NoldusHub Reference Manual

Overview Reference Manual

NoldusHub

NoldusHub is a platform for behavioral research in areas like psychological research, customer experience, and usability testing.

NoldusHub supports you in:

- Recording behavioral observations.
- Coding the recorded behaviors on a timeline.
- Unraveling the sequence of research events.
- Integrating data modalities such as eye tracking or emotion data in a complete lab.

Furthermore, NoldusHub facilitates multiple test stations, each with an arbitrary number of data modalities, while various experiment leaders and supporting staff can view and participate.

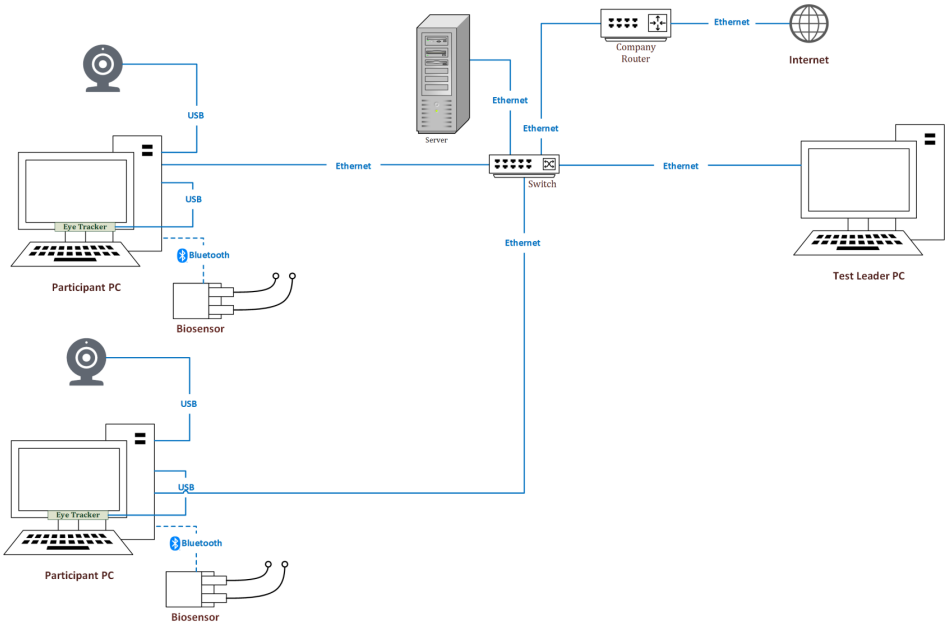
Setup

A typical NoldusHub setup consists of the following parts:

- A server that hosts the NoldusHub software.
- One or more test stations/Participant PCs, each with a USB camera and an eye tracker.
- A Test leader PC.
- A (routing) switch for connecting the server and PCs.

Furthermore, Participant PCs can be extended with data modality hardware for recording:

- Heartbeat
- Skin conductance



This image shows the typical setup of NoldusHub consisting of the parts explained before.

NoldusHub basic concepts

- **Test station**
  A test station is a space or room in which a participant's physiology and behavior are measured. Each test station consists of one Participant PC.
- **Device**
  A device is an instrument that registers physiological data signals like the heart rate.
- **Signal**

  A signal is the physiological data signal delivered by a device. Examples of signals are:
  - **Electrodermal activity (EDA)**
  - **Photoplethysmography (PPG)**

  And a device can deliver multiple signals. For example, a Shimmer GSR+ device provides an EDA and a PPG signal.
- **Session**
  A session records a research observation with the accompanying data from a test station.
- **Project**
  A project is an overall container for your research observations. Projects contain test stations with devices/signals and recorded sessions.

NoldusHub continuously monitors system connectivity and data quality during sessions. And after recording a session, you can visualize and analyze your results with NoldusHub.

NoldusHub basic workflow

The basic flow for recording an observation with NoldusHub consists of the following steps:

1. Add a new project or open an existing project.
2. Select devices.
3. Optionally: create markers.
4. Calibrate eye tracker.
5. Record a session.

How to get started with NoldusHub and where to find more information

Progressive learning is an excellent way to master NoldusHub:

1. Start with the Quickstart which covers the essentials you need to record a session, so you get up and running quickly.
2. In the bottom right, click  for help and to leave your suggestions.

Getting started

Getting started

Quickstart

Aim

To master the basic steps for carrying out an observation with NoldusHub. After completing this tutorial, you will know how to:

1. Log in to NoldusHub.
2. Create a test station and add devices.
3. Create a new project.
4. Optional: Define markers.
5. Calibrate eye tracker.
6. Record a session.
7. Replay a session.
8. Optional: Score markers.

Before you begin

For this tutorial, you must have:

- A NoldusHub account.
- A test leader PC; this can be your workstation with Google Chrome installed.
- A Participant PC which shares its screen and webcam. See the Installation Documentation for more information.

Furthermore, you should be familiar with the concepts of test stations, devices, projects, and sessions as described in the overview.

Note

- If you have `Administrator` rights, you have the ability to add test stations and devices. Persons with `Researcher` rights may create and invite others to projects, but cannot add test stations or devices; therefore, skip step 2 below.

What you will do

You will carry out an observation in which webcam images of a participant are recorded. It's up to you whether to involve an actual participant or act as a participant yourself.

Procedure

Step 1: Log in to NoldusHub

You can only use NoldusHub after you are authorized, so first, you need to log in on your workstation (which acts as the test leader PC):

1. Open Google Chrome and navigate to your NoldusHub domain, for example, `https://noldushub.mydomain.com`.
   ↪ NoldusHub opens with the *Login page*.
2. Enter your **Username** and **Password**.
3. Click **Log in**.

If you are a researcher, proceed to step 3. Step 2 can only be done by administrators.

Step 2: Create a test station and add devices

Now you need to add a test station from which to record sessions:

1. Click **Create test station**.
2. Enter the name you want to give your test station in the **Full name** field, for example, `Test room B`.
3. Enter an abbreviated name for your test station in the **Nickname** field, for example, `TRB`.
4. Click **Save**.
5. To activate your test station switch the toggle in front of your test station to the right by clicking on it.
   ↪ The toggle turns green .

Next, you need to add devices to your test station:

1. Expand the test station settings by clicking .
2. Click **Add devices**.
3. Select the devices you want to add using the checkboxes in the **Add devices** list.
   ⇨ Hover over items to see tooltips with the corresponding computer names.
4. Click **Add device**.

For more information about this page see Test stations and devices.

Step 3: Create a new project

The next step is creating a project for gathering your recordings:

1. Click **Projects** in the top bar.
2. Click **Create project**.
3. Enter the name you want to give your project in the **Enter name** field.
4. Click **Save**.
   ↪ The *Test stations page* opens and shows your test stations and devices. For more information about this page see Project devices and test stations.

Optional Step 4: Define markers.

It is possible to define markers within your project. Markers allow you to timestamp an event during the replay of your session. In order to be able to score markers later, you first need to define your markers.

1. To open the project's *Marker page*, click **Markers** in the *Setup* section inside your project.
2. To define your first marker, click **Add marker**.
3. Enter the **Name** of your marker in the Name field.
4. Optional: To define another marker click **Add marker**. Repeat step 3.
5. Click **Save**.

Step 5: Calibrate eye tracker

Next, you need to calibrate the eye tracker on the Participant PC to ensure the recording is as accurate as possible. Calibration is an interplay between a test leader PC and the relevant Participant PC and starts from the test leader PC (in this case, your workstation).

1. You: Ask the participant to take a seat in front of the Participant PC and to follow the instructions on the screen.
2. You:
   Click **Record Session**
   ↪ NoldusHub asks whether you want to calibrate the eye tracker or skip the calibration and start recording. If you skip calibration, the last stored calibration will be used.
   OR
   Click ⋮ **> Calibrate** in the *Screen video pane*.
   ↪ NoldusHub shows a *Welcome screen* for starting the calibration on the Participant PC.
3. Participant: Follow the instructions that are shown on the screen.
4. Participant: Once the calibration is finished, click **Close**.
   ↪ NoldusHub shows the *Calibration results pop-up* on the test leader PC.
5. You: If the calibration succeeded, click **ACCEPT.**
   OR
   If calibration failed, click **Recalibrate** and repeat steps starting from 3. Some tips on how to calibrate your eye tracker successfully can be found in the FAQ section.

Step 6: Record a session

You are all set for your first recording:

1. Optional: NoldusHub records all available data signals by default, but you can click ⊕ (**Select data**) if you want to select specific data signals to be recorded.
   1. Select or clear the **data** checkboxes you want to display or hide.
   2. Click **Save**.
2. Click **Start Recording**.
   ↪NoldusHub asks whether you want to calibrate the eye tracker. Click **Start calibration** to start calibrating the eye tracker, and tell the participant to follow the instructions on their screen. Click **Skip and start recording** to start recording straight away. If you skip the calibration, NoldusHub will use the last stored calibration.
3. Instruct the participant to perform the requested actions at the recording test station.
4. When the participant has finished the requested actions, click **Stop Recording**.
5. Enter a name for the recorded session and click **Save**.

Step 7: Replay a session

After finishing your recording, you can replay your session to investigate the recorded data signals for your research:

1. Navigate to the *Sessions page* and click **Sessions** in the *Replay* section of your project.
2. Scroll to the session you want to replay and click the corresponding ▷ or on the name.
3. Optional: Click **+ Add signal...** inside the *Timeline* pane to select additional data signals to display.
   1. Select or clear the **signal** checkboxes you want to display or hide.
   2. Click ⊗.
4. Start the replay by clicking ▷ inside the *Timeline* pane.

Optional Step 8: Score markers

During the replay of your session, it is possible to score markers.

1. Start the replay inside the *Timeline* pane using ▷.
2. Once you are at the point in time where you want to score, press the corresponding **shortcut key** or click the corresponding button inside the *Score a marker* pane.
3. Your scored markers are visible inside the *Scored markers* pane.
4. If necessary, repeat step 2 for the rest of the recording.

Topics

Topics

Login page

This page provides background information about the login page and describes what actions you can take that are related to this page.

Background

What is the login page?

The login page is a page where you start each time you visit NoldusHub and where you can login.

If you forgot your password and are unable to log in, please contact your administrator and ask to have your password reset.

Actions

What do you want to do?

- Log in.
- Log out.
- Change password.
- Reset password of a user (only for administrators).

Learn the basics of using NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

User management

This page provides background information about user management and describes the actions you can take for user management.

Background

What is user management?

User management enables system administrators to authorize users to access NoldusHub.

User types

NoldusHub distinguishes *application* and *project-level* users.

Application-level users

The application level is the highest, and you must add every user at this level.

Project-level users

Project-level users are optional and based on application-level users, NoldusHub calls project-level users *project members*. To set up a project member, the corresponding application-level user needs to be available or added first. As said earlier, project members are optional, so you only need to set up project members if other users also require access to your project.

Application-level roles and permissions

NoldusHub secures access by requiring users to log in with a username and password. So, only users you authorize in NoldusHub have access. Furthermore, NoldusHub allows you to set permissions for users. Permissions specify what users can do in NoldusHub, for example, create a new project or add other users. Grant permissions by assigning one of the following roles to a user:

Role	Permissions
`Administrator`	The user has all rights in NoldusHub. All projects will be visible for them and they can setup test stations.
`Researcher`	The user can create, delete and invite others to projects. Projects are visible if they are the owner or if they are invited as a project member.
`User`	The user can be invited to projects. Projects are only visible if they are invited as a project member.

Project member roles and permissions

You can set the permissions for project members by assigning them one of the following roles:

Role	Permissions
`Owner`	The project member has all project rights.
`Editor`	The project member has all project rights.

Actions

What do you want to do?

- Add a user..
- Edit a user.
- Reset the password for a user.
- Delete a user.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Test stations and devices

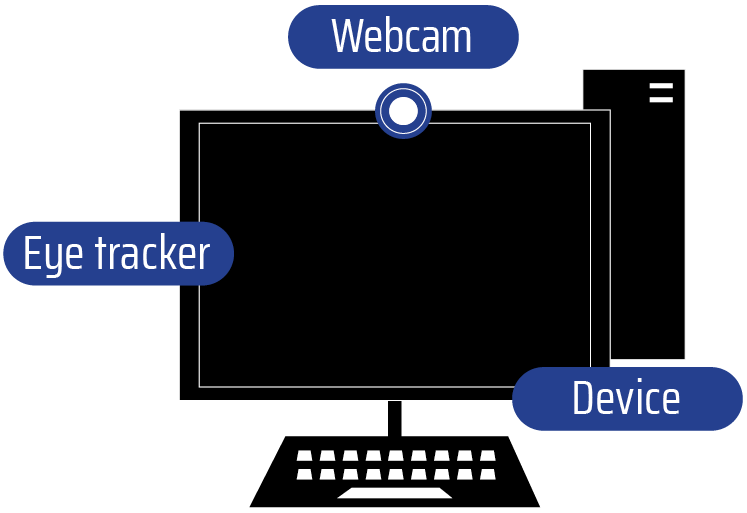
This page provides background information about test stations and devices and describes what actions an `Administrator` can take for test stations and devices.

Background

What is a test station?

A test station is a PC setup where research observations occur. Research participants sit in front of the PC screen and carry out assignments. Therefore, a test station is also known as a Participant PC and usually consists of a PC with:

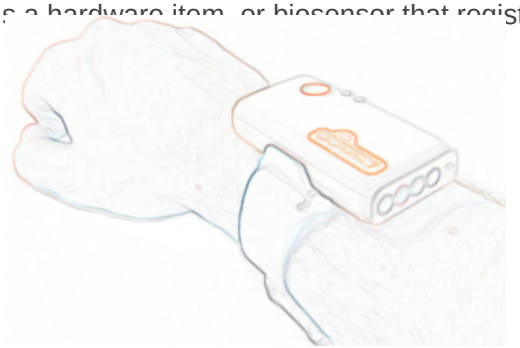
- A webcam (either external or built into the computer).
- An eye tracker.
- One or more physiological measurement devices.



This image shows the usual setup of a Participant PC that consists of a computer, webcam, eye tracker, and other devices such as biosensors.

What is a device?

A device is a hardware item, or biosensor that registers physiological data signals like heart rate.



Actions

What do you want to do?

- Create a test station.
- Rename a test station.
- Delete a test station.
- Add a device to a test station.
- Delete a device from a test station.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Topics

Projects

This page provides background information about projects and describes what actions you can take for projects.

Background

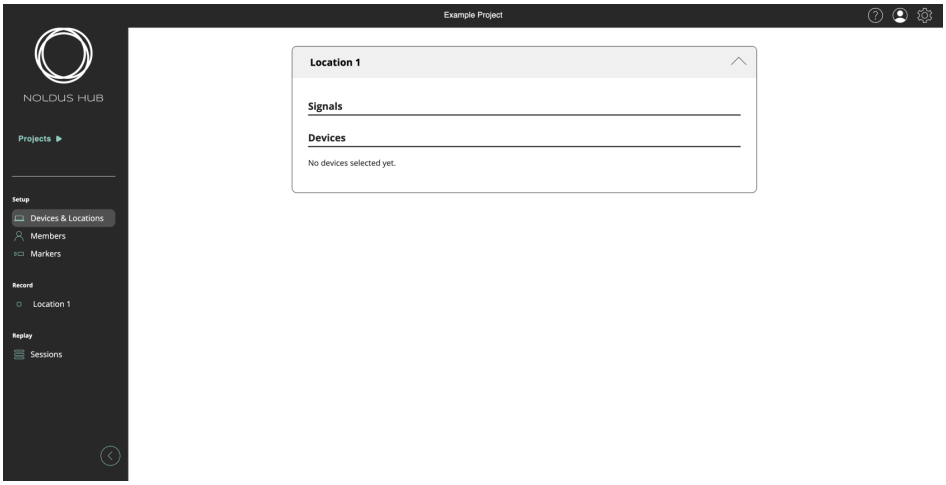
What is a project?

A project is a container for arranging your research session recordings. You are free to arrange projects in such a way that they best match how you want to organize your research. We advise you to record all sessions of one research experiment in one project.

To go inside a project click the name of the project inside the *Projects page.* To navigate to the *Projects page*:

- As an `Administrator`, click **Projects**.
- As a `Researcher` or `User`, your home page is the *Projects page*.

The name of the project that you are working in is always displayed at the top of the screen, such as in *Example Project* here:



This image shows the page once you enter a project. The project name can be found at the top of this screen.

Actions

What do you want to do?

- Create a project.
- Delete a project.
- Navigate to the sessions list.
- Back up all projects. (ask your administrator)

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.

- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Topics

Project devices and test stations

This page provides background information about project test stations and devices and describes what actions you can take for each.

Background

All the test stations and devices you or your adminstrator created are available in projects as *Test stations* for recording sessions.

Devices and test stations

Your project's available devices and test station appear on the *Test stations page*. To display this page, click **Test stations** from your *Project page.*

Devices and signals

The *Test stations page* also shows the *signals* provided by the devices. Signals are the physiological data signals delivered by devices, for example, Electrodermal activity (EDA). The time-lapse values of the signals you set up in a project are included in your recording sessions.

Devices and signals are logically connected

A device and its signals are logically connected in NoldusHub. When you switch off a device, all its connected signals are also automatically switched off. And vice versa, when you switch off all signals for a device, the device itself is also switched off.

The same applies to switching on: When you switch on a device, all its signals are also switched on.

So, for example, when you switch off an `Eye tracker` device, the `Gaze` signal is automatically switched off. Or the other way around: When you switch on a `Screen video` device, the `Screen video` signal is also switched on.

Actions

What do you want to do?

- Set up devices and test stations for a project.
- Connect devices to a Participant PC.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.

- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Topics

Project member

This page provides background information about project members and describes what action you can take for project members.

Background

What are project members?

You can share your project with co-workers and lab-mates by inviting them as project members. All administrator users automatically have access to all projects. Other users can be invited in the Members module of the Setup menu.

Roles and permissions

You can set the permissions for project members by adding them as an `Editor`. As the creator of the project, you are immediately assigned the `Owner` role.

Role	Permissions
`Owner`	The project member that created the project and has all project rights.
`Editor`	The project member can edit a project.

Actions

What do you want to do?

- Select members for a project.
- Delete a project member.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Project recording

This page provides background information about project recordings and describes what actions you can take for project recordings.

Background

What is a project recording?

A project recording is a recording of a participant's behavior and physiological measurements. Project recordings are time-limited because you control how long they last by starting and stopping a recording. As for content, a project recording consists of:

- Screen video footage showing the participant's screen content and what actions the participant performs.
- Face video footage showing the participant during the recording.
- Timeline data showing the recorded data signals.

Actions

What do you want to do?

- Record a session for a project.
- Set up devices and test stations for a project.
- Calibrate eye trackers.
- Set up members for a project.
- Score a marker.
- Remove a scored marker.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Session list

This page provides background information about the session list and describes what actions you can take in the session list.

Background

What is the session list?

The sessions list is a list with the previously saved project sessions. New session recordings are added to the top of the list once you save them.

Actions

What do you want to do?

- Replay a session from a project.
- Download a session.
- Delete a session.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Project session

This page provides background information about project sessions and describes what actions you can take for project sessions.

Background

What is a project session?

A project session is a saved project recording that could, depending on the recorded data, consist of:

- Screen video footage of the participant's screen content and actions the participant has performed.
- Face video footage of the participant during the recording.
- Timeline of the recorded data signals.
- Previously scored markers, if you (or someone else) replayed the recording before and scored markers.

Actions

What do you want to do?

- Replay a session from a project.
- Score a marker.
- Remove a scored marker.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Topics

Markers

This page provides background information about markers and describes what actions you can take.

Background

What is a marker?

With the use of markers, you can annotate events that are important to your study. Examples of markers may be *blinking,* to keep track of when the participant blinks, or *talking,* the moment the participant starts talking.

A marker consists of a name, type of marker, shortcut key and color of marker. You first have to define the markers that you want to use in your project. Afterward, you can use key shortcuts during the replay of your session to place markers, which is called "scoring." During the scoring of markers, a timestamp is added along with the name and color of the marker in the pane *Markers*.

Types of markers

There is one type of marker available:

Type of marker	Explanation
`Point Marker`	The marker is a point in time and has no duration.

Actions

What do you want to do?

- Define a marker.
- Edit a defined marker.
- Delete a defined marker.
- Score a marker.
- Remove a scored marker.

Learn the basics of NoldusHub

- Read the overview to learn the NoldusHub fundamentals.
- Follow the quickstart guide / tutorial to learn the basic steps for carrying out an observation in NoldusHub.

Topics

Data signals

This page provides background information about the different data signals that are visualized and processed in NoldusHub.

Background

What is a data signal?

Data signals inside NoldusHub are the visualizations of the data being recorded. All data gathered by all the devices that are turned on in the Project devices and test stations page are automatically recorded. However, it is possible to change which data are visualized in the timeline.

To do so:

On the *recording* page:

1. Click  (**Select data**) inside the *Timeline* pane.
2. Select or clear the **data signal** checkboxes you want to select or deselect.
3. Click **Save**.

On the *replay* page:

1. Click **+Add signal...** inside the *Timeline* pane.
2. Select or clear the data signal checkboxes you want to select or deselect.
3. Click  .

Data signals in NoldusHub

Which data signals would you like to read more about?

- Heart rate (PPG/ECG)
- Electrodermal Activity (EDA)
- Facial expressions
- Eye tracking data
- Cognitive load

Guides

Guides

Log in to NoldusHub

Aim

To get access to NoldusHub.

Before you begin

- You must have been added as a user in NoldusHub by the system administrator and must have received a username and password.

Procedure

1. Open Google Chrome and navigate to your NoldusHub domain, for example, `https://noldushub.mydomain.com`.
2. Enter your **Username** and **Password**.
3. Click **Log in**.

What's next?

It is possible to change your password.

Guides

Log out or change your password

Aim

To log out or to change your password.

Before you begin

- To log out or to change your password you have to be logged in.

Procedure

Log out

1. Open your account with .
2. Click **Log out**.

Change your password

1. Open your account with and click **Change password**.
2. In the **Current password** field, enter your current password.
3. In the **New password** and **Repeat password** field, enter your new password.
4. Click **Save**.

Guides

Add, edit or delete a user

Aim

To add, edit or delete a new application user.

Background

User types

NoldusHub distinguishes *application* and *project-level* users. See User management for more information about the differences.

Before you begin

- You must have the `Administrator` role to add an application-level user.
- You need to determine what application-level role the new user needs.

Procedure

Add a user

1. Open the application settings by clicking  .
2. Click **User management**.
3. Click **Add user**.
4. In the **First name**, **Last name**, and **Email address** fields, enter the corresponding values for the new user.
5. In the **Username** field, enter the display name for the user in NoldusHub.
   Note: The following characters are allowed in the username: a to z (lowercase), A to Z (uppercase), 0 to 9, '@' (at sign), '.' (period), '-' (hyphen) and '_' (underscore).
6. In the **Password** and **Repeat password** fields, enter the password for the user.
7. Select the role you want to assign to the new user using the **Role** list.
8. Click **Save**.
9. Provide the username and password to the user.

Edit a user

1. Open the application settings by clicking  .
2. Click **User management**.
3. Scroll to the user you want to edit and click the accompanying  for the user.

4. Edit either the user's **First name**, **Last name**, or **Email address** fields, or change the user's role in the **Role** list.
5. Click **Save**.

Delete a user

1. Open the application settings by clicking  .
2. Click **User management**.
3. Scroll to the user you want to delete and click the corresponding  .
4. Click **Yes**.

What's next?

A logical next step is to create a test station.

Guides

Reset the password for a user

Aim

To reset the password for an existing application user.

Before you begin

- You must have the `Administrator` role to reset the password for a user.
- Users can also change their own password. If you forgot your password and are unable to login, please contact your administrator and ask them to reset your password for you.

Procedure

1. Open the application settings by clicking  .
2. Click **User management**.
3. Scroll to the user for whom you want to reset the password and click the accompanying  for the user.
4. Click **Reset password**.
5. In the **Password** and **Repeat password** fields, enter the new password for the user.
6. Click **Save**.
7. Provide the new password to the user.

What's next?

It is also possible to delete a user.

Guides

Create, rename or delete a test station

Aim

To create, rename or delete a test station.

Before you begin

- You must have the `Administrator` role to create, rename or delete a test station.
- You must have installed and connected at least one Participant PC.
- Navigate to the *Test stations page.*

Note

- Test stations must be created from your Test leader PC.
- You can create as many test stations as you want but can only have two test stations active simultaneously.

Procedure

Create a test station

1. Click **Create test station**.
2. To give your test station a name, enter the name in the **Full name** field, for example, `Test room B`.
3. To give your test station an abbreviated name, enter an abbreviated name in the **Nickname** field, for example, `TRB`.
4. Click **Save**.
5. To activate your test station switch the toggle in front of your test station to the right by clicking on it.
   ↪ The toggle turns green .

Rename a test station

1. To rename your test station, click ⋮ on the test station you want to rename and select **Rename**.
2. Enter the new name for your test station in the **Full name** field.
3. Enter the new abbreviated name for your test station in the **Nickname** field.
4. Click **Save**.

Delete a test station

1. To delete your test station, click ⋮ on the test station you want to delete and select **Delete**.
2. Click **Yes**.

What's next?

Complete your test station by adding devices.

Guides

Add or delete a device

Aim

To add a device to a test station or to delete a device from a test station.

Before you begin

- You must have the `Administrator` role to add or delete a device from a test station.
- The device you want to add must already be installed at the test station (Participant PC).
- Navigate to the *Test stations page.*

Note

- Devices must be added from your Test leader PC.

Procedure

Add a device to a test station

1. Unfold the test station where you want to add a device by clicking .
2. Click **Add devices**.
3. Select the device(s) you want to add using the checkboxes in the **Add devices** list.
   ⇨ Hover over items to see tooltips with the corresponding computer names.
4. Click **Add device**.

Delete a device from a test station

1. Unfold the test station where you want to delete a device by clicking .
2. To delete the device click .

What's next?

Create a project to record and replay your sessions.

Guides

Create or delete a project

Aim

To create or delete a project.

Before you begin

- You must have the `Administrator` or the `Researcher` role to create or delete a project.
- Navigate to the *Projects page.*

Procedure

Create a project

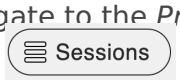
1. To create a new project, click **Create project**.
2. Enter the name you want to give your project in the **Enter name** field.
3. Click **Save**.

Delete a project

1. To delete your project scroll and click the corresponding  .
2. Click **Yes**.

Navigate to the sessions list

There are two ways to get to the sessions list:

1. Navigate to the *Projects page.*
2. Click 

on the line of the corresponding project.

OR

1. Navigate to the *Projects page.*
2. Scroll to and click on the name of the project.
3. Navigate to *Sessions* in the side menu.

What's next?

Set up your project with devices & test stations, and members.

Guides

Back up all projects in NoldusHub

Aim

Do you want to save your data outside of NoldusHub? Make a backup of your data using our scripts.

Background

To create a backup, the processes that are running in the background of NoldusHub need to be stopped before data can be copied. The scripts that are needed for this are available in the NoldusHub program files.

Before you begin

- You must have the `Administrator` role to back up NoldusHub data.
- Every time the *BackupNoldusHub* script runs it create a new folder with the current date and time (for example "2022-12-09_15-38-49"). This folder contains:
  - A subfolder "Video" with video files.
  - An archive "DockerVolumes.zip" with other data.
  - A "readme.txt" with instructions on how to restore your backup.

Note

- Backing up projects is only possible from the server PC.

Procedure

1. Make sure you are logged in as an `Administrator`. Otherwise, ask your `Administrator` to back up the projects for you.
2. To find the scripts that are available for NoldusHub, navigate to: "C:\Program Files\Noldus\Noldus Hub".
3. To stop the processes of NoldusHub, run the script **StopNoldusHub**. Make sure to run this script before proceeding to step 4.
4. To back up your NoldusHub data, run the script **BackupNoldusHub**. The backup will be placed inside the folder: "D:\NoldusHubBackup\".
   Optional: To change the destination folder, change the value of the variable "*$customer_backup_folder_root*" on line 7.
5. To start all the processes of NoldusHub again, run the script **StartNoldusHub**.

Guides

Set up devices and test stations for a project

Aim

To set up measurement devices and test stations.

Before you begin

- The devices and test stations functionality depends on your user role:
  - As an `Administrator` you can set up devices and test stations for any project.
  - As a `Researcher` you can set up devices and test stations for projects you created yourself and for projects shared with you as a member.
  - As a `User` you can set up devices and test stations for projects shared with you as a member.
- Navigate to the project for which you want to set up the devices and test stations.

Note

Devices and signals are logically connected

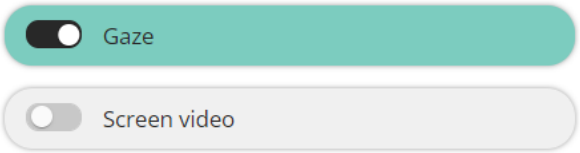
A device and its signals are logically connected in NoldusHub. When you switch off a device, all its connected signals are also automatically switched off. And vice versa, when you switch off all signals for a device, the device itself is also switched off.

The same applies to switching on: When you switch on a device, all its signals are also switched on.

So, for example, when you switch off an `Eye tracker` device, the `Gaze` signal is automatically switched off. Or the other way around: When you switch on a `Screen video` device, the `Screen video` signal is also switched on.

Procedure

1. If you want to set up a test stations other than the first, click `⌵` on the appropriate test stations to collapse its details.
2. Switch on or switch off the signals and devices toggles to select or unselect them for your project. For example, switch on the `Gaze` signal and switch off the `Screen video` signal:



What's next?

You can calibrate an eye tracker for your project or jump right in to record a session.

Guides

Connect biosensor to Participant PC

Aim

To connect a biosensor to a Participant PC. See Supported devices for a list of our currently supported eye trackers, biosensors and webcam.

Note

- If your devices won't connect check out our FAQ for troubleshooting. If your issue or question is not covered, get in contact with Noldus Support through https://my.noldus.com/login. They will be happy to help you.

Procedure

1. Turn on the Participant PC and log in.
2. Open N-Linx agent on the Participant PC.
3. Click **Add plugin**. Browse to the location of the plugins.
4. Select **Shimmer physiological.nlp** and click **Open**.
5. Take the biosensor out of its dock and turn it on.
6. Start the Shimmer Consensys software by clicking the  icon in the taskbar. The active Consensys icon now appears in the list of active programs at the bottom-right.
7. Right-click the Consensys icon, and select the correct Shimmer sensor. See the Device ID at the bottom of the sensor.
8. Select **Start**. The selected sensor status will change from *Connecting* to *Streaming*.
9. Check in NoldusHub on the Test leader PC that all devices are connected properly. If not, check out our Frequently Asked Questions section (FAQ).
0. If your participant arrives, connect the leads/electrodes to the participant.

What's next?

You can record a session.

Guides

Calibrate eye tracker

Aim

To calibrate an eye tracker device to ensure recordings are as accurate as possible.

Before you begin

- The calibrate functionality depends on your application-level user role:
  - As an `Administrator` you can calibrate eye trackers for any project.
  - As a `Researcher` you can calibrate eye trackers for projects you created yourself and projects shared with you as a member.
  - As a `User` you can calibrate eye trackers for projects shared with you as a member.
- Ask a colleague or co-worker to assist you as a participant because calibration is an interplay between a Test leader PC and the Participant PC.
- Navigate to the *record page* of the test station inside your project for which you want to calibrate the eye tracker.

Note

- Calibration starts from the Test leader PC.
- Each procedure step indicates who, you or the participant, must execute the step.
- Check the Frequently Asked Questions (FAQ), if you run into trouble.

Procedure

1. You: Ask the participant to take place at the Participant PC and to follow the instructions on the screen.
2. You: Click **Record Session**
   ↪ NoldusHub asks whether you want to calibrate the eye tracker or skip the calibration and start recording. If you skip calibration, the calibration that was stored last will be used. In this case, click **Calibrate**.
   OR
   Click ⋮ **> Calibrate** in the *Screen video* pane.
   ↪ NoldusHub shows a *Welcome screen* for starting the calibration at the test station (Participant PC).
3. Participant: Follow the instructions that are shown on the screen of the Participant PC. They have to click on **Start**.
4. Participant: Once the calibration is finished, click **Close**.
   ↪ NoldusHub shows the *Calibration results pop-up* on the test leader PC.

5. You: If calibration succeeded, click **ACCEPT.**
   OR
   If calibration failed, click **Recalibrate** and repeat steps starting from 3. Some tips on how to calibrate your eye tracker successfully can be found in the FAQ section.

What's next?

You can set up other users as members for your project or jump right in to record a session.

Guides

Select project members

Aim

To share your project with co-workers.

Background

User types

NoldusHub distinguishes *application* and *project-level* users. See User management for more information about the differences.

Project member roles and permissions

As the creator of the project, you are immediately assigned the `Owner` role. You can select users to add them as an `Editor`. If a user is not an administrator on the application level they will have to be invited as an `Editor` in order to see the project. The rights of editors are equal to the rights of the owner.

Role	Permissions
`Owner`	The project member has all project rights.
`Editor`	The project member has all project rights.

Before you begin

- The sharing project functionality depends on your application-level user role:
  - As an `Administrator` you can select members for any project.
  - As a `Researcher` you can select members for projects you created yourself and projects shared with you as a member.
  - As a `User` you can select members for projects shared with you as a member.
- The project member you want to select must already be available as an application-level user.
- You need to determine what project member role the new project member needs.
- Navigate to the project for which you want to select members.

Procedure

Select member(s) for a project

1. Navigate to the *members page* by clicking **Members** in the *Setup section*.
2. Click **Share project**.
3. To open the user list, click in the **Choose members** field.
4. Optional: To narrow down the list, enter the first characters of the username of the user you want to add.
5. Select the user you want to add to your project.
6. Optional: To add other members, repeat steps 3-5.
7. Click **Save**.

Delete a member from a project

1. Navigate to the *members page* by clicking **Members** in the *Setup section*.
2. Scroll to the member you want to delete and click the corresponding  .
3. Click **Yes**.

What's next?

A logical next step would be to record a session.

Guides

Record a session for a project

Aim

To record a session for your research project.

Before you begin

- The record functionality depends on your application-level user role:
  - As an `Administrator` you can record a session for any project.
  - As a `Researcher` you can record a session for projects you created yourself and for projects shared with you as a member.
  - As a `User` you can record a session for projects shared with you as a member.
- Navigate to the *record page* of the test station inside your project for which you want to record a session.
- Make sure you have connected your devices to the Participant PC.

Note

Resizing panes

The panes of the *Record page* can be resized and relocated to your preference. You will have to redo the resizing and relocating every time you visit the page as your preferences are not stored.

You have the following options:

- Hover with the mouse over the lower right corner of the panes that you want to resize. Click and drag the panes to your preferred size. Note that there should be free space available if you want to make the pane larger, otherwise it will not be resized.
- Hover with the mouse over the title bar and click and drag the pane to your preferred location. Note that there should be free space available where you want to place the pane, otherwise it will not be relocated.

Procedure

1. Optional: NoldusHub records all available data signals by default, but you can click  (**Select data**) if you want to select specific data signals to be visualized or not.
   1. Select or clear the **data signal** checkboxes you want to select or deselect.
   2. Click **Save**.
2. Click **Start Recording**.

   ↪NoldusHub asks whether you want to calibrate the eye tracker. Click **Start calibration** to

start calibrating the eye tracker, and tell the participant to follow the instructions on their screen. Click **Skip and start recording** to start recording straight away, NoldusHub will use the latest stored calibration.

3. Instruct the participant to perform the requested actions at the recording test station.
4. When the participant has finished the requested actions, click **Stop Recording**.
   Note: *Beware that there is no going back once you click Stop Recording. It is not possible to resume your recording.*
5. Enter a name for the recorded session and click **Save**.

What's next?

A logical next step would be to replay your recorded session.

Guides

Define, edit or delete a marker

Aim

To define, edit or delete a marker in your project's markers setup.

Before you begin

- The marker functionality depends on your project-level user (member) role:
  - As an `Owner` or `Editor`, you can define and score markers.
  - As a `Coder`, you can only score markers and not define them.
- Navigate to the project for which you want to define, edit or delete markers.

Procedure

Define a marker

1. To open the project's *Marker page*, click **Markers** in the *Setup* section inside your project.
2. To define your first marker, click **Add marker**. If there are defined markers already, click **Edit list.**
3. Enter the **Name** of your marker in the Name field.
4. Optional: To define another marker click **Add marker**. Repeat step 3.
5. Click **Save**.

Edit a defined marker

1. To open the project's *Marker page*, click **Markers** in the *Setup* section.
2. Click **Edit list**.
3. Adjust the **Name** of your marker in the Name field.
   ↪ NoldusHub shows a warning that the name change will affect all previously scored markers.
4. Click **Save**.

Delete a defined marker

1. To open the project's *Marker page*, click **Markers** in the *Setup* section.
2. Click **Edit list**.
3. On the marker that you want to delete, click  .
4. Click **Save**.

What's next?

With markers defined, you can now score a marker.

Guides

Score and remove a marker

Aim

To score a marker or remove a scored marker in your project's recording.

Before you begin

- The marker functionality depends on your project-level user (member) role:
  - As an `Owner` or `Editor`, you can define and score markers.
  - As a `Coder`, you can only score markers and not define them.
- Beware that you first have to define markers before you can score them.
- Navigate to the session inside your project for which you want to define, edit or delete markers.

Procedure

Score a marker

1. Start the replay inside the *Timeline* pane using  .
2. Once you are at the point in time where you want to score, press the corresponding **shortcut key**.
3. Your scored markers are visible inside the *Scored markers* pane.
4. If necessary, repeat step 2 for the rest of the recording.

Remove a scored marker

1. In the *Scored markers* pane, click  on the marker that you want to delete.
2. If necessary, repeat step 1.

What's next?

You can define a marker.

Guides

Replay a session from a project

Aim

To replay an earlier recorded session from a project.

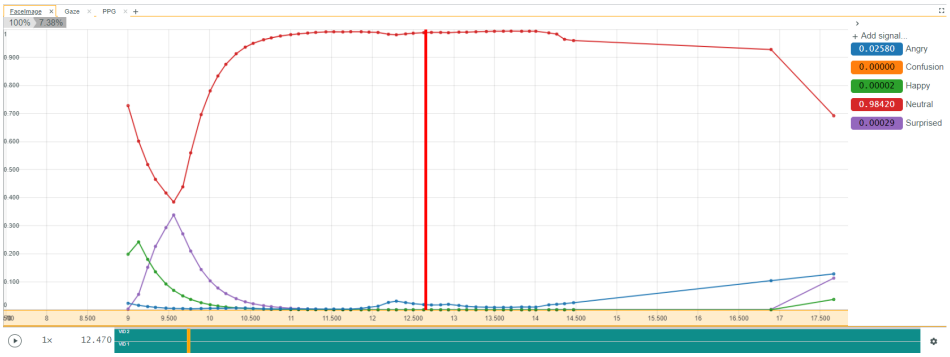
Before you begin

- The record functionality depends on your application-level user role:
  - As an `Administrator` you can record a session for any project.
  - As a `Researcher` you can record a session for projects you created yourself and for projects shared with you as a member.
  - As a `User` you can record a session for projects shared with you as a member.
- Navigate to the *replay page* of the session inside your project for which you want to replay a session.

Note

- The *Timeline* pane allows you to:
  - Replay a session from the beginning.
  - Replay from a specific point in time.
  - Jump forward and backward.
  - Replay at different speeds such as 0.5x, 1x or 2x.
  - Select which recorded data streams you want to replay.

The *Timeline* pane shows the recorded data signals plotted on a timeline:



Resizing panes

The panes of the *Replay page* can be resized and relocated to your preference. You will have to redo the resizing and relocating every time you visit the page as your preferences are not stored.

You have the following options:

- Hover with the mouse between the panes, and drag and drop to rescale.
- Hover with the mouse over the panes and click to open the panes in full screen. Click again to exit the full screen.
- Hover over the panes, click and hold the tab with the data signal that you want to move and drag the panes to the preferred spot, drop the panes at the corresponding location.

Procedure

1. Scroll to the session you want to replay and click the corresponding or on the name.
2. Optional: Click **+ Add signal...** inside the *Timeline* pane to select additional data signals to display in Timeline.
   1. Select or clear the **data signal** checkboxes you want to select or deselect.
   2. Click .
3. Start the replay by clicking inside the *Timeline* pane.
4. Optional: You can add markers to your recording.

What's next?

Downloading a session or adding a marker to your recording would be logical next steps.

Guides

Download or delete a session

Aim

To download the recorded session data or to delete a recorded session.

Background

You can download the recorded session data for further processing in other software. For example, you can import the downloaded data into Excel or SPSS as input for (statistical) analysis. Or you can delete a session if the recording went wrong or for another reason.

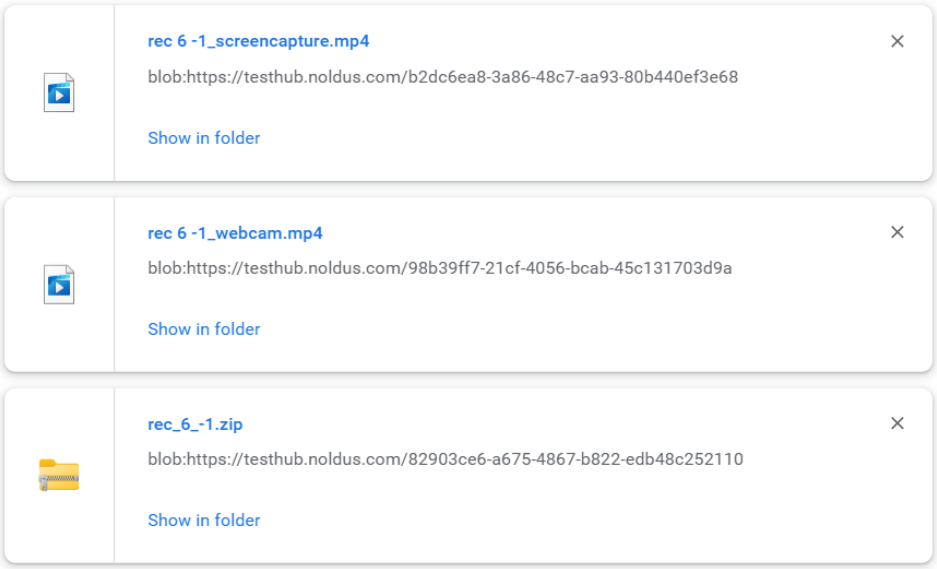
Before you begin

- The download and delete a session functionality depends on your application-level user role :
  - As an `Administrator` you can download a session for any project.
  - As a `Researcher` you can download a session for projects you created yourself and for projects shared with you as a member.
  - As a `User` you can download a session for projects shared with you as a member.
- Navigate to the project from which you want to download a session.

Procedure

Download a session

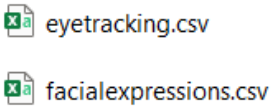
1. Click **Sessions** in the *Replay section*.
   ↪ NoldusHub opens the *Project sessions page* with all recorded sessions.
2. To download a session, scroll to the session you want to download and click the corresponding .
   ⇨ This procedure assumes the session name is `rec 6-1`.
   ⇨ **All data streams (CSV-files)** checkbox is automatically selected.
3. Optional: If you want to download the screen and face video as well, select the **All videos** checkbox.
   ⇨ This procedure assumes the checkbox **All videos** is selected.
4. Click **Download**.
   ↪ Chrome downloads the files. The CSV-files are stored in a combined ZIP file. And the screen and webcam footage in separate MP4 files:



This image shows the way the files are downloaded.

⇨ NoldusHub prefixes the file names with the session name for easy reference.

⇨ The Zip file contains a separate CSV file for each device. For example:



This image shows examples of the CSV files that are saved: eyetracking.csv and facialexpressions.csv.

Delete a session

1. Click **Sessions** in the *Replay section*.
2. Scroll to the session you want to delete and click the corresponding .
3. Click **Yes**.

Resources

Supported devices

On this page, an overview of the supported devices of NoldusHub can be found. The following type of devices are discussed:

Eye trackers

The following eye trackers that are currently on the market are supported in NoldusHub.

Eyetech

- VT3-mini - 40 Hz, 120 Hz. Firmware version 2019.2.3.0_19.11.22.72.

Tobii Pro

- Nano - 60 Hz.
- Spectrum - 60 Hz, 120 Hz, 150 Hz, 300 Hz, 600 Hz or 1200 Hz.

The following eye trackers are discontinued by their manufacturer but are still supported in NoldusHub.

Tobii Pro

- X2-30
- X2-60
- X60
- X120
- T60
- T120

Biosensors

The following biosensors currently on the market are supported in NoldusHub.

Shimmer

- Shimmer3 ECG unit for the signals:
  - Heart rate
  - Interbeat intervals
- Shimmer3 GSR+ unit for the signals:
  - Heart rate
  - Interbeat intervals

    - Tonic skin conductance
    - Skin conductance peak rate

Webcams

Logitech

- Brio webcam, VGA resolution.

FAQ

Troubleshooting

Below is a list with Frequently Asked Questions (FAQ). Is your question not on this list? Reach out to Noldus support via the MyNoldus customer portal for assistance!

Overview Frequently Asked Questions (FAQ)

Timeline

Why are some signals not displayed in real time?

Some signals are running behind compared to other signals as they are not raw data but preprocessed data. This is the case for EDA signals, for example. As seen in the picture below, the EDA data is coming in later than the other data. This is normal and has to do with the processing that takes place to plot this data.

Why do I not see any signals in the Timeline during replay?

This can happen if you did not record EDA data during a session. Click on the **+Add signal** button and deselect all EDA signals. Go back to your replay and all your signal data should now be visible.

Markers

Why am I not seeing markers that I defined in the Marker pane?

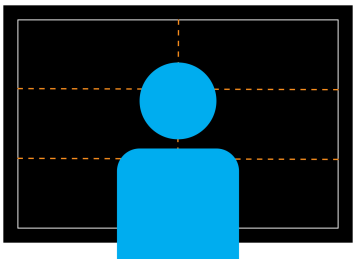
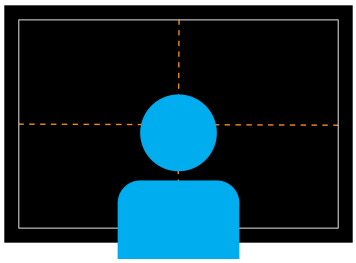
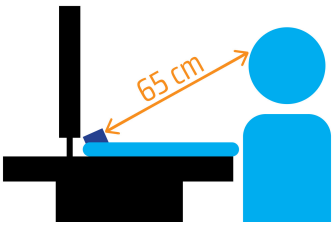
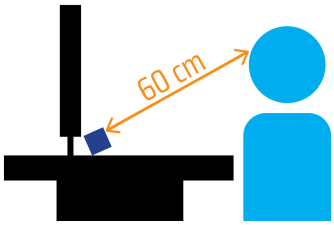
To define markers it is important to click the Save button to store them. Otherwise, your markers will be lost.

Eye tracking

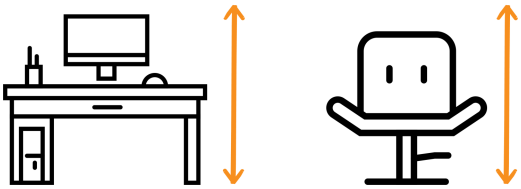
How should the participant be seated for eye tracking?

For accurate eye tracking results, take note of the following recommendations:

- The participant should be facing straight toward the center of the screen.
- The height and distance from the monitor differ per eye tracker brand. See the table for guidelines:

	Tobii Pro eye tracker	Eyetech VT3 Mini
Vertical position	 The height of the eyes should be at one-third from the top of the monitor.	 The height of the eyes should be halfway down the monitor.
Distance from eye tracker	 The distance between eyes and eye tracker should be ca. 65 cm. TIP Sitting at an arm's length from the monitor is approximately the correct distance.	 The distance between eyes and eye tracker should be ca. 60 cm. TIP Use the measuring tape supplied by Eyetech.

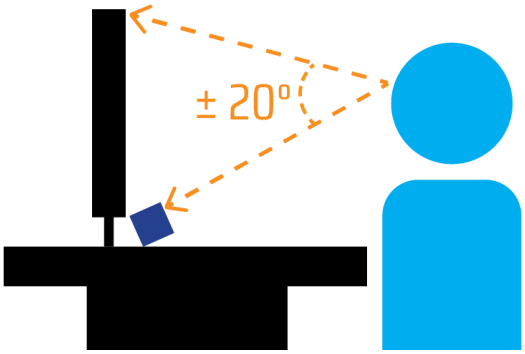
- To optimize the head position towards the eye tracker, use a table or chair that can be adjusted in height.



- During the test, let the participant be seated as still as possible. Do not, for example, use a chair with wheels.

- Make sure that the participant can read items on the screen and, if needed, can easily reach the keyboard and mouse.
- Take care that lighting from windows, or other light sources, does not interfere with the eye tracking.

- The angle between the eye tracker and the gaze point at the screen is maximally 36° and ideally 20°. In general, when the participant is seated at the correct distance and height in front of the monitor, the angle is correct.



Why am I not receiving eye tracker data?

- If you have an Eyetech eye tracker, it could be that you did not calibrate the eye tracker. The Eyetech eye tracker does not provide data prior to calibration. Calibrate the Eyetech eye tracker and see if this fixes your issue. If not, reach out to your system administrator or Noldus Support.
- If you have a Tobii eye tracker, follow the instructions to install the eye tracker as described by Tobii. If you still run intro problems, reach out to your system administrator or Noldus Support.

Why are the calibration dots not distributed evenly across the participant screen?

When the calibration screen does not look as expected - for example, if the calibration dots are all in one corner - check your Windows display scale. It should be at 100%.

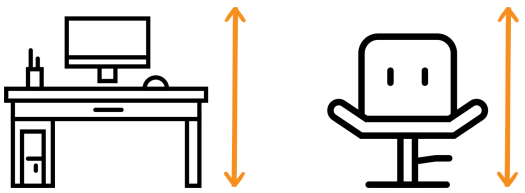
If the display scaling is set to 100% but problems still occur, do the following:

1. Disconnect the eye tracker from the participant PC.
2. Reconnect the eye tracker.
3. Restart the participant PC.
4. Refresh the browser page on the test leader PC.

Why is the calibration failing?

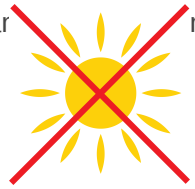
If calibration fails, or calibration quality is repeatedly not good enough, this may be due to several reasons:

- The participant is not seated correctly in front of the computer. The participant may be sitting at an angle to the monitor or sitting at an incorrect height or distance. The optimal height and distance toward the monitor differ per eye tracker brand. See How should the participant be seated for eye tracking? for more details. To seat the participant appropriately, follow the two guidelines below:
  1) Use a table or a chair that is easily adjustable in height.

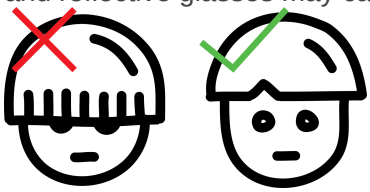


- 2) Do not use a chair with wheels, or a swivel chair, because the participant may change position during either the calibration or test, leading to incorrect eye tracking data.

- The participant does not correctly follow the dots during the calibration. This may result in a deviation between the displayed calibration dots and the measured gaze data (low accuracy). Ask the participant to focus on the dots and not anticipate where the dots may appear.
- The ar may not be optimal. Avoid overhead light and bright sunlight in the experiment room.



- The eye tracker may not correctly detect the eyes. Make sure the eyes are not (partially) covered by hair. Also, opening the eyes wider may help. Be aware that thick black mascara, bifocal or multifocal glasses, and reflective glasses may cause problems with eye tracking.



- The eye tracker may be dirty. This may result in large gaze circles in the calibration results plot (low precision). Clean the eye tracker gently. Please refer to the documentation that came with your eye tracker for cleaning instructions. Disconnect your eye tracker from the power source before cleaning. Do not use strong cleaning agents, and ensure the eye tracker does not become wet.
- If you use the Eyetech VT3 Mini, it is essential that both of the green lights on the eye tracker light up during the entire calibration. This means that both eyes are detected during the whole calibration.

Screen sharing

Why does screen sharing not work?

When the live view on the test leader PC does not display the participant's screen after the screen is shared, check the following:

- Both the test leader PC and the test participant PC have internet access.

If this does not solve the problem, the network configuration in your company may have restrictions. Contact your system administrator or Noldus Support for help.

Devices

Why does my biosensor not work?

When devices cannot connect, or screen or camera views do not show any data, rebooting the Participant PC is the first step. If that doesn't work try the following:

- Right-click the N-Linx agent icon in the toolbar on the Participant PC and select **Open N-Linx Agent**.
  Check if you see the Shimmer physiology plugin. If not, add the Shimmer plugin using the 'Add plugin' button at the bottom of the window.

- Right-click the N-Linx agent icon  in the toolbar on the Participant PC and select **Open N-Linx Agent**. Check if you see the Shimmer ECG or Shimmer PPG. If not, restart streaming in Consensys.

  Check in NoldusHub on the Test leader PC that you have restored the connection with the biosensor.

Backup NoldusHub

How can I back up my NoldusHub data?

Only users with the `Administrator` role can create a backup of all data in NoldusHub. This is typically the system administrator in your organization.

Technical FAQ

Troubleshooting

Below is a list of Frequently Asked Questions (FAQ), which are answered in technical detail.

This list contains more technical fixes than those explained than in the general FAQ, and may be more relevant for system administrators than for users. Don't see your question on this list? Get in contact with Noldus Support via the MyNoldus user portal. We are happy to help.

Overview: Frequently Asked Questions (FAQ)

Why does screen sharing not work?

The reference manual tells the user to check their internet connection on both the Test leader PC and Participant PC. If internet is active and the problem is still not resolved, they can get in contact with their system administrator or with Noldus Support.

As an administrator, check that the ports needed for communication between the Test leader PC and the Participant PC are not blocked. Do the following:

On **both PCs**, create inbound and outbound rules in Windows Firewall to allow traffic through the UDP ports 3478, 5349, 19305, and 19307.

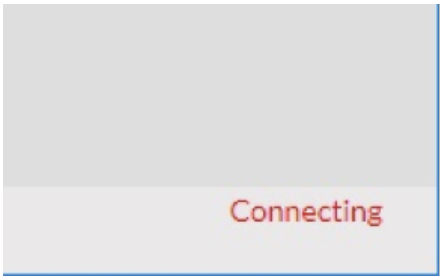
If this does not solve the problem, the network configuration in your company may be blocking all traffic through UDP ports. You can use the following tool to see if traffic through UDP ports is blocked: https://webrtc.org/. If traffic through UDP ports is blocked, this is indicated under **Network**. Contact Noldus Support for further assistance.

Why am I not receiving eye tracker data?

Lack of eye tracking data can occur in the following cases:

- Your eye tracker is not connected to the test Participant PC. To fix this:
  Make sure you have the Noldus Media plug-in installed:
  1. Double-click the  **N-Linx Agent icon**.
  2. Right-click in the Agent and click **update plug-in.**
  3. Navigate to the folder with the plug-in.
  4. Click **OK**.

- The N-Linx Agent is not connected to N-Linx Server. To check this, click the arrow in the bottom-right corner of your screen to open the system tray. If N-Linx Agent is connected to N-Linx Server, the N-Linx Agent icon is gray. If there is no connection, the icon is red.
  To solve this:
  1. Double-click the **N-Linx Agent icon**.
  2. Correct the IP address of the computer with N-Linx Server.
  3. Click **Connect**.
- Windows Firewall blocks inbound and outbound traffic through TCP port 5672.
  To solve this:
  Check whether the inbound and outbound rules in Windows Firewall allow traffic through TCP port 5672. If your PC was provided by Noldus, this rule should have been created already. If you provided your own PCs, verify the Firewall settings now.
- There is no connection to the Noldus network communication protocol, N-Linx, on the server. If this is the case, the statuses `Connecting` and `Failed` are displayed alternatingly in the bottom-right corner of NoldusHub.



  To solve this:
  1. Press **Ctrl+Alt+Del**.
  2. Choose **Task Manager > Details**.
  3. Check the statuses of `RabbitMQ`, `NLinxDiagService`, and `NLinxStorageService`. They should be running.
  4. If one of these services is not running, right-click the line and choose **Start**.
  5. Once the connection is reestablished, the statuses Connecting and Failed should disappear.

Why won't my Shimmer device connect over Bluetooth?

There are multiple possibilities as to why your Shimmer device may not want to connect to your Participant PC over Bluetooth. Some steps you can try to solve this issue can be found below.

- Verify that the Shimmer has been programmed with Bluetooth (BT)-enabled firmware (for example, *LogAndStream*).
- Verify that the Shimmer is within range of the Participant PC and has a line of sight.
  - Shimmer has a Bluetooth range of 10m but the range of the Participant PC may vary and should be verified. The Bluetooth connection doesn't necessarily need line of sight once established; however, for first connection, it is recommended.
- Verify that there are no issues with low or problematic battery.
  - Place the Shimmer device in a powered charging dock. If the cause of the connection issues is the Shimmer battery, this should resolve it.
- Make multiple connection attempts.
  - Multiple connection attempts may be required for the following reasons:
    - When the Shimmer device is not connected the device is 'listening' for a connection only 12.5% of the time.
    - When a Bluetooth device connects with another device they synchronize their frequency hopping pattern. If they have not connected for a long time, the frequencies can become

severely out of sync. Once a connection is made, the frequency patterns are again synchronized.

How can I back up my NoldusHub data?

Only users with the `Administrator` role can create a backup of the data in NoldusHub. To back up your data and projects, follow the instructions from the Back up all projects in NoldusHub guide. Keep in mind it is only possible to back up all data available in NoldusHub and not from only specific projects.

Privacy policy

Personal data in NoldusHub

NoldusHub records your participant's behavior while interacting with the digital content on their screen. When you use a camera to record the participant, 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. 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. By default video and audio of the participants is stored. If you enter participant details like their name as session or project names, this is also personally identifiable information.
  - Who will have access to the personally identifible 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 recordings will be deleted.
  - The right of subjects to withdraw permission for the use of the recordings and instructions for the participant to withdraw permission.
  - The right to data portability and instructions for the participant how to receive their recordings.
  - Security and privacy measures taken. In NoldusHub, video and audio is streamed over a secure network. The videos and other data are stored locally on the server.
- The videos are stored until they are removed manually in NoldusHub by deleting the session or the entire project.
- We recommend not to store any personally identifiable information in the project and session names. Use generic names instead, like Participant 1, Participant 2, etc.

For information about Noldus' Privacy Policy with regard to your data, see: https://www.noldus.com/legal/privacy-policy

Facial Expressions

Facial expressions in NoldusHub

NoldusHub analyzes facial expressions from videos of your test participants. This functionality uses the analysis options from FaceReader version 9 (Vicarous Perception Techologies bv, 2022).

NoldusHub can classify the following facial expressions of your test participant:

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

These emotional categories have been described by Ekman [1] as the basic or universal emotions. The expressions are visualized in a timeline and can be exported to log files. Each expression has a value between 0 and 1, indicating its
intensity. ‘0’ means that the expression is absent, ‘1’ means that it is fully present. The application has been trained using intensity values annotated by human experts.

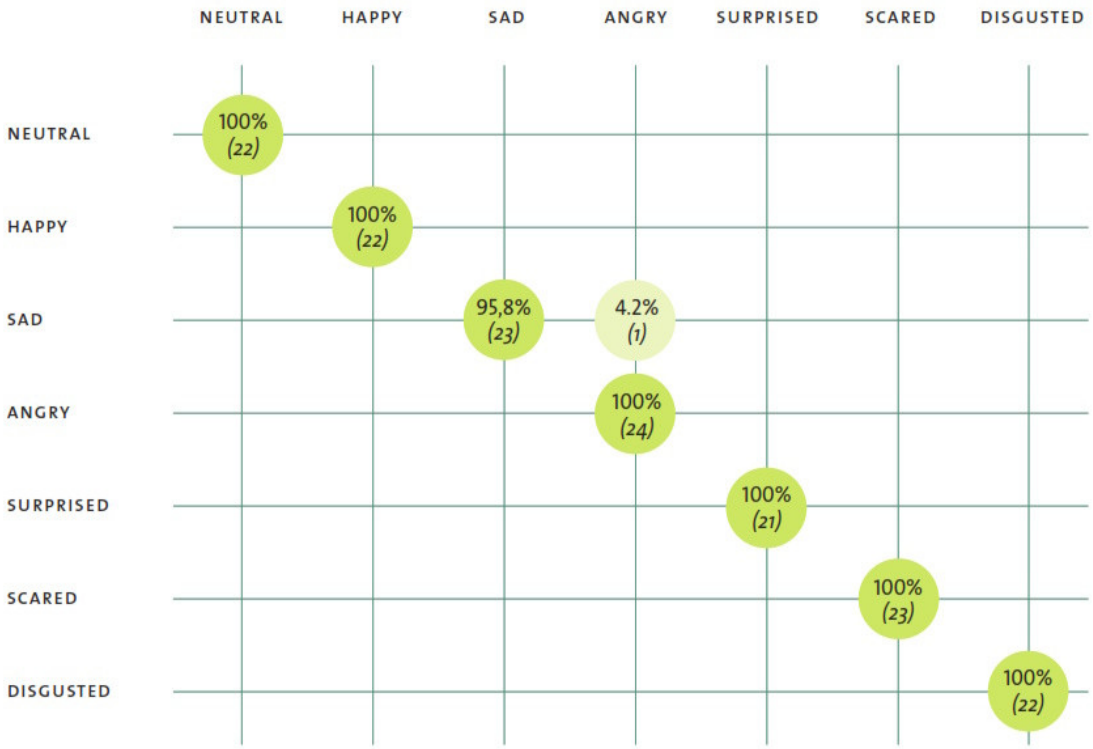
How does facial expression analysis work?

Facial expressions are classified according to the steps below.

1. **Face finding**. The position of the face in an image is found using a deep learning based face-finding algorithm [2], which searches for areas in the image having the appearance of a face at different scales.
2. **Face modeling**. FaceReader uses a facial modeling technique based on deep neural networks [3]. It synthesizes an artificial face model, which describes the location of 468 key points in the face. 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. **Face classification**. Then, classification of the facial expressions takes place by a trained deep artificial neural network to recognize patterns in the face [4]. FaceReader directly classifies the facial expressions from image pixels. Over 20,000 images that were manually annotated were used to train the artificial neural network.

Validation

Facial expression analysis has been compared with those of intended expressions. The figure below shows the results of a comparison between the analysis in FaceReader version 9, from which the expressions are delivered through API to NoldusHub, and the intended expressions in images of the Amsterdam Dynamic Facial Expression Set (ADFES) [5]. The ADFES is a highly standardized set of pictures containing images of eight emotional expressions. The test persons in the images have been trained to pose a particular expression and the images have been labeled accordingly by the researchers. Subsequently, the images have been analyzed in FaceReader. As you can see, FaceReader classifies all ‘happy’ images as ‘happy’, giving an accuracy of 100% for this expression.



Affects

In addition to the basic emotional categories, the following affects are estimated based on facial expressions:

- Interested
- Bored
- Surprised

Affects are estimated using facial expressions over a time interval. For each frame, the estimate of the affect is calculated using the current frame and all the previous frames in the time interval. To calculate interested, bored and confused the following time intervals are used:

- Interested – 2 seconds.
- Bored – 5 seconds.
- Confused – 2 seconds.

At the start of the analysis, there is no time interval yet to analyze these affects. Therefore the visualization will display no data. The analysis starts when half the time interval has been reached. This means that the analysis of interested and confused starts 1 second after the start of the recording. The analysis of bored starts 2.5 seconds after the start of the recording.

The analysis of interested, bored, and confused is based on references [6], [7], and [8].

References

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2. Zafeiriou, S.; Zhang, C.; Zhang, Z. (2015). A survey on face detection in the wild: past, present and future. Computer Vision and Image Understanding. September 1, 2015, 138, 1-24.
3. 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). In Proceedings of the IEEE International Conference on Computer Vision 2017 (pp. 1021-1030).
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5. Schalk, J. van der; 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.
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More information

More information on facial expression analysis and validation is present in the FaceReader Methodology Note which can be obtained from your Noldus sales representative.

Resources

Electrodermal activity (EDA)

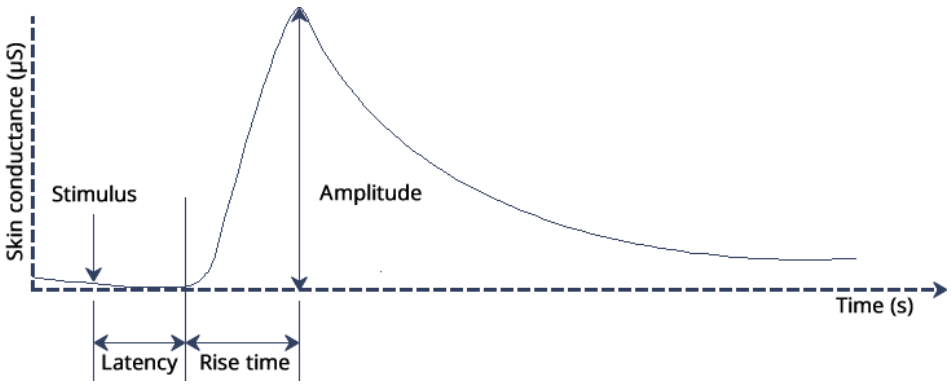
What is electrodermal activity?

Electrodermal activity (EDA) is variation in the electrical conductivity of the skin. It is also referred to as skin conductance response, or galvanic skin response. This signal is usually measured by the electrical current produced when applying a minor and harmless voltage between two electrodes attached to the skin. From the magnitudes of the measured current and the applied voltage, the electrical conductance can be calculated. Conductance is expressed in micro Siemens (?S), the inverse of electrical resistance in kilo Ohm (k?). Skin conductivity is influenced by factors like the diameters of sweat ducts in the skin and the accumulation of sweat under the electrodes attached to the skin.

The EDA signal

The raw EDA signal is generally decomposed into two components:

- Phasic EDA responses are temporary conductance elevations triggered by the autonomous nerve system (ANS) in response to external or endogenous stimuli. For human subjects, single phasic responses follow a prototypical pattern (see figure below): The first 3-5 seconds after stimulus presentation no conductivity changes are observed (the latency period). Then, after approximately 8-10s (the rise time), conductivity steeply inclines to a peak value. The amount of incline is referred to as the amplitude. Then, conductivity decays towards baseline over another 20-25s.
- Baseline EDA, also referred to as tonic EDA level, are the constant or slowly-changing conductivity levels that occur regardless of phasic EDA responses. Conductivity levels may fluctuate over time due to factors not related to ANS responses but to processes like the accumulation of sweat under the sensors and mechanical factors like pressing or pulling the electrodes attached to the skin.

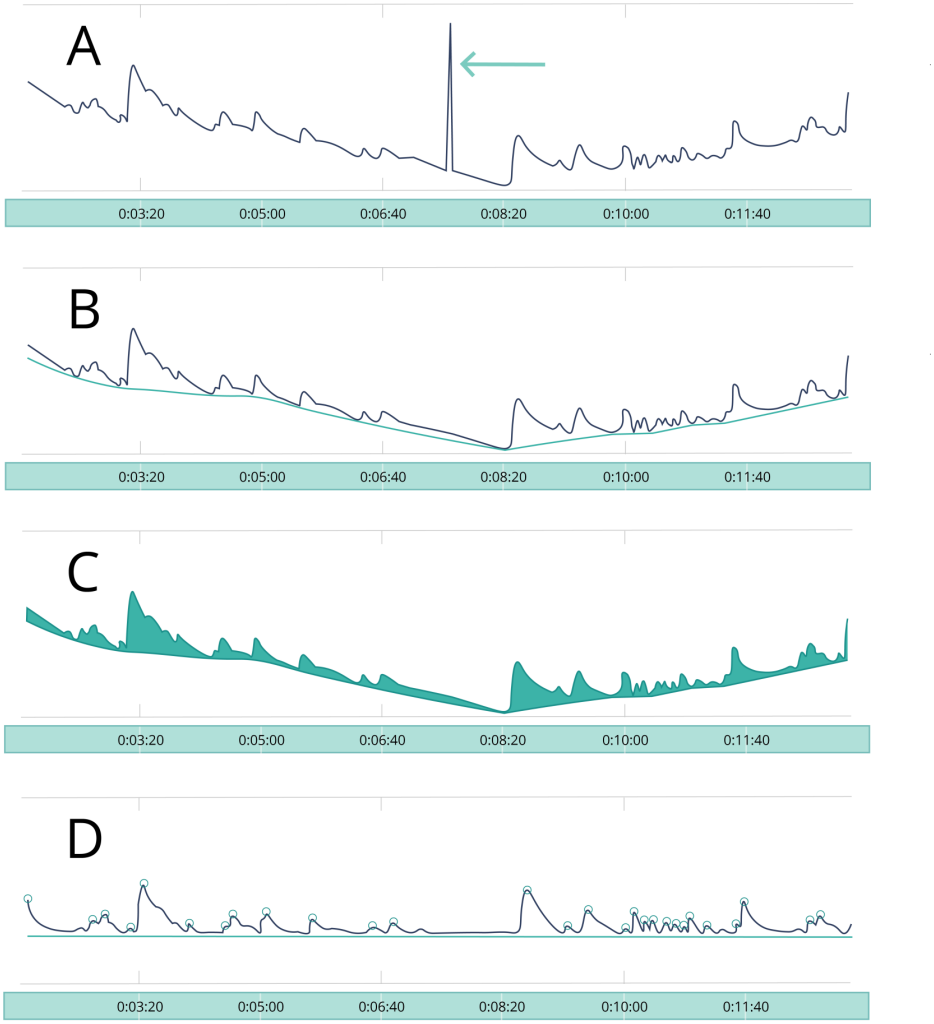


Interpretation of phasic EDA responses

Phasic EDA responses are invoked by the sympathetic branch of the ANS, which regulates involuntary physiological responses to physiological and psychological stressors in preparation of a “flight or fight response”. The frequency of phasic EDA responses indicates the magnitude of sympathetic ANS activation. This explains why momentary phasic response frequency is associated with self-reports of momentarily experienced anxiety (

Strohmaier et al, 2020). Therefore, the frequency of phasic EDA responses is often used as a proxy for sympathetic ANS activity or emotional arousal. As EDA responses are involuntary and proportional to experienced emotion or anxiety, it has gained popularity in psychological studies of unconscious or unexpressed emotional responses to anxiety triggers. However, it should be noted that EDA does not relay information on the quality of the emotion that is experienced.

The number of Phasic EDA responses per time unit (typically per minute) is used as a measure for the magnitude of the ANS activation that invoked the responses. The phasic EDA peak shown above constitutes an isolated single peak. In practice, multiple EDA responses can be stacked if these are triggered at high frequencies in sequence. In the Figure below, stacking of phasic responses is observed for the phasic response that starts at approximately 3:15 minutes after start. Subsequent stacked peaks typically have lower amplitudes because of physiological constraints. However, these reflect equal elevations of ANS arousal as any other phasic peak.



Signals present in NoldusHub

In NoldusHub, the available EDA signals are:

- EDA peak rate - the number of skin conductance peaks per minute
- EDA tonic - the skin conductance baseline in µS.

The NoldusHub algorithms

First, short-lived data artefacts in the raw data are removed by median Filtering (See section A in the figure above). Then the signal baseline is assessed (green line in section B). To obtain the , which is subtracted from the raw signal to produce a baselined EDAphasic EDA responses are identified by Wiener deconvolution using as a signal template the averaged stimulated EDA response assessed by Bach et al (2010) for visually presented stimuli. Deconvolution allows for the detection of stacked EDA peaks, and is not sensitive for differences in peak amplitude. This allows for a better detection of trains of stacked EDA peaks. A minimum amplitude threshold is used as additional detection criterion to prevent spurious peak detection. 30 sec delay in liveview

References

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Strohmaier,A.R., Schiepe-Tiska,A. and Reiss,K.M. (2020). A COMPARISON OF SELF-REPORTS AND ELECTRODERMAL ACTIVITY AS INDICATORS OF MATHEMATICS STATE ANXIETY. AN APPLICATION OF THE CONTROL-VALUE THEORY. Frontline Learning Research, 8: 16-32.

Heart rate data

Two methods to measure heart rate data

NoldusHub measures heart rate data based on two methods that give similar results, but have important differences which will be discussed on this page. The two methods are:

- Photoplethysmography (PPG)
- Electrocardiography (ECG)

ECG

ECG determines the heart rate by measuring the electrical signals coming from the heart. It is a reference signal for health assessment and for research. For measurement, several electrodes are placed on the chest. Each electrode has its own signal which can be found in NoldusHub under the names lead I, lead II, lead III.

PPG

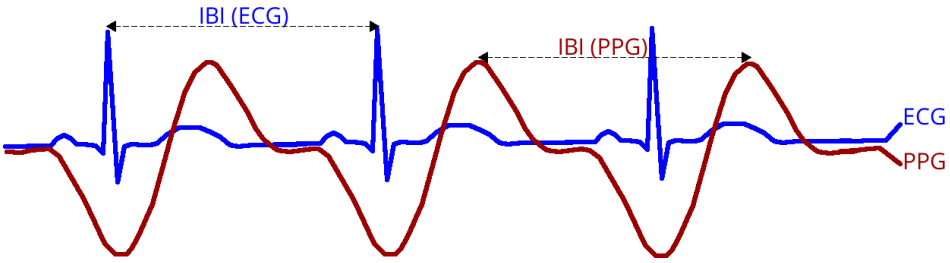
PPG determines heart rate by measuring changes in light reflection or transmission through the skin due to blood volume changes. It is generally measured with a single sensor on a finger or an ear lobe.

Raw and derived signals

The picture below is an example of a raw ECG signal and a raw PPG signal. Due to the fact that blood must travel through the body, the peaks in the PPG signal are later than the peaks in the ECG signal.

Heart rate is the number of peaks per minute.

Interbeat interval (IBI) is the number of ms between two heart beats.



Differences between ECG and PPG data

ECG	PPG
Direct – electrical current from the heart	Indirect – reflection by blood volume

Reference signal for health	Uses ECG as ground truth and research
Invasive - several sensors on chest	Non invasive - one sensor on ear lobe or finger
Accurate	Sensitive to noise and movement
Sharp peak, accurate pulse detection	Broad peak, pulse detection is less accurate
Data obtained accurately using a small time window and real-time signal	Requires time window of several minutes for accurate data

Signals present in NoldusHub

PPG

- Heart rate (BPM): the number of peaks, heart Beats, Per Minute.
- Interbeat interval (ms): the number of ms between two heart beats.
- Raw data: the raw PPG signal.

ECG

- Heart rate (BPM): the number of peaks, heart Beats, Per Minute.
- Interbeat interval (ms): the number of ms between two heart beats.
- Lead 1 (mV): the ECG vector signal measured from RA to LA.
- Lead 2 (mV): the ECG vector signal measured from the RA to LL.
- Lead 3 (mV): the ECG vector signal measured from the LA to LL. This is derived by subtracting Lead 1 from Lead 2.
- Vx (mV): The ECG vector signal measured from the average of the RA, LA and LL to the V electrode.

Image of position of Shimmer ECG electrodes on body.jpg

Image not found or type unknown

For more details on the Lead and Vx signals, consult the Shimmer ECG user guide.

Data processing

The heart rate data are preprocessed in the following way:

- High pass filter - The data below 0.5 HZ is not included.

- Notch filter - To remove artifacts caused by the power frequency, the 50 (Europe) or 60 (USA) Hz frequency band is not included.

Eye tracking data

Gaze overlay

Gaze data is visualized in NoldusHub through the Gaze overlay on the Screen video in the *Screen video pane* inside the record and replay page.

Gaze data consists of two parts: fixations and saccades. Fixations are visualized with the pink dot; the line following the dot represents the saccades. These concepts are explained below.

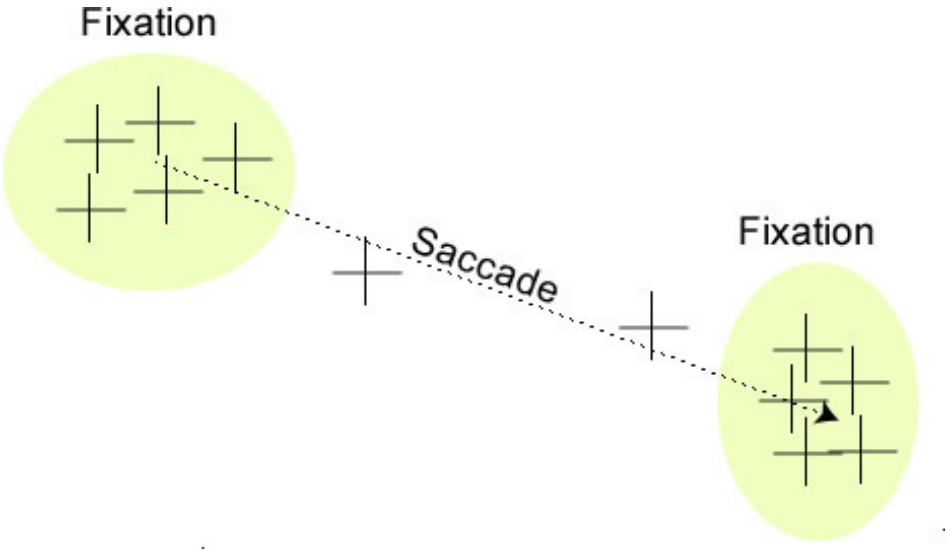
What are fixations and saccades?

The moments that our eyes focus on something are called fixations. The duration of fixations varies between roughly 50 ms and 1 s.

The image below illustrates what this looks like when we collect eye tracking data. Each cross is a gaze point that is sampled by an eye tracker. During a fixation, these gaze points are close together.

Fixations are alternated with saccades, which are rapid eye movements from one fixation to another. Saccades last much shorter than fixations, roughly 30 to 80 ms.

Below it is explained how NoldusHub calculates fixations and saccades.



How does NoldusHub calculate fixations?

There are several algorithms to calculate fixations from the raw eye tracking gaze points [1]. An algorithm that is commonly used in eye tracking software is the Identification by Dispersion-Threshold (I-DT) fixation algorithm. This algorithm detects fixations based on the distance between gaze points.

NoldusHub uses the I-DT fixation algorithm published by LC Technologies [2]. It is a variant of the fixation algorithm described by Salvucci and Goldberg (2000) [1]. See references 3-5 for reviews on the I-DT fixation algorithm.

Fixations in NoldusHub

In NoldusHub, a fixation is recorded if gaze points are within 20 pixels of the fixation center for a minimum duration of 5 samples. This is 83 ms for an eye tracker that samples at 60 Hz.

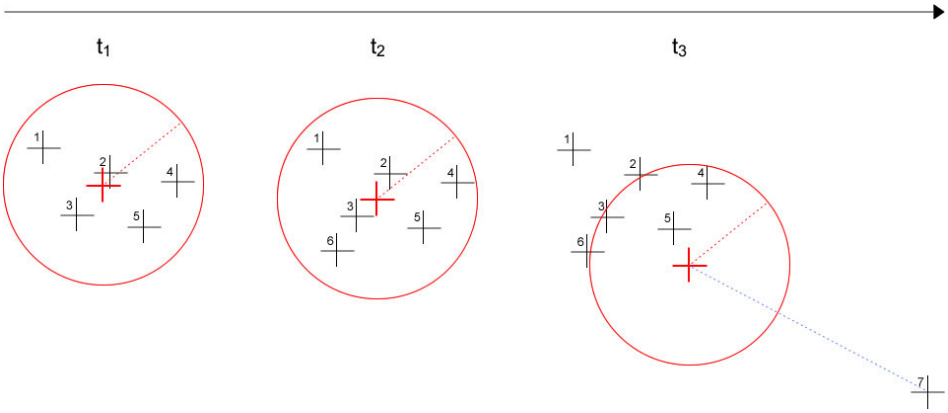
The figure below illustrates this in more detail.

- The black crosses are gaze points recorded by the eye tracker.
- The red dotted line is the dispersion threshold.
- The red cross is the average x,y coordinate of the gaze points in the fixation.
- t1, t2, and t3 are three eye tracker sample points.

The I-DT fixation algorithm in NoldusHub

In more detail, the I-DT fixation algorithm makes use of two thresholds: a dispersion threshold and a duration threshold.

The dispersion threshold determines the maximum distance between a gaze point and the average of all gaze points in a fixation. The default dispersion threshold in NoldusHub is 20 pixels.
The duration threshold determines the minimum duration that gaze points should be within the dispersion threshold, to become a fixation. The default duration threshold in NoldusHub is 5 samples. For an eye tracker that samples with 60 samples per second, this means 83 ms.



- At t1, five gaze points are recorded. They are all within the dispersion threshold. The duration threshold is exceeded. A fixation is recorded.
- At t2, another gaze point (6) is recorded. The average gaze point moves slightly. All gaze points are still within the dispersion threshold. All gaze points belong to the same fixation.
- At t3, another gaze point (7) is recorded. The average gaze point moves. The distance between gaze point 7 and the average gaze point exceeds the dispersion threshold. The fixation ends and a saccade is recorded.

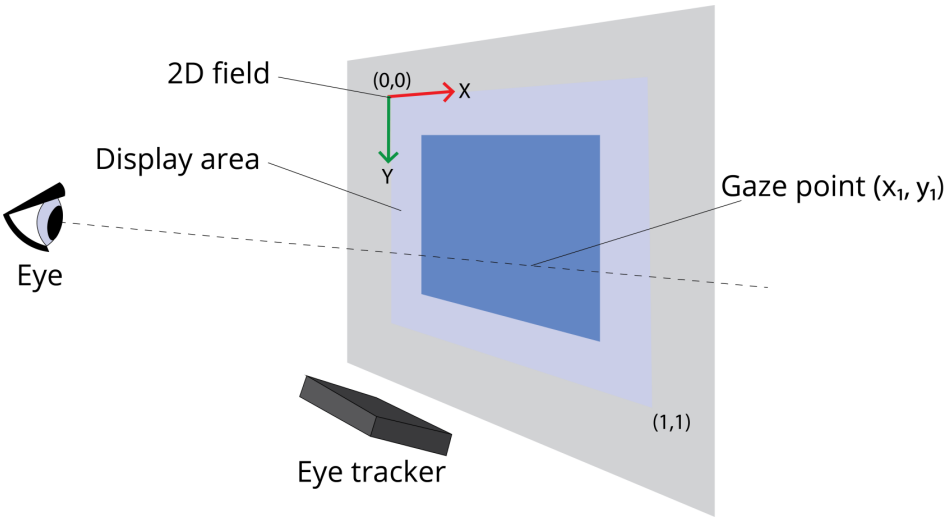
NoldusHub calculates the gaze point using the average of both eyes. It also takes into consideration the validity of the samples that come from the eye tracker. The validity that is received from the eye tracker is defined as either Valid or Invalid. NoldusHub discards samples where X or Y value is NaN:

- If samples for both eyes are valid and none of the values are NaN then the average is calculated;
- If the validity for one of the eyes is Invalid or there are NaN values then the other eye (valid and without NaN values) is used;
- If both eyes have NaN values or are invalid then the gaze point is set to fixed [NaN, NaN] point.

Eye tracker data signals

The eye tracker collects several types of data signals.

To understand the different signals it is important to know that the fixation and gaze points are positioned in a 2D field on the user display area. The user display area can be a computer screen but can also be, for example, an area of a shop shelf as seen through mobile glasses. The 2D field is mapped to normalized coordinates for X and Y, as a floating point value, which runs from 0.0 to 1.0, both ends included. Point (0, 0) denotes the upper left corner, and point (1, 1) indicates the lower right corner.



- Fixation X: the X coordinate of the fixation center, a floating point value from 0.0 to 1.0.
- Fixation Y: the Y coordinate of the fixation center, a floating point value from 0.0 to 1.0.
- Fixation status: can be undefined, fixation, or saccade, it tells whether the eye is moving or not. If the eye is moving the status is saccade. If the eye is not moving, it is fixated and thus the status is fixation. Undefined is shown if it is unknown whether the eye is moving or not.
- Gaze X: the X coordinate of the gaze point, a floating point value from 0.0 to 1.0.
- Gaze Y: the Y coordinate of the gaze point, a floating point value from 0.0 to 1.0.
- Validity: can be valid, invalid, or indeterminate. It indicates the validity of the gaze origin data.

References

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Cognitive load

All workload items that are currently in NoldusHub are not final yet. They are in the beta stage. Keep this in mind if you want to use this data.

More information about cognitive load will follow.