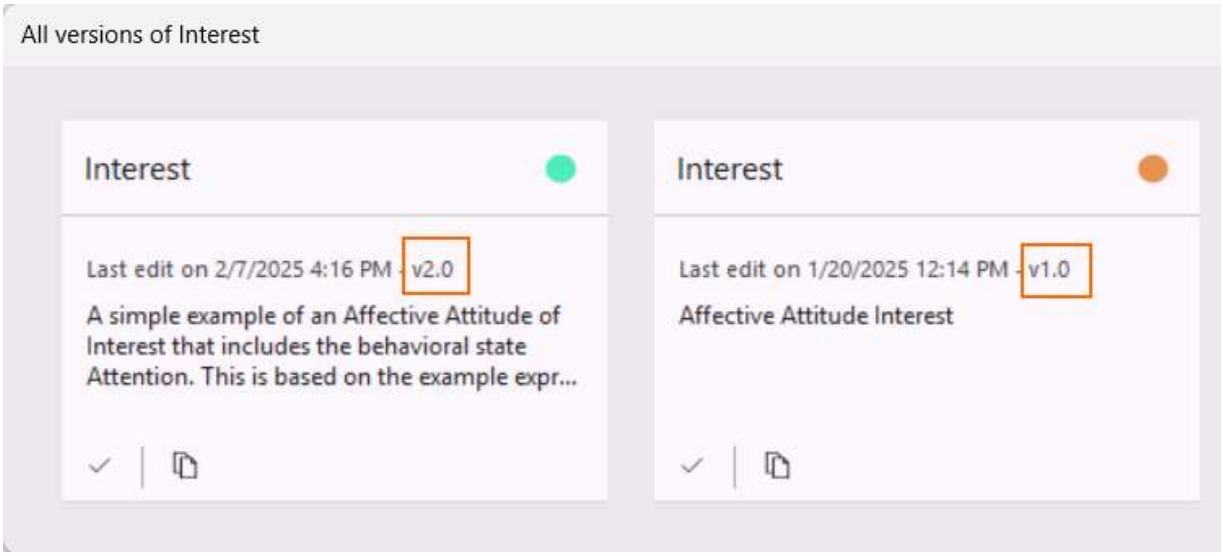
1. McDaniel, B., D'Mello, S., King, B., Chipman, P., Tapp, K., & Graesser, A. (2007, January). Facial features for affective state detection in learning environments. In *Proceedings of the Cognitive Science Society* (Vol. 29, No. 29).
2. Kapoor, A., Mota, S., & Picard, R. W. (2001, November). Towards a learning companion that recognizes affect. In *AAAI Fall symposium* (pp. 2-4).
3. Grafsgaard, J., Wiggins, J. B., Boyer, K. E., Wiebe, E. N., & Lester, J. (2013, July). Automatically recognizing facial expression: Predicting engagement and frustration. In *Educational Data Mining 2013*.

Please cite the original work in your studies when based on FaceReader's analysis.

Please note that the custom expressions in FaceReader are not qualitatively validated (due to lack of available real-world data, except Attention (binary)). The idea with most of these custom expressions is that they are primarily theory-based (based on findings/observations in the literature). They can serve as a starting point,

and their formulas can be modified as needed. Regardless, the custom expressions are based on FaceReader's validated AU predictions, so the source of their input information is validated. The extra AU custom expressions are indirectly validated, e.g. Blink (AU45) is based on eye closure (AU43), which is validated; AU 51-53 are based on head pose angles, which are internally validated.

Some Custom Expressions have been updated in FaceReader 10. You can continue using the older versions (that were available in FaceReader 9) by clicking **Show all versions**. The screenshot below shows the two versions of Interest that are available in FaceReader 10.



Select one of the actions below to work with custom expressions:

- Add a Custom Expression to your project
- View a Custom Expression definition
- Copy a Custom Expression
- Import a Custom Expression
- Export a Custom Expression definition
- Delete a Custom Expression
- Define a new Custom Expression
- Custom Expression inputs in detail
- A Custom Expression block in detail
- Working with custom expression blocks
- Input simulator

- Visualize Custom Expressions
- Export Custom Expressions
- Custom Expression intensities in The Observer XT

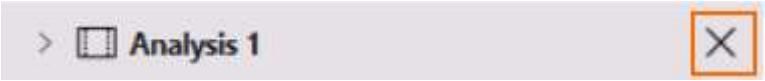
Add a Custom Expression to your project

Aim

To analyze a Custom Expression, that is, to quantify the activation of the Custom Expression in the test participant's face.

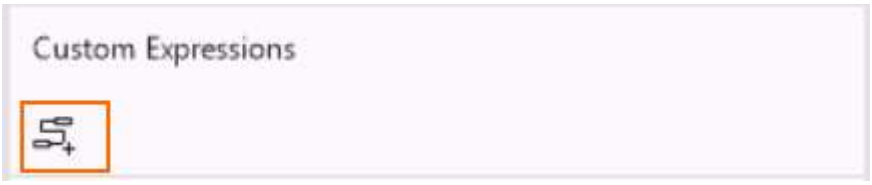
Prerequisite

- You have the Action Unit Module or Baby FaceReader.
- Your FaceReader computer has a connection to the internet to access the Remote Custom Expression Library.
- All the analyses in the project are closed. To close an analysis, click the button next to it.



Procedure

1. From the **File** menu select **Custom Expressions Browser** or click the **Add custom expression to project** icon in the Custom Expressions pane.

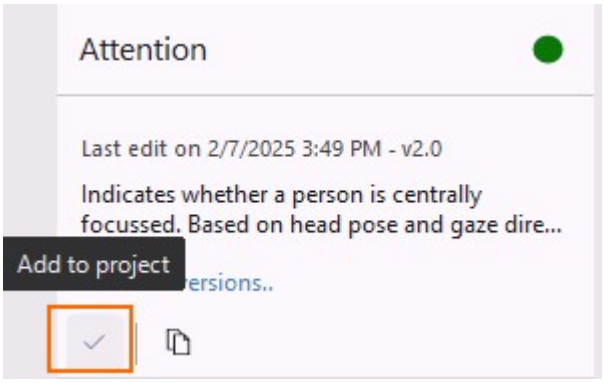


   The Custom Expression browser opens with three tabs: Project Custom Expressions, **My Custom Expressions** and **Remote Custom Expression Library**.

2. Click the **Remote Custom Expression Library** tab.

   If you like you can sort the custom expressions, please see below.

3. Add a Custom Expression to the project that is currently open by clicking the **Add to project** icon and then click **OK**.


Attention
Last edit on 2/7/2025 3:49 PM - v2.0
Indicates whether a person is centrally focussed. Based on head pose and gaze dire...
Add to project
ersions..

View a Custom Expression definition

Aim

To view what elements have been used in a Custom Expression definition and how they are combined.

Prerequisite

- You have the Action Unit Module or Baby FaceReader.
- Your FaceReader computer has a connection to the internet to access the Remote Custom Expression Library.

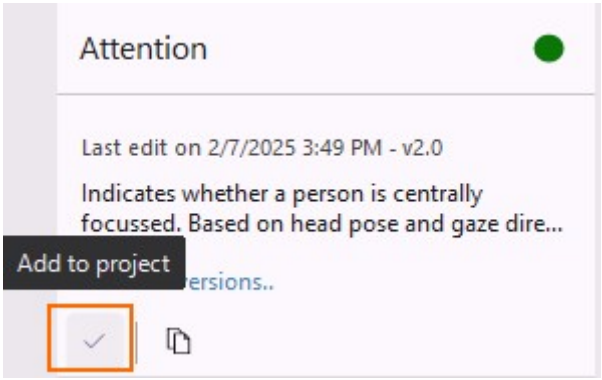
Procedure

1. From the **File** menu select **Custom Expressions Browser**.

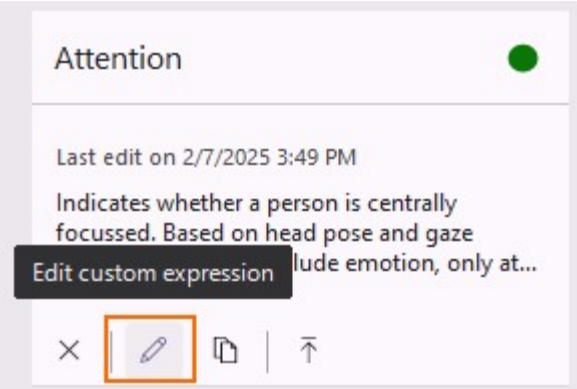
   The Custom Expression browser opens with three tabs: Project Custom Expressions, **My Custom Expressions** and **Remote Custom Expression Library**.

   If you like you can sort the custom expressions, please see below.

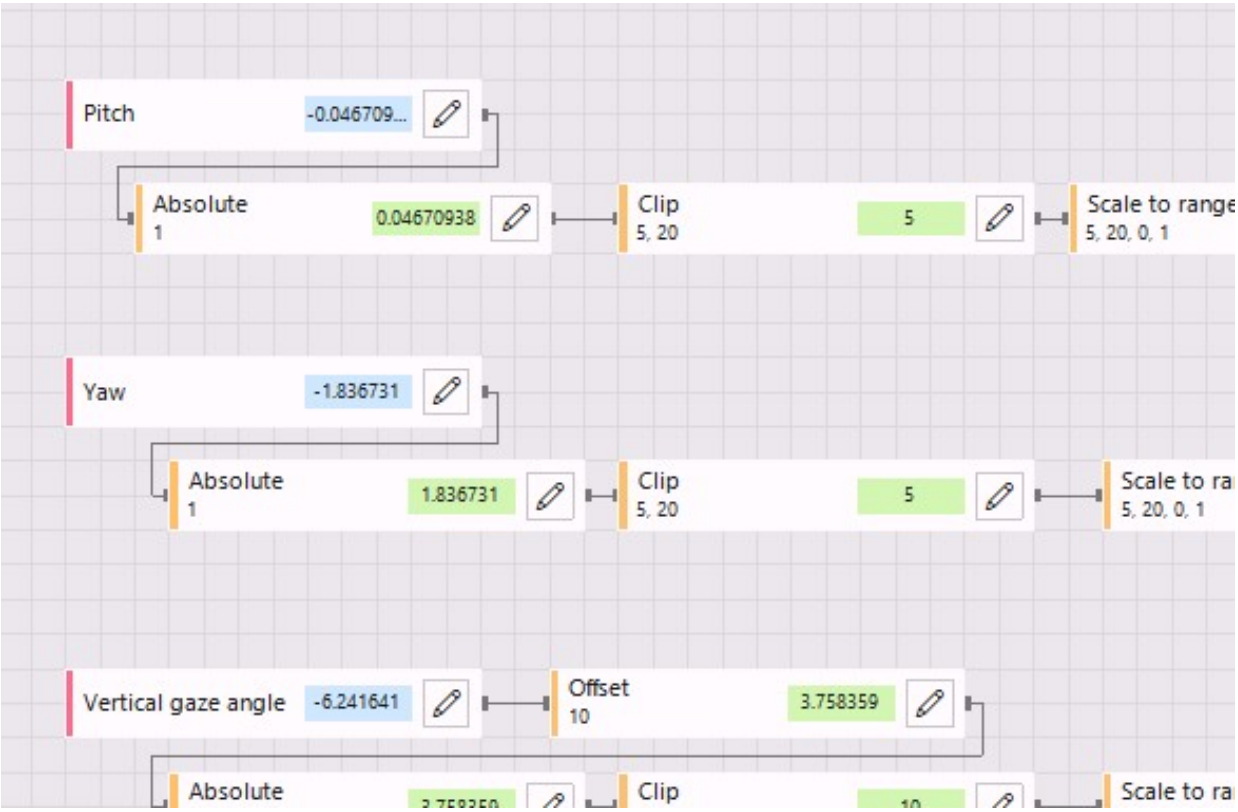
2. Add a Custom Expression to your project by clicking the **Add to project** icon.



3. Click the **Edit Custom Expression** icon.



A new window opens with a detailed view of the blocks and processors that are part of the expression. In the screenshot below you can see part of the Custom Expression ‘Attention’.



To sort custom expressions

Click the **Sort by name** or **Sort by date modified** button on the toolbar to sort your **Project Custom Expressions**, the expressions under **My Custom Expressions** or the expressions in the **Remote Custom Expression Library** in alphabetical order or by date last modified. Click the **Revert sort order** to change the order from A-Z into Z-A or from latest to earliest date or vice versa.

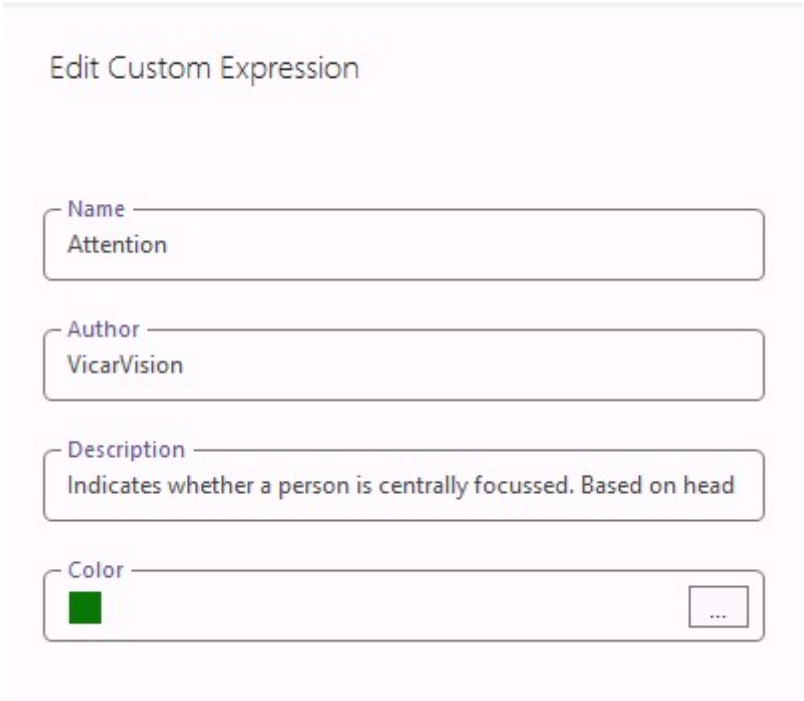
To zoom in and out

Use the **Zoom out**, **Zoom in** and **Fit to screen** icons on the toolbar to customize the window. You can also use **Ctrl-** and **Ctrl+** or Ctrl + scroll wheel to zoom out or in.

To rename a Custom Expression or change its color

Click the **Edit information** icon on the toolbar to open a new pane with the Custom Expression's name, author, description and color. If you like you can edit the information.

Each Custom Expression has its own unique color which is the same throughout the program.


Edit Custom Expression
Name
Attention
Author
VicarVision
Description
Indicates whether a person is centrally focussed. Based on head
Color
...

Copy a Custom Expression

Aim

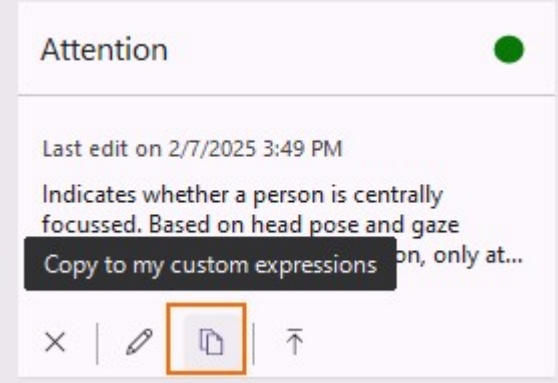
To edit the Custom Expression and use it in your project.

Prerequisite

- You have the Action Unit Module or Baby FaceReader.
- Your FaceReader computer has a connection to the internet to access the Remote Custom Expression Library.

Procedure

Click the **Copy to my custom expressions** button to copy your **Project Custom Expressions** or custom expressions from your **Remote Custom Expression Library** to **My Custom Expressions**.



Import a Custom Expression

Aim

To use a Custom Expression made on another computer.

Prerequisite

- You have the Action Unit Module or Baby FaceReader.
- You have received a Custom Expression (*.FCX) file or you have exported a Custom Expression definition (see Export a Custom Expression definition).

Procedure

Click the **Import custom expression** button on the toolbar and browse to the location where you stored your Custom Expression (*.FCX file). Select it and then click **Open**. The new Custom Expression is added to **My Custom Expressions**.

Edit a Custom Expression

Aim

To change the Custom Expression definition before using it in your analyses.

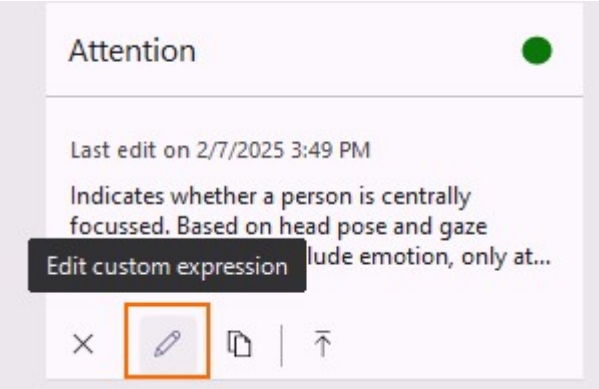
Prerequisite

- You have the Action Unit Module or Baby FaceReader.
- You can edit either **Project Custom Expressions** or Custom Expressions under **My Custom Expressions**. It is not possible to edit Custom Expressions from the **Remote Custom Expression Library**. To use a Custom Expression from the **Remote Custom Expression Library** in your project, you can either add it to your project or copy it to the list under **My Custom Expressions** (and then edit it and add it to your project).

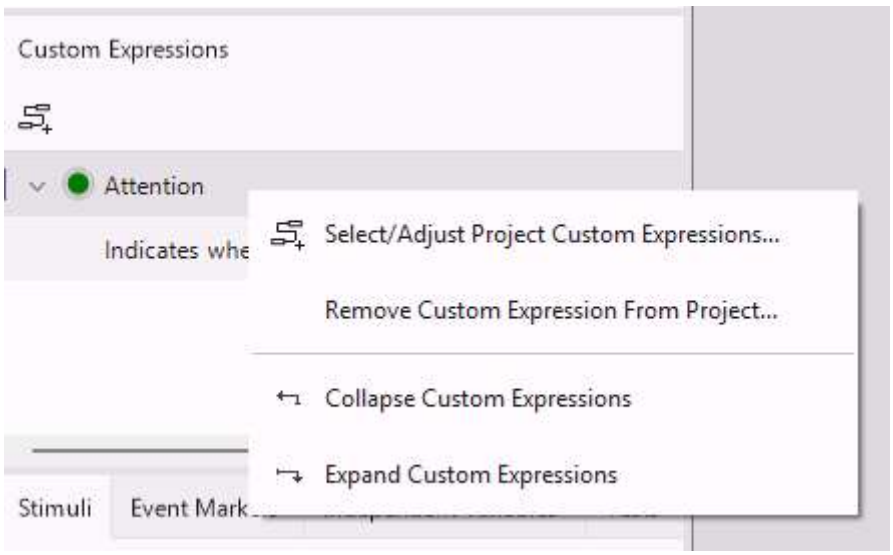
Procedure

Editing Project Custom Expressions

- Locate the Custom Expression under **Project Custom Expressions** and click the **Edit custom expression** button. The detailed view of the Custom Expression opens and you can now add blocks, edit the existing ones or edit the processors.

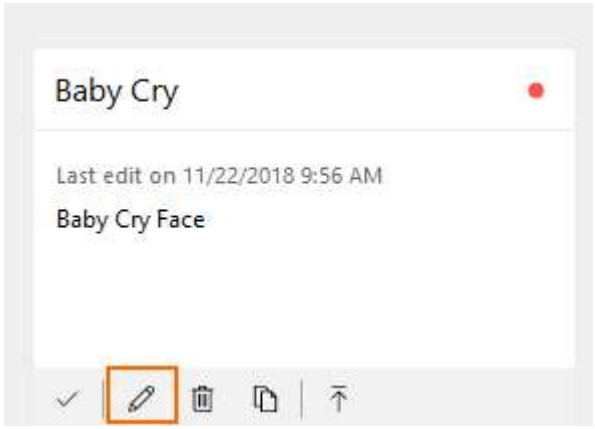


- Right-click the Custom Expression in the Custom Expressions pane and select **Select/Adjust Project Custom Expressions**. Locate the Custom Expression under **Project Custom Expressions** and click the **Edit custom expression** button (see above).



Editing My Custom Expressions

Locate the Custom Expression in the list under My **Custom expressions** and click the **Edit custom expression** icon. The detailed view of the Custom Expression opens and you can now add blocks, edit the existing ones or edit the processors.



Export a Custom Expression definition

Aim

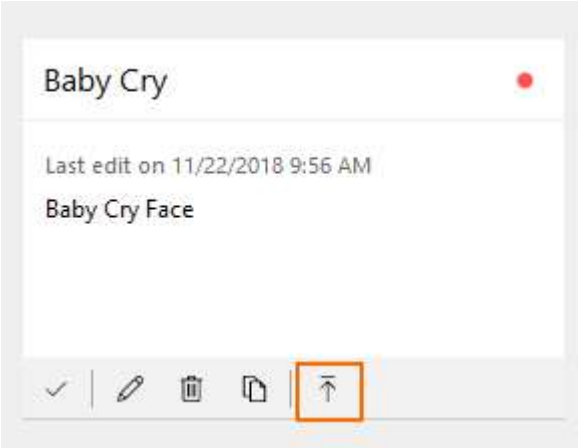
To save the Custom Expression to a FCX file and use it on another computer, give it to a colleague or send it to Noldus Support.

Prerequisite

You have the Action Unit Module or Baby FaceReader.

Procedure

Click the **Export** button to save your **Project Custom Expression** or Custom Expression under **My Custom Expressions** as a FCX file.



Delete a Custom Expression

Aim

To clean up your project and remove the Custom Expressions that you will not use anymore.

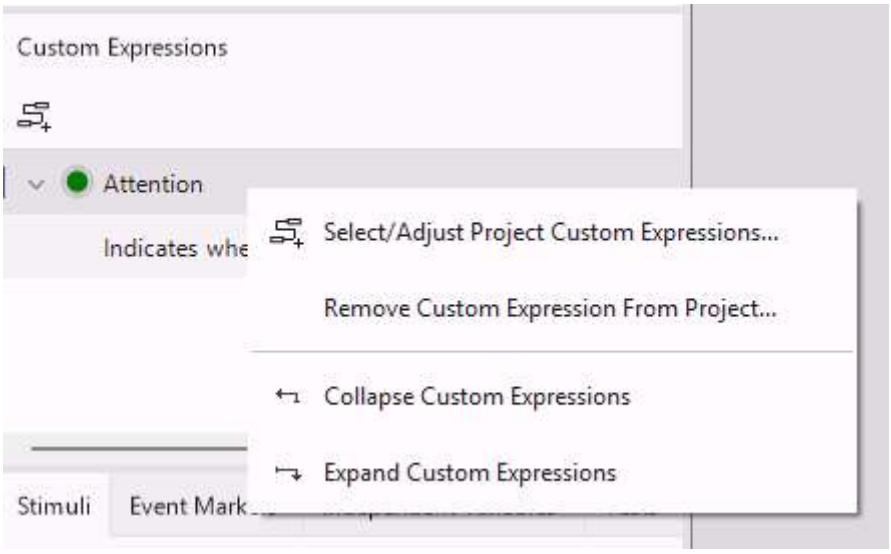
Prerequisite

- You have the Action Unit Module or Baby FaceReader.
- You can delete **Project Custom Expressions** and Custom Expressions under **My Custom Expressions**. It is not possible to delete the Custom Expressions under **Remote Custom Expression Library**.

Procedure

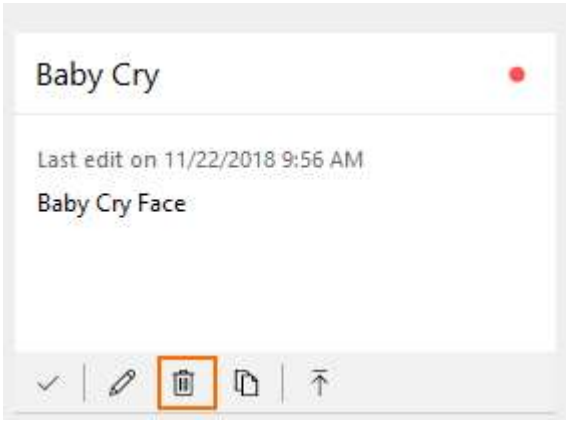
To delete a Project Custom Expression

Locate the Custom Expression in the **Custom Expressions** pane. Right-click on the expression and select **Remove Custom Expression From Project**.



To delete a Custom Expression in the list under My Custom Expressions

Locate the Custom Expression in the list under **My Custom Expressions** and click the **Delete** button.


Baby Cry
Last edit on 11/22/2018 9:56 AM
Baby Cry Face

Define a new Custom Expression

Aim

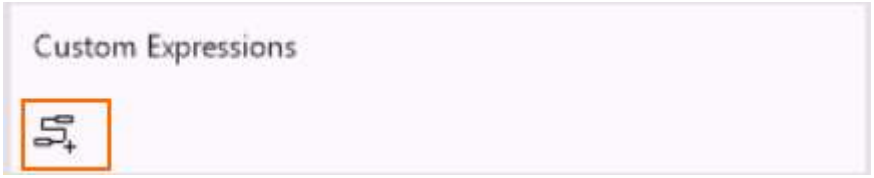
To construct your own Custom Expression and use it to quantify its activation in the test participant's face.

Prerequisite

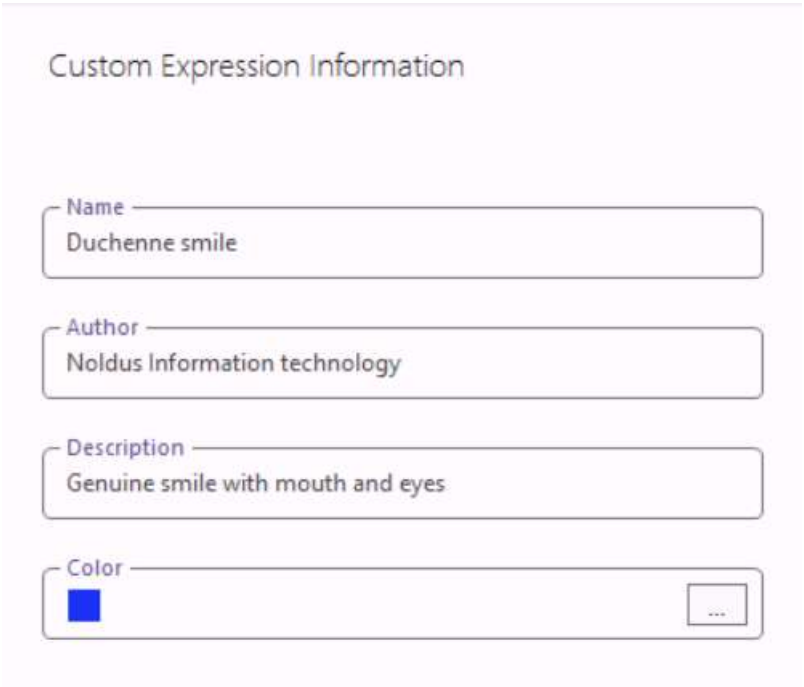
You have the Action Unit Module or Baby FaceReader.

Procedure

1. From the **File** menu select **Custom Expressions Browser** or click the **Add custom expression to project** icon in the Custom Expressions pane.



2. Click **New Custom Expression** in the toolbar. The **Custom Expression Information** window opens. Enter a name and (optional) a description for the expression and choose a color. You can also enter the name of the author (optional).



A new window opens with a grid with an Output block.

3. Click the **Add block** button on the toolbar to add the blocks that define your Custom Expression. The block browser opens with the Inputs, Processors and Custom Expressions that you can use.
4. Click on an Input, Processor or Custom Expression and then click **OK** to add it to the grid.

- See Custom Expression inputs in detail
- See Custom Expression processors in detail

5. Repeat step 2 and 3 to add more blocks to the grid.
6. Connect the blocks with connectors in such a way that you get the correct definition of the Custom Expression.

Tip: You can check whether you defined your Custom Expression correctly by using the Input simulator.

Custom Expression inputs in detail

You can choose one or more of the following building blocks:

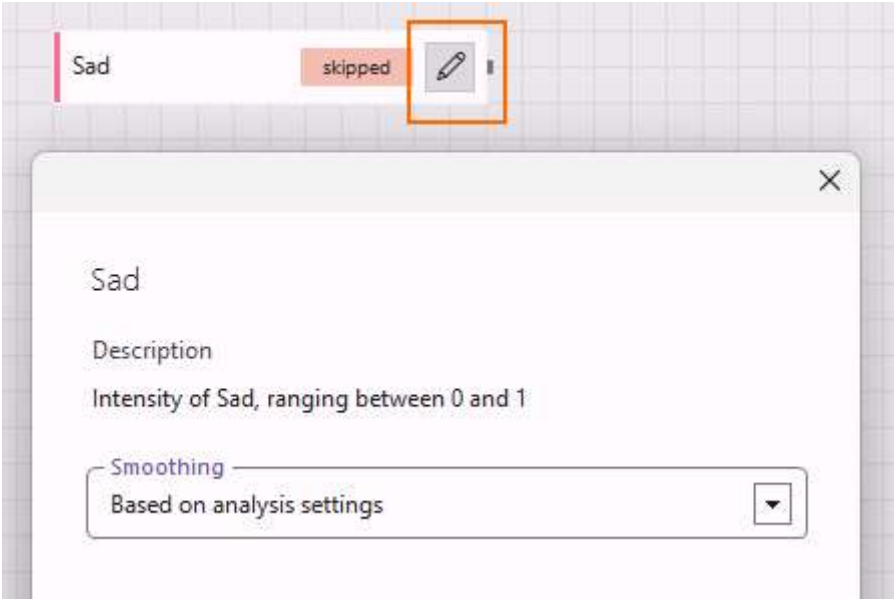
Facial Expressions

The default facial expressions (Neutral, Happy, Sad, Angry, Surprised, Scared, Disgusted and Contempt).

Please note that the default expressions are available as building blocks with Baby FaceReader but they do not generate an output as Baby FaceReader cannot detect the default facial expressions.

1. Click the facial expression building block you need and then click **OK** to add it to the grid.
2. Click the **Edit** button to select one of the three **Smoothing** options and choose whether the smoothed or raw values are used:

- **Based on analysis settings** — FaceReader uses the option chosen in the Analysis Settings. See Classification in the Settings chapter.
- **Always smoothed** — FaceReader uses smoothed data.
- **Always raw** — FaceReader uses the raw, unsmoothed data.



Derived Expressions

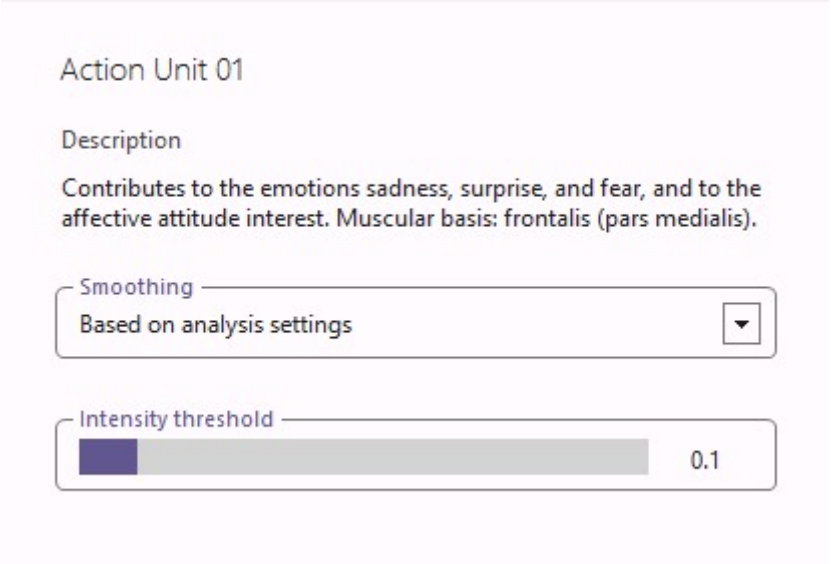
Valence and Arousal

Action Units

The 20 Action Units that are available in FaceReader, unilateral Action Units (left and right) and combined.

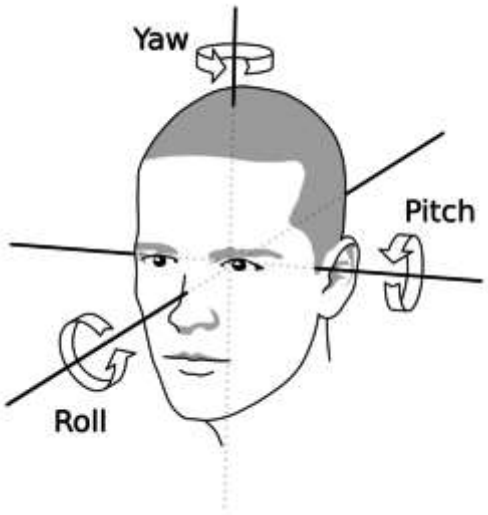
1. Click the Action Unit building block you need and then click **OK** to add it to the grid.
2. Click the **Edit** button to select one of the three **Smoothing** options and choose if the smoothed or raw values are used. See Facial Expressions.
3. Set the **Intensity threshold**. If the intensity of the Action Unit is lower than this threshold, the Action Unit will not be taken into account. The output of the building block will be zero.

   Default value: 0.1 which is equal to the **Not Active** threshold (see Action Unit Intensity).



Head Orientation

Orientation of the head relative to the x, y and z-axis (Pitch, Yaw and Roll).



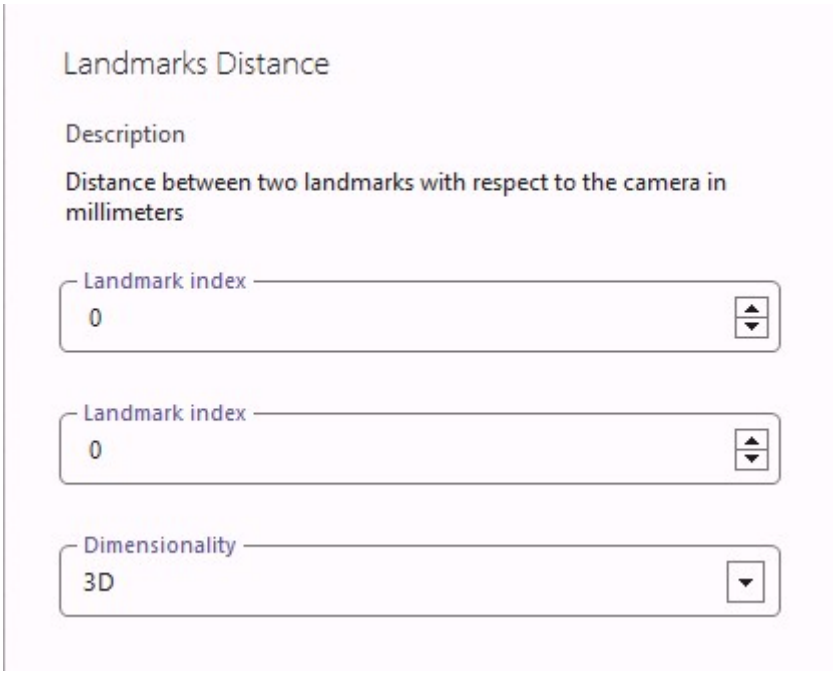
Head Position

Horizontal position, Vertical position and Depth position relative to the camera.

Landmarks

Landmark X, Landmark Y, Landmark Z (respectively, the horizontal, vertical and depth translation of the landmark relative to the camera) and Landmarks Distance (the distance between two landmarks relative to the camera in millimeters).

1. Click one of the four building blocks and then click **OK** to add it to the grid.
2. Click the **Edit** button to set the **Landmark index** and in case of **Landmarks Distance** also the **Dimensionality** (either 2D or 3D).



Gaze Angles

Horizontal gaze angle, Vertical gaze angle.

Heart Rate

Heart Rate, Heart Rate Variability (RMSSD) and Heart Rate Variability (SDNN).

Tip: Click on one of the blocks to read the information that comes with it. Each block comes with a description and information on what values it can have as output. The Action Units also come with an example video in which the Action Unit is demonstrated.

Voice Expressions

Neutral from Voice, Happy from Voice, Sad from Voice and Angry from Voice.

Voice secondary Expressions

Valence from Voice, Arousal from Voice, Loudness, Speech rate

Miscellaneous

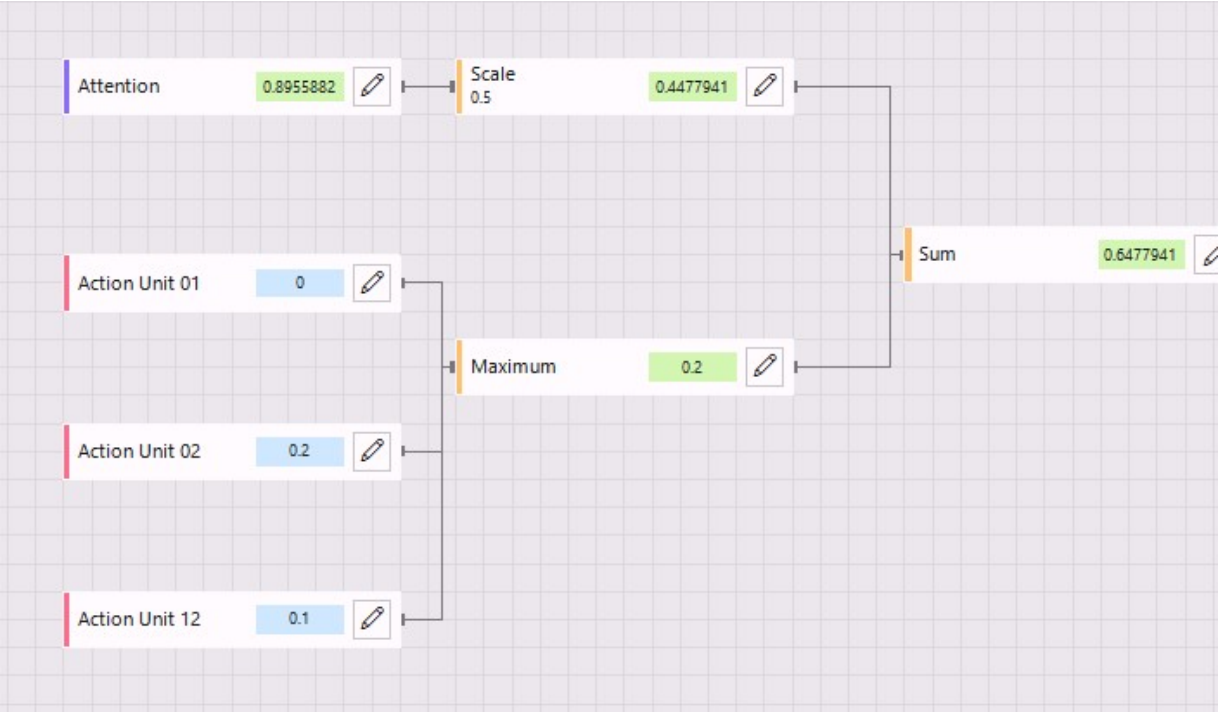
Model quality — The model quality has a value between 0 and 1 and is represented by the Model quality bar in the analysis.

Custom Expression processors in detail

To combine blocks you need processors. The following processors are available:

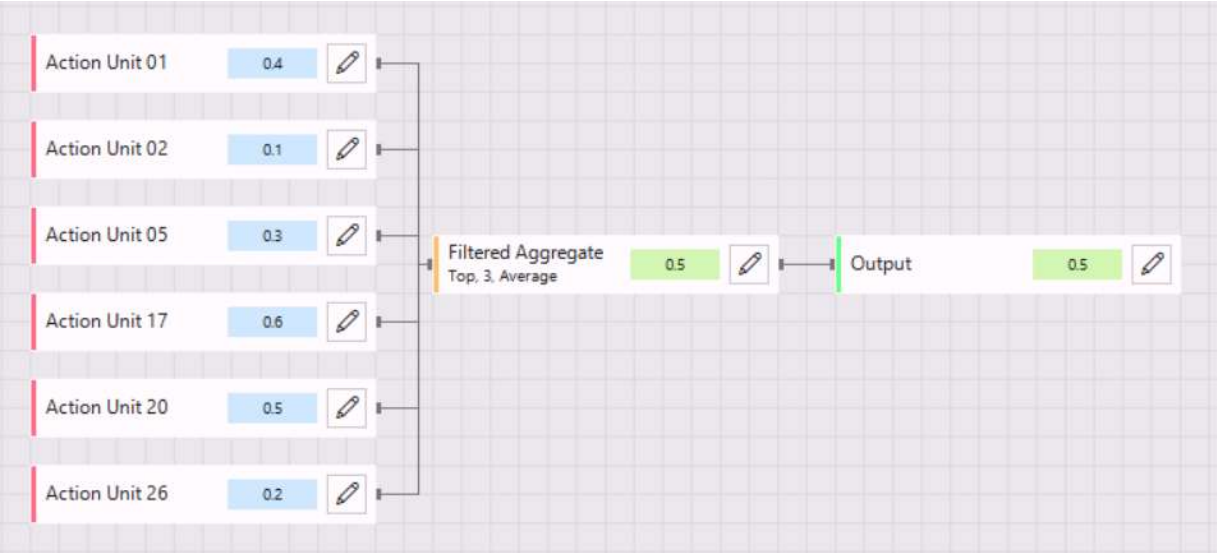
Mathematical processors

- **Maximum** — This processor compares two (or more) numerical input values. The output is the highest value. For instance, when calculating Valence, FaceReader compares the intensities values of Angry, Sad, Scared and Disgusted. The highest value of the four is subtracted from the intensity of Happy.
- **Minimum** — This processor compares two (or more) numerical input values. The output is the lowest value.
- **Sum** — This processor calculates the sum of all its numerical input values. The screen shot below is part of the Custom Expression 'Interest'. The first step in the definition is to assess which of the Action Units 1, 2 or 12, has the highest value and sum this value and half of the intensity of Attention.



- **Average** — This processor calculates the average of all its numerical input values.
- **Filtered Aggregate** — With this processor FaceReader can, for instance, calculate the average of the three highest input elements. In the screen shot below FaceReader calculates the average intensity of the three Action Units

with the highest intensity (1, 17 and 20). In this example this means calculating the average of 0.6; 0.5 and 0.4. The output value is 0.5.

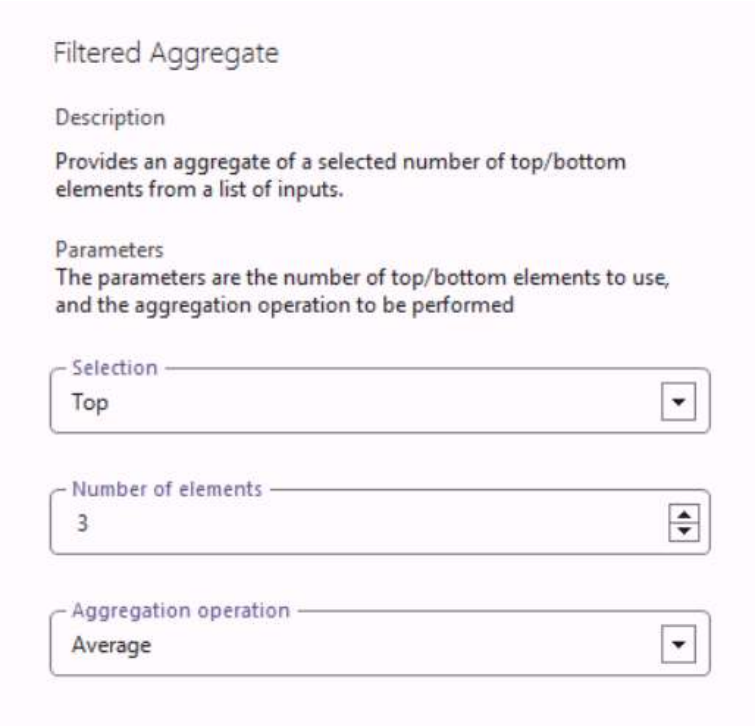


Click the pencil icon to edit the settings:

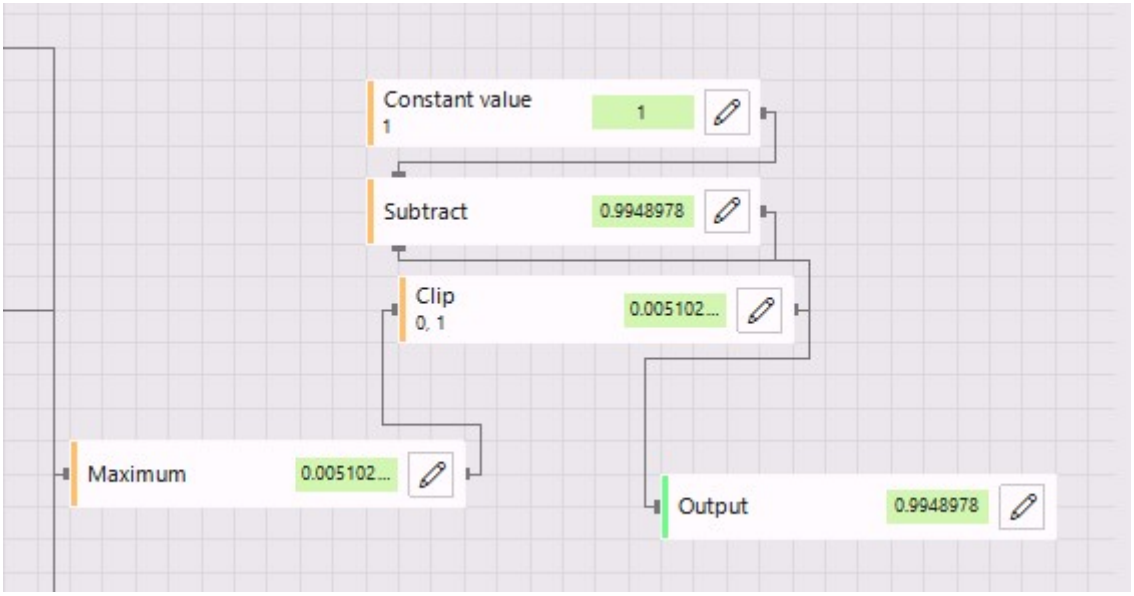
- **Selection**: either *Top* or *Bottom*.

- **Number of elements**: select how many inputs you want to take into account.

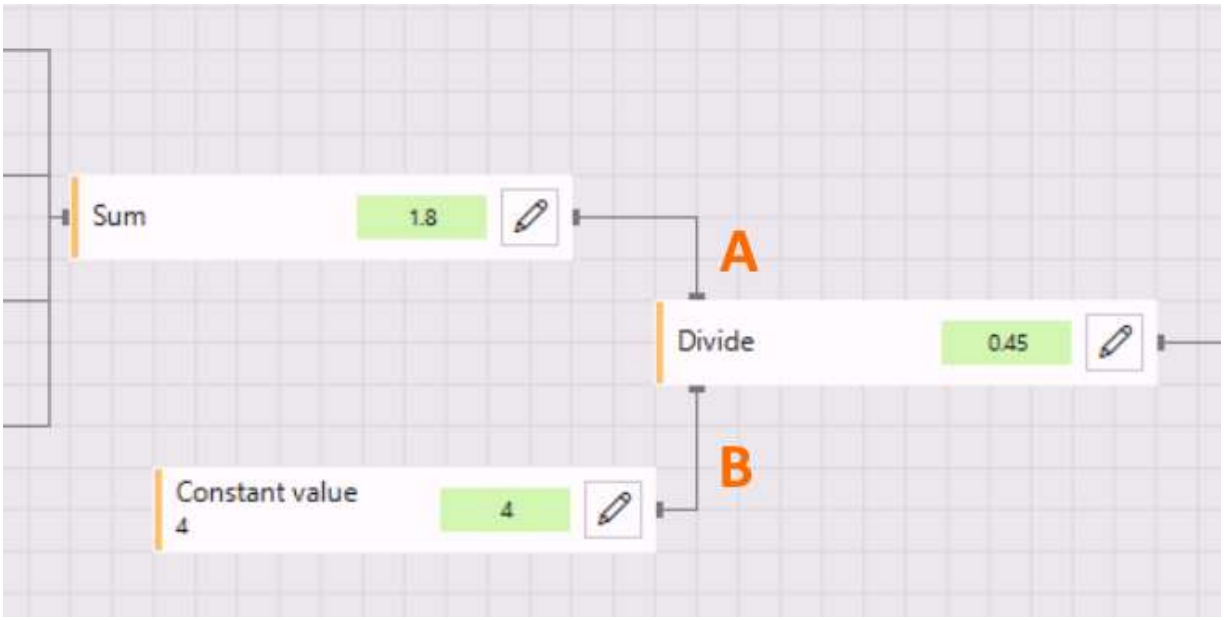
- **Aggregation operation**: select whether you want to calculate the *Average*, *Sum*, *Standard Deviation*, *Maximum*, *Minimum* or *Median* of the input values.



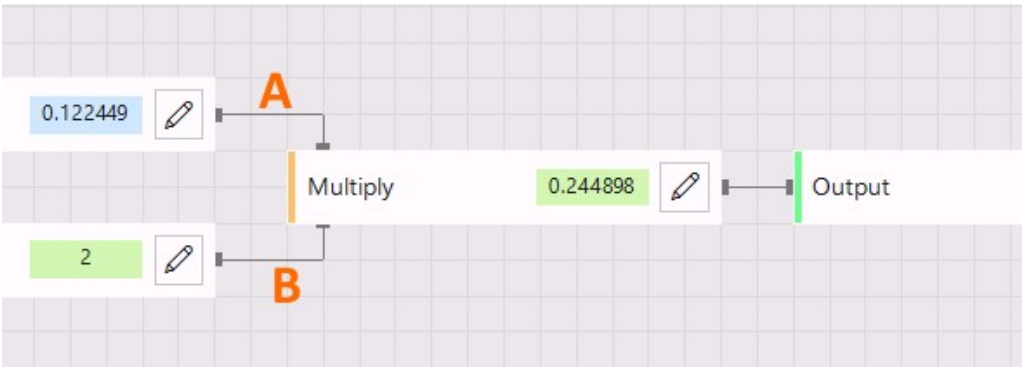
- **Scale** — This processor multiplies its numerical input value with the value you enter as a parameter.
- **Offset** — This processor adds the value that you enter as a parameter to the numerical input value.
- **Subtract** — With this processor FaceReader subtracts numerical input value B (bottom connector) from numerical input value A (top connector). The screenshot below is part of the definition of the Custom Expression 'Attention' in which the maximum of four input values is subtracted from the constant value *1*.



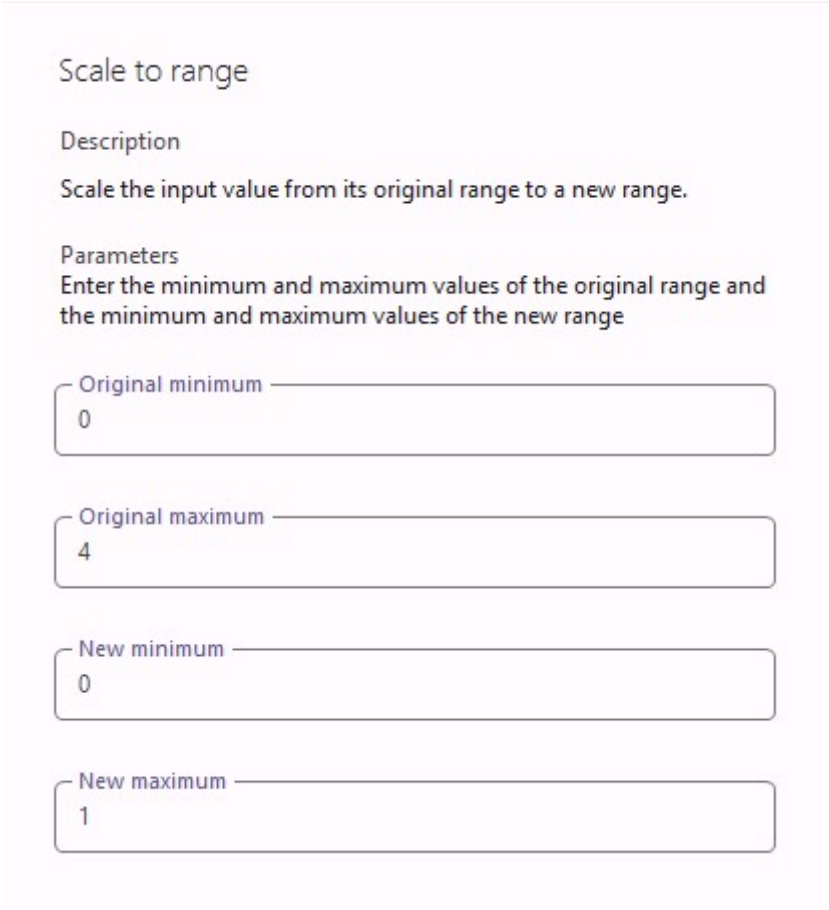
- **Divide** — With this processor FaceReader divides numerical input value A (top connector) by numerical input value B (bottom connector).



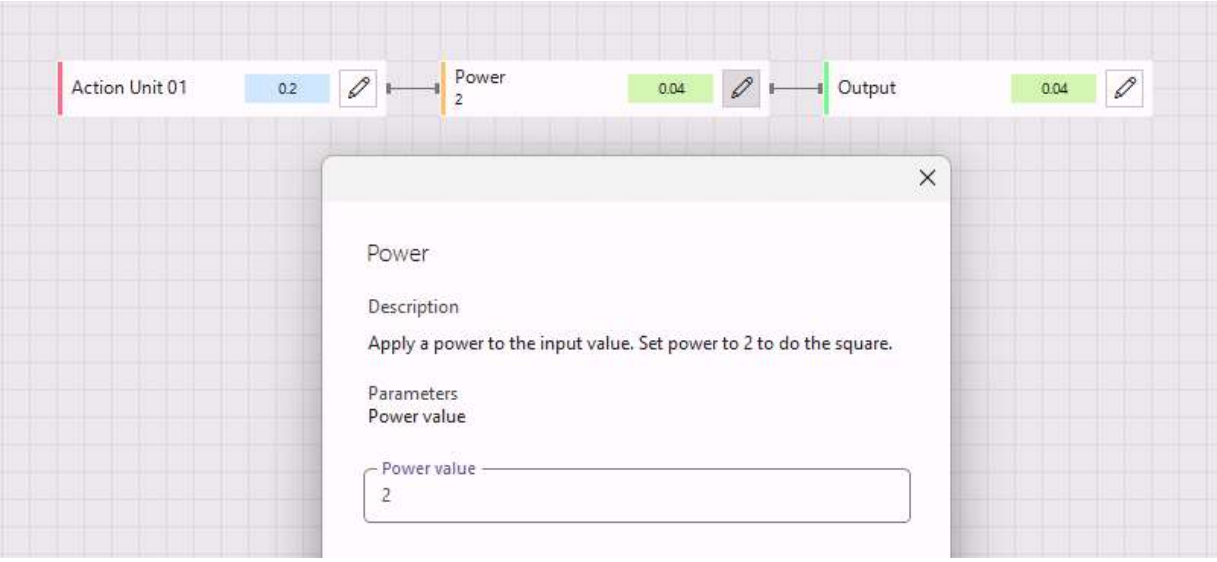
- **Multiply** — With this processor FaceReader multiplies input value A (top connector) by input value B (bottom connector).



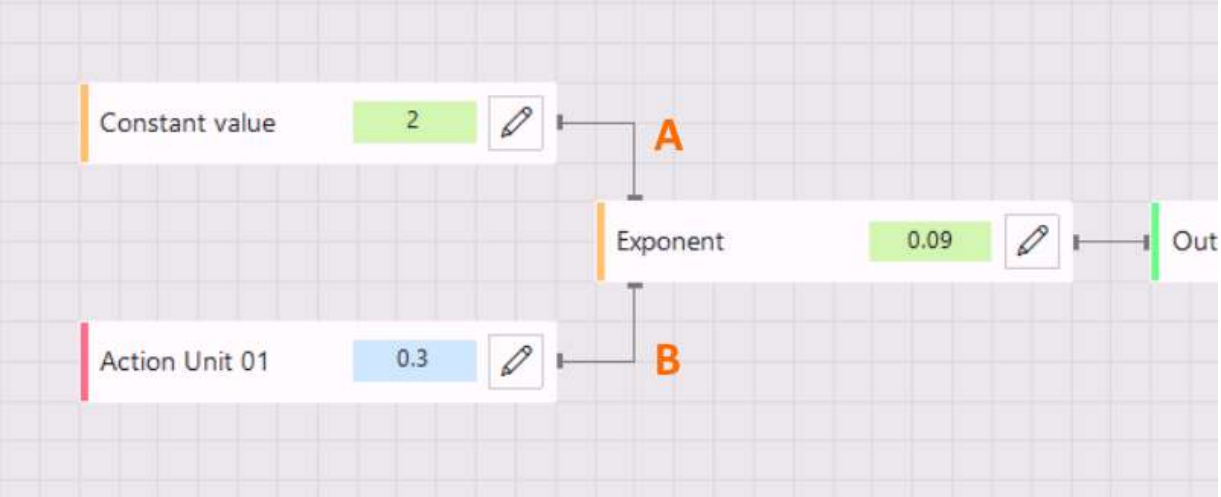
- **Scale to range** — Use this processor if you want the numerical input to fall within a new range. Enter the minimum and maximum values of the original range and the minimum and maximum value of the new range. The Custom Expression definition for 'Confusion' contains the 'Scale to range' processor in the screenshot below. In step x of the definition the output values can range from 0 to 4. With the 'Scale to range' processor, you scale the values from 0 to 1.



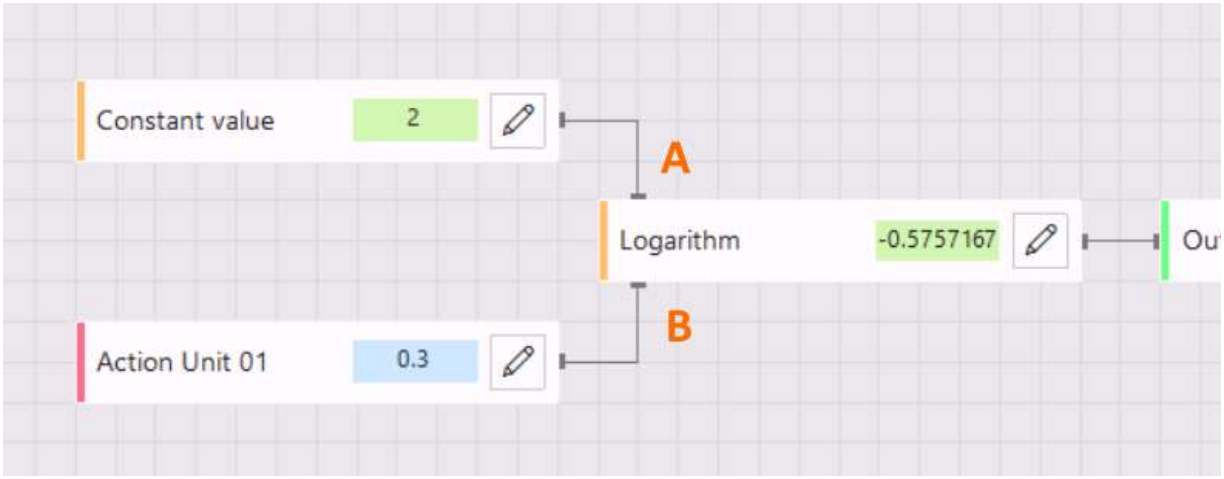
- **Power** — With this processor the input value (0.2 in the example in the screenshot below) is raised to the power of n. In this example n=2 and the output is 0.04.



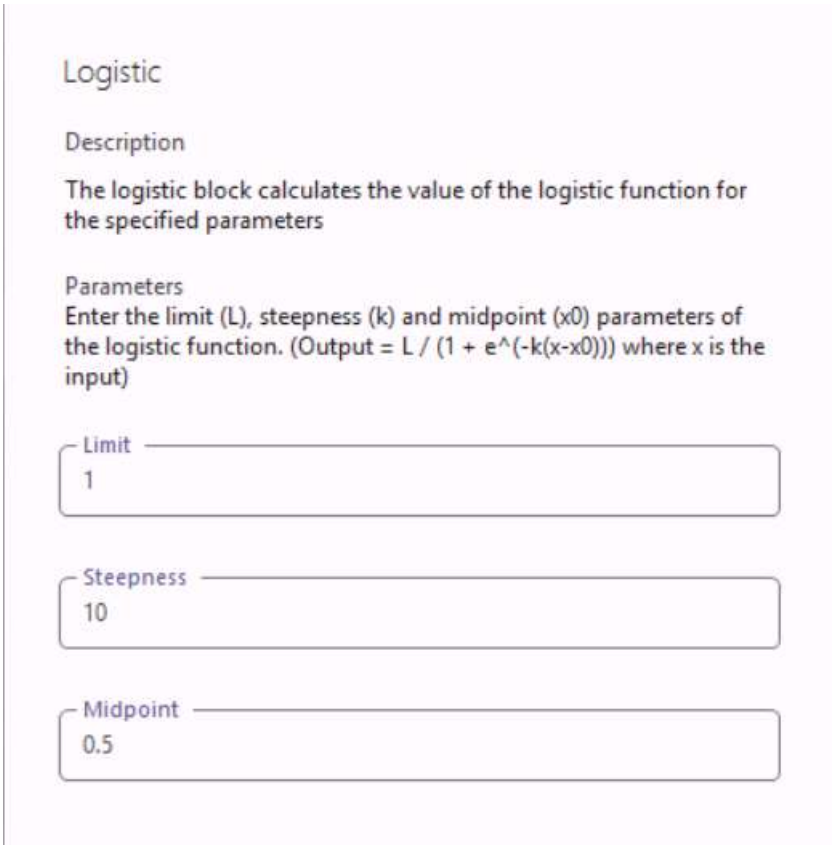
- **Exponent** — This processor has two inputs (A and B). The Exponent block uses the formula: B to the power of A (0.3 to the power of 2 in the example below). If you connect the input blocks the other way around the result is 2 to the power of 0.3.



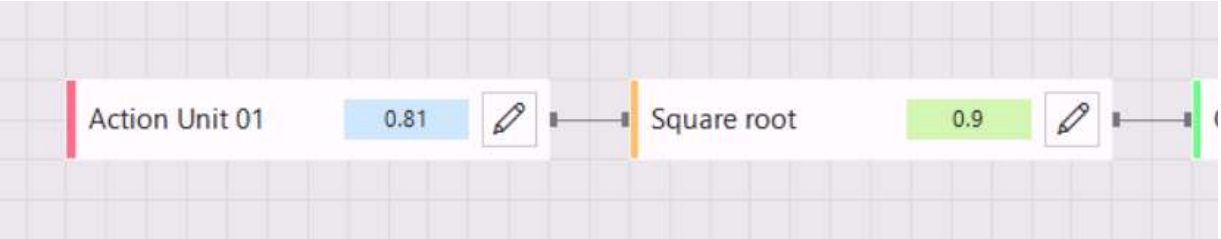
- **Logarithm** — This processor takes the logarithm of the top input (A) with the bottom input (B) as base. The output is Log B(A) (logarithm of 2 to base 0.3 in the example below). If you connect the input blocks the other way around the result is logarithm of 0.3 to base 2.



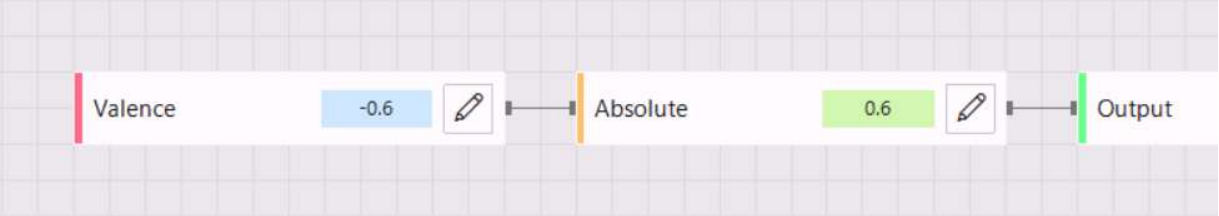
- **Logistic** — A Logistic block has one input, x. When you click the pencil button you can set the limit (L), the steepness (k) and the midpoint (x0). The output is L/(1+e^(-k(x-x0))). The Logistic processor is used in the custom expression 'Spontaneous laughter'. The S-shaped logistic function helps to promote high activation values and suppress low activation values.



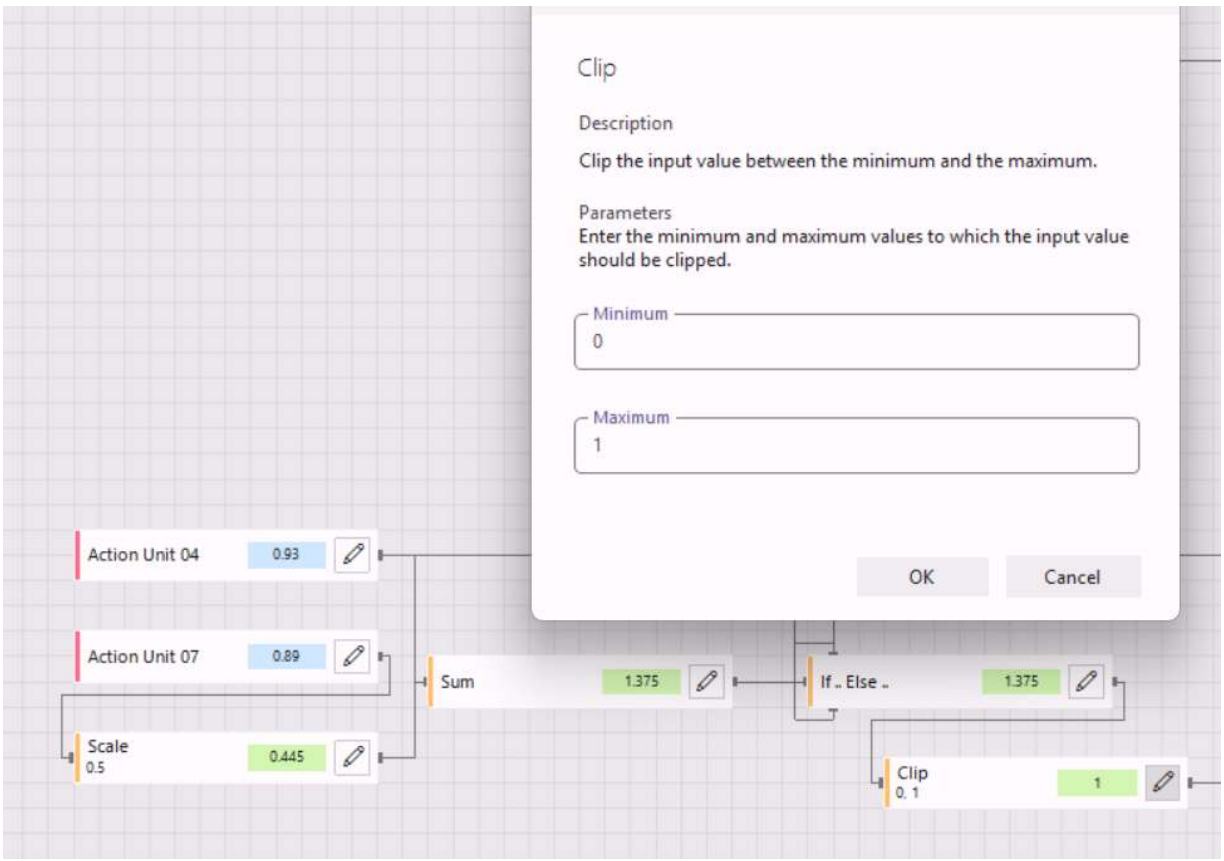
- **Square root** — This processor takes the square root of the input value.



- **Absolute** — This processor takes the absolute value of the input. You can, for instance, base your Custom Expression on the Valence and treat positive and negative values similarly. An input value of -0.6 (like in the screenshot below) results in an output of 0.6 and a Valence intensity of 0.6 also results in an output of 0.6.

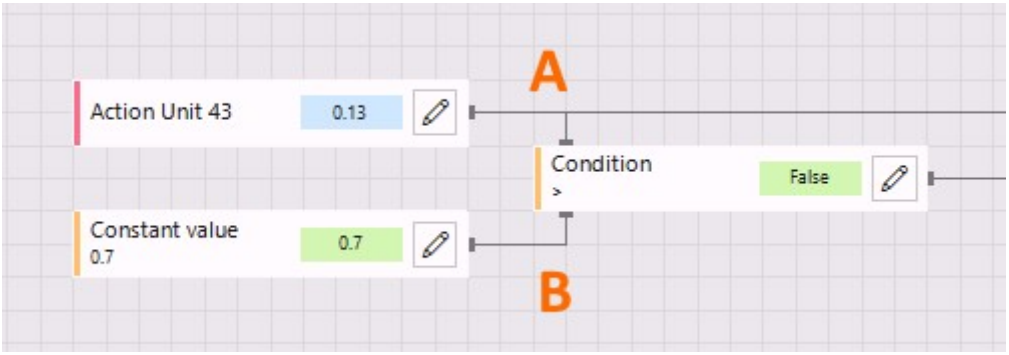


- **Clip** — This processor changes the input value into a value that fits in a range between a minimum and a maximum value. The example in the screenshot below shows part of the definition for Frowning. The input value (Sum = the sum of the intensities values of Action Unit 4 and 0.5 x Action Unit 7) is >1. The maximum set for the clip range is 1 so the output value is 1.

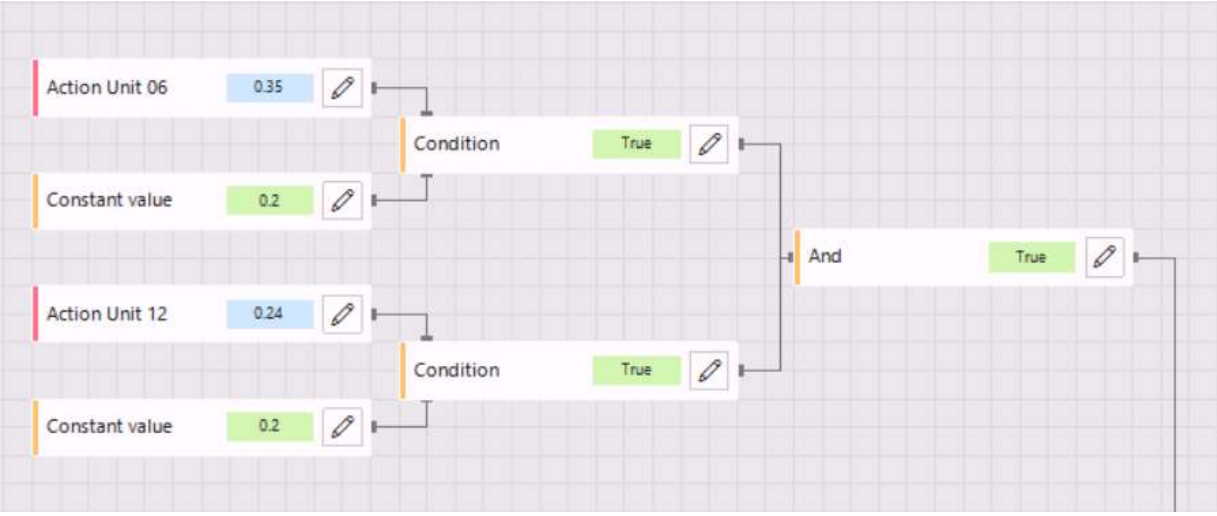


Logical

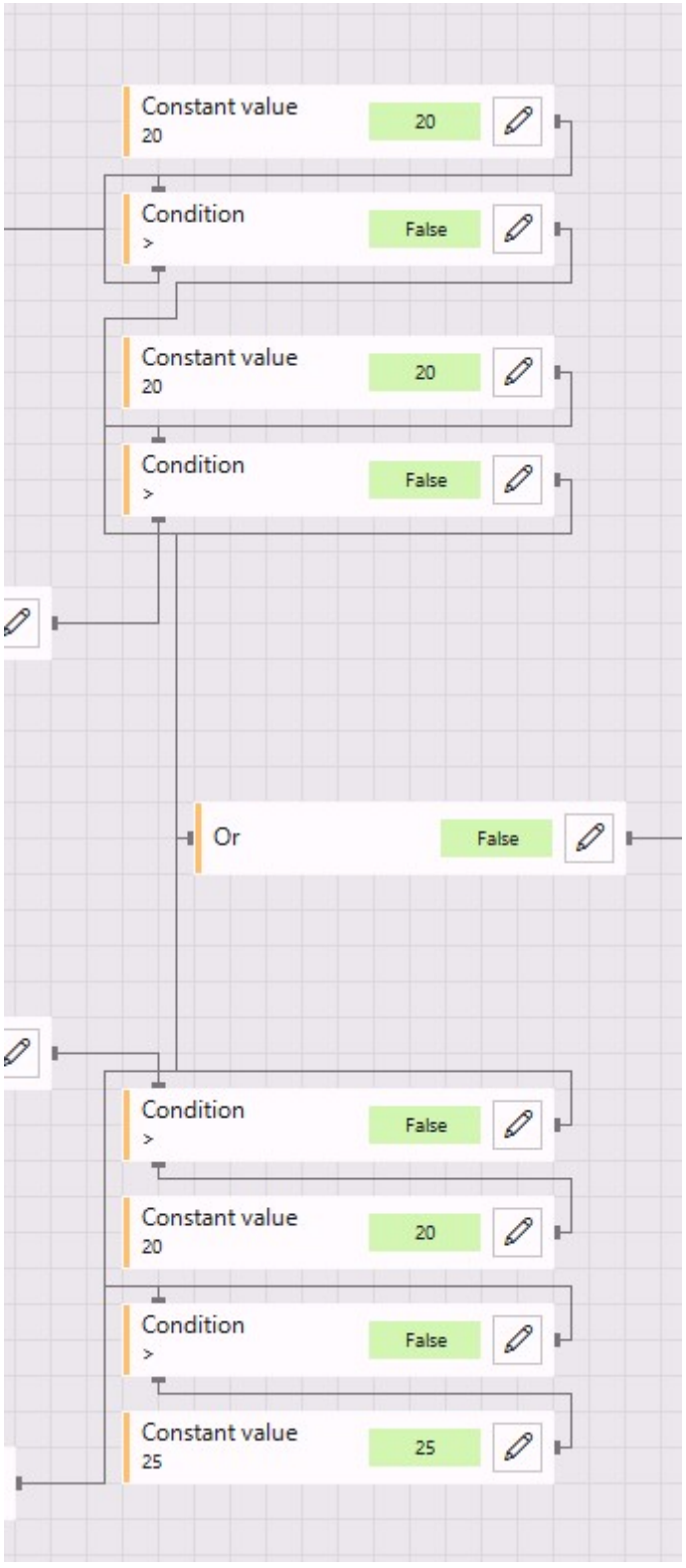
- **Condition** — This processor compares input value A (top connector) with input value B (bottom connector). It checks either whether A>B, A≥B, A<B, A≤B or A=B (depending on what comparison type you choose). The condition can either be True of False. In the screen shot below the value of Action Unit 43 is compared with the value 0.7 using the comparison operator '>'. As 0.13 is smaller than 0.7, the condition is False.



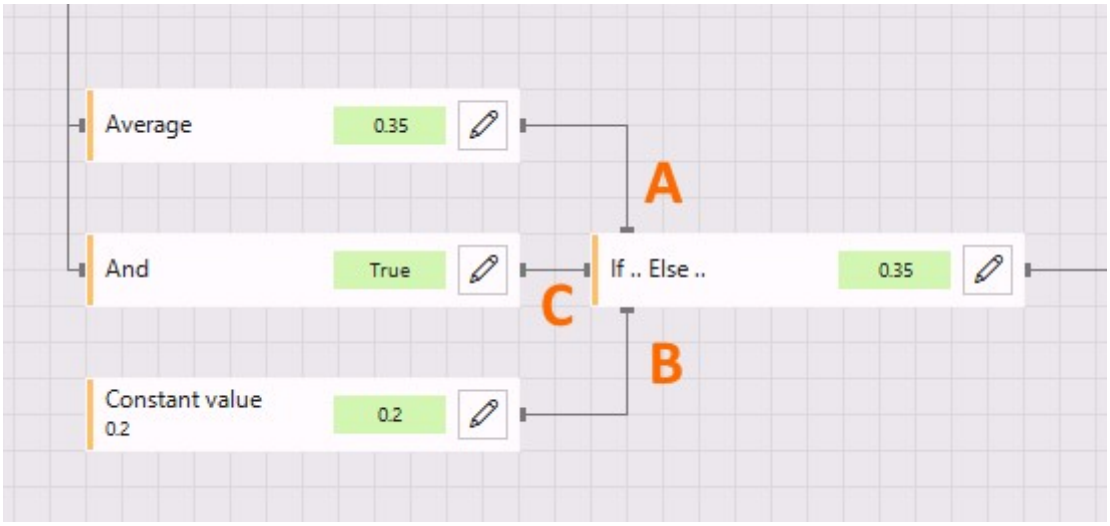
- **And** — This processor has multiple Boolean values (True/False) as input and a single Boolean value as output. Use this processor, for instance if you want two or more conditions to be true for the Custom Expression to be active. The screenshot below is part of the definition of the Custom Expression 'Duchenne smile'. For a Duchenne smile (genuine smile) both Action Unit 6 and Action Unit 12 must be active. In this example, the definition is that both Action Units must have a value greater than 0.2. If Condition 1 (for Action Unit 6) AND condition 2 (for Action Unit 12) are true, there is a Duchenne smile.



- **Or** — This processor has multiple Boolean values (True/False) as input and a single Boolean value as output. It compares two or more conditions with an OR logic. The screenshot below shows part of the definition of the Custom Expression 'Attention' (binary). The Or processor checks four conditions. If one of them is true, the output is *True*. If all four conditions are false, the output is *False*.


Constant value
20
20
Condition
>
False
Constant value
20
20
Condition
>
False
Or
False
Condition
>
False
Constant value
20
20
Condition
>
False
Constant value
25
25

- **Not** — This processor has a single Boolean value as input (for instance, a condition that is either True or False) and a single Boolean value as output. If the input is True, the output is False and vice versa.
- **If.. Else..** —. An If.. Else block has three inputs: (1) Condition C (left connector); (2) Numerical value A (top connector); (3) Numerical value B (bottom connector). The output is A if C is True and B if C is False. The screen shot below is part of the definition of the Custom Expression 'Duchenne smile'. The output of the If.. Else.. processor is the average intensity value of Action Unit 12 and Action Unit 6 if Action Unit 6 AND Action Unit 12 are active (that is, have both an intensity value higher than 0.2). The output is 0.2 if one or both Action Units are not active.



Temporal

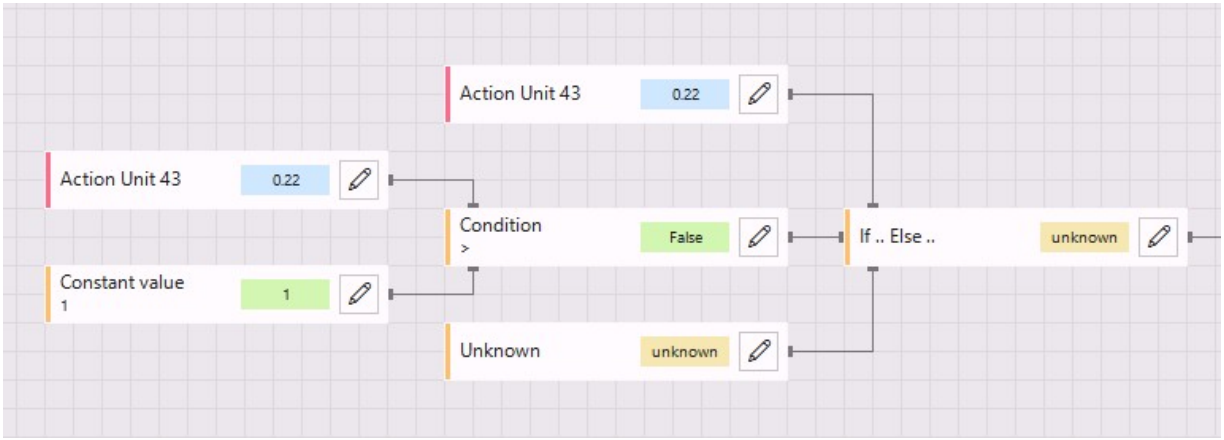
The temporal processors are identical to their non-temporal counterparts except for the temporal aspect. The temporal processors calculate the (weighted) average/ sum/maximum/minimum over the time (duration) you specify. You can also specify the minimum percentage of valid samples required to produce a valid output. You can use the temporal processors if your custom expression cannot be determined based on a single point in time and requires a history. For the running processors you cannot set any parameters.

- **Temporal average** — This processor calculates the average of its numerical input values over the specified time.
- **Temporal weighted average** — This processor calculates a weighted average of its numerical input values over the specified time. Older results weigh less than more recent results.
- **Temporal standard deviation** — This processor calculates the standard deviation of its numerical input values over the specified time.

- **Temporal first derivative** — This processor calculates the rate of change over the specified time. The output is (value of the last valid frame - value of first valid frame)/duration.
- **Temporal sum** — This processor calculates the sum of all its numerical input values over the specified time.
- **Temporal maximum** — This processor compares two or more numerical input values. The output is the highest value.
- **Temporal minimum** — This processor compares two or more numerical input values. The output is the lowest value.
- **Temporal counter** — This processor counts the number of times an input value crosses a given threshold in a specified direction.
- **Running average** — This processor calculates the average value over all previous valid samples.
- **Running maximum** — This processor calculates the maximum value of all previous valid samples.
- **Running minimum** — This processor calculates the minimum value of all previous valid samples.
- **Running counter** — This processor counts the total number of times an input value crosses a given threshold in a specified direction from the beginning of the analysis.

Miscellaneous

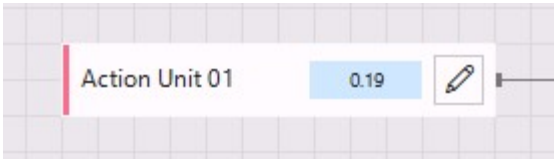
- **Constant value** — Use this processor for instance in combination with a Condition to compare the intensity value of an Action Unit with the constant value. See 'Condition' for an example.
- **Unknown** — Use this processor to give a custom expression the value 'Unknown'. In the screenshot below we defined a custom expression that only gives a value if Action Unit 43 has intensity = 1. In the example, the intensity of AU43 < 1. That means that the condition is false and that the output of the If/else processor is B (Unknown).



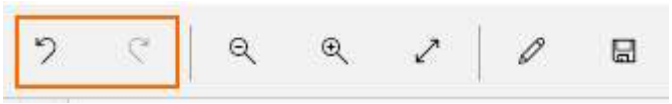
- **pi (π)** — The number pi (≈ 3.14159) is a mathematical constant, the ratio of a circle's circumference to its diameter.
- **e** — The number e (Euler's number, ≈ 2.71828) is a mathematical constant.

Tip: Click on a processor to read the information that comes with it. Each processor comes with a description and information on what type of input it can have, what the output will be and what parameters you can define.

A Custom Expression block in detail



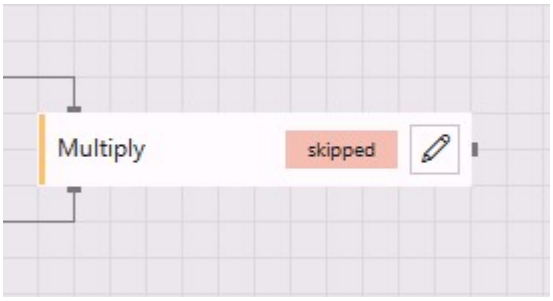
- **Color** — The color on the left side of the block indicated what type of block it is (red for input blocks, orange for processors, purple for Custom Expressions and green for the output block).
- **Name** — The name of the block.
- **Value or state** — The value of an input block (as defined with the input simulator, shown in a blue field) or the output value or state of a processor block (shown in a green field).
- **Description/parameters button** — Click the pencil button to enter the parameters and to view a description of the block.



- **Connectors** — Use the connectors to connect the block to other blocks. Input blocks have one output connector. Processors have one or more input connectors and one output connector. When you hover with your mouse over a connector, you can see what type of input is required and how many inputs are allowed (for an input connector) and what type of output it has and how many output connections are allowed (for an output connector). To make a connection, drag with your mouse from one connector to the other. To delete a connection, hover with your mouse over it until it becomes green and then click.

Note

A block gets the label ‘skipped’ (in an orange field) if its value or state is not taken into account when calculating the output value of the Custom Expression. For instance, because one (or more) of its own input or output connections are missing or because a connection further down in the definition is missing.


Multiply
skipped

Working with custom expression blocks

Copy and paste a block

Right-click a block, select **Copy** and then right-click it again and select **Paste** to duplicate the block.

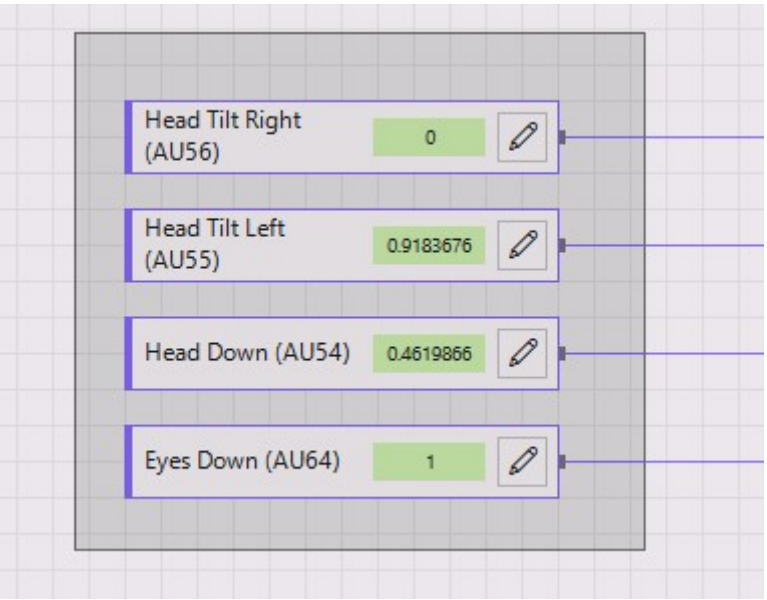
Delete a block

Click the block and then click **Delete** on your keyboard or right-click the block and select **Delete**.

Multi-select blocks

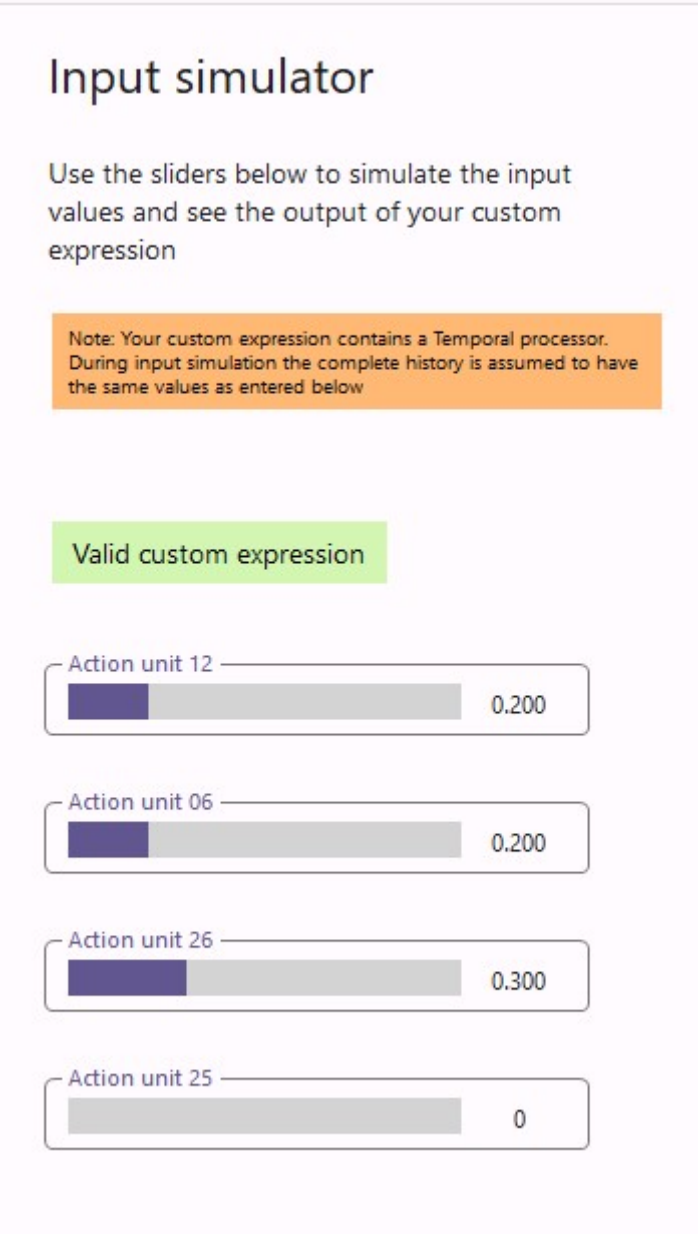
Select multiple blocks to move them together in one of the following two ways:

- Press the Ctrl key on your keyboard and select multiple blocks.
- Drag with your mouse to draw a box around multiple blocks.



Input simulator

To check whether you defined your Custom Expression correctly, you can use the Input simulator. The Input simulator allows you to fill in values for each input. You can also use the slider to specify a value. Each step in the definition will be calculated and you can check what the output is. In this way you can assess whether you correctly defined your Custom Expression.



The Input simulator indicates whether the Custom Expression is valid. If, for instance one of the connections is missing, the Custom Expression is invalid.

If you use a temporal processor in your definition, FaceReader comes with the following note: “Your Custom Expression contains a Temporal processor. During input simulation the complete history is assumed to have the same value as entered below”. In the screenshot above you can see this note, indicating that the definition of the Custom Expression contains a temporal processor. If you, for instance, filled in 02.00 seconds as the duration of the history when defining the temporal processor, FaceReader assumes that during these 02.00 seconds the Action Units 6, 12, 25, and 26 had a constant value, that is, the value that you defined in the Input simulator.

Visualize Custom Expressions

Aim

To display Custom Expressions during or after the analysis.

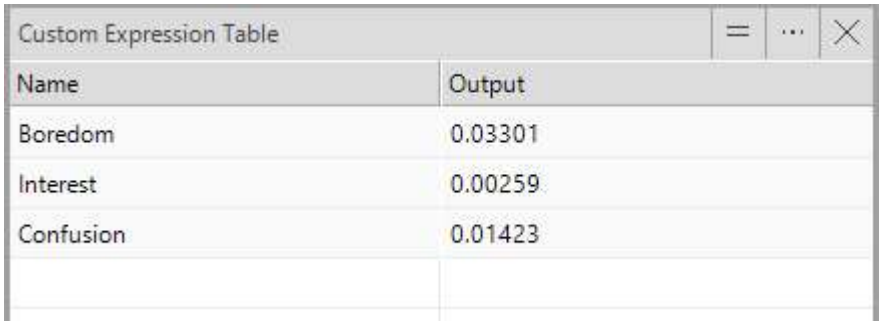
Prerequisites

- Your FaceReader license includes the Action Unit Module or you have Baby FaceReader.
- Action Unit analysis is switched on in the Settings.

  See

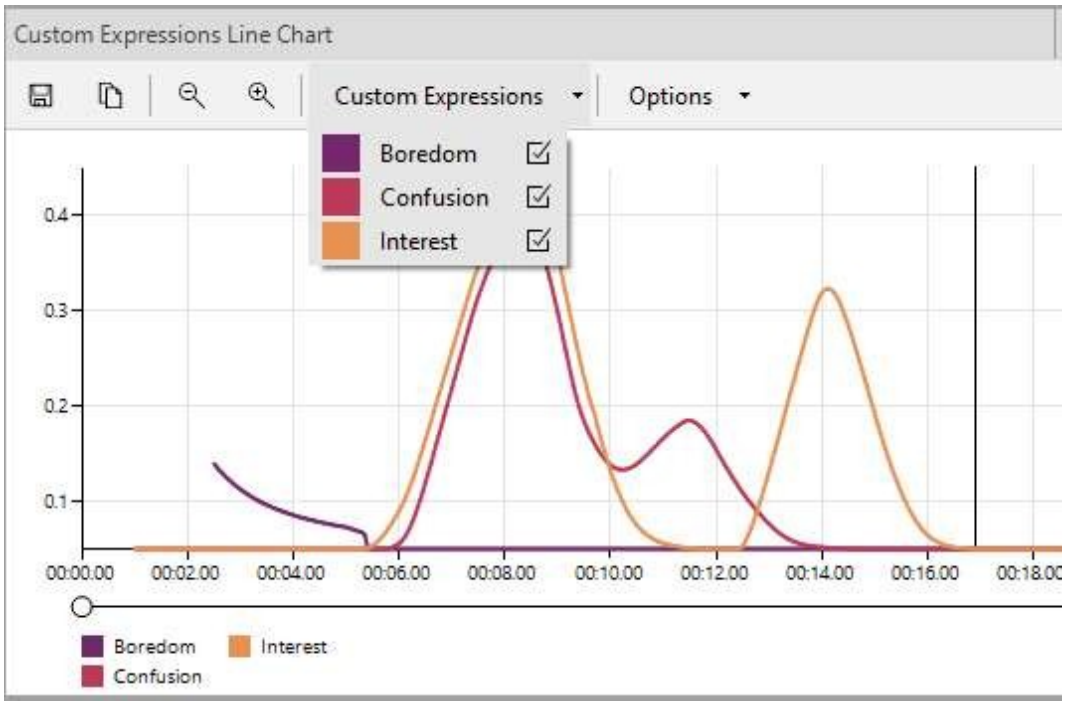
Custom Expressions Table

Select **Custom Expression Table** from one of the visualization windows. The table shows the intensities of the Custom Expressions that you added to your project. If your input is a live video stream or a video file, you will see the intensities change over time during the analysis or when you play back the analysis, reflecting the changes in custom expressions on the face.



Custom Expressions Line Chart

1. Select the **Custom Expressions Line Chart** from one of the visualization windows (see Manage analysis windows).
2. Choose which Custom Expressions to display from the **Custom Expressions** list on the toolbar. By default all Custom Expressions are selected.



Note

To copy, save, or zoom in this window, see Common options in FaceReader's output

Export Custom Expressions

Aim

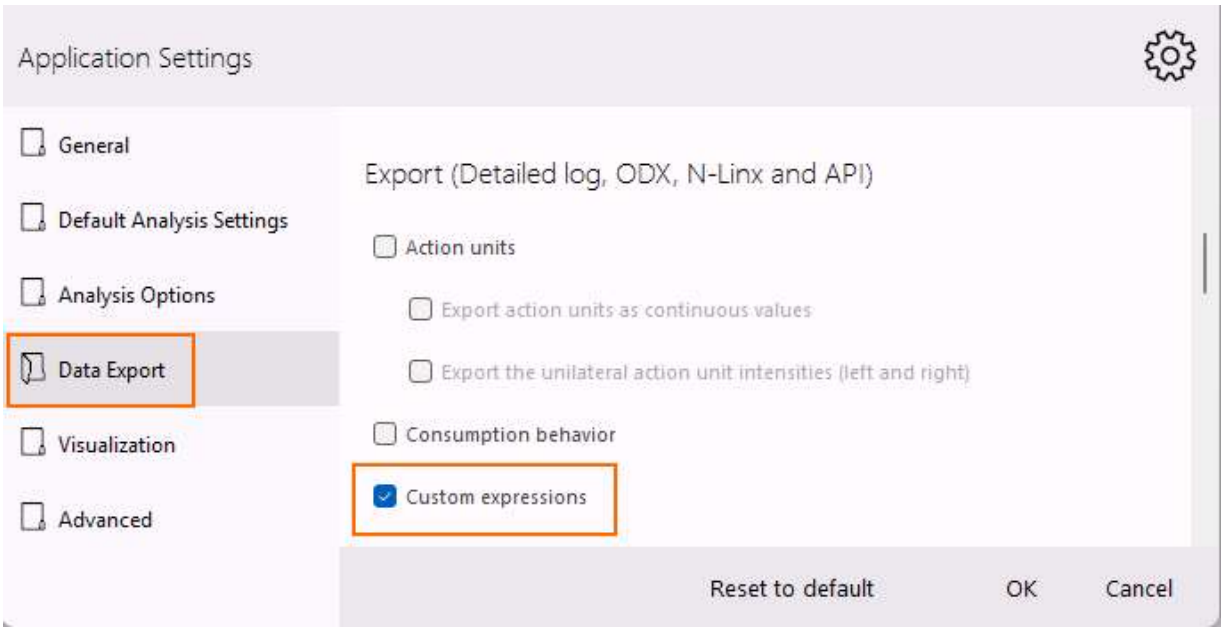
To export the Custom Expressions to a text file or The Observer XT format file.

Prerequisites

- You have the Action Unit Module or Baby FaceReader.
- You carried out an analysis.

Procedure

1. Choose **File** > **Settings** and then click the **Data Export** tab.
2. Under **Export (Detailed log, ODX, N-Linx and API)**, select **Custom expressions** and then click **OK**.



3. Choose **File** > **Export** and select one of the options.

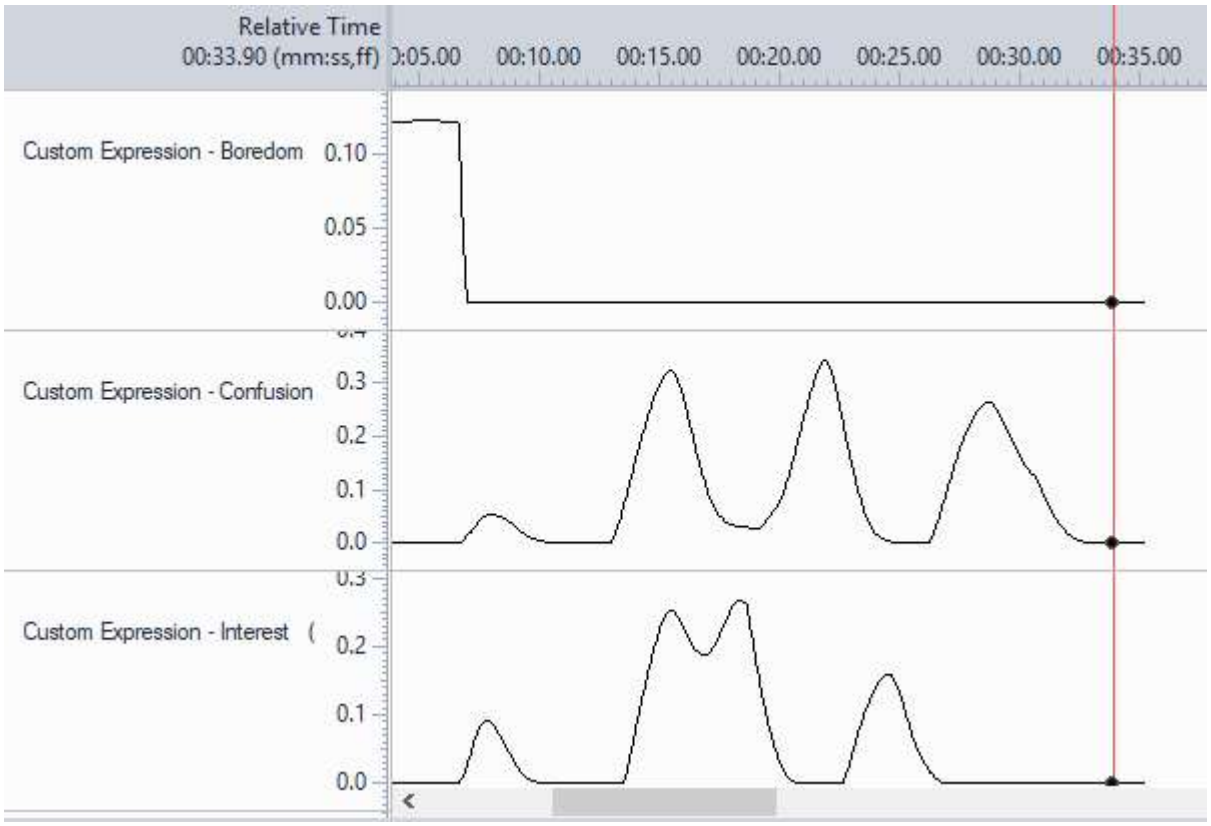
   See Export the data in FaceReader's output

	Custom Expression - Boredom	Custom Expression - Confusion	Custom Expressic
	0.122902700	0.000000000	0.000000000
	0.122776400	0.000000000	0.000000000
	0.122644100	0.000000000	0.000000000
	0.122517700	0.000000000	0.000000000
	0.122401400	0.000000000	0.000000000
	0.122300000	0.000000000	0.000000000
	0.122206700	0.000000000	0.000000000
	0.122117200	0.000000000	0.000000000
	0.122020000	0.000000000	0.000000000
	0.121939300	0.000000000	0.000000000
	0.121881900	0.000000000	0.000000000
	0.121844700	0.000000000	0.000000000
	0.121824900	0.000000000	0.000000000
	0.121817300	0.000000000	0.000000000
	0.121818100	0.000000000	0.000000000
	0.121826200	0.000000000	0.000000000
	0.121839100	0.000000000	0.000000000
	0.121855200	0.000000000	0.000000000
	0.121872300	0.000000000	0.000000000
	0.121889300	0.000000000	0.000000000
	0.121904500	0.000000000	0.000000000
	0.121910800	0.000000000	0.000000000
	0.121914600	0.000000000	0.000000000
	0.121917600	0.000000000	0.000000000
	0.121920200	0.000000000	0.000000000

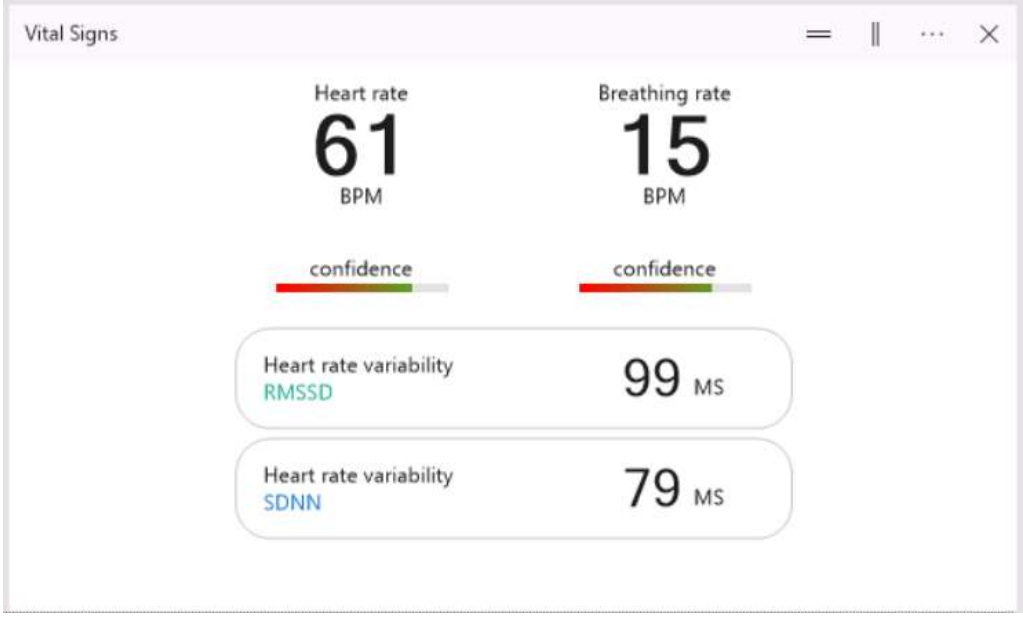
Custom Expression intensities in The Observer XT

If you send FaceReader data to The Observer XT 13 or higher versions using the N-Linx network communication protocol, Custom Expression intensities are imported as external data. You can also manually import Custom Expressions. To be able to import Custom Expressions as external data you need the External Data Module of The Observer.

See FaceReader with The Observer XT



The Vital Signs Module



Main topics

- Introduction to the Vital Signs Module
- Analyze heart rate, heart rate variability and breathing rate
- Analysis in phases
- Visualize vital signs

Introduction to the Vital Signs Module

Vital signs

The Vital Signs Module allows you to measure heart rate, heart rate variability and breathing rate. Heart rate and heart rate variability are measured by means of remote photoplethysmography (RPPG). Breathing rate is measured by detecting upper-body movement associated with respiration.

Remote PPG

Photoplethysmography is a simple and low-cost optical technique that can be used to detect blood volume changes in the tissue under the skin. It is based on the principle that changes in the blood volume result in changes in the light reflectance of the skin.

With each cardiac cycle the heart pumps blood to the periphery. Even though this pressure pulse is somewhat damped by the time it reaches the skin, it is enough to distend the arteries and arterioles in the subcutaneous tissue.

PPG is often used non-invasively to make measurements at the skin surface. In remote PPG (RPPG), FaceReader can detect the change in blood volume caused by the pressure pulse when the face is properly illuminated. The amount of light reflected is then measured. When reflectance is plotted against time, each cardiac cycle appears as a peak. This information can be converted to heart rate average and variability.

For an overview of the accuracy of the estimated heart rate, see Gudi et al. (2020).

References

Photoplethysmography

Reisner, A. T., Shaltis, P. A., McCombie, D. and Asada, H. H. (2008). Utility of the Photoplethysmogram in Circulatory Monitoring. *Anesthesiology*, 108, 950-958.

http://en.wikipedia.org/wiki/Photoplethysmogram

Remote PPG and FaceReader

Gudi, A.; Bittner, M.; Van Gemert, J. (2020) Real-time webcam heart rate and variability estimation with clean ground truth for evaluation. *Applied Sciences* 10(23): 8630.

Tasli H. E., Gudi, A., and den Uyl, M. (2014). Integrating Remote PPG in Facial Expression Analysis Framework. *Proceedings of the 16th International Conference on Multimodal Interaction, Istanbul*, November 12-16, 2014, 74-75.

http://www.vicarvision.nl/pub/RPPG_Facial_Expression_Analysis.pdf

Please cite the original work in your studies when based on FaceReader's remote PPG.

Patent number

The European Patent Office has granted patent EP2960862A1 to Vicarious Perception Technologies for the method for stabilizing vital sign measurements using parametric facial appearance models via remote sensors (https://patents.google.com/patent/EP2960862A1/en).

Vital Signs Module

With FaceReader's Vital Signs Module, you can analyze heart rate, heart rate variability (HRV), and breathing rate of the test participant without additional hardware other than a suitable webcam.

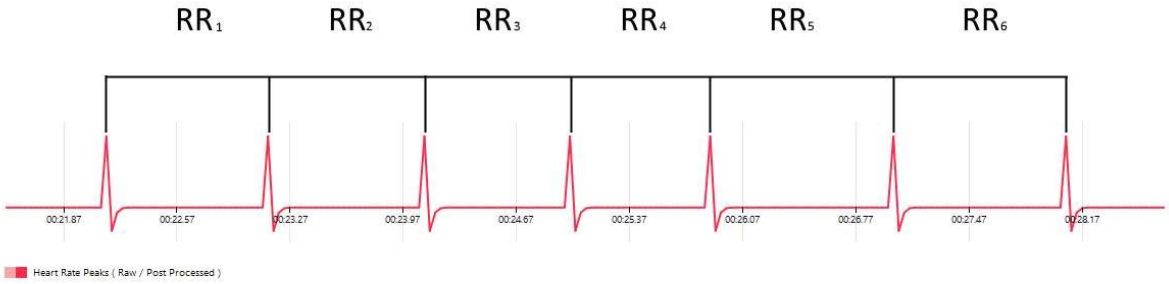
Heart rate variability can be derived from the single heart beats that are used to calculate the heart rate. HRV measures the variability between heart beats, which can give important insights into the physiology of a person as it reflects changes in activation of the autonomic nervous system. With FaceReader, you can obtain the timing of individual heart beats (which can be visualized in FaceReader's heart beat log), as well as HRV measures like RMSSD and SDNN. In addition, FaceReader can measure a test participant's respiration rate.

RMSSD

One of the most commonly used measures of heart rate variability is the root mean square of successive differences (RMSSD).

The differences in time between single heart beats are called RR intervals or inter-beat intervals.

$RR_n = beat_{n+1} - beat_n$



Differences between the RR intervals are called successive differences (SD)

$SD_n = RR_{n+1} - RR_n$

The RMSSD is the root mean square of two successive RR intervals. The unit of RMSSD is the same as the time unit chosen in equation 1 (usually it is milliseconds).

$$RMSSD = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(SD_n)^2}$$

SDNN

SDNN is the standard deviation of normal to normal R-R intervals. “Normal” means that abnormal beats, like ectopic beats (heart beats that originate outside the right atrium’s sinoatrial node), have been removed.

Guidelines for an optimal vital signs measurement

Lighting

Make sure that lighting is diffuse. Indirect natural light is preferable, otherwise artificial diffused lighting can also be used. Lighting is preferably from a frontal direction and there are no strong shadows on the face. Strong specular reflection (e.g., bright white spots on the forehead) should be avoided.

See also Camera and accessories

Subject requirements

- Distance between camera and subject: 0.5 - 1 m.
- Ensure that the subject’s full forehead/upper part of the face is clearly visible for reliable RPGG measurements. Since RPPG primarily depends on the analysis of the upper region of the face, it must be well exposed to the camera, and not occluded by hair, a hat, etc.

- For reliable breathing rate measurements it is crucial that the test participant's shoulders are visible in the camera view/video. Excessive movement of e.g., arms in front of the chest will reset the calibration and should be avoided. If chest motions are very shallow or if there is no breathing detected, a warning will be shown in the Vital Signs window informing you that FaceReader "failed to model body pose".

Camera settings

Remote PPG is intended to work with the cameras supported for FaceReader (see Camera and accessories). Do note that for Remote PPG the following cameras are unsuitable due to internal video processing: Logitech Brio, Microsoft Lifecam. Below you find recommended settings:

- In general, videos should be recorded with the minimum amount of compression (e.g., ideal settings are: the YUY2 stream encoded with HUFFYUV, FFV1, MJPEG (lossless/low compression ratio), H264/H265 (lossless/low compression ratio)). If your camera offers different video formats, choose the format that gives the highest file size, (for example, .avi).
- Frame rate: at least 15 fps; preferred 30 fps. Make sure FaceReader analyzes each frame. See Video in Settings
- Face size: at least 100 x 100 pixels, for example:

  In a 1280 x 720 video, the face should cover 8-14% of the frame dimensions

  In a 800 x 448 video, the face should cover 12-20%of the frame dimensions

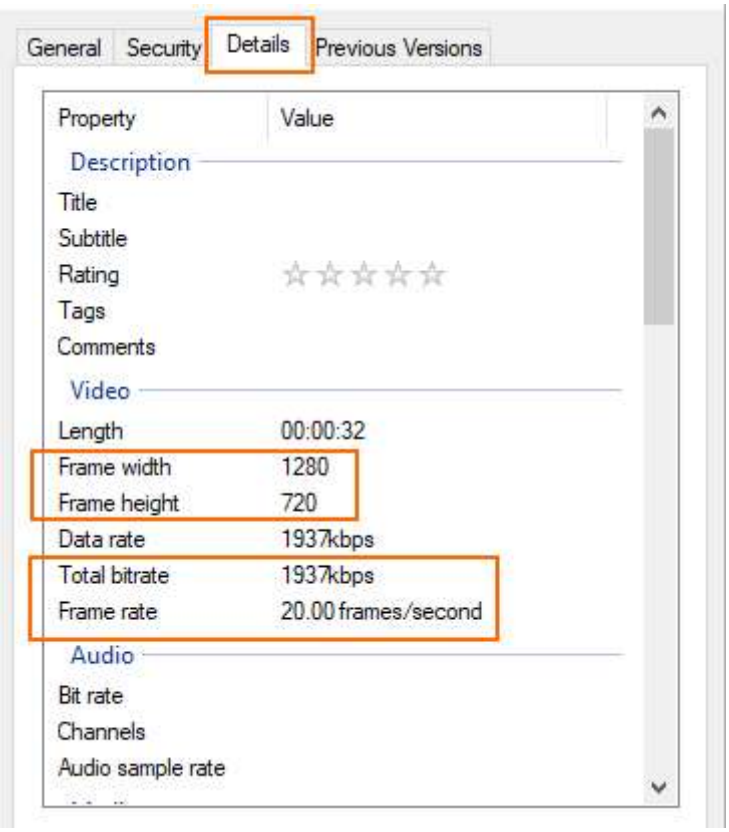
  Note that most cameras will only allow lossless/low compression recording at a lower resolution such as 800 x 448.

- Bits per pixel ratio: at least 0.15 bits/pixel, preferred 1 bit/pixel. The BitsPerPixel ratio is calculated as follows:

$$[\text{BitsPerPixel}] = \frac{[\text{BitRate}]}{[\text{FrameRate}] * [\text{TotalPixels}]}$$

  For example, a video recorded at 30 fps with a resolution of 640 x 480 pixels should have a bit rate of at least 1.382 Mbit/second (preferred 9.216 Mbit/second).

  You can find the frame rate, resolution and bit rate of your video when you right-click the video filename in Windows Explorer and select **Properties**. You can find the information on the **Details** tab.



- The following camera capture settings are optimal for accurate Remote PPG measurement:

  - Saturation: High

  - Contrast: High

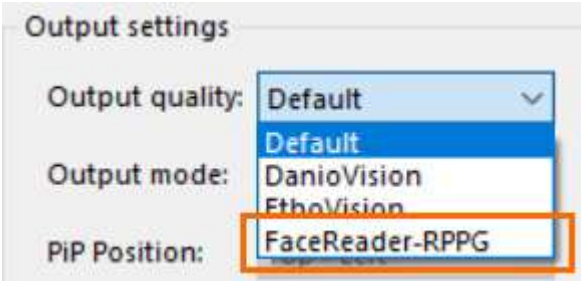
  Do note that adjusting these settings to extreme values can result in the image being distorted which may cause FaceReader to not find the face. Therefore, these settings should be adjusted such that the face appearance remains proper.

  These camera settings allow for the best possible heart rate detection. These settings might impact the visual quality of the video, but will lead to a more accurate heart rate estimation.

- For optimal remote PPG measurements the camera should be able to capture a frontal view of the subject's face throughout the session. The accuracy of the measurement is related with the head pose. Frontal head pose is recommended where abrupt head pose changes can degrade the optimal performance. Ensure that the camera is roughly at eye level.

Recording video with MediaRecorder

To ensure video recording with enough detail for remote PPG, MediaRecorder 6 (Noldus' video recording tool) has a setting. In the **Output settings** window, choose 'FaceReader-RPPG' from the list.



Analyze heart rate, heart rate variability and breathing rate

Aim

To switch on heart rate, heart rate variability, and breathing rate analysis.

Prerequisite

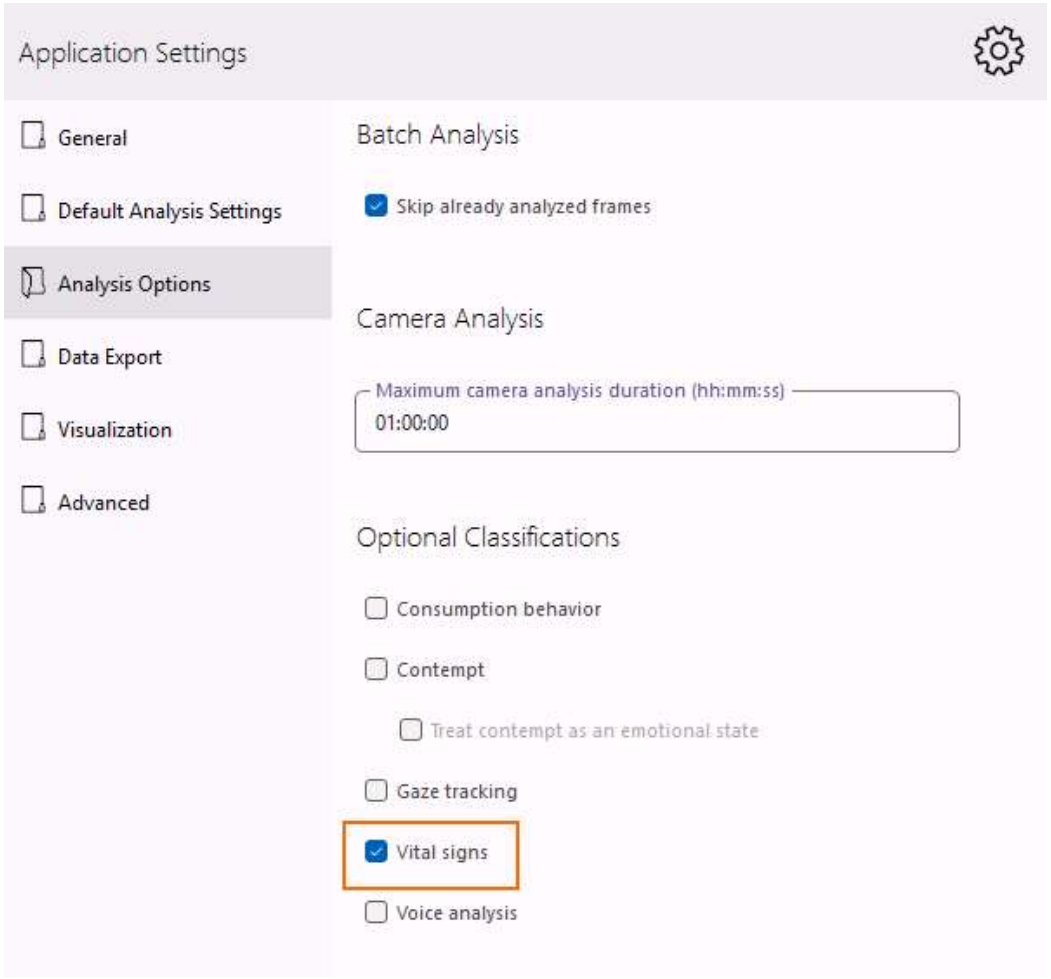
You have the Vital Signs Module.

Procedure

1. Choose **File** > **Settings** > **Analysis options**.
2. Under **Optional Classifications**, select **Vital signs**.

Note

The option to analyze vital signs must be switched on, which is by default the case if you have the Vital Signs Module. However, when you upgrade a basic FaceReader license with the Vital Signs Module, you must switch the option on manually.


Application Settings
General
Default Analysis Settings
Analysis Options
Data Export
Visualization
Advanced
Batch Analysis
Skip already analyzed frames
Camera Analysis
Maximum camera analysis duration (hh:mm:ss)
01:00:00
Optional Classifications
Consumption behavior
Contempt
Treat contempt as an emotional state
Gaze tracking
Vital signs
Voice analysis

Analysis in phases

Heart rate and breathing rate analysis is carried out in three phases, calibration, calculation, and post-processing.

Calibration

FaceReader requires a 8.5 second calibration period for RPPG measurements in which the signal of the skin color is sampled and processed for a reliable measurement. During the calibration stage the test participant should look into the camera and avoid extensive head movement.

Calibration is done at the start of analysis and every time the participant's face is found again after it was not found for some time. When the face is found again, the Heart rate window shows Calibrating.

FaceReader needs at least 5 minutes to calculate a value for the heart rate variability. This default setting was chosen according to standards found in the literature. You can change the heart rate variability period in the settings (File > Settings > Advanced settings).

The calibration period for breathing rate measurements is 15 seconds. Excessive movements of e.g., arms in front of the chest will reset calibration. If chest movements are very shallow, or there is no breathing detected, a warning message will be shown in the Vital Signs window.

Calculation

To calculate the heart rate and breathing rate, for each time step the pulses/breaths over the previous ten seconds are used. Heart rate is expressed in beats per minute (bpm) and breathing rate in breaths per minute (bpm).

Post-processing

At the end of analysis, the estimated heart rate, heart rate variability, and breathing rate are post-processed to improve the accuracy, also in the initial 8.5/15 seconds and every time a new calibration was carried out. Note that after analysis the reported heart rate and breathing rate values can differ from those seen during analysis. Do not rely on the exact values you see during analysis.

Visualize vital signs

Aim

To display the heart rate, heart rate variability and breathing rate during or after the analysis.

Prerequisites

- Your FaceReader license includes the Vital Signs Module.
- Vital signs analysis is switched on in the Settings.

  See Analyze vital signs.
- You are running an analysis, or viewing the analysis afterwards.

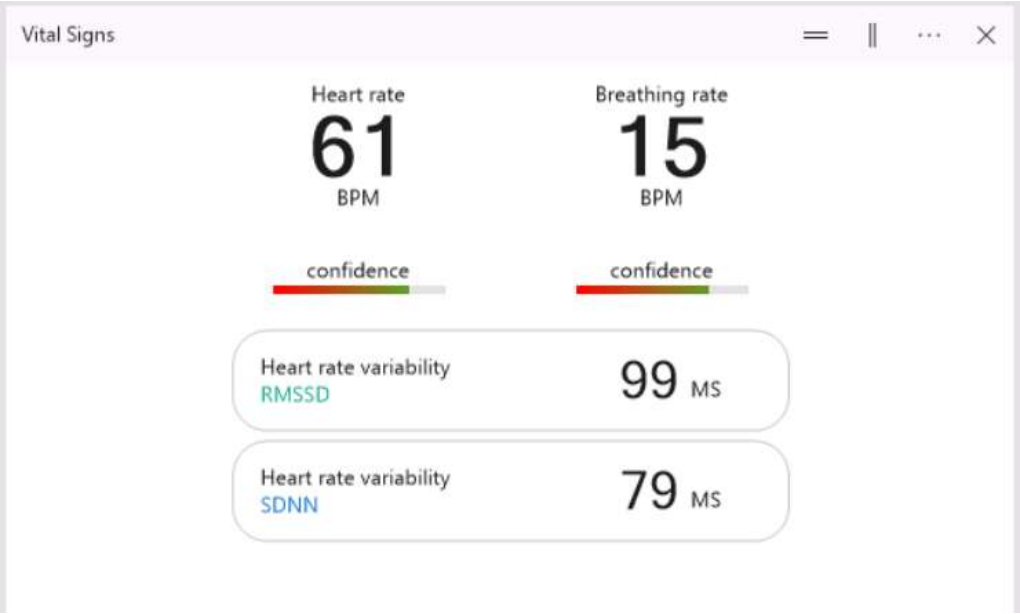
Vital Signs

The Vital Signs window shows the current heart rate of the participant estimated by means of remote photoplethysmography. Heart rate is expressed in beats per minute (bpm). The Vital Signs window also shows the heart rate variability (RMSSD and SDNN) and breathing rate. The window shows confidence indicator bars indicating how confident the current measurements are.

See Introduction to the Vital Signs Module

To view the Vital Signs window

Click the **Select window** button in one of the analysis windows and select **Vital Signs** and again **Vital Signs**.



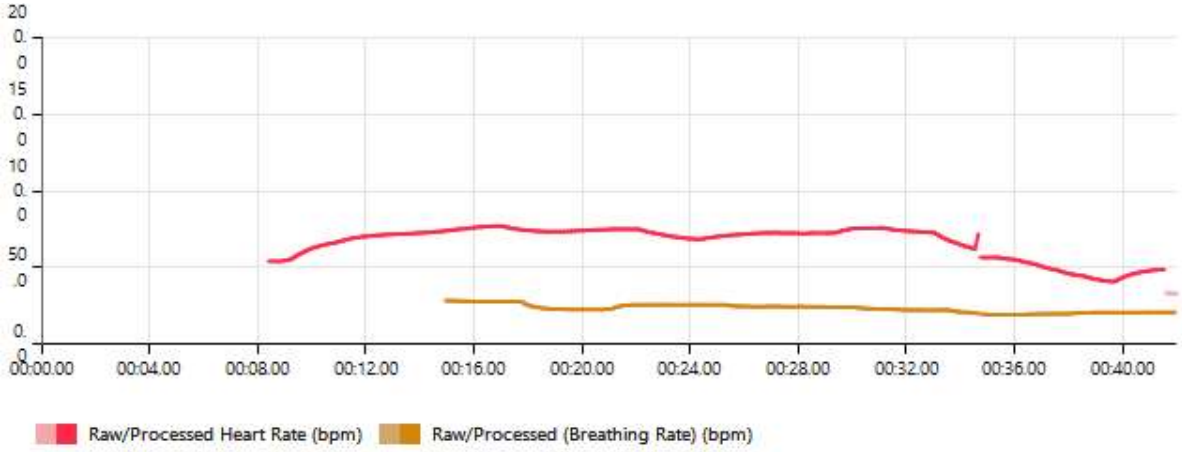
If your settings deviate from the recommended settings, a warning will show up in the Vital Signs ~~Heart Rate~~ window, informing you that the ratio between the frame rate, bit rate and resolution is too low to estimate the vital signs ~~heart rate~~ with high accuracy. See Camera settings for the recommended settings.

Vital Signs Line Chart

The Vital Signs Line Chart shows the heart rate, heart rate variability estimated with Remote photoplethysmography, and the respiratory rate plotted against time.

To view the Vital Signs Line chart

Click the **Select window** button in one of the visualization windows and select **Vital Signs** > **Vital Signs Line Chart**.



From the **Vital Signs** drop-down list, select what you want to view, **Heart Rate**, **Heart Rate Variability (RMSSD)**, **Heart Rate Variability (SDNN)** and/or **Breathing Rate**. Please note that in the chart above heart rate variability was not selected. When you play back a video, a hairline shows the time in the video.

At the end of analysis, the estimated heart rate, heart rate variability, and breathing rate are post-processed to improve the accuracy, also in the initial 8.5/15 seconds and every time a new calibration was carried out. Note that the reported heart rate and breathing rate values after analysis can differ from those seen during analysis. Do not rely on the exact values you see during analysis. The heart rate, heart rate variability, and breathing rate lines in the 'Vital Signs Line Chart' have a different color before and after post-processing.

Notes

- Click **Options** and then select **Auto Scale Y axis** to adjust the Y axis to the maximum value.

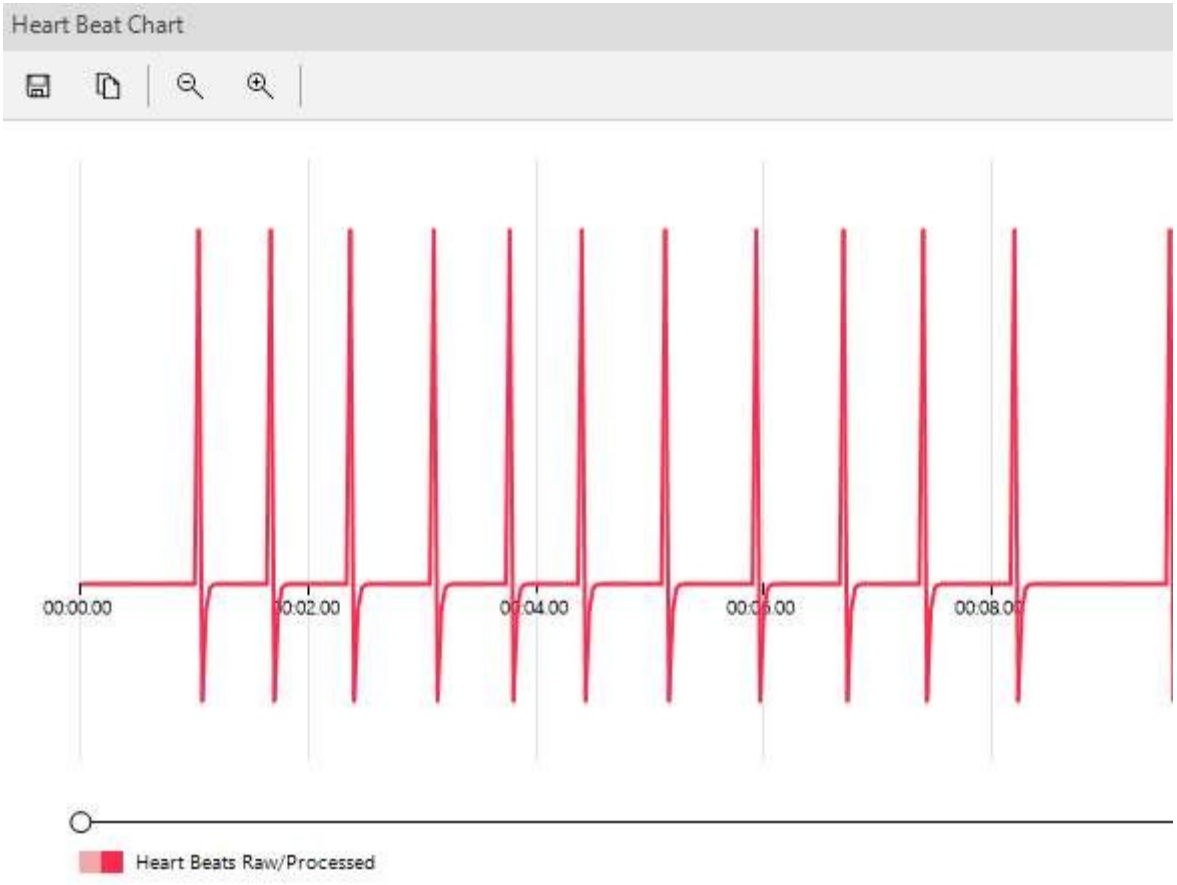
Heart Beat Chart

The Heart Beat Chart shows the heart beats on a time line. It gives you an impression of the heart rate variability.

Heart rate and heart rate variability are subject to Post-processing. The heart rate peaks have a different color before and after post-processing.

To view the Heart Beat Chart

Click the **Select window** button in one of the visualization windows and select **Vital Signs** > **Heart Beat Chart**.


Heart Beat Chart
00:00.00
00:02.00
00:04.00
00:06.00
00:08.00
Heart Beats Raw/Processed

Export heart rate, heart rate variability and breathing rate data

Aim

To export the heart rate, heart rate variability and breathing rate data of your test participants to an Excel file or a text file to view them outside FaceReader or to import them into The Observer XT.

Prerequisites

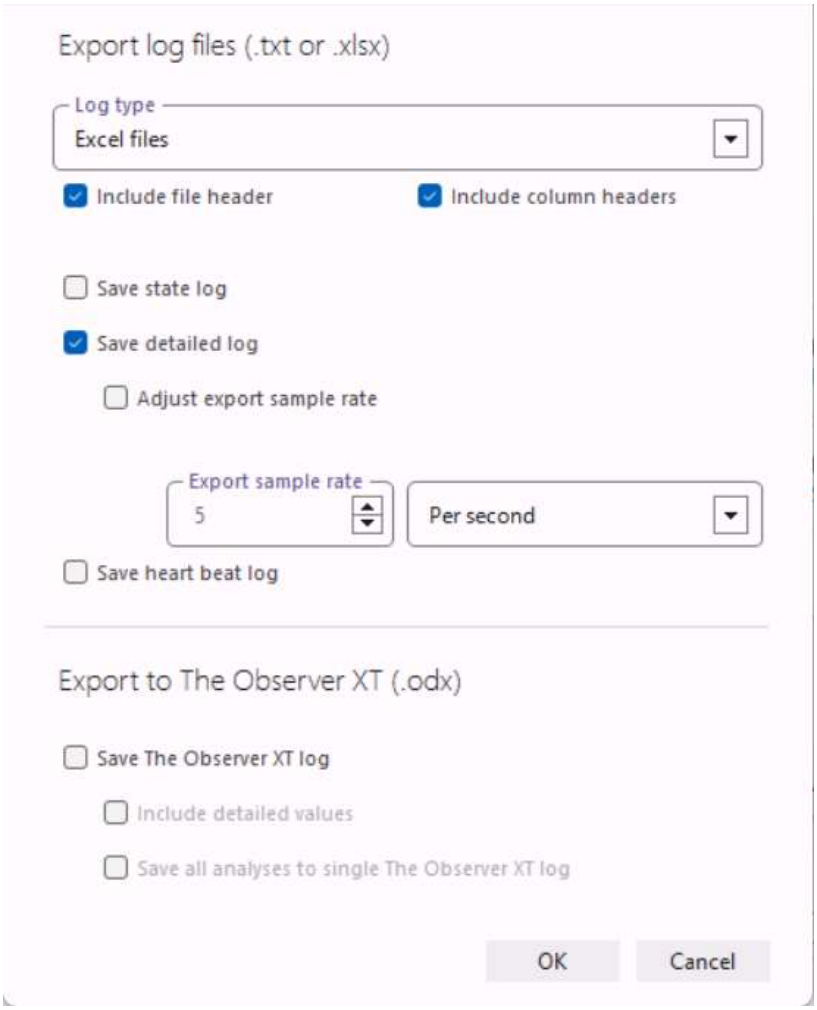
- You have the Vital Signs Module.
- You selected Vital Signs analysis and export in the Settings.
- You carried out an analysis.

Procedure

1. Choose **File** > **Export** and select one of the three options.

   See Export the data in FaceReader's output

2. Browse to the folder in which you want to save the export files and click **Select**.
3. From the **Log type** drop-down list select the format of your log files, either Excel format or text. Choose *Text files* if you want to import the log files into The Observer XT.
4. Select **Save detailed log** and click **OK**.


Export log files (.txt or .xlsx)
Log type
Excel files
Include file header
Include column headers
Save state log
Save detailed log
Adjust export sample rate
Export sample rate
5
Per second
Save heart beat log
Export to The Observer XT (.odx)
Save The Observer XT log
Include detailed values
Save all analyses to single The Observer XT log
OK
Cancel

Export heart beat log

Aim

To export the inter-beat interval data (the time intervals between individual hear beats).

Prerequisites

- Your FaceReader license includes the Vital Signs Module.
- Vital signs analysis and export is switched on in the Settings.

  See Analyze vital signs
- You ran a video or camera analysis.

Procedure

1. From the **File** menu select **Export** and select one of the three available options.
2. Select the folder in which you want to save the log file.
3. Select **Save heart beat log**.

See Export analysis results in FaceReader's output.

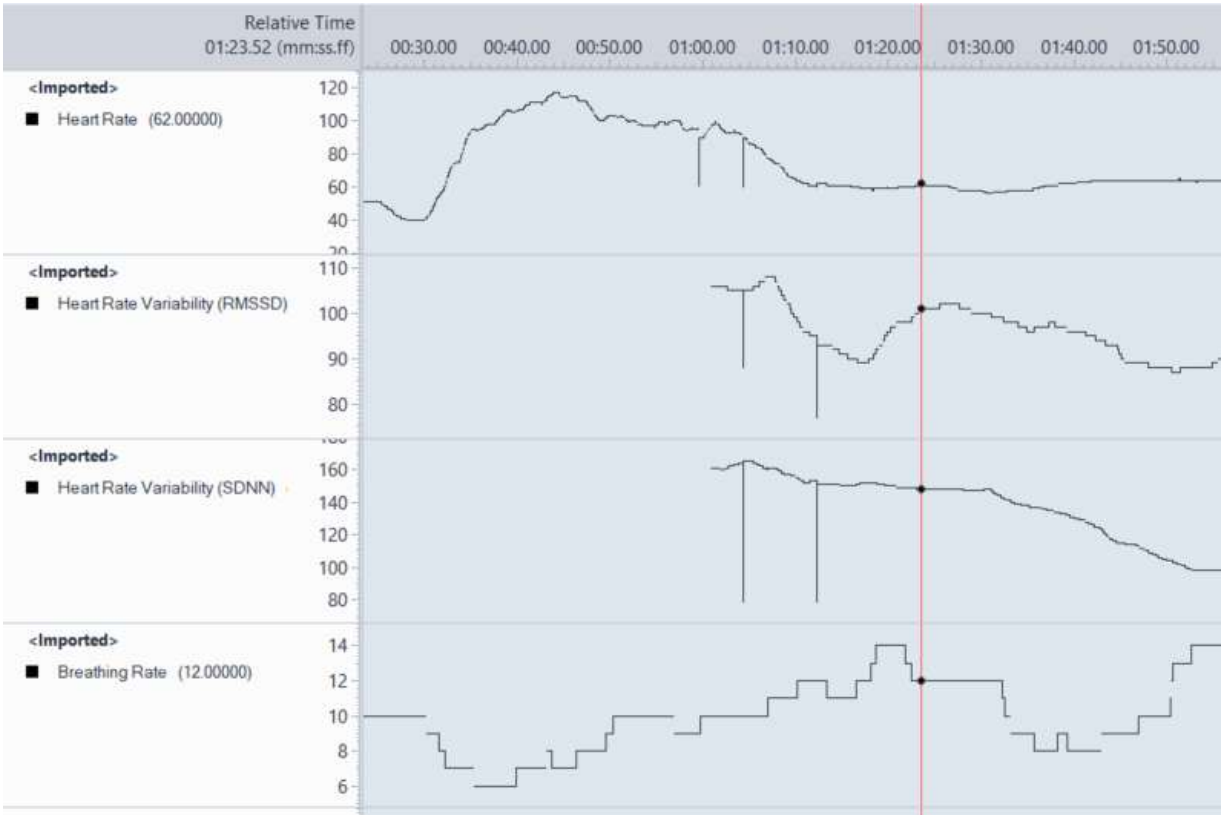
	A	B	C	D
1	Video analysis heart beat log			
2				
3	Face Model	General		
4	Calibration	-		
5	Start time	55:03.9		
6	Filename	\Videos\Natasja.avi		
7	Frame rate	30.00003		
8				
9	Age	Gender		
10	31	Female		
11				
12				
13	Time	Interbeat Interval (s)		
14	00:01.5	1.3		
15	00:02.3	0.866667		
16	00:03.4	1.033333		
17	00:04.4	1		
18	00:05.9	1.5		
19	00:07.4	1.533333		
20	00:08.8	1.366667		
21	00:10.3	1.566667		
22	00:11.8	1.5		
23	00:12.6	0.8		
24	00:13.3	0.666667		

Vital signs data in The Observer XT

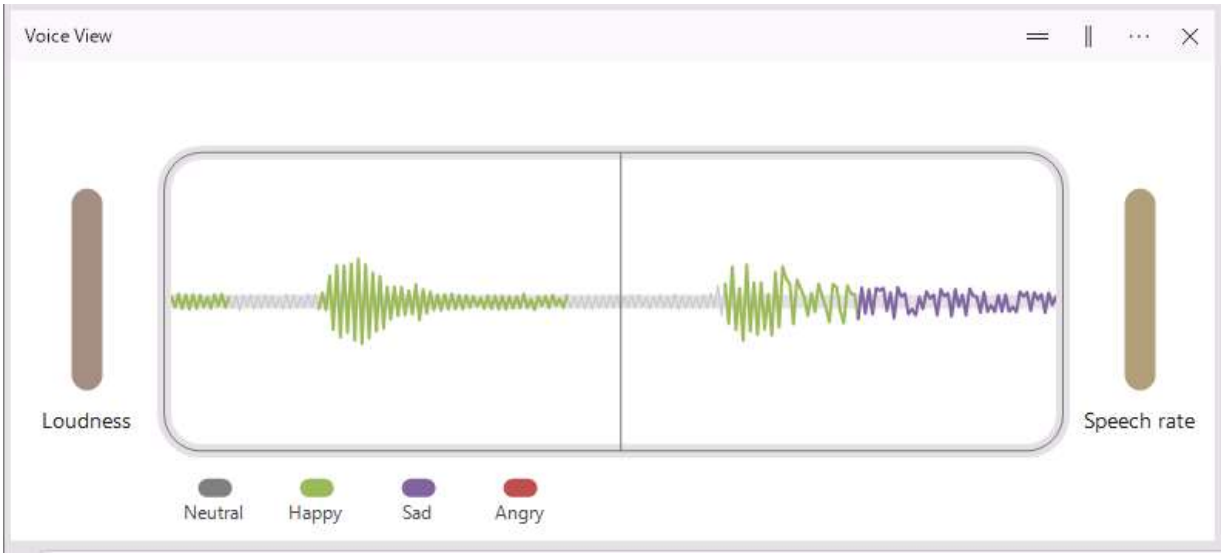
If you send FaceReader data to The Observer XT 13 or higher versions using the N-Linx network communication protocol, Vital Signs data are imported as external data. You can also manually import Vital Signs data. To be able to import Vital Signs data as external data you need the External Data Module of The Observer.

See FaceReader with The Observer XT

Please note that the data in the screen shot below come from a project in which the **Heart rate variability period** was set to one minute (the default is five minutes).


Relative Time
01:23.52 (mm:ss.ff)
00:30.00
00:40.00
00:50.00
01:00.00
01:10.00
01:20.00
01:30.00
01:40.00
01:50.00
<Imported>
Heart Rate (62.00000)
120
100
80
60
40
<Imported>
Heart Rate Variability (RMSSD)
110
100
90
80
<Imported>
Heart Rate Variability (SDNN)
160
140
120
100
80
<Imported>
Breathing Rate (12.00000)
14
12
10
8
6

The Voice Analysis Module



Main topics

- Introduction to the Voice Analysis Module
- Analyze voice characteristics
- Visualize voice characteristics
- Export voice analysis data

Introduction to the Voice Analysis Module

The Voice Analysis Module enables you to analyze vocal characteristics. FaceReader can currently detect the following emotions in a voice: Neutral, Happy, Sad, Angry. The software was trained and tested using British and American English data, both acted and natural speed. Preliminary tests show potential applicability to other languages, particularly those with close linguistic and cultural similarities.

An audio buffer is used to collect approximately one second of data before starting the analysis because audio (unlike video) cannot be segmented into discrete frames. FaceReader uses a simple Voice Activity Detection (VAD) and analyzes all sound above the threshold. If there is noise in the audio signal this will be analyzed as well.

There is no preprocessing step to decide if audio is speech, so background noise can result in incorrect detections. Using a high-quality microphone and limiting background noise is recommended to improve the accuracy of the voice analysis. Furthermore, it might be necessary to adjust the microphone's sensitivity to achieve the best results.

Please note that you cannot combine the Voice Analysis Module with Baby FaceReader and you cannot analyze emotions in voices in a multi-subject analysis.

Note

The Voice Analysis module employs Voice Activity Detection (VAD) based on a Gaussian Mixture Model (GMM) to distinguish between speech and non-speech segments. This approach helps ensure that only voiced segments are processed, reducing the influence of silence or background noise. While GMM-based VAD is generally reliable under typical conditions, it is not immune to mis-classifications, particularly in environments with overlapping speech, high levels of ambient noise, or non-speech sounds within similar frequency bands. Only if voice is detected, the following measures will be calculated and reported by FaceReader.

Analyze voice characteristics

Aim

To switch on voice analysis.

Prerequisite

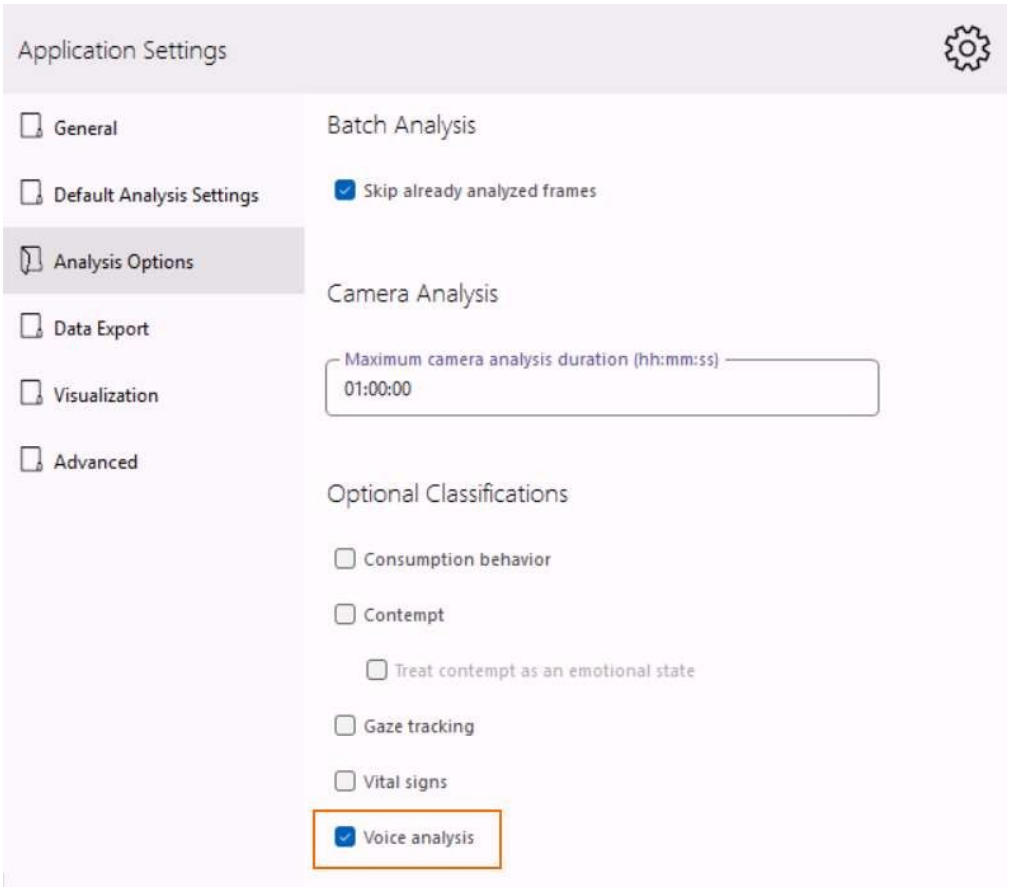
You have the Voice Analysis Module.

Procedure

1. Choose **File** > **Settings** > **Analysis options**.
2. Under **Optional Classifications**, select **Voice analysis**.

Note

The option to analyze the voice must be switched on, which is by default if you have the Voice Analysis Module. However, when you upgrade a basic FaceReader license with the Voice Analysis Module, you must switch the option on manually.


Application Settings
General
Default Analysis Settings
Analysis Options
Data Export
Visualization
Advanced
Batch Analysis
Skip already analyzed frames
Camera Analysis
Maximum camera analysis duration (hh:mm:ss)
01:00:00
Optional Classifications
Consumption behavior
Contempt
Treat contempt as an emotional state
Gaze tracking
Vital signs
Voice analysis

Visualize voice characteristics

Aim

To display the voice characteristics during or after the analysis.

Prerequisites

- Your FaceReader license includes the Voice Analysis Module.
- Voice analysis is switched on in the Settings.

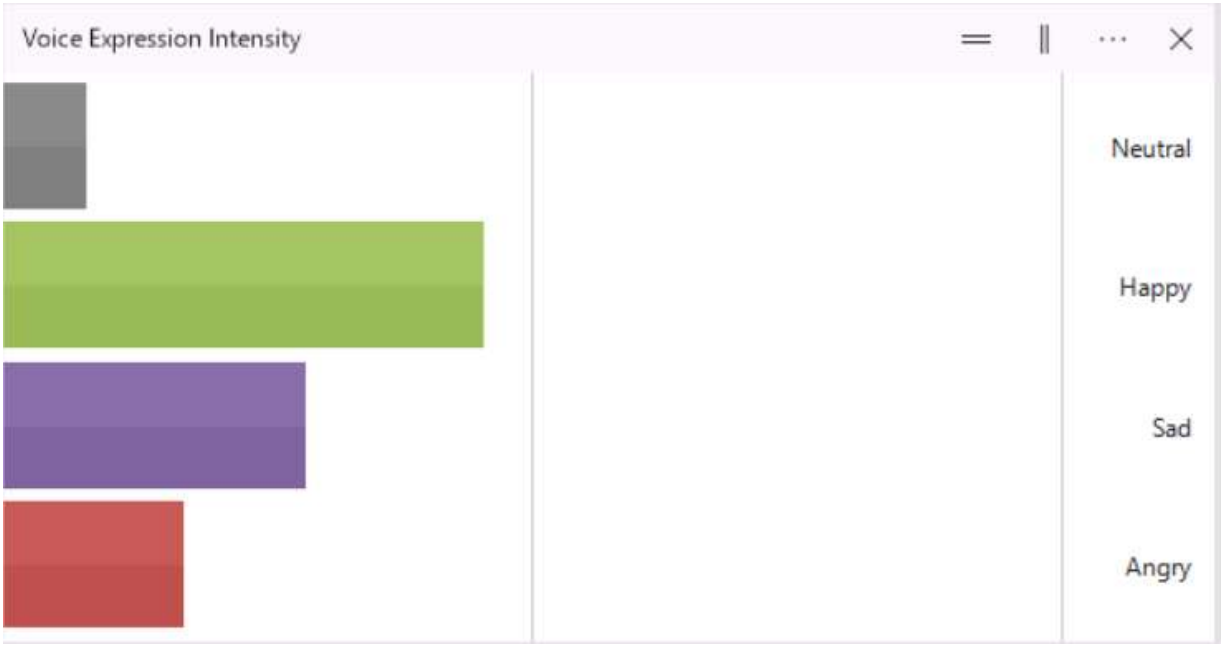
  See Analyze voice characteristics
- You are running an analysis, or viewing the analysis afterwards.

Voice Expression Intensity

The **Voice Expression Intensity** chart displays the intensity of the four basic emotions that can be recognized in the voice (Neutral, Happy, Sad and Angry). You will see the bars change over time, reflecting the changes in expressions in the voice.

To view the Voice Expression Intensity Chart

Click the **Select window** button in one of the analysis windows and select **Voice Analysis** and then **Voice Expression Intensity Chart**.

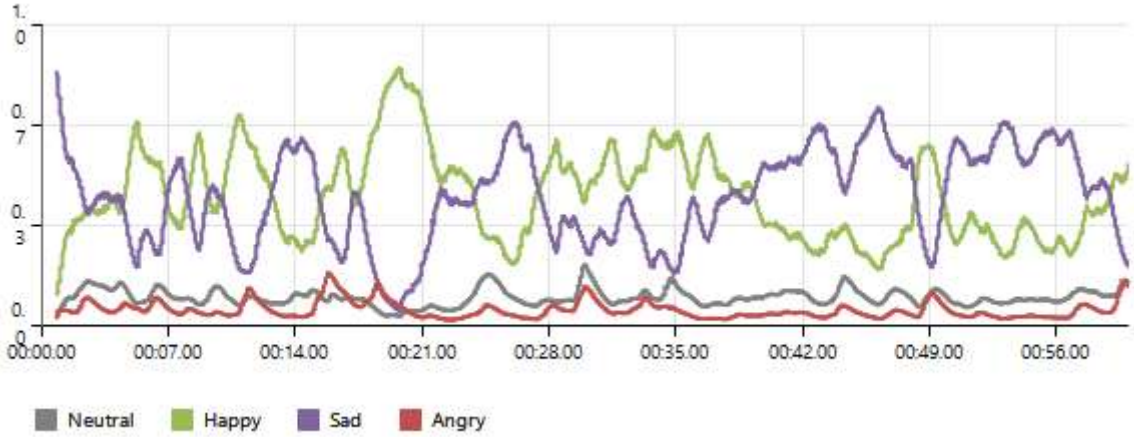


Voice Expression Line Chart

The **Voice Expression Line Chart** shows the detected emotions over time. There are gaps in the line chart if the VAD does not detect voice. This detection method cannot be adjusted. If there is noise in the audio signal, the Voice Expression Line Chart may show continuous lines even though the participant did not speak all the time.

To view the Voice Expression Line Chart

Click the **Select window** button in one of the analysis windows and select **Voice Analysis** and then **Voice Expression Line Chart**.



There are gaps in the line chart at the time points when the volume was below the threshold.

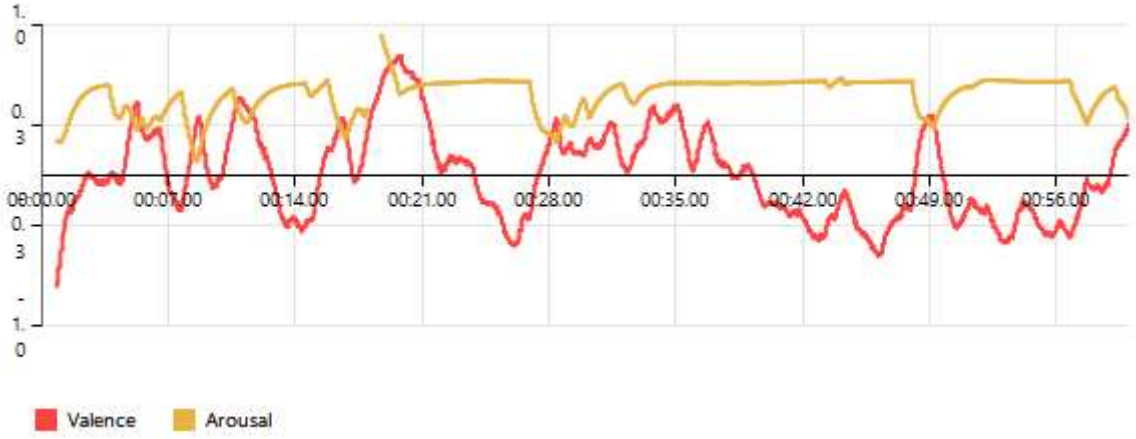
Voice Valence and Arousal Line Chart

The Voice Valence indicates whether the emotional state of the subject is positive or negative. 'Happy' is the only positive emotion, while 'Sad' and 'Angry' are considered to be negative emotions. Valence is calculated by subtracting the intensity of the strongest negative emotion from the intensity of 'Happy'.

Arousal is the weighted average of Loudness and Speech rate. See How is Loudness calculated? and How is Speech rate calculated?

To view the Voice Valence and Arousal Line Chart

Click the **Select window** button in one of the analysis windows and select **Voice Analysis** and then **Voice Analysis and Arousal Line Chart**.



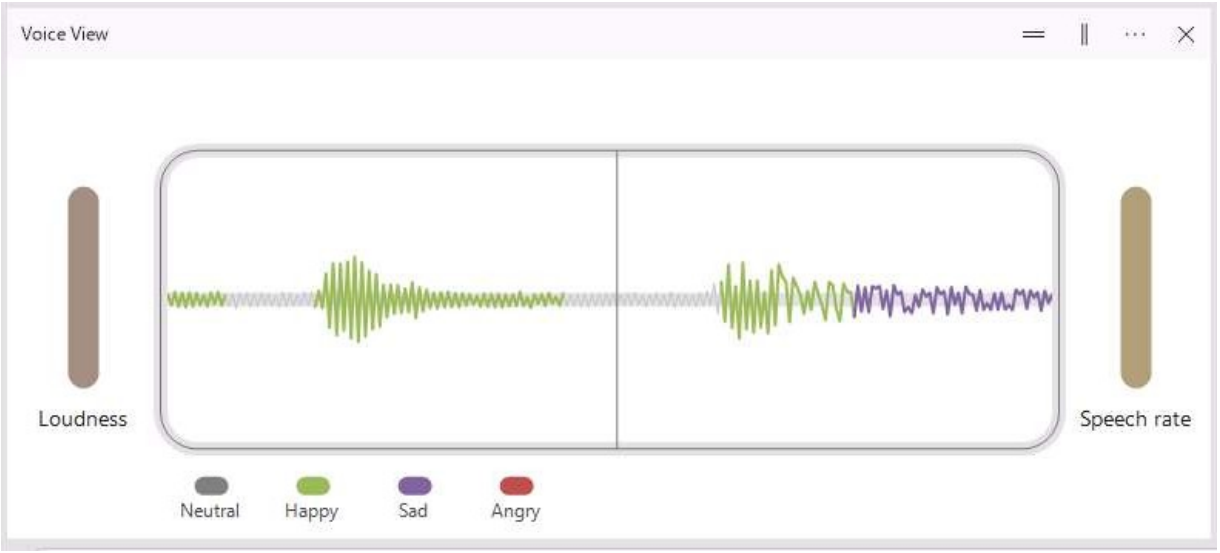
There are gaps in the line chart at the time points when the volume was below the threshold.

Voice View

The **Voice View** shows a two-second audio waveform. The color indicates the detected emotions. If a volume threshold is crossed, the two meters on either side of the waveform show the volume-independent **Loudness** and the **Speech Rate**.

To view the Voice View

Click the **Select window** button in one of the analysis windows and select **Voice Analysis** and then **Voice View**.



How is Loudness calculated?

Loudness is a custom volume-independent loudness measure. Variations in microphone sensitivity and speaker positioning can significantly affect the absolute volume of a recording. To address this, the loudness measure is computed using a continuously updated, normalized audio signal. For each frame in the video, the system analyzes the past second of audio. Within this one-second window, the audio is normalized so that its maximum absolute amplitude is 1.0. This ensures that the measurement reflects the speaker's vocal dynamics, i.e. how energetically a person is speaking within their own dynamic range, rather than the recording conditions. After normalization, the RMS (root mean square) value is calculated to capture the average energy of the speech in that time frame. Because the signal is normalized before computing the RMS, the resulting loudness value is always scaled between 0 and 1, where 0 corresponds to silence and 1 represents a sustained signal at maximum amplitude.

How is Speech rate calculated?

The **speech rate** measure estimates how quickly a person is speaking. The algorithm detects peaks in the audio signal, typically corresponding to syllables, by identifying bursts of vocal energy. These peaks are counted over the same one-second window used for loudness analysis. The count is then normalized to a value between 0 and 1, using an upper bound suitable for capturing various emotional states [1,2]. A higher value indicates faster speech, while a lower value reflects slower or more deliberate speaking.

1. Arnfield, S., Roach, P., Setter, J., Greasley, P., Horton, D. (1995) Emotional stress and speech tempo variation. Proc. ESCA/NATO Workshop on Speech under Stress, 13-15.

2. Braun, Angelika & Oba, Reiko. (2007). Speaking Tempo in Emotional Speech - a Cross-Cultural Study Using Dubbed Speech.

Export voice analysis data

Aim

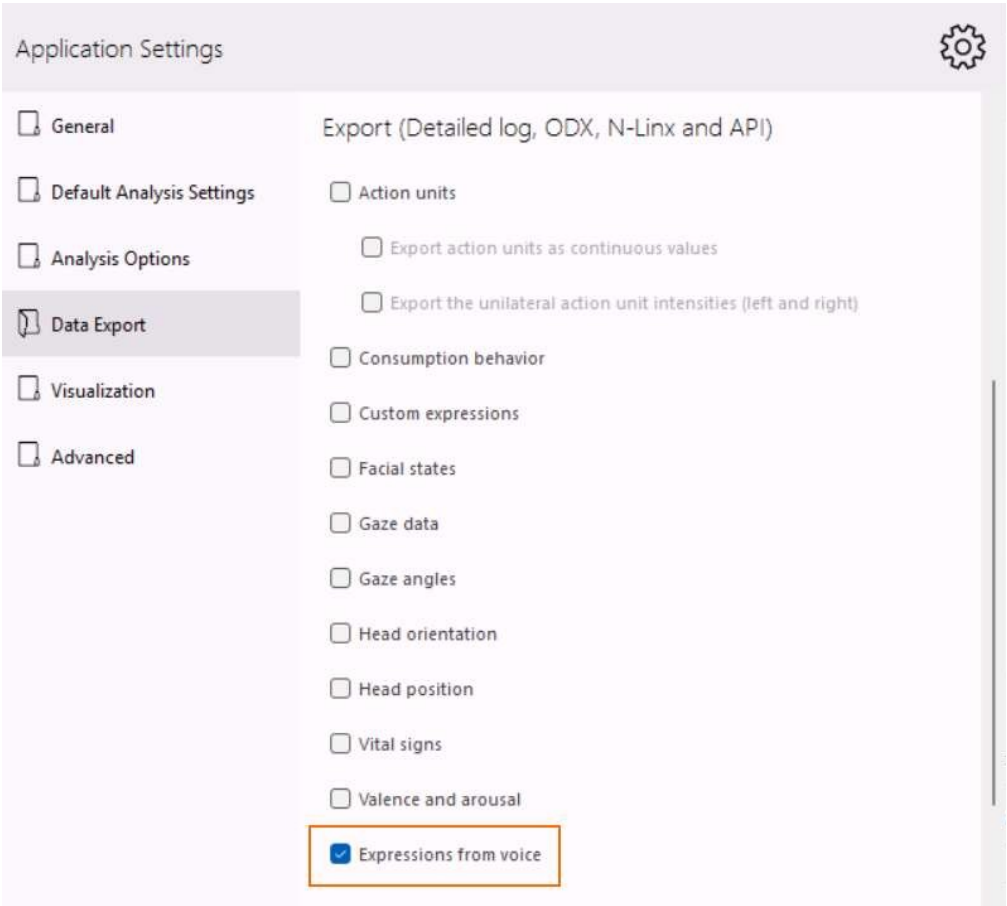
To export the expressions detected in your test participant's voice to a text file or The Observer XT format file.

Prerequisites

- You have the Voice Analysis Module.
- You carried out an analysis.

Procedure

1. Choose **File** > **Settings** and then click the **Data Export** tab.
2. Under **Export (Detailed log, ODX, N-Linx and API)**, select **Expressions from voice** and then click **OK**.



3. Choose **File** > **Export** and select one of the options.

   See Export the data in FaceReader's output

The export file contains columns for each expression (**Neutral from Voice**, **Happy from Voice**, **Sad from Voice** and **Angry from Voice**), as well as for Valence (**Valence from Voice**), Arousal (**Arousal from Voice**), **Loudness** and **Speech rate**. Each expression has a value between 0 and 1, indicating the intensity of the expression. '0' means that the expression is not detected in the voice, '1' means that it is maximally present. **Arousal from Voice**, **Loudness** and **Speech rate** also have a value between 0 and 1. **Valence from Voice** has a value between +1 and -1. For more information see **Voice Valence and Arousal Line Chart** and **Voice View**.

The first milliseconds of the log file have 'Unknown' as value. This is due to the audio buffer which is used to collect approximately one second of data before starting the analysis.

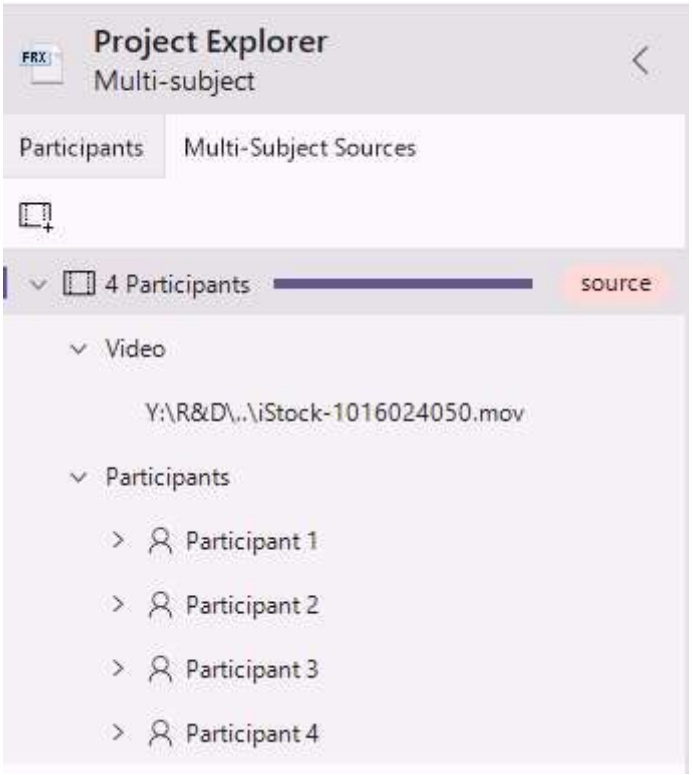
13	Video Time	Neutral from Voice	Happy from Voice	Sad from Voice	Angry from Voice	Valence from Voice	Arou
14	00:00:00.000	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKI
15	00:00:00.250	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKI
16	00:00:00.500	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKI
17	00:00:00.750	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKI
18	00:00:01.000	0.47170192	0.24564469	0.06998252	0.21267095	0.032973737	0.91
19	00:00:01.250	0.5148786	0.20663673	0.10867676	0.16980807	0.036828652	0.92
20	00:00:01.500	0.5602067	0.17317338	0.12781641	0.13880356	0.034369826	0.90
21	00:00:01.750	0.6017447	0.14796497	0.12785622	0.12243422	0.020108745	0.83
22	00:00:02.000	0.5512831	0.15565746	0.10905298	0.1840067	-0.02834925	0.71
23	00:00:02.250	0.4904525	0.17415021	0.095062114	0.24033535	-0.06618513	0.62

Voice expression data in The Observer XT

If you send FaceReader data to The Observer XT 13 or higher versions using the N-Linx network communication protocol, Voice expression data are imported as external data. You can also manually import Voice expression data. To be able to import Voice expression data as external data you need the External Data Module of The Observer.

See FaceReader with The Observer XT

The Advanced Research Module



Main topics

- Introduction to the Advanced Research Module
- Analyze multiple subjects per video
- Track the test participant's gaze when presenting stimuli

Introduction to the Advanced Research Module

The Advanced Research Module enables you to analyze multiple faces in a video, for instance participants in a focus group that were filmed with a single camera. See Analyze multiple subjects per video for the steps to follow.

Please note that you cannot use any of the following analyses in a multi-subject analysis: Vital Signs analysis, Voice analysis and Consumption Behavior analysis.

With the Advanced Research Module you can also track the gaze of a test participant. For gaze tracking you need the Stimulus Presentation Tool. After the test you can visualize the stimulus with a gaze overlay. You can also create a heatmap showing the hotspots on the stimulus where the participant looked the longest. See Track the test participant's gaze when presenting stimuli.

Please note that you cannot combine the Advanced Research Module with Baby FaceReader.

Analyze multiple subjects per video

Aim

To analyze facial expressions of multiple faces in a video.

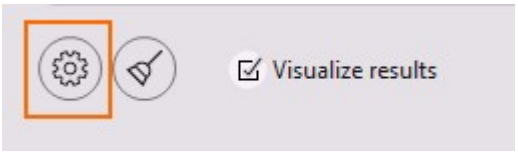
Prerequisites

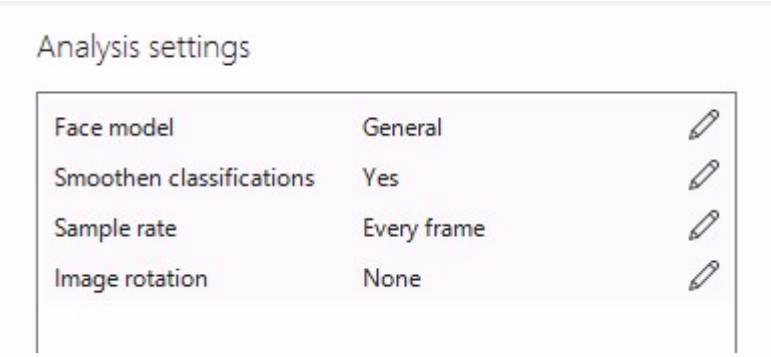
You have a pre-recorded video to analyze in FaceReader. It is not possible to analyze facial expressions of multiple subjects when you do a camera analysis.

Procedure

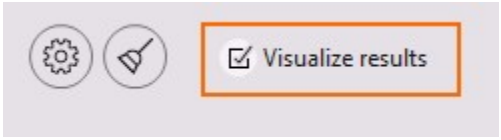
1. On the **Multi-subject Sources tab** click the **Add multi-subject video** icon or from the **Project** menu select **Multi-Subject Sources** > **Add Multi-Subject Video**.

2. Optionally, click the **Analysis settings** button to view or adjust the settings. See Settings for the current analysis for more information.





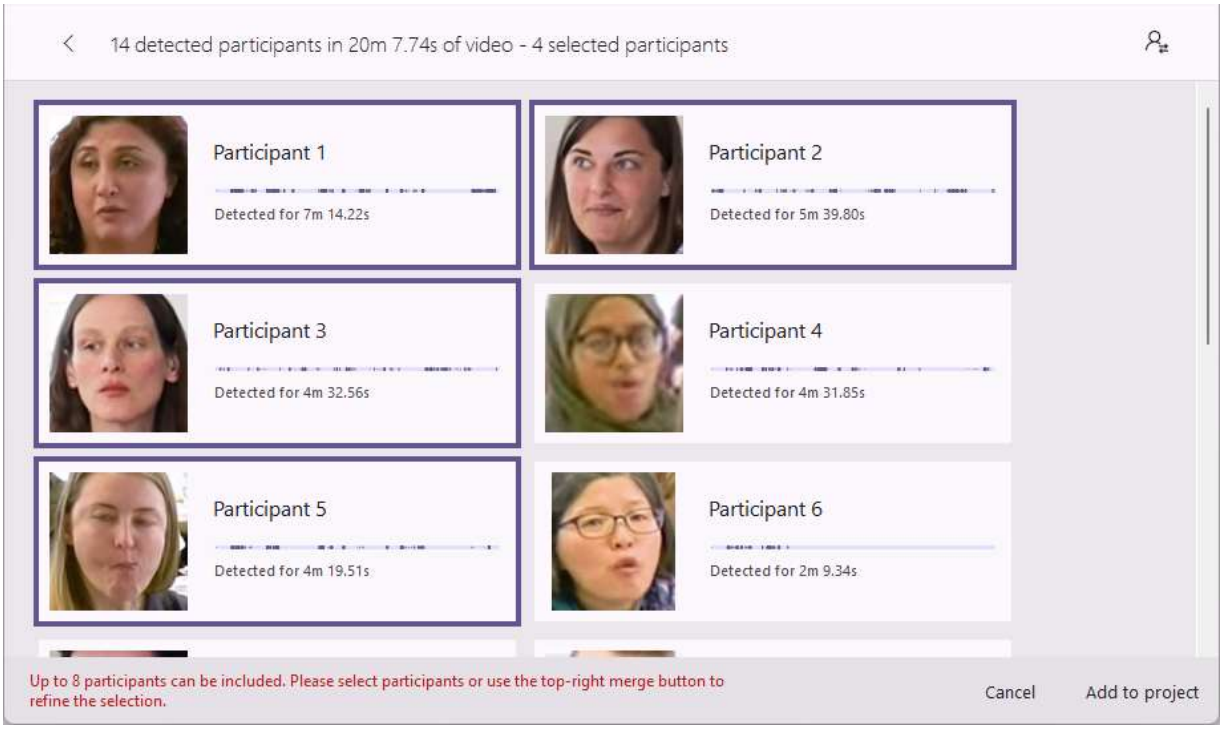
3. Position the video to where you want to start the analysis. Optionally, deselect the **Visualize results** checkbox to speed up the analysis.



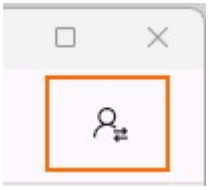
4. Click the **Start analysis** button.

The track bar shows the progress of the analysis, the analysis speed (in fps), how many minutes:seconds.milliseconds of the video have been analyzed, the duration of the video and whether the video has audio.

5. Click the **Stop Analysis** button to stop the analysis or wait until the video has been fully analyzed. FaceReader shows how many participants were detected in the video and for how many minutes/seconds each participant was detected.



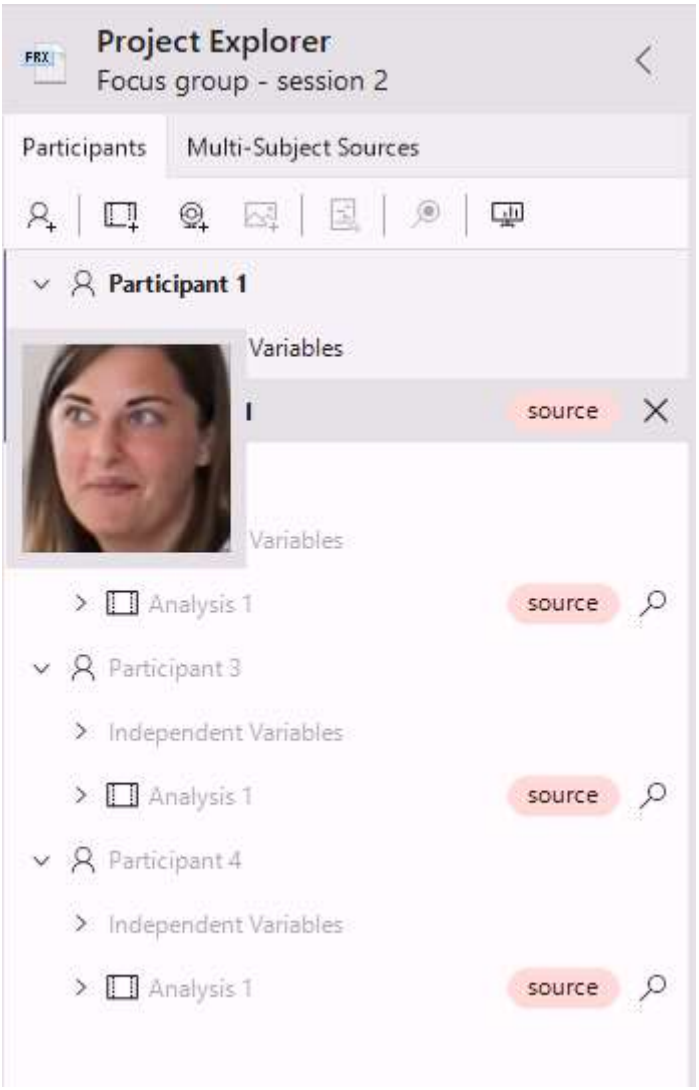
6. Optional — Select participants to merge them, for instance because a participant walks out of the camera view and FaceReader labels him/her as a new participant when he/she enters the camera view again.



7. Select the participants that you want to add to your project and click **Add to project** and **Yes** to confirm your choice. You can add a maximum of eight participants. The participants are added to the **Participants** tab and the **Multi-Subject Sources** tab of the Project Explorer.

Participants tab

On the **Participants** tab you can find the individual analyses per participant. When your hover with your mouse over the video icon of one of the participants, you will see the first face image that could be analyzed. In this way you can identify who is participant 1, participant 2, etc.



Click the magnifying glass button next to one of the analyses to open it. A standard analysis view will open. Click the **Show framing** icon in the **Analysis Visualization** window to view who is participant 1, 2, 3, etc.

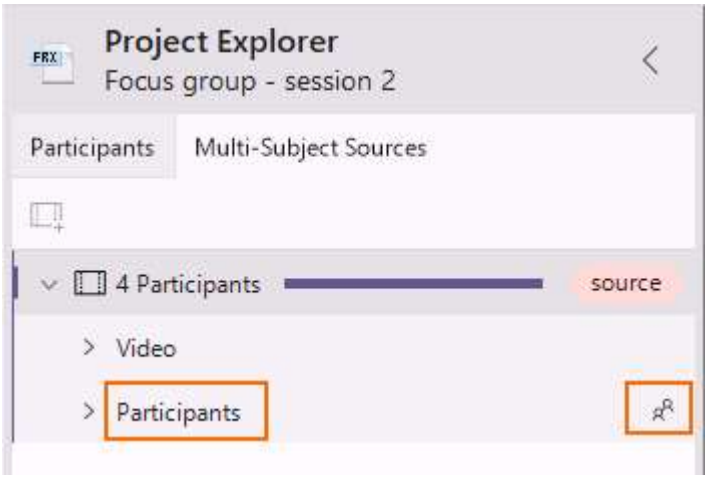
Source: Video from YouTube showing prof. Dick Krueger at the University of Minnesota leading a focus group discussion.

On the track bar you can see in what parts of the video the participant face could be analyzed. The rest of the data is shown as gaps (shown in white).

If you analyze multiple videos of the same participants, FaceReader will not recognize the participants in the second, third etc. video. If you like, you can bring the analyses together. Right-click on an analysis in the Project Explorer, click **Analysis** and then **Move Analysis To Other Participant**. Select the target participant and then **Yes** to confirm the move.

Multi-Subject Sources tab

On the **Multi-Subject Sources** tab the participants are grouped by source. Double-click **Participants** or click the icon next to **Participants** to get an overview of the participants that were detected in the video and added to the project. The overview also shows for how many minutes/seconds each participant was detected.



Click the **source** button on the **Participants** tab or the **Multi-Subject Sources** tab to view the **Multi-Subject Source** window again. Click **Exclude/Merge** if you want to exclude/merge (more) participants.

Please note:

- You cannot calibrate participants in a multi-subject analysis.
- You cannot add analyses to multi-source participants.
- You cannot re-analyze the video.

Track the test participant’s gaze when presenting stimuli

Aim

To assess what details in a stimulus attract the test participant’s attention.

Prerequisites

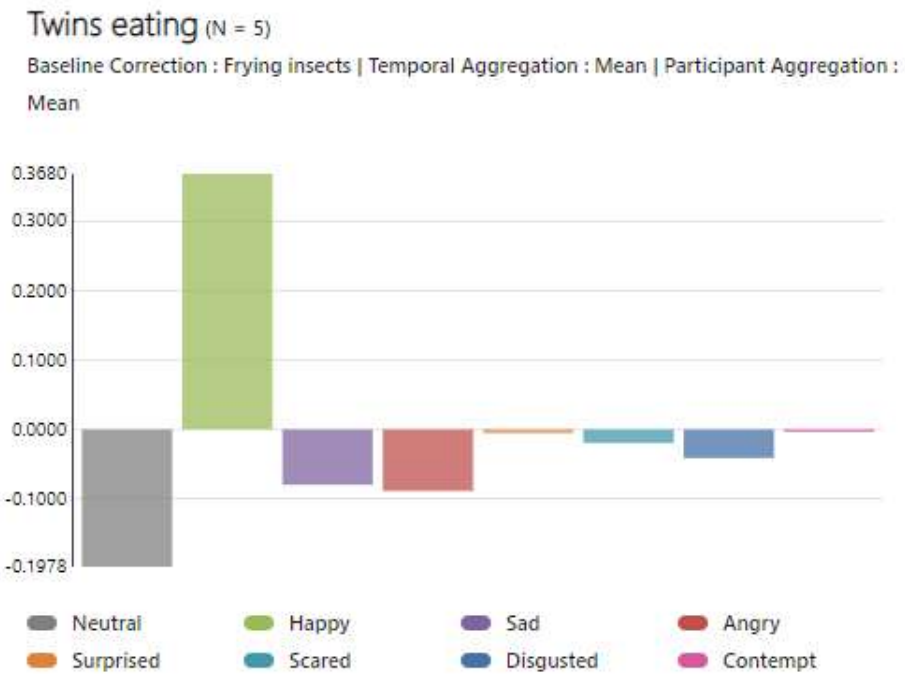
- You have installed the Stimulus Presentation Tool.
- You selected **Gaze tracking** in the **Settings** > **Analysis options**.

Procedure

Define a test in FaceReader and select **Perform gaze calibration**.

See Define a test and Carry out a test with the Stimulus Presentation Tool under Project Analysis.

Project Analysis



Main topics

- Introduction to Project Analysis
- Important concepts in Project Analysis
- Stimuli and the Stimulus Presentation Tool
- Event markers
- Independent variables
- Project analysis in short
- Data selection
- Visualize your data in a chart
- Calculate statistics and summarize them in a table
- Visualize your stimulus, participant videos and line chart
- Compare data

Introduction to Project Analysis

In FaceReader you can:

- Annotate Stimuli and events, to compare different parts of the analysis.
- Automatically present Stimuli to the test participant and synchronize them with FaceReader data (for this purpose use the The Stimulus Presentation Tool). Alternatively, manually present Stimuli to test participants and keep track which analysis parts correspond with the moments the Stimuli were shown.

In the Project Analysis section you can:

- Create and compare groups of participants.
- Calculate mean intensities of facial expressions (and other parameters) of single participants, for participant groups, or when Stimuli were shown. If you have the Action Unit Module you can also calculate statistics for Action Units and Custom Expressions. If you have the Vital Signs Module you can calculate statistics for heart rate, heart rate variability, and breathing rate. If you have the Voice Analysis Module you can calculate statistics for expressions in the voice, loudness and speech rate.
- Calculate relative statistics using baseline correction.

  For example, calculate the expression intensities of test participants when they watched a certain commercial relative to the expression intensities when they were watching a neutral Stimulus. You can mark the time during which the test participants watched the commercial with a Stimulus.

Note

Project Analysis was not designed for image analyses. Therefore, if your project only contains image analyses, you cannot carry out group analyses.

Important concepts in Project Analysis

Independent variables

Independent variables

Independent Variables are factors that remain constant throughout an analysis, but can vary per participant. By default, each project contains the independent variables *Age* and *Gender* of the participant. These can be estimated by FaceReader, from the analyzed images. Alternatively, you can enter the values of these variables manually.

You can define more independent variables. Examples of independent variables are the native language of the test participant, or whether the participant has previous experience with the product under investigation.

Independent variables can be used to compare participant groups.

See Independent variables

Stimuli and Event markers

You can mark episodes that you are especially interested in. This can be, for example, a time fragment during which the test participant watches a certain commercial. Or it can be the time a participant is allowed to drink or eat a certain product you are interested in.

Stimuli

Use Stimuli to mark the parts of the analyses you are especially interested in. Stimuli are, for instance, the new commercials the test participants will watch or the pages of your newly developed website they will view. These time fragments have a fixed duration.

You can use a video fragment as Stimulus source, for example a video with the commercial. You can score a Stimulus manually during or after carrying out the analysis. But if you use The Stimulus Presentation Tool, any Stimulus included in the test is automatically recorded by FaceReader, so you do not need to score it manually.

See Stimuli and the Stimulus Presentation Tool

You can analyze the facial expressions over the time the Stimulus occurred and visualize the test participants face together with the Stimulus video. If you have the Action Unit Module you can also analyze Action Units and Custom Expressions. If you have the Vital Signs Module you can analyze heart rate, heart rate variability, and breathing rate.

Event markers

With Event markers you can mark time fragments in the analysis, just like with Stimuli. In contrast to Stimuli, Event markers have no fixed duration and are not linked to a video. With Event markers you can, for example, mark episodes where something unexpected occurs, like a visitor entering the room, or mark events that have no fixed duration, like drinking a fruit juice. You score an Event marker manually and score it again, or score another one to set the stop time of the marker.

See Event markers

Stimuli and Event markers in The Observer XT

Stimuli and Event markers can be exported into the detailed log. If you use FaceReader together with the annotation software The Observer XT, the Stimuli and events are imported into The Observer XT as state events. These can then be used to select the time fragments for further analysis.

See FaceReader with The Observer XT

The Stimulus Presentation Tool

With the Stimulus Presentation Tool you can automatically present Stimuli to test participants. You do not have to score Stimuli manually. You can organize the Stimuli in Tests (see below). The Stimuli and analysis are automatically synchronized.

See The Stimulus Presentation Tool

Tests

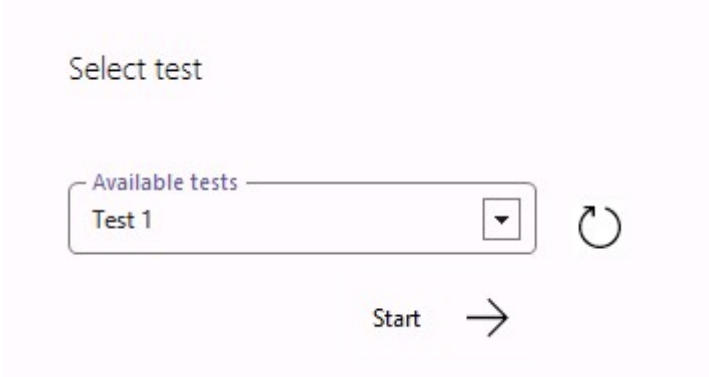
In a test you define which Stimuli to present to test participants and in which order. Tests are carried out with the Stimulus Presentation Tool. When you carry out a test, a participant and analysis is automatically added to the project. The Stimulus Presentation Tool displays the Stimuli during the test while FaceReader records and/or analyzes the participant's face.

See Define a test

Calibration versus baseline correction

Instead of participant calibration, or continuous calibration, you can define a *Neutral* stimulus. Score this Stimulus when the test participant watches a neutral set of images or a neutral video fragment. In the analysis, calculate the facial expressions during the experimental Stimulus relative to the facial expressions during the neutral Stimulus.

Stimuli and the Stimulus Presentation Tool



Main topics

- Define Stimuli
- Score Stimuli
- The Stimulus Presentation Tool
- Carry out a test with the Stimulus Presentation Tool
- Define a test
- Specify connection settings for the Stimulus Presentation tool
- Run a test
- Computer settings for a two computer setup with Stimulus Presentation Tool
- Create exceptions in Windows Firewall for Stimulus Presentation Tool
- Synchronize computers with a network time protocol

Define Stimuli

Aim

To define the Stimuli to show to test participants and, to score them manually, the associated key codes.

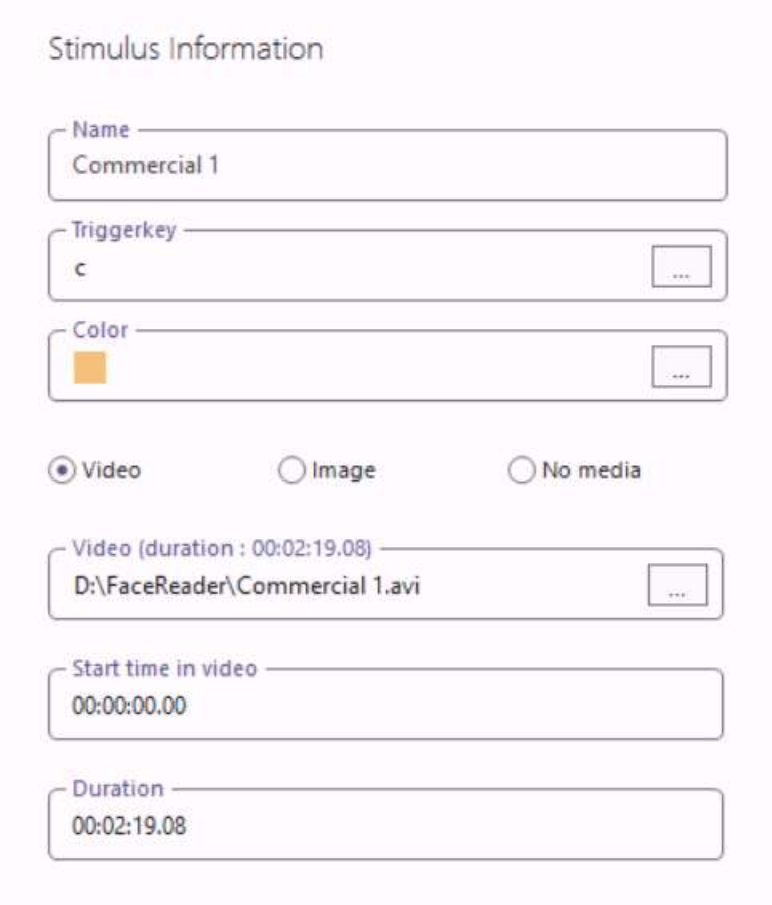
Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- You have Stimuli with a fixed duration, for example video fragments.

Procedure

1. Choose **Project** > **Stimulus** > **Add Stimulus** or click the **Add Stimulus** button on the bottom-left pane.

2. In the window that opens, enter the Stimulus name, for instance, ‘Commercial 1’.



3. Under **Trigger key**, enter a keyboard key for this Stimulus. If you score the Stimuli manually, press this key when the Stimulus (commercial 1 in this example) starts.
4. Under **Color**, optionally change the color for the Stimulus and click **OK**. This color will be used throughout the program for this Stimulus.
5. Select to present either a video, or an image as Stimulus, or no external Stimulus.

If your Stimulus is a video

1. Select the video, for instance, the video with the six commercials which your test participants will watch.
2. Enter the **Start time** in video (in hours:minutes:seconds with two decimals). In our example this is the start time of Commercial 1. If this commercial starts half a minute after the start of the video, enter 00:00:30.00. Leave 00:00:00.00 if the video starts with this Stimulus.
3. Enter the **Duration** (in hours:minutes:seconds.milliseconds). In our example this is the duration of Commercial 1.

If the entire video file is a Stimulus, do not edit **Duration**.

If your Stimulus is an image

1. Select the image, for example a screen capture of a web page, or a wrapping of a chocolate bar.
2. Enter the **Duration** (in hours:minutes:stimulusseconds.milliseconds).

If your Stimulus is not a video or image

To score an event manually, for example a Stimulus by an external program other than the Stimulus Presentation Tool, or a phase in a test:

1. Select **No Media**.
2. Enter the **Duration** (in hours:minutes.seconds.milliseconds).

Note

To delete or edit a Stimulus, open the **Stimuli** tab at the bottom of the Project Explorer. Right-click the Stimulus you want to delete or edit, and select the option you require.

Score Stimuli

Aim

To mark the time the Stimulus was shown to the test participant.

Prerequisites

- Your license includes the Project Analysis Module.
- You defined Stimuli.

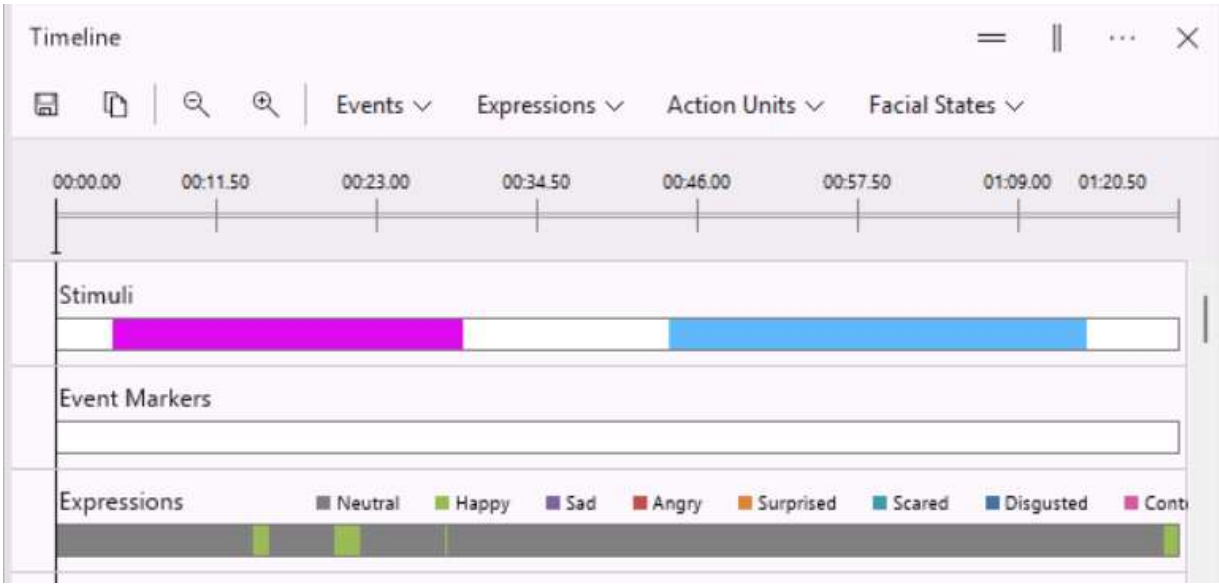
  See Define Stimuli
- You have a video or camera analysis.

Procedure

To score a Stimulus during an analysis

- Automatically — Use The Stimulus Presentation Tool
- Manually — Press the trigger key that is associated with your Stimulus.

If you have the **Timeline** window open, a bar appears with the same length as the Stimulus duration that you chose when you created the Stimulus. You can press the Stimulus trigger key for each time the Stimulus starts.



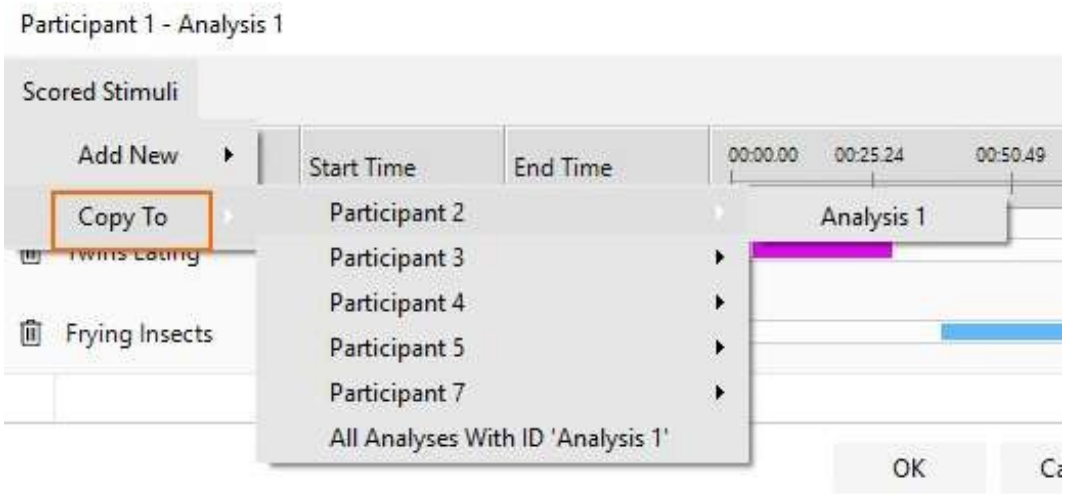
To score a Stimulus after an analysis

Open the **Timeline** window and scroll the video to the position where the Stimulus starts. Then press the Stimulus trigger key. A question appears whether you want to score the Stimulus at that point. Choose **Yes**.

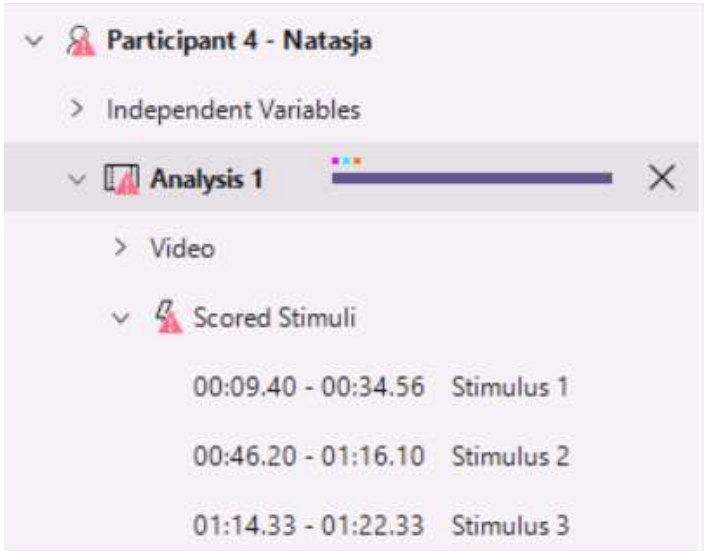
Notes

- Multiple instances of the same Stimulus may not overlap. Therefore, do not start a Stimulus when the previous instance of this Stimulus has not ended.
- Do not score a Stimulus when the remaining video time is shorter than the Stimulus duration. If you do so, opening the **Scored Stimulus** window automatically moves the Stimulus start time to the latest possible moment in that video.
- Scored Stimuli appear in the Project Explorer as dots above the analysis bar. Expand the **Analysis** and **Scored Stimuli** items to view the scored Stimuli.

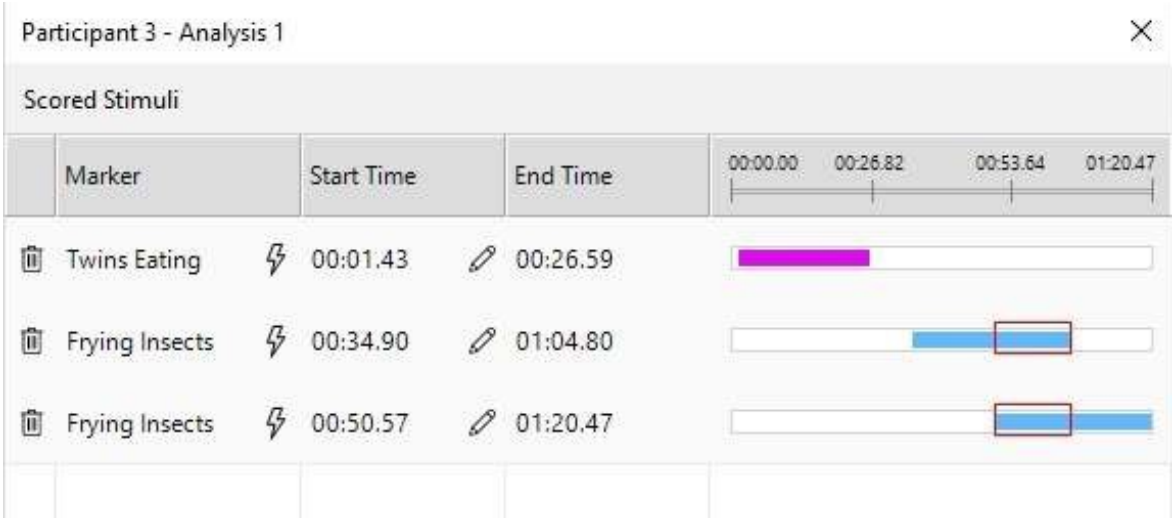
- To copy scored Stimuli to other participants or analyses, unfold the analysis and double-click **Scored Stimuli**. Click the Stimulus you want to copy. Click **Scored Stimuli** at the top of the window that opens, and choose one of the options under **Copy To**.



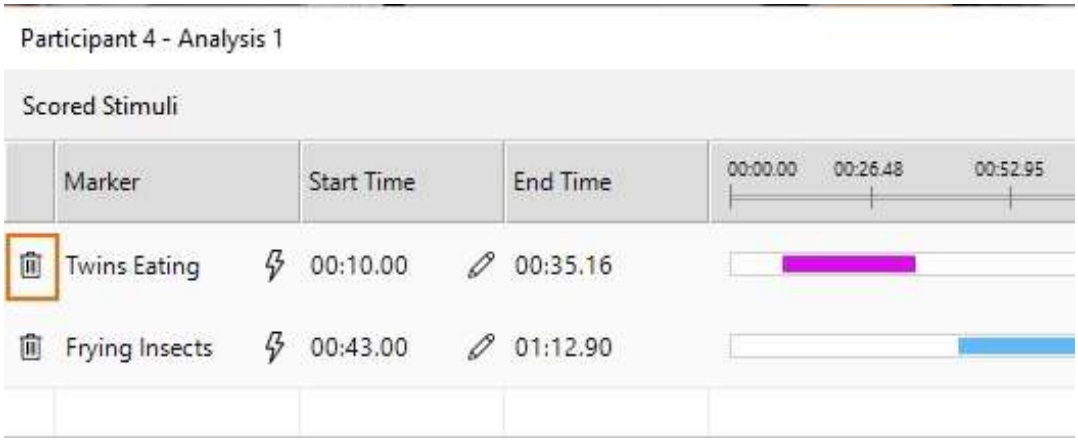
- To make sure the analysis is not interrupted, FaceReader does not give a warning during the analysis if you score overlapping Stimuli or score a Stimulus that continues after the end of the analysis. Instead, an error mark will appear in the Project Explorer and you must correct the scored Stimuli after the analysis is finished.



To do so, double-click **Scored Stimuli** or one of the lines. Alternatively, right-click **Scored Stimuli**, then select **Edit Analysis**, and then **Edit Scored Stimuli & Event Markers**. The Scored Stimuli window opens. The time periods in which Stimuli of the same type are overlapping are marked in red.



Move the Stimuli to their correct position, so that they are no longer overlapping. To delete a scored Stimulus, click the **Delete Scored Marker** button.



The Stimulus Presentation Tool

What is the Stimulus Presentation Tool?

FaceReader is often used to analyze how a subject responds to one or more Stimuli in form of video, for example video commercials. Synchronizing the display of a Stimulus with the trigger of the corresponding Stimulus marker in FaceReader is essential.

With FaceReader and the Stimulus Presentation Tool, you can:

- Define the Stimuli to be presented, organized in a test (see below).
- Present the Stimuli while FaceReader analyzes the test participant's face.
- Automatically synchronize FaceReader data with Stimulus trigger markers.
- Track the test participant's gaze with the Advanced Research Module.

Tests

A test is a collection of video Stimuli being presented to a test participant. You can store one or more tests in your FaceReader project. The Stimulus Presentation Tool displays the Stimuli during the test while FaceReader records and/or analyzes the participant's face.

Furthermore:

- A test includes independent variables, like *Gender*, *Age*, or any other variable of interest defined in the project.
- Presentation of Stimuli can be randomized.

Software you need

- FaceReader with the Project Analysis Module.
- The Stimulus Presentation Tool.
- The Advanced Research Module if you want to track the test participant's gaze.
- Recommended for two-PC configurations: a Network Time Protocol tool to synchronize computers.

  See Synchronize computers with a network time protocol

To install the Stimulus Presentation Tool

1. Download the installation file **Stimulus Presentation Tool 5 Setup.exe** from the MyNoldus portal (my.noldus.com) and run it.
2. Follow the instructions on the screen.

By default, the Stimulus Presentation Tool is installed in the following location:

C:\Program Files\Noldus\Stimulus Presentation Tool 5.

To upgrade the Stimulus Presentation Tool

If you upgraded FaceReader from version 6, 7, 8 or 9 and have Stimulus Presentation Tool version 1, 2, 3 or 4, there is no need to uninstall the previous version. However, version 1 works only with FaceReader 6, version 2 only with FaceReader 7, version 3 only with FaceReader 8 and version 4 only with FaceReader 9.

Computer configurations

One computer

In this configuration, the test participant uses a computer (for example the Noldus Portable Observation Lab) where both FaceReader and the Stimulus Presentation Tool are installed.

Two computers

In this configuration, the computer of the test participant has the Stimulus Presentation Tool installed and running. On the test leader computer, FaceReader is installed and running. The two computers are connected through a network.

To allow proper communication between the FaceReader PC and the test participant's PC, follow the procedure in Computer settings for a two computer setup with Stimulus Presentation Tool first.

Carry out a test with the Stimulus Presentation Tool

Aim

To carry out a test with the Stimulus Presentation Tool so that the Stimuli are shown to the test participants and the test participant's face is analyzed.

Prerequisites

- Your FaceReader license includes the Project Analysis Module
- You installed the Stimulus Presentation Tool.

  See To install the Stimulus Presentation Tool
- You have defined one or more Stimuli.

  See Define Stimuli
- You have opened the FaceReader project that contains those Stimuli.
- Optionally, the Advanced Research Module if you want to track the test participant's gaze.

Procedure

Carry out the following steps:

1. Define a test
2. Specify connection settings for the Stimulus Presentation tool
3. Run a test

Define a test

Aim

To define the Stimuli to show to the test participants and the order they should be presented.

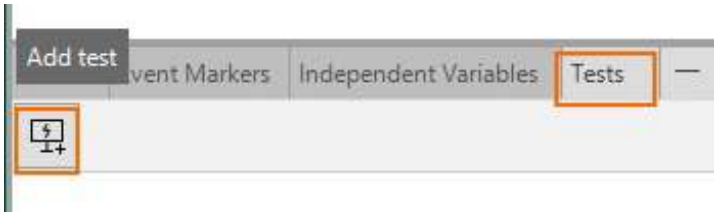
Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- You have defined one or more Stimuli.

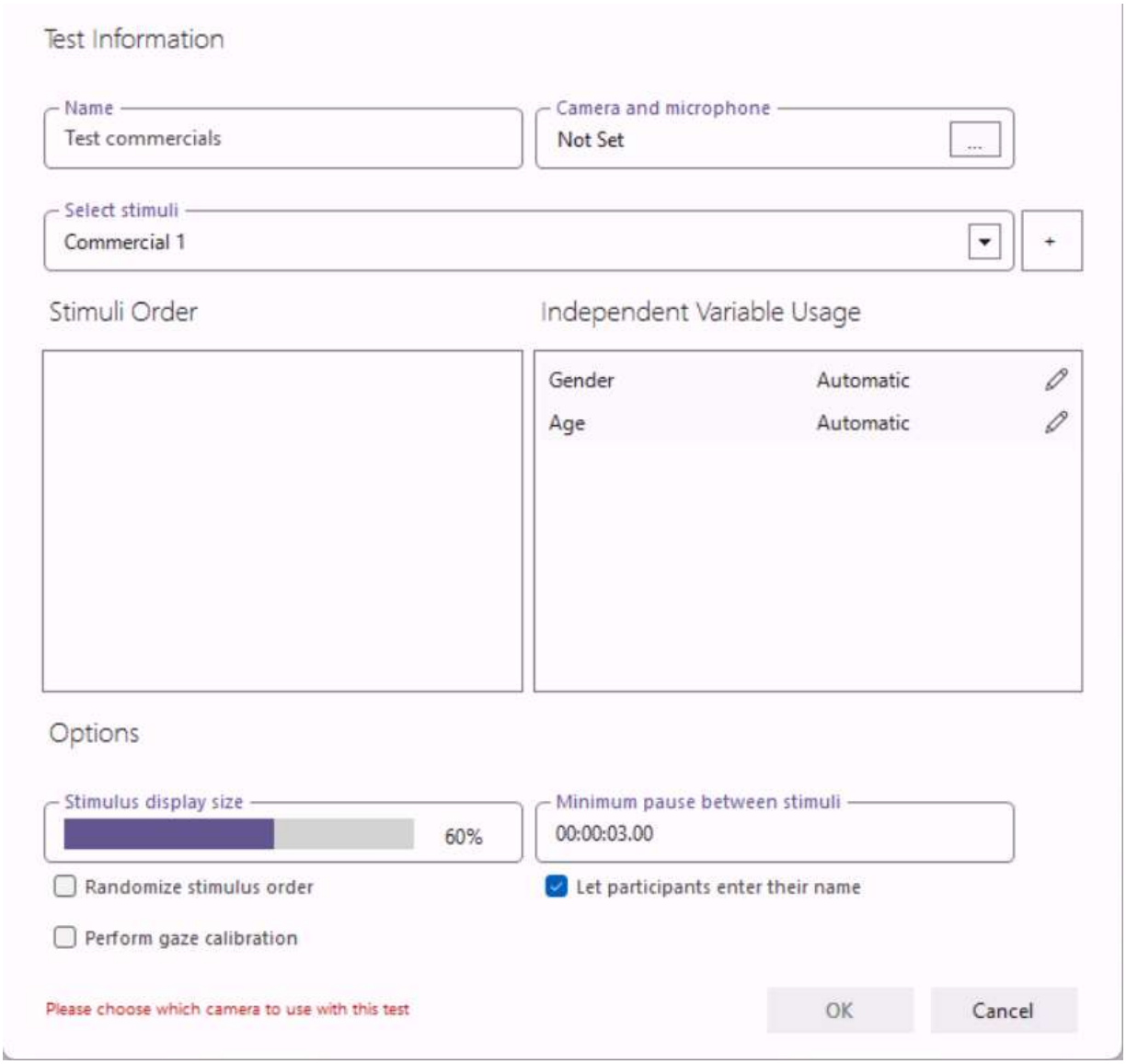
  See Define Stimuli
- You have opened the FaceReader project that contains those Stimuli.

Procedure

1. In FaceReader, choose **Project** > **Tests** > **Add Test**, or on the bottom-left pane, click the **Test** tab and click the **Add Test** button.



2. Give a Name to the test (default: Test 1, Test 2,...).



3. Select the **Default camera** you want to use. In the **Select Camera** window, choose the options that apply and click **OK**.

4. *Add Stimuli.*

   From the **Select Stimuli** list, select the first Stimulus video you want to add, and click the **Add** button. Repeat this step for the next Stimulus.

5. The Stimuli appear under **Stimuli Order**.

6. *Specify the independent variables for the test.*

   Under **Independent Variable Usage**, click an independent variable and choose how you want to determine the value for a participant.

- **Automatic** (only for *Gender* and *Age*) — FaceReader enters the values automatically for each participant, based on the analysis.

- **Entered by Participant** — The participant is asked to enter the value of this variable at the start of the test.

Instead of asking a participant to fill in a value for an independent variable, you can ask him/her any type of question. When defining the independent variable/question you must define either a Numerical or Nominal value/ answers. In a consumer test you can ask, for instance, what the participant had for breakfast and define the following Nominal answers: *cereal*, *bread*, *pancakes*, *hot meal* and *coffee only*.

A variable/question can have a maximum number of 50 characters.

- **Leave blank** — To leave the value blank and edit it later.

- **[value or category]** — Specify one of the values available; note that the value you specify here will be assigned to all analyses and participants who take part in that test. Use this option for example to compare data between tests which differ by that variable.

7. Under **Options**, choose the additional options that apply:

   - **Stimulus display size** - Default value is 60%. Change the value to 100% to display the stimulus full-screen.

   - **Minimum pause between stimuli** - Define the length of the pause between stimuli (in hours:minutes:seconds.milliseconds). The default value is 3 seconds. Please note that the pause can be longer than the value you set if FaceReader needs more time to load the stimulus.

   - **Randomize stimulus order** to present the Stimuli in a random order.

   - **Perform gaze calibration** — This enables FaceReader to track the gaze of the test participant.

   - **Let Participants enter their name** at the start of the test.

8. Click **OK**.

Notes

- Video formats accepted by FaceReader: QuickTime (mov), MP4, VOB (from camcorders), H.264 DivX, MPEG-4 DivX, MPEG-1, MPEG-2, DV-AVI.
- Once the Stimuli are listed under **Stimuli Order**, you cannot change their order. To put them in a specific order, delete the Stimuli and re-add them in that order.

- To add Stimuli that are not in the list, close the **Add New Test** window, then add the Stimuli you need (see Define Stimuli), then on the bottom-left pane click the **Test** tab and double-click the test to the re-open the test window, and complete step 4.
- To add independent variables, close the **Add New Test** window, then add the independent variables (see Define Independent Variables). Next, on the bottom-left pane click the **Test** tab and double-click the test to the re-open the test window, and complete step 6.
- To delete a Stimulus from the test, under **Stimuli Order** click the **Delete** button for that Stimulus.
- To edit an existing test, double-click the test name on the bottom-left pane (**Test** tab).
- To delete a test, on the bottom-left pane (**Test** tab) right-click the test name and select **Delete Test**.

Specify connection settings for the Stimulus Presentation tool

Aim

To specify the connection settings in FaceReader so that it can communicate with the Stimulus Presentation Tool.

Prerequisites

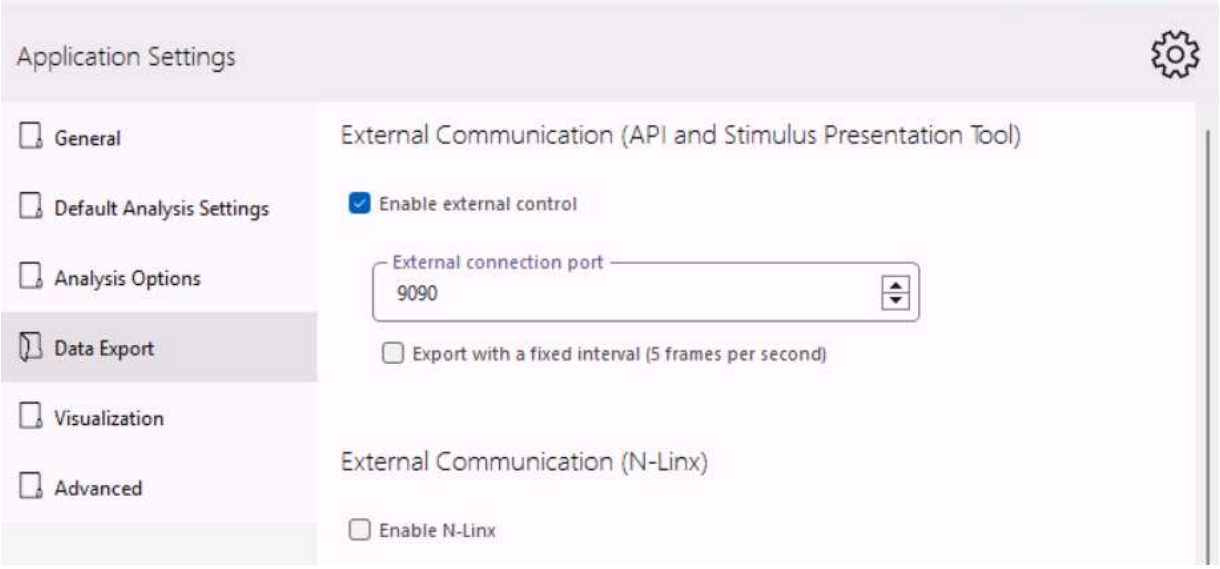
- Your FaceReader license includes the Project Analysis Module.
- You installed the Stimulus Presentation Tool.

  See To install the Stimulus Presentation Tool
- If you run a test in a two-PC configuration, the two computers are connected, and the appropriate settings were made.

  See Computer settings for a two computer setup with Stimulus Presentation Tool

Procedure

1. In FaceReader, choose **File** > **Settings** > **Data Export**.
2. Under **External Communication (API and Stimulus Presentation Tool)**, select **Enable External Control**.



Note

Make sure the **External Connection Port** number is the same as that in the Stimulus Presentation Tool. By default, this is *9090*. If you prefer, you can enter another port number. Enter this number also in the Stimulus Presentation Tool.

See Specify the connection settings in the Stimulus Presentation Tool so that it can communicate with FaceReader

Run a test

Aim

To display the Stimuli to the test participants and to carry out the analysis.

Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- You installed the Stimulus Presentation Tool.

  See To install the Stimulus Presentation Tool
- You have defined at least one test in your FaceReader project.

  See Define a test
- If you run a test in a two-PC configuration, the two computers are connected, and the appropriate settings were made.

  See Computer settings for a two computer setup with Stimulus Presentation Tool
- Optionally, the Advanced Research Module to track the test participant's gaze.

Procedure

1. On the test leader's PC, open the FaceReader project.
2. On the participant PC, start Stimulus Presentation Tool.

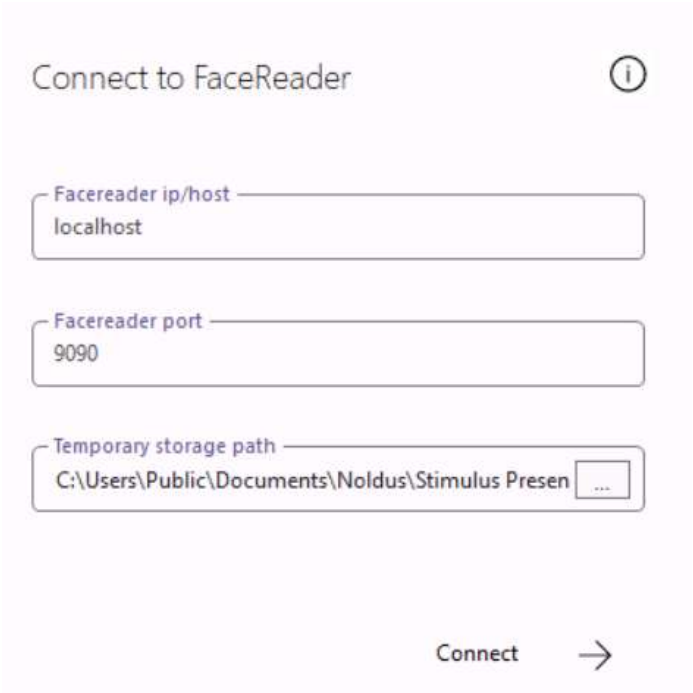
3. *Specify the connection settings in the Stimulus Presentation Tool so that it can communicate with FaceReader*

   In the **Connect to FaceReader** window, under **FaceReader IP/Host** enter the IP address of the computer with FaceReader. In a One computer setup, leave the default address *127.0.0.1*. This is identified as the same PC.

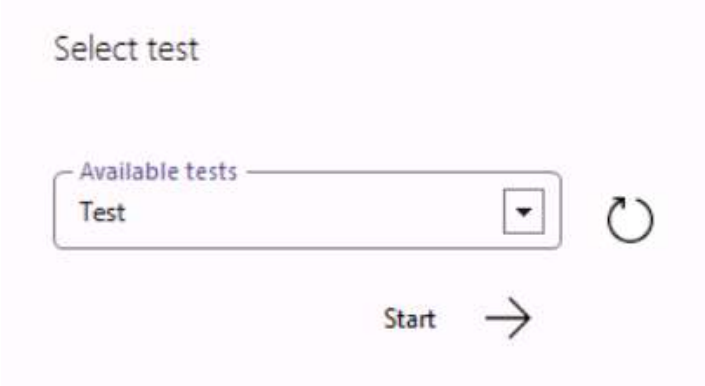
   Under **FaceReader Port** leave *9090* or enter the number entered in FaceReader in step 1.

   When necessary, change the **Temporary storage path** of the participant PC where data are stored during the test.

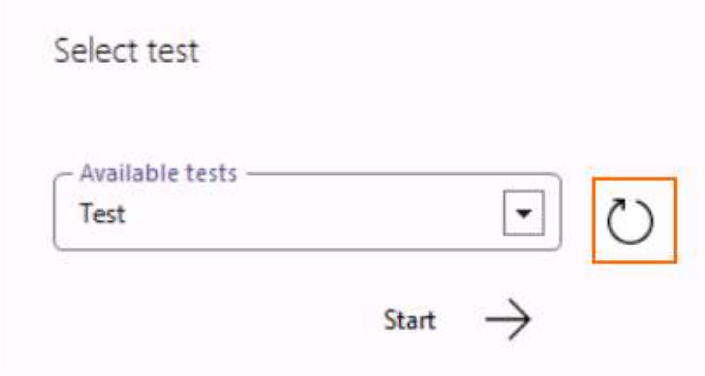
When ready, click **Connect**.



4. In the **Select Test** window, choose a test from the **Available Tests** list, then click **Start**.



If the test you require is not listed, in FaceReader open the project that contains that test. Next, in the Stimulus Presentation Tool click the **Refresh** button.



5. Let the participant sit in front of the computer.
6. In the **Welcome** window, let the participant enter

   - His/her name (optional; see step 7 in Define a test).

   - The values of the independent variables (optional, see step 6 in Define a test).

7. When ready, ask the participant to click **Start**.

   The **Start** button is available when the participant has entered the values of all required independent variables.

8. If you selected **Perform gaze calibration** when you defined the test, a message appears informing the participant that calibration will start when they click. The participant should look at the dots that appear on the screen and hover over them with their mouse.
9. After a couple of seconds the first Stimulus is displayed.
10. At the end of the test a message **Thanks for Participating** appears. The participant and analysis are added automatically in FaceReader.

Notes

Before the test

- To go from **Select Test** to **Connect to FaceReader**, click the arrow at the bottom-left corner of the Stimulus Presentation Tool window.

- To go from the **Welcome** window back to **Select Test**, click anywhere on the window, then press **Alt**+**Home**, then click **Connect**.

During the test

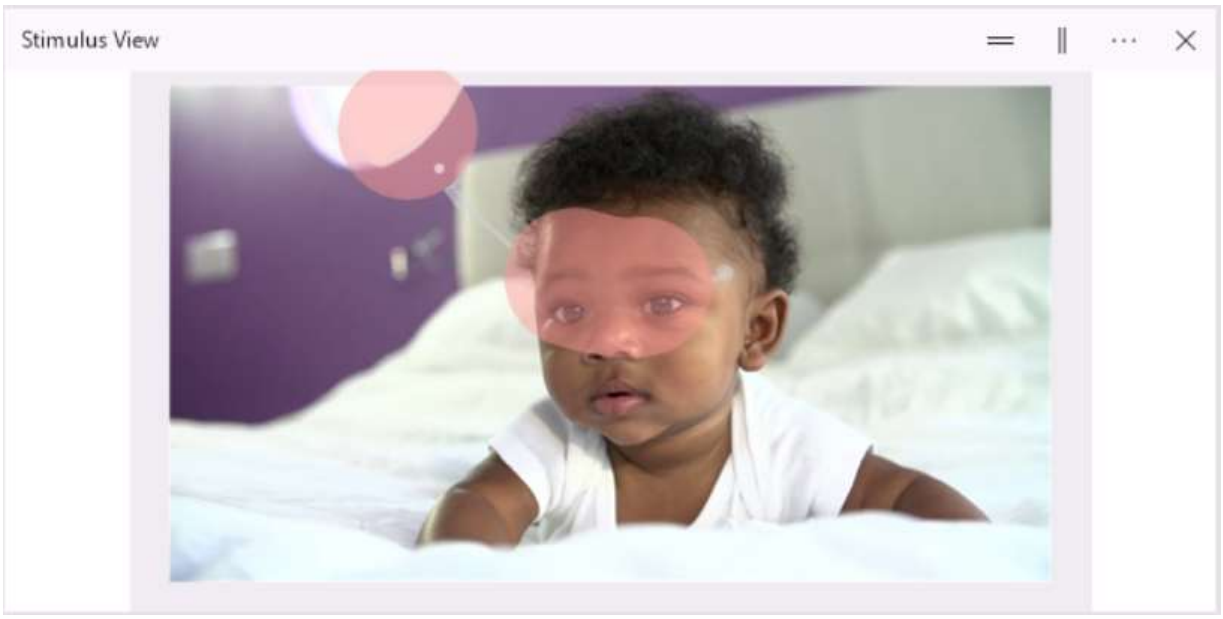
- During the test, FaceReader shows the message **Test in Progress**. To change the views in FaceReader, click **OK** and select the windows you require. Do not change settings.
- Analysis is done automatically during the test. Do not click the **Start/Stop analysis** button during the test.
- Between presentation of two Stimuli, a message "Get ready" is shown for a number of seconds.
- After the test participant has clicked **Start** in the **Welcome** window (step 7), and before the first Stimulus is presented, a new FaceReader analysis is created and started in the background on the FaceReader PC.
- When a stimulus starts, the Stimulus Presentation Tool sends the information to FaceReader, which scores the start of the Stimulus.
- To switch the Stimulus Presentation Tool window to full screen, press **F11**. Press **F11** again to resume the original window size.
- To stop the test before the end of the last Stimulus, in FaceReader click the **Stop analysis** button or in the Stimulus Presentation Tool click anywhere on the window, then press **Alt**+**Home**. The analysis and participant are marked with an error icon.

After the test

- To start the test for the next participant, click the arrow at the bottom-right corner of the Stimulus Presentation Tool window.

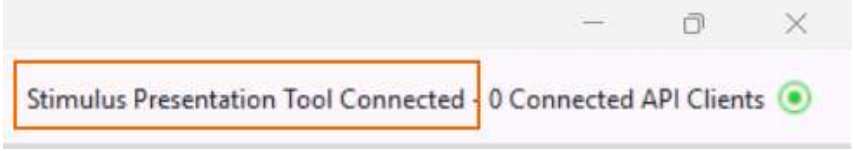
- To choose another test, click anywhere on the Stimulus Presentation Tool window, then press **Alt**+**Home**, then click **Connect**.
- To close the Stimulus Presentation Tool, click the **Close** button.

- You can view the stimuli in the **Stimulus View** window, next to the face of the participant and, for instance, the **Expression Intensity** chart with his/her facial expressions. If you selected **Perform gaze calibration** when you defined the test and selected **Gaze tracking** in the **Settings**, you can also see the gaze tracking data.



General

- You can connect FaceReader with one Stimulus Presentation Tool at a time.
- When the Stimulus Presentation Tool is connected to FaceReader, this is displayed in the upper-right corner of the FaceReader window.



Computer settings for a two computer setup with Stimulus Presentation Tool

Aim

To allow communication between the computers through Windows FireWall and to synchronize the computers in order to synchronize the Stimuli and analysis.

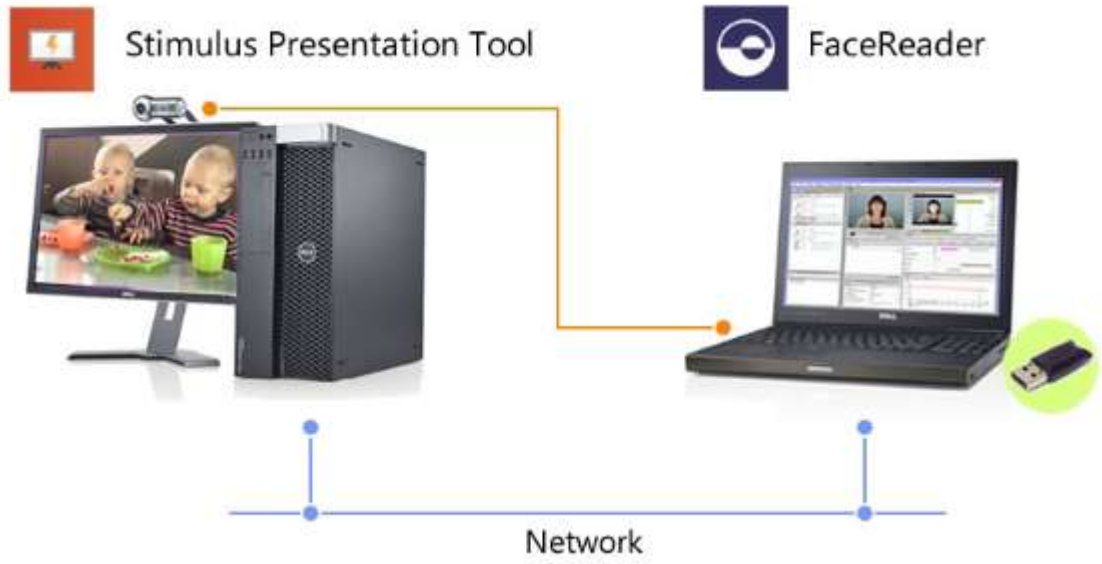
Prerequisite

You use the Stimulus Presentation Tool on another computer than the one with FaceReader.

Procedure

You must carry out the following steps:

- Create exceptions in Windows Firewall for Stimulus Presentation Tool
- Synchronize computers with a network time protocol



Create exceptions in Windows Firewall for Stimulus Presentation Tool

Aim

To allow traffic in Windows FireWall for port 9090, or the port you choose if 9090 is not available.

See Computer configurations

Prerequisite

You use the Stimulus Presentation Tool on another computer than the one with FaceReader.

Procedure

1. In the Windows' **Search** field, type **firewall**, and under the results click **Windows Firewall**.
2. Turn on the firewall for all networks, then click OK.
3. Click **Advanced Settings**.
4. On the left panel of the **Windows Firewall and Advanced Security** window, click **Inbound Rules** and on the right panel under **Actions** choose **New Rule**.
5. In the **New Inbound Rule Wizard**, on the **Rule Type** page, choose **Port**, then click **Next>**.
6. Select **Specific local ports** and enter *9090* (or the port chosen, if different), then click **Next>**.
7. On the **Action** page select **Allow the connection**, then click **Next>**.
8. On the **Profile** page choose the network the rule applies to, then click **Next>**.
9. On the **Name** page, enter a **Name** (for example Port9090). Then click **Finish**.

10. On the left panel of the **Windows Firewall and Advanced Security** window, click **Outbound Rules** and on the right panel under **Actions** choose **New Rule**. Repeat the procedure to complete the Outbound Rule. Make sure you choose the same options as for the Inbound Rule.
11. Repeat all steps above for the other PC.

Synchronize computers with a network time protocol

Aim

To synchronize face analysis with stimulus presentation. The clocks of the test participant PC and the FaceReader PC must be exactly the same. We recommend to set the two clocks to the same time using a Network Time Protocol (NTP) server. Noldus has tested the Stimulus Presentation Tool with NetTime version 3.14.

Prerequisite

You use the Stimulus Presentation Tool on another computer than the one with FaceReader.

Procedure

The following steps are needed on both PCs:

1. Install NetTime
2. Adjust the NetTime Settings
3. Create exceptions for NetTime in Windows Firewall
4. Before the start of a test with Stimulus Presentation Tool, synchronize the two PCs. You can also choose to do this automatically at regular intervals (minimum 15 minutes).

   See Synchronize the test PC to the FaceReader PC

Install NetTime

Do the following on both FaceReader and test PCs:

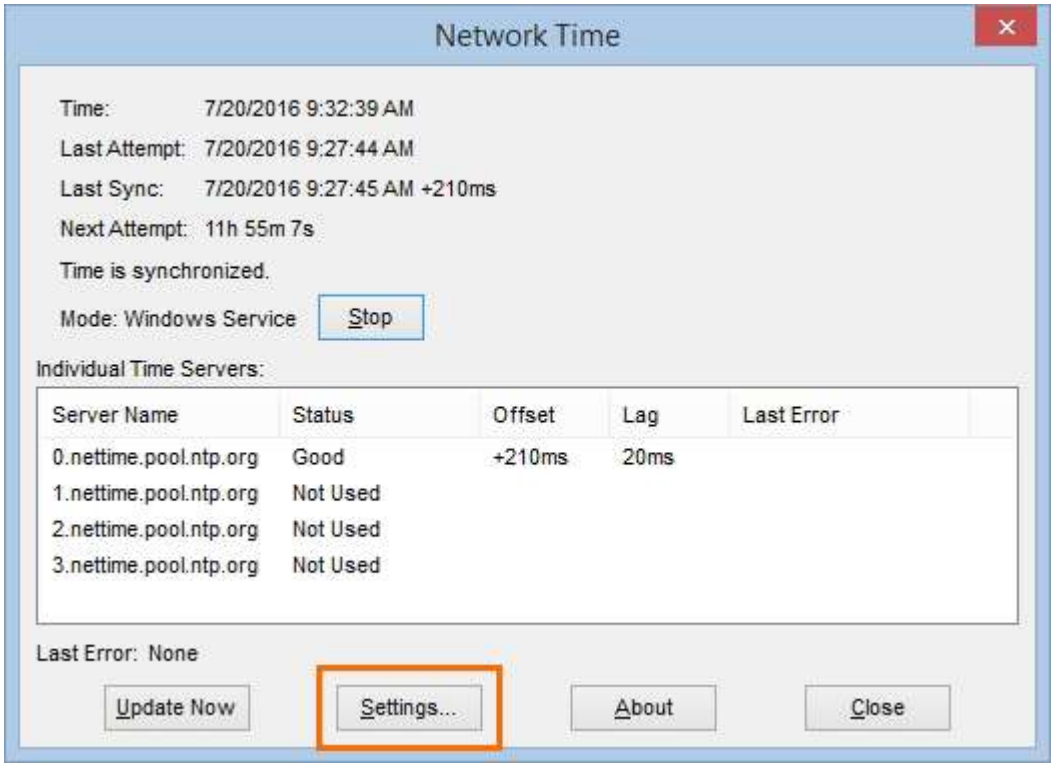
1. Browse to http://www.timesynctool.com, and download the latest version of **NetTimeSetup.exe**.
2. Run the installation file. During installation, select **Install as Service (Recommended)**.

Adjust the NetTime Settings

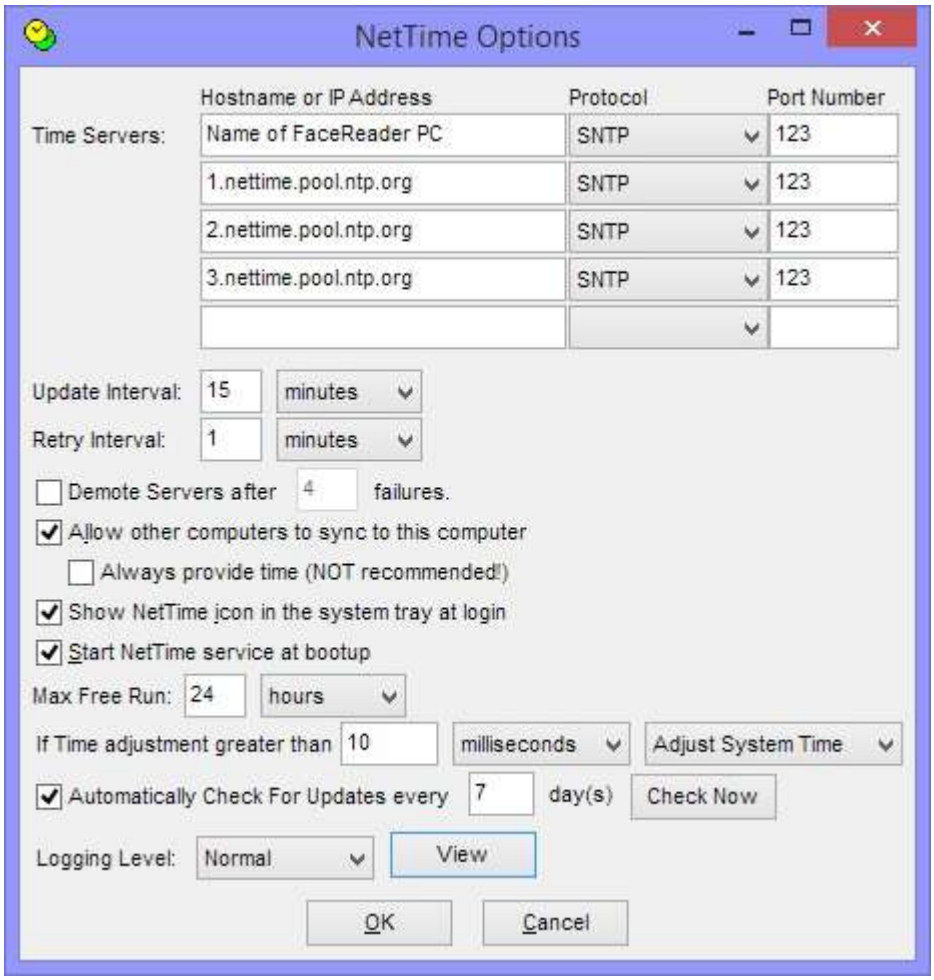
1. Click the arrow in the lower-right corner of your screen to open the system tray.

2. Click the **Network Time Synchronization** icon.

3. Click **Settings**.



4. Under Hostname or IP Address:



- *For the FaceReader PC* — Leave the **Time Servers** names as shown in the next table.

- *For the test PC* — In the first **Time Servers** field, enter the name of the FaceReader PC, and delete all other external Time Servers. See the following table.

	FaceReader PC	Test PC
Time Servers	0.nettime.pool.ntp.org	[FaceReader PC's name]
	1.nettime.pool.ntp.org	[empty]
	2.nettime.pool.ntp.org	[empty]
	3.nettime.pool.ntp.org	[empty]
Update Interval	15 minutes	60 seconds

To find the name of a PC, right-click **My Computer** and choose **Properties**.

5. Choose *SNTP* as **Protocol** and *123* as **Port**.
6. Next to **Update Interval** enter (see also the table above):

   - *For the FaceReader PC* — 15 minutes.

   - *For the test PC* — 60 seconds.

7. *For the FaceReader PC only* — Select **Allow other computers to sync to this computer**.
8. *For both PCs* —

   - Select **Show NetTime icon in the system tray at login** and **Start NetTime service at bootup**.

   - De-select **Demote Servers after [ ] failures**.

   - Next to **If time adjustment greater than**, select **10 milliseconds**, then **Adjust System Time**.

9. Click **OK**. When a warning appears about Update Intervals being lower than 10 minutes (on the test PC), click **No**.

Create exceptions for NetTime in Windows Firewall

To prevent that syncing fails because of the Firewall, create exceptions on both PCs as follows.

1. In the Windows' Search field, type **firewall**, and under the results click **Windows Defender Firewall**.
2. Turn on the firewall for all networks, then click **OK**.
3. Click **Advanced Settings**.
4. *Inbound Rule*

   - On the left panel of the **Windows Defender Firewall and Advanced Security** window, click **Inbound Rules** and on the right panel under Actions choose **New Rule**.

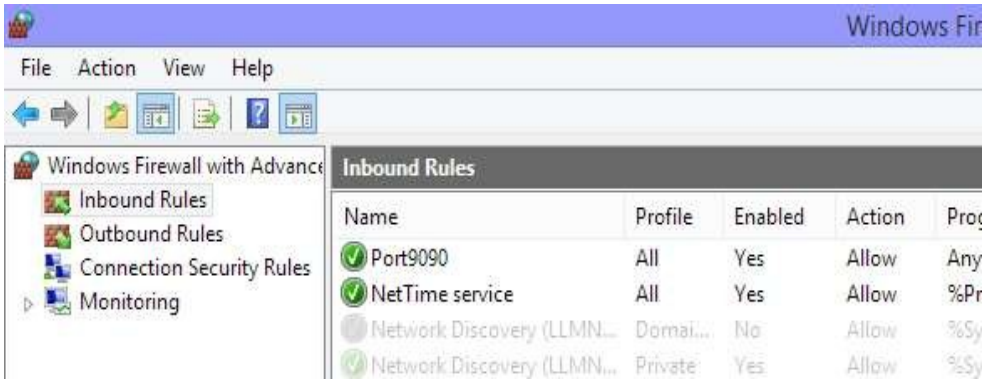
   - In the **New Inbound Rule Wizard**, on the **Rule Type** page, choose **Program**, then click **Next>**.

   - On the **Program** page, select **This Program path**, click **Browse** and select the file

   C:\ProgramFiles (x86)\NetTime\NetTimeService.exe.

   - Then click **Open** and **Next>**.

   - On the **Action page** select **Allow the connection**, then click **Next>**.



- On the **Profile** page select all options **Domain**, **Private**, and **Public**. Then click **Next>**.

- On the **Name** page, enter a Name (for example NetTime Service). Then click **Finish**.

5. *Outbound Rule*

   -On the left panel of the **Windows Defender Firewall and Advanced Security** window, click **Outbound Rules** and on the right panel under **Actions** choose **New Rule**.

   -Repeat the step 4 above to complete the **Outbound Rule**. Make sure you choose the same options as for the Inbound Rule.

6. Repeat all steps above for the other PC.

Note

If you followed all procedures for establishing Firewall exceptions (Create exceptions in Windows Firewall for Stimulus Presentation Tool and Create exceptions for NetTime in Windows Firewall), each computer should have two Inbound Rules and two Outbound Rules:

- One for the port (for communication between FaceReader and Stimulus Presentation Tool)
- One for NetTime Service.

Synchronize the test PC to the FaceReader PC

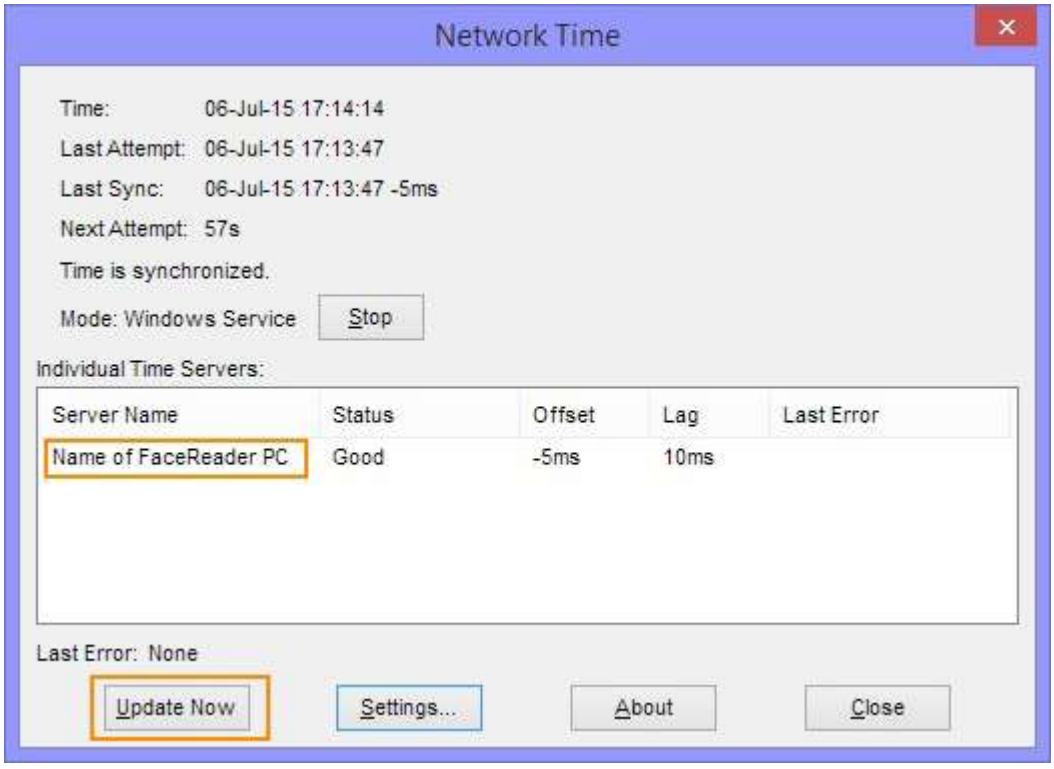
1. Always start the test PC after starting the FaceReader PC. This ensures that the test PC always finds its time server.
2. On the test PC, click the arrow in the lower-right corner of your screen to open the system tray.

3. Click the **Network Time Synchronization** icon.

4. Make sure that the first item under **Server Name** is the name of the FaceReader PC. If this is not the case, click **Settings** and enter the FaceReader PC's name for the first time server.

   See Adjust the NetTime Settings

5. Click the **Update Now** button.



The **Offset** and **Lag** are updated. Please note that you may get an error if the test PC is in another network.

Offset is the estimated difference in time between the clocks that cumulated up to the time of the update. This is the accuracy of synchronization of the Stimulus Presentation Tool with FaceReader. A positive value means that the FaceReader PC clock is faster than the test PC.

Lag (also known as delay) is the traveling time of time packets from the client to the server and from the server back to the client. The shorter this lag, the more accurate the estimate of the offset between clocks.

6. You are now ready to start the test with the Stimulus Presentation Tool.

   See Run a test

Notes

- After clicking **Update Now**, always make sure that on the **Network Time** window the **Status** cell for the FaceReader PC says **Good**.
- To change the order of the servers in the **NetTime Options** window, copy and paste the name of one cell to the other.
- Click **Update Now** every time you start a test to keep the time offset between FaceReader and Stimulus Presentation Tool as low as possible.
- For more information:

  https://en.wikipedia.org/wiki/Network_Time_Protocol

  http://www.timesynctool.com

Event markers

Event markers are used to indicate that, for instance, the participant was distracted or was trying food product A. With Event markers, you can mark the parts of the analyses you are especially interested in and that were not defined as Stimuli beforehand. In contrast to Stimuli, Event markers have no fixed duration. In FaceReader you can compare the analyses over these time periods with other data.

Main topics

- Define Event markers
- Score Event markers

Define Event markers

Aim

To specify the markers and their associated key codes.

Prerequisite

Your FaceReader license includes the Project Analysis Module.

Procedure

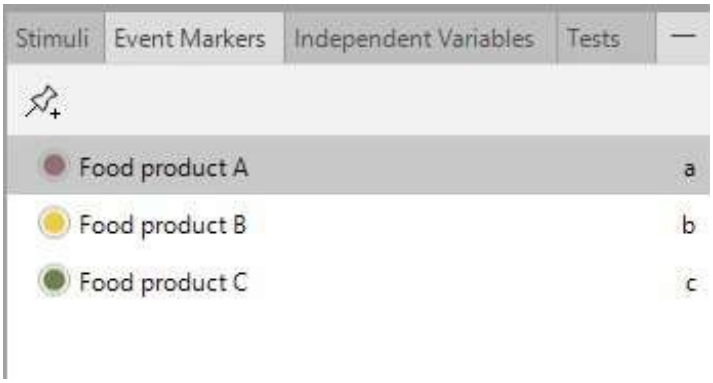
1. Choose **Project** > **Event Marker** and then **Add Event Marker**.

2. In the **Name** field, enter the Event marker name, for instance, *Food product A*.
3. Click the button on the right of the **Trigger Key** field and enter the key for this marker. This is the key on your keyboard that you press when the event (In this example *Test participant takes food product A*) starts.
4. Select a color for the marker and click **OK**. This color will be used throughout the program for the Event marker.

Notes

To delete or edit an Event marker:

1. Open the **Event Markers** tab at the bottom of the Project Explorer.



2. Right-click the Event marker you want to delete or edit and select the option you require.

Score Event markers

Aim

To mark episodes other than the time Stimuli were presented.

Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- You have a video or camera analysis.
- You defined Event markers.

Procedure

To score during an analysis

1. Press the trigger key that is associated with your Event marker. If you have the **Timeline** window open, a bar appears in the line Event markers.
2. Press the same trigger key to stop the Event, or press another key to start another event.

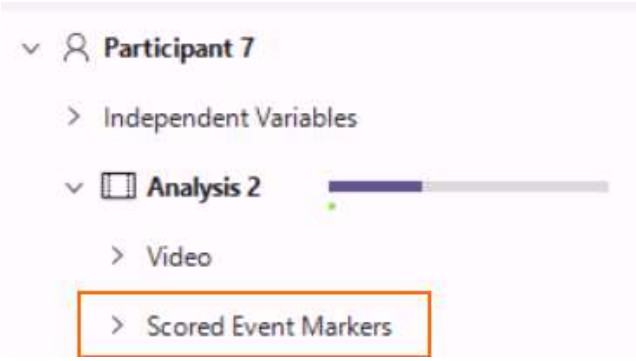
To score after an analysis

1. Open the **Timeline** Window and scroll the video to the position where the event starts.
2. Press the Event marker trigger key. A question appears whether you want to score the Event marker at that point. Choose **Yes**.
3. Scroll the video to the position where the Event marker should stop
4. Press the same trigger key to stop the event, or press another key to stop the event and start another event.

Notes

- Scored Event markers appear as dots below the analysis in the project explorer.

- To edit a scored Event marker, unfold the analysis and double-click **Scored Event markers**. In the window that opens, edit the markers by dragging them to the correct position.



- To copy a scored Event marker to other participants or analyses, unfold the analysis and double-click **Scored Event Markers** (see picture above). Click the Event marker you want to copy. Click **Scored Event Markers** at the top of the window, and choose one of the options under **Copy To**.

Independent variables

Independent variables are factors that can vary but are constant per participant and can, potentially, affect the analysis results. Examples are the nationality of the participant, or the previous experience with a product or commercial. Independent Variables can be used to compare participant groups, for example to compare groups of males and females, or to make groups with and without previous experience with the product.

By default, each project contains the independent variables *Age* and *Gender* of the participant. These cannot be deleted. Their values can be estimated by FaceReader, from the analyzed images. Alternatively, you can enter the values manually.

Independent Variables must be scored for each participant. Participants for which one or more Independent Variables have not been scored are left out of the analysis.

Main topics

- Define Independent Variables
- Score Independent Variables

Define Independent Variables

Aim

To define factors that can vary but are constant per participant and can, potentially, affect the analysis results.

Prerequisite

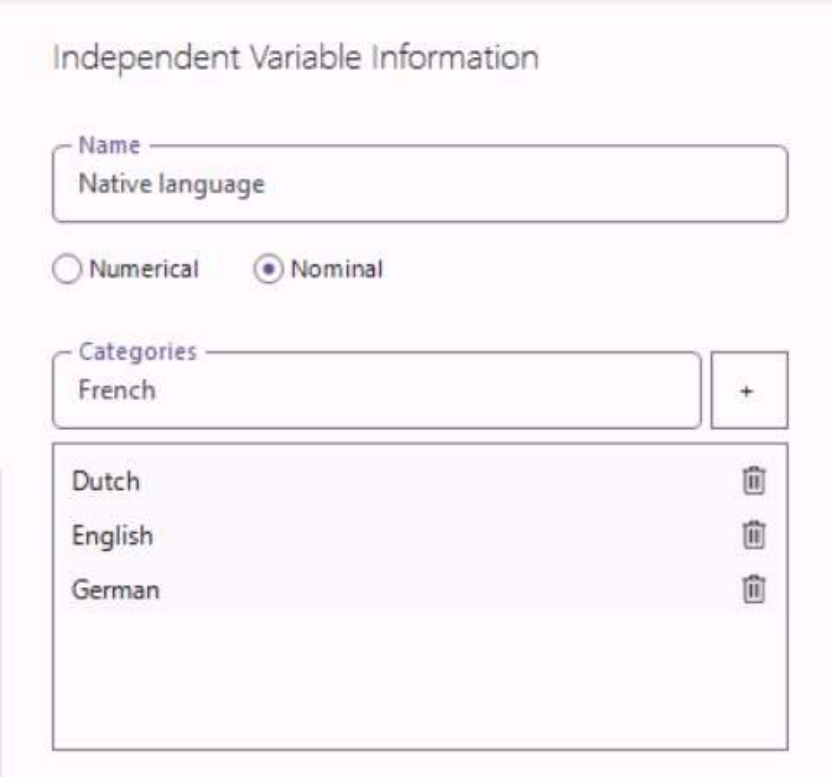
Your FaceReader license includes the Project Analysis Module.

Define independent variables

1. Choose **Project** > **Independent Variables** > **Add Independent Variable**.
2. Give a name to the variable, for example *Experience level*.
3. Choose one of the following:

   Numerical – Numerical variable values can have decimals and can also be negative.

   Nominal – Enter the independent variables categories in the **Categories** field. Click the Plus button to add the category. Define at least two categories for each independent variable.



Notes

- To delete or edit an independent variable, open the **Independent Variables** tab at the bottom of the Project Explorer.

  Right-click the independent variable you want to delete or edit and select the option you require.

Score Independent Variables

Aim

To enter a value for each Independent Variable.

Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- You defined independent variables.

Procedure

1. Expand the **Participant** item in the Project Explorer.
2. Double-click **Independent Variables**.
3. Click the pencil button next to the Independent Variable.
4. Select the category. In the example below, this would mean defining the native language of each participant.

Note

The Independent Variables item in the Project Explorer displays a warning icon if the values have not been scored yet for a participant. Open the participant item and double-click **Independent Variables**. Then fill in the values.

Project analysis in short

Aim

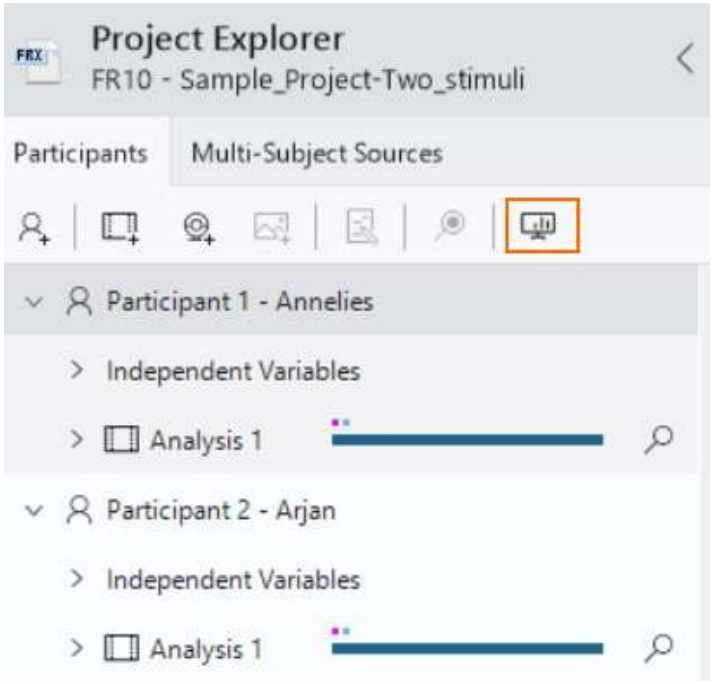
- Visualize or tabulate the data that you have acquired and calculate the average intensities of the facial expressions and other parameters for your participant groups.
- Compare participant groups and run a t-test to test for significant differences.
- Play back your stimulus video together with a video of the participant's face and a Line Chart with the facial expressions and other parameters.
- Create heatmaps on your stimuli showing the hotspots that attracted your test participants' attention.
- Calculate correlations between data sets and visualize data sets side by side or in a correlation graph.

Prerequisites

- Your license includes the Project Analysis Module.
- Your project includes one or more video analyses or camera analyses.

Procedure

1. Open the Project Analysis: from the **Project** menu select **Open Project Analysis** or click the **Open project analysis** icon above the **Participants** list.



Default FaceReader shows a Line Chart with the average intensities of the facial expressions of all your test participants. See Line Chart for more information about this type of chart. FaceReader also shows the face video of your first test participant. If your project contains stimuli FaceReader will show the first stimulus video/image.

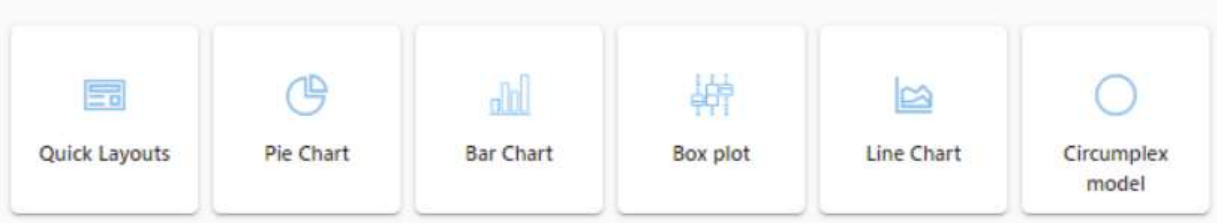
If your stimulus is a video — Play the stimulus video and the face video together with the Line Chart. See Visualize your stimulus, participant videos and line chart for more details.

2. Click one of the tiles for the option of your choice:

- **Quick Layouts** — This option allows you to pick from a couple of charts to give you a first impression of the data. See Quick Layouts for more information.
- **Pie chart**, **Bar chart**, **Box plot**, **Line chart** or **Circumplex model** — Select one of the options to visualize your data. Circumplex Model is only available if you scored stimuli or event markers in your project. See Visualize your data in a chart for more information.
- **Heatmap** — To create a heatmap on one of the stimuli.
- **Table** — To calculate statistics on the analyzed facial expressions and other parameters of all participants, participant groups or single participants. See Calculate statistics and summarize them in a table for more information.
- **Stimulus** — To add your stimulus videos to the visualization. You can play back your stimulus videos together (synchronized) with a Line chart with

the facial expressions and other parameters. See Visualize your stimulus, participant videos and line chart for more information.

- **Participant** — To add your participant face video to the visualization. You can play back your participant videos together (synchronized) with the stimulus video and a Line chart with the facial expressions and other parameters. See Visualize your stimulus, participant videos and line chart for more information.
- **Compare** — To compare two or more data sets in a chart or table and carry out a t-test to test for significant differences. See Compare data for more information.



3. Select the data you want to include in your analysis. See Data selection for more information. Your chart/table will appear.

Click **Save Layout** to save the chart/tables you made so you can use them again. Enter a **Layout name** and click **OK**.

Click **Load Layout** to open the charts/tables/videos that you saved in your layout.

Click **Clear Layout** to delete all the charts/tables/videos.

Data selection

Aim

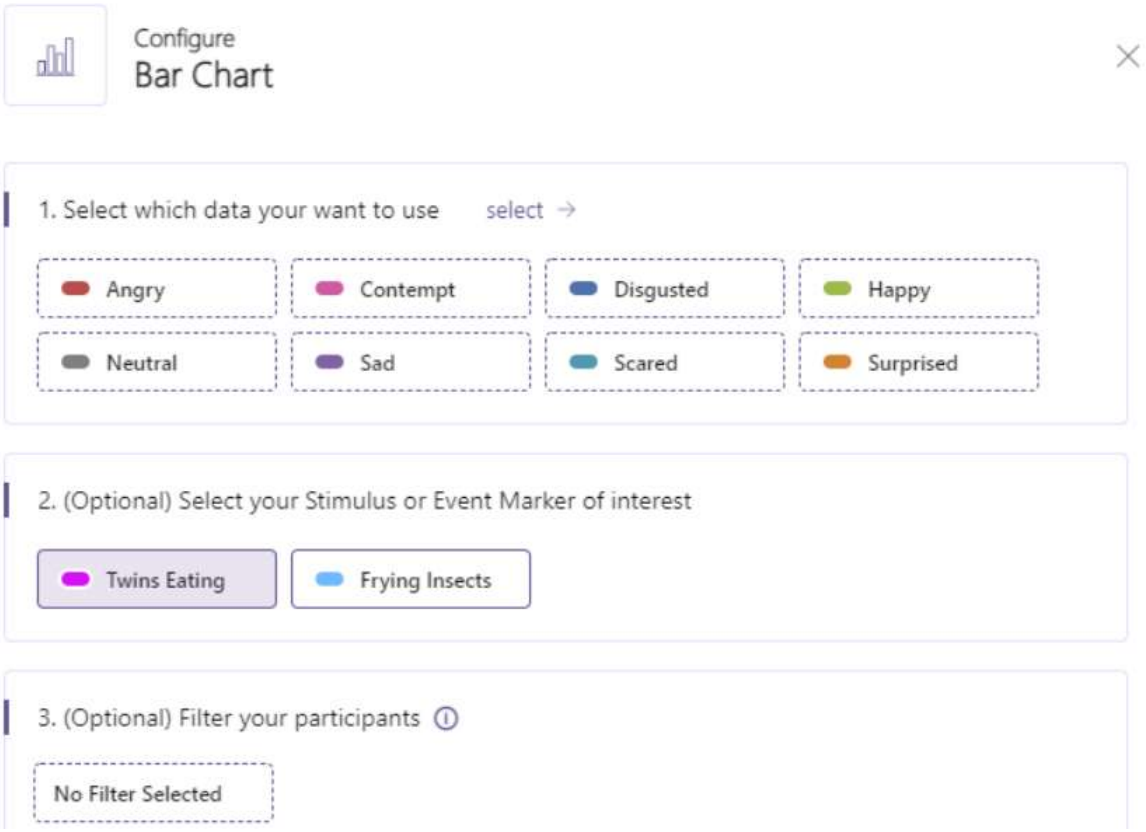
- Select what parameters to analyze
- Select what stimuli/event markers to analyze
- Select absolute or relative values for your parameters
- Select how to aggregate data over time and over test participants
- Select participants

Prerequisites

- Your license includes the Project Analysis Module.
- Your project contains video or camera analyses.

Procedure

1. Open the Project Analysis section (see Project analysis in short).
2. Select the chart or table of your choice. The Data selection window opens.

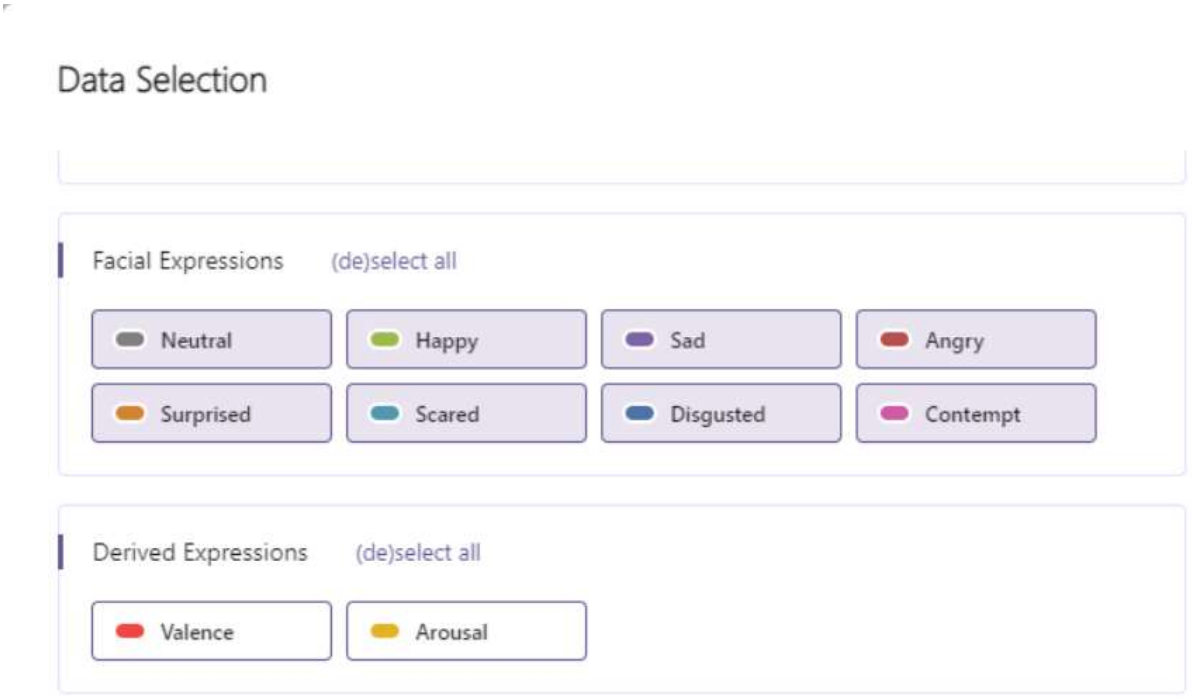


Select what parameters to analyze

The first section lists the parameters that will be included in your chart or table. Click **select** to see all the variables that are available and make a selection. The parameters in gray are the ones that are selected.

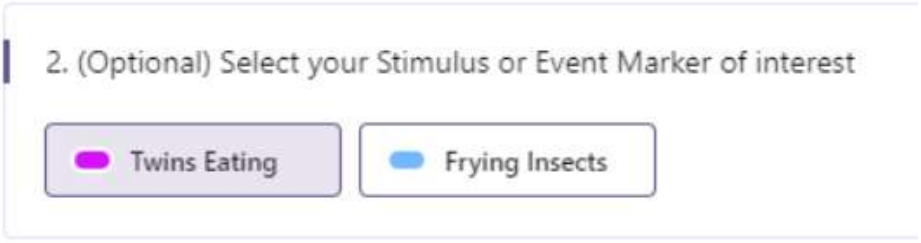
Notes

- It is not possible to select *Valence* or *Arousal* when you make a Pie Chart.
- You cannot select any parameters when you make a Circumplex Model because this chart always shows a combination of *Valence* and *Arousal*.



Select what stimuli/event markers to analyze

The **Stimulus or Event Marker** section lists the stimuli and event markers that were scored in the project. Click a stimulus or event marker to select it and to visualize/ tabulate the data during this stimulus/event marker. If you do not make a selection the whole observation period is taken into account.



Advanced options for data analysis

Aim

- To select whether you want to visualize/tabulate absolute or relative values of your parameters
- To select how to aggregate data over time.
- To select how to aggregate data over test participants.

Prerequisites

- Your license includes the Project Analysis Module.
- Your project contains video or camera analyses.

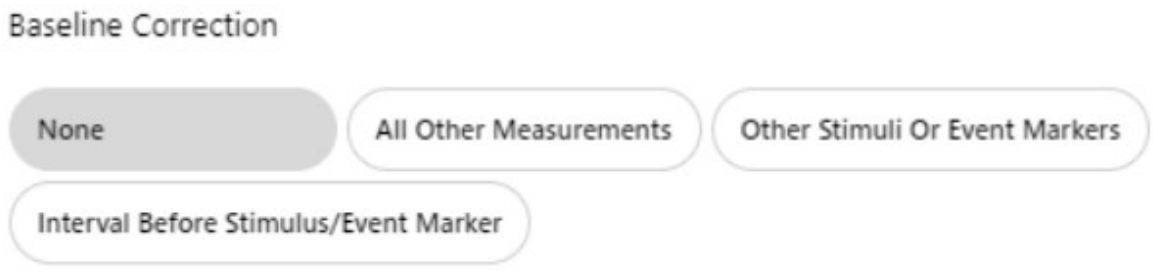
Procedure

1. Open the Project Analysis section (see Project analysis in short).
2. Select the chart or table of your choice. The Data selection window opens.
3. Click **select** next to **Advanced Options** to open the **Advanced Options** window and click the options you want to use:

Select absolute or relative values for your parameters

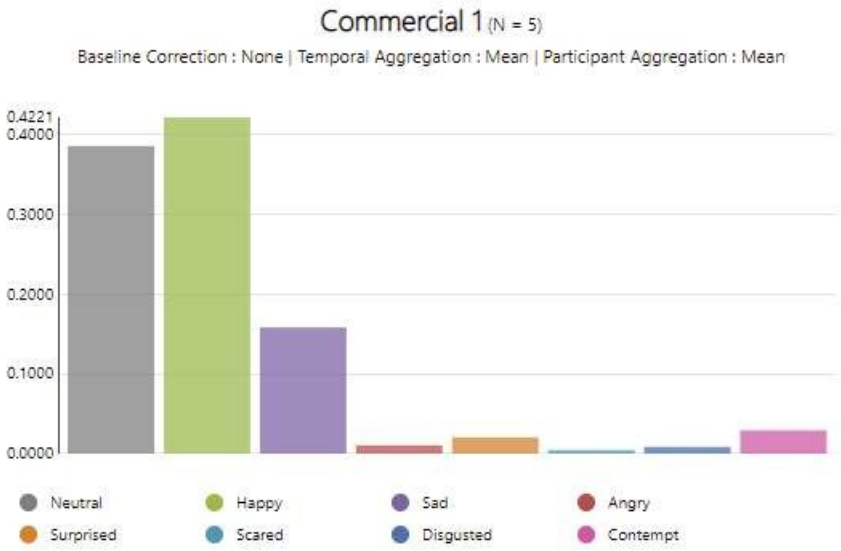
Select one of the options under **Baseline Correction** to visualize/tabulate either the absolute values or relative values of your parameters.

Baseline Correction is not available when you make a Pie Chart. You can only visualize absolute values as relative values can be negative.



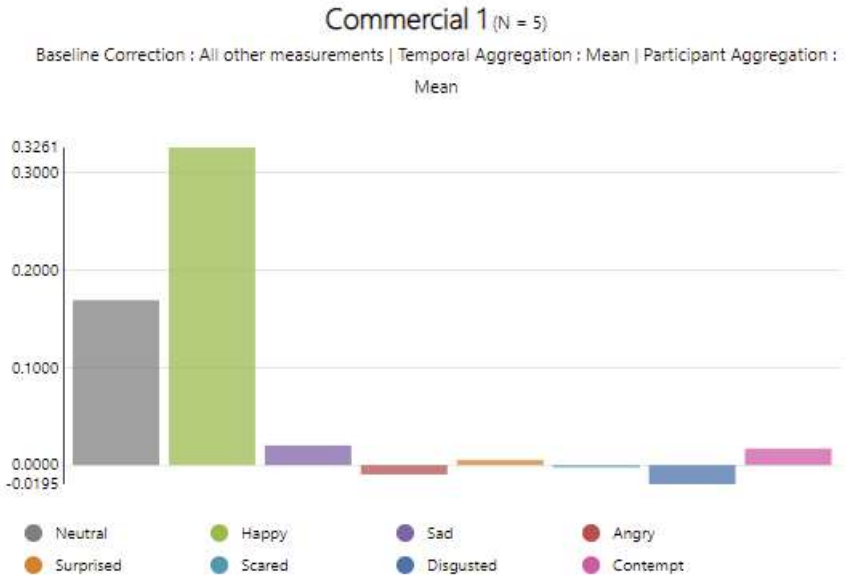
- **None** (default) — With this option selected the absolute intensities of the selected data will be visualized/tabulated.

The bar chart in the example below shows the mean absolute intensities of the facial expressions that the test participants showed during *Commercial 1*.

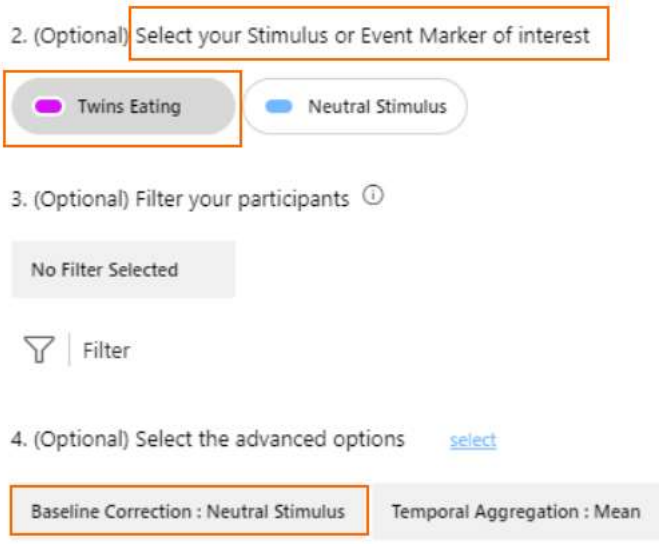


- **All Other Measurements** — To visualize/tabulate the selected data during a stimulus relative to all other time fragments. Use this option to calculate in which way the facial expressions, for example, during watching a certain commercial differ from the expressions while the participants were not watching it.

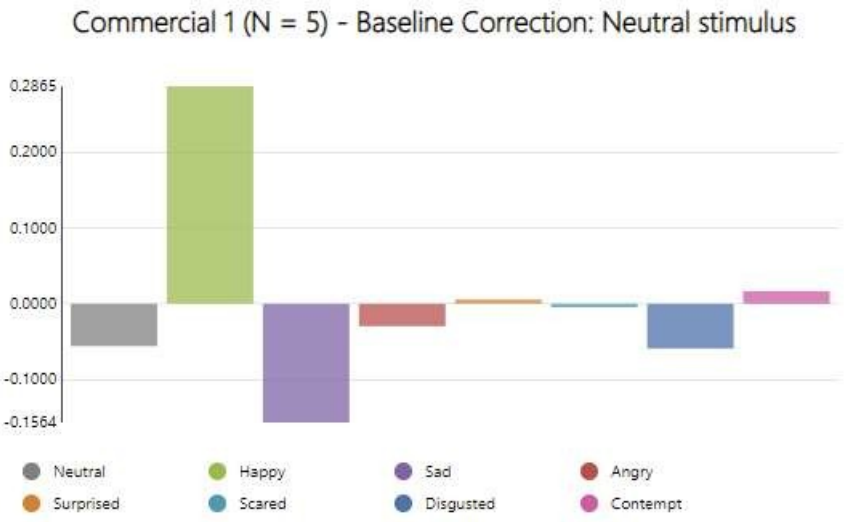
  The bar chart in the example below shows the mean intensities of the facial expressions of the test participants during *Commercial 1* relative to the facial expressions that they showed during the rest of the test. The chart shows that the test participants were happier during *Commercial 1* than during the rest of the test.



- **Other Stimuli Or Event Markers** — The selected data during a stimulus/ event marker relative to the expression intensities during another stimulus/ event marker. When you select this option, choose what stimuli or event markers to use as the baseline. With this option you can for example correct the facial expressions of test participants when they watched a certain commercial for the expressions while watching a neutral scene.

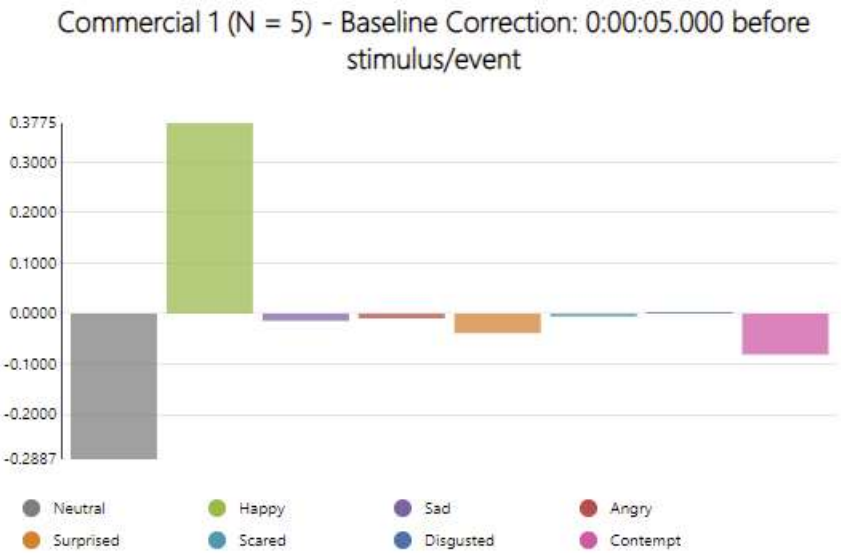


The bar chart in the example below shows the mean intensities of the test participants during *Commercial 1* relative to the facial expressions that they showed during a *Neutral stimulus*. The charts shows that the test participants were happier during *Commercial 1* than during the *Neutral stimulus*.



- **Interval before stimulus/event marker** — The selected data during a Stimulus relative to the expressions just before the stimulus or event. With this option you can measure the effect of a stimulus on the participant's mood, by looking at the changes induced by the stimulus. Enter the duration of the interval before the stimulus or event marker in the **Interval** field.

The bar chart in the example below shows the mean intensities of the facial expressions of the test participants during *Commercial 1* relative to the facial expressions that they showed during the 5-second interval before *Commercial 1*. The chart shows that the test participants were happier during *Commercial 1* than during the 5-second interval before *Commercial 1*.

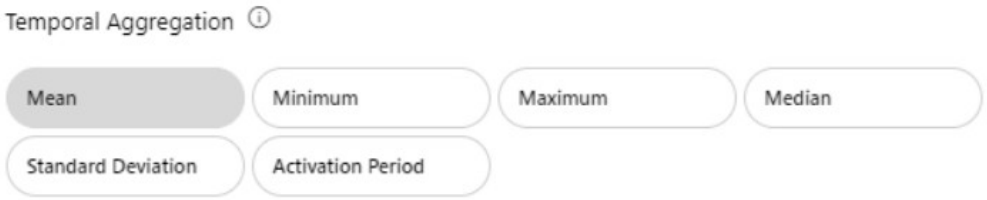


Select how to aggregate data over time and over test participants

Select one of the options under **Temporal Aggregation** to select how the values per test participant are aggregated over time. If you choose **Activation Period** FaceReader counts the percentage of frames which have an activation higher than the threshold. The default threshold is 0.2. That means that the value for 'Happy' is, for instance, 60% if the intensity of 'Happy' is 0.2 or higher in 60% of the frames.

Notes:

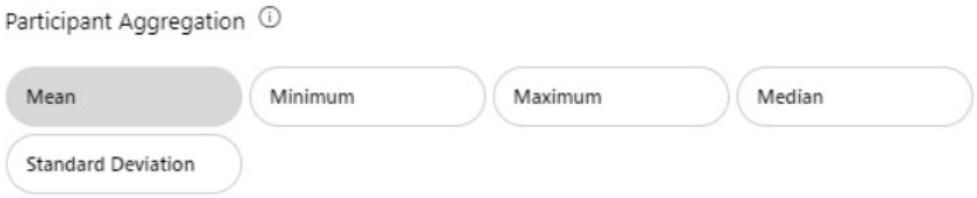
- Temporal aggregation is not available when you make a Circumplex Model or Line Chart because these chart types are based on temporal data.
- You can select multiple temporal aggregation methods when you make a table.



Select one of the options under **Participant Aggregation** to select how the values of the different participants are aggregated.

Note:

Participant Aggregation is not available when you make a Box Plot because a Box Plot by definition shows a number of participant aggregation values (Q1, Q2, Q3). See Box Plot for more information.



How baseline correction and aggregation is performed

Suppose you have three participants with one analysis each and you scored the same Stimulus for all three participants. You selected **All Other Measurements** as **Baseline Correction** in the **Advanced Options** and **Mean** for both **Temporal Aggregation** and **Participant Aggregation.** As an example, calculation of the relative mean value of Happy during the Stimulus is done in the following way:

Participant 1 (P1) — (mean intensity Happy P1 within Stimulus interval) - (mean intensity Happy P1 outside Stimulus interval) = A

Participant 2 (P2) — (mean intensity Happy P2 within Stimulus interval) - (mean intensity Happy P2 outside Stimulus interval) = B

Participant 3 (P3)— (mean intensity Happy P3 within Stimulus interval) - (mean intensity Happy P2 outside Stimulus interval) = C

Relative Mean value of Happy = (A + B + C)/ 3

Select participants

Aim

To select which participants to include in your analysis. You can make a selection based on name, analysis number or the values of one or more independent variables.

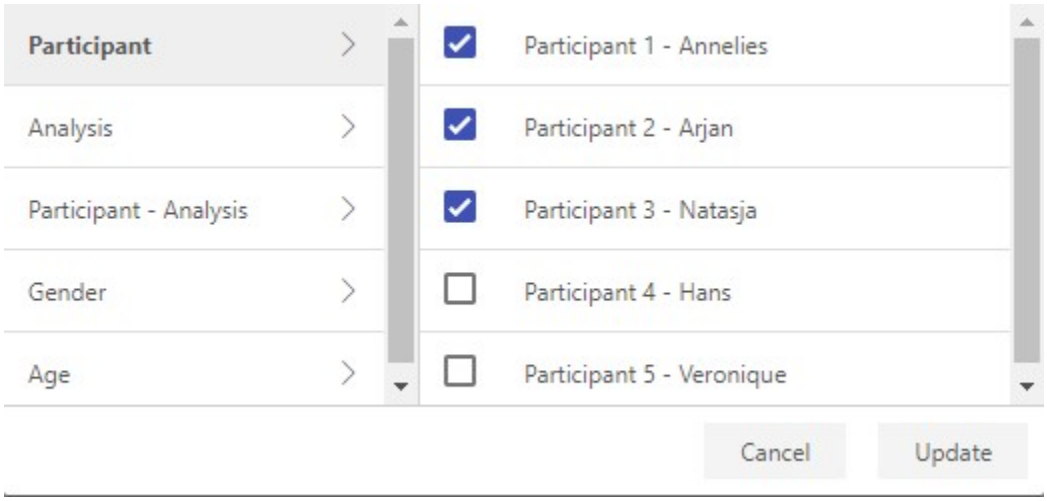
Prerequisites

- Your project includes the Project Analysis Module.
- Your project contains video or camera analyses.

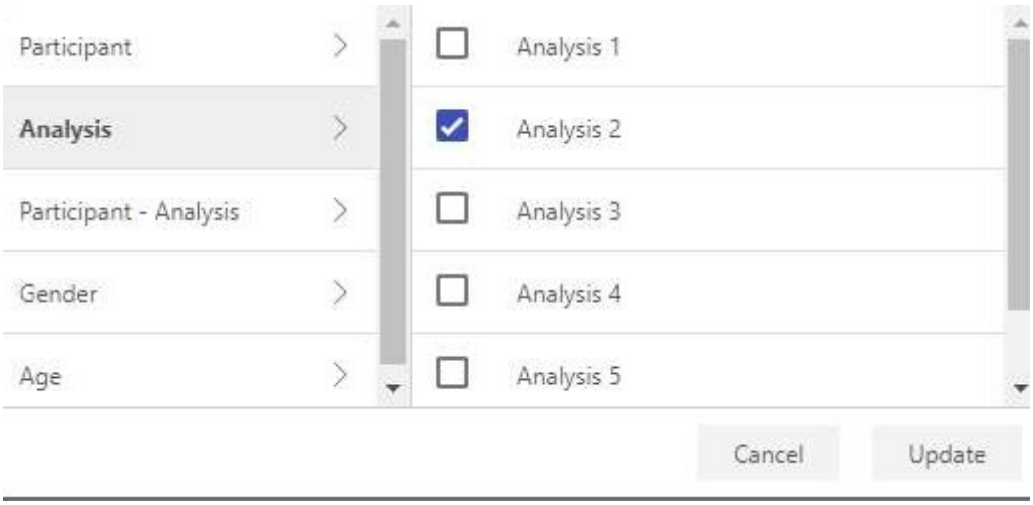
Procedure

1. Open the Project Analysis section.
2. Select what chart/table you want to create.
3. Under **Filter your participants** click **Adjust Filter** to make a selection based on:

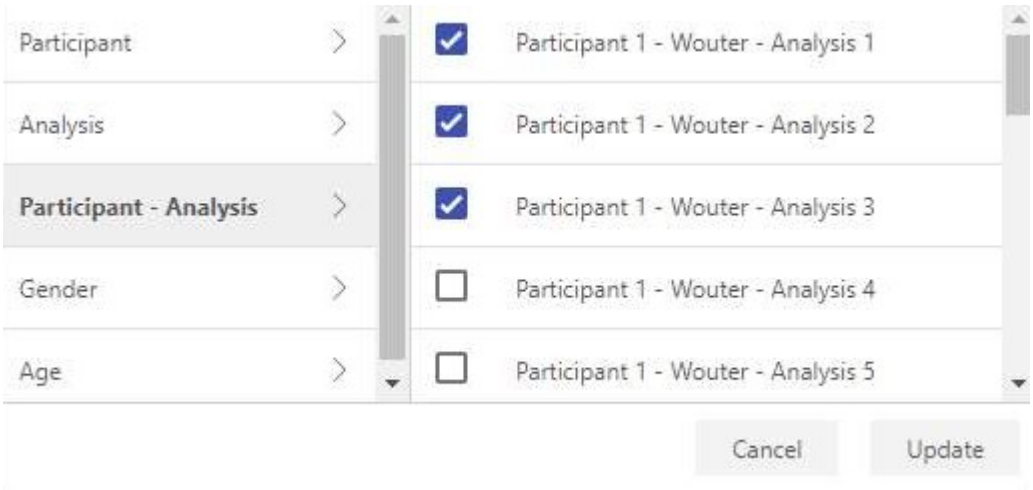
- **Participant** — Select the participants that you want to include in your analysis.



- **Analysis** — Select the analyses that you want to include in your charts/ table. For instance, select 'Analysis 2' if these are the analyses of test day 2 on which the respondents tested 'Ice cream 2'.

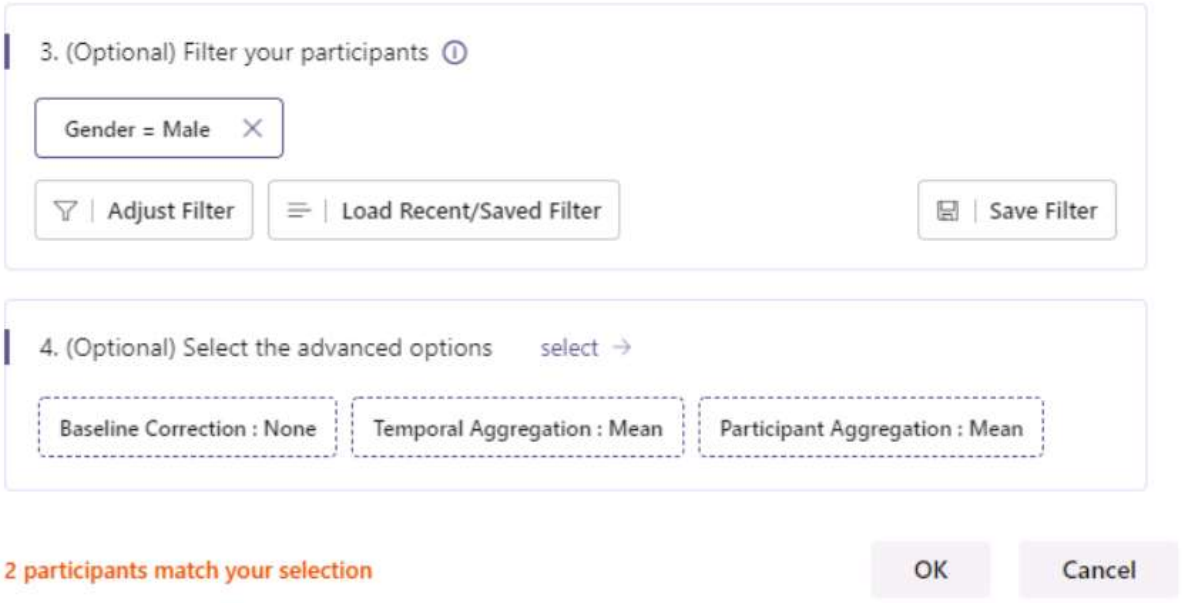


- **Participant - Analysis** — Select the participant/analysis combinations that you want to include in your charts/table. For instance, select the first three analyses of test participant 1-10 if these are the analyses of test day 1, 2 and 3 on which these participants tested razor blade X.



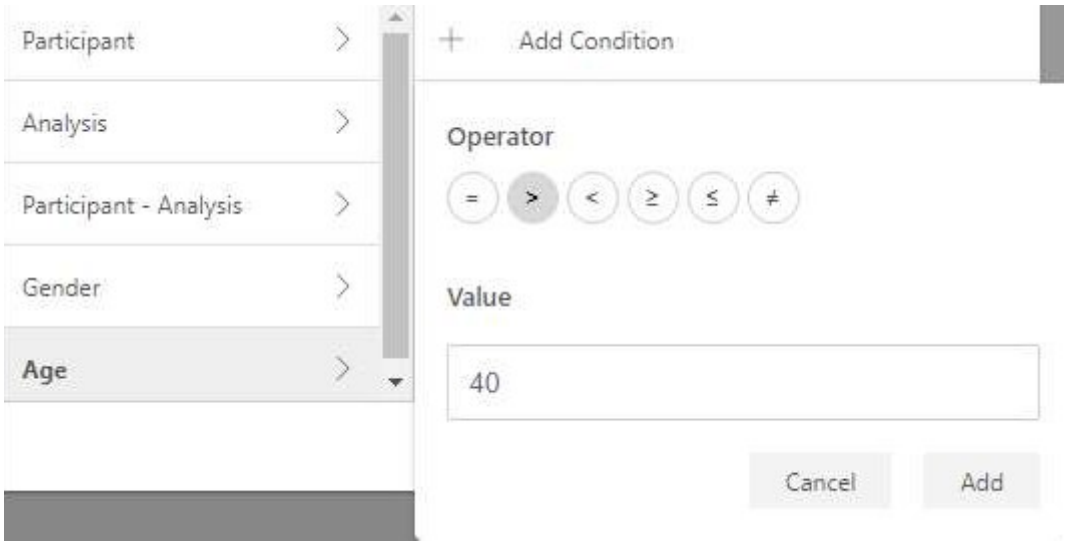
- **Age, Gender and other independent variables** — Age and gender are the independent variables that can be estimated by FaceReader, from the analyzed images. You can, for instance, first select all male respondents and make a bar chart of their facial expressions during Stimulus 1 and then select all female subjects and make a similar chart. You can also make a selection based on the independent variables that you defined yourself like socioeconomic status of the test participants or whether the participant had previous experience with the product under investigation.

4. Click **Update** to add the filter to your selection. In the lower left corner of the filter window the number of participants that match your filter are shown.



Add condition

For numerical variables like age or number of years of experience with the product, you can add a condition and select, for instance, all the test participants older than 40.

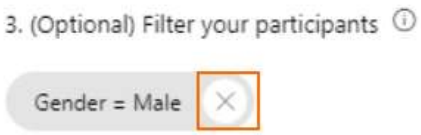


5. Click **Add** to add the condition to the list of values to choose from.

6. Click **Update** to add the filter to your selection.

Remove a filter

To remove a filter from your selection, click the button next to it.



Change your selection

Click **Adjust Filter** to open the window to filter your participants.

The blue dots indicate what independent variables have been used to make a selection. Change your selection and click **Update** to add the new filter to your selection.

Save your selection

To save your selection criteria, click **Save Filter** and enter a name for your filter.

Load an existing filter

To open a filter that you have saved previously.

Quick Layouts

Aim

Visualize your data in a number of charts to get a quick first impression of your results.

Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- Your project includes one or more video or camera analyses.

Procedure

1. Open the Project Analysis section and click **Quick Layouts**.
2. Select the data you want to include in your analysis. See Data selection for more information.
3. Select which Quick Layout you prefer. Click **OK** when you are ready.

- Stimulus, participant video and Line Chart, see Visualize your stimulus, participant videos and line chart.

- Stimulus, Line Chart, Bar chart, Circumplex Model and Pie chart.

- Stimulus and Line Chart.

- Pie chart, Box Plot and Table. See also Calculate statistics and summarize them in a table.

By default FaceReader shows a Line chart and the face video of the first participant. If you selected a stimulus, FaceReader will also show the (first) stimulus video/image.

If your stimulus is a video — Play the stimulus video together with the Line Chart. See Visualize your stimulus, participant videos and line chart for more details.

Visualize your data in a chart

Aim

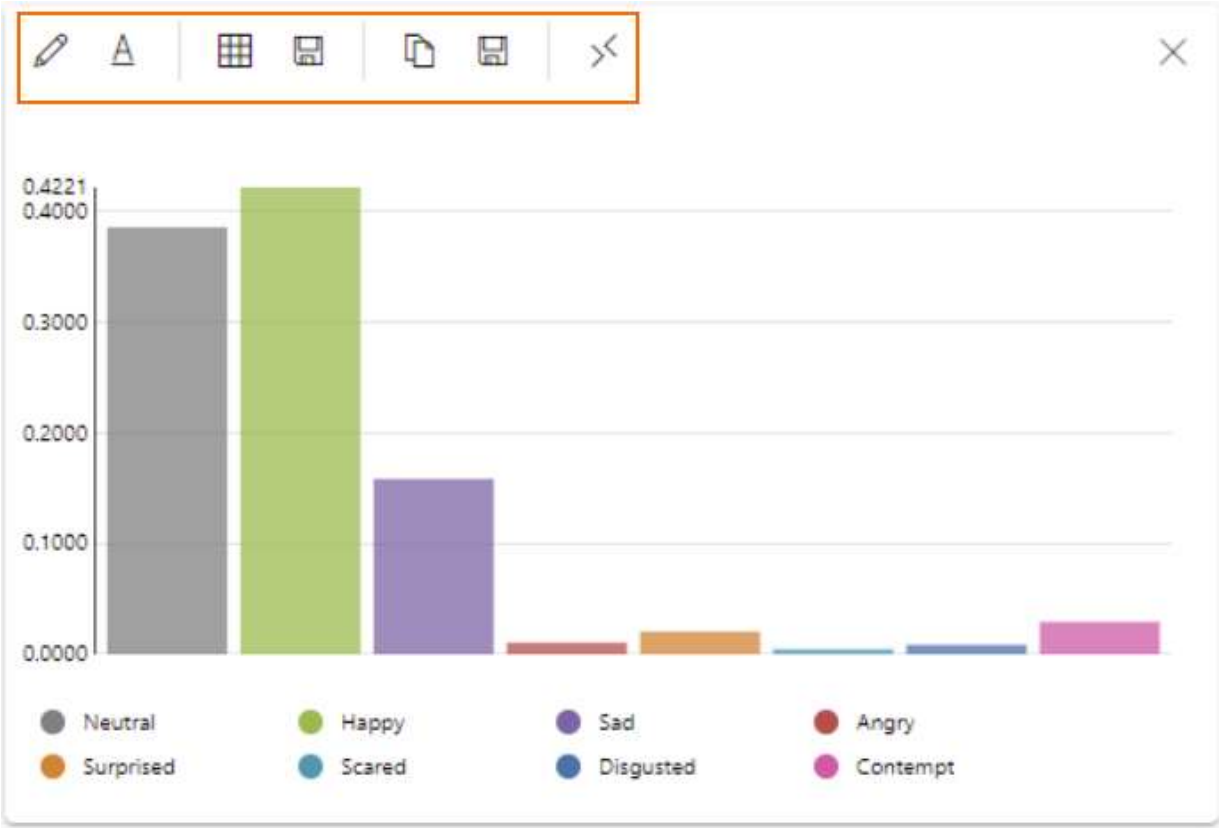
To visualize your data in a Pie Chart, Box Plot, Bar Chart, Circumplex Model or Line Chart.

Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- Your project includes one or more video or camera analyses.

Procedure

1. Open the Project Analysis section and click either **Pie chart**, **Box Plot**, **Bar Chart**, **Circumplex Model** or **Line Chart**.
2. Select the data you want to include in your analysis. See Data selection for more information. Click **OK** when you are ready. FaceReader will show the chart.



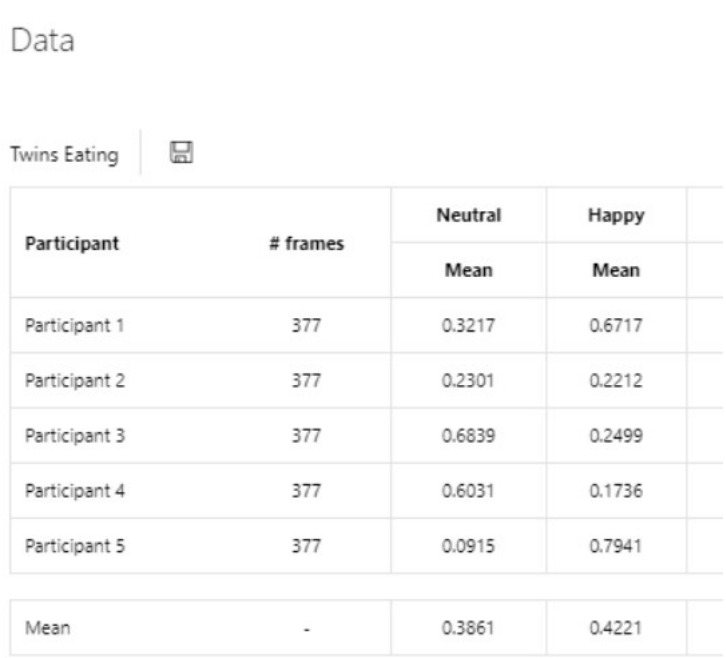
Click on the colored circles below the chart to exclude or re-include the corresponding data from/into the chart.

Each chart has a toolbar with the following information/icons:

- **Edit selection** — Click this button to open the Data selection window and change your selection. Click **OK** when you are ready.
- **Adjust caption** — Click this button to change or reset the chart's caption.
- **Display data** — Click this button to view a table containing the data on which the chart is based, per participant and aggregated over participants. The table also shows the number of frames in the participant video or camera stream that was taken into account. If the chart is a Line chart or Circumplex Model the table shows the data per sample point aggregated over participants.

  The table in the example below comes from the 'FaceReader sample project - Two stimuli' and shows the mean intensities of the facial expressions Neutral and Happy per test participant and (in the last row) the mean intensities over test participants during the time that the test participants watched the 'Twins eating' stimulus.

  Click the **Save** button to save the table, either in *.txt format or in *.xlsx format.



Data

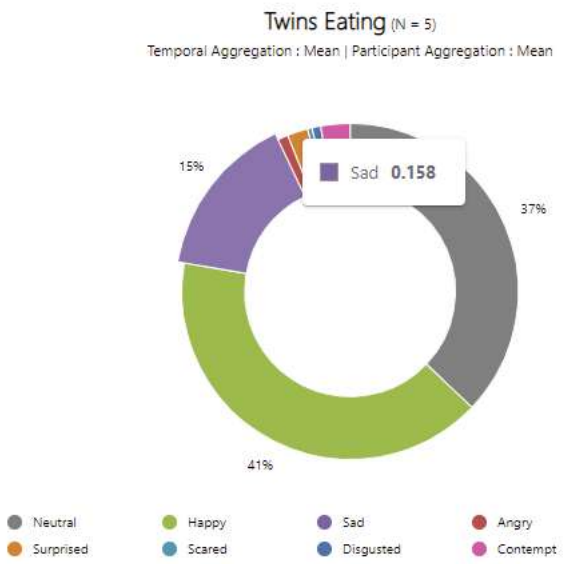
Twins Eating

Participant	# frames	Neutral	Happy
		Mean	Mean
Participant 1	377	0.3217	0.6717
Participant 2	377	0.2301	0.2212
Participant 3	377	0.6839	0.2499
Participant 4	377	0.6031	0.1736
Participant 5	377	0.0915	0.7941
Mean	-	0.3861	0.4221

- **Save data** — To save the data, either in *.txt format or in *.xlsx format. This results in the same output as when you click the **Save** button under **Display data**.
- **Copy as image** — To copy the chart to the clipboard.
- **Save as image** — To save the chart in one of the following formats: *.png, *.jpg, *.bmp, *.gif or *.tif.
- **Increase/Decrease Size** — To increase or decrease the chart's width.
- **Close** — To close the chart.

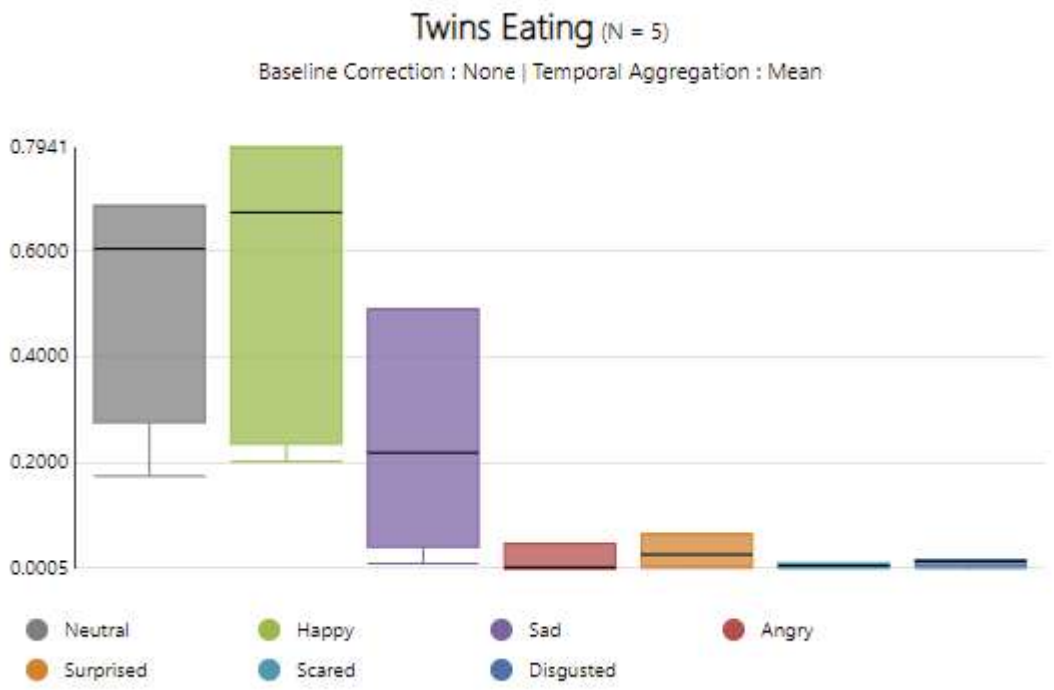
Use the four-arrow cursor to move your chart to another position in the layout.

Pie chart

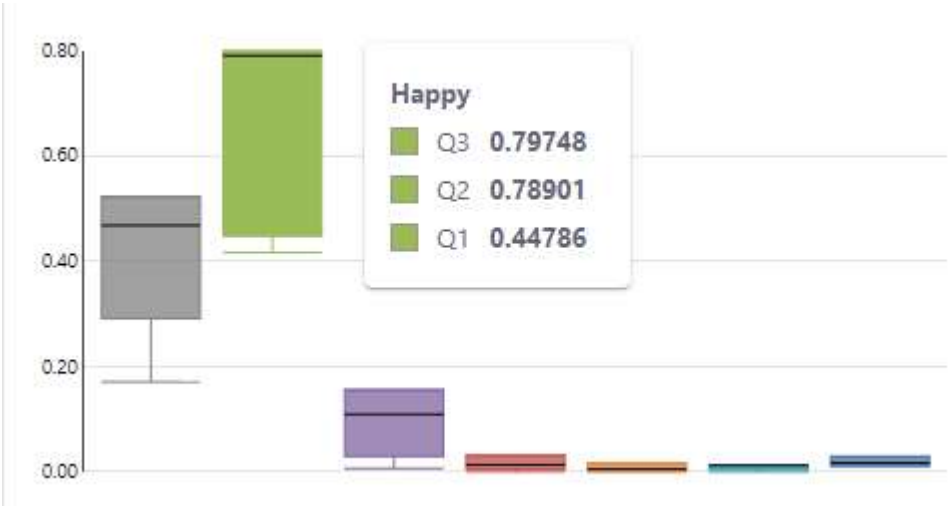


A Pie Chart shows for each parameter that you selected the proportion of the analysis time it was the dominant one (for facial expressions) or it was active (for Action Units) aggregated over the participants that you selected. In the above Pie Chart 'Happy' was the dominant facial expression for 41% of the analyzed time and 'Neutral' for 37% of the time. When you move over the chart with your mouse pointer you can also see the percentages for the other facial expressions. For instance, 'Sad' was the dominant facial expression for 0.158 (= 15.8%) of the analyzed time.

Box Plot



A Box Plot shows the minimum value (the lowest data point of the error bar), Q1 (first quartile) and Q3 (third quartile) (the borders of the box) and the median (Q2) for each parameter that you selected. When you move over the plot with your mouse pointer, you can see the values for Q1, Q2 and Q3.



Notes

- A quartile is the percentage of participants that shows this or a lower expression intensity. So if the first quartile (Q1, or 25th quartile) of the facial expression Happy is 0.3, this means that 25 percent of the participants has an intensity of Happy of maximally 0.3.
- The individual participants represent the samples. Hence, if you have five participants with three analyses each, the box plots are based on five samples.
- The quartiles are calculated with N + 1 Basis interpolation, which is also used in the statistical program SPSS. If the sample size is lower than 3, the first quartile (25th quartile) is the same as the minimum and the third quartile (75th quartile) is the same as the maximum value, which is also the same as in SPSS.

Bar chart

A Bar Chart shows the values of the parameters you selected, aggregated over your selected participants and aggregated over time. When you move over the chart with your mouse pointer you can see the value for each parameter.

Circumplex Model

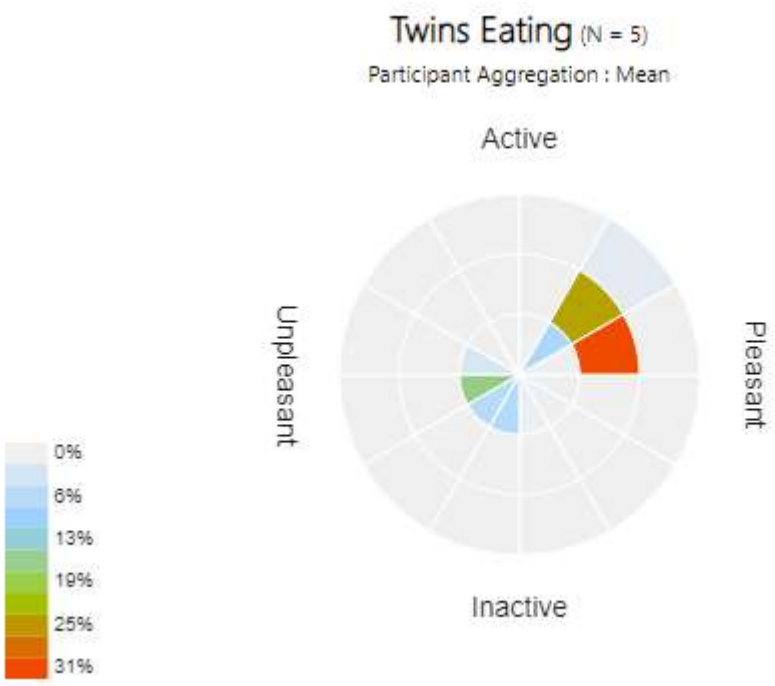
A Circumplex Model describes emotions in the form of a heatmap in a two-dimensional circular space, containing arousal on the vertical axis and valence on the horizontal axis. The center of the circle represents a neutral valence and a medium level of arousal. The Circumplex Model is based on the data of the participants that you selected.

The Circumplex Model is only available if you scored stimuli or event markers in your project.

The chart below shows the Circumplex Model for the five test participants in the 'FaceReader sample project - Two stimuli'. The data that are taken into account are those of the time period when the test participants were watching the 'Twins eating' stimulus. You can visualize another Circumplex Model, select the 'Frying insects' stimulus and compare the two plots.

The color of the heatmap is based on the percentage of time the affect that was most present occurred. This percentage of time (37% in the plot below) is set as the maximum and is colored red.

The Circumplex Model in FaceReader is based on the model described by Russel (1980).

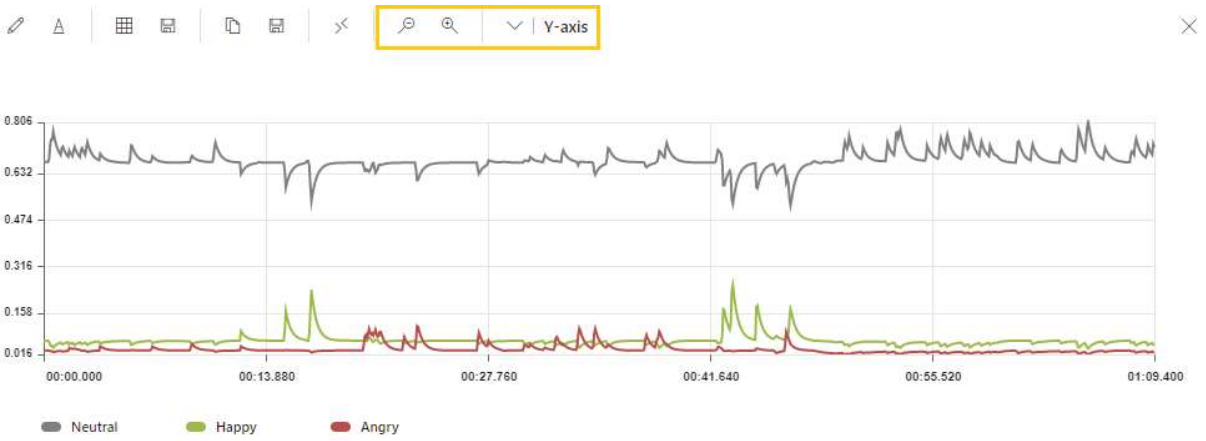


Line Chart

A Line chart shows the values of your parameters over time, aggregated over the test participants you selected. The Line Chart below shows the custom expressions of the five test participants in the 'FaceReader sample project - Two stimuli'. The data that are taken into account are those of the time period when the test participants were watching the 'Twins eating' stimulus.

You can visualize a Line Chart together with the stimulus/event marker and one or more participant videos. If the stimulus is a video, you can play it back and a hairline in the Line Chart shows the position in the video.

Please note that a warning will appear if you select analyses of different length. This may happen in a project in which no stimuli were presented to the test participants. The Line chart will show data up to the duration of the shortest analysis.



A Line Chart has a number of two icons in the toolbar:

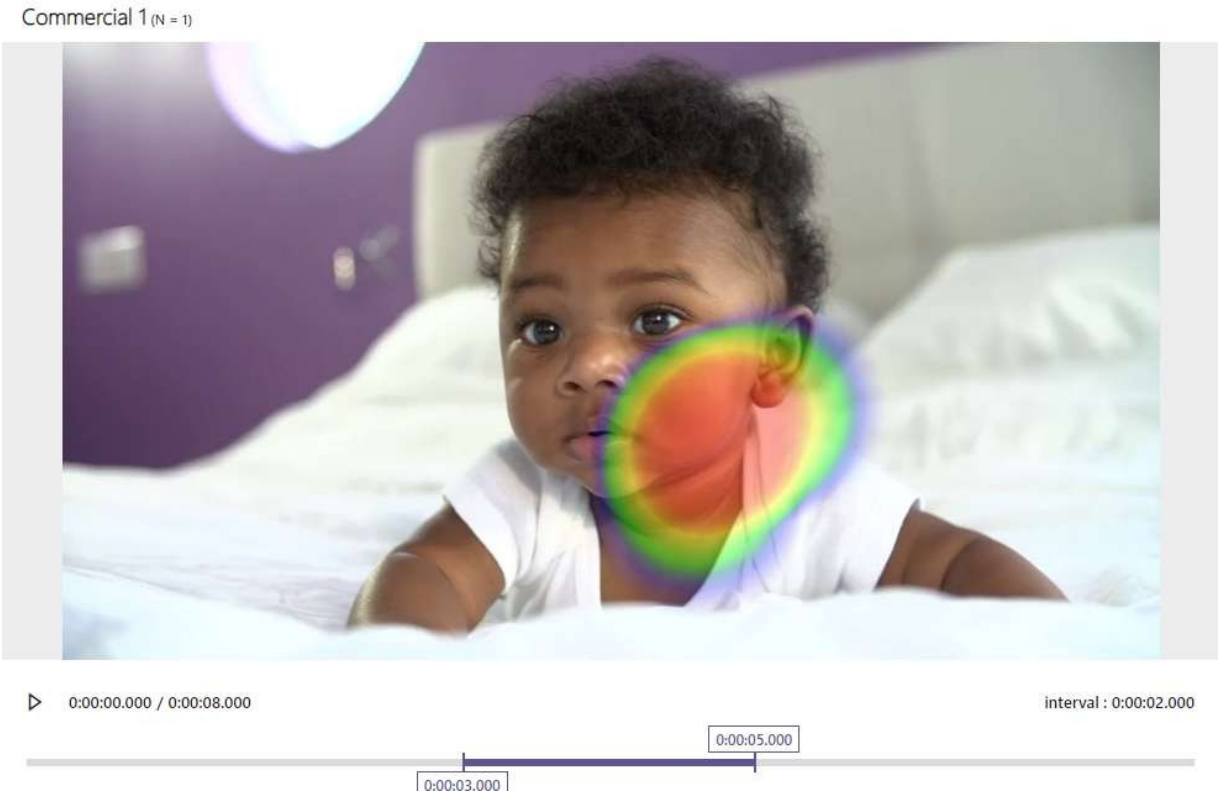
- **Zoom out** and **Zoom in** — To zoom out and in on the timeline.

And the Y axis icon to access:

- **Auto range** — To display a scale with a minimum and maximum value that fit your data.
- **Full range** — To display a scale with a minimum of -1.00 and a maximum of +1.00. Use this scale to compare multiple charts, for instance, one chart for your female subjects and one for your male subjects.
- **MIN** and **MAX** — To set the minimum and maximum Y-value.

Heatmap

A heatmap shows the hotspots of the test participant's gaze overlay on a stimulus, indicating where the test participant looked the longest. On the time axis you can define an interval for which you want to see the heatmap.



Calculate statistics and summarize them in a table

Aim

To calculate statistics on the analyzed facial expressions and other parameters of all participants, participant groups or single participants.

Prerequisites

- Your FaceReader license includes the Project Analysis Module.
- Your project includes one or more video or camera analyses.

Procedure

1. Open the Project Analysis section and click **Table**.
2. Select the data you want to include in your analysis. See Data selection for more information. Click **OK** when you are ready. FaceReader will show a table with the results.

Twins Eating (N = 5)

Baseline Correction : None | Temporal Aggregation : Mean | Participant Aggregation : Mean

Participant	Neutral	Happy	Sad	Angry	Surprised	Scared	Disgusted
	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Mean	0.3861	0.4221	0.1584	0.0105	0.0205	0.0046	0.0085

A table has the same information/icon in the toolbar as a chart. See Visualize your data in a chart for more information.

Visualize your stimulus, participant videos and line chart

Aim

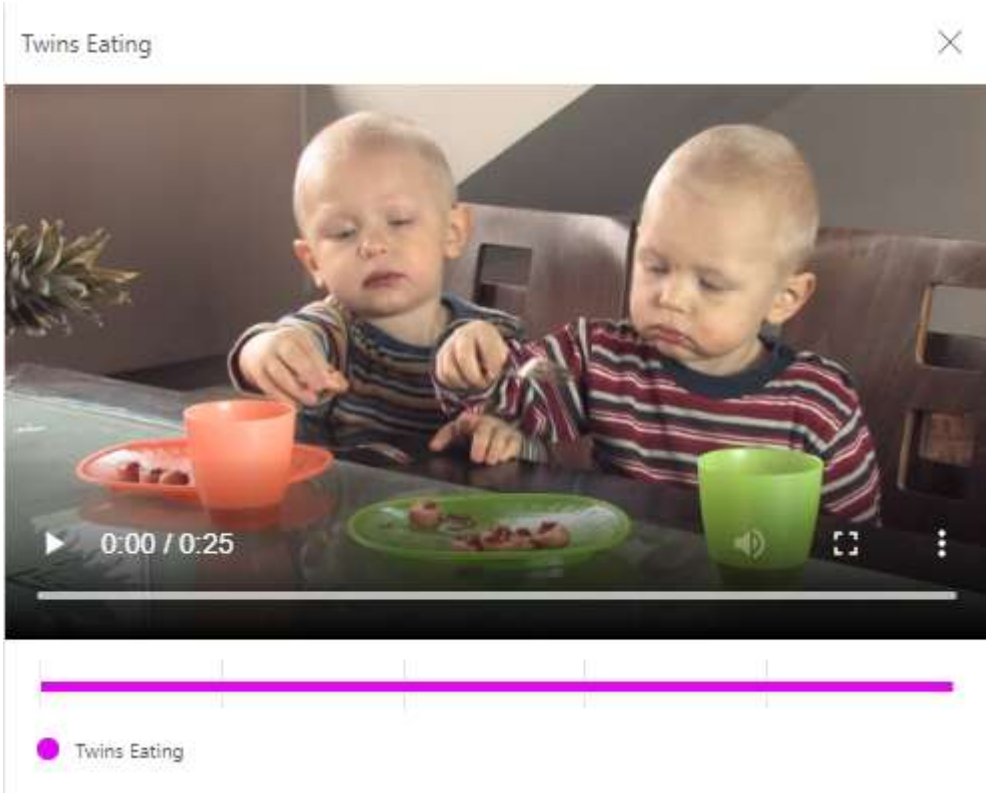
To display the stimulus video to play it back together with the recorded video of the test participant's face and a Line Chart with the data.

Prerequisites

- Your license includes the Project Analysis Module.
- Your project contains video or camera analyses and one or more stimuli.

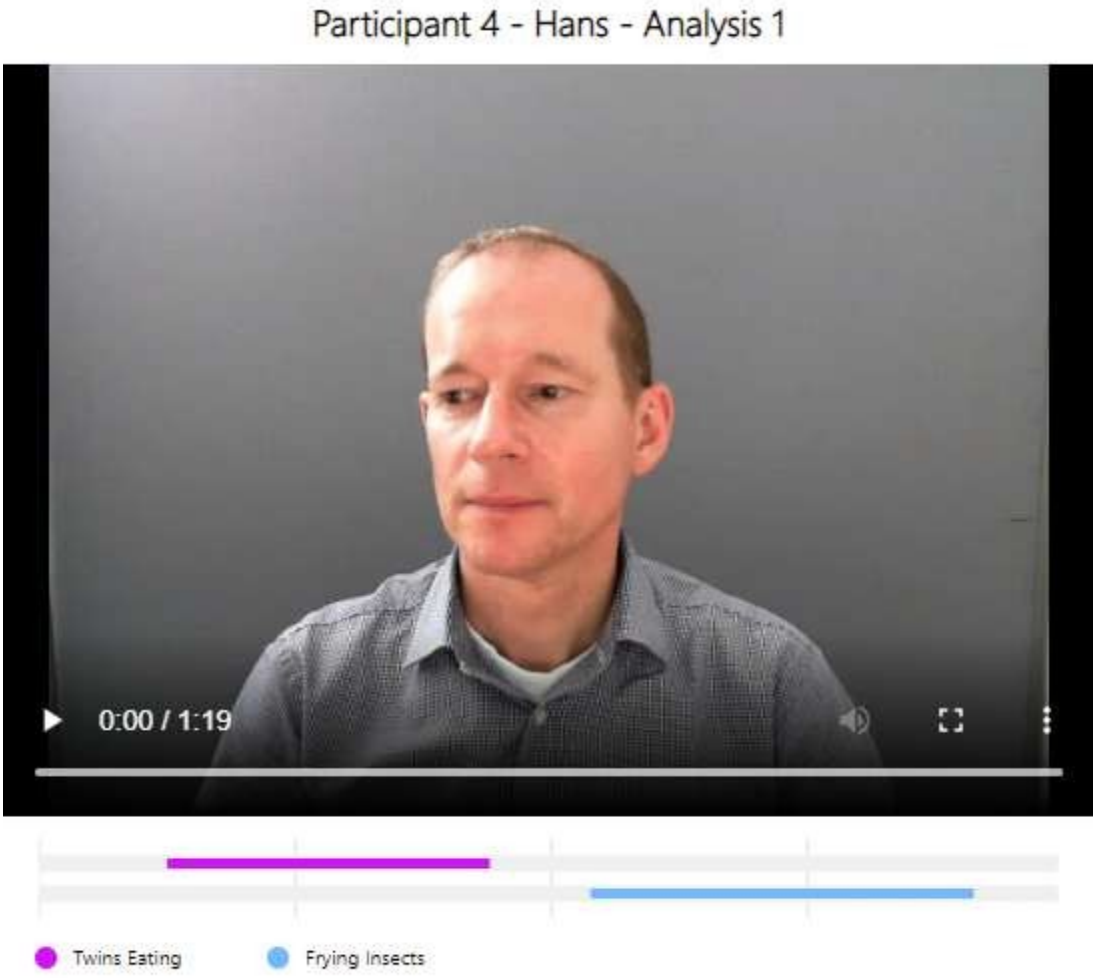
Procedure

1. Open the Project Analysis section and click **Stimulus**.
2. Select the stimulus that you want to display and click **OK**. The stimulus video will open.



Not all videos supported by FaceReader can directly be shown in the Project Analysis Module. They might require conversion first:

3. Click **Participant** and select the appropriate participant and analysis to display the corresponding video. Then click **OK**. The participant video will open next to the stimulus video.



The participant video window contains three icons, one to switch the sound on and off, one to display the video full screen and one to move the video from the video window and display it as a picture-in-picture.

The participant video displayed above is from the 'FaceReader sample project - Two stimuli'. In this project the test participants watched two stimulus videos, 'Twins Eating' and 'Frying insects'.

You can display a Line Chart together with the stimulus video and the participant video and play back the videos in sync. A hairline in the Line Chart shows the position in the videos.

Compare data

Aim

To compare two or more data sets in a chart or table and carry out a t-test to test for significant differences.

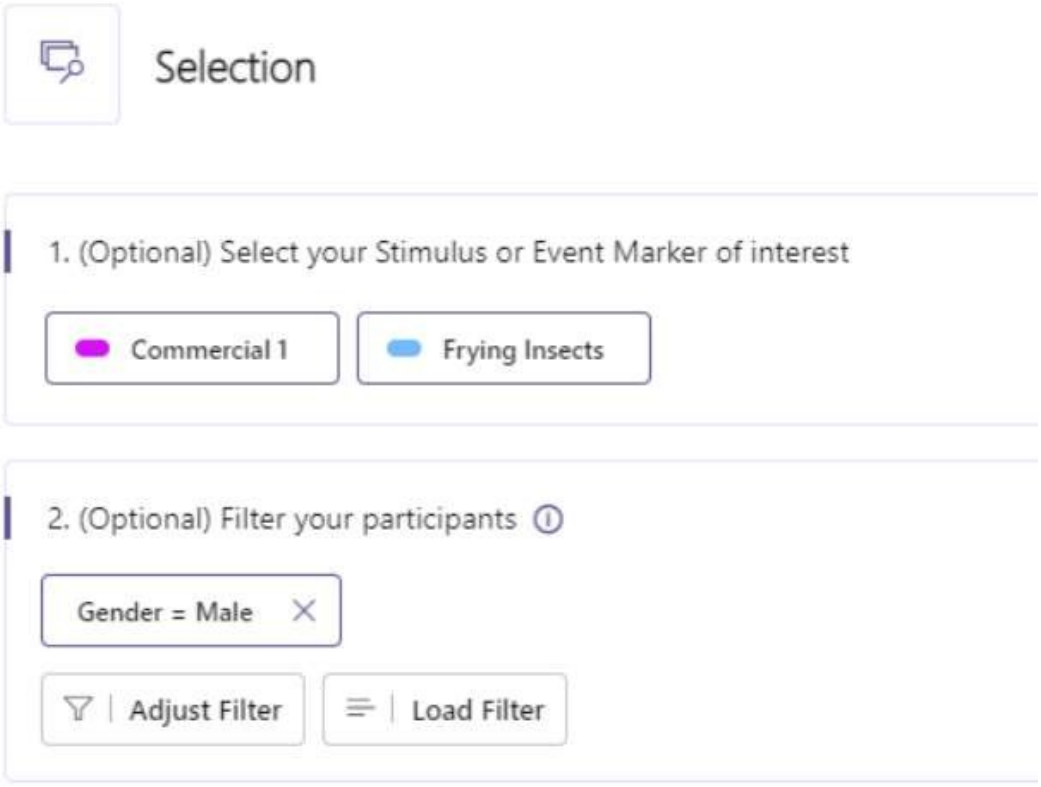
Prerequisites

- Your license includes the Project Analysis Module.
- Your project contains video or camera analyses.

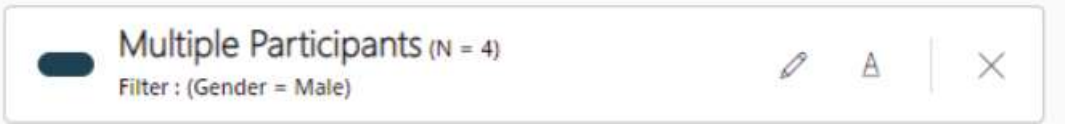
Procedure

Select data

1. Open the Project Analysis section and click **Compare**.
2. Click **Add Data Selection**.
3. If your project contains stimuli or events markers — Select a stimulus/event marker to compare data sets for this stimulus/event marker only.
4. Click **Adjust Filter** to choose what participants you want to include in the selection. You can base your selection on participant name, analysis name, participant/analysis combination, gender or age. Select, for instance, all the male subjects in your project. Click **Update** to add the filter to your selection. See Select participants for more information.



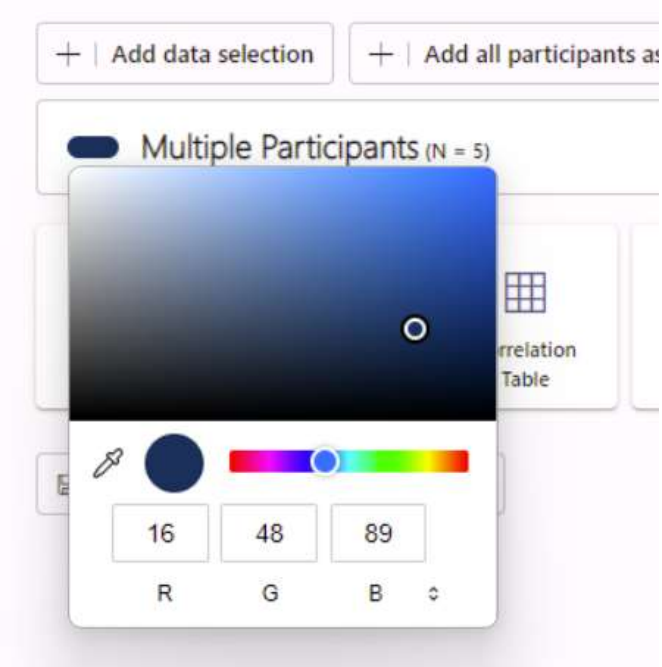
5. Click **OK**. The Participant Filter is added to the Selection window. You can see how many test participants have been selected.



6. Click **Add Data Selection** to select a second data selection.
7. Click **Adjust Filter** and select the second set of data. Select, for instance, all female subjects in your project. Click **Update** and then **OK**.
8. Repeat steps 6 and 7 to add more data sets to the comparison in case you have more than two participant groups.

9. Select whether you want to compare the two data sets in a **Bar Chart**, **Table**, **Correlation Table** or **Line Chart** or visualize **Insights**.
10. Select the parameters you want to visualize/tabulate. Then click **OK**.
11. Select the advanced options of your choice. Then click **OK**. See Advanced options for data analysis for more information.

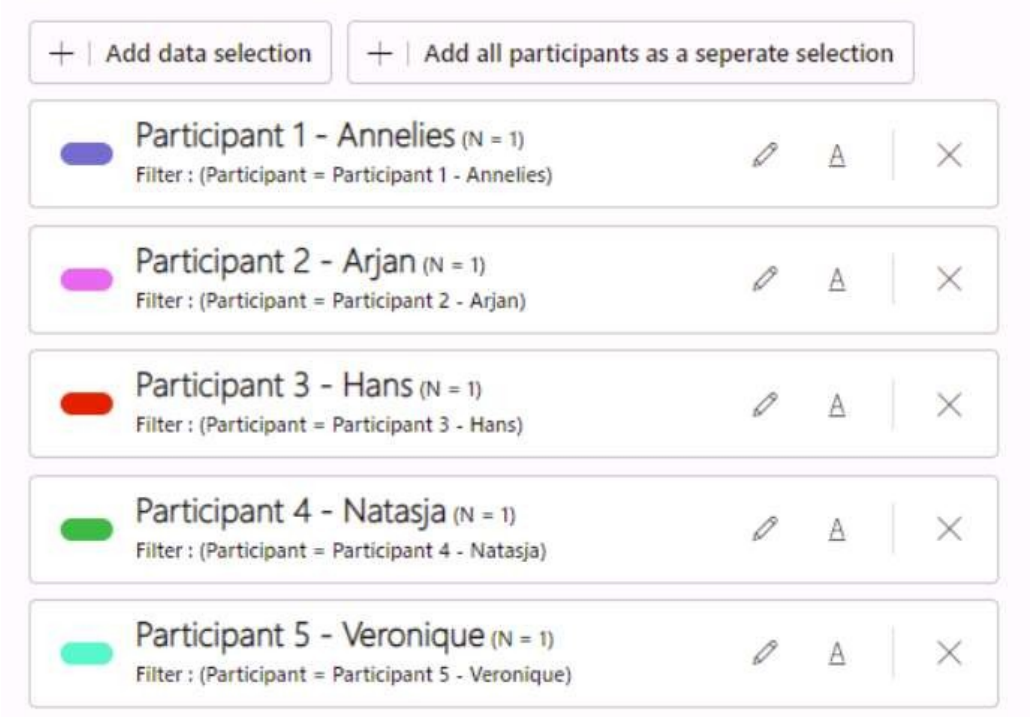
Tip: You can change the color of the selected data. Click on the colored bar in front of the data set and pick the color you like.



Add all participants as a separate selection

Select this option to compare the data of all the participants in your project.

1. Open the Project Analysis section and click **Compare**.
2. Click **Add all participants as a separate selection**. A list with all the participants in your project will appear as a separate data selection.



3. Select whether you want to compare the data sets in a **Bar Chart**, **Table**, **Correlation Table** or **Line Chart** or visualize **Insights**.
4. Select the parameters you want to visualize/tabulate. Then click **OK**.
5. Select the advanced options of your choice. Then click **OK**. See Advanced options for data analysis for more information.

Adjust your selection

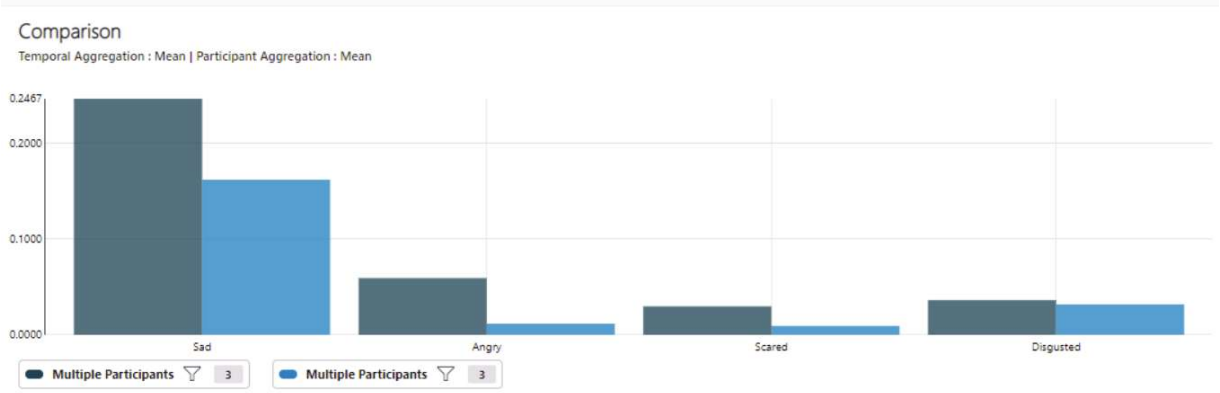
- **Edit selection** — Click the pencil icon to change your selection.
- **Adjust caption** — To give the selected data a more logical or shorter name.

- **Remove data selection**

Compare data in a bar chart

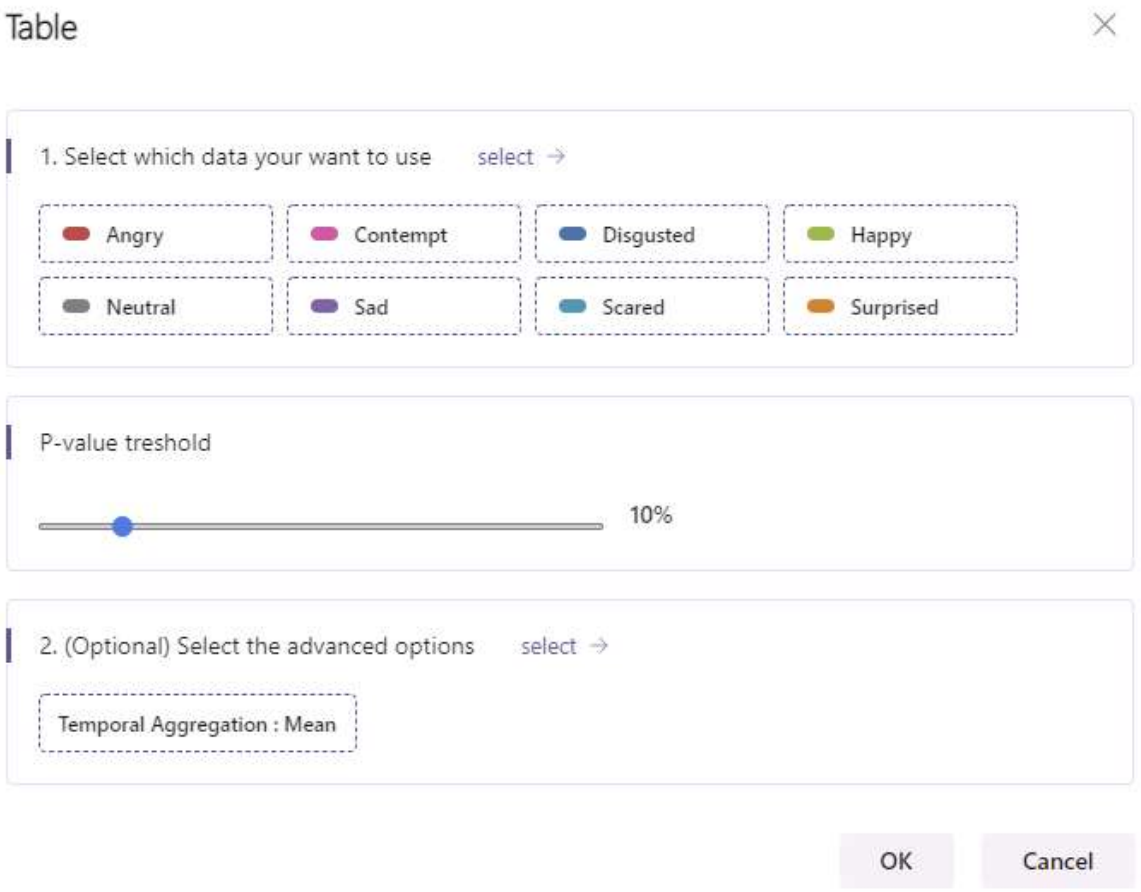
1. Select two or more data sets following the steps in Compare data.
2. Click **Bar Chart** and select the parameters you want to visualize in your chart.
3. Select what **Temporal Aggregation** method and **Participant Aggregation** method you want to use and click **OK**. Your Bar Chart appears.
4. Hover with your mouse over a filter icon to see what data have been selected.

The Bar Chart in the example below shows the mean intensities of the four negative facial expressions (*Sad*, *Angry*, *Scared* and *Disgusted*) for two groups of test participants (*Male* and *Female* subjects).



Compare data in a table and carry out a t-test

1. Select two or more data sets following the steps in Compare data.
2. Click **Table** and select the parameters you want to include in your test.
3. Set a **P-value threshold** to carry out a two-tailed t-test. The default value for the threshold is 10%.
4. Select what **Temporal Aggregation** method you want to use and click **OK**.



Your table appears with the mean values and standard deviation for the parameters that you have selected in step 2. Each row in the table shows the results for one of the data sets that you have selected in step 1.

5. Click one of the rows to test for significant differences. Colored cells indicate significant differences. When you move with your mouse pointer over a colored cells you can see the exact P-value.

The table in the example below shows the mean intensities and standard deviations of four facial expressions of two groups of test participants, *Male* (upper row) and *Female* (lower row). The colored cell indicates that the two groups show a significant difference in the intensity of *Happy*.

Comparison

Temporal Aggregation : Mean

		Happy		Sad		Angry	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Multiple Participants	5	0.0895	0.0215	0.3339	0.2373	0.0526	0.0493
Multiple Participants	8	0.3724	0.1794	0.1604	0.1903	0.0124	0.0102

Note on standard deviations

Each participant is a replicate. So if you have one participant with three analyses, the standard deviations will be zero, because the sample size is one. If you have three participants with two analyses each, the standard deviations will be based on three samples.

IMPORTANT Please note that the appropriate statistical test depends on your data. Your data may not be normally distributed, which means that you need a non parametric test instead of a *t*-test. Also corrections like Bonferroni on the P-values may be needed for multiple comparisons. Consult your statistician for advice.

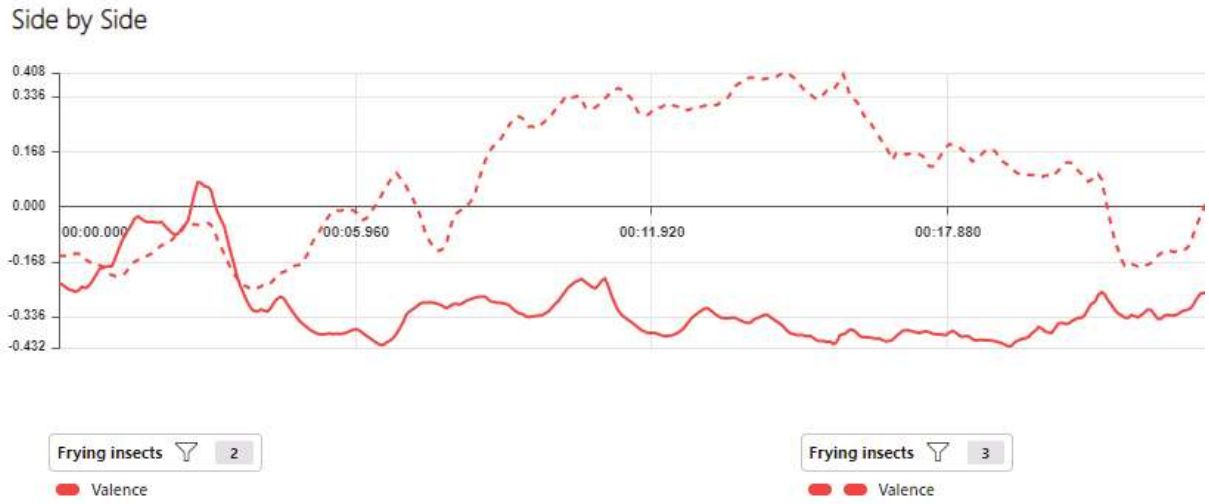
Compare data in a line chart

1. Select two or more data sets following the steps in Compare data.
2. Click **Line Chart** and select the parameters you want to include in your test.
3. Select what **Comparison Type** you prefer: either **Side By Side** or **Synchrony**.
4. Select what **Baseline correction** method and what **Temporal Aggregation** method you want to use and click **OK**.

Side by side

If you choose the option **Side By Side** the absolute intensities of the facial expressions are plotted over time. Hover with your mouse over a filter icon to see what data have been selected. The example in the screenshot below comes from the FaceReader 10 - Sample project - Two stimuli. The data of the participants older than 40 (n=2) are shown as continuous lines and the data of the participants younger than 40 (n=3) as dotted lines. The graph shows that a few seconds after

the start of the 'Frying insects' stimulus the younger participants had a higher valence than the older participants and it remained higher until the end of the stimulus. The reason was that the female participants found the stimulus so disgusting that they started to laugh.



Synchrony

If you choose **Synchrony** a correlation chart will be shown with a sliding window of 10 seconds. The screenshot below again shows the data of the FaceReader 10 - Sample Project - Two stimuli during the 'Frying insects' stimulus. The graph shows the correlation between the valence of the older participants (n=2) and the valence of the younger participants (n=3). The correlation varies quite a lot with a peak at the start of the stimulus and a smaller peak around 15 seconds after the start of the stimulus.

How is the correlation calculated?

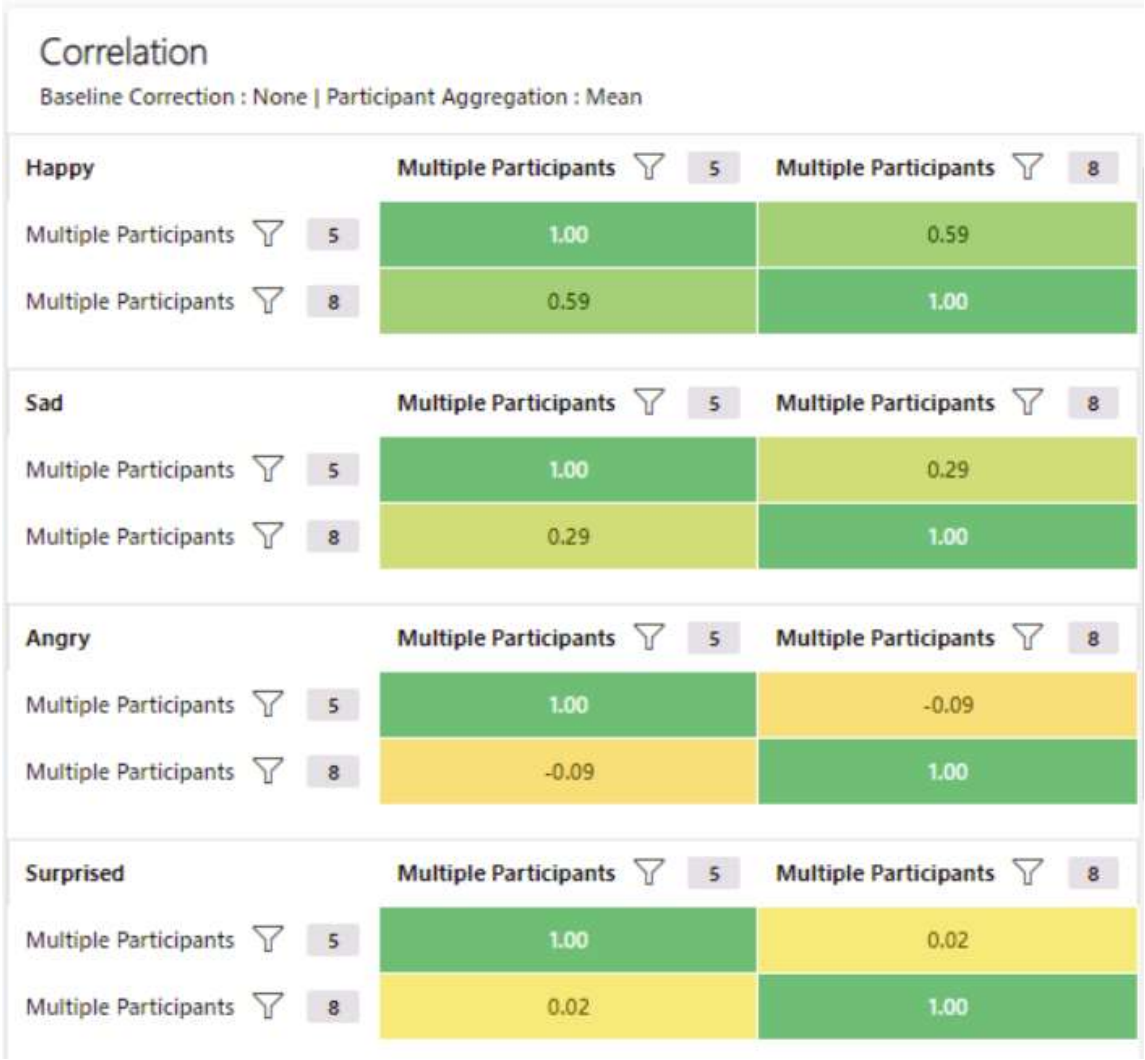
FaceReader calculates a Pearson correlation coefficient. Its value ranges from -1 to 1. *1* indicates a perfect positive linear relationship, *-1* indicates a perfect negative linear relationship. *0* indicates no linear relationship at all.

Compare data in a correlation table

1. Select two or more data sets following the steps in Compare data.
2. Click **Correlation Table** and select the parameters you want to include in your test.
3. Select what **Baseline correction** method and what **Temporal Aggregation** method you want to use and click **OK**.

The Correlation Table appears with for each parameter (facial expression, Valence, Arousal, etc.) the correlation between the two data sets. When you hover with your mouse over the filter icons you can see what data have been selected.

See How is the correlation calculated? for more details.

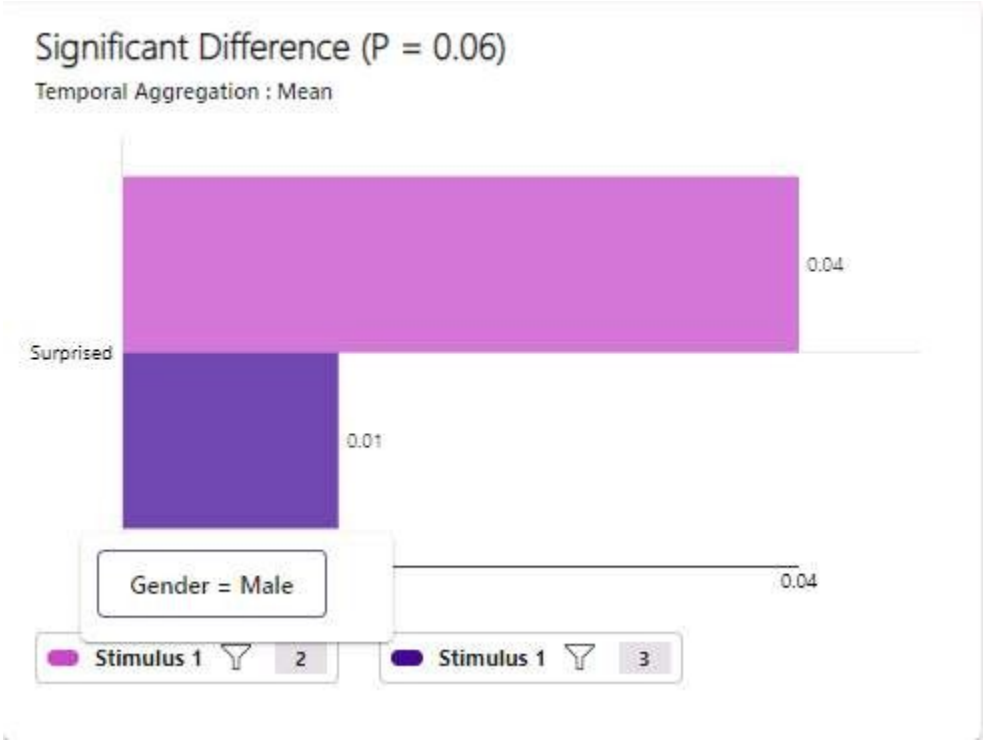


Compare data and visualize insights

1. Select two or more data sets following the steps in Compare data.
2. Select **Insights** and select the parameters you want to visualize in your chart.
3. Set a **P-value threshold** to carry out a two-tailed t-test. The default value for the threshold is 10%.
4. Select what **Temporal Aggregation** method you want to use and click **OK**.

   Bar charts will appear for all the parameters that show significant differences.
5. Move with your mouse pointer over a filter icon to see what data have been selected.

The bar chart in the example below shows the insight when comparing *Male* and *Female* test participants during *Stimulus 1*. A P-value threshold of 10% was used. FaceReader shows bar charts for the parameters that are significantly different, in this case *Surprised*. The data selection also included *Happy* but the two groups did not show any significant differences for this facial expression.



Settings

Main topics

- Settings in detail
- General settings
- Default Analysis Settings
- Analysis options
- Data Export
- Visualization
- Advanced options

Settings in detail

These topics list the settings that you can make in FaceReader. Each topic refers to one tab in the **Settings** window.

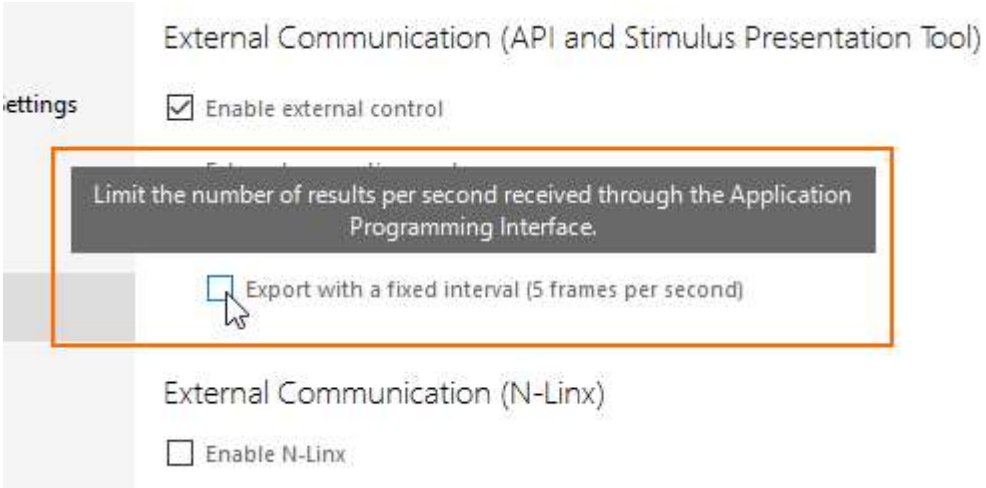
See also Choose settings

To access settings for all future analyses

Choose **File** > **Settings**.

Choose the option you require. These settings will be used for all new analyses, including the one currently open if that has not been analyzed yet.

For many options, additional information is available as tool tips, as shown in the figure below. The settings you specify this way apply to all future analyses.



To reset to Default

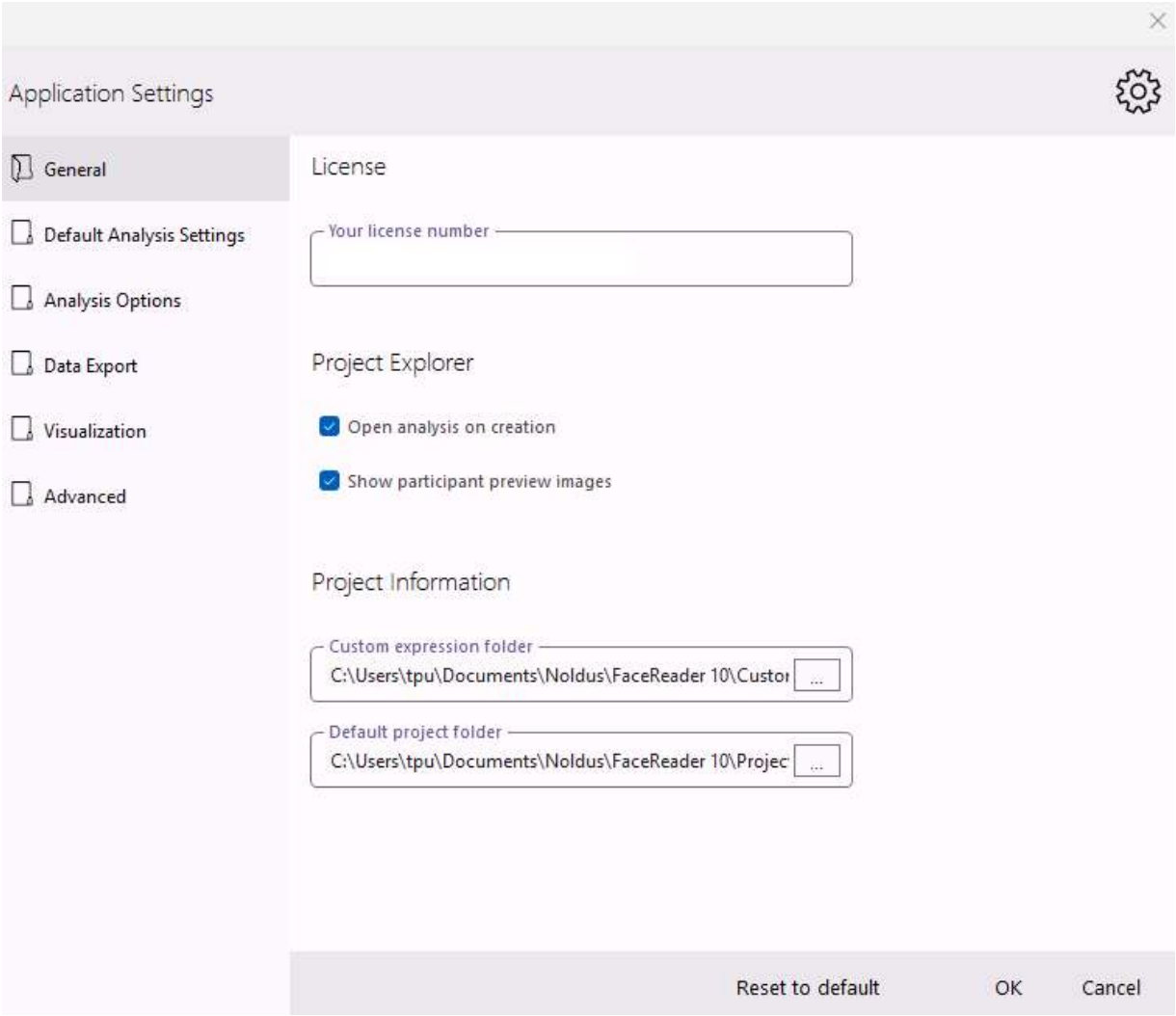
Click the **Reset to Default** button to undo the changes you made in the settings and go back to the default settings.

Notes

- Clicking **Reset to Default** resets all tabs to the default settings, not only the tab that is currently open.
- Clicking **Reset to Default** will make **General** the default face model. If you are in the middle of a project in which you used another face model, make sure that you re-select the face model you used. This way you do not mix data obtained with different face models.

General settings

In the General settings you can view your license info and select the default location where FaceReader saves its projects.



License

Your license number

Shows the license number of the hardware key currently plugged in or the license number connected to your software activation key. This license determines the software modules that you can use.

See also:

- Modules in Introduction

- FaceReader trial version in Installation

Project Explorer

Open analysis on creation

The analysis immediately opens once it is created. Default: selected.

Show participant preview image

If enabled you will see a preview image of each participant by hovering over the video icon in the Participant Explorer. Default: selected.

Project Information

Custom expression folder

The default folder where newly-defined and imported custom expressions are saved. Click the button next to it to select another location.

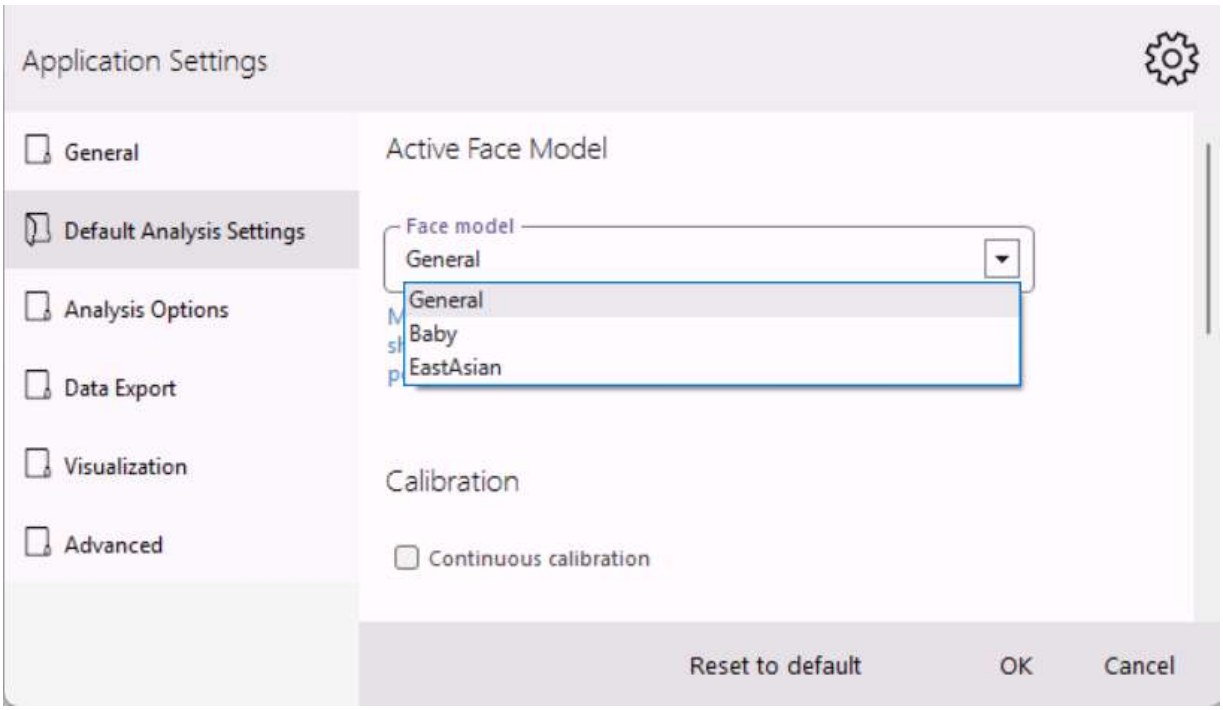
Default: C:\Users\<your username>\Documents\Noldus\FaceReader 10 ~~9~~\Custom Expressions.

Default project folder

The default location where the projects are stored. Click the button next to it to select another location.

Default: C:\Users\<your username>\Documents\Noldus\FaceReader 10 ~~9~~\Projects.

Default Analysis Settings



Active Face Model

Face model

Choose the model that will be used by FaceReader for finding, modeling and classifying faces. Note that for a specific analysis you can use another model. If you have Baby FaceReader there is only one face model available ('Baby').

See Settings for the current analysis in Analyze facial expressions

You can choose between the following models:

- **General** (default) — This model has been trained on a very diverse selection of images. The model works well under most circumstances for most people.
- **Baby** — Select this model if you work with babies or infants between the age of 6 months and 2 years. If you have a regular FaceReader license, the baby face model is not available.
- **EastAsian** — Select this model to analyze East Asian faces, for instance, Chinese or Japanese faces.

Calibration

Continuous calibration

With this option selected, FaceReader continuously calibrates during an analysis.

See Continuous calibration in Analyze facial expressions

Classification

Smoothen classifications

With this option selected (default), classification values are transformed to obtain a smooth output signal. FaceReader smoothens the classification values taking the duration between frames into account. When there is a large time gap between frames, FaceReader will consider the facial expressions detected in those frames as less correlated then when there is a small time gap and thus adapts the strength of the smoothing.

When this option is not selected, FaceReader gives the raw output data.

If you are analyzing a set of images, this option has no effect.

Rotation

Image rotation

If you have images that are rotated, select one of the options from the drop-down list to make sure the faces are upright.

- None (default).
- 90° CW (clockwise).
- 180° CW.
- 270° CW.

Video

Sample rate

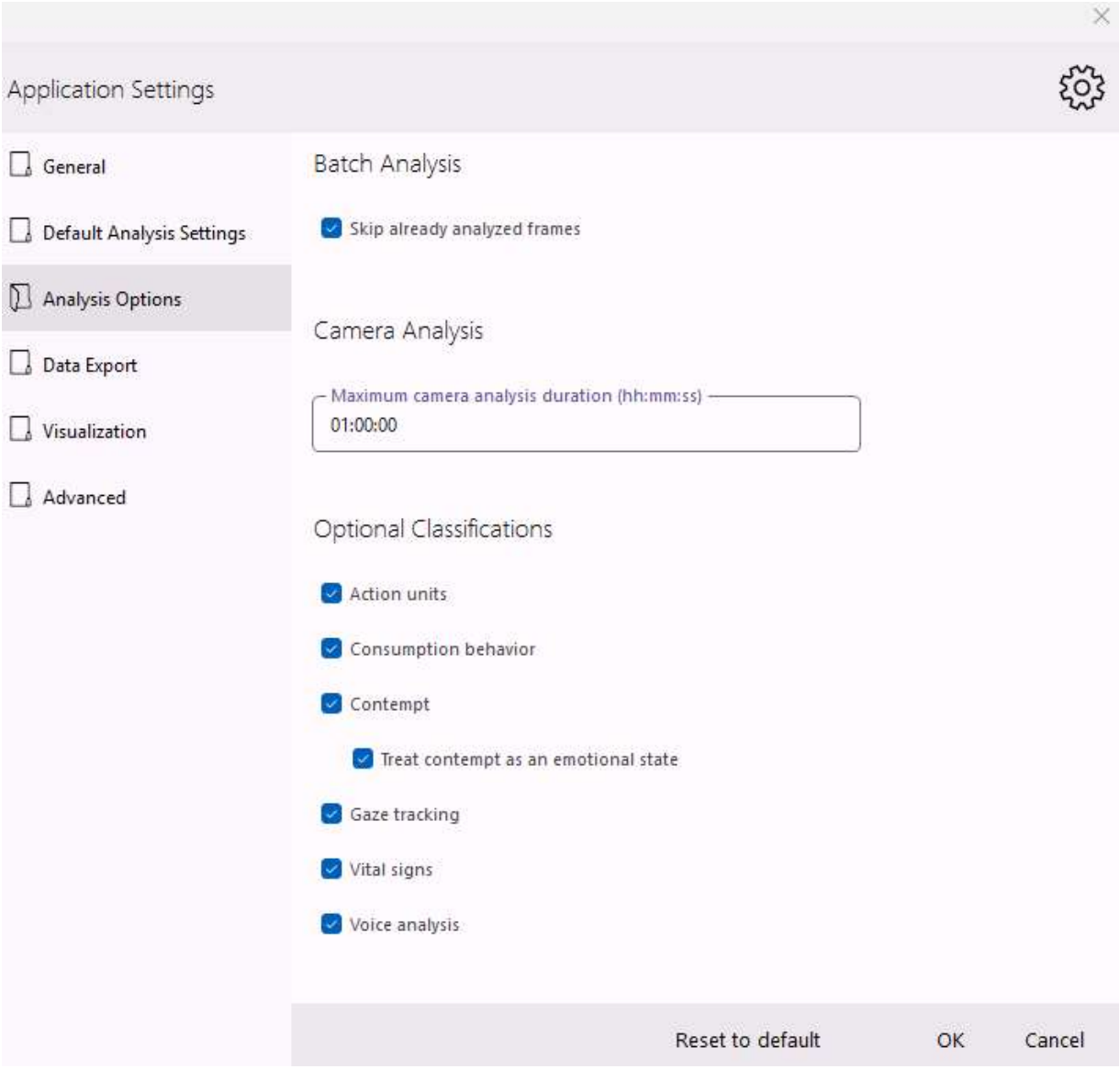
This option applies when you perform video analysis.

By default, **Every frame** is selected. This means that all video frames are analyzed. To speed up the analysis, change the sample rate to analyze **Every 2nd frame** or **Every 3rd frame**.

Under normal circumstances, analyzing 10 -15 frames per second is sufficient for an accurate analysis. This means that if your video contains 30 frames per second or more, you can safely decrease the sample rate of FaceReader without loss of accuracy and make the analysis two to three times faster.

For camera analysis — Video is sampled at 15 frames per second, also when your camera is set to a higher frame rate, and independent of what you choose under **Sample rate**.

Analysis options



Batch analysis

Skip already analyzed frames

When you have selected this option, video fragments that were already analyzed will be skipped in batch analysis.

IMPORTANT Make sure you deselect this option when you carry out a camera analysis while simultaneously recording video and want to re-analyze these videos

offline. Otherwise FaceReader will not analyze the frames that were already analyzed in the camera analysis.

Camera Analysis

Maximum Camera Analysis Duration

Enter the maximum duration for analyses carried out with a live camera image.

- Default: 1 hour.
- Maximum: 2 hours.

Optional classifications

Action units

With this option selected, FaceReader classifies Action Units. This option is only available when you have the Action Unit Module.

See The Action Unit Module

Consumption behavior

With this option selected, FaceReader analyzes whether the test participant is taking a bite or a sip ('Intake event') or is Chewing.

See The Consumption Behavior Module

Contempt

Select this option to classify Contempt, which is an expression in which one corner of the lips is tightened and slightly raised.

Treat Contempt as an Emotional State

Select this option to add Contempt to the expression states in the State log and Timeline. This makes contempt mutually exclusive with the other expressions.

Gaze tracking

With this option selected, FaceReader classifies whether the test participant looks left, forward or right, while taking the head orientation into account. The output is one of nine gaze directions: Left, Left-Up. Left-Down, Right, Right-Up, Right-Down, Up, Down and Forward. In addition, the gaze angle can be logged and visualized (Horizontal gaze angle and Vertical gaze angle).

See Show Global Gaze Direction in FaceReader's output

Vital signs

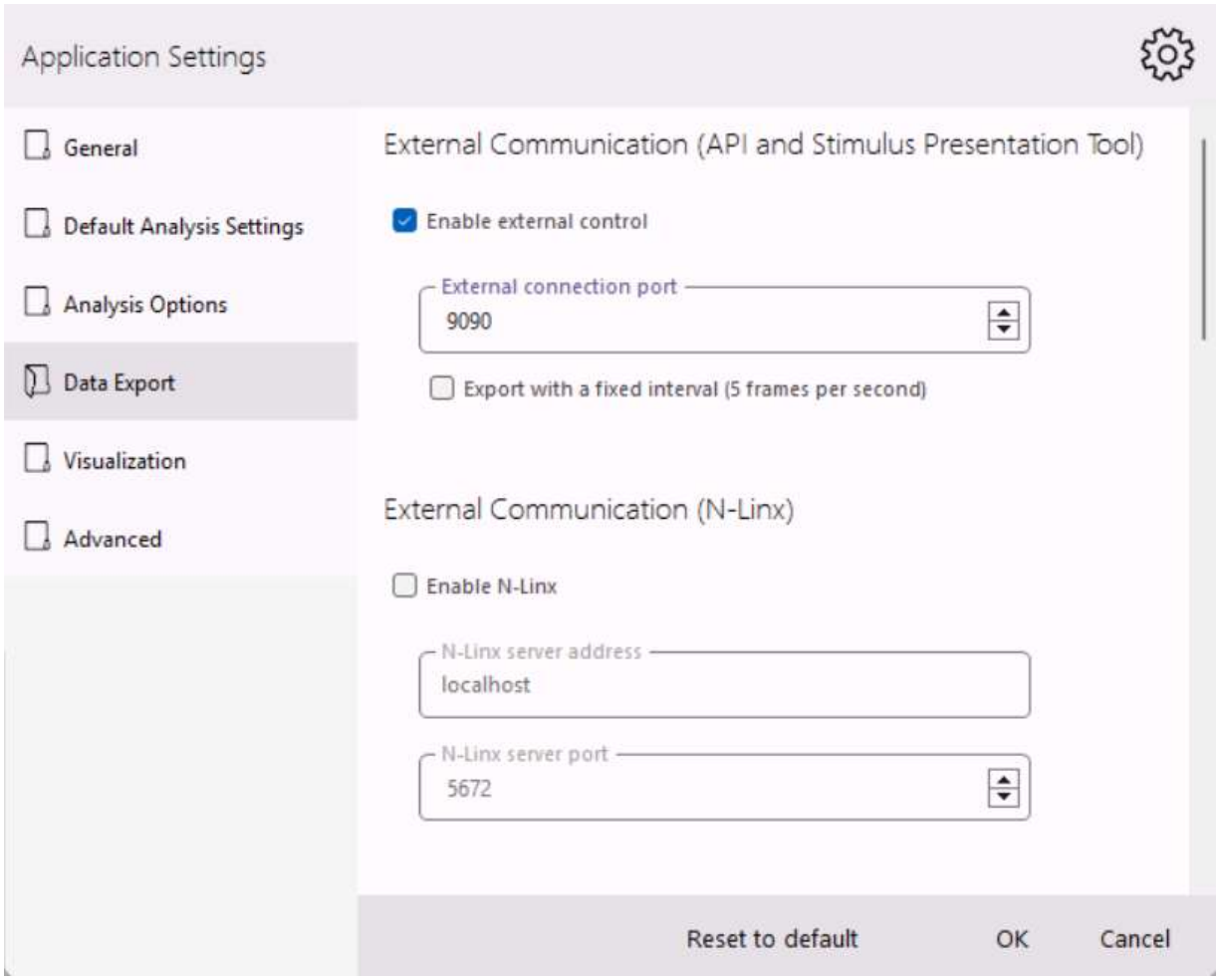
With this option selected, FaceReader estimates the participant's current heart rate and heart rate variability by means of Photoplethysmography and respiratory (breathing) rate. This option is only available if your license includes the Vital Signs Module.

See The Vital Signs Module

Voice analysis

Select this option to analyze vocal characteristics and determine whether there is happiness, sadness or anger audible in the voice or whether it is neutral.

Data Export



External communication (API and Stimulus Presentation Tool)

External communication is needed when you use the Stimulus Presentation Tool. Also, with FaceReader, an Application Programming Interface (API) is included. This API allows you to analyze images or videos with FaceReader on one computer and send the logged data to an application on another computer. Our support department (see Help desk for contact information) can supply you with a detailed description of how to use the API functionality. They can also give you an example of an application that can receive FaceReader data.

Enable external control (API)

Select this option when you want to use the Stimulus Presentation Tool and when you want to use the API functionality.

Default: Not selected.

External connection port

Specify the port through which the external application or the Stimulus Presentation Tool can connect to FaceReader. External applications can also receive the logged data through this port.

Default: 9090.

Please note that if you use The Observer XT 13 or higher versions with FaceReader 7 or higher, you do not use this setting, but connect with the Noldus network communication protocol N-Linx instead.

See External Communication (N-Linx)

Export with a fixed interval (5 frames per second)

If this option is selected, an update to the Detailed log will be made every 200 milliseconds. If your computer cannot process the incoming images fast enough, frames will be skipped and a record with MISSING will be added to the Detailed log.

Default: Not selected.

External Communication (N-Linx)

N-Linx is a network communication protocol that enables data transfer between Noldus software. Use N-Linx if you have The Observer XT 13 or higher versions, and want FaceReader to start and stop analyzing together with an observation in The Observer XT. The FaceReader data are imported automatically into the observation and synchronized with the manual annotations.

If you do not use N-Linx, or if you have an older version of The Observer XT, you must export the FaceReader data and import them into The Observer XT manually. Data import with N-Linx is easier and faster and ensures synchronization. For this functionality to work, your license for The Observer XT must include the External Data Module.

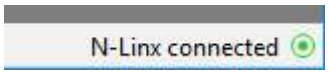
Enable N-Linx

Select this option to start and stop FaceReader analysis together with an observation in The Observer XT and to import the data automatically in the observation.

N-Linx server address

Enter the IP address, or full computer name, of the computer with N-Linx Server.

If connection with N-linx Server is established the text **N-Linx connected** appears in the upper right corner of your FaceReader window.



See also the Reference Manual - N-Linx. You can download it from the download section of the Noldus website.

https://my.noldus.com

Export (Detailed log, ODX, N-Linx and API)

By default, the detailed export file contains the classification output values for the six basic emotions, and the neutral state. Contempt is added if you selected it as optional classification in the Analysis options tab. Select one of the options below to add extra information to the log file.

IMPORTANT Please note that if your observations are long, writing a lot of extra information to the log can make your log files very large and can make the analysis slower.

Action units

This option is only available if your FaceReader license includes the Action Unit Module. With this option selected, extra columns with the Action Units are added to the log file. Values are between A (trace) and E (max). This option is only available when you have the Action Unit Module.

See Action Units in the log files in The Action Unit Module

Export action units as continuous values

With this option selected, the Action Unit categories A-E are exported as numerical values between 0 and 1.

See Action Units in the log files in The Action Unit Module

With this option selected, the Action Unit intensities can be imported into The Observer XT as external data.

See Import the detailed logs as external data in FaceReader with The Observer XT

Export the unilateral action unit intensities

If you select this option, the Detailed log file will have three columns for each unilateral Action Unit, one for the intensity of the Action Unit on the right side of the face, one for the left side and one combined which is the maximum of the left and right values.

Consumption behavior

This option is only available if your FaceReader license includes the Consumption Behavior Module. With this option selected, FaceReader adds three columns to the Detailed log file, 'Intake event', 'Chewing' and 'Chew motion' with for each analyzed frame 'Yes' or 'No' to indicate whether the behavior was active or not.

Custom expressions

This option is only available if your FaceReader license includes the Action Unit Module. Selecting this option, adds a column to the Detailed log file for each custom expression showing its intensity for each analyzed frame.

Facial states

With this option selected, 5 extra columns are added to the Detailed log: **Mouth** (open or closed), **Left-Eye** (open or closed), **Right-Eye** (open or closed), **Left-Eyebrow** (raised, neutral or lowered) and **Right-Eyebrow** (raised, neutral or lowered).

See Facial States in FaceReader's output

Gaze data

With this option selected, two extra columns are added to the Detailed log: **Gaze Direction** and **Gaze Type**. The gaze direction can either be Left, Left-Up, Left-Down, Right, Right-Up, Right-Down, Up, Down and Forward. The gaze type is either Fixation, Saccade or Unknown. This option is only available if **Gaze tracking** is selected in the **Analysis Options**.

Gaze angles

With this option selected two extra columns are added to the Detailed log: **Horizontal gaze angle** and **Vertical gaze angle**. The horizontal and vertical gaze angles are 0 degrees when the test participant looks straight ahead.

Head orientation

With this option selected, three extra columns are added to the Detailed log: **Pitch**, **Yaw** and **Roll** (in degrees).

See Reporting Display in FaceReader's output

Head position

With this option selected three extra columns are added to the Detailed log: **Horizontal position**, **Vertical position** and **Depth position** with the head position angles in millimeters relative to the camera.

Vital signs

This option is only available if your FaceReader license includes the Vital Signs Module. With this option selected, eight extra columns (**Heart Rate**, **Heart Rate Variability (RMSSD)**, **Heart Rate Variability (SDNN)**, **Heart Rate Warnings**, **Heart rate confidence**, **Breathing Rate**, **Breathing Rate Warnings** and **Breathing rate confidence**) are added to the Detailed log.

The **Heart Rate Warnings** and **Breathing Rate Warnings** columns may contain the following warnings:

- FIND_FAILED/FIT_FAILED — If no face is found or the face cannot be modeled (e.g. because the quality of the video is poor)
- MISSING — If you work live (using a camera) and your computer cannot process the incoming images fast enough, frames will be skipped
- Framerate, bitrate, resolution ratio too low — If your camera settings deviate from the recommended settings. See The Vital Signs Module for more information about the recommended settings for heart rate, heart rate variability, and breathing rate measurement.

The **Heart rate confidence** values and **Breathing rate confidence** values are values between 0 and 1, indicating the quality of the heart rate/breathing rate measurements.

Valence and Arousal

If you select this option the valence and arousal are added to the log file.

See Valence and Arousal Line Chart and in FaceReader's output.

Expressions from voice

This option is only available if your FaceReader license includes the Voice Analysis Module. With this option selected seven extra columns are added to the Detailed log: **Neutral from Voice**, **Happy from Voice**, **Sad from Voice**, **Angry from Voice**, **Valence from Voice**, **Arousal from Voice**, **Loudness** and **Speech rate**. **Voice Analysis** in the **Analysis Options** must be enabled.

Export (Detailed log and API)

Consumption behavior statistics

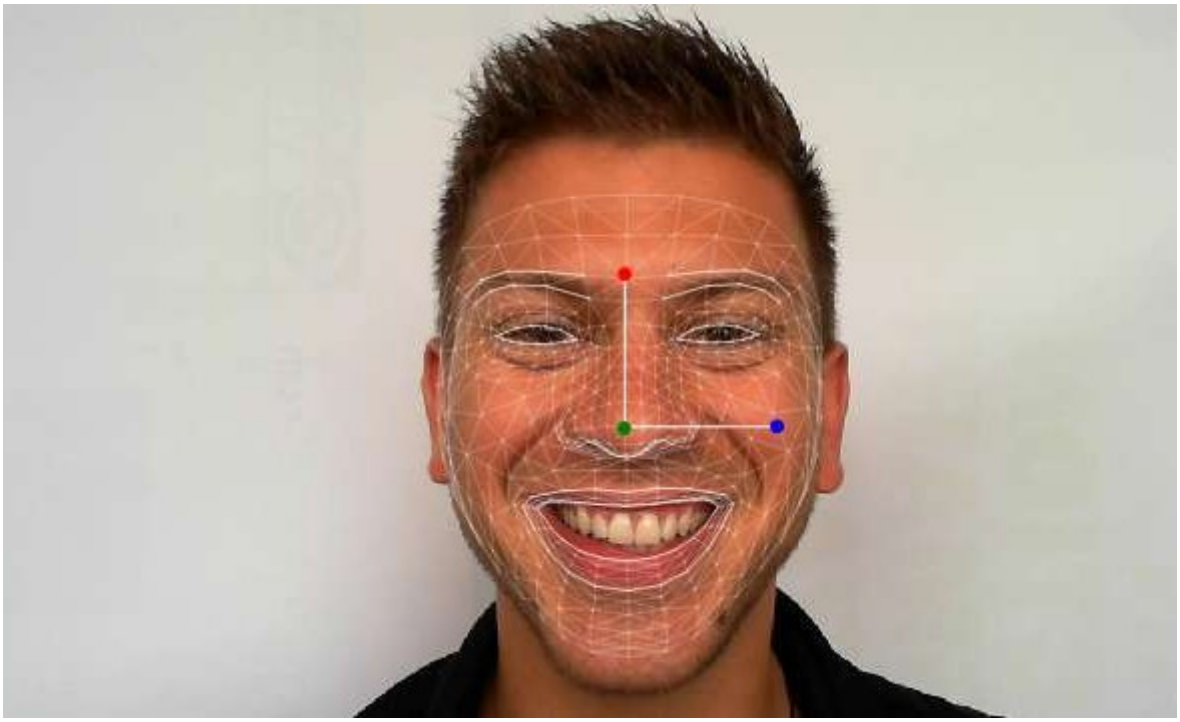
This option is only available if your FaceReader license includes the Consumption Behavior Module. Select this option to add the variables **Intake count** and **Chew motion count** to the Detailed log.

Gaze fixation index and location

This option is only available if your FaceReader license includes the Advanced Research Module. Select this option to add three columns to the Detailed log file: **Gaze Location X**, **Gaze Location Y** and **Fixation Index**. **Gaze Location X** and **Gaze Location Y** are the x,y coordinates of the test participant's gaze point on the screen. The X,Y-coordinates are in pixels relative to the upper left corner of the screen. The **Fixation Index** is the total number of fixations up until that point in time.

2D Landmarks

With this option selected the X-Y-coordinates of the dots around the eyes, nose and mouth of the mesh are added to the log file. The log file has 134 numbers in the column **Landmarks**. The first two numbers are the X- and Y-coordinates of landmark 0, the third and fourth are the coordinates of landmark 1 etc.



The following landmarks are present in the detailed log:

- 0-9 – left eyebrow
- 10-19 – right eyebrow
- 20-21 – corners left eye
- 22-23 – corners right eye
- 24-26 – nose

- 27-66 – mouth

The X,Y-coordinates are in pixels relative to the upper left corner of the image.

Please contact Technical Support if you want to know the position of the landmark points in the face. They can send you a photo of a face with the 67 landmark point positions. They can also provide you with a photo of all the 468 landmark point positions in the face.

See Show Mesh in FaceReader's output

Log complete set of 3D landmarks

Select this option if you want to include the X,Y, Z coordinates of all the (468) landmark points in the Detailed log.

Please note that the 3D landmarks are not in pixels but in millimeters relative to the camera.

To project the 3D landmark points on the camera or video images you need the camera matrix

C=

fx, 0, cx

0, fy, cy

0, 0, 1

if

w = image width in pixels

h = image height in pixels

then:

fx = 1.2 * Max(w,h)

fy = 1.2 * Max(w,h)

cx = w/2

cy = h/2

Then each 3D world coordinate (xw, yw, zw) can be projected to an image coordinate (xm, ym) by

xm = (xw * fx)/zw + cx

ym = (yw * fy)/zw + cy

Export (Detailed log only)

Subject characteristics

With this option selected, three extra columns are added to the Detailed log: **Gender** (male/female), **Age** (an estimation of the test person's age) and **Glasses** (Yes/No).

See Circumplex Model of Affect in FaceReader's output

Participant name and analysis index

The name of the participant and the name of the analysis.

Model quality

The model quality is indicated by a value between 0 and 1.

See one of the following:

- Step 3 in Manual procedure image analysis
- Step 3 in Manual procedure video and camera analysis in Analyze facial expressions

Empty Data

Choose how the following values are exported to the export files:

- Log value when the face could not be found – The term when FaceReader cannot find a face

  Default: FIND-FAILED.

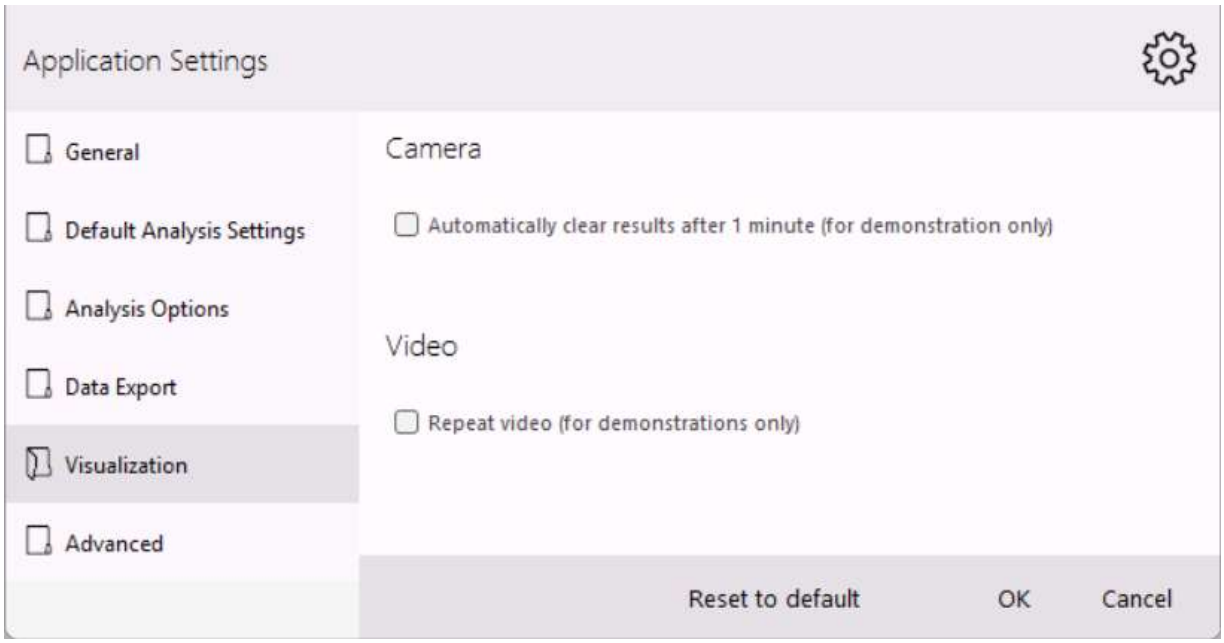
- Log value when the model fit failed – The term when FaceReader finds a face but cannot create a model of it.

  Default: FIT-FAILED.

- Log value for when an item is unknown – The term when FaceReader finds a face and can create a model, but cannot determine the facial expression.

  Default: UNKNOWN

Visualization



Camera

Automatically clear results after 1 minute (for demonstration only)

Select this option when giving a demonstration, to make sure that FaceReader can run for a long time.

Default: Not selected.

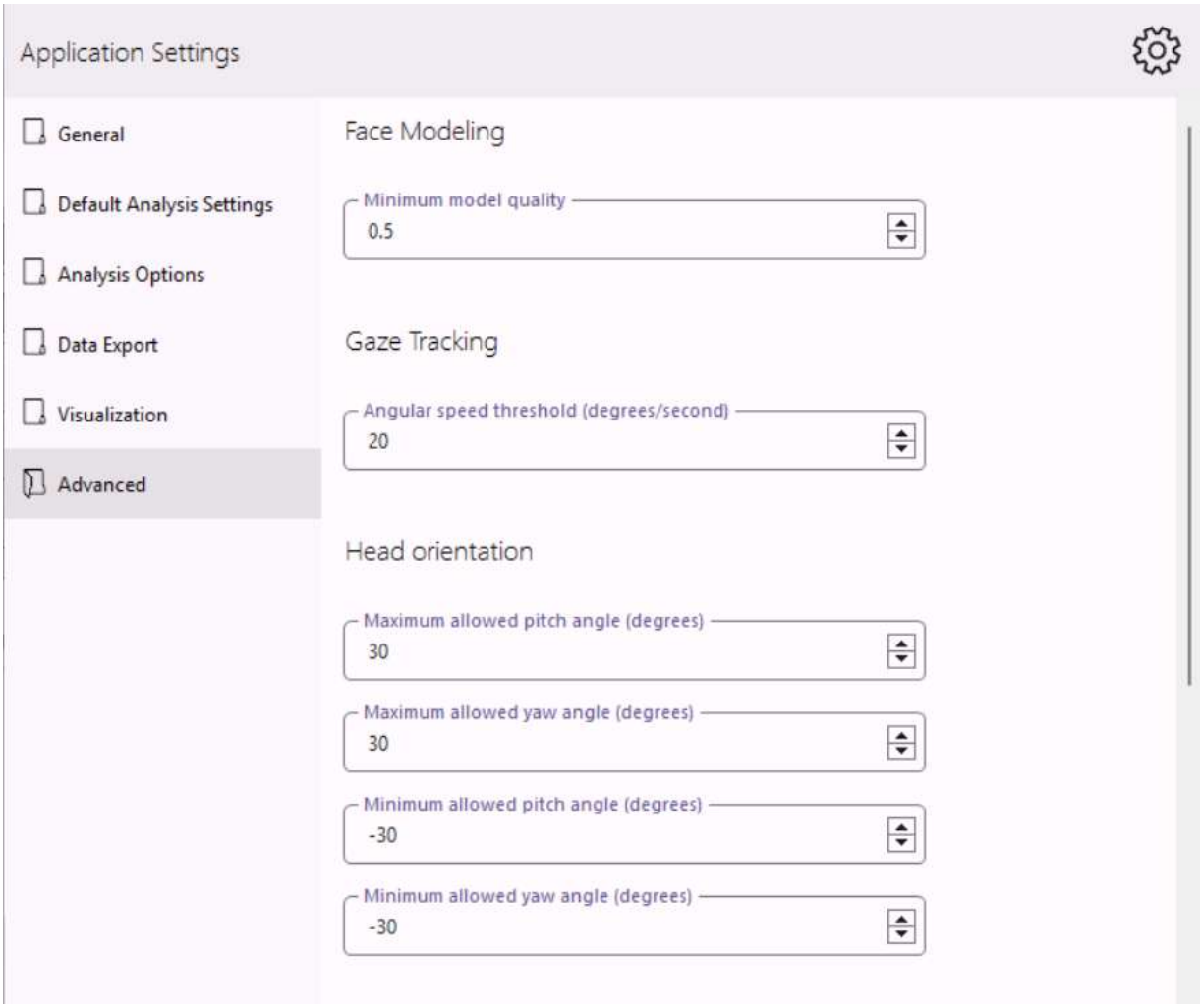
Video

Repeat video (for demonstrations only)

This option is for demonstration purposes only. If you select this option your video is played continuously.

Default: Not selected.

Advanced options



Face Modeling

Minimum model quality

The minimum model quality required for a model to be valid.

Accepted values: 0 (low quality) - 1 (high quality).

Default value: 0.5 (this is the hatched line that you see in the middle of the **Model quality** bar).

Gaze tracking

Angular speed threshold

This threshold is used to distinguish between saccades (faster than the threshold) and fixations (slower than the threshold).

Head Orientation

The test person should stand or sit and look frontally into the camera, an angle of 30° (in both directions, yaw and pitch) is accepted by default. If the angle is bigger than this threshold, the face model will be rejected. You can increase or decrease the thresholds to accept face models of lower/higher quality, respectively.

- **Maximum allowed pitch angle** — If the pitch angle is higher than this threshold, the face model will be rejected.

  Default value: 30 degrees.

- **Maximum allowed yaw angle** — If the yaw angle is higher than this threshold, the face model will be rejected.

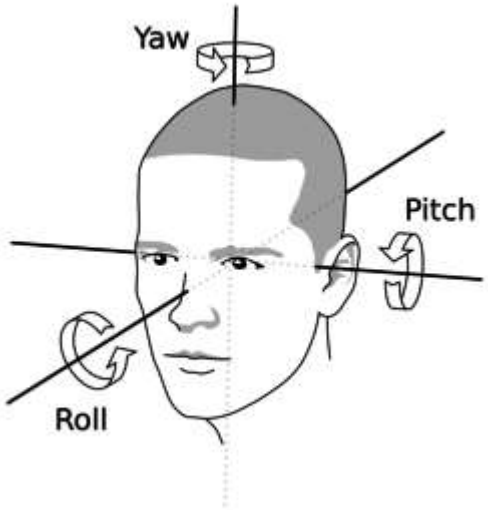
  Default value: 30 degrees.

- **Minimum allowed pitch angle** — If the pitch angle is lower than this threshold, the face model will be rejected.

  Default value: -30 degrees.

- **Minimum allowed yaw angle** — If the yaw angle is lower than this threshold, the face model will be rejected.

  Default value: -30 degrees.



Heart rate

Heart rate variability period

The minimum time that is needed to calculate heart rate variability.

Accepted values: 1-60 minutes. Default: 5 minutes.

See also Calibration in The Vital Signs Module.

Size of Interest

You can set the Size of Interest by clicking the up and down arrows for the Minimum face fraction and/or the Maximum face fraction.

Minimum face fraction

Minimum fraction of the face surface relative to the entire image surface.

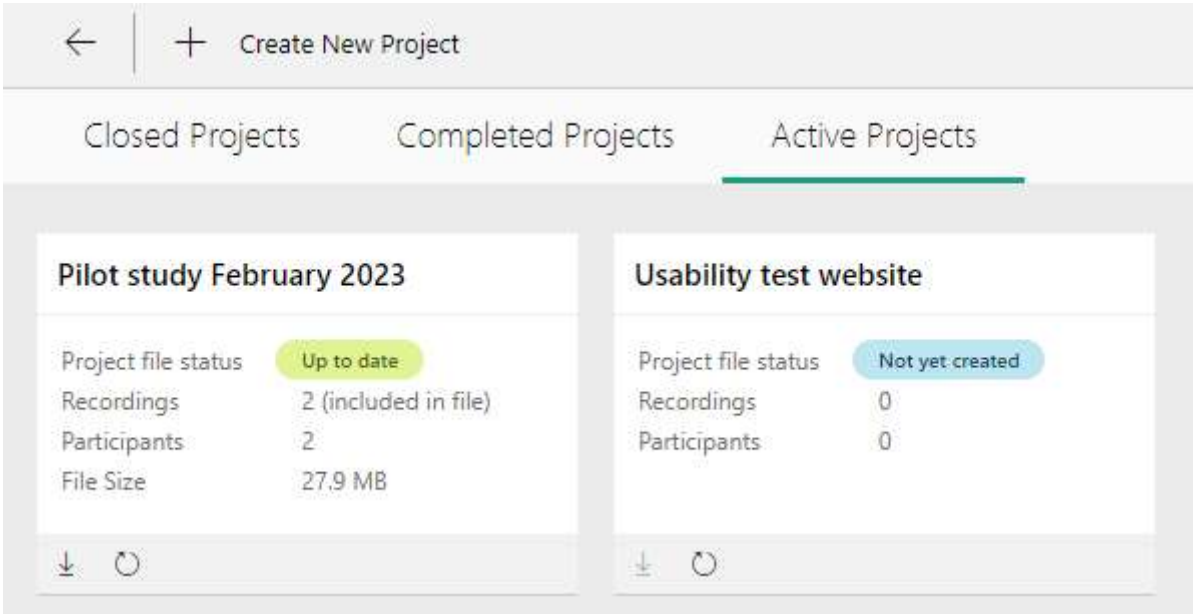
Accepted values: 0.01 - 1. Default: 0.11.

Maximum face fraction

Maximum fraction of the face surface relative to the entire image surface.

Accepted values: 0.01 - 1. Default: 0.80.

FaceReader in combination with FaceReader Online



Main topics

- What is FaceReader Online?
- Import your FaceReader Online project into FaceReader
- Create a FaceReader Online trial account

What is FaceReader Online?

FaceReader Online is our facial expression analysis service that runs online on a cloud server and does not need any on-site installation. This means that you can test appreciation or impact on-site while participants can stay at home, allowing you to incorporate a much larger number of participants and saving them the effort of coming to the lab at the same time. If you like, you can define questions in FaceReader Online or integrate FaceReader Online into your own survey software, such as Qualtrics. You can view a screen recording with the test participant's gaze overlay in FaceReader Online's Recording Results.

You can import data from your FaceReader Online projects directly into FaceReader and analyze the data using all the analysis functions that are available in FaceReader.

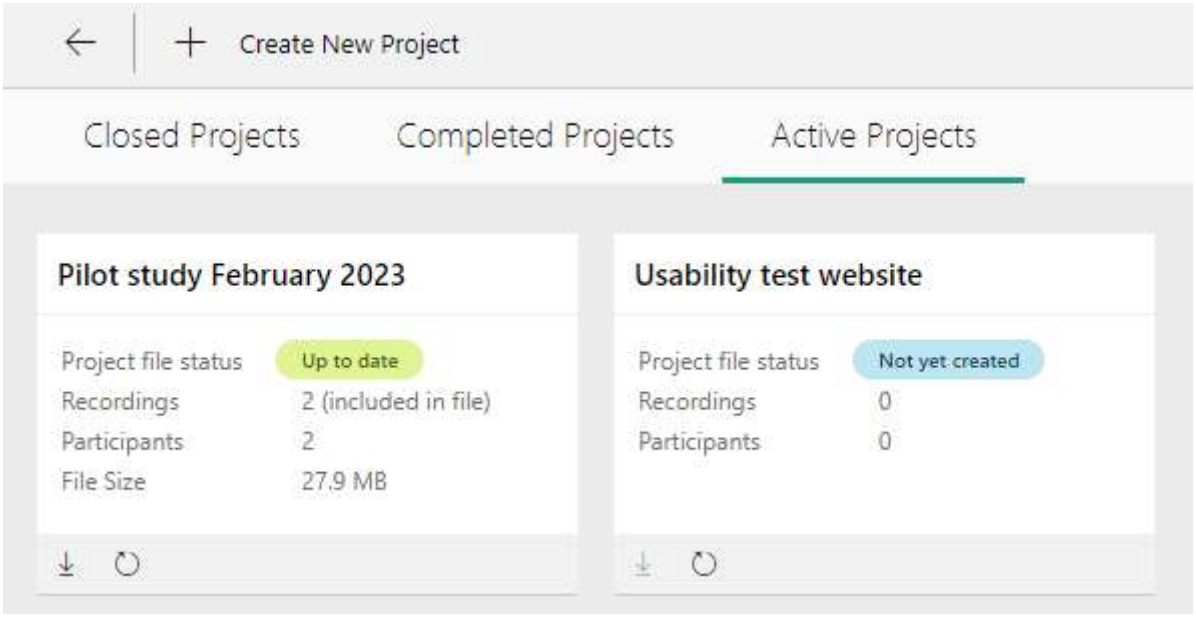
Import your FaceReader Online project into FaceReader

1. Use one of the following two options:

   - In the FaceReader Start window click **Import project** or

   - From the **File** menu select **Import FaceReader Online Project**.

2. Sign in to your FaceReader Online account. A webpage on the FaceReader Online website opens showing an overview of all your Active, Completed and Closed projects.



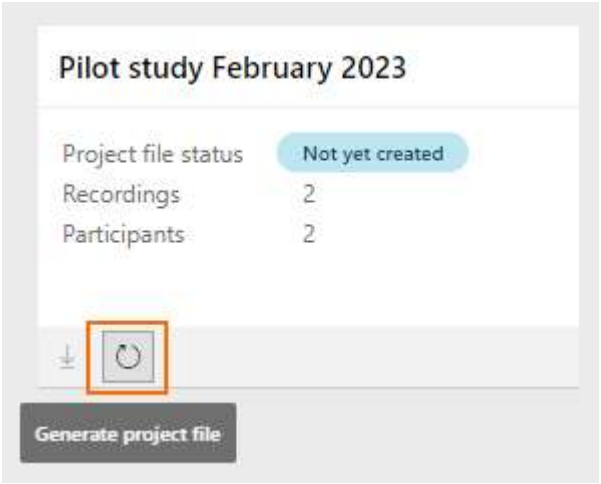
3. The status of your FaceReader Online projects is either:

   - **Not Yet Created**: you do not have a project file yet.

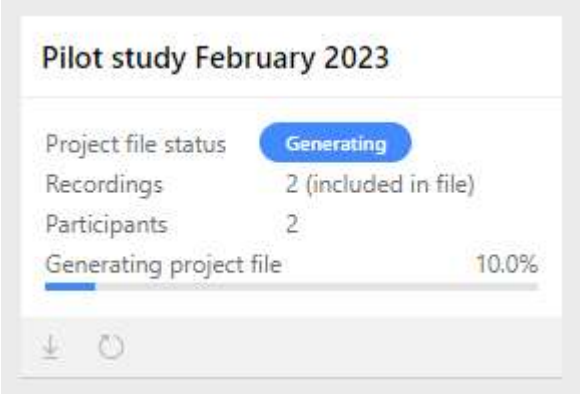
   - **New Results Available**: invitees participated in your FaceReader Online test after you created the previous project file. The data of these participants are not in the project file yet.

   - **Up To Date**: your project file contains the data of all the subjects who participated in your test sofar.

4. Click the **Generate project file** icon to create a project file or add new results or recordings to your existing project file.

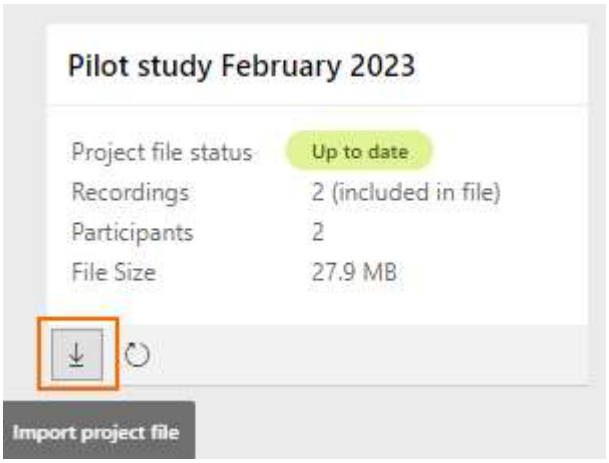


5. Select whether you want to include recordings in your project file and click **Generate**. The project file status changes to **Generating** and you can follow the progress of the file generation.

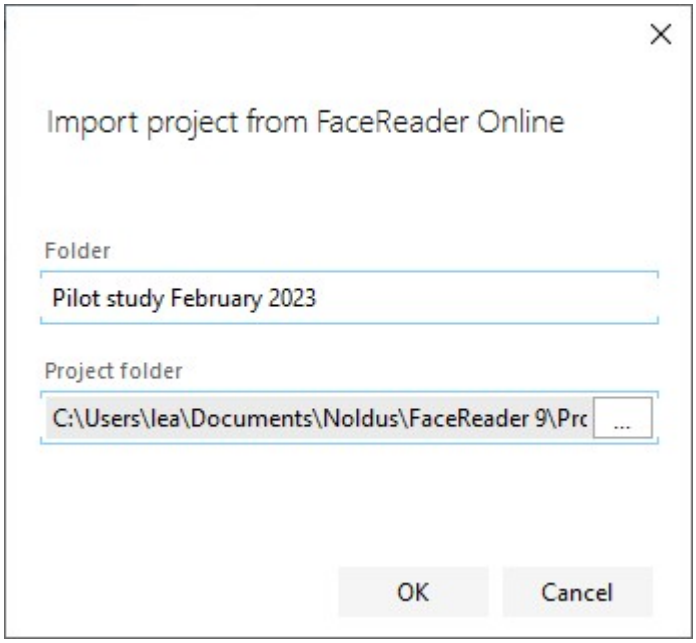


When the project file is ready, the project file status will change to **Up To Date**.

6. Click the **Import project file** icon



7. Select where you want to save your FaceReader project. Optionally, enter a new name for your project and click **OK**.



You are now ready to:

- Open the analyses, view the data per test participant and make charts — See FaceReader's output. If you selected to show your participants' recordings when you created the FaceReader Online project and you included your recordings when you imported the project in FaceReader, you can visualize the test participant's face next to the **Stimulus View** and, for instance, the participant's **Expression Intensity** chart. See **Stimulus View** in FaceReader's output for more information. If you selected to **Include**

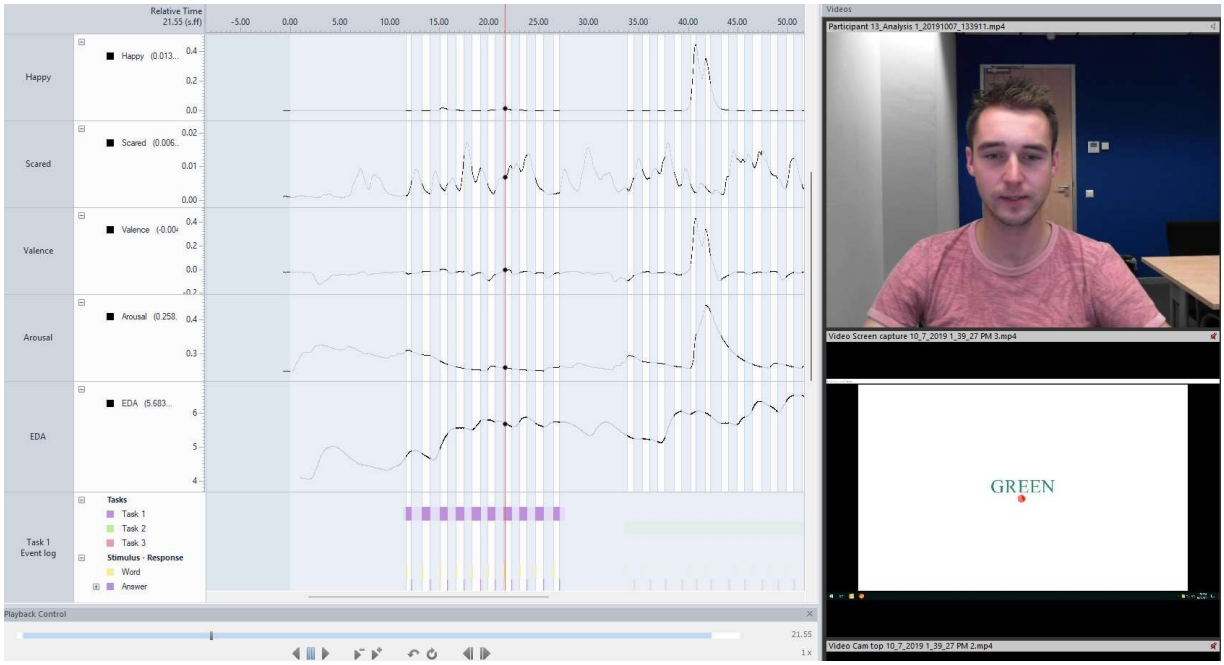
gaze tracking when you defined your FaceReader Online experiment, the **Stimulus View** window shows the participant's gaze overlay.

- Export the data of each participant in a State log or Detailed log file — See FaceReader's output.
- If you selected to include your recordings when you imported the project — Re-analyze the videos, for instance, to select the EastAsian face model instead of the General model or to calibrate and then run a new analysis.
- In the Project Analysis section — Visualize your data in charts and calculate statistics over all participants or per participant group (for instance, male and female participants or different age groups).

Create a FaceReader Online trial account

If you are new to FaceReader Online and want to try it out you can create a trial account. In the FaceReader Start window select **Create account** under **FaceReader Online** and follow the steps on your screen. Click **Learn more** in the Start window to open the FaceReader Online page on the Noldus website.

FaceReader with The Observer XT



Main topics

- FaceReader in combination with The Observer XT
- Control FaceReader with The Observer XT using N-Linx
- Import FaceReader videos only
- Import multiple FaceReader analyses into the same observation
- How FaceReader data are imported into The Observer XT
- Visualize FaceReader data in The Observer XT
- The Observer XT sample projects with FaceReader data

FaceReader in combination with The Observer XT

Integrating FaceReader data with other data may give you a more complete picture of the phenomena that you are studying. For instance, when testing your newly developed website, it may be interesting to know what emotions it evokes, but it may be even more intriguing to see at what part of the web site your test person is looking when his facial expressions are classified as 'happy' or 'surprised'. Manually logging the test person's verbal reactions or measuring his physiological responses makes the picture complete. For the integration of all these data, you can use The Observer XT.

You can let FaceReader record a video of the test participant’s face and import FaceReader's log files together with the video into The Observer XT. You can then visualize the test person's facial expressions together with your observational data and calculate statistics. The procedure for co-acquiring and importing FaceReader data depends on whether you observe live or offline. If you observe live, the procedure depends on the version of The Observer XT.

IMPORTANT Make sure that FaceReader elements that are imported into The Observer XT do not already exist in the Coding Scheme of The Observer XT. Otherwise the FaceReader data will be assigned to the element that was already present in the Coding Scheme and your Observer data will be incorrect. Please be especially aware to not use the element names *Unknown*, or *Neutral* in the Coding Scheme of The Observer XT, since these names are used for the facial expressions.

Which option applies to you?

- Observe live in The Observer XT with the External Data Module
- Observe live in The Observer without the External Data Module
- Observe offline in The Observer XT

Observe live in The Observer XT with the External Data Module

The Observer XT 13.0 and higher versions make use of the Noldus network communication protocol N-Linx to control FaceReader.

For details on N-Linx, see the Reference Manual - N-Linx. You can download it from the download section of the Noldus website.

https://my.noldus.com

To use this functionality, you need the External Data Module (EDM) of The Observer XT.

For the detailed procedure, see Control FaceReader with The Observer XT using N-Linx

Observe live in The Observer without the External Data Module

If you do not have The External Data Module (EDM), you can set up The Observer XT to start and stop FaceReader analysis together with an observation. See Add a Custom External Device in The Observer XT Help for the procedure.

Observe offline in The Observer XT

When you carry out offline observations in The Observer XT, you start and stop FaceReader analysis manually. Also you must export the data from FaceReader and import them together with the videos into The Observer XT manually.

Control FaceReader with The Observer XT using N-Linx

Aim

To automatically analyze facial expressions with FaceReader together with an observation in The Observer XT, import the FaceReader data and videos and synchronize them automatically with the event log.

Background

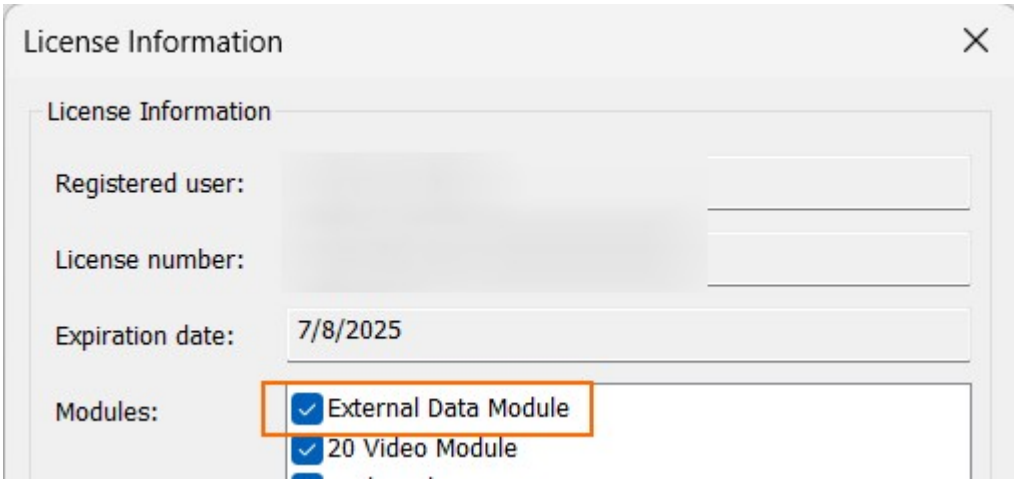
The communication between FaceReader and The Observer XT makes use of the Noldus network communication protocol N-Linx.

For details on N-Linx, see the Reference Manual - N-Linx. You can download it from the download section of the Noldus website.

https://my.noldus.com

Prerequisites

- You have a license for The Observer XT 14.1 or higher that includes the External Data Module. To see if you have this module, open The Observer XT and choose **Help** > **About The Observer XT** > **License info**.



- N-Linx Server is installed on a computer in the network.
- Both FaceReader and The Observer XT are open.

- You created a project in The Observer XT and FaceReader. These projects are open.
- Your FaceReader project does not contain image analyses. You cannot mix image analyses with camera analyses in FaceReader.
- You selected a default camera in FaceReader.
- **IMPORTANT** The Coding Scheme in The Observer XT does not contain element names that are also used in FaceReader, like *Neutral*, *Unknown*, or *Happy*.
- FaceReader, The Observer XT and N-Linx Server run on computers that are part of the same network.

Procedure

1. If FaceReader, The Observer XT, and N-Linx Server are not all installed on the same computer, make sure that traffic through the N-Linx port is not blocked by Windows Firewall. Create exceptions in Windows Firewall for the N-Linx port on all computers with FaceReader, The Observer XT, and N-Linx Server.

   See Create exceptions for the N-Linx port in Windows Firewall

2. If FaceReader and The Observer are installed on different computers and you want to import the FaceReader videos automatically in The Observer XT, make sure that The Observer XT can access the FaceReader videos.

   See Make sure The Observer XT can access the FaceReader video files

3. Set up FaceReader to work with The Observer XT
4. Set up The Observer XT to work with FaceReader
5. Carry out your observation in The Observer XT and co-acquire data with FaceReader.

   See Observe in The Observer XT and analyze in FaceReader

Note

Check on the download section of the Noldus website if an update of this procedure is available. For example in case of an update of The Observer XT or N-Linx.

https://my.noldus.com

Create exceptions for the N-Linx port in Windows Firewall

Aim

To make sure traffic through the port that is used by N-Linx is not blocked by Windows Firewall.

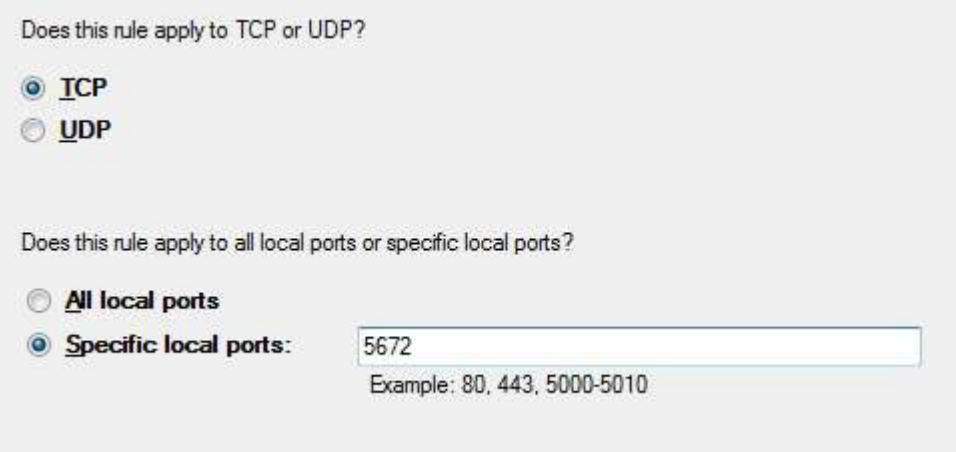
Prerequisite

FaceReader, The Observer XT and N-Linx Server are not all installed on the same computer. If they are all installed on the same computer, skip this topic.

Procedure

Follow this procedure for all computers with FaceReader, The Observer XT, and N-Linx Server.

1. Open the Control Panel and select **Windows Defender Firewall**.
2. On the left side of the window, click **Advanced Settings**.
3. Click **Inbound Rule** and click **New Rule** in the **Actions** pane.
4. In the **New Inbound Rule Wizard** Window that opens, select **Port** and click **Next**.
5. Select **TCP** and enter *5672* in the **Specific local ports** field and click **Next**.



6. Click **Allow the connection** and click **Next**.
7. Select to which network the rule applies and click **Next**.
8. Give the rule a name, for example **N-Linx connection** and click **Finish**.

9. Check in the **Inbound Rules** windows that this rule is set to **Enabled**.
10. Click **Outbound Rule** and click **New Rule** in the **Actions** pane.
11. Repeat steps 4-9 for the outbound rule.
12. Close all Control Panel windows.

Make sure The Observer XT can access the FaceReader video files

Aim

To make sure The Observer XT can access that videos FaceReader records. The videos are not copied to The Observer XT. The Observer XT creates a link to the FaceReader videos.

Procedure

Carry out the following steps:

1. Share the folder where FaceReader stores its video files.

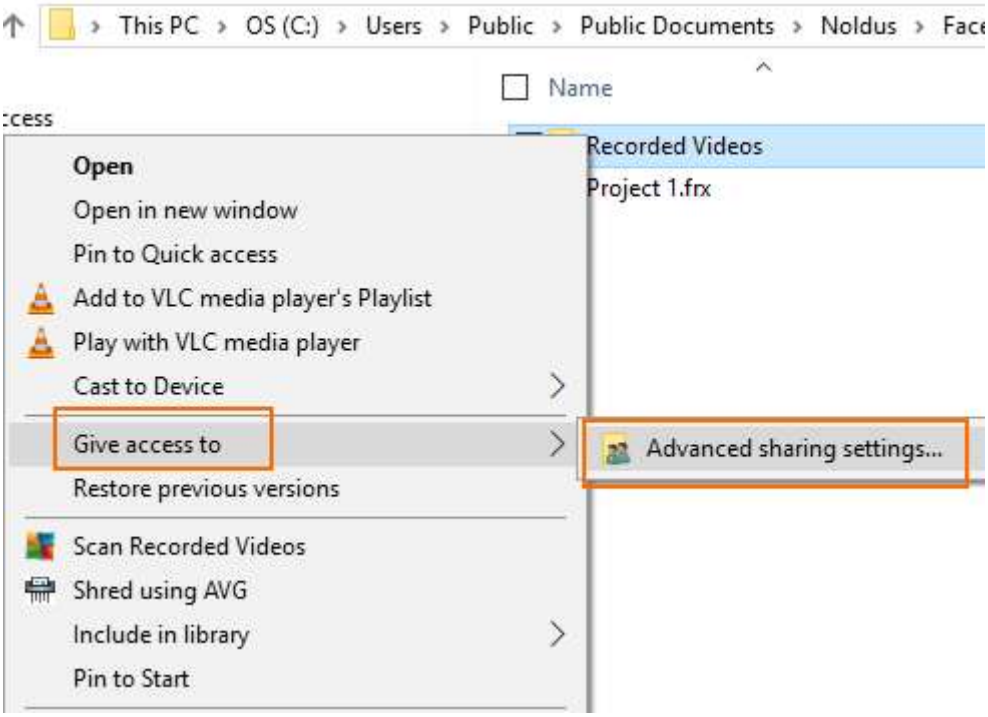
   IMPORTANT Since the FaceReader videos are stored in the subfolder **Recorded Videos** in the project folder, this procedure has to be carried out for every new FaceReader project. If a project has only a few videos it may be easier to import the video files manually into The Observer XT.

2. Switch off password protected sharing on the FaceReader computer
3. Map the shared folder with FaceReader video files

Share the folder where FaceReader stores its video files

1. Right-click the folder where the video files are going to be stored, which is by default C:\Users\<your username>\Documents\Noldus\FaceReader 10 \Projects\[Project name]\Recorded Videos

   and select **Give access to** and then **Advanced Sharing Settings**.

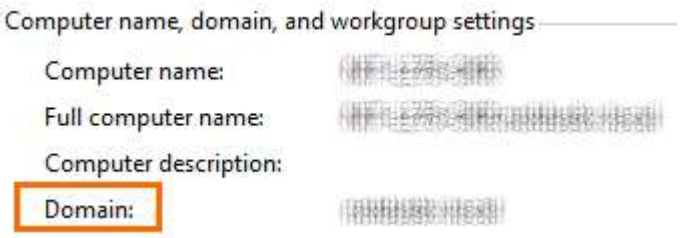


2. Change the sharing options for all your network profiles ('Private', 'Guest or Public' and 'Domain'): select the option **Turn on file and printer sharing** for all your profiles.
3. Under 'All Networks' select the option **Turn on sharing so anyone with network access can read and write files in the Public folders**. Then click **Save Changes**.

Switch off password protected sharing on the FaceReader computer

This procedure is needed to make sure that the folder where FaceReader stores its videos files can be accessed without a password by the computer with The Observer XT.

The procedure differs for a Windows workgroup or a domain. To see whether the FaceReader computer is in a workgroup or a domain, open the Control Panel and choose **System** and then **Advanced System Settings** and click the **Computer Name** tab. The type of network is listed under **Computer name, domain, and workgroup settings**.



Procedure for workgroup

1. Follow the procedure in Share the folder where FaceReader stores its video files to open the Advanced sharing settings.
2. Under **Password protected sharing**, select the option **Turn off password protected sharing**.

   IMPORTANT If you do not see this option, most likely your computer is in a domain, not a workgroup. Carry out the procedure for domain below.

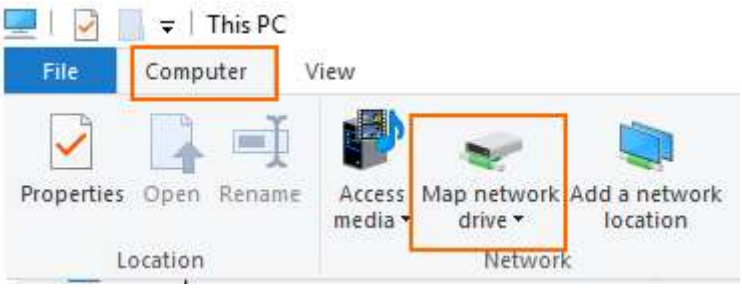
Procedure for domain

1. Press the **Windows key** + **R**.
2. Type **lusrmgr.msc** and press **OK**.
3. Open the **Users** folder and double-click **Guest**.
4. Deselect **Account is disabled** and click **OK** and close the **lusrmgr** window.
5. Press the **Windows key** + **R**.
6. Type **gpedit.msc** and press **OK**.
7. Open Computer Configuration\Windows Settings\Security Settings\Local Policies\User Rights Assignment and double-click **Deny access to this computer from the network**.
8. Click **Guest** and then choose **Remove** > **OK**.
9. Close the **Local Group Policy Editor** window.

Map the shared folder with FaceReader video files

Carry out this procedure on both computers.

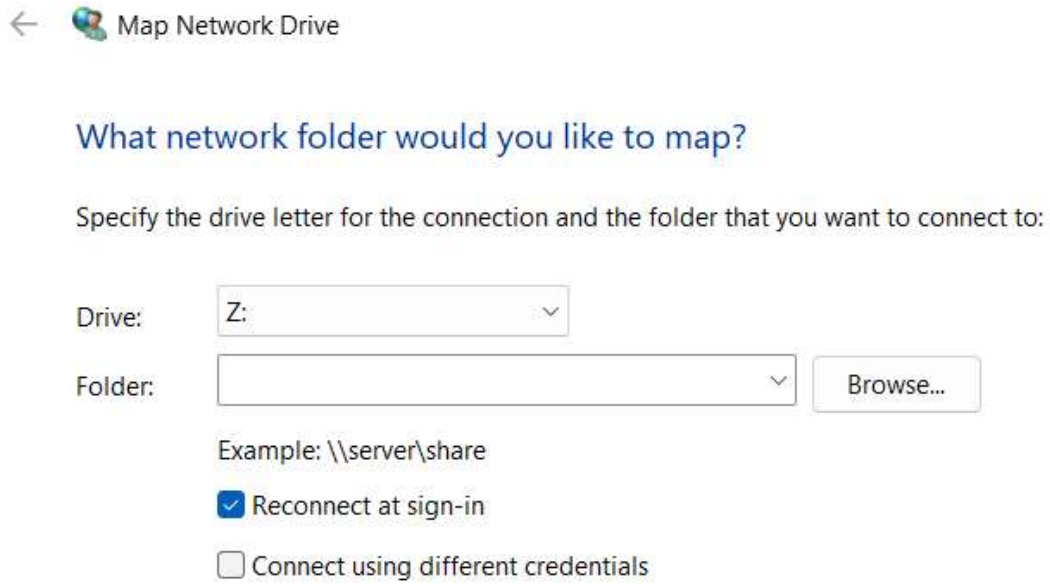
1. Open File Explorer and then **This PC**.
2. Click **Computer** and then click the **Map network drive** icon.



3. Choose a name for the drive and browse to the shared folder.

   IMPORTANT Make sure you select the same drive letter on both computers.

4. Click **Finish**.



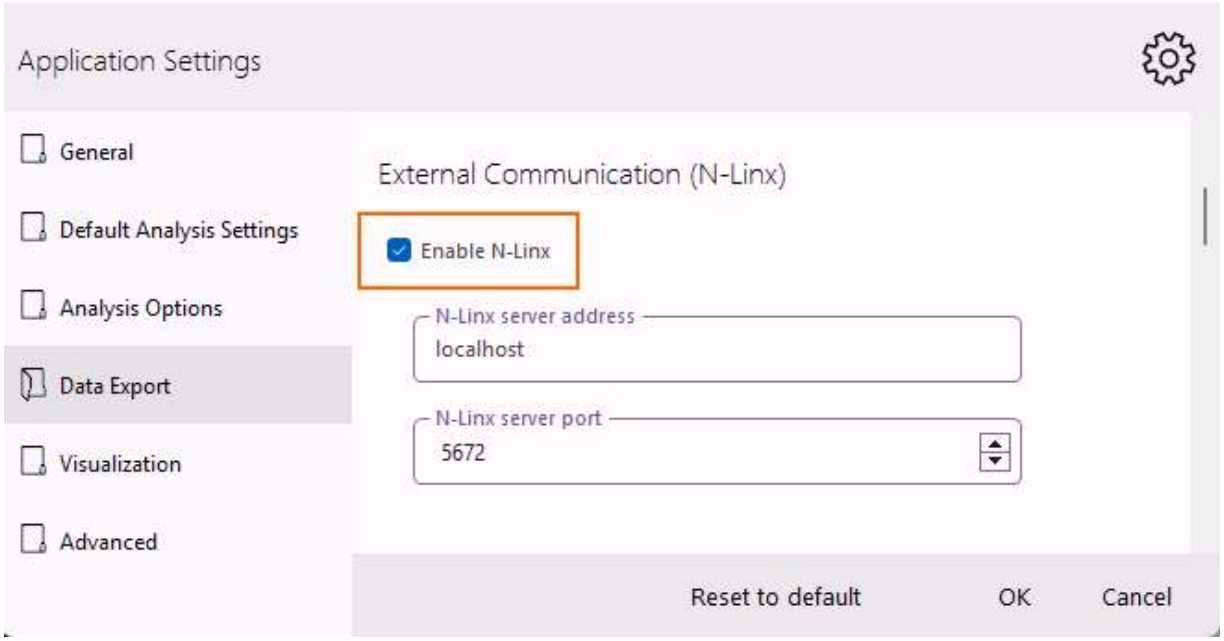
Notes

- When you now start the computer with The Observer XT you need to enter the login details for the computer with FaceReader.
- Make sure the computer with FaceReader videos is switched on when you open your project in The Observer XT. Otherwise The Observer XT will not be able to open the videos.

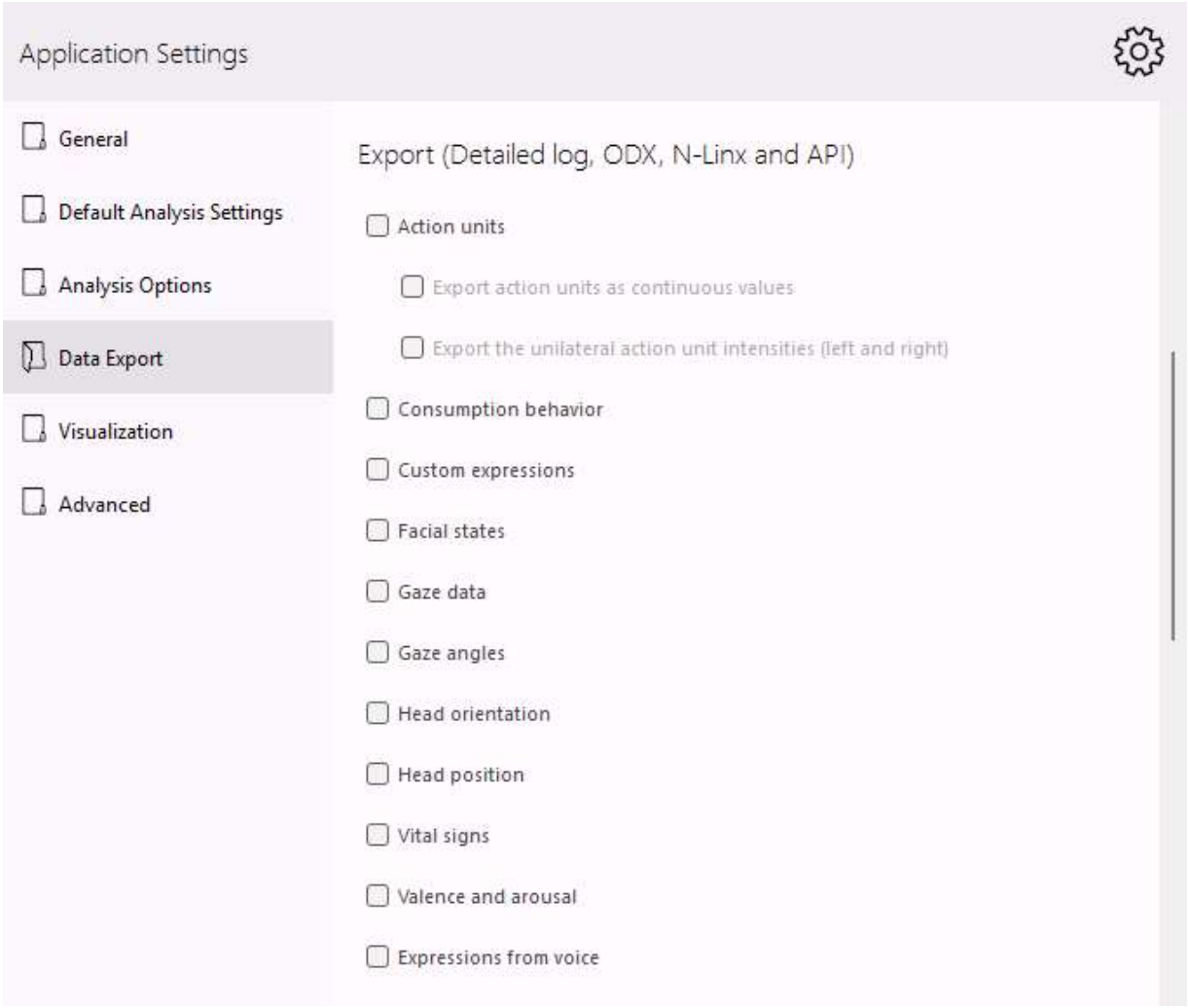
Set up FaceReader to work with The Observer XT

Procedure

1. Choose **File** > **Set Default camera**, choose your camera and select the option **Record**.
2. Choose **File** > **Settings** > **Data Export**.
3. Under **External Communication (N-Linx)**, select **Enable N-Linx**.



4. If FaceReader and N-Linx Server run on the same computer, leave the default address *localhost* in the **N-Linx server address** field. If the programs run on different computers, enter the IP address or computer name of the computer with N-Linx Server. To find that name, open the Control Panel and choose **System**.
5. In the **N-Linx server port** field, leave the default port *5672*. Ask your system administrator for assistance if this port is in use by another program.
6. Under **Export (Detailed Log, ODX, N-Linx and API)**, choose which data to send to The Observer XT.


Application Settings
General
Default Analysis Settings
Analysis Options
Data Export
Visualization
Advanced
Export (Detailed log, ODX, N-Linx and API)
Action units
Export action units as continuous values
Export the unilateral action unit intensities (left and right)
Consumption behavior
Custom expressions
Facial states
Gaze data
Gaze angles
Head orientation
Head position
Vital signs
Valence and arousal
Expressions from voice

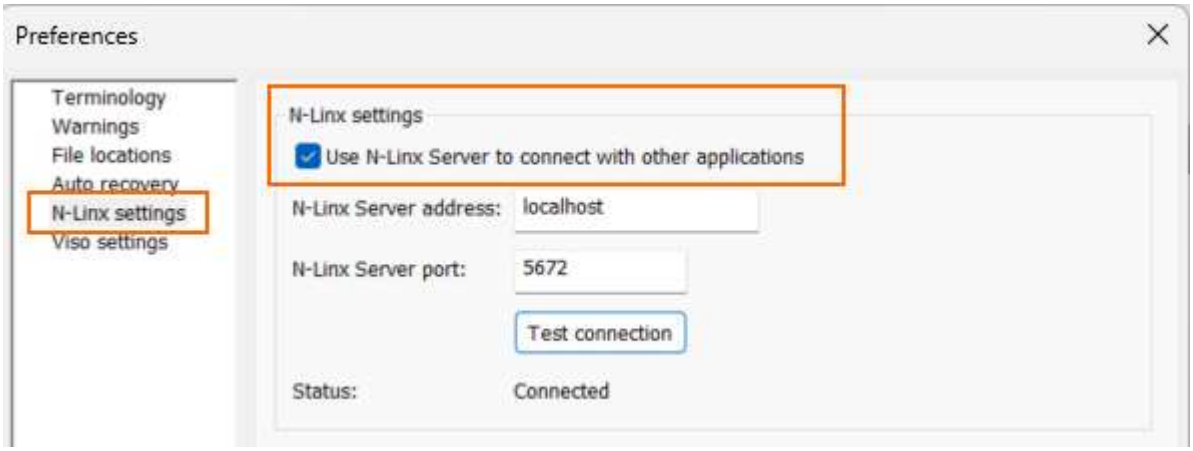
Set up The Observer XT to work with FaceReader

Prerequisites

- FaceReader is open.
- You followed the steps in Set up FaceReader to work with The Observer XT

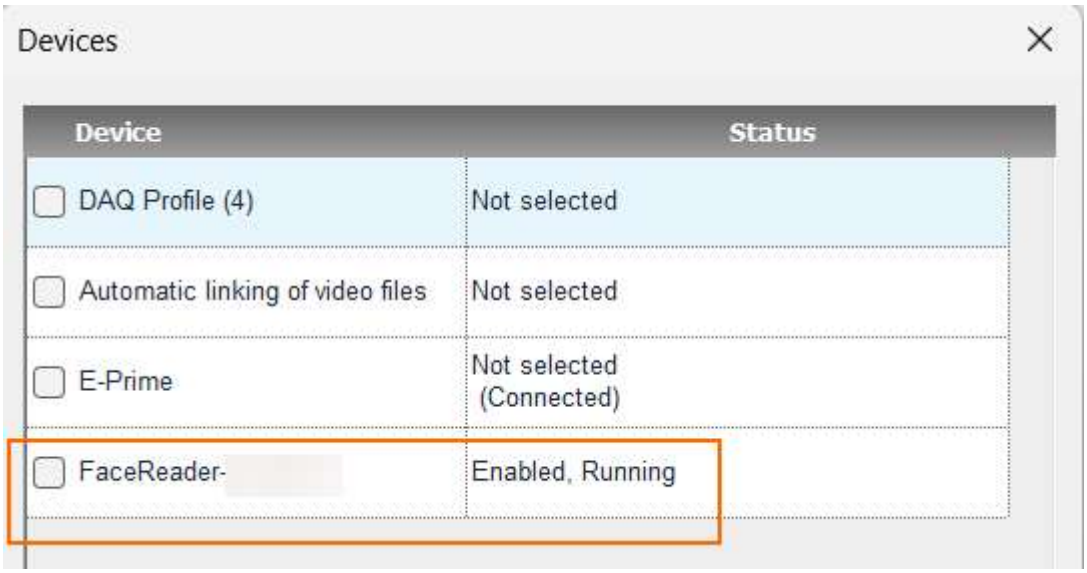
Procedure

1. In The Observer XT, open your project and choose **File** > **Preferences** > **N-Linx Settings**.
2. Select **Use N-Linx server to connect with other applications**.



3. In the **Services address** field, enter the name of the computer with N-Linx Server. Enter *localhost* if N-Linx Server and The Observer XT run on the same computer.
4. In the **Services port** field, leave the default port *5672*. Ask your system administrator for assistance if this port is used by another program.
5. Click **Test connection**. If connection with N-Linx Server is found, the **Status** will change to **Connected**. If not, enter the correct settings and click **Test connection** again.
6. Click **OK**.
7. Choose **Setup** > **Project Setup**.
8. Select **Live Observation**. The **Devices** window now opens. If not, click the **Devices** button.

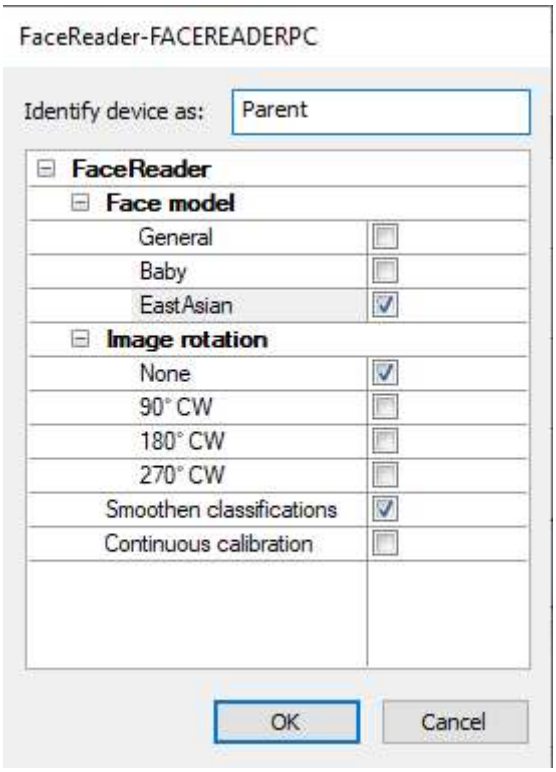
9. Double-click the line **FaceReader -[computer name]**



10. If you have multiple instances of FaceReader connected to The Observer XT, enter a unique name in the **Identify device as** field. This name will be added as Subject to the Coding Scheme.

    If you leave the **Identify device as** field empty, no subject will be added.

11. Select the FaceReader settings for your experiment.



For an explanation of the settings, see:

Smoothen classifications – Classification

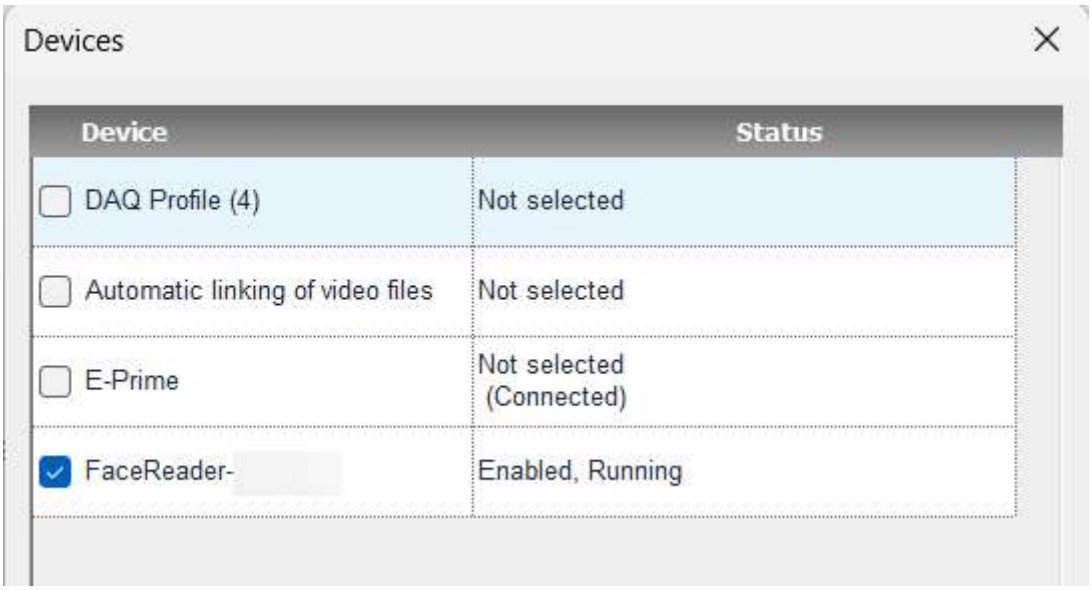
Continuous calibration – Procedure

To use Participant calibration (see Create a participant calibration), select that option manually in FaceReader.

Face model – Active Face Model

Image rotation – Rotation

12. Click **OK** and select the checkbox in front of the line **FaceReader - [computer name]**.


Devices
Device
Status
DAQ Profile (4)
Not selected
Automatic linking of video files
Not selected
E-Prime
Not selected
(Connected)
FaceReader-
Enabled, Running

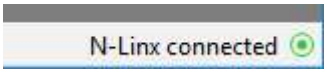
Observe in The Observer XT and analyze in FaceReader

Procedure

1. Check the following:

   That your camera is connected to the PC, that it is turned on, and selected as default camera in FaceReader.

   That FaceReader is open and the upper-right corner shows the text **N-Linx-connected**.

   That you selected the data to export in FaceReader.

   IMPORTANT Select only the data you really need. Data files can become very large when you select many export options. This slows down data import into The Observer XT.

2. Let the test participant take place at the test computer and check that the FaceReader webcam has a proper view of the face.

   See Camera and accessories in Installation

3. Create a new observation in The Observer XT. A new participant is created in FaceReader with a camera analysis.

4. Start the observation in The Observer XT. Dependent on the settings in The Observer XT, the **Independent Variables** list appears. This list contains the independent variables you created in The Observer XT together with the FaceReader independent variables *Age*, *Gender* and *ParticipantID*. When you enter the values of the user defined independent variables, the observation and FaceReader analysis start.

   See Independent Variables how FaceReader independent variables are imported into The Observer XT.

5. Score data in The Observer XT. FaceReader automatically analyzes the camera images and creates a video file.

6. Stop the observation.

   Classification in FaceReader is automatically stopped. The FaceReader data and videos are automatically imported into the observation. The Expression states are imported as behaviors and the values of the detailed log are imported as external data.

Notes

- If your license for The Observer XT does not include the External Data Module, you must set up The Observer XT to start and stop FaceReader analysis together with an observation.

  See **Add a Custom External Device** in The Observer XT Help for the procedure.

  IMPORTANT Importing FaceReader data adds FaceReader elements to the coding scheme. However, these elements cannot be scored manually in a new observation in The Observer XT.

- When you enter a name in the **Identify device as** field in step 10 of Set up The Observer XT to work with FaceReader, this name is added as a subject to the Coding Scheme. When you now manually score events, The Observer XT expects that for each event you first score a subject and then a behavior. Define a subject in the Coding Scheme. Then choose **Setup** > **Project Settings** > **Scoring Options** and select **Auto-record subject**. You now have to score the subject only once at the start of the test.

Offline observations

Aim

To manually import FaceReader data and videos into The Observer XT.

Procedure

Carry out the following steps

1. Export FaceReader log files
2. Import the FaceReader data and videos into The Observer XT
3. Synchronize data sets. See **Carry out an observation**/**Synchronize data sets** in The Observer XT Help.

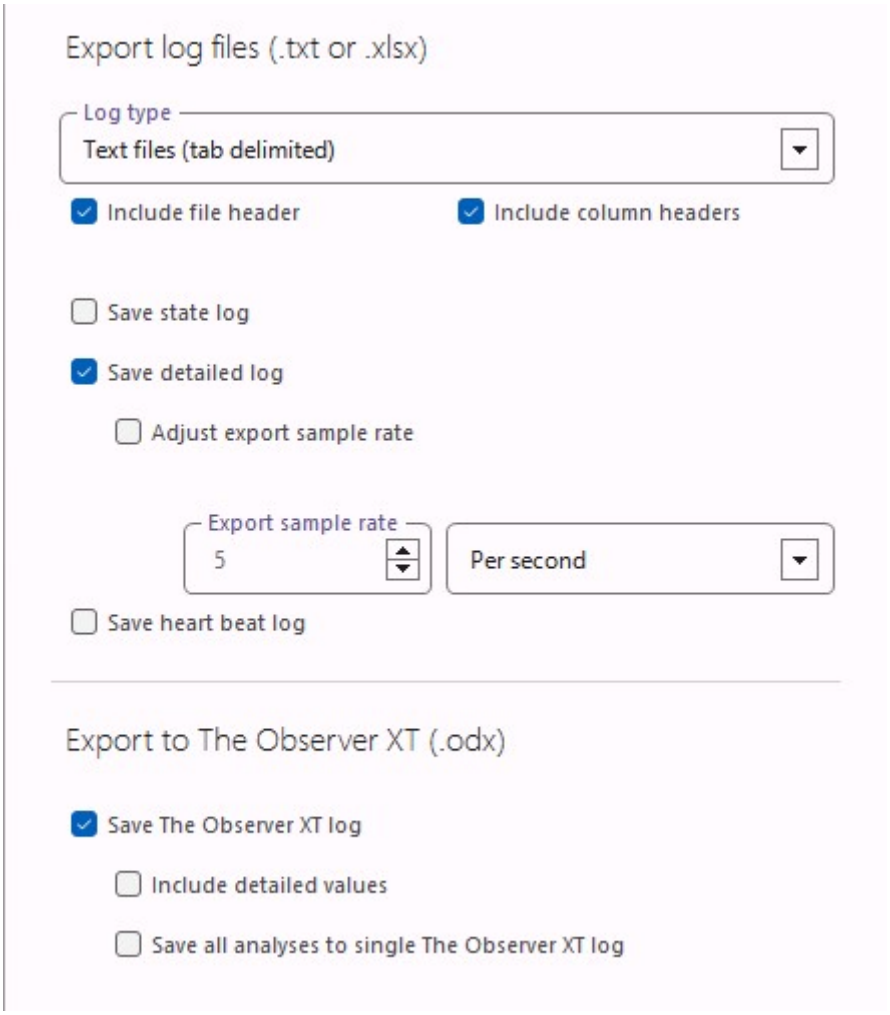
Export FaceReader log files

In FaceReader, choose **File** > **Export** > [one of the options], to export the data for a single analysis, single participant, or entire project.

Under **Export to text files (.txt)** choose **Save Detailed log**. The Detailed log file contains the intensities of the facial expressions per sample and other data that you have selected under **Settings** > **Data Export**.

IMPORTANT Select **Include file header** and **Include column headers**. If you do not select both check boxes, import into The Observer XT fails.

Under **Export to The Observer XT (.odx)**, choose **Save The Observer XT log**. Do not select the **Include detailed values** checkbox. Select **Save all analyses to single The Observer XT log** to export one log file with the data of all the participants in the project. The Observer XT log file lists the dominant facial expressions during the tests.



See also Export analysis results in FaceReader's output.

Then:

- Import the FaceReader data and videos into The Observer XT

Import the FaceReader data and videos into The Observer XT

Procedure

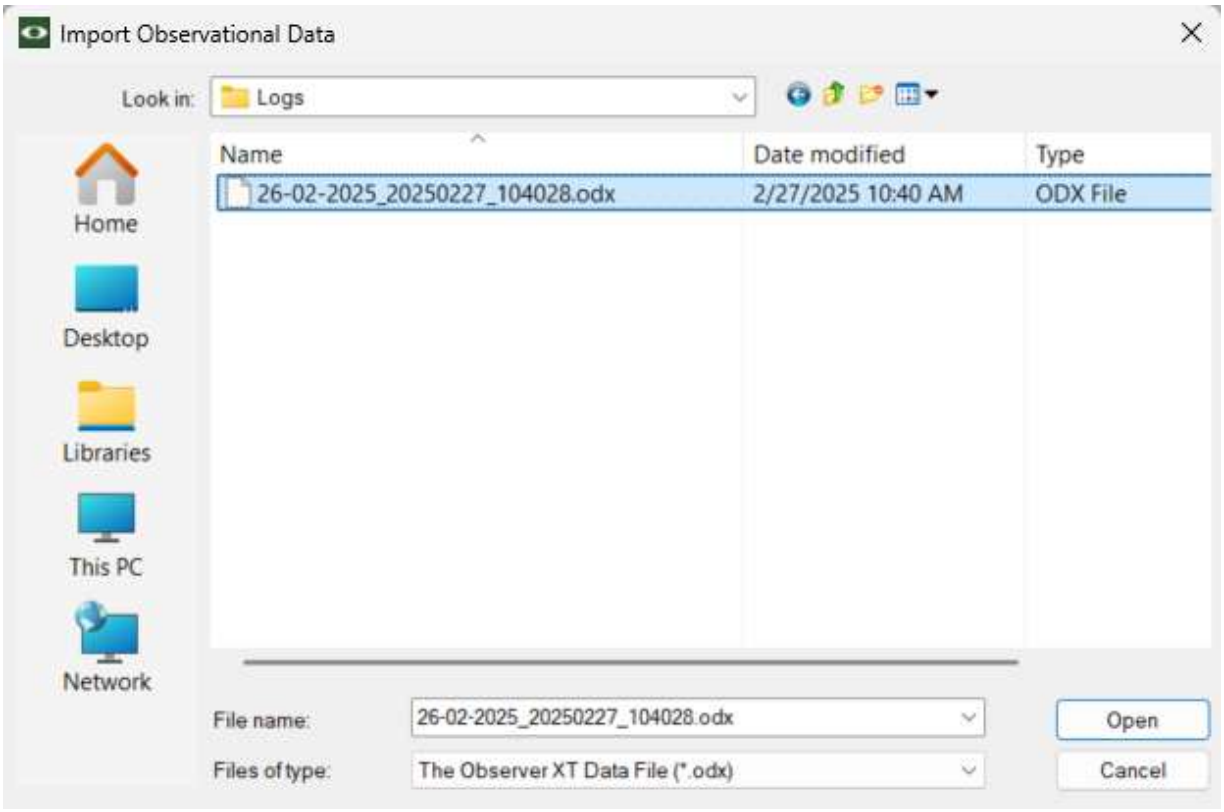
Carry out the following steps:

- Import the Observer XT log files plus videos into The Observer XT.
- Import the detailed logs as external data

Import the Observer XT log files plus videos into The Observer XT

1. Start The Observer XT, open the appropriate project or create a new one. Choose **File** > **Import** > **Observational Data**.
2. In the **Files of type** field, select **The Observer XT (*.odx)** from the list.
3. Browse to your Observer log file and open it. The log files are by default in the folder:

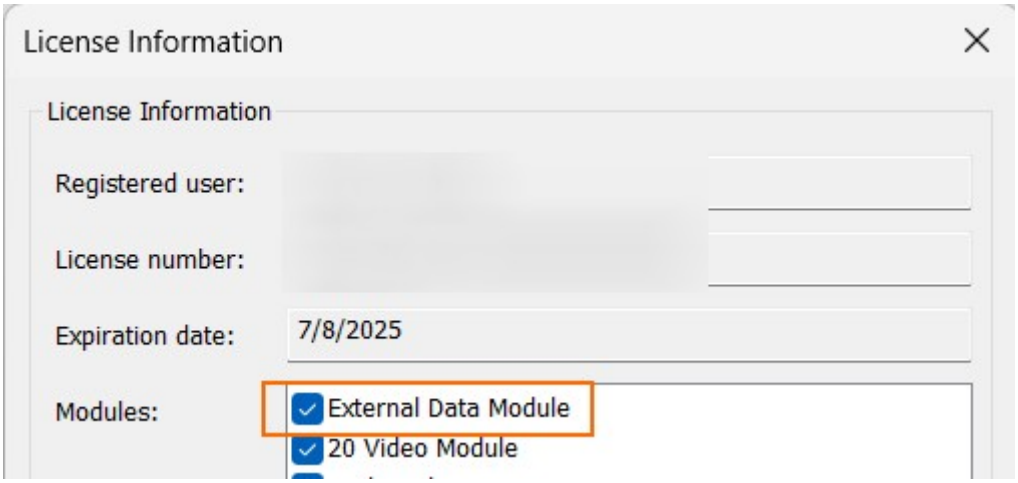
   C:\Users\<your username>\Documents\Noldus\FaceReader 10\Projects\[project name]\Logs.



This imports the FaceReader analysis together with the video of the test participant's face.

Import the detailed logs as external data

To import FaceReader data as external data, your license for The Observer XT must include the External Data Module. To see if you have this module, open The Observer XT and choose **Help** > **About The Observer XT** > **License info**.

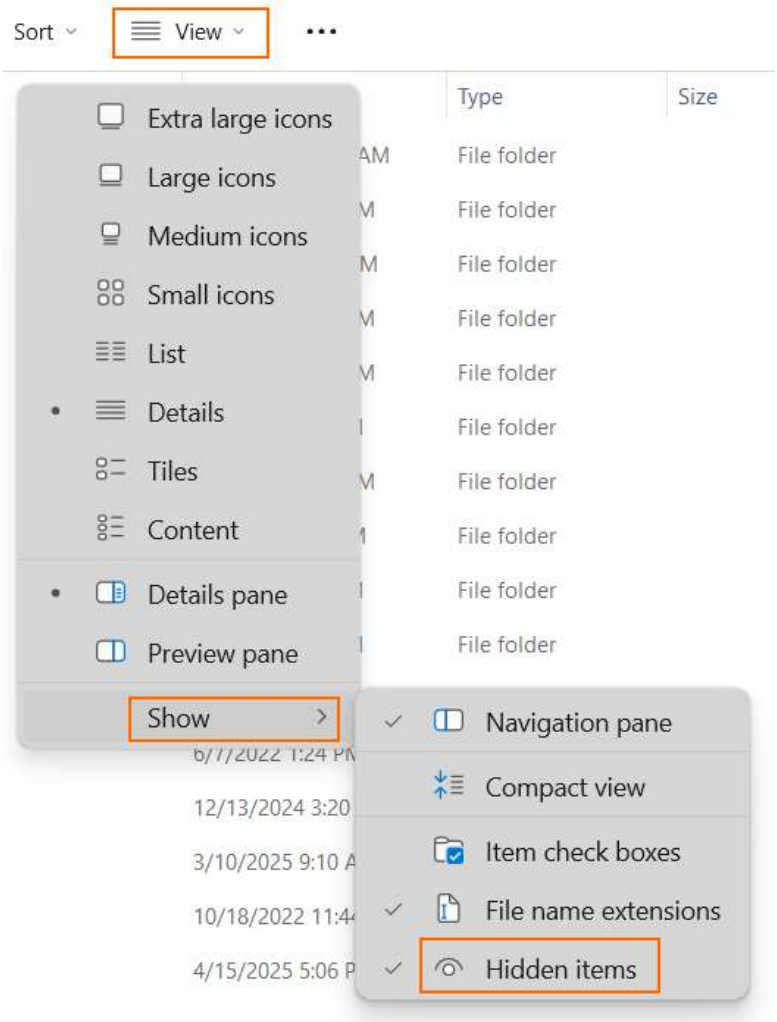


On the FaceReader > Drivers & Tools section of our MyNoldus portal (my.noldus.com) you will find an import profile to import Detailed log files. Follow the steps below to copy the import profile to your computer:

1. Make sure The Observer XT is not running.
2. Download the Import Profile from the MyNoldus portal.
3. Copy the import profile *FaceReader 10 Detailed log as external data.eip* to the default directory for import profiles:

   C:\ProgramData\Noldus\Common\Profiles.

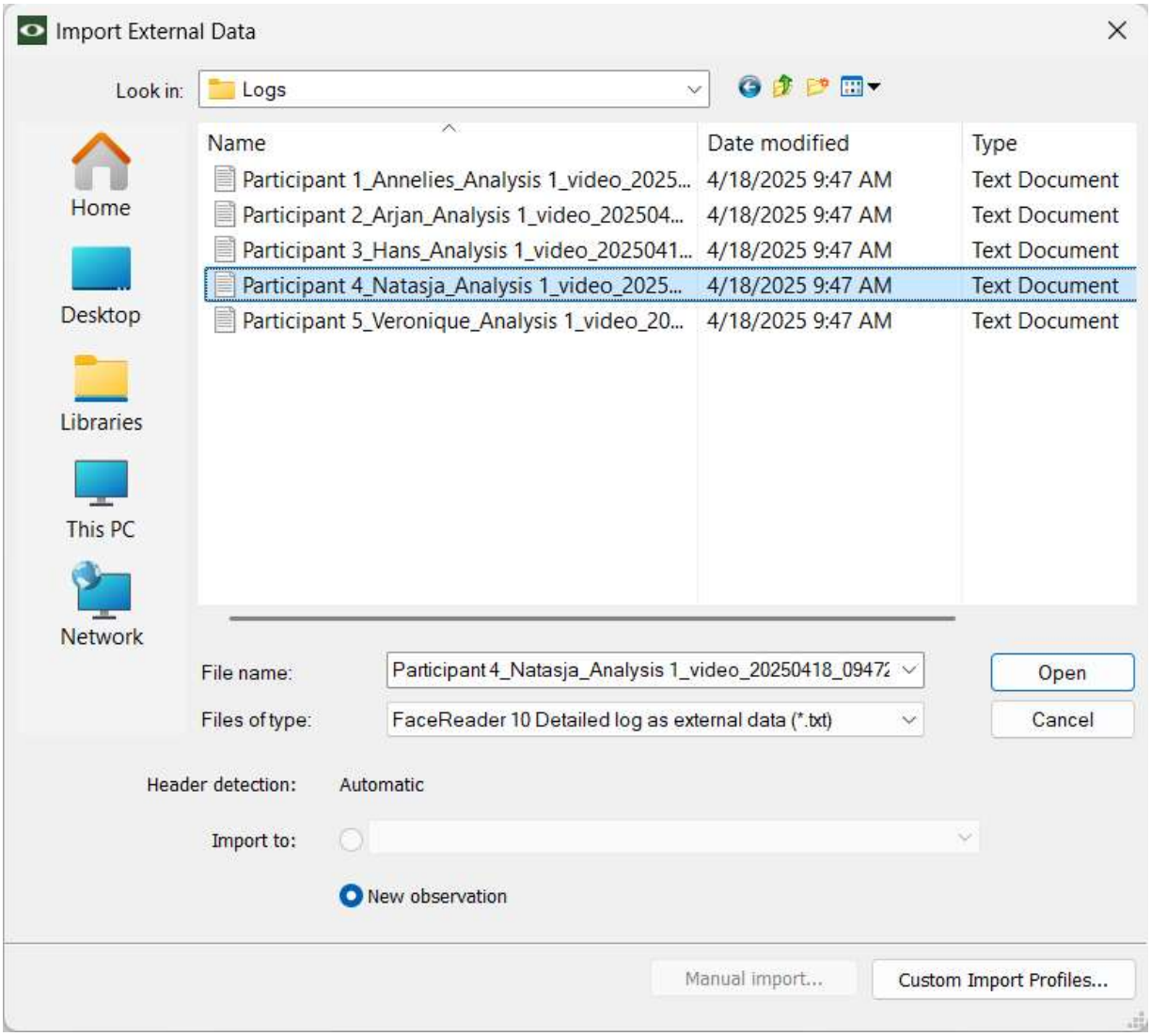
   The **ProgramData** folder is a hidden folder. To view this folder, browse to C:\ and from the **View** drop-down list select **Show** and then **Hidden items**.



You are now ready to import your log files into The Observer XT. To do so:

1. Choose **File** > **Import** > **External Data**.
2. In the **Files of type** field, select **FaceReader 10 Detailed log as external data (*.txt)** from the drop-down list.
3. Browse to the location on your computer where you stored your log file. The default location is:

   C:\Users\<your username>\Documents\Noldus\FaceReader 10\Projects\[project name]\Logs.
4. Select the observation into which you want to import the log file.
5. If a message appears that missing values are found, choose **Import and Ignore** > **OK**.



6. Select the appropriate log file and click **Open**. The data are imported into The Observer XT.

If you have additional modules and selected additional data when you exported the Detailed log data (like Action Units or Expressions from voice), you need to make a new import profile. See **External Data** in The Observer XT Help how to do so, or contact Noldus Support.

What's next

Synchronize the data sets. See **Carry out an observation/Synchronize data sets** in The Observer XT Help.

Notes

- **IMPORTANT** Importing FaceReader data adds FaceReader elements to the coding scheme. However, these elements cannot be scored in a new observation in The Observer XT. Make sure the FaceReader elements do not already exist in the coding scheme of The Observer XT.
- If you only import FaceReader data as external data into The Observer XT, the videos are not imported. Continue with Import FaceReader videos only
- If you import FaceReader data as .odx file into The Observer XT, the FaceReader independent variables and videos are also imported.
- If you Import the detailed logs as external data, they are imported as continuous values.
- You can calculate statistics like, e.g., the mean and maximum classification value for each of the facial expressions in The Observer XT. For more information see **Calculate Statistics** in The Observer XT Help.

Import FaceReader videos only

Aim

To import the videos of the test participants' faces into the observation in The Observer XT after you carried out the analysis.

Prerequisite

One of the following is true:

- You observe offline in The Observer XT.
- You control FaceReader with The Observer XT 14.0 or lower.
- You do not import FaceReader analyses as .odx files manually. When you import the .odx output of FaceReader analyses into The Observer XT, the FaceReader videos are also imported, so you can skip this topic.

Procedure

1. Open your observation in The Observer XT.
2. Click the **Import video** button on the toolbar.

3. Select your video file and click **OK**.
4. Synchronize the video file with the observation and imported FaceReader data. See **Carry out an observation/Synchronize data sets** in The Observer XT Help.

Import multiple FaceReader analyses into the same observation

Aim

To import analyses of different test participants from the same experiment into the same observation of The Observer XT. You are, for example, interested in the interaction between a doctor and a patient. You want to import the analysis results of both the doctor and the patient into the same observation in The Observer XT.

Prerequisites

- You are interested in the interaction between two or more test participants. For example, a doctor and a patient, a teacher and a pupil, or a parent and a child. You want to import their analyses together into the same observation of The Observer XT.
- You exported the FaceReader data as .odx files.

  See Export analysis results

Procedure

To be able to import multiple analyses into the same observation of The Observer XT, the exported FaceReader data must be converted. Conversion adds a Subject to the data. Conversion is done with the Subject labeler.

To install the Subject labeler

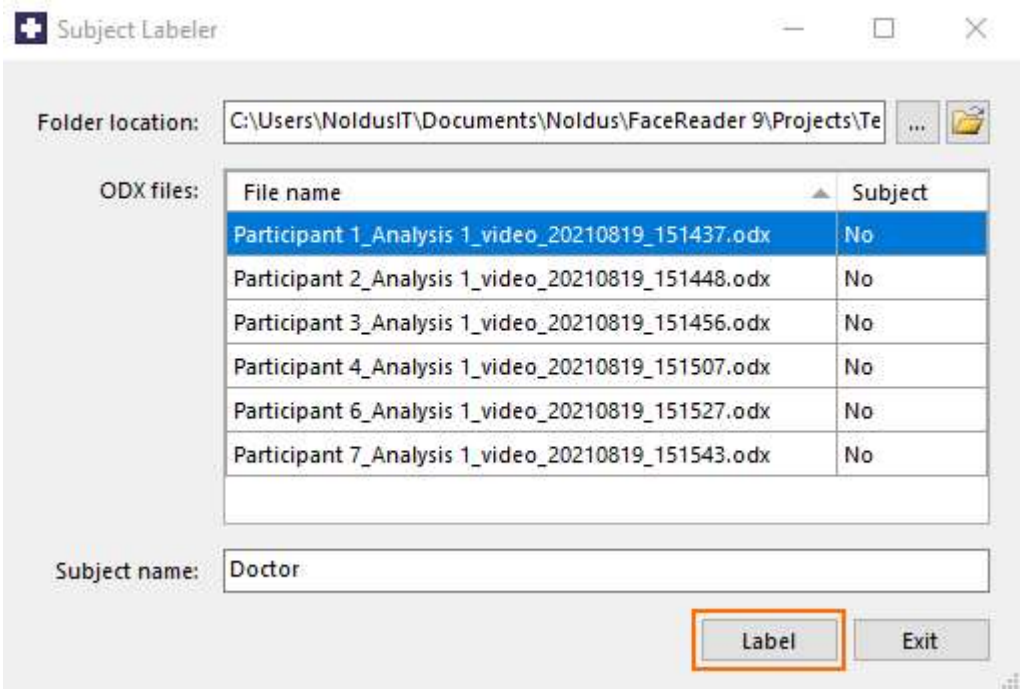
1. Download the installation file from the Drivers & Tools section of the MyNoldus portal (my.noldus.com).
2. Double-click the file *Subject Labeler Setup.exe*
3. Choose **Standard** as installation type and choose **Next**.
4. Accept the terms in the End-user license agreement and click **Install**.

To convert the export files

1. Open the Subject Labeler.
2. Browse to the folder that contains the FaceReader export files.

   The .odx files found in this folder are listed in the **ODX files** field. The **Subject** column shows whether a Subject is present in the export file or not.

3. Select the files to add the first Subject to. For example, the analyses of the doctors.
4. In the **Subject name** field, enter a name to add as Subject to the files, for example *Doctor*.
5. Click **Label.**

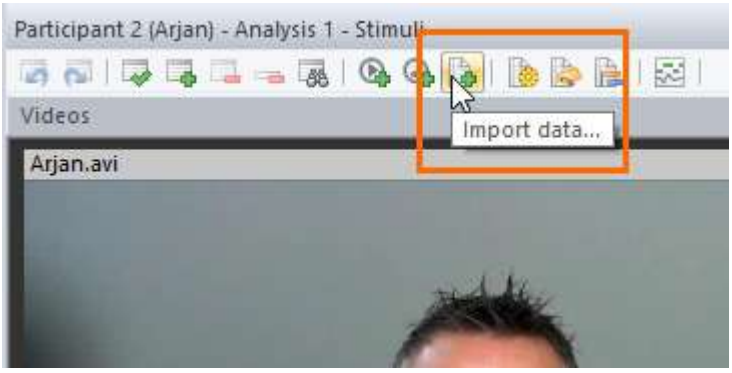


This adds the **Subject name** to the .odx file and the file name.

6. Repeat all steps for the other Subject, for example the analyses of the Patients.

To import the converted file into The Observer XT

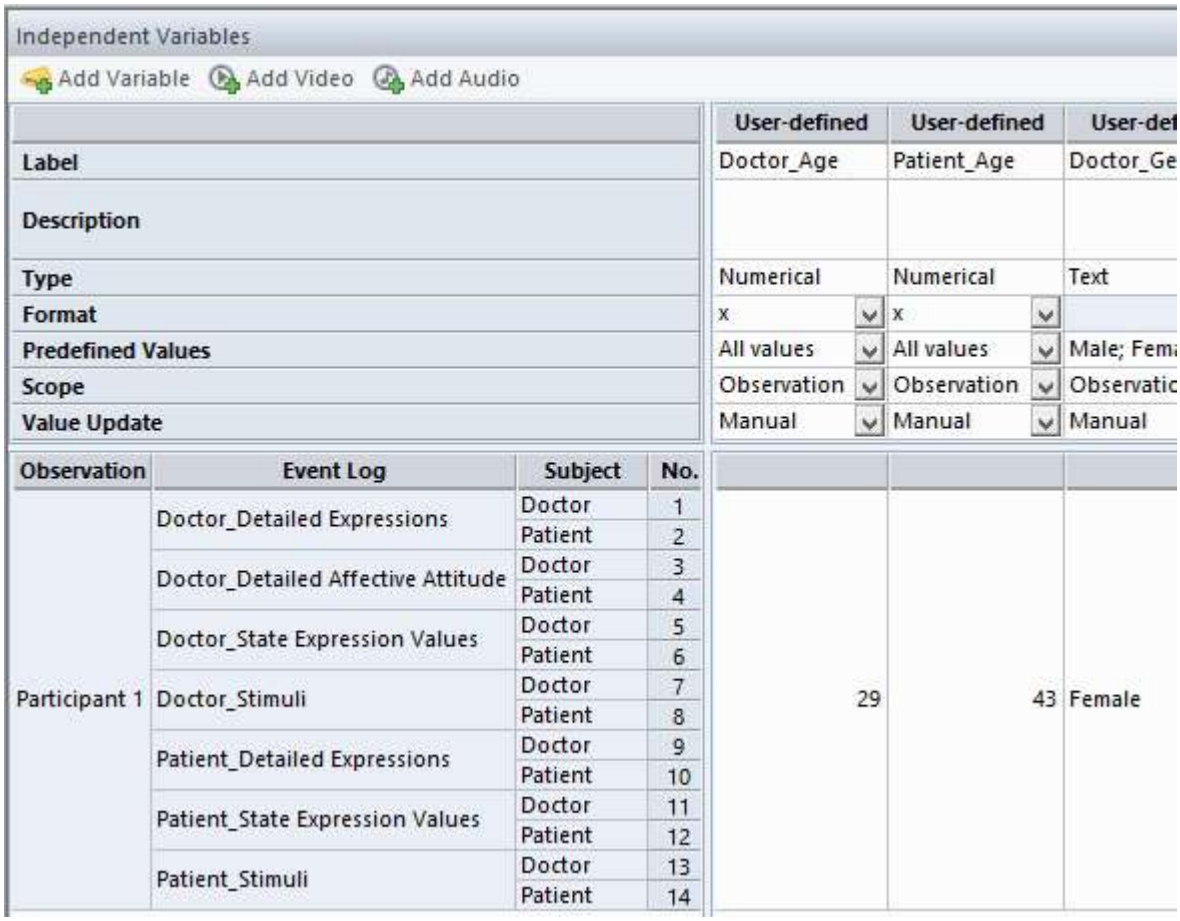
1. Open the observation.
2. Click the **Import data** button on the toolbar and choose **Import Observational Data**.



3. Browse to the converted file and select it. Then click **Open**.
4. If the question appears **Do you want to import new coding scheme elements**, click **Yes, import new coding scheme elements**.
5. A message appears that import is successful. Click **Close**.

Notes

- If an ODX file contains Subjects, it cannot be converted. FaceReader export files do not contain Subjects. However, The Observer XT export files may have Subjects.
- After conversion, the file appears in the **ODX files** field of the ODX converter. The **Status** column shows that this file contains a Subject and cannot be converted anymore.
- Importing multiple analyses into the same observation adds each FaceReader independent variable as a separate variable to the Independent Variables list of The Observer XT. Although the coding scheme contains Subjects, the independent variables have scope **Observation**.



- See **Set up your project**/ **Create Coding Scheme**/ **Subjects** in The Observer XT Help for more information on Subjects.

How FaceReader data are imported into The Observer XT

See Visualize FaceReader data in The Observer XT for a full overview of how FaceReader data appear in The Observer XT.

Event data

FaceReader event data are imported into The Observer XT as separate event logs within the observations. This is the case for the following FaceReader data:

- State Expression Values
- Facial States
- Stimuli
- Event markers
- Action Units (with the Action Unit Module, if you exported them to an odx file)
- Consumption Behavior events (*Intake event*, *Chewing* and *Chew motion*, with the Consumption Behavior Module)
- Gaze direction

Continuous data

Continuous data are imported into The Observer XT at a sample rate of 5 frames per second. Your license for The Observer XT must include the External Data Module. The following data can be imported as continuous data:

- Facial expression intensity values.
- Valence.
- Arousal.
- Head orientation (Pitch, Yaw, Roll).
- Head position (Horizontal, Vertical and Depth position).
- Gaze angle (Vertical and Horizontal gaze angle).
- Action Units (with the Action Unit Module, if you selected 'Export action units as continuous values' in the Settings and exported them in a Detailed log file).
- Heart rate, heart rate variability, and respiratory (breathing) rate (if your FaceReader license includes the Vital Signs Module).

- Custom Expressions (if your FaceReader license includes the Action Unit Module).
- Expressions from voice (including *Valence from voice*, *Arousal from voice*, *Loudness* and *Speech rate*, with the Voice Analysis Module).

Note

See Set up FaceReader to work with The Observer XT how to select the data to export from FaceReader and to import in The Observer XT.

Independent Variables

The FaceReader independent variables *Age*, *Gender* and *ParticipantID* are imported into The Observer XT together with the FaceReader data. The values for *Age* and *Gender* are estimated by FaceReader and the *ParticipantID* is the participant number automatically assigned by FaceReader. If the independent variables are not present yet in The Observer XT, they will be added to the **Independent Variables** list. If you created them as **User defined variables** in the **Independent Variables** list of The Observer XT (with the exact variable names as mentioned above) and no values are filled in yet before observation start, the FaceReader values are imported into the list after the end of the observation. If you already entered values in The Observer XT before observation start, these values are maintained. FaceReader does not overwrite the Independent Variable values in The Observer XT.

To enter the independent variable values in The Observer XT instead of importing the FaceReader values, create user defined independent variables *Age*, *Gender* and *ParticipantID* in The Observer XT. Make sure the names match exactly. Choose to enter the independent variables before starting the observation (Choose **Setup** > **Project Settings** > **Observation Settings** and choose **Before Observation** from the **Edit Independent Variables** list).

To import FaceReader independent variable values in the Independent Variables list of The Observer XT, the variable name must exactly match the FaceReader variable name. FaceReader contains by default the independent variables *Age, Gender* and *ParticipantID*. If you, for example, have an Independent Variable *age* in The Observer XT (lower case a instead of upper case), or *Participant ID* (with a space), a new Independent Variable *Age* or *ParticipantID* will be added to the Independent Variables list when you import the FaceReader data.

Notes

Duplicate elements

IMPORTANT Elements that are imported as events into The Observer should not already exist in the Coding Scheme of The Observer XT with the exact same name. As an example, you may have a mutually exclusive behavior group that contains the

behavior *Neutral*, or *Unknown*. If you import FaceReader emotional expressions into The Observer XT, the expressions *Neutral*, or *Unknown* will then be scored for the behavior group that was already present in the Coding Scheme and will not be present in the imported event log **State Expression Values**. Therefore both the event log with the manual annotations and the event log State Expression Values will be incorrect.

Sample rate

FaceReader data are imported into The Observer XT with a sample rate of 5 frames per second. This is to limit the amount of data that is transferred to The Observer XT. FaceReader itself samples with the camera frame rate and converts the data to a sample rate of 15 frames per second after the analysis is finished. Therefore, the data in The Observer XT may differ slightly from the analysis results in FaceReader.

See Camera frame rate and samples in FaceReader in Set up your project

Vital signs

If your FaceReader license includes the Vital Signs Module, FaceReader can estimate the test participants' heart rate, heart rate variability, and respiratory (breathing) rate. These data can be imported real-time in The Observer XT.

In FaceReader, the first 15 seconds of the analysis is used for calibration and the heart rate and breathing rate data are post-processed after the analysis is finished. The Observer XT imports the heart rate and breathing rate data real-time. Therefore, the heart rate and breathing rate data of the first ten seconds that are imported into The Observer XT contain data that are not yet calibrated. The data that are imported are not post-processed and will differ from the FaceReader data. Since post-processing is used to re-calculate the data, based on the calibration, the data in FaceReader itself are more reliable.

Whereas for heart rate the first 8.5 seconds of an analysis are post-processed after the analysis is finished, for breathing rate this is 15 seconds and for heart rate variability this is the first 5 minutes (or even longer).

See Vital Signs Module

Event log duration

- There will be a slight delay between the moment you start an observation in The Observer XT and the moment FaceReader starts analyzing. Since the end of all event logs is determined by the end of the observation, the FaceReader event log will have a shorter duration than The Observer XT event log in the analysis. This is caused by the offset between the event logs.
- The observation in The Observer XT ends when you click the stop observation button. However, the FaceReader analysis will stop when you

confirm to the message in The Observer XT **Are you sure you want to stop the observation?** Therefore the FaceReader event log will be longer than The Observer XT event log. However the event log duration in the analysis is determined by the end of the observation (see the previous bullet).

Visualize FaceReader data in The Observer XT

State Expression values

State Expression values are imported into the observation as a separate event log. When you open the coding scheme, you will see that a behavioral group **Dominant Expressions** has been added with the six basic expressions, **Contempt (optionally)**, the **Neutral** state plus **Unknown** and **Not Analyzed** as behaviors. **Unknown** is the expression that is logged when FaceReader cannot find or model the face. See the figure below for a visualization of imported State log values.

Event Markers and Stimuli

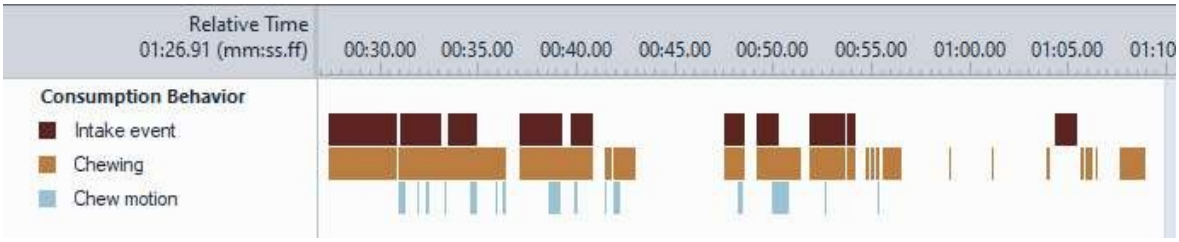
Event Markers and Stimuli are imported as separate event logs into the observation. They are added to the Coding Scheme as behavior groups **Event Markers** and **Stimuli**. See the figure below for an example of a visualization of imported Event Markers and Stimuli.

Facial States and Global Gaze Direction

If you imported Facial States or Global Gaze Direction in The Observer XT, the new observation contains an extra Event log: **Facial States**. The behavioral group **Facial States** has been added to the coding scheme containing the states as State Events with modifiers. For example the State **Left eye** has the modifiers **Open** and **Closed**.

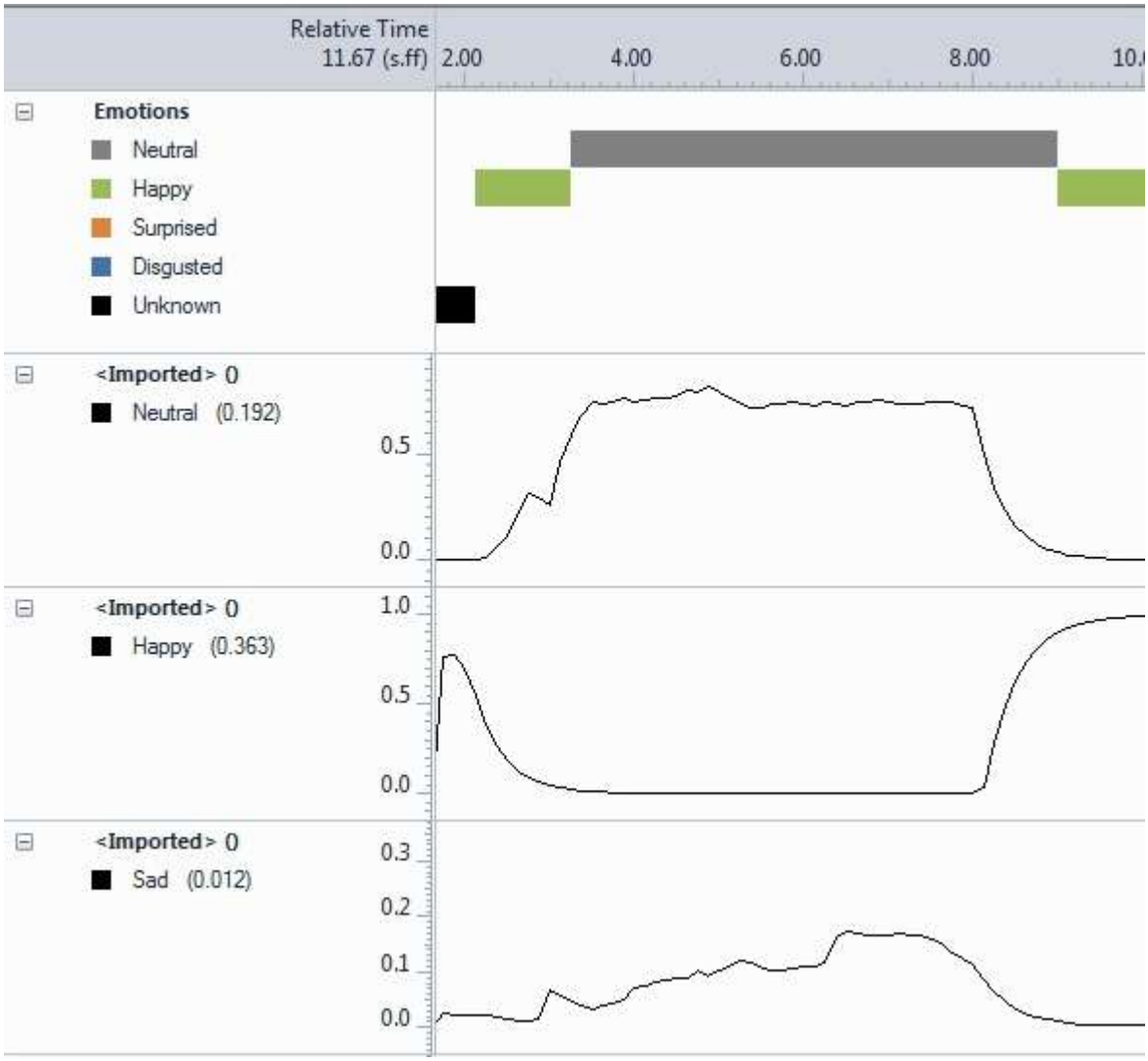
Consumption Behavior data

If you imported a Detailed log file with Consumption Behavior events in The Observer XT, the new observation contains an extra Event log: **Consumption Behavior**. The behavioral group **Consumption Behavior** has been added to the coding scheme containing the states as State Events.



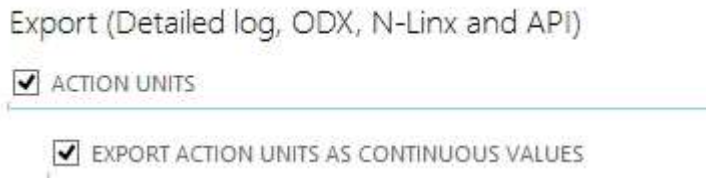
Continuous data

Continuous data are shown as a continuous graphs when you use FaceReader and The Observer XT 13 or higher versions with N-Linx, or imported the detailed log as external data into The Observer XT. Your license for The Observer XT must include the External Data Module.

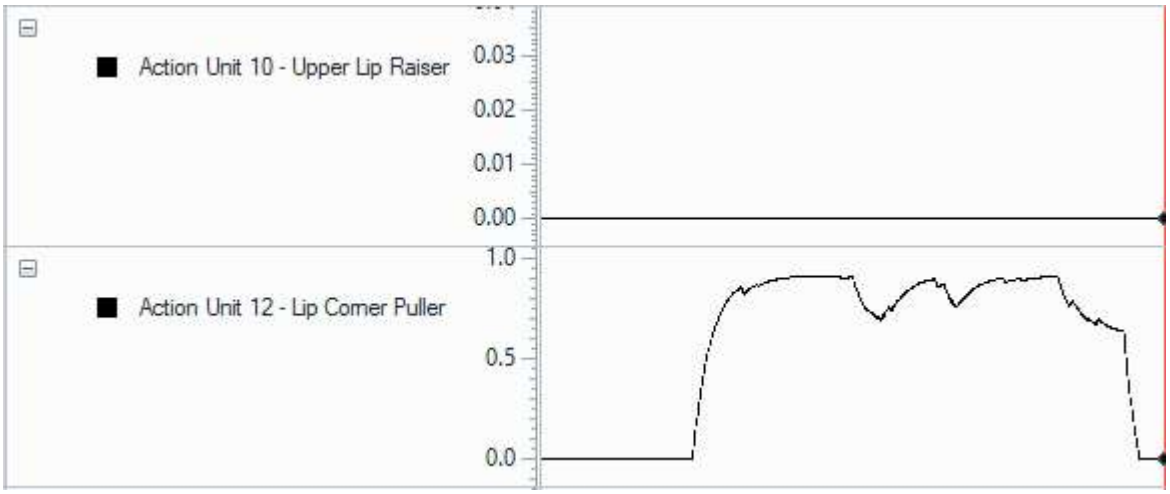


Action Unit Intensities as continuous data

This option is only available if your FaceReader license includes the Action Unit Module. In addition to this, you chose to export Action Units as continuous values in the **Data export** tab of the FaceReader **Settings** window (**File** > **Settings**).

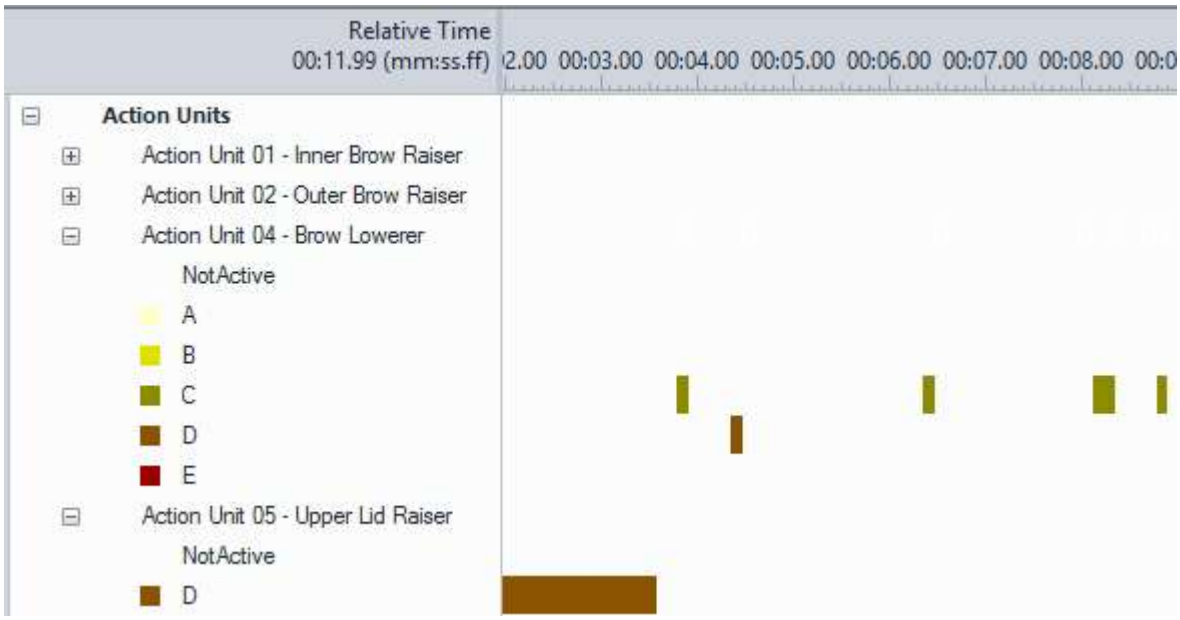


You imported the detailed log into The Observer XT as external data. The Action Unit intensities are displayed as continuous graphs.



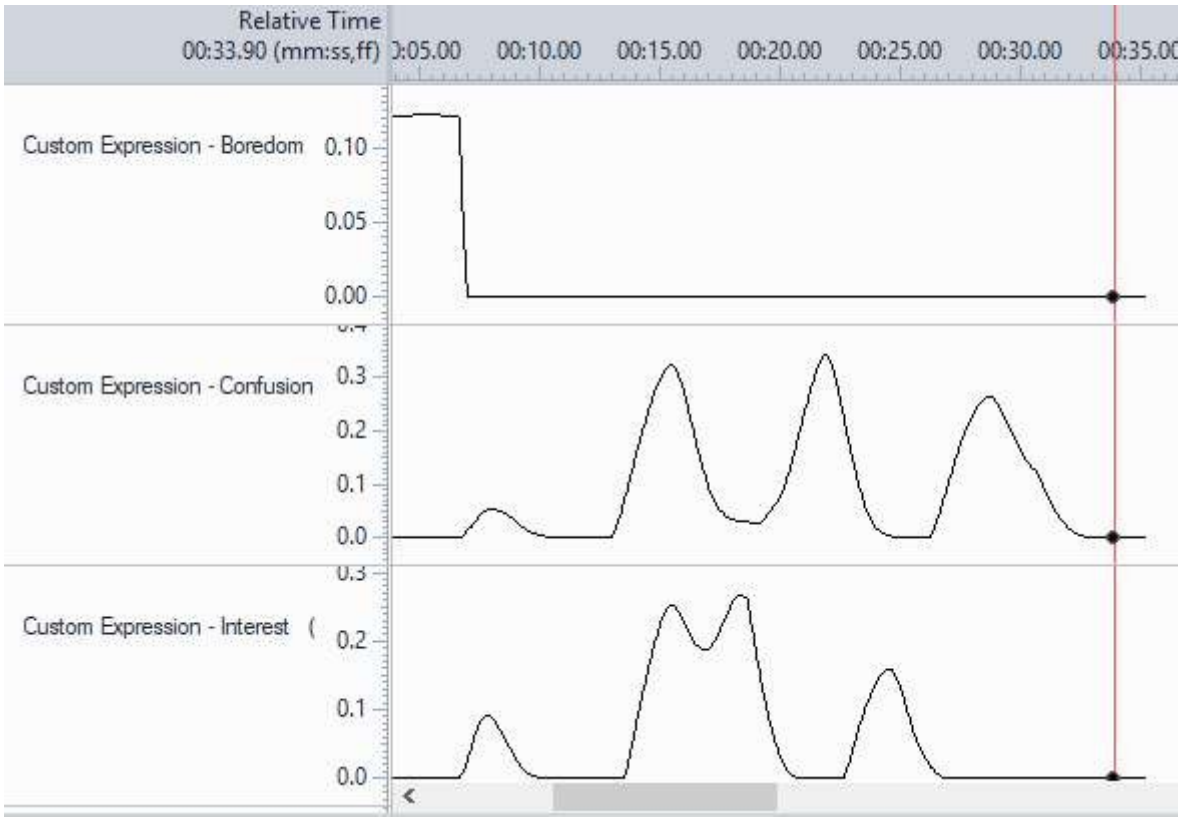
Action Units as observational data

This option is only available if you have the Action Unit Module in FaceReader. If you imported the detailed log as odx file, or used FaceReader and The Observer XT with N-Linx, the Action Units are imported as a separate event log in the observation. The Coding Scheme contains a behavior group **Action Units** with the modifier group **Activation intensity** that contains the intensities **A** to **E**. See the figure below for an example of a visualization. Click the **+** sign next to an Action Unit to visualize its intensity values (A, B,...).



Custom Expression intensities as continuous data

This option is only available if your FaceReader license includes the Action Unit Module. You imported the detailed log into The Observer XT as external data (either via the N-Linx protocol or manually). The Custom Expression intensities are displayed as continuous graphs.



Expressions from voice intensities as continuous data

This option is only available if your FaceReader license includes the Voice Analysis Module. You imported a detailed log file into The Observer XT (either via the N-Linx protocol or manually). The **Expressions from voice** are displayed as continuous graphs, one for each expression and graphs for *Valence from voice*, *Arousal from voice*, *Loudness* and *Speech rate*.

Data selection and statistical analysis

You can use the imported data for data selection and statistical analysis. For example to select the time period over which *Stimulus 1* was scored and to analyze the facial expressions over this time period. For more information on Data selection and statistical analysis, see The Observer XT Help.

The Observer XT sample projects with FaceReader data

On the MyNoldus portal of the Noldus website (my.noldus.com) under The Observer XT > Downloads > Sample projects, you can find two sample projects with FaceReader data for The Observer XT.

Child FaceReader

In this sample project the facial expressions of a child playing an online game are recorded in a media file and analyzed with FaceReader. Simultaneously, the Noldus screen capture device is used to create a media file of the monitor. With an Event marker the time intervals during which the child looks away were marked in Facereader. FaceReader data, with Action Units, Stimuli and Event markers, and video files were imported into The Observer XT.

For a full description of this sample project you can download the PDF file "Description of sample projects of The Observer XT - psychology usability ergonomics" from The Observer XT section of the Noldus website. You need to register and login to be able to download this file.

https://my.noldus.com

FaceReader & The Observer

In this sample project two test participants test the taste of three fruit juices. The time periods after the test participants drank each fruit juice were marked with Event markers. Each participant has been videotaped with two cameras, a webcam (for analysis in FaceReader) and a camcorder (to see what cup the participant takes). The FaceReader log files (Observer log and Detailed log), with Action Units, Stimuli and Event markers, have been imported into The Observer XT. The test participants' behavior has been manually scored.

In the Data profile Intervals by fruit juices, the time intervals after the participants drank each fruit juice were separated using the imported FaceReader Event markers Fruit juice 1, Fruit juice 2 and Fruit juice 3, respectively.

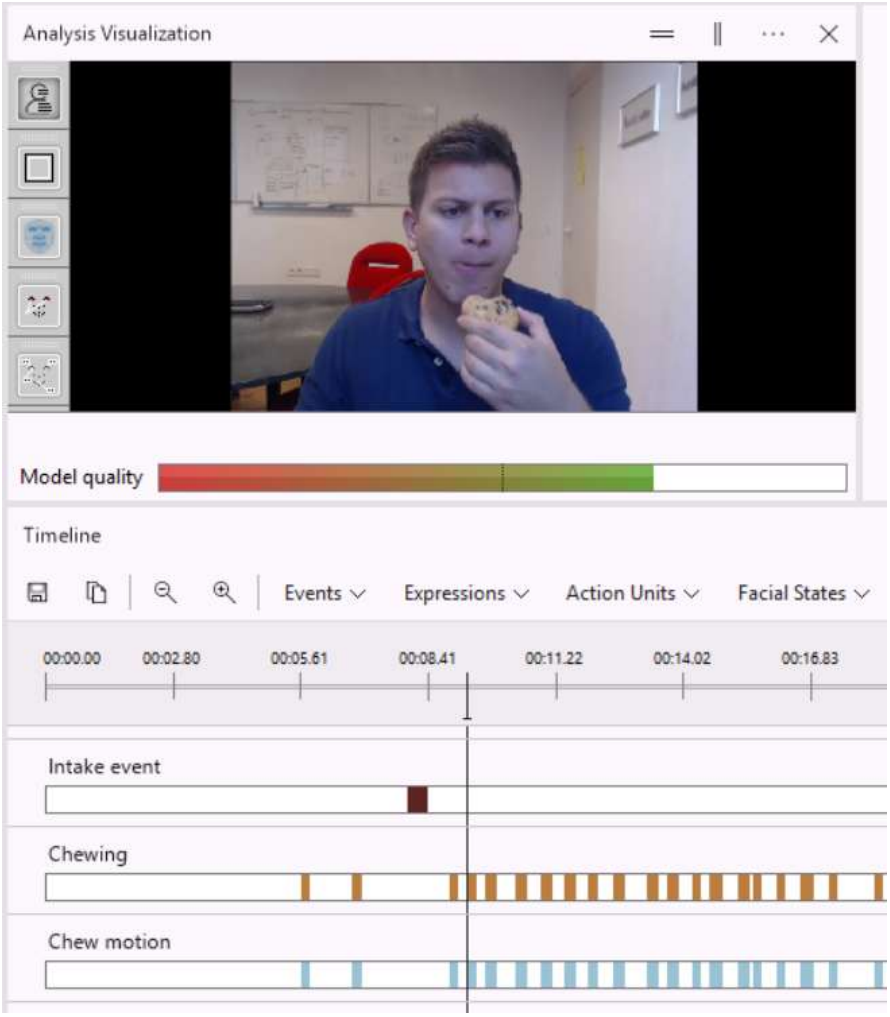
Under Behavior Analysis, you can find the archived Behavior Analysis State Expression Values per fruit juice, with an accompanying chart. For this Behavior analysis the data profile 'Intervals by fruit juices' was used.

Video files

You can download the associated media files from the MyNoldus portal. Before opening the sample projects, make sure to copy the media files to the default **Video files** folder of The Observer XT:

C:\Users\Public\Public Documents\Noldus\The Observer XT\Video Files.

The Consumption Behavior Module



Main topics

- Introduction to the Consumption Behavior Module
- Analyze Consumption Behavior
- Visualize Consumption Behavior

Introduction to the Consumption Behavior Module

The Consumption Behavior Module allows you to analyze the behaviors Intake event, Chewing and Chew motion.

Intake event is taking a bite or sip. Chew motion is one movement of the jaws to chew the food in the mouth. Chewing is the state from the first chew motion (after taking a bite) till the last chew motion (before swallowing the food).

Please note that you cannot combine the Consumption Behavior Module with Baby FaceReader and you cannot analyze consumption behavior in a multi-subject analysis.

Guidelines

To make sure that analysis of consumption behavior goes well, it is important that not only the face but also the test participant's hands are visible in the camera view. Currently, FaceReader can only detect hands and no cutlery, hence, the hands entering the face region is important for FaceReader to detect eating behavior. Wiping the mouth can yield a false positive intake event.

To detect drinking behavior, FaceReader uses images of cups, not straws. Hence, it is important not to use straws in your experiments.

Analyze Consumption Behavior

Aim

To switch on Consumption Behavior analysis.

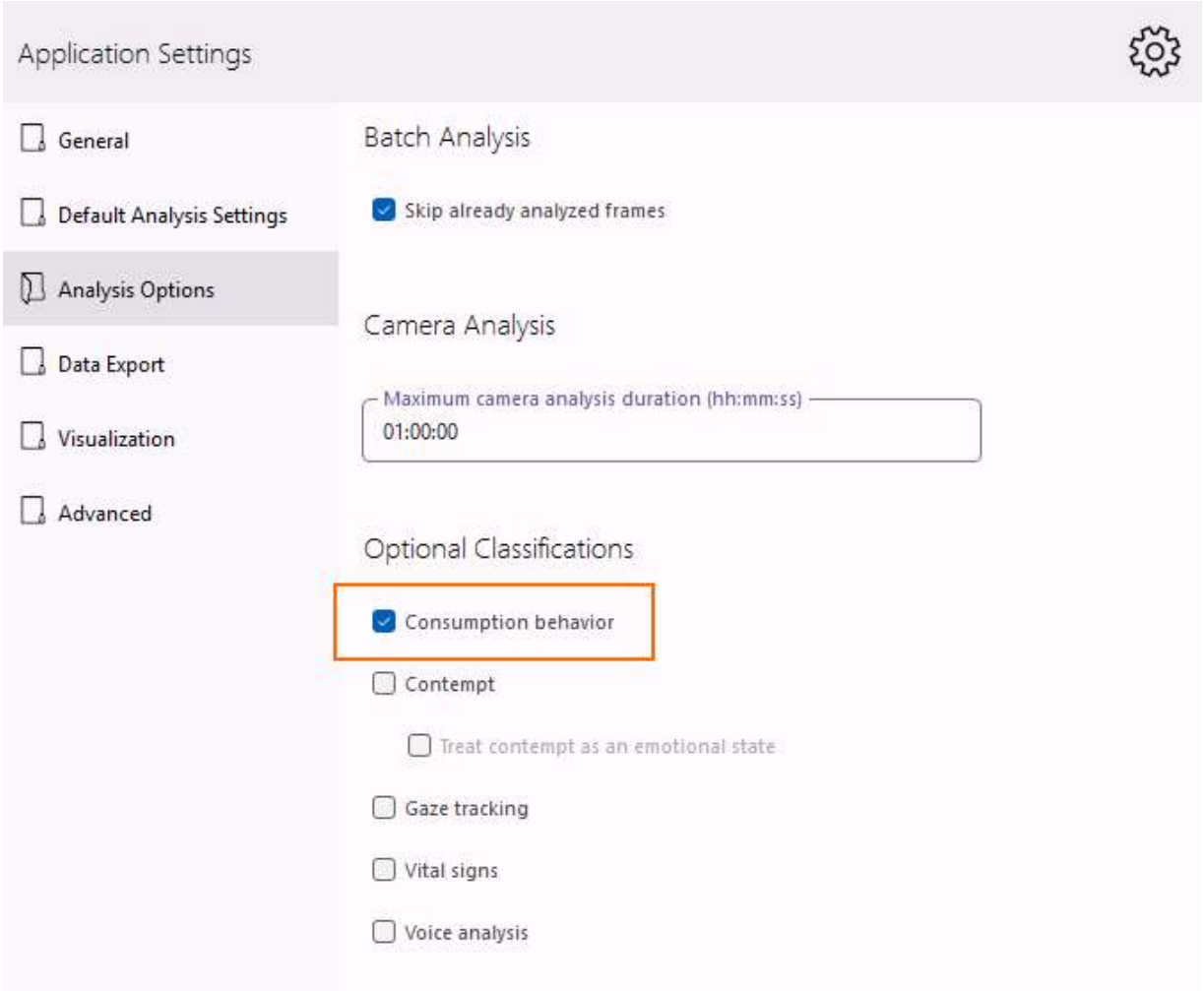
Prerequisite

- You have the regular version of FaceReader with the Consumption Behavior Module.
- From the participant, both the face and the hands are visible.
- You followed the Guidelines for good analysis.

Procedure

1. Choose **File** > **Settings** > **Analysis options**.

2. Under **Optional Classifications**, select **Consumption behavior**.



Visualize Consumption Behavior

Aim

To display the Consumption Behavior during or after the analysis.

Prerequisites

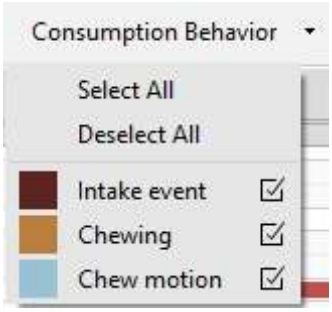
- You have the regular version of FaceReader and your license includes the Consumption Behavior Module.
- Consumption Behavior analysis is switched on in the Settings.

  See Analyze Consumption Behavior

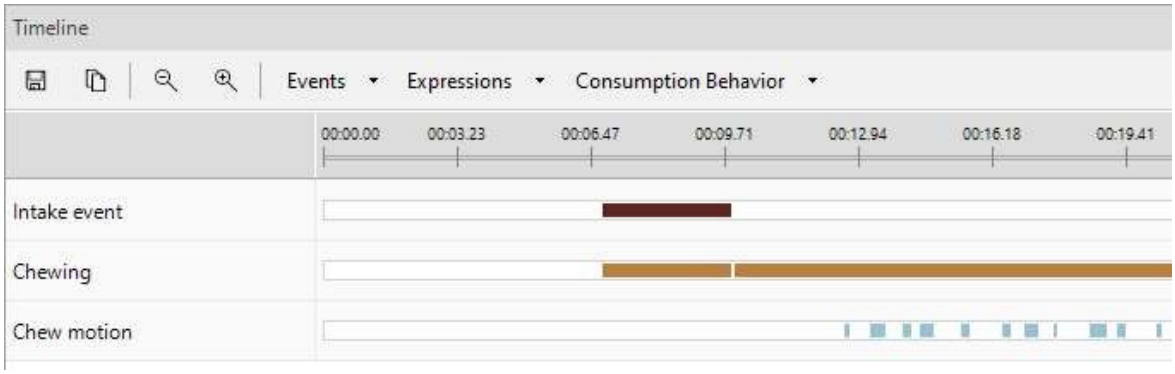
Consumption Behavior on the Timeline

1. Click the **Select window** button in one of the visualization windows and select **Timeline**. The **Timeline** window opens. The Timeline gives an overview of the Facial Expressions States, and Optional classifications on a timeline.

2. From the **Consumption Behavior** drop-down list, select what behaviors you want to view.



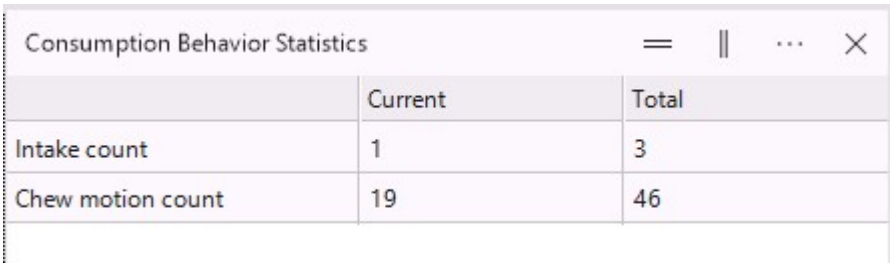
You can play back through the timeline together with playing back the analyzed video.



Consumption Behavior Statistics

1. Click the **Select window** button in one of the visualization windows and select **Consumer Behavior** and then **Consumption Behavior Statistics**.

   The table displays the number of intake events (bites and sips) and chew motions. The **Current** column displays the numbers up to the current moment in the analysis. During the analysis, the **Total** column displays the numbers up to the current moment in the analysis. After the analysis, the **Total** column displays the numbers in the entire analysis.



	Current	Total
Intake count	1	3
Chew motion count	19	46

Export Consumption Behavior events

Aim

To export the Consumption Behavior events (*Intake event*, *Chewing*, *Chew motion*) to a text file, Excel file or The Observer XT format file.

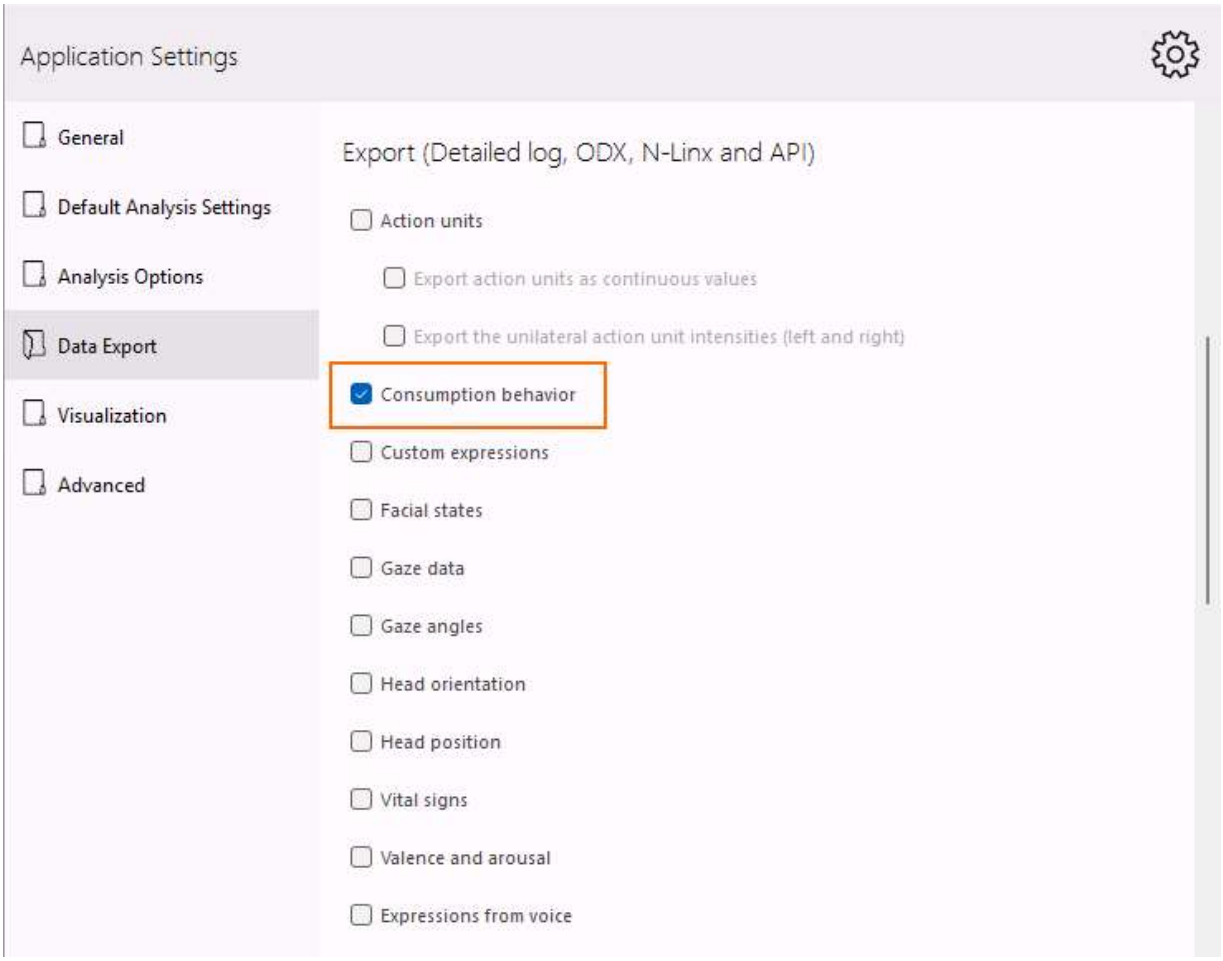
Prerequisites

- Your FaceReader license includes the Consumption Behavior Module.
- Consumption Behavior analysis is switched on in the Settings.

  See Analyze Consumption Behavior

Procedure

1. Choose **File** > **Settings** and then click the **Data Export** tab.
2. Under **Export (Detailed log, ODX, N-Linx and API)**, select **Consumption behavior**.



If you like, you can export the *Consumption behavior events* together with the *Consumption behavior statistics* (*Intake count* and *Chew motion count*) in one log file. In that case under **Export (Detailed log and API)**, also select **Consumption behavior statistics**. See Export Consumption Behavior statistics.

3. Choose **File** > **Export** and select one of the three options.

   See Export the data in FaceReader's output

4. Choose the folder in which to save your log files and click **Select Folder**.
5. From the **Log type** drop-down list select the format of your log files, either Excel format or text.
6. Select **Save detailed log** or **Save The Observer XT log** if you want to open your log files in The Observer XT. Then click **OK**.

The log files contain three columns (in addition to the columns with the intensities of the facial expressions) with the Consumption behavior events ('Intake event',

'Chew motion' and 'Chewing') and for each exported sample 'Yes' or 'No' to indicate whether the behavior was active or not.

13	Video Time	Intake event	Chewing	Chew motion
14	00:00:00.000	No	No	No
15	00:00:01.000	No	No	No
16	00:00:02.000	No	No	No
17	00:00:03.000	No	No	No
18	00:00:04.000	No	No	No
19	00:00:05.000	No	No	No
20	00:00:06.000	No	No	No
21	00:00:07.000	Yes	No	No
22	00:00:08.000	Yes	No	No
23	00:00:09.000	Yes	No	No
24	00:00:10.000	No	No	No
25	00:00:11.000	No	No	No
26	00:00:12.000	No	No	No
27	00:00:13.000	No	No	No
28	00:00:14.000	No	No	No
29	00:00:15.000	No	No	No
30	00:00:16.000	No	No	No
31	00:00:17.000	No	No	No
32	00:00:18.000	No	No	No
33	00:00:19.000	No	No	No
34	00:00:20.000	No	No	No
35	00:00:21.000	No	No	No
36	00:00:22.000	Yes	No	No
37	00:00:23.000	Yes	Yes	Yes
38	00:00:24.000	No	No	No
39	00:00:25.000	No	No	No

Export Consumption Behavior statistics

Aim

To export the Consumption Behavior statistics (*Intake count* and *Chew motion count*) to a text file or Excel file.

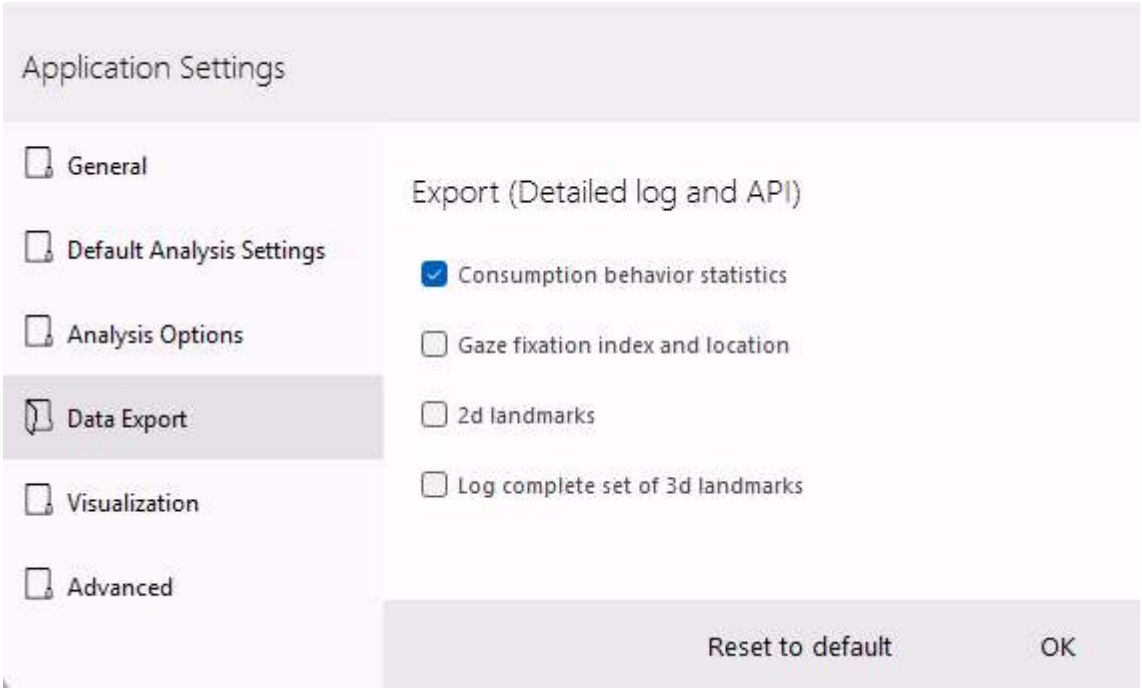
Prerequisites

- Your FaceReader license includes the Consumption Behavior Module.
- Consumption Behavior analysis is switched on in the Settings.

  See Analyze Consumption Behavior

Procedure

1. Choose **File** > **Settings** and then click the **Data Export** tab.
2. Under **Export (Detailed log and API)**, select **Consumption behavior statistics**.



If you like, you can export the *Consumption behavior statistics* together with the *Consumption behavior events* (*Intake event, Chewing* and *Chew motion*) in one log file. In that case under **Export (Detailed log, ODX, N-Linx and API)** also select **Consumption behavior**. See Export Consumption Behavior events.

3. Choose **File** > **Export** and select one of the three options.

   See Export the data in FaceReader's output

4. Choose the folder in which to save your log files and click **Select Folder**.
5. From the **Log type** drop-down list select the format of your log files, either Excel format or text. Choose *Text files* if you want to import the log files into The Observer XT.
6. Select **Save detailed log** and click **OK**.

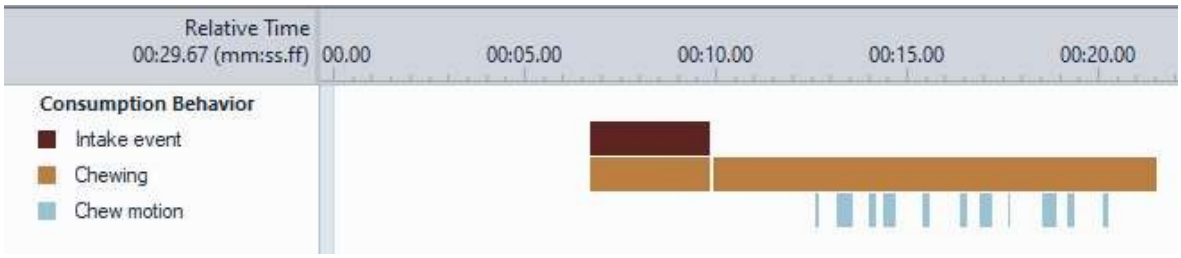
The log files contain two column (in addition to the columns with the intensities of the facial expressions) with the Consumption behavior statistics ('Intake count' and 'Chew motion count') with for each analyzed frame the total number of intake/chew motion events up until that point in time.

13	Video Time	Intake count	Chew motion count
14	00:00:00.000	0	0
15	00:00:01.000	0	0
16	00:00:02.000	0	0
17	00:00:03.000	0	0
18	00:00:04.000	0	0
19	00:00:05.000	0	0
20	00:00:06.000	0	0
21	00:00:07.000	1	0
22	00:00:08.000	1	0
23	00:00:09.000	1	0
24	00:00:10.000	1	0
25	00:00:11.000	1	0
26	00:00:12.000	1	0
27	00:00:13.000	1	0
28	00:00:14.000	1	0
29	00:00:15.000	1	0
30	00:00:16.000	1	0
31	00:00:17.000	1	0
32	00:00:18.000	1	0
33	00:00:19.000	1	0
34	00:00:20.000	1	0
35	00:00:21.000	1	0
36	00:00:22.000	2	0
37	00:00:23.000	2	0
38	00:00:24.000	2	0
39	00:00:25.000	2	0

Consumption behavior data in The Observer XT

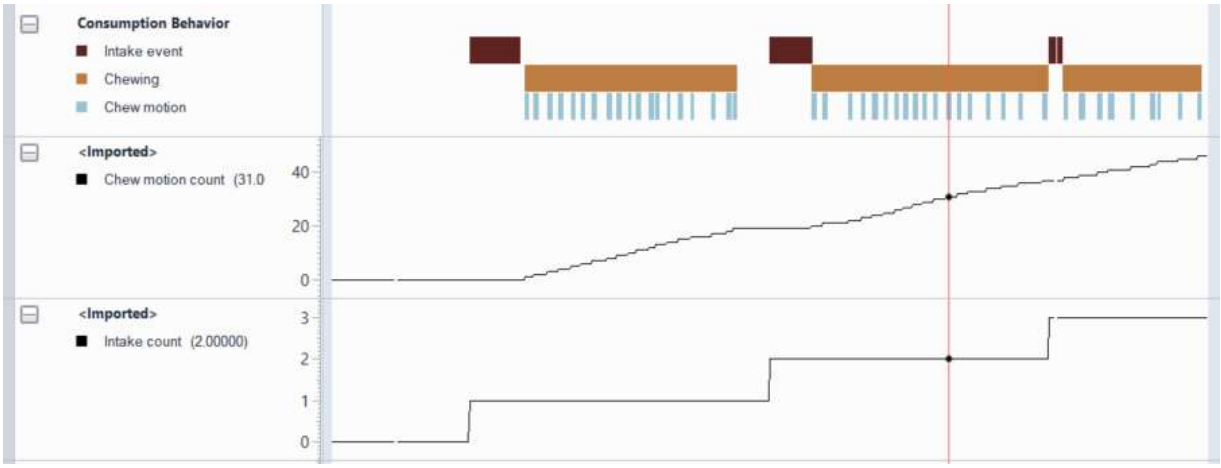
Consumption behavior events

If you send FaceReader data to The Observer XT 13 or higher versions using the N-Linx network communication protocol or export the Consumption behavior events as *.odx data and import them into The Observer, they are imported as event log data. A new behavioral group (**Consumption Behavior)** is added to the coding scheme.



Consumption behavior statistics

You can also import the Consumption behavior statistics into The Observer XT, either automatically using the N-Linx protocol or manually by importing your Detailed log files as external data.



Video and image formats

Main topics

- Supported video formats
- Other video formats
- Unsupported video formats
- Video length, duration and number of samples
- Supported Image formats

Supported video formats

FaceReader supports the following video formats:

Container	Code	Name/Encoder
mpg	mpg1	MPEG-1 Part 2
mpg	mpg2	MPEG-2
mpg	H264	H.264/ MPEG-4
mpg	H265	H.265/ MPEG-4
vob (DVD)	mpg2	MPEG-2
mp4	mp4v	MPEG-4 Video
mov	mp4v	MPEG-4 Quicktime
avi	XVID	XviD ISO MPEG-4
avi	XVID	XviD 1.1.0 Final
avi	DIB (_RGB)	BI_RGB Raw Bitmap
avi	DIV3	DivX 3 Low-Motion
avi	DIV5	DivX 5.x/6.x
avi	DIVX	DivX 4
avi	dvsd	DVC/DV Video
avi	DX50	DivX 6.0.0
avi	DX50	DivX 5.x
avi	CRAM	Microsoft Video 1
avi	cvid	Cinepak
avi	IV32	Indeo 3.x
avi	MJPG	Motion JPEG
avi	MP42	S-MPEG 4 version 2
avi	WMV3	WMP v9 (VC-1 Simple/Main)
asf (.wmv)	WMV1	WMP v7
asf (.wmv)	WMV2	WMP v8

Container	Code	Name/Encoder
asf (.wmv)	WMV3	WMP v9 (VC-1 Simple/Main)
asf	MP43	S-Mpeg 4 version 3
3gp	s263	ITU H.263 video (3GPP)

Notes

- The container is not the same as the file extension. Different containers can have the same file extension.
- If you are not sure what the format of your video files is, you can use a program like GSpot to find this out.To download GSpot (free of charge):

http://www.headbands.com/gspot

Video file extensions in Project wizard

The following video file extensions can be used in combination with the project wizard:

- .mpg
- .mpeg
- .avi
- .wmv
- .mov
- .asf
- .3gp
- .vob
- .mp4
- .mkv
- .flv

Other video formats

For a number of other formats, codecs are included, but these formats have not been tested. We can, therefore, not guarantee that they work.

Container	Code	Name/Encoder
avi	DIV1, DIV2, mp41, MPG4, MPG3	Divx (1,2,3)
avi	DIV4, DIV6, col1,col0,3ivd	DivX 4, 5, 6, 3ivx D4, MPEG-4
avi	h261	H.261
avi	h262	H.262
avi	h263	H.263/H.263i
avi	h264, s264, AVC1, DAVC, H264, X264, VSSH	
avi	IV31	Indeo Video 3
avi	mp4s, m4s2, fmp4, 3iv2, smp4	MPEG-4 Part 2 (AVP), Xvid
avi	SVQ 1	Sorenson 1 (Quicktime)
avi	SVQ 3	Sorenson 3 (Quicktime)
avi	VP31, VP30, VP3	On2 VP3
avi	VP50, VP5, VP51	On2 VP5
avi	VP60, VP61, VP62, VP6F, VP6A	On2 VP6 (used by FLV)
flv	FSV1	Flash Screen Video
mpg	mp2v, mpg2, vcr2, hdv1, hdv2, hdv3, mx*n, mx*p	MPEG-2 Part 2
mpg	mpeg, mp1v, PIM1	MPEG-1 Part 2
rm	RV10, RV13, RV20	Real Video 1.0, 1.3, 2.0
wmv	wmv1, wmv2	WMV 1/2 (7/8)
wmv	wmv3, wvc1, wmva	WMV 3/WMV-9/VC-1*

* Not all profiles are supported.

Unsupported video formats

The following codecs are not included and installing them yourself will not work:

Container	Code	Name/Encoder
avi	IV50, IV51	Indeo 5.x
avi	tscc	TechSmith Screen Capture
avi	IV41	Indeo 4.x
avi	I263	H.263
avi	cvid(_RGB)	BI_RGB Raw Bitmap
avi	(_RGB)	BI_RGB Raw Bitmap (8bit)
mp4	avc1	MPEG-4 AVC
mov	3IV1	3ivx (MPEG-4 based)
mov	svq3	Unknown
mov	avc1	MPEG-4 AVC

Video length, duration and number of samples

For some video formats, FaceReader may have a slightly different calculation of the video length, duration, or number of samples than other video programs, like, for example, Windows Media Player. This is the case in the following cases:

The frame information in the video is incorrect – Somehow the information on video duration, number of video frames and video frame rate do not agree. If this is the case, FaceReader calculates the frame rate from the number of frames and the duration of the video file. This may slightly differ from how other programs calculate this information.

The video frame rate varies – If this is the case, FaceReader calculates the average frame rate over the entire video.

If the way FaceReader calculates the video information leads to analysis problems, convert the videos with a converter based on FFMPEG. For example, use WinFF.

http://winff.org/html_new/

Supported Image formats

The minimum dimensions of your images should be about 640 x 480 pixels (120 x 120 minimally for the face area, 200 x 200 is recommended). For FaceReader to work at a reasonable speed, the maximum dimensions should not be greater than about 2000 x 2000 pixels.

FaceReader supports the following image formats:

- JPG
- BMP
- GIF
- TIF
- PNG

Animated GIFs are not supported, FaceReader uses the first frame of the animated GIF.

Image file extensions in Project Wizard

The following image file formats can be used in combination with the project wizard:

- .bmp
- .jpg
- .jpeg
- .jpe
- .jfif
- .png
- .gif
- .tiff
- .tif

Keyboard shortcuts

Keyboard shortcuts allow you to activate the functions in FaceReader that are on the menu. With keyboard shortcuts you can use FaceReader without taking your hands off the keyboard. Using keyboard shortcuts can help in the prevention of repetitive strain injury.

General

Ctrl+O	Open Project
Ctrl+Q	Close Project
Ctrl+S	Save Project
Ctrl+Shift+S	Save Project As
Alt+F4	Exit

Participant menu

Ctrl+Shift+P	Add Participant
Ctrl+Shift+V	Add video analysis
Ctrl+Shift+C	Add camera analysis
Ctrl+Shift+I	Add image analysis

Technical support

FaceReader Help

To open FaceReader Help, press **F1** or choose **Help** > **Help**. There is also a shortcut to FaceReader Help on the desktop and in the Start menu of the computer with FaceReader. Use the Search function to find information on the topic you are looking for.

Help menu

FaceReader's Help menu contains the following options:

- **Help** – Opens the FaceReader Help.
- **Noldus Online**

- **FaceReader Home Page** — Links to the FaceReader section on the Noldus website.

- **Check for Updates** — Brings you to the MyNoldus section on the Noldus website. Create a new account or log into your existing account. Under **Downloads** click on **Software and documentation** and check whether there are updates available.

- **Contact Help Desk** — Brings you to the MyNoldus section on the Noldus website. Create a new account or log into your existing account. Under **Get support** you will find the contact details of the help desk in your region, you can view the status of your current support cases or submit a new support case.

- **Customer Support Center** — Brings you to the MyNoldus section on the Noldus website. Create a new account or log into your existing account. On your MyNoldus page you can find the licenses and NoldusCare contracts associated with your account, you can download the latest version of the software, manuals and sample projects, contact Support or request a Sales visit.

- **Report an Issue** — You are forwarded to an online form where you can report your issue. Noldus Support will contact you after they received the form.

- **FaceReader Online** — This is a link to the FaceReader Online section on the Noldus website.
- **FaceReader SDK** — This brings you to the FaceReader SDK portal. You can fill out an SDK (software development kit) request form.
- **License**

  - **Deactivate** — This option is available if you activated FaceReader with a software license key. See Deactivate your FaceReader license for the procedure to follow.

  - **Upgrade** — Clicking this option opens the **Upgrade Key** dialog box. The dialog box contains your license number. It opens automatically when you start FaceReader for the first time after installation and FaceReader detects that you have a hardware key for an earlier version. See Upgrade the license.

- **About** – Choose this option to see details of exactly which version of FaceReader you are using, the serial number of your software and what modules have been enabled.

Help desk

> If you have any problems, questions, remarks or comments, please let us know. From the **Help** menu select **Noldus Online** and then **Contact Help Desk** or browse to https://my.noldus.com. This brings you to the MyNoldus section on the Noldus website. Create a new account or log into your existing account. Under **Get support** you will find the contact details of the help desk in your region, you can view the status of your current support cases or submit a new support case.

We offer 24 hour support via several help desks in different time zones.

Check the FaceReader Online Help before contacting our support department. Press **F1** to open it, then use the search function to find the topic you are having problems with.

Before you contact Technical Support, please have the version number and license number of your copy of FaceReader available. To find these numbers, choose **Help** > **About**.

In order to provide adequate support, it is possible that we request you to supply us with video recordings made by your organization. Since May 25th 2018 the new GDPR rules apply to all people in the EEA (EU + Norway, Iceland and Liechtenstein). For this reason we need your signed consent that you agree with the fact that you have given us permission to use these video recordings. Please be aware that the persons who are recognizable in the videos also have to give consent that the videos are sent to Noldus Information Technology BV and our technology partners, and that it is your responsibility to arrange this consent. More information regarding our Privacy policy can be found at:

https://www.noldus.com/legal/privacy-policy

NoldusCare

Your FaceReader license includes one year NoldusCare. NoldusCare extends the standard service you are entitled to and provides peace of mind at reasonable cost. Please look on our web site for more information. We also recommend a training upon installation of FaceReader.

noldus.com/nolduscare