Pupillometry

Documentation

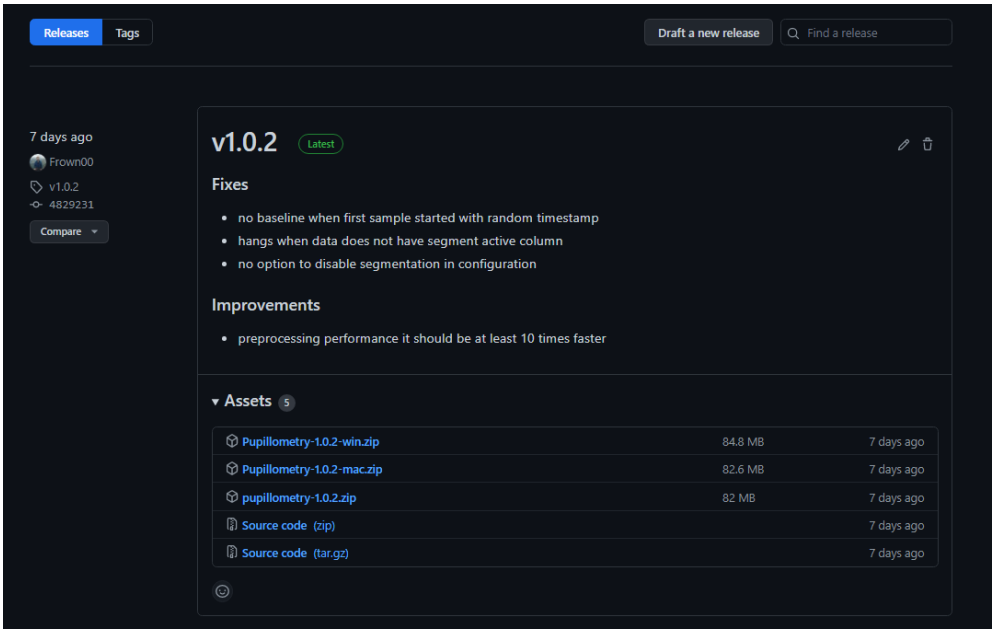
v1.1.3

Contents

1. Introduction

1.1. Installation

We download the archived application from the site with all versions depending on the system used
https://github.com/Frown00/Pupillometry/releases



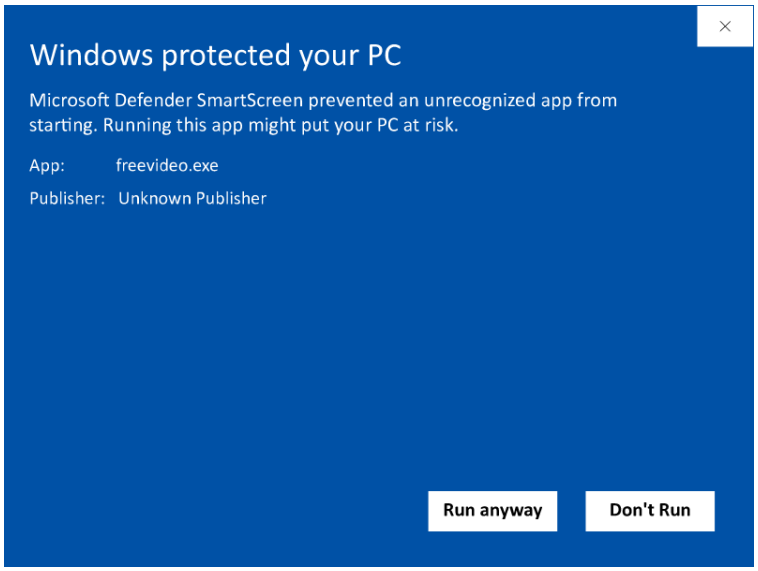
The software was created with a view to working on **Windows** and on this system it was tested and hence in the further part of the manual will be presented the application with its use.

Having downloaded the zip file extract it

Name	Date modified	Type	Size
locales	2022-05-23 00:50	File folder	
resources	2022-05-23 00:51	File folder	
swiftshader	2022-05-23 00:50	File folder	
chrome_100_percent.pak	2022-05-23 00:50	PAK File	139 KB
chrome_200_percent.pak	2022-05-23 00:50	PAK File	203 KB
d3dcompiler_47.dll	2022-05-23 00:50	Application extens...	4,419 KB
ffmpeg.dll	2022-05-23 00:50	Application extens...	2,628 KB
icudtl.dat	2022-05-23 00:50	DAT File	9,978 KB
libEGL.dll	2022-05-23 00:50	Application extens...	431 KB
libGLESv2.dll	2022-05-23 00:50	Application extens...	7,834 KB
LICENSE.electron.txt	2022-05-23 00:50	Text Document	2 KB
LICENSES.chromium.html	2022-05-23 00:50	Chrome HTML Do...	5,331 KB
Pupillometry.exe	2022-05-23 00:51	Application	136,344 KB
resources.pak	2022-05-23 00:50	PAK File	5,011 KB
snapshot_blob.bin	2022-05-23 00:50	BIN File	49 KB
v8_context_snapshot.bin	2022-05-23 00:50	BIN File	161 KB
vk_swiftshader.dll	2022-05-23 00:50	Application extens...	4,408 KB
vk_swiftshader_icd.json	2022-05-23 00:50	JSON File	1 KB
vulkan-1.dll	2022-05-23 00:50	Application extens...	715 KB

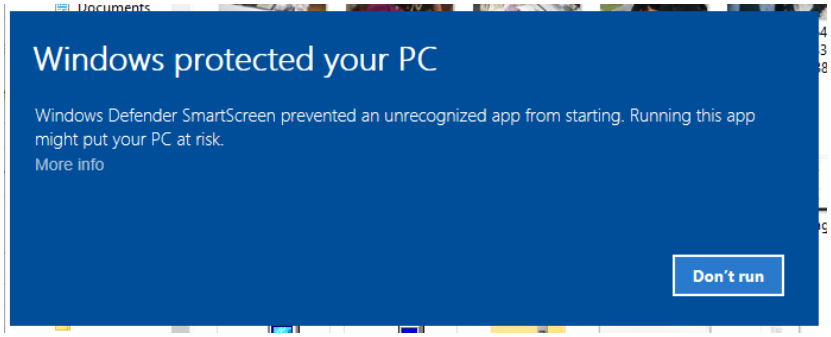
Without any further installation, you should be able to run the .exe

For windows, you may see a warning about preventing an unrecognizable application from running.
This is due to the lack of certification, which requires a fee. In such a situation, you should ignore and run anyway.



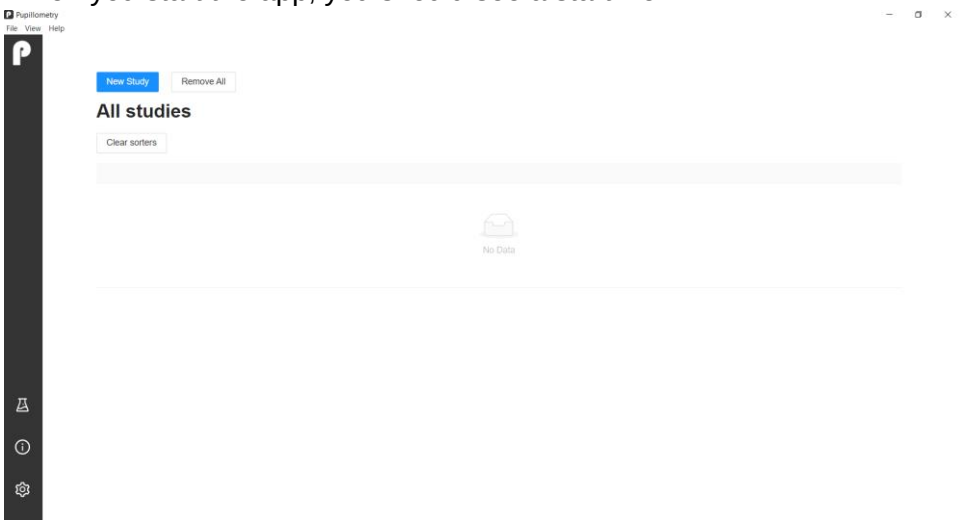
Example from
https://codesigningstore.com/what-is-an-unknown-publisher-warning

The lock can also occur from Windows Defender, then the solution is to disable it for the duration of using the application.



https://i.stack.imgur.com/WfWww.png

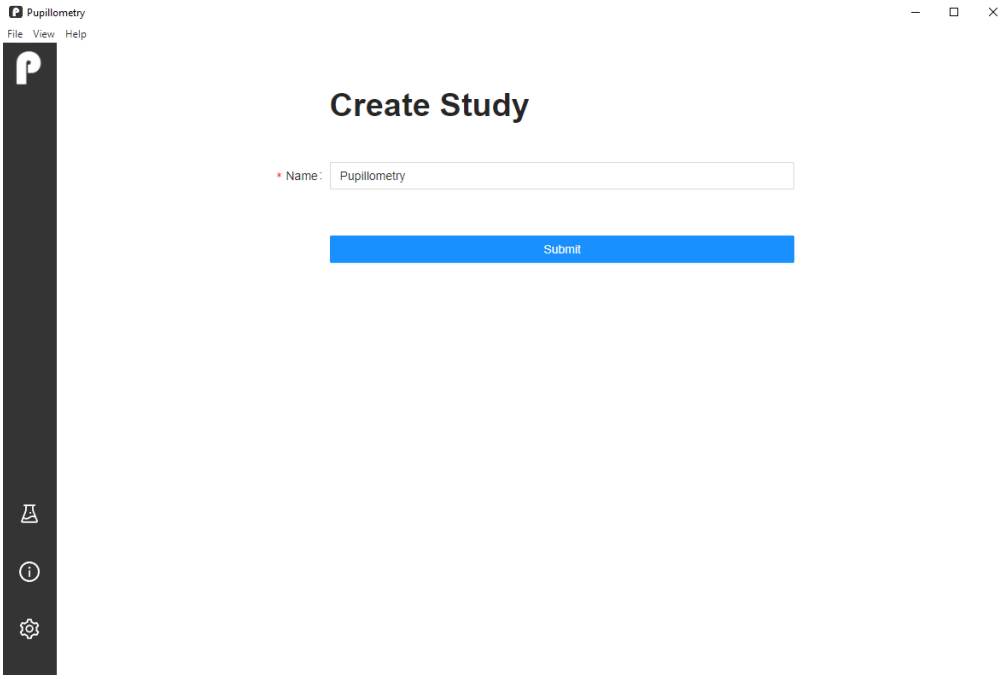
When you start the app, you should see a start view



* *To go to this view from anywhere in the application or refresh its status,* ***click on the logo***

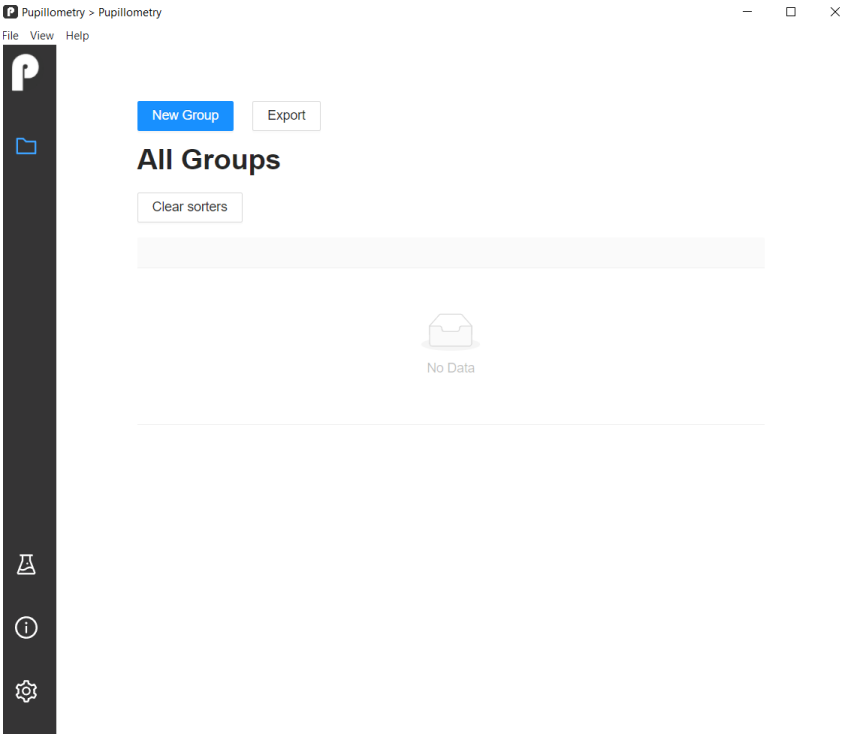
1.2. Create a study

By clicking on the **New Study** button , we go to the form of creating researchIn the



Name field, we enter the name of our study. It must be *unique* and consist of at least *2* characters

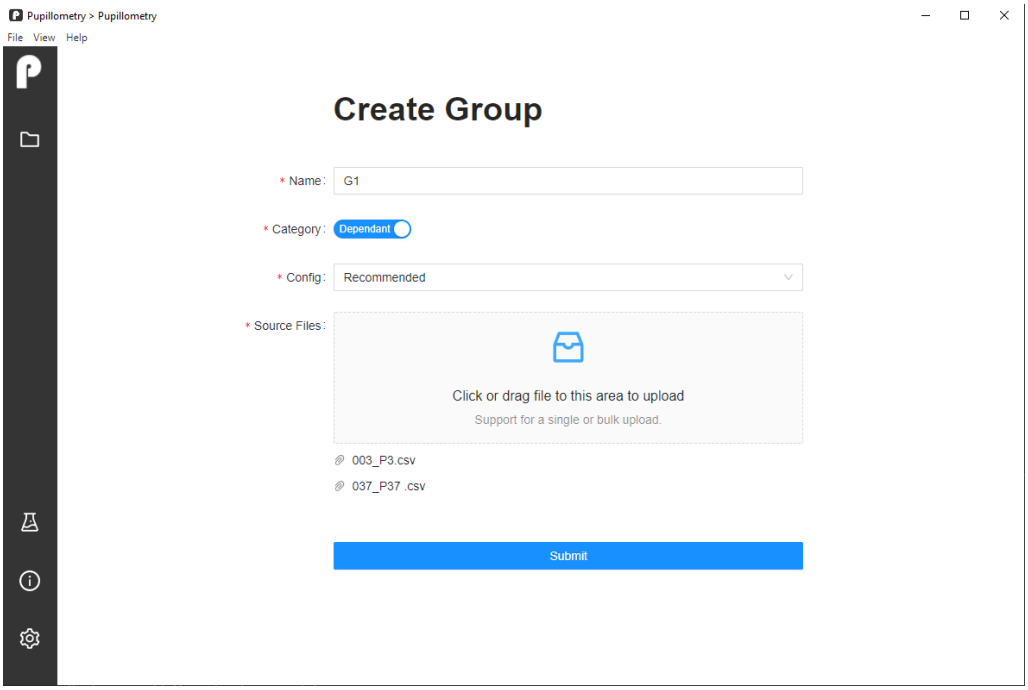
Perform actions by clicking the **Submit** *(or enter)* button and the following view should appear.



This is a view of a newly created study, in which we have access to all groups of study participants belonging to it.
We have access to this view by ***clicking on the folder icon***
(highlighted in the *above inthe idoku* in *blue)*

1.3. Create a group

By clicking on the **New Group** button, we go to the form of creating groupsParameters

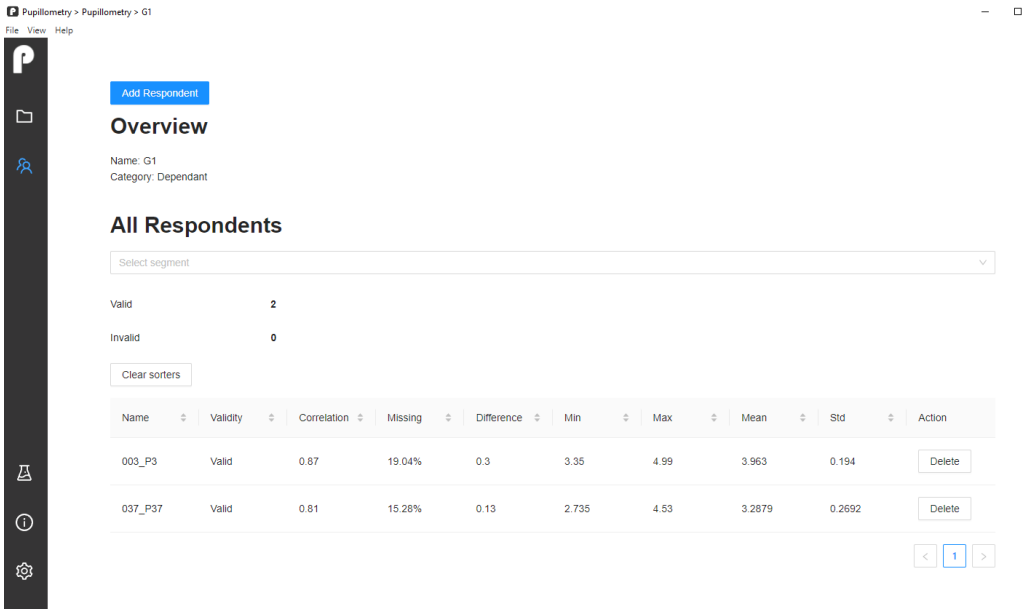


- **Name**
  Group Name/ID
    - at least 2 characters
    - unique within the study
- **Category**
  determines whether participants in the group were dependent or independently subjected
    - affects only the name when exporting measures, and not the course of calculating measures, statistics
- **Config**
  selection of one of the established configurations
    - two built-in
        - Recommended - recommended on the basis of reviewed research, but it is suggested to test and create your own
        - Just testing - basic for experimentation (resampling disabled to speed up)
- **Source Files**
  of participant data in the format determined in the selected configuration
    - required format: *csv*
    - access to sample measurements are in the folder with extracted files
      /resources/assets/examples

After selecting the parameters, click the Submit button and wait for the application to process the data. Which **can take a long time** depending on the number of participants you choose, the size of the data, the configuration you choose, and your processor. In the case *of recommended* configuration approx. **1 min** per participant **(60MB)**

** Progress at the loading screen is updated after each processed participant*

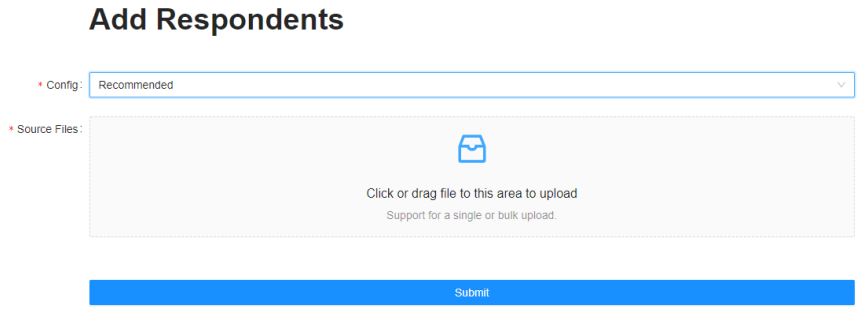
When the task is complete, the following view should appear.



This is a view of the newly created group, in which we have access to all the participants belonging to it.
We have access to this view by clicking ***on the icon of two people***
(highlighted in the above view in blue)

1.4. Adding new participants

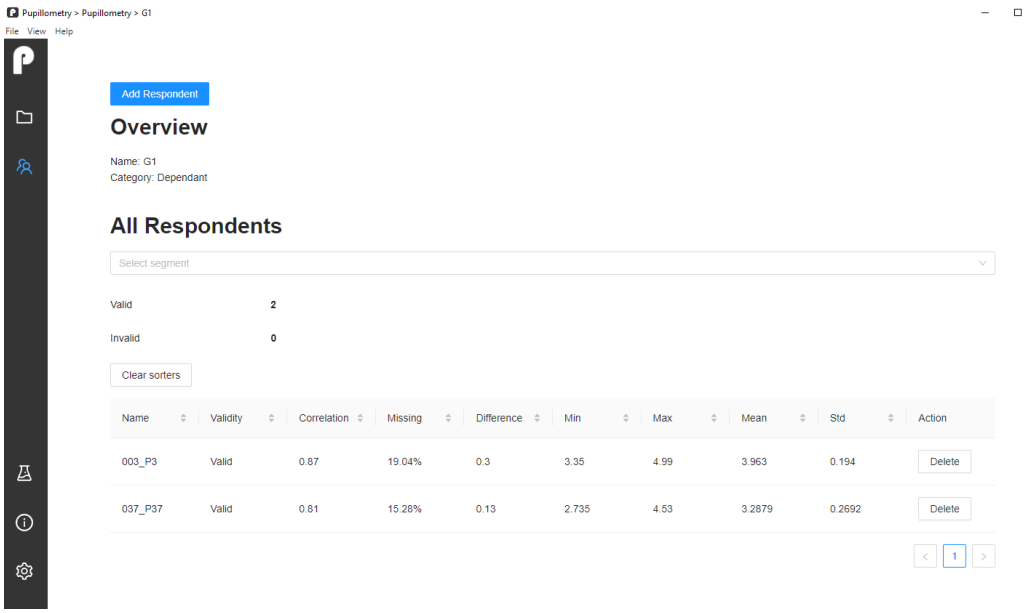
By clicking on the **Add Respondent** button, we go to the form of adding new participants to the existing group



Action analogous to creating a new group.

1.5. Analysis

From the group view, we have access to charts of processed data and general statistics depending on the selected segment, which can be sorted by clicking on the column name. By default, the first segment is selected, but you can change it by selecting one of the options from the drop-down menu *(Select segment)*
However, to display the chart and wider statistics about a given respondent, click on its name.

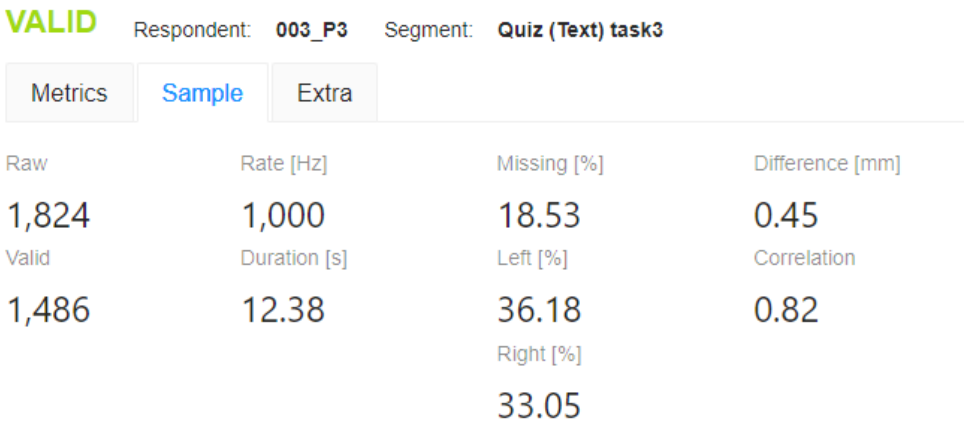


After selecting the **P3** respondent, a panel with charts should be displayed.
Chart depending on the selection of the measure *(bar under the name of the configuration used)*
and segment/task *(bar above the save as PNG button)*

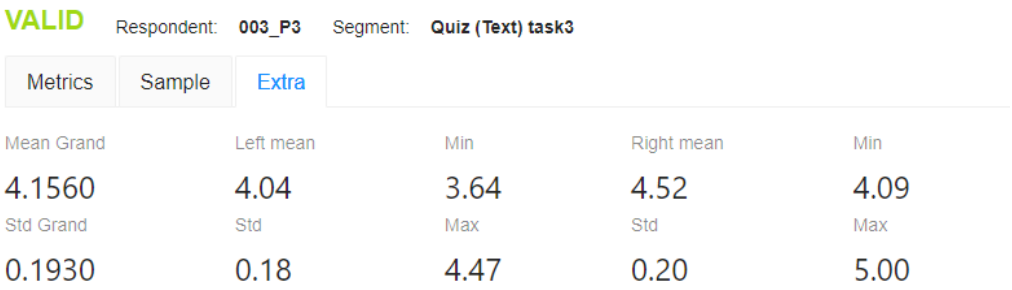
Through the **Mark as Invalid** button you can change the correctness of a given segment
Through **the Save as PNG** *(Generate PNG)* button , save the graph as a png file with 3 times scaled resolution (standard resolution set in the configuration)

Below the graph are statistics about the selected segment and measure.

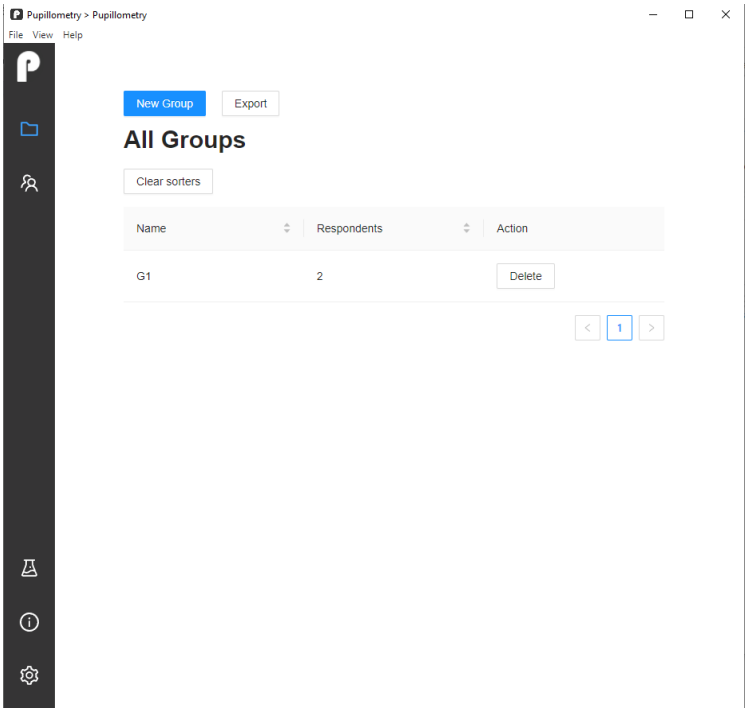
In the **Samples** tab we have access to information about the tested samples



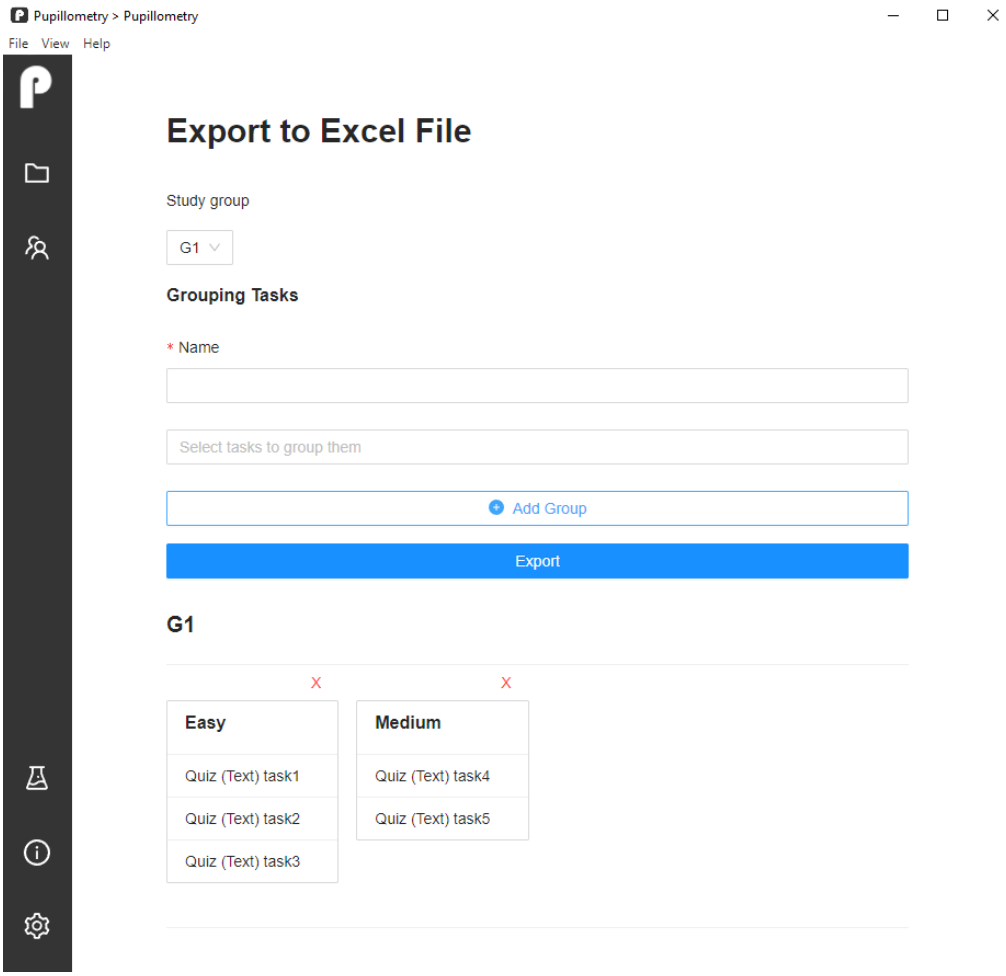
In the **Extra** tab we have access to statistics about both eyes and the average deviation in all segments



The above method is useful to check whether the data is definitely correct, to preview the chart or to exclude from the analysis.
However, for further research, it is necessary to export to excel.



By clicking the **Export** button we will go to the form grouping tasks / segments

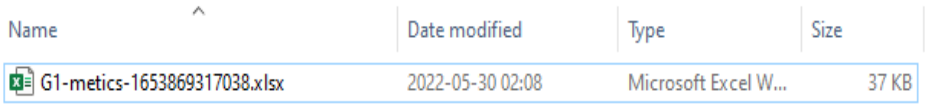


Tasks are grouped by:

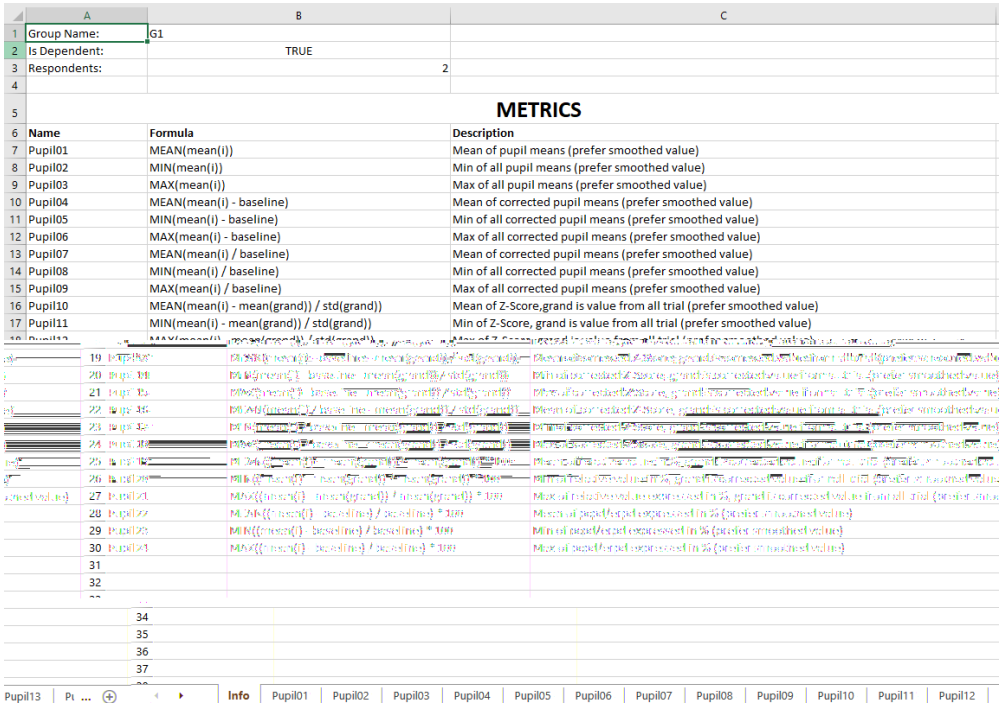
1. Selection of the group **(Study group)** for which we will create groups of tasks,
2. Name a task group by selecting an option from the drop-down menu **(Select tasks to group them)**
3. Press the **Add Group** button, which will add the task group to the list and display it below.

   * *If a mistake occurs, delete the group by clicking the red cross*

After creating the task groups and exporting, the folder with the generated <nazwa_grupy>-metrics-<czas_utworzenia>.xlsx file should open.



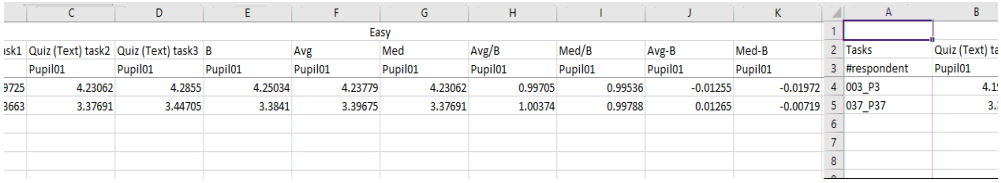
In the file we have access to the description of all metrics along with the name of the group, whether it is independent or dependent and the number of participants



	A	B	C
1	Group Name:	G1	
2	Is Dependent:	TRUE	
3	Respondents:	2	
4			
5		**METRICS**	
6	**Name**	**Formula**	**Description**
7	Pupil01	MEAN(mean(i))	Mean of pupil means (prefer smoothed value)
8	Pupil02	MIN(mean(i))	Min of all pupil means (prefer smoothed value)
9	Pupil03	MAX(mean(i))	Max of all pupil means (prefer smoothed value)
10	Pupil04	MEAN(mean(i) - baseline)	Mean of corrected pupil means (prefer smoothed value)
11	Pupil05	MIN(mean(i) - baseline)	Min of all corrected pupil means (prefer smoothed value)
12	Pupil06	MAX(mean(i) - baseline)	Max of all corrected pupil means (prefer smoothed value)
13	Pupil07	MEAN(mean(i) / baseline)	Mean of corrected pupil means (prefer smoothed value)
14	Pupil08	MIN(mean(i) / baseline)	Min of all corrected pupil means (prefer smoothed value)
15	Pupil09	MAX(mean(i) / baseline)	Max of all corrected pupil means (prefer smoothed value)
16	Pupil10	MEAN(mean(i) - mean(grand)) / std(grand))	Mean of Z-Score,grand is value from all trial (prefer smoothed value)
17	Pupil11	MIN(mean(i) - mean(grand)) / std(grand))	Min of Z-Score, grand is value from all trial (prefer smoothed value)

Info | Pupil01 | Pupil02 | Pupil03 | Pupil04 | Pupil05 | Pupil06 | Pupil07 | Pupil08 | Pupil09 | Pupil10 | Pupil11 | Pupil12

For each metric, a separate worksheet with statistics is dedicated, taking into account the grouping of tasks



	C	D	E	F	G	H	I	J	K
				Easy					
	Quiz (Text) task2	Quiz (Text) task3	B	Avg	Med	Avg/B	Med/B	Avg-B	Med-B
	Pupil01	Pupil01	Pupil01	Pupil01	Pupil01	Pupil01	Pupil01	Pupil01	Pupil01
9725	4.23062	4.2855	4.25034	4.23779	4.23062	0.99705	0.99536	-0.01255	-0.01972
3663	3.37691	3.44705	3.3841	3.39675	3.37691	1.00374	0.99788	0.01265	-0.00719

	A	B
1		
2	Tasks	Quiz (Text) ta
3	#respondent	Pupil01
4	003_P3	4.1
5	037_P37	3.
6		
7		
8		

*If any measurement is incorrect, instead of a number there will be an **INVALID** label*

2. Processing

Below in the subsections are described the processes that are performed in turn in the same order as the described sub-points (src/main/pupillary/Pupillometry.ts)

2.1. Parsing

The first step is to map the data for unification. For further processing, a single measurement (regardless of column names) is in the form: { leftPupil: number rightPupil: number timestamp: number segmentActive: string}

2.2. Segmentation

The segmentation process involves dividing all measurements into smaller sets to simplify analysis.
(Due to implementations, it also reduces the need for RAM)

2.3. **Eye** selection

If a measurement from both eyes is selected, this process will be skipped. In the case of choosing, for example, the left, then the measurements of the right will be a reflection of measurements from the left eye, so that in further processes it can be considered that we should count from both and you do not have to take this choice into account.

2.4. Reject erroneous measurements

The following processes are called markers because they denote data that is omitted from the process of calculating measures

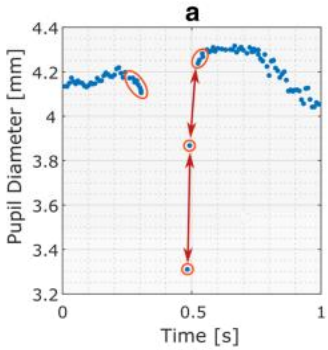
2.4.1. Eye Tracker

For data from iMotions, erroneous pupil diameter measurements are marked with **a value of -1** and these are marked for omission

2.4.2. Outside the designated scope

Depending on the set min and max parameters, those measurements that do not fall within the prescribed range of permissible pupil diameter are determined.

2.4.3. Expansion speed



Method for testing the speed of change of measurements on the basis of which erroneous measurements are evaluated and determined for omission. The whole converges to perform a few steps
(1) Calculation of the expansion velocity for each measurement

$$d'[i] = max\left(\left|\frac{d[i] - [d[i-1]}{t[i] - t[i-1]}\right|, \left|\frac{d[i+1] - d[i]}{t[i+1] - t[i]}\right|\right)$$

where d[i] is a single measurement of pupil diameter

t[i] is a single measurement timestamp(2) Calculation of the mean absolute deviation

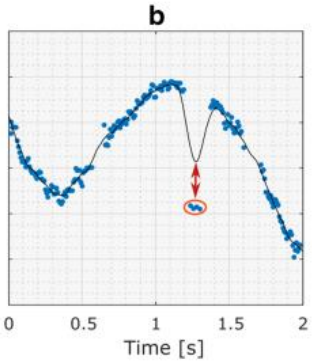
$$MAD = median(|d'[i] - median(d')|)$$

(3) Calculation of the threshold

$$Threshold = median(d') + n * MAD$$

(4) Indication to omit those measurements whose speed exceeds the permitted thresholdThe issue is described in more detail in the following scientific article (subsection
Step 2: Filtering the raw data)
https://link.springer.com/content/pdf/10.3758/s13428-018-1075-y.pdf

2.4.4. Deviation from the trend line

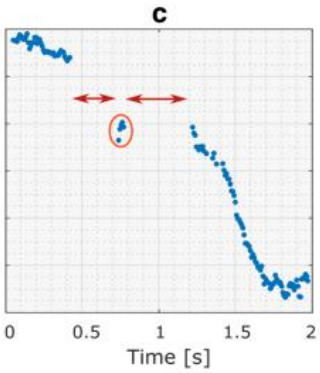


Some eye-trackers, especially those with a high sampling rate, can produce small groups of data that, when you look at the chart, you can see that they are inappropriate, because they deviate significantly from the trend line. Due to the fact that there are many of them, they are resistant to the previous marker, so a separate method is needed to capture them.

It consists in temporarily increasing the sampling to (1000 Hz), smoothing, and then on these generated data using the marker from the previous subsection

The issue is described in more detail in the following scientific article (subsection *Step 2: Filtering the raw data*)
https://link.springer.com/content/pdf/10.3758/s13428-018-1075-y.pdf

2.4.5. Temporally isolated samples



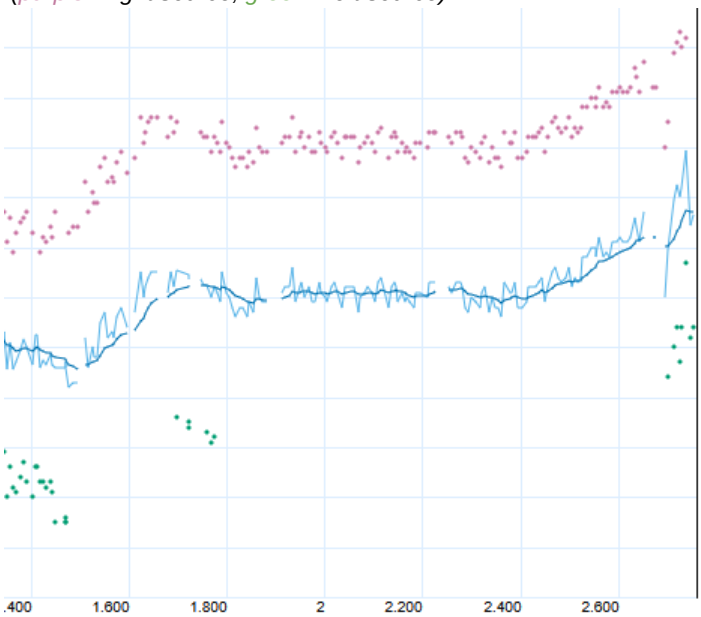
A method that captures isolated samples depending on the parameters given in the configuration (min. distance from the rest and max. size of the islet) and determining them to be omitted.

The issue is described in more detail in the following scientific article (subsection *Step 2: Filtering the raw data*)
https://link.springer.com/content/pdf/10.3758/s13428-018-1075-y.pdf

2.5. Basic calculations

2.5.1. Average pupils

Calculation of the average for each measurement from both pupils. In the absence of a correct one of the two measurements, the last difference is added or subtracted, when both measurements were correct, to the average measurement. Without correcting the average measurement, if there was no measurement of one of the pupils, the trend line soared or suddenly fell.
The following chart clipping illustrates a case in which, without correction, a line chart (blue) would deviate from the correct average.
The dots symbolize single measurements
(purple - right source, green - left source)



2.5.2. Measurement status

The following shall be calculated:

- minimum
- maximum,
- average
- standard deviation
- number of correct measurements

for the entire segment

2.5.3. Correlation

Using an external function, the correlation between the left and right pupils is calculated (those measurements where both measurements occur are taken into account). The range of values is (-1, 1), where 1 is the ideal correlation. When the points taken into account for

correlation is less than 2 - the value is 1, because there may be a situation when we have a reading from only one eye

2.5.4. Pupil difference

Calculation of the average difference of the pupils in order to be able to exclude the entire segment. In most people, it should not exceed 0.4 mm, but about 20% of the population (different data speak of a different percentage division) is affected by anisocory, which is manifested by a greater difference between the two pupils. However, it should not be more than 1 mm.

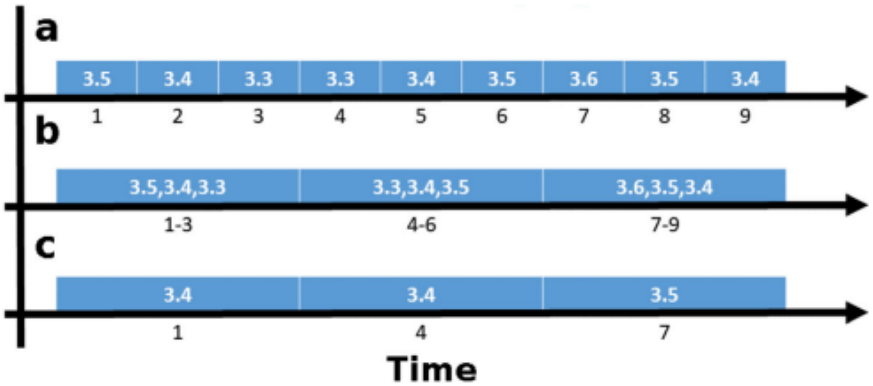
More information

- https://en.wikipedia.org/wiki/Anisocoria
- https://journals.lww.com/co-ophthalmology/Abstract/2016/11000/An_approach_to_anisocoria.4.aspx

2.6. Increase the quality of the estimate

2.6.1. Resampling

At the time of processing a single segment, the approximate sampling rate is calculated. This is the number of all samples divided by the duration of the experiment in seconds.
Based on the calculated sampling rate and the checked (configuration), a decision is made whether the data is to be upsampled or downsampled.
In the case **of upsampling,** we produce data through **linear interpolation** of correct measurements.
A **downsampling** we reduce data **using the basket** method
More information**:** https://pubmed.ncbi.nlm.nih.gov/30710333/



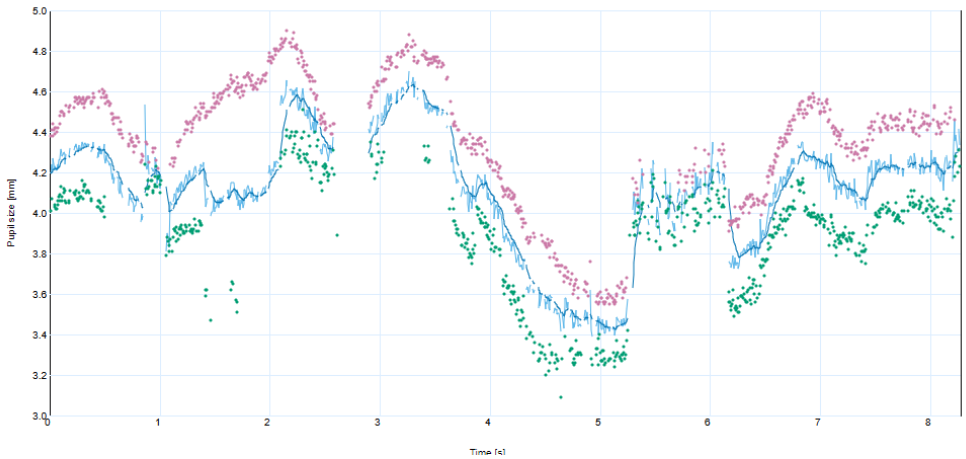
The method of division into baskets (a, b, c)

2.6.2. Smoothing

Data can be smoothed. For this purpose, according to the guidelines, a low-pass-filter with a default suggested cut-off frequency of 4 Hz is used for processing petometric data.

Guidelines
https://link.springer.com/content/pdf/10.3758/s13428-018-1075-y.pdf
The source cited by
the https://pubmed.ncbi.nlm.nih.gov/19635092/

In the case of testing, we can observe the action.



Darker blue means smoothed measurements

2.7. Baseline

The stage of calculating the base size of the pupil diameter for a given participant.
Below options, one is executed depending on the configuration.

2.7.1. Based on the selected segment

Depending on the set parameter in the configuration, a given segment is selected on the base, which is calculated as the average of all samples and assigned as the participant's baseline

2.7.2. Initial calculation

In each segment, the average from the beginning is calculated and assigned to the entire segment. The length *of the baseline* counting period depends on the parameter specified in the configuration.

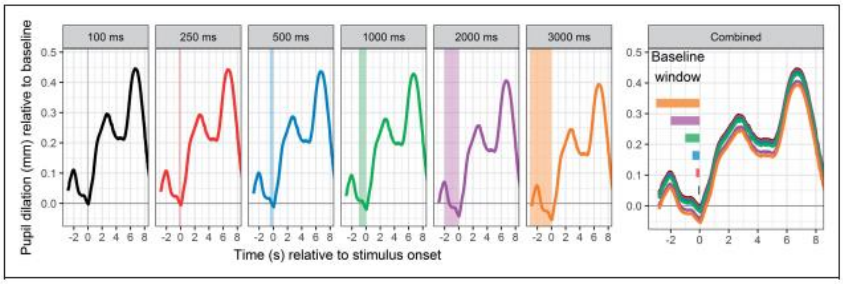


Figure 4. Different baseline intervals end at the onset of the stimulus and extend backwards by variable durations (highlighted in each panel by a shaded vertical area). Comparison of the resulting baseline-corrected data is shown on the far-right panel, revealing negligible differences across baseline durations.

Source: https://pubmed.ncbi.nlm.nih.gov/30261825/

2.8. Calculation of measures

At this stage, measures for uncorrected and baseline corrected data are calculated

2.8.1. Average

All designs:

$$MEAN(mean) = \frac{\sum x_i}{n}$$

$$MEAN(mean_{-baseline}) = \frac{\sum (x_i - baseline)}{n}$$

$$MEAN(mean_{/baseline}) = \frac{\sum (x_i \,/\, baseline)}{n}$$

$$MIN(mean) = min\{x_1, \ldots, x_k\}$$

$$MIN(mean_{-baseline}) = min\{x_1 - baseline, \ldots, x_k - baseline\}$$

$$MIN(mean_{/baseline}) = min\{\frac{x_1}{baseline}, \ldots, \frac{x_k}{baseline}\}$$

$$MAX(mean) = max\{x_1, \ldots, x_k\}$$

$$MAX(mean_{-baseline}) = max\{x_1 - baseline, \ldots, x_k - baseline\}$$

$$MAX(mean_{/baseline}) = max\{\frac{x_1}{baseline}, \ldots, \frac{x_k}{baseline}\}$$

where:

x_i single measurement of the pupil diameter of both eyes

n sum of correct measurements

$baseline$ base pupil diameter size

2.8.2. Z-score

All designs:

$$Zscore = \Sigma \frac{x_i - mean_{grand}}{std_{grand}}$$

$$Zscore_{-baseline} = \Sigma \frac{x_i - baseline - mean_{grand}}{std_{grand}}$$

$$Zscore_{/baseline} = \Sigma \frac{\frac{x_i}{baseline} - mean_{grand}}{std_{grand}}$$

$$MEAN(Zscore) = \frac{Zscore}{n}$$

$$MIN(Zscore) = min\{Zscore_1, \ldots, Zscore_k\}$$

$$MAX(Zscore) = max\{Zscore_1, \ldots, Zscore_k\}$$

$$MEAN(Zscore_{-baseline}) = \frac{Zscore_{-baseline}}{n}$$

$$MIN(Zscore_{-baseline}) = min\{Zscore_{-baseline_1}, \ldots, Zscore_{-baseline_k}\}$$

$$MAX(Zscore_{-baseline}) = max\{Zscore_{-baseline_1}, \ldots, Zscore_{-baseline_k}\}$$

$$MEAN(Zscore_{/baseline}) = \frac{Zscore_{/baseline}}{n}$$

$$MIN(Zscore_{/baseline}) = min\{Zscore_{/baseline_1}, \ldots, Zscore_{/baseline_k}\}$$

$$MAX(Zscore_{/baseline}) = max\{Zscore_{/baseline_1}, \ldots, Zscore_{/baseline_k}\}$$

where:

x_i single measurement of the pupil diameter of both eyes

$mean_{grand}$ average of all valid samples (all segments)

std_{grand} standard deviation from all valid samples (all segments)

n sum of correct measurements

2.8.3. Relative [%]

$$relative = \Sigma \frac{x_i - mean_{grand}}{mean_{grand}} \cdot 100$$

$$MEAN(relative) = \frac{relative}{n}$$
$$MIN(relative) = min\{relative_1, \ldots, relative_k\}$$
$$MAX(relative) = max\{relative_1, \ldots, relative_k\}$$

where:

x_i	single measurement of the pupil diameter of both eyes
$mean_{grand}$	average of all valid samples (all segments)
n	sum of correct measurements

2.8.4. PCPD / ERPD [%]

$$erpd = \Sigma \frac{x_i - baseline}{baseline} \cdot 100$$

$$MEAN(erpd) = \frac{erpd}{n}$$
$$MIN(erpd) = min\{erpd_1, \ldots, erpd_k\}$$
$$MAX(erpd) = max\{erpd_1, \ldots, erpd_k\}$$

where:

x_i	single measurement of the pupil diameter of both eyes
$baseline$	base pupil diameter size
n	sum of correct measurements

2.8.5. Validation

Finally, each segment is validated depending on the set parameters in the settings.

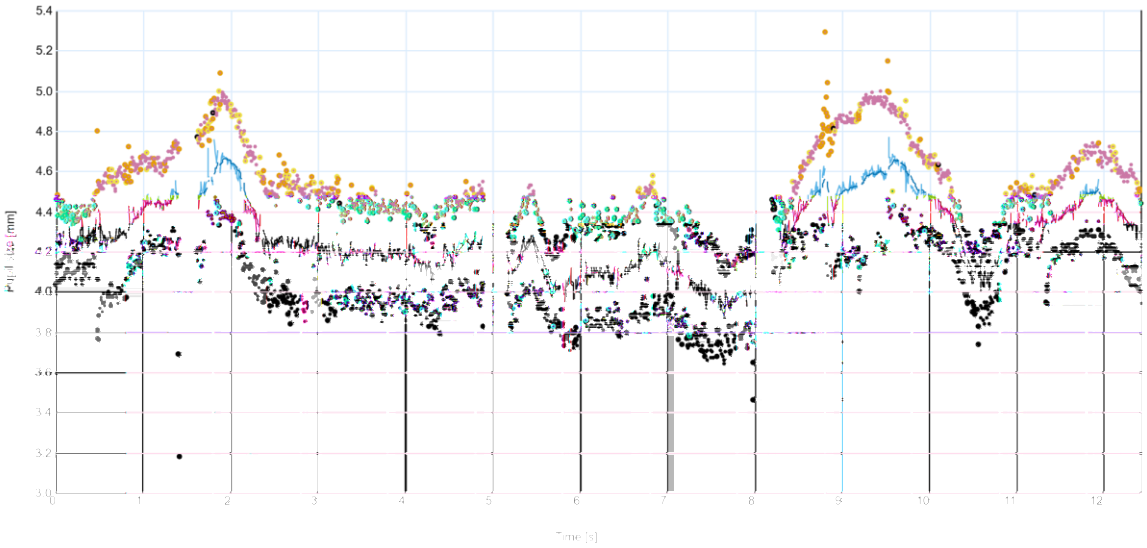
3 issues are evaluated:

- percentage of missing measurements
    - those omitted count

- degree of correlation
    - must be larger than the specified parameter for the segment to be correct
- mean pupil difference
    - must be less than the specified parameter for the segment to be correct

3. Visualization

3.1. Legend



Test executed on /resources/assets/examples/003_P3.csv task Quiz(Text) task3 (in the experimentation option)

- unsmoothed average (for test environment)
- smoothed average
- measurements from the right eye
- measurements from the left eye
- marked by the marker "Speed of expansion"
- marked by the marker "Deviation from the trend line"
- marked by marker "Samples temporarily isolated"
- marked by the marker "Outside the designated range"

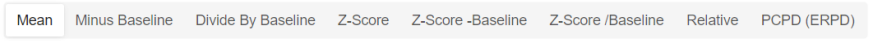
(on the presented graph turned off to increase visibility)

* *Light blue when processing in save mode is moderately smoothed or not depending on the configuration*

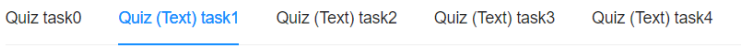
3.2. Description of operation and capabilities

- The *d3* library was used to generate the charts.js
- **Each measurement is a point on the** timelines and the size of the pupil diameter, which is why the loading speed is significantly influenced by the amount of data that the participant contains.
- **The axis range** is automatically generated depending on the boundary points to be displayed.
- For a point on an axis with an incomplete number, the **decimal range** is limited to **3**

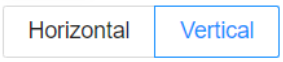
- **Single points** were marked with circles, those **excluded** from conversion with **a circle** in the appropriate color depending on the marker, and the **line** calculated and interpolated linearly **average**
- **The height and width of the chart** depends on the set configuration. *It can be changed without having to be reprocessed*
- From the visualization level, we have access to the selection of the chart depending on the measure



- Below you can change the segment for which the chart is displayed



- And change the layout of the task selection display



- On the right is a drop-down menu to change the participant

3.3. Write to PNG

With each chart we have options to save to a png file by clicking the **Save as PNG** button
The functionality has performance problems, after clicking you should wait a dozen or so seconds without a loading screen
After this time, a system window will appear with the choice of location for the created file, which is at a resolution 3 times higher than set in the configuration.
(Scaling instead of a specific resolution is due to the limitations of the library used)
By default, the file name is *<nazwa_uczestnika-<nazwa_segmentu>-<nazwa_miary>.png*

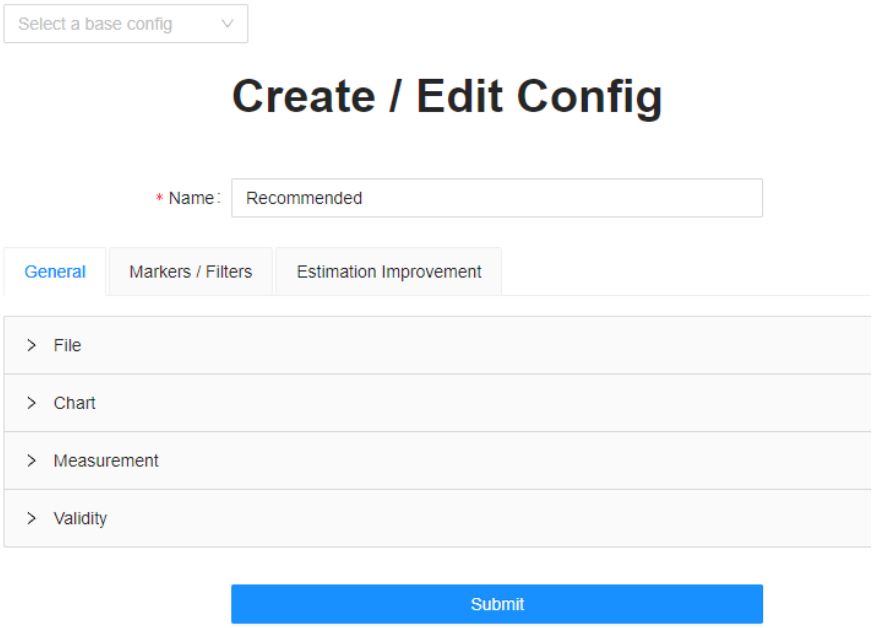
The problems are due to the fact that this functionality did not have a high priority due to the fact that the user can take a screenshot himself using a program that allows you to take screenshots.

4. Configuration

You can create new configurations based on existing ones. By default, two *Recommended* and *Just testing* are available

Recommended - recommended settings mainly based on the following scientific article https://link.springer.com/content/pdf/10.3758/s13428-018-1075-y.pdf

Just testing - the same as recommended with resampling disabled and display of measurements marked to be skipped



New configuration creation form

At the very top we have the option to choose a configuration on the basis of which you can create a new one. By default, the first of the drop-down menu options (Recommended) is set

In the **name** field, set a unique name for the new configuration. The name *Recommended* is forbidden and an attempt to create will end in an error

4.1. General Tab

4.1.1. File

Separator
a sign separating data with measurements
Timestamp
measurement timestamp column name
Left Pet
column name of the left pupil
Right Pet
right pupil column name
Segment Active
name of the column used to segment

4.1.2. Greyhound

Width [px]
width of the displayed chart
Height [px]
height of the displayed chart
Show Eye Plot
whether to show measurements from both eyes
Show Mean Plot
whether to show the average on the chart
Show SmoothPlot
whether to show a smoothed average on the chart
Show rejected
which rejected (marked) measurements show

- *invalid* - not within the range
- *outliers* - marked by other markers
- *missing* - missing, marked by iMotions as -1

4.1.3. Measurement

Eye
selection of the eye or both for further processing
Baseline
choice of baseline counting method

- *from Start* - selecting the measurements from the beginning of each segment and the average serves as a baseline
- *selected segment* - the average of the selected segment as a baseline *(for each segment the same)*

Baseline Param
Parameter for baseline depends on the choice of counting method

- if *from Start* then the parameter is the number of milliseconds of the period that will be used to convert baselin
- if *selected segment* then parameter is the name of the segment

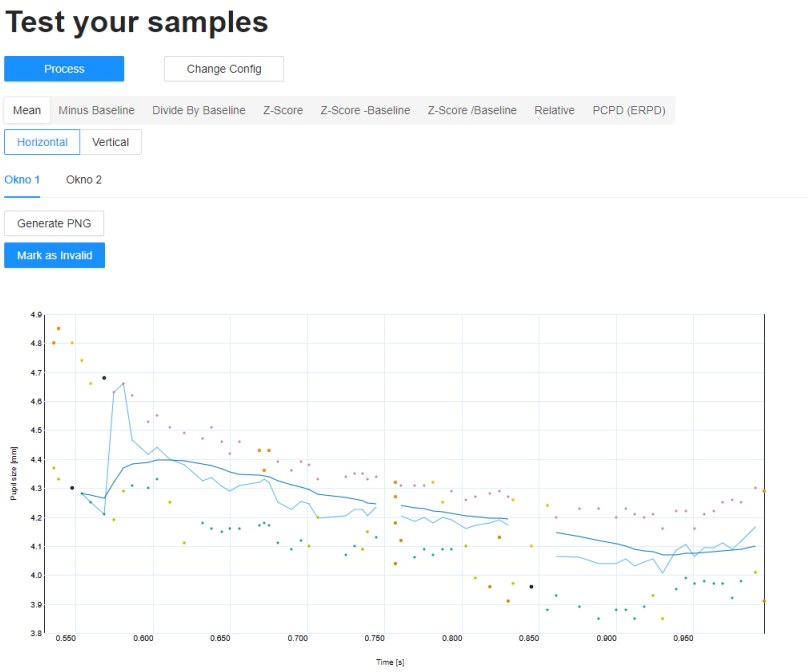
Segmentation

Segmentation type

- no - no segmentation, the whole as one segment
- scene - division into scenes (segments) depending on the Active Segment column
- time windows - division into scenes depending on time windows

Time windows

Time windows, due to a lower priority, are entered as a single string. Each window is separated by a semicolon.
<name1>,<start>,<end>;<name2>,<start>,<end>
for example.
Window 1, 0, 1000; Window 2, 1000, 2000



4.1.4. Validity

Parameters to automatically evaluate segments as valid or invalid

Missing [%]

Acceptable percentage of missing (also omitted) measurements of both pupils

Correlation

Minimum required correlation of both pupils

Difference [mm]

Permissible difference between the two pupils

4.2. Markers / Filters tab

4.2.1. Out of Range

Min [mm]
minimum allowable pupil size
Max [mm]
maximum permissible pupil size

4.2.2. Dilation Speed

Use
Enable/disable marker option
Gap minimum duration [ms]
minimum break from the previous and next correct measurement
Gap maximum duration [ms]
maximum break from the previous and next correct measurement
Gap backward padding [ms]
if the measurement is within the gap range, what period of time before this measurement is to be determined to be omitted
Gap forward padding [ms]
if the measurement is within the interval range, what period of time after this measurement is to be determined to be omitted

4.2.3. Trendline Deviation

Use
Enable/disable marker option
Passes
Number of marker executions (one by one)
Cutoff frequency [Hz]
low-pass-filter limit frequency
Threshold Multiplier
Threshold multiplier for measurement evaluation
Gap minimum duration [ms]
minimum break from the previous and next correct measurement
Gap maximum duration [ms]
maximum break from the previous and next correct measurement
Gap backward padding [ms]
if the measurement is within the gap range, what period of time before this measurement is to be determined to be omitted
Gap forward padding [ms]
if the measurement is within the interval range, what period of time after this measurement is to be determined to be omitted

4.2.4. Temporally Isolated Samples

Use
Enable/disable marker option
Min Isolation Gap
Minimum interval for recognition of isolation of samples

Max Island Size
Maximum period of time of groups of samples that may be considered to be time-isolated

4.3. Estimation Improvement tab

4.3.1. Resampling

Use
Option to enable/disable resampling
Rate [Hz]
Expected sampling rate
Acceptable Gap
Acceptable gap for linear interpolation, otherwise a gap in the graph

4.3.2. Smoothing

Use
Anti-aliasing enable/disable option
Cutoff Frequency [Hz]
low-pass-filter frequency

5. System

5.1. Interface

5.1.1. View all studies

Otherwise the main view, from which we have access to all other views

Each border means a navigation button that will direct us to a separate view:

Green-view *of all studies* (refresh)

Blue-test view

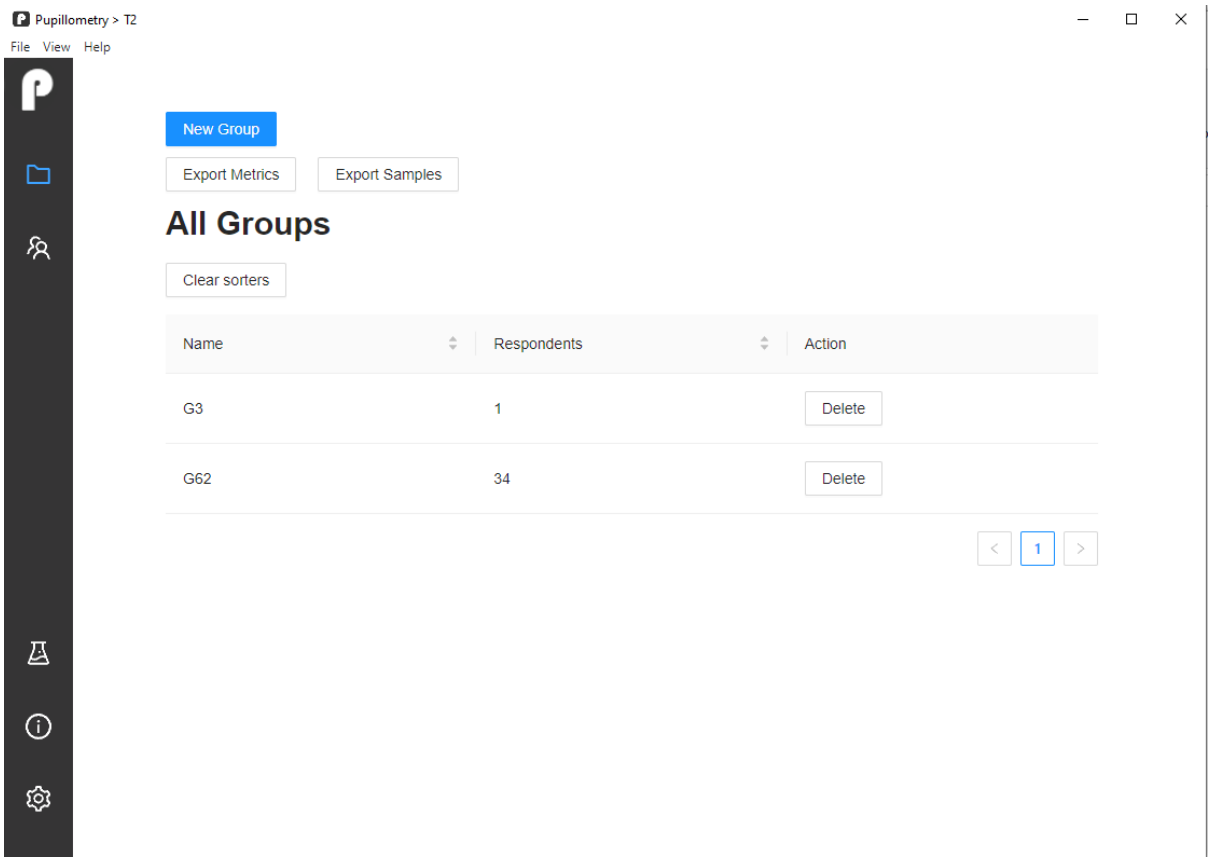
Yellow-view *with software information*

Red-view *configuration* and

- Clicking on the name of a single study takes you to *the study view* with all the groups created in it
- **The New Study** button

5.1.2. Single bview

When you switch to *Research view,* two additional options appear in the navigation bar. Icon of a briefcase and two people. Clicking on one of them will take you to the last saved option.



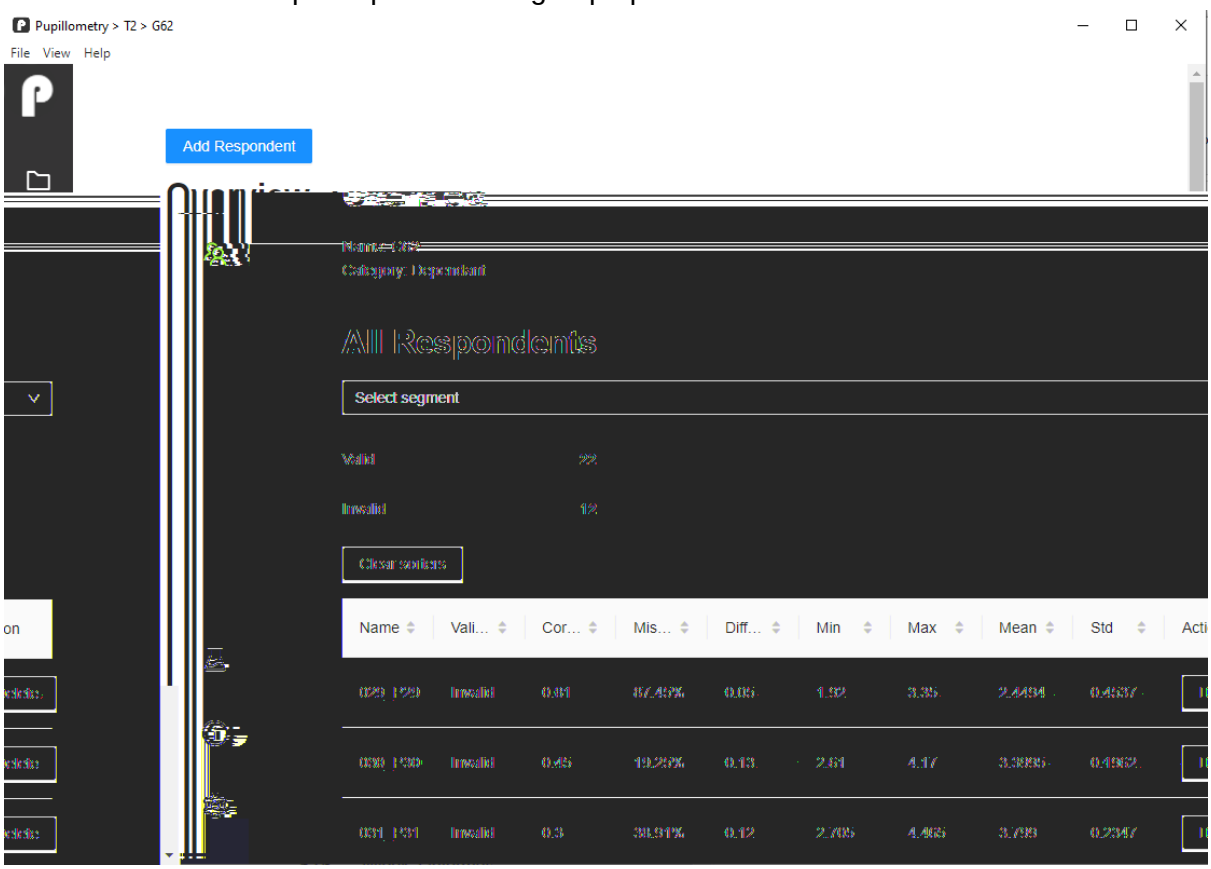
The currently selected view is highlighted in blue

From thesej positions you can:

- Switch to single group view by clicking the group name from the list that appears.
- We can also sort groups by selected column
- With the ***Clear sorters button*** we clean the selected sorts
- Use the **Delete** button to delete the group and clear the data stored with it
- Use the **New Group** button to go to the form for creating a new group
- Use the **Export Metrics** button to move to *the segment grouping and export metrics view*
- Use the **Export Samples** button to save simplified and cleared measurements with columns [TIMESTAMP, PUPIL, SEGMENT] in an excel file. Where, in turn, they denote the measured time point, the average diameter of the pupils and the name of the segment (task)
    - option for special needs of further processing *(recommended export of participants **individually** due to lack of optimization)*

5.1.3. Single group view

When you select a group, the general view of the group and all participants in the group opens



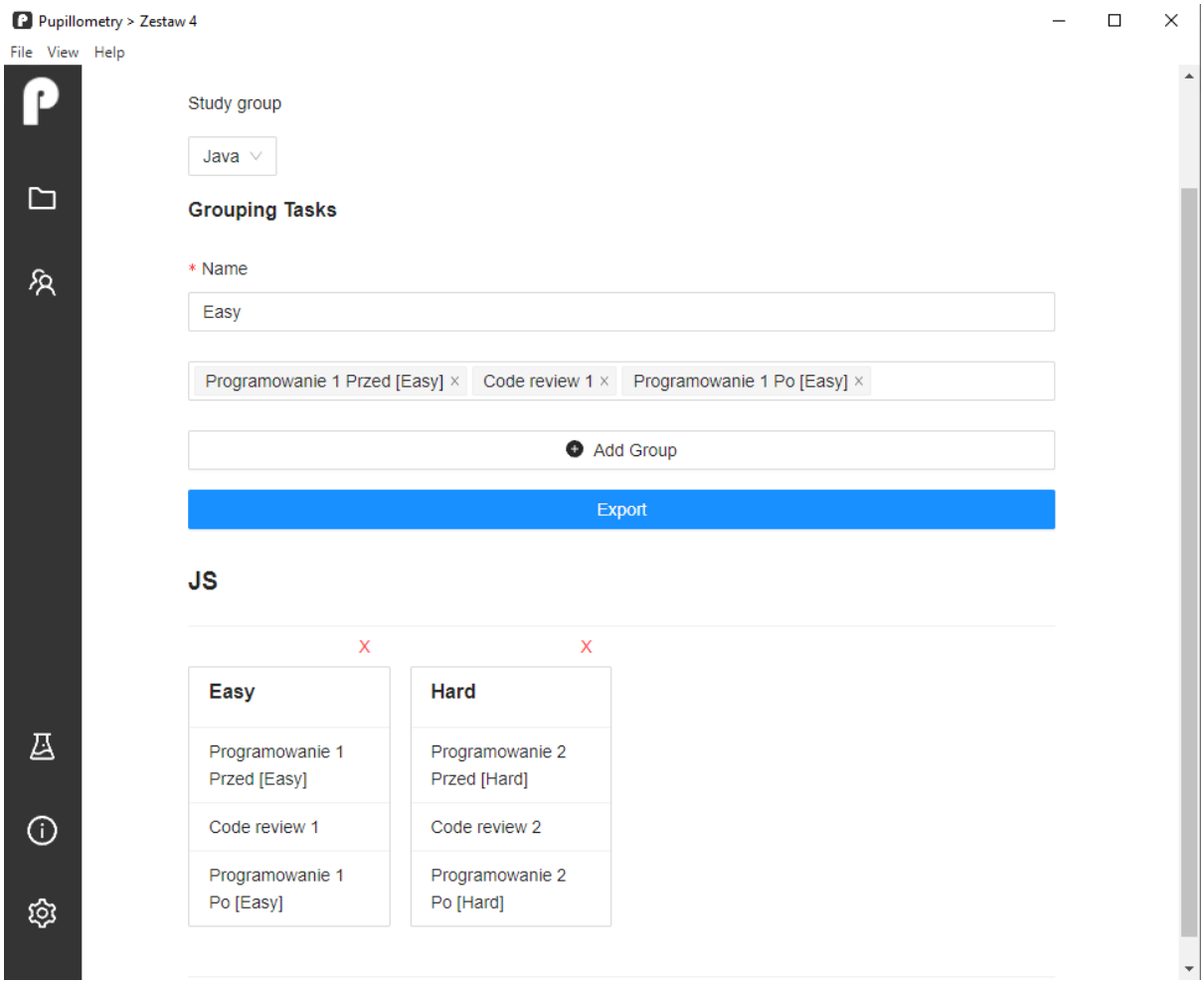
From this item you can:

- View part of the statistics for the selected segment (Select segment). By default, set to the first in the list.
  Not showing up at the beginning (Unresolved error)
- Find out the number of valid and invalid participants for the selected segment
- Sort participants by selected column
- Use the ***Add Respondent*** button to go to the form of adding additional participants to the group
- Clear ***sorters*** button to clear selected sorts
- Go to *the participant's view* by clicking their name from the list
- Delete **button** to remove the participant from the group and clear the data stored with him

5.1.4.

5.1.5. View of grouping segments (tasks) and exporting metrics

We have access to it from the view of a single study



For each group of participants in this item, you can create task groups (Add Group) and export metrics.
If no task group is created, the whole will be exported as one task group with this *"Entire Study"*

5.1.6. Test/Experiment view

Access to this view is by clicking the *lab vessel* icon

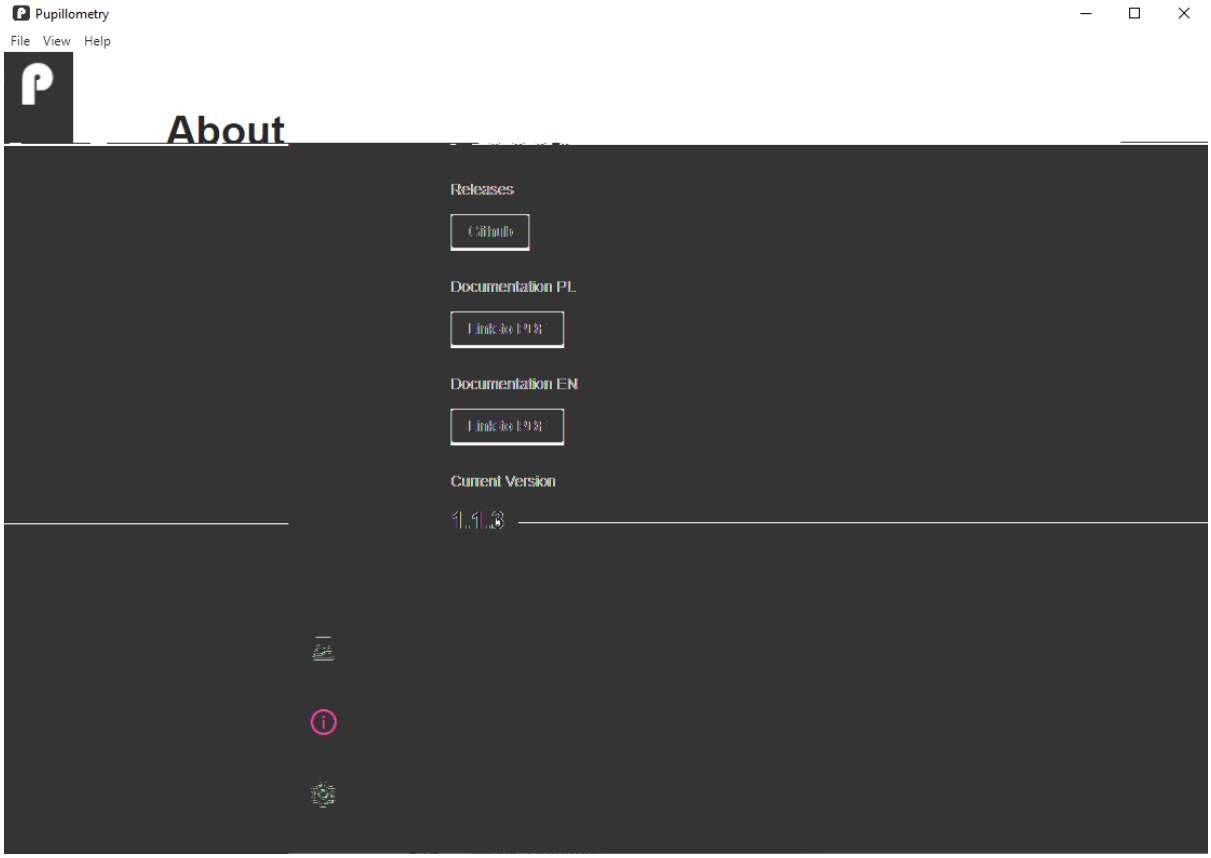
This is a place to test the previously created configuration and modify it (for the duration of the experiment) in order to adjust it accordingly.

A view similar to *that of a single participant.*
The difference lies in the lack of data saving and the Change Config, which changes part of the view to the form to adjust the current configuration.

* *When you click Change Config the name of the button will change to Show Stats*

5.1.7. App information view

Access to this view is by clicking the *"i in the circle"* icon

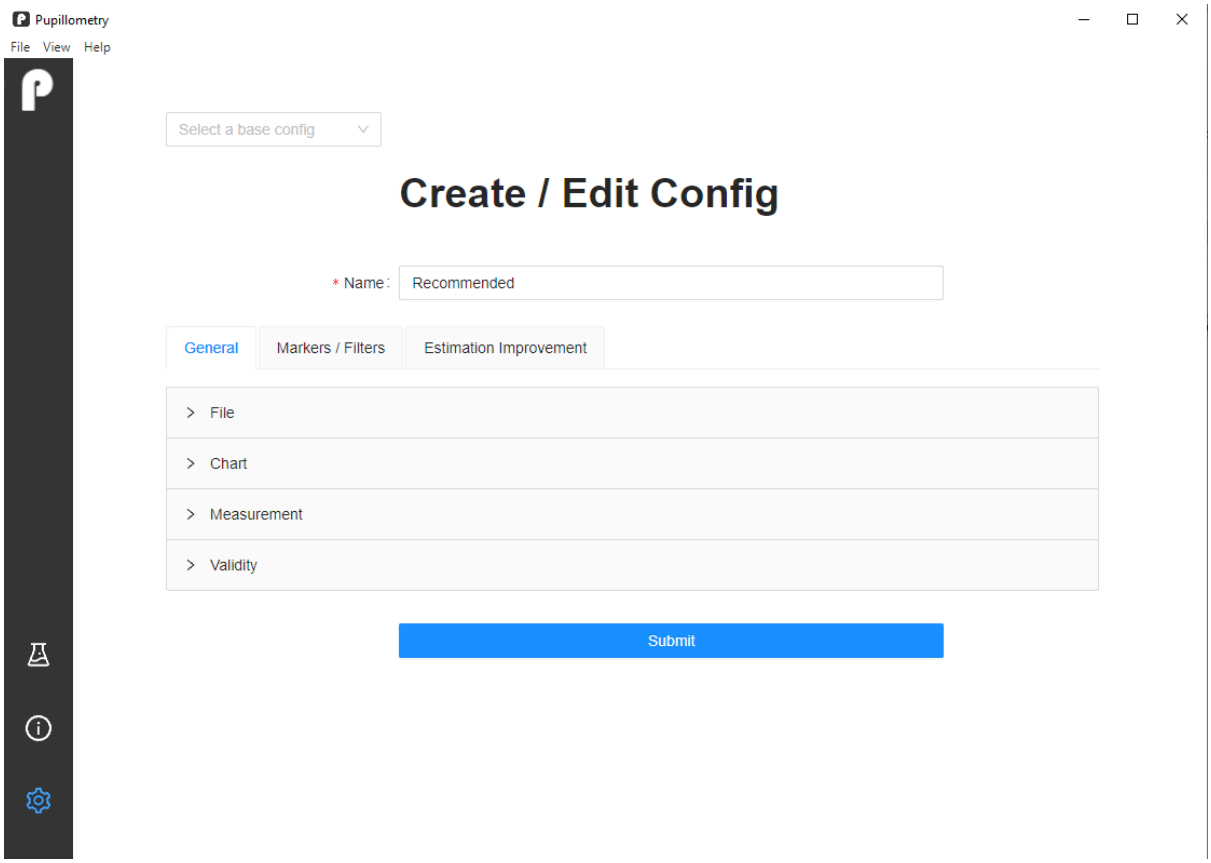


Here we have information about the current version of the software and links to all releases of the program and current documentation.

It is worth noting that the documentation is also in folderze `/resources/assets/docs`
but may be updated, so the suggested option is to download from the page to which it redirects link

5.1.8. Configuration view

Access to this view is by clicking *the gear* icon



Here we can add and edit sets of configuration options.
Addition is done

- by selecting the basic configuration,
- renaming,
- modification of what the user is interested in
- Submit button

Editing is done in the same way, only you need to set/leave the name of the existing configuration

It is not possible to delete a single configuration

5.2. Supported operating systems

Software written mainly for **windows**, but thanks to the use of electron there is also a version for **mac** and **linux**

5.3. RAM consumption

The technology used is resource-intensive and the written software has not been properly optimized.
Each segment is processed separately, so depending on the file size and individual segments, consumption will vary.
When testingthese datasets, the consumption did not exceed **4GB**, so this amount should be sufficient

5.4. Data recording

The electron-store library was used, which stores data in json format in the appData folder (depending on the system).
Due to limitations

- max 500MB
- the greater the amount of data, the more noticeable the slowdown of the program

only statistics and information on research are stored there.
C:\Users\<user>\AppData\Roaming\Electron\config.json

The measurement data is compressed with *zipson,* saved without the extension, and is located in the application folder
/resource/data/<nazwa_badania>/<nazwa_grupy>/<nazwa_uczestnika>
They are required for the correct display of charts

6. Dictionary

Study - an experiment related to the measurement of pupil diameter

Participant - a collection of measurements of the examined person collected using an eye tracking tool

Segment - a part of the measurements made classified as a separate entity, in the context of the study a task or a scene

Sampling rate - a value specifying the number of samples per second and expressed in hertz [Hz]