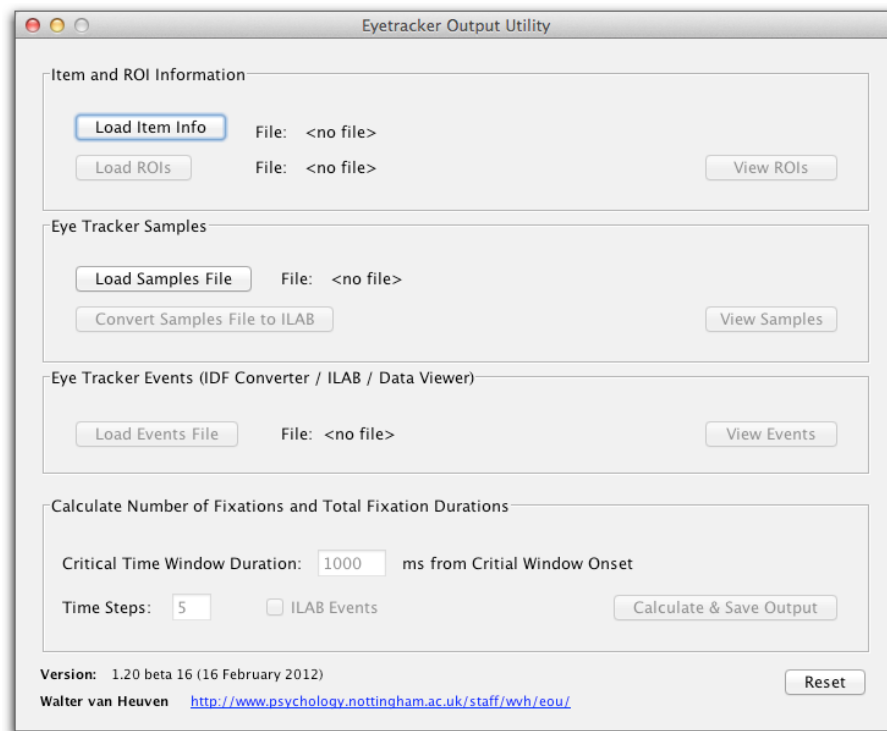


Eyetracker Output Utility



Latest version: 1.27, 22 July 2016

Please note that this program is still under development

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Eyetracker Output Utility is a program to visualize, analyze, and convert gaze data from different eye tracking systems (SMI, Tobii, SR Research). The program can visualize gaze data, create realtime [QuickTime](#) movies, convert data to ILAB, and calculate the number of fixations and total fixation durations in regions of interest within specified time windows.

SMI: <http://www.smivision.com/>

Tobii: <http://www.tobii.com/>

SR Research: <http://sr-research.com/>

ILAB: <http://www.brain.northwestern.edu/ilab/>

To view QuickTime movies you need to install [Apple's QuickTime](#) software.

The ***Eyetracker Output Utility*** uses [Werner Randelshofer QuickTimeOutputStream](#) class included in **QuickTimeDemo.jar** to create QuickTime movies.

QuickTimeDemo.jar is licensed under the terms of the [Creative Commons Attribution 3.0](#).

Disclaimer

Please note that this software is under development. The software is stable, but there is the possibility that not all functionality is in tact or correct, and that it may even crash.

Use of the ***Eyetracker Output Utility*** is entirely at your own risk. I will not be liable for any data loss, hardware damage or whatever this program might cause.

Copyright

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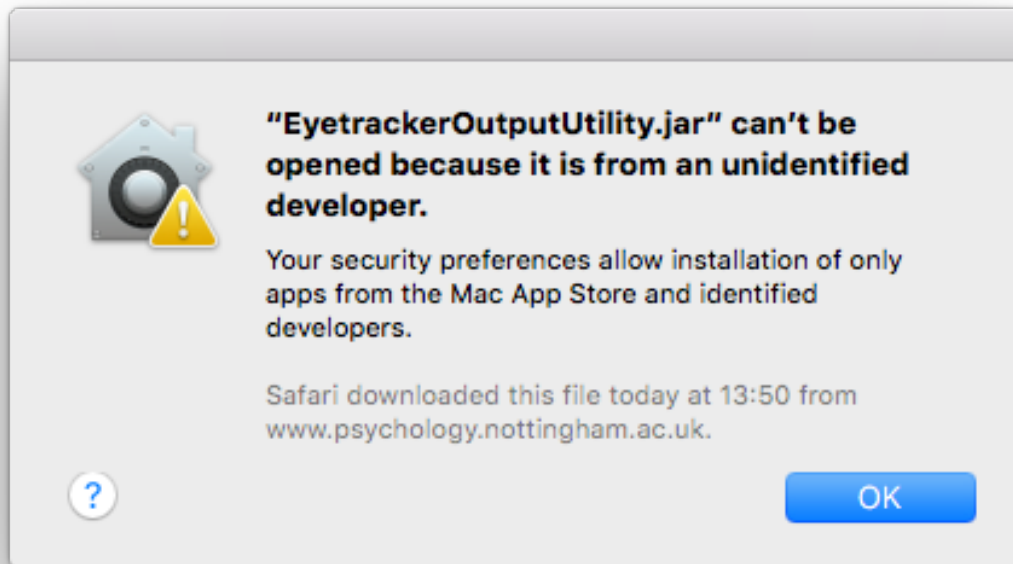
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1. Running the Program

Double click on "EyetrackerOutputUtility.jar" to start the program. If you see the following dialog box on OS X, right click on "EyetrackerOutputUtility.jar" and select "Open" from the menu.



If the program does not start in Windows you might need to fix the ".jar" file association problem (use [Jarfix](#) to solve this problem).

Alternatively you can navigate to the "Eyetracker Output Utility" folder and type

```
java -jar EyetrackerOutputUtility.jar
```

in the "Command Prompt" application in Windows. On OS X you can start the program also in the Terminal. Please note that the program will give more feedback about errors when you start it in the [Command Prompt](#) (Windows) or [Terminal](#) (OS X). The program also creates a log file with detailed feedback, warnings and error information.

Do not move EyetrackerOutputUtility.jar outside of the "Eyetracker Output Utility" folder. The jar file should be in the same folder as the "lib" folder. When you start the program it checks online whether there is a new version is available. The *Eyetracker Output Utility* runs on any computer with [Java SE 8](#) or higher installed.

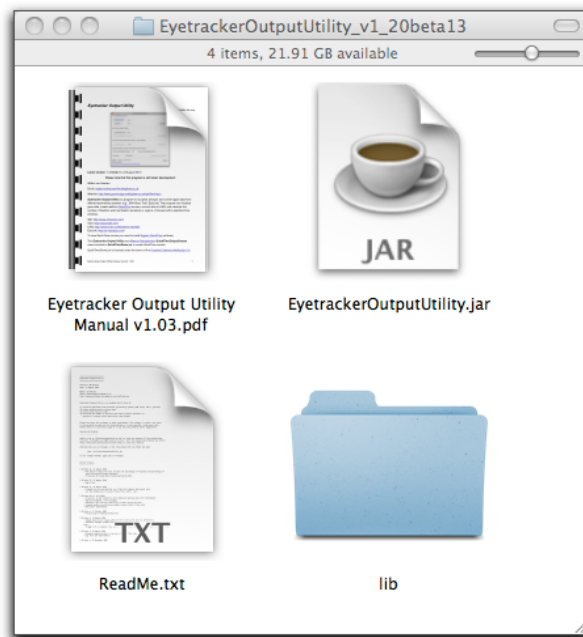


Figure 1. Folder content after unzipping the file: EyetrackerOutputUtility.zip.

1.1 Required Files

To view gaze data the program requires a file with gaze data (samples or samples and events). In addition the program requires an item information file and a region of interest (ROI) file to calculate the number and percentage of fixations and total fixation durations in ROIs.

- Item Information file
- Region Information file
- Gaze data file (samples)

Place all files in the same folder when you use the program. Images associated with items can be placed inside another folder (e.g, img).

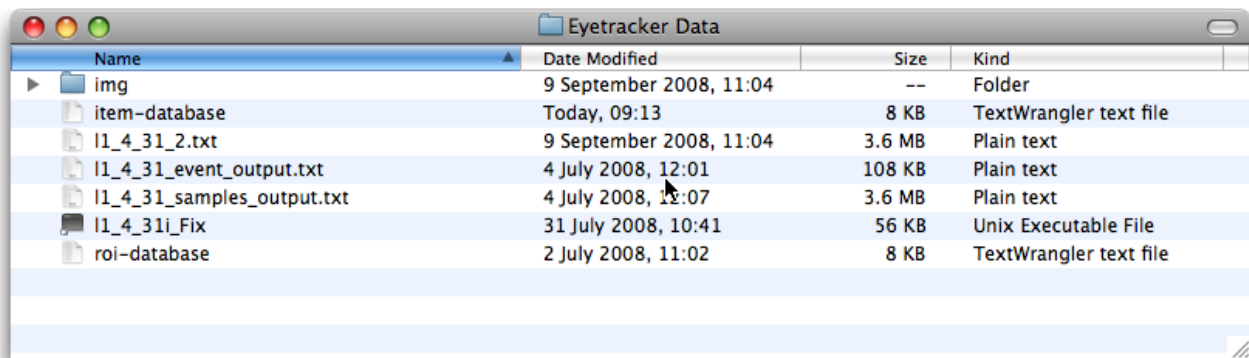


Figure 2. Example of the folder structure.

1.1.1 Item Information file

The item information file is a tab-delimited text file with up to 7 columns. For data from SMI systems (e.g., Hi-Speed, RED) the file should have at least 3 columns. For data from the Tobii (e.g., T60, T120) and SR Research (e.g., EyeLink I, II, 1000/2000) eye trackers the file should have 7 columns. To create text files use on Windows [Notepad++](#) and on OS X [TextWrangler](#). The file should use [unicode](#) encoding (UTF-8, no BOM).

Column 1: Item Number

SMI data: if the Samples file contains trigger information that corresponds to item numbers then use the same item numbers in the *Item Information* file.

Column 2: Name and location of the picture file associated with the item

Example: /img/batman.jpg

The location of the image file is relative to the location of the *Item Information* file.

Please note that file names should not contain any spaces. The image file format can be JPEG, GIF, PNG, BMP, or WBMP. If your image files are very large (e.g., several

megabytes) the program might run very slowly. Compress your images to improve the performance of the program (e.g., convert images to jpeg format).

Column 3: Onset of the Critical Time Window of an item (in milliseconds)

You can define a critical time window onset within an item. For example, if a picture is visible for 20 seconds but you are only interested in the gaze data after 10 seconds you can set the onset of the critical time window to 10000 ms. This is especially useful when you combine visual and auditory information and you want to focus only on the gaze data when a particular word is spoken (e.g., visual world paradigm, see [Tanenhaus et al., 1995](#)). The duration of the critical time window can be set in the main window.

If your experiment does not require a critical time window onset enter 0 in this column, which means that the onset of the critical time window is the trial onset.

Column 4 (optional): Item information

In this column you can enter text to describe the item or to indicate to which condition the item belongs.

Column 5 (optional for data from SMI data): Item number

If the Samples file (see Section 1.1.3.1) does not contain the correct trigger information that corresponds to the item number in the *Item Information* file (e.g., trigger is always 0) column 5 can be used to set the trigger information in the Samples file to the item number based on the set number in the Samples file.

Thus, if set number 4 corresponds to item number 16 you can put in the 5th column of item 16 number 4 so that the program knows which set number corresponds to which item number.

Enter 0 in this column when you use data from the Tobii or EyeLink eye trackers.

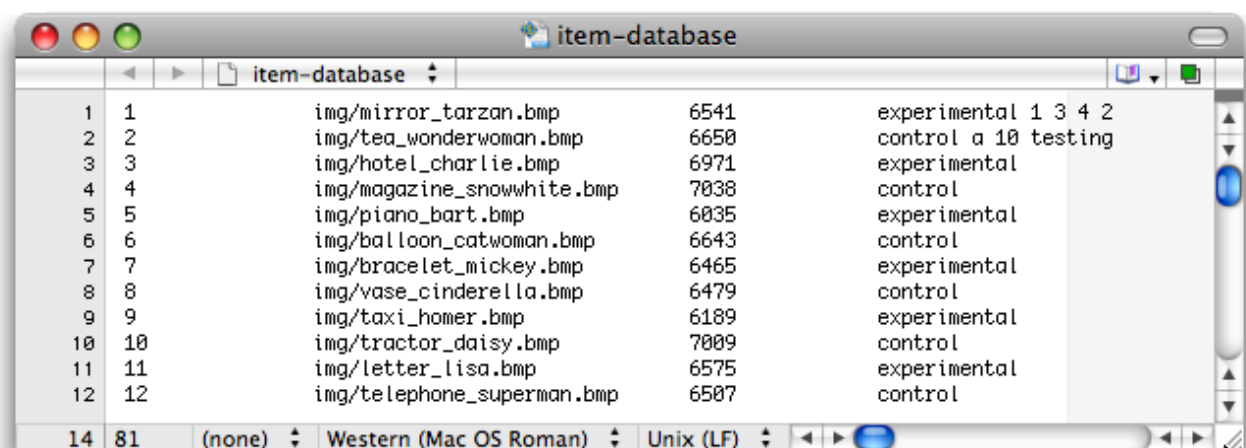
Column 6 (only for Tobii and EyeLink data): Start time of the item (in milliseconds) from the start time of the data collection.

You can use column 6 and 7 to define the start and end time of each item.

Note that the start of data collection is time point 0 ms. (see Section **1.1.3.3**).

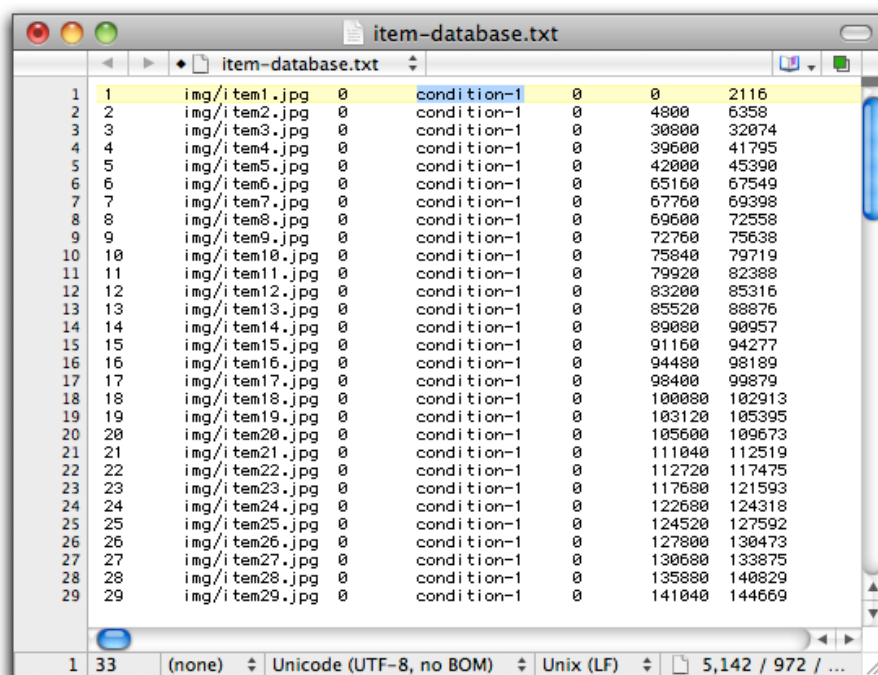
Column 7 (only for Tobii and EyeLink data): End time of the item (in milliseconds) from the start time of the data collection.

Note that the start of data collection is time point 0 ms. (see Section **1.1.3.3**).



| Line | Item Number | Image | Critical Time Window Onset | Item Information |
|------|-------------|----------------------------|----------------------------|----------------------|
| 1 | 1 | img/mirror_tarzan.bmp | 6541 | experimental 1 3 4 2 |
| 2 | 2 | img/tea_wonderwoman.bmp | 6650 | control a 10 testing |
| 3 | 3 | img/hotel_charlie.bmp | 6971 | experimental |
| 4 | 4 | img/magazine_snowwhite.bmp | 7038 | control |
| 5 | 5 | img/piano_bart.bmp | 6035 | experimental |
| 6 | 6 | img/balloon_catwoman.bmp | 6643 | control |
| 7 | 7 | img/bracelet_mickey.bmp | 6465 | experimental |
| 8 | 8 | img/vase_cinderella.bmp | 6479 | control |
| 9 | 9 | img/taxi_homer.bmp | 6189 | experimental |
| 10 | 10 | img/tractor_daisy.bmp | 7009 | control |
| 11 | 11 | img/letter_lisa.bmp | 6575 | experimental |
| 12 | 12 | img/telephone_superman.bmp | 6507 | control |

Figure 3a. Example of an item database file for data from an SMI eye tracker. The file has 4 columns: item number, image, critical time window onset, item information.



| Line | Item Number | Image | Condition | Value 1 | Value 2 |
|------|-------------|----------------|-------------|---------|---------|
| 1 | 1 | img/item1.jpg | condition-1 | 0 | 2116 |
| 2 | 2 | img/item2.jpg | condition-1 | 0 | 4800 |
| 3 | 3 | img/item3.jpg | condition-1 | 0 | 30800 |
| 4 | 4 | img/item4.jpg | condition-1 | 0 | 39600 |
| 5 | 5 | img/item5.jpg | condition-1 | 0 | 42000 |
| 6 | 6 | img/item6.jpg | condition-1 | 0 | 65160 |
| 7 | 7 | img/item7.jpg | condition-1 | 0 | 67760 |
| 8 | 8 | img/item8.jpg | condition-1 | 0 | 69600 |
| 9 | 9 | img/item9.jpg | condition-1 | 0 | 72760 |
| 10 | 10 | img/item10.jpg | condition-1 | 0 | 75840 |
| 11 | 11 | img/item11.jpg | condition-1 | 0 | 79920 |
| 12 | 12 | img/item12.jpg | condition-1 | 0 | 83200 |
| 13 | 13 | img/item13.jpg | condition-1 | 0 | 85520 |
| 14 | 14 | img/item14.jpg | condition-1 | 0 | 89080 |
| 15 | 15 | img/item15.jpg | condition-1 | 0 | 91160 |
| 16 | 16 | img/item16.jpg | condition-1 | 0 | 94480 |
| 17 | 17 | img/item17.jpg | condition-1 | 0 | 98400 |
| 18 | 18 | img/item18.jpg | condition-1 | 0 | 100080 |
| 19 | 19 | img/item19.jpg | condition-1 | 0 | 103120 |
| 20 | 20 | img/item20.jpg | condition-1 | 0 | 105600 |
| 21 | 21 | img/item21.jpg | condition-1 | 0 | 111040 |
| 22 | 22 | img/item22.jpg | condition-1 | 0 | 112720 |
| 23 | 23 | img/item23.jpg | condition-1 | 0 | 117680 |
| 24 | 24 | img/item24.jpg | condition-1 | 0 | 122680 |
| 25 | 25 | img/item25.jpg | condition-1 | 0 | 124520 |
| 26 | 26 | img/item26.jpg | condition-1 | 0 | 127800 |
| 27 | 27 | img/item27.jpg | condition-1 | 0 | 130680 |
| 28 | 28 | img/item28.jpg | condition-1 | 0 | 135880 |
| 29 | 29 | img/item29.jpg | condition-1 | 0 | 141040 |

Figure 3b. Example of an item database file for data from an EyeLink eye tracker (SR Research). The file has 7 columns.

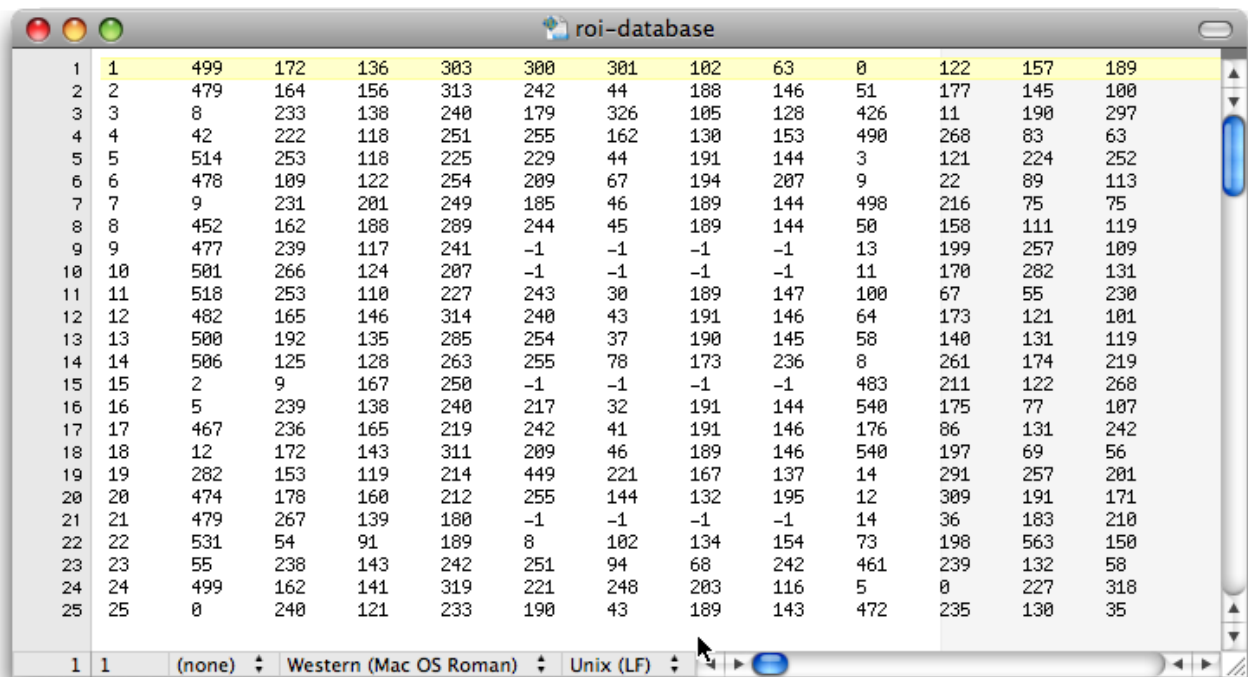
1.1.2 Region of Interest (ROI) information file

Tab-delimited text file with at least 5 columns. The file should use Unicode encoding (UTF-8, no BOM). A ROI is a rectangle on the screen defined by the top-left X-coordinate and Y-coordinate and the width and height of the rectangle (e.g., 50, 50, 200, 100).

Column 1: Item Number

Column 2 - 5: X-coordinate, Y-coordinate, Width, Height

Note that the top left of the screen is X=0, Y=0. Each additional ROI requires 4 more columns. If a ROI is undefined for some of the items use -1,-1,-1,-1 for the ROI.



| | | | | | | | | | | | | | |
|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1 | 1 | 499 | 172 | 136 | 303 | 300 | 301 | 102 | 63 | 0 | 122 | 157 | 189 |
| 2 | 2 | 479 | 164 | 156 | 313 | 242 | 44 | 188 | 146 | 51 | 177 | 145 | 100 |
| 3 | 3 | 8 | 233 | 138 | 240 | 179 | 326 | 105 | 128 | 426 | 11 | 190 | 297 |
| 4 | 4 | 42 | 222 | 118 | 251 | 255 | 162 | 130 | 153 | 490 | 268 | 83 | 63 |
| 5 | 5 | 514 | 253 | 118 | 225 | 229 | 44 | 191 | 144 | 3 | 121 | 224 | 252 |
| 6 | 6 | 478 | 109 | 122 | 254 | 209 | 67 | 194 | 207 | 9 | 22 | 89 | 113 |
| 7 | 7 | 9 | 231 | 201 | 249 | 185 | 46 | 189 | 144 | 498 | 216 | 75 | 75 |
| 8 | 8 | 452 | 162 | 188 | 289 | 244 | 45 | 189 | 144 | 50 | 158 | 111 | 119 |
| 9 | 9 | 477 | 239 | 117 | 241 | -1 | -1 | -1 | -1 | 13 | 199 | 257 | 109 |
| 10 | 10 | 501 | 266 | 124 | 207 | -1 | -1 | -1 | -1 | 11 | 170 | 282 | 131 |
| 11 | 11 | 518 | 253 | 110 | 227 | 243 | 30 | 189 | 147 | 100 | 67 | 55 | 230 |
| 12 | 12 | 482 | 165 | 146 | 314 | 240 | 43 | 191 | 146 | 64 | 173 | 121 | 101 |
| 13 | 13 | 500 | 192 | 135 | 285 | 254 | 37 | 190 | 145 | 58 | 140 | 131 | 119 |
| 14 | 14 | 506 | 125 | 128 | 263 | 255 | 78 | 173 | 236 | 8 | 261 | 174 | 219 |
| 15 | 15 | 2 | 9 | 167 | 250 | -1 | -1 | -1 | -1 | 483 | 211 | 122 | 268 |
| 16 | 16 | 5 | 239 | 138 | 240 | 217 | 32 | 191 | 144 | 540 | 175 | 77 | 107 |
| 17 | 17 | 467 | 236 | 165 | 219 | 242 | 41 | 191 | 146 | 176 | 86 | 131 | 242 |
| 18 | 18 | 12 | 172 | 143 | 311 | 209 | 46 | 189 | 146 | 540 | 197 | 69 | 56 |
| 19 | 19 | 282 | 153 | 119 | 214 | 449 | 221 | 167 | 137 | 14 | 291 | 257 | 201 |
| 20 | 20 | 474 | 178 | 160 | 212 | 255 | 144 | 132 | 195 | 12 | 309 | 191 | 171 |
| 21 | 21 | 479 | 267 | 139 | 180 | -1 | -1 | -1 | -1 | 14 | 36 | 183 | 210 |
| 22 | 22 | 531 | 54 | 91 | 189 | 8 | 102 | 134 | 154 | 73 | 198 | 563 | 150 |
| 23 | 23 | 55 | 238 | 143 | 242 | 251 | 94 | 68 | 242 | 461 | 239 | 132 | 58 |
| 24 | 24 | 499 | 162 | 141 | 319 | 221 | 248 | 203 | 116 | 5 | 0 | 227 | 318 |
| 25 | 25 | 0 | 240 | 121 | 233 | 190 | 43 | 189 | 143 | 472 | 235 | 130 | 35 |

Figure 4. ROI information file example. Each item in this file has three ROIs (4 x 4 = 16 columns).

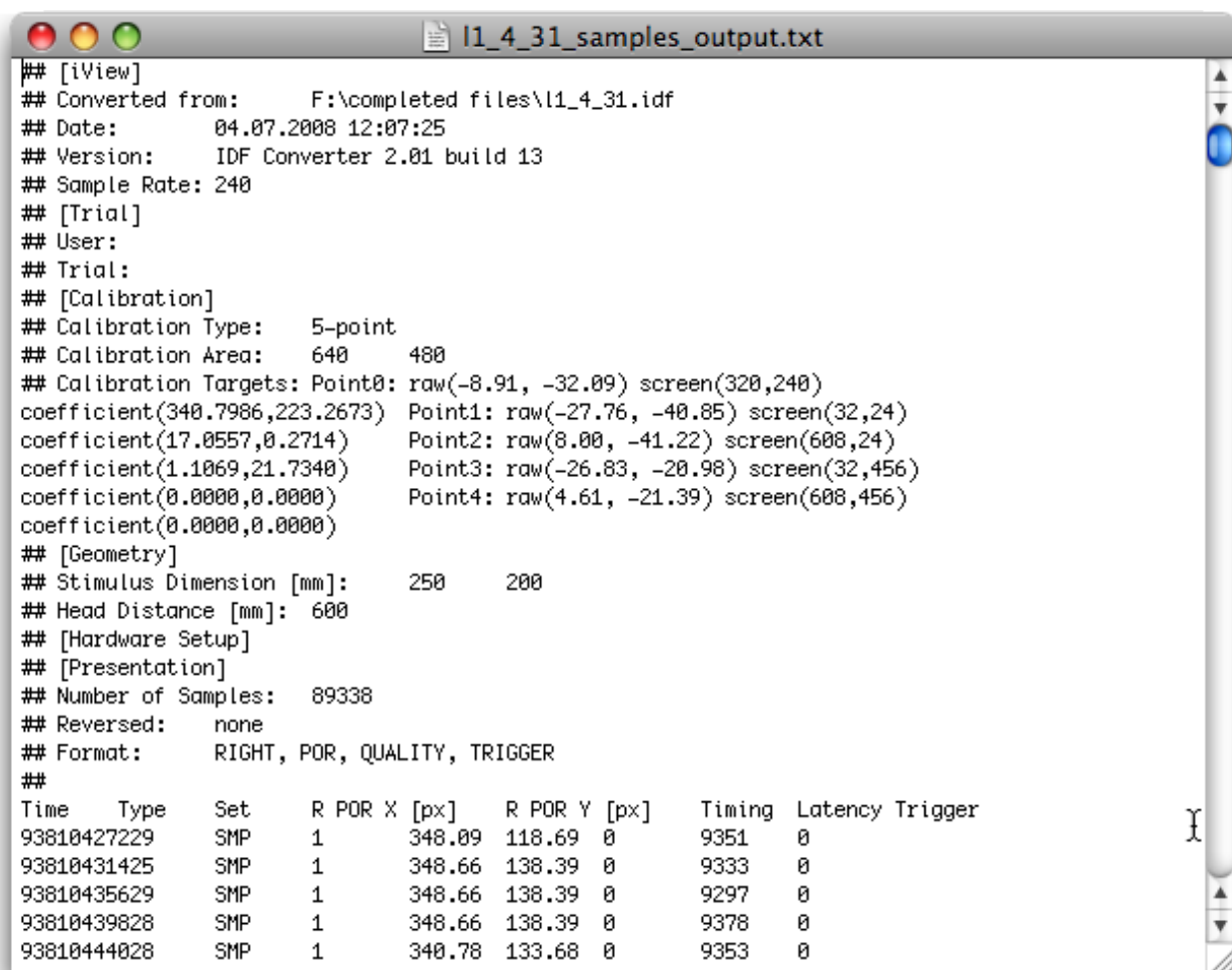
1.1.3 Samples File

The **Eyetracker Output Utility** can read gaze data (samples) from SMI (e.g., RED/Hi-Speed), Tobii (e.g., T60, T120, TX300) and SR Research (e.g., EyeLink I,II, 1000/2000) eye trackers.

1.1.3.1 SMI

Use the **IDF Converter** program that comes with the SMI eye tracker to convert IDF files to text files. Software can also be downloaded [here](#).

The **Eyetracker Output Utility** only reads samples files with the following 8 columns: Time, Type, Set, R POR X [px], R POR Y [px], Timing, Latency, Trigger. It is also important that the columns appear in precisely this order (see Figure 5).



```
## [iView]
## Converted from:      F:\completed files\l1_4_31.idf
## Date:               04.07.2008 12:07:25
## Version:            IDF Converter 2.01 build 13
## Sample Rate: 240
## [Trial]
## User:
## Trial:
## [Calibration]
## Calibration Type:    5-point
## Calibration Area:    640      480
## Calibration Targets: Point0: raw(-8.91, -32.09) screen(320,240)
                        coefficient(340.7986,223.2673) Point1: raw(-27.76, -40.85) screen(32,24)
                        coefficient(17.0557,0.2714) Point2: raw(8.00, -41.22) screen(608,24)
                        coefficient(1.1069,21.7340) Point3: raw(-26.83, -20.98) screen(32,456)
                        coefficient(0.0000,0.0000) Point4: raw(4.61, -21.39) screen(608,456)
                        coefficient(0.0000,0.0000)
## [Geometry]
## Stimulus Dimension [mm]: 250      200
## Head Distance [mm]: 600
## [Hardware Setup]
## [Presentation]
## Number of Samples: 89338
## Reversed: none
## Format: RIGHT, POR, QUALITY, TRIGGER
##
Time      Type      Set      R POR X [px]  R POR Y [px]  Timing  Latency  Trigger
93810427229 SMP      1        348.09  118.69  0      9351    0
93810431425 SMP      1        348.66  138.39  0      9333    0
93810435629 SMP      1        348.66  138.39  0      9297    0
93810439828 SMP      1        348.66  138.39  0      9378    0
93810444028 SMP      1        340.78  133.68  0      9353    0
```

Figure 5. SMI Hi-Speed 240 eye tracker samples output.

1.1.3.2 Tobii

Use Text Export in **Tobii Studio** to export gaze data (see Figure 6). The exported text files (see Figure 7) should have at least these 4 columns: Timestamp, Number, GazePointXLeft, GazePointYLeft. Only gazepoint data from the left eye is used.

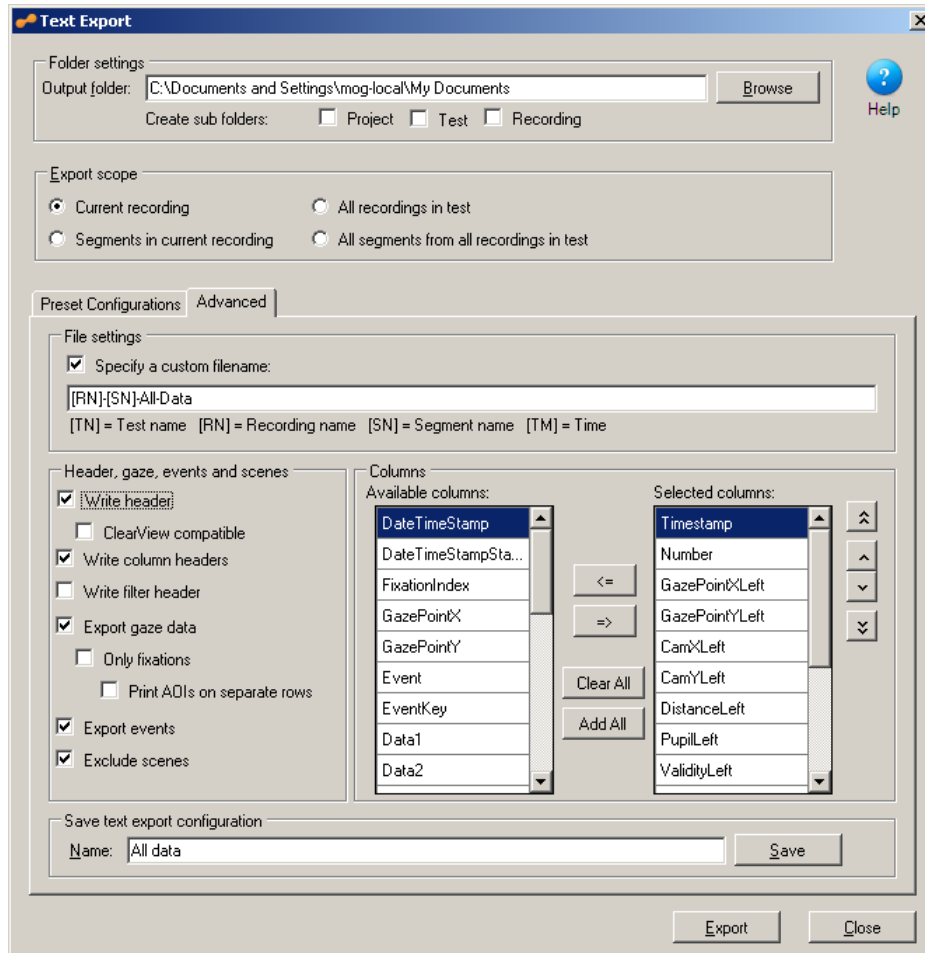


Figure 6. Text Export in Tobii Studio.

tobii-studio-export.txt

Last Saved: 08/07/2010 16:22:30
File Path: ~/Desktop/Tobii/tobii-studio-export.txt

tobii-studio-export.txt

1 Data properties:
2
3 Recording date: 14/06/2009
4 Recording time : 12:08:50:156 (corresponds to time 0)
5 Study: My study
6 Subject: me
7 Recording: screen test
8 Screen resolution: 1024 x 768
9 Coordinate unit: Pixels
10
11
12 Data:
13
14 Timestamp Number GazeptX (L) GazeptY (L) CamX (L) CamY (L) Distance (L) Pupil (L) Validity (L) G
15
16 17 1 -1024 -768 0.686 0.364 -1.000 -1.000 4 -1024 -768 0.391 0.375 -1.000 -1.000 4
17 36 2 -1024 -768 -1.000 -1.000 -1.000 -1.000 4 -1024 -768 -1.000 -1.000 -1.000 -1.000 4
18 56 3 -1024 -768 -1.000 -1.000 -1.000 -1.000 4 -1024 -768 -1.000 -1.000 -1.000 -1.000 4
19 77 4 -1024 -768 0.685 0.365 -1.000 -1.000 4 -1024 -768 0.390 0.376 -1.000 -1.000 4
20 97 5 716 613 0.683 0.367 637.570 5.529 0 726 571 0.389 0.379 642.266 4.890 0
21 117 6 712 623 0.680 0.370 623.295 5.408 0 721 578 0.388 0.381 634.657 4.833 0
22 137 7 845 738 0.680 0.370 623.295 5.354 0 835 702 0.387 0.381 634.657 4.753 0
23 157 8 874 731 0.681 0.369 623.295 5.381 0 847 715 0.387 0.381 634.657 4.789 0
24 176 9 876 730 0.681 0.369 623.295 5.491 0 839 724 0.387 0.380 634.657 4.801 0
25 196 10 868 736 0.681 0.369 623.295 5.404 0 844 723 0.387 0.380 634.657 4.874 0
26 216 11 868 733 0.682 0.369 623.720 5.452 0 840 723 0.388 0.380 634.513 4.904 0
27 236 12 869 724 0.682 0.369 623.720 5.352 0 842 712 0.388 0.380 634.513 4.955 0
28 256 13 868 744 0.683 0.369 623.720 5.357 0 843 716 0.389 0.381 634.513 4.908 0
29 276 14 860 720 0.684 0.370 623.720 5.509 0 846 727 0.389 0.381 634.513 4.914 0
30 296 15 856 732 0.684 0.370 623.720 5.406 0 836 746 0.390 0.381 634.513 5.001 0
31 316 16 854 737 0.685 0.370 625.318 5.465 0 835 755 0.391 0.381 635.039 4.986 0
32 336 17 840 741 0.686 0.371 625.318 5.521 0 805 748 0.392 0.381 635.039 5.115 0
33 356 18 845 752 0.686 0.371 625.318 5.417 0 815 740 0.392 0.381 635.039 4.936 0
34 376 19 844 752 0.687 0.371 625.318 5.415 0 809 739 0.393 0.381 635.039 4.994 0
35 396 20 838 755 0.688 0.371 625.318 5.460 0 809 725 0.393 0.381 635.039 4.919 0
36 416 21 841 755 0.688 0.370 627.653 5.422 0 812 718 0.394 0.381 636.796 4.946 0
37 436 22 843 746 0.688 0.370 627.653 5.557 0 797 744 0.394 0.381 636.796 4.976 0
38 456 23 832 744 0.688 0.370 627.653 5.521 0 794 753 0.394 0.380 636.796 5.092 0
39 475 24 816 746 0.688 0.370 627.653 5.522 0 818 741 0.394 0.380 636.796 5.014 0
40 495 25 832 749 0.688 0.370 627.653 5.654 0 803 738 0.394 0.381 636.796 4.943 0
41 515 26 825 749 0.688 0.370 625.994 5.630 0 807 739 0.394 0.381 636.477 4.976 0
42 535 27 841 766 0.688 0.370 625.994 5.633 0 812 739 0.393 0.381 636.477 5.005 0

11 1 (none) Unicode (UTF-8, no BOM) Windows (CRLF) 1,054,964 / 202,016 / 12,638

Figure 7. Exported gaze file from Tobii Studio.

1.1.3.3 SR Research (EyeLink)

For eye tracking systems from SR Research (e.g., EyeLink I, II, 1000, 2000) use the **edf2asc** program to convert ".edf" to ".asc" files. The ".asc" files contain samples and events information. The **Eyetracker Output Utility** will read both information when you click on the "Load Samples File" button.

To determine the correct timings of your relevant events you have to find time point zero. First look for the row that begins with **START** in the ".asc" file. In the example below (Figure 8) **START** is followed by the time stamp 1465324. This is considered in the program as time point 0 and items need to be defined in the *Item Information* file relative to this time point.

| | | | | | | |
|----|--------------|---------|--------------------------------------|------------|------------------|------------------|
| 35 | MSG | 1465255 | DRIFTCORRECT L LEFT | at 512,384 | OFFSET 0.67 deg. | -11.0,-17.0 pix. |
| 36 | MSG | 1465258 | drift_correction | | | |
| 37 | MSG | 1465258 | TRIALID 0 | | | |
| 38 | MSG | 1465314 | RECCFG P 250 1 1 | | | |
| 39 | MSG | 1465314 | REFLREJECT 0 | | | |
| 40 | MSG | 1465314 | GAZE_COORDS 0.00 0.00 1023.00 767.00 | | | |
| 41 | START | 1465324 | LEFT | SAMPLES | EVENTS | |
| 42 | PRESALER | 1 | | | | |
| 43 | VPRESALER | 1 | | | | |
| 44 | PUPIL AREA | | | | | |
| 45 | EVENTS GAZE | LEFT | RATE | 250.00 | | |
| 46 | SAMPLES GAZE | LEFT | RATE | 250.00 | | |
| 47 | SFIX L | 1465324 | | | | |
| 48 | | 1465324 | 508.6 | 394.5 | 3193.0 | |
| 49 | INPUT | 1465324 | 248 | | | |
| 50 | | 1465328 | 508.6 | 394.3 | 3193.0 | |
| 51 | | 1465332 | 508.1 | 394.3 | 3194.0 | |

Figure 8. Output file of the edf2asc program.

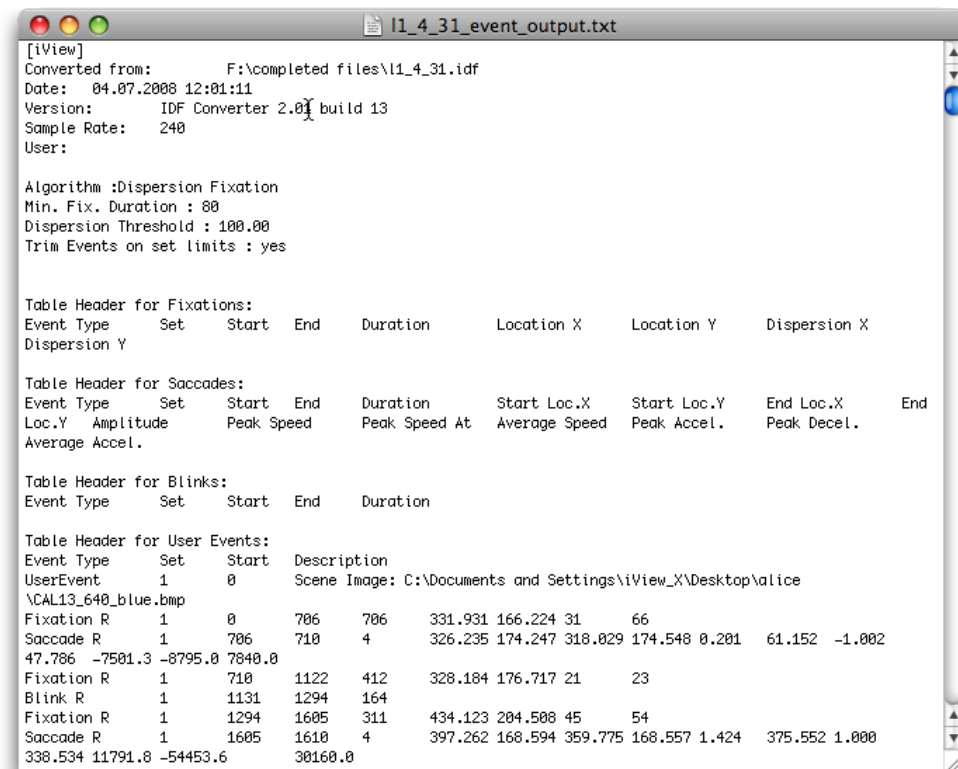
edf2asc can be downloaded from the [SR-Research Support Site](#).

1.1.4 Events File

The program can read Events files created by the **IDF converter** and **ILAB** (only fixation output).

Use the "IDF Converter" software that comes with the SMI eye tracker to convert the eye tracker output file to Events output.

1.1.4.1 Example 1: IDF Events file



```
[iView]
Converted from: F:\completed files\i1_4_31.idf
Date: 04.07.2008 12:01:11
Version: IDF Converter 2.0 build 13
Sample Rate: 240
User:

Algorithm :Dispersion Fixation
Min. Fix. Duration : 80
Dispersion Threshold : 100.00
Trim Events on set limits : yes

Table Header for Fixations:
Event Type Set Start End Duration Location X Location Y Dispersion X
Dispersion Y

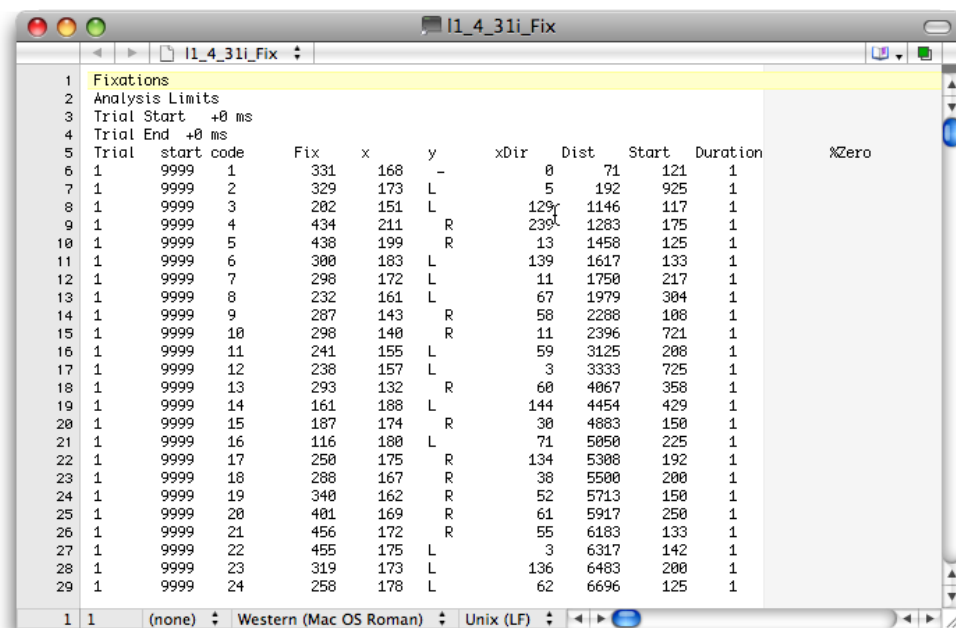
Table Header for Saccades:
Event Type Set Start End Duration Start Loc.X Start Loc.Y End Loc.X End
Loc.Y Amplitude Peak Speed Peak Speed At Average Speed Peak Accel. Peak Decel.
Average Accel.

Table Header for Blinks:
Event Type Set Start End Duration

Table Header for User Events:
Event Type Set Start Description
UserEvent 1 0 Scene Image: C:\Documents and Settings\iView_X\Desktop\alice
\CAL13_640_blue.bmp
Fixation R 1 0 706 706 331.931 166.224 31 66
Saccade R 1 706 710 4 326.235 174.247 318.029 174.548 0.201 61.152 -1.002
47.786 -7501.3 -8795.0 7840.0
Fixation R 1 710 1122 412 328.184 176.717 21 23
Blink R 1 1131 1294 164
Fixation R 1 1294 1605 311 434.123 204.508 45 54
Saccade R 1 1605 1610 4 397.262 168.594 359.775 168.557 1.424 375.552 1.000
338.534 11791.8 -54453.6 30160.0
```

Figure 9. Example of an event output file created with **IDF converter**.

1.1.4.2 Example 2: ILAB fixations file



| | | | | | | | | | | |
|----|-------------------|------------|-----|-----|-----|------|------|-------|----------|-------|
| 1 | Fixations | | | | | | | | | |
| 2 | Analysis Limits | | | | | | | | | |
| 3 | Trial Start +0 ms | | | | | | | | | |
| 4 | Trial End +0 ms | | | | | | | | | |
| 5 | Trial | start code | Fix | x | y | xDir | Dist | Start | Duration | %Zero |
| 6 | 1 | 9999 | 1 | 331 | 168 | - | 0 | 71 | 121 | 1 |
| 7 | 1 | 9999 | 2 | 329 | 173 | L | 5 | 192 | 925 | 1 |
| 8 | 1 | 9999 | 3 | 202 | 151 | L | 129 | 1146 | 117 | 1 |
| 9 | 1 | 9999 | 4 | 434 | 211 | R | 239 | 1283 | 175 | 1 |
| 10 | 1 | 9999 | 5 | 438 | 199 | R | 13 | 1458 | 125 | 1 |
| 11 | 1 | 9999 | 6 | 300 | 183 | L | 139 | 1617 | 133 | 1 |
| 12 | 1 | 9999 | 7 | 298 | 172 | L | 11 | 1750 | 217 | 1 |
| 13 | 1 | 9999 | 8 | 232 | 161 | L | 67 | 1979 | 304 | 1 |
| 14 | 1 | 9999 | 9 | 287 | 143 | R | 58 | 2288 | 108 | 1 |
| 15 | 1 | 9999 | 10 | 298 | 140 | R | 11 | 2396 | 721 | 1 |
| 16 | 1 | 9999 | 11 | 241 | 155 | L | 59 | 3125 | 208 | 1 |
| 17 | 1 | 9999 | 12 | 238 | 157 | L | 3 | 3333 | 725 | 1 |
| 18 | 1 | 9999 | 13 | 293 | 132 | R | 60 | 4067 | 358 | 1 |
| 19 | 1 | 9999 | 14 | 161 | 188 | L | 144 | 4454 | 429 | 1 |
| 20 | 1 | 9999 | 15 | 187 | 174 | R | 30 | 4883 | 150 | 1 |
| 21 | 1 | 9999 | 16 | 116 | 180 | L | 71 | 5050 | 225 | 1 |
| 22 | 1 | 9999 | 17 | 250 | 175 | R | 134 | 5308 | 192 | 1 |
| 23 | 1 | 9999 | 18 | 288 | 167 | R | 38 | 5500 | 200 | 1 |
| 24 | 1 | 9999 | 19 | 340 | 162 | R | 52 | 5713 | 150 | 1 |
| 25 | 1 | 9999 | 20 | 401 | 169 | R | 61 | 5917 | 250 | 1 |
| 26 | 1 | 9999 | 21 | 456 | 172 | R | 55 | 6183 | 133 | 1 |
| 27 | 1 | 9999 | 22 | 455 | 175 | L | 3 | 6317 | 142 | 1 |
| 28 | 1 | 9999 | 23 | 319 | 173 | L | 136 | 6483 | 200 | 1 |
| 29 | 1 | 9999 | 24 | 258 | 178 | L | 62 | 6696 | 125 | 1 |

Figure 10. Example of an ILAB fixations output file.

2. Guide to calculate the number of fixations and total fixation durations

2.1 Load Item Info file: e.g., "item-database"

Click on the button "Load Item Info". Section 1.1.1 describes the format of the Item Information file.

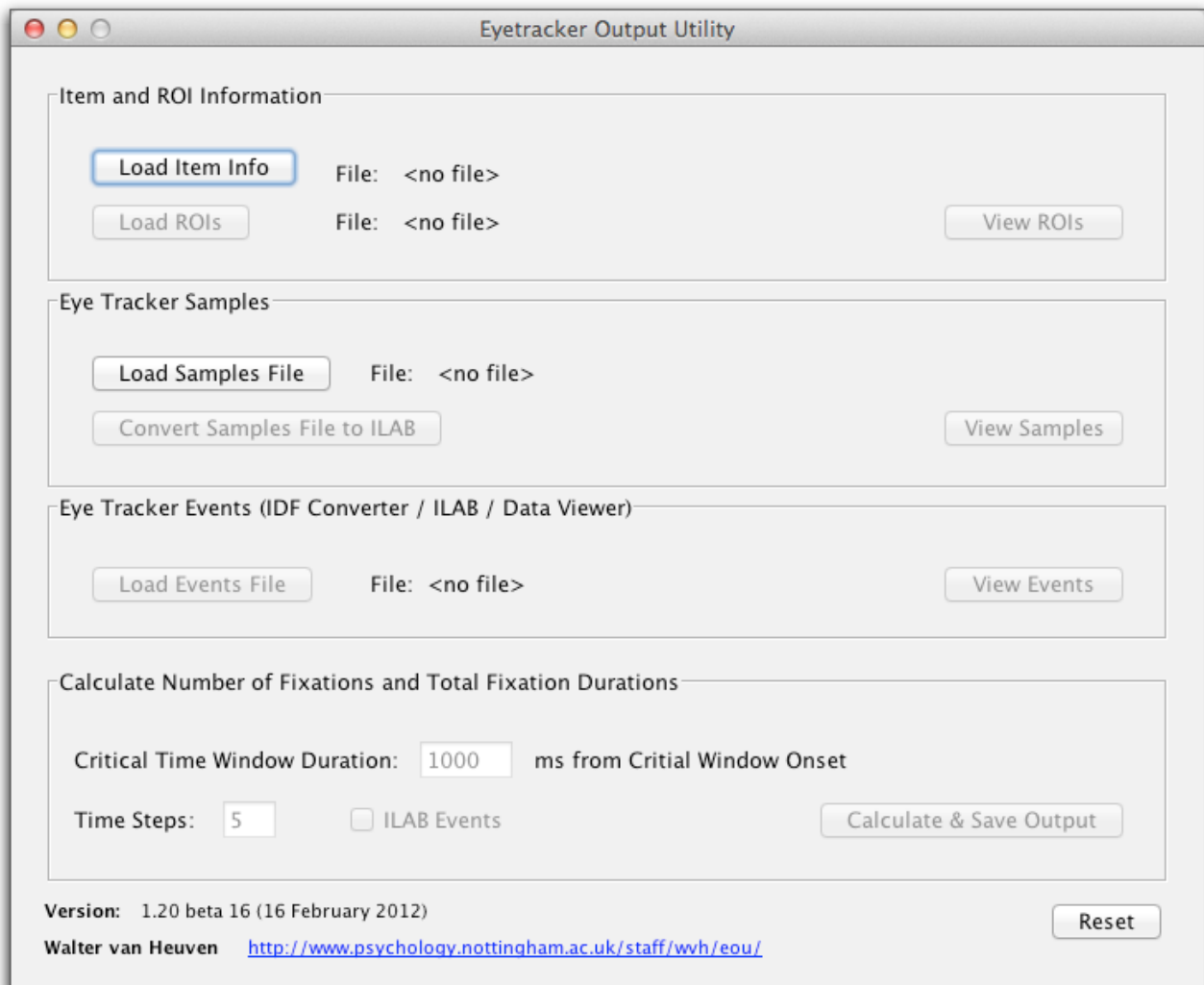


Figure 11. Main window of the *Eyetracker Output Utility*.

2.2 Load ROIs file: e.g., "roi-database"

Click on the button "Load ROIs". Section 1.1.2 described the format of the ROI file.

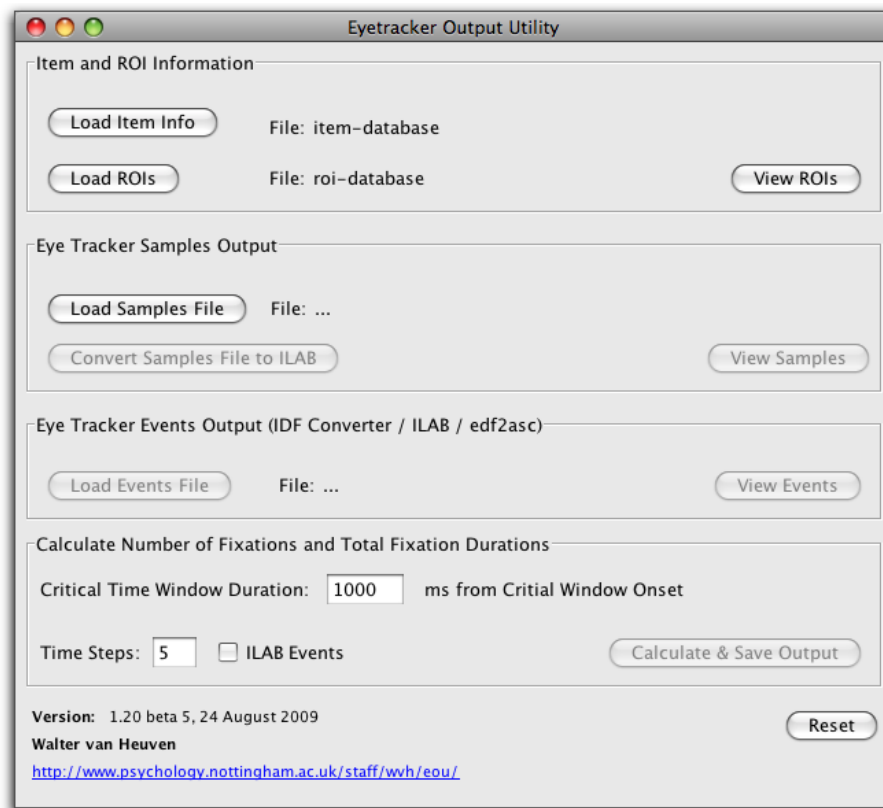


Figure 12. Name of the ROI file is shown.

You can view the ROIs by clicking on the button "View ROIs".



Figure 13. Item Information and ROI screen.

2.3 Load Samples File

Click on the button "Load Samples File". The format of the gaze data file is different for each eye tracker (SMI, Tobii, SR Research). The program reads exported gaze data from the IDF converter, Tobii Studio, edf2asc and EyeLink Data Viewer.

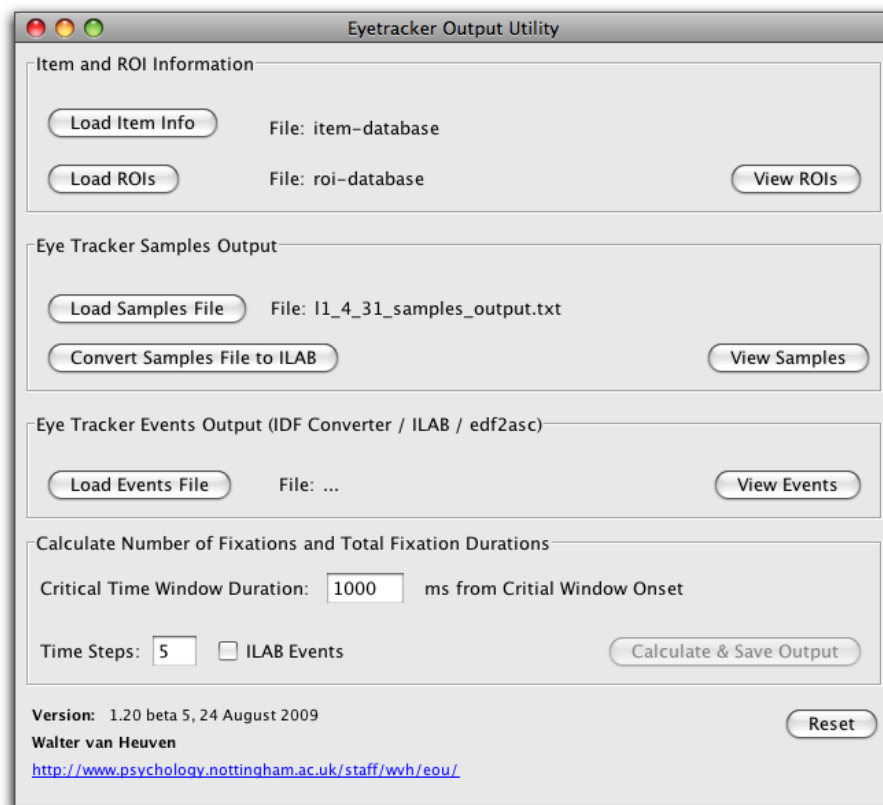


Figure 14. Name of the Sample file is shown and button "View Samples" is enabled.

Click on the button "View Samples" to view the gaze data.

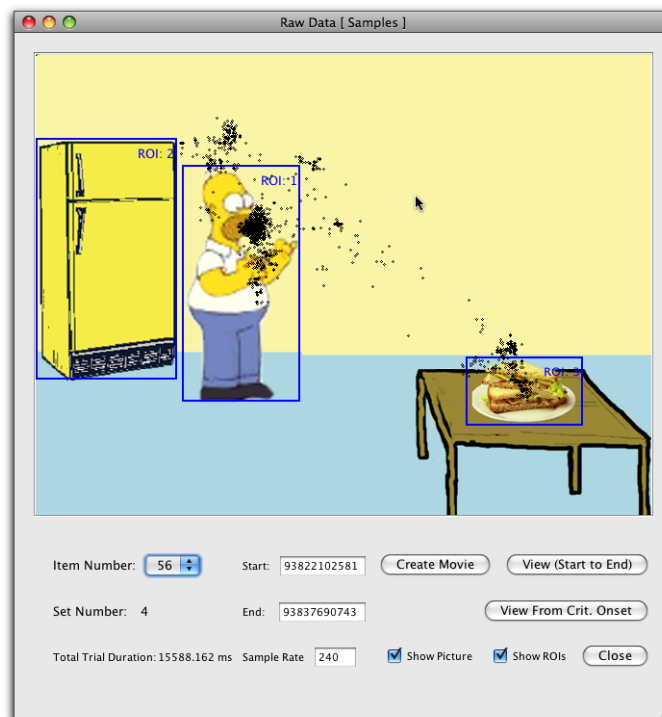


Figure 15. Raw gaze data.

Data can be viewed from trial onset or from critical window onset. Furthermore, the program can create a realtime QuickTime movie of gaze data. Please note that the created QuickTime movies can be very large. To reduce the movie size considerably you can use the QuickTime player with a QuickTime Pro license to compress the movie (e.g., use the "Export for Web" option in the QuickTime player).

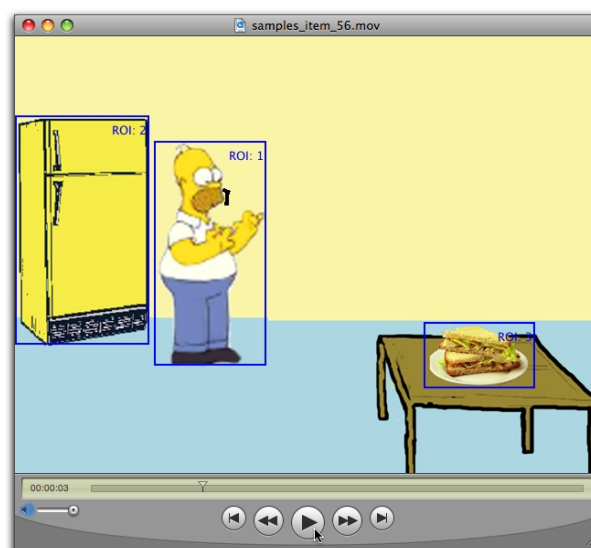
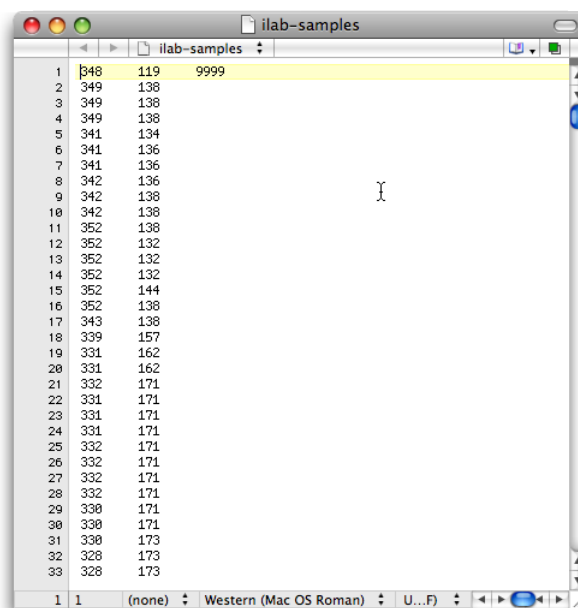


Figure 16. Quicktime movie of gaze data.

You can also convert the gaze data (samples) to a file that you can import in **ILAB** so that you can use **ILAB** to find fixation, saccade, and blink events. **ILAB** is a program for postexperimental eye movement analysis that runs in **MatLab**. (**ILAB** website: <http://www.brain.northwestern.edu/ilab/>).

[Gitelman D.R. \(2002\) ILAB: a program for postexperimental eye movement analysis. *Behavioral Research Methods, Instruments and Computers*, 34\(4\): 605-612.](#)

Note that the ILAB compatible file contains either 3 columns for Tobii and SMI data (X, Y, codes) or 4 columns (X, Y, pupil data, codes) for EyeLink data.



| Line | X | Y | Codes |
|------|-----|-----|-------|
| 1 | 348 | 119 | 9999 |
| 2 | 349 | 138 | |
| 3 | 349 | 138 | |
| 4 | 349 | 138 | |
| 5 | 341 | 134 | |
| 6 | 341 | 136 | |
| 7 | 341 | 136 | |
| 8 | 342 | 136 | |
| 9 | 342 | 138 | |
| 10 | 342 | 138 | |
| 11 | 352 | 138 | |
| 12 | 352 | 132 | |
| 13 | 352 | 132 | |
| 14 | 352 | 132 | |
| 15 | 352 | 144 | |
| 16 | 352 | 138 | |
| 17 | 343 | 138 | |
| 18 | 339 | 157 | |
| 19 | 331 | 162 | |
| 20 | 331 | 162 | |
| 21 | 332 | 171 | |
| 22 | 331 | 171 | |
| 23 | 331 | 171 | |
| 24 | 331 | 171 | |
| 25 | 332 | 171 | |
| 26 | 332 | 171 | |
| 27 | 332 | 171 | |
| 28 | 332 | 171 | |
| 29 | 330 | 171 | |
| 30 | 330 | 171 | |
| 31 | 330 | 173 | |
| 32 | 328 | 173 | |
| 33 | 328 | 173 | |

Figure 17. Example of an **ILAB** compatible file created by the **Eyetracker Output Utility**.

2.3.1 Use ILAB to convert samples to fixation information

Below you can find the steps to read the file and calculate the location and duration of fixations. The example below involves data from a Tobii system (50 Hz, 21 trials).

1) File menu -> Convert to Text File...

| | |
|--|-----|
| Choose a column delimiter | Tab |
| Enter the number of columns | 3 |
| Enter column number for Horizontal Eye Data | 1 |
| Enter column number for Vertical Eye Data | 2 |
| Enter column number of Pupil Data or 0 for none | 0 |
| Enter column number for trial starts and stops or 0 for none | 3 |
| Enter the data sampling rate in Hz | 50 |
| Enter the subject ID (or leave blank) | |
| Enter the file creation date (or leave blank) | |
| Enter the file creation time (or leave blank) | |
| Enter a description (or leave blank) | |

2) Properties Window

- Click on Edit Trial Codes

- TRIAL CODES

Start 1:21, 9999

Target 1:21, 9999

End 150

Press on "OK" button

Trials, Start Codes, Target, and Stop Codes should now be the same

- Select a Coordinate System: Cortex-640x480

Press on the "OK" button

3) Analysis -> Fixations...

Press on the "OK" button

4) Analysis -> Save results as text...

Fixations checkbox should be selected. Press then on the "OK" button to save the data as an Excel file.

5) Convert the Excel file to a tab-delimited text file

Open the Excel file in Excel and then select File->Save As...

The ***Eyetracker Output Utility*** can read this file (see Section 2.4), visualize the fixations, and calculate the number of fixations and total fixation durations in regions of interest within particular time windows (see Section 2.5).

2.4 Load Events file

Click on the button "Load Events File".

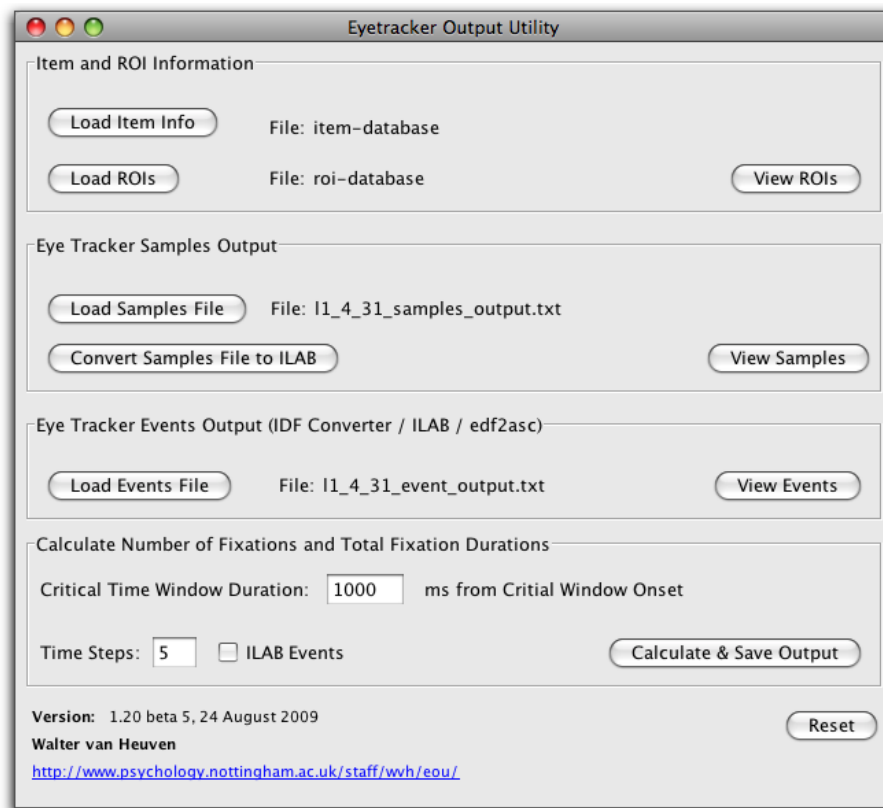


Figure 18. Name of the Event file is shown and button "View Events" is enabled.

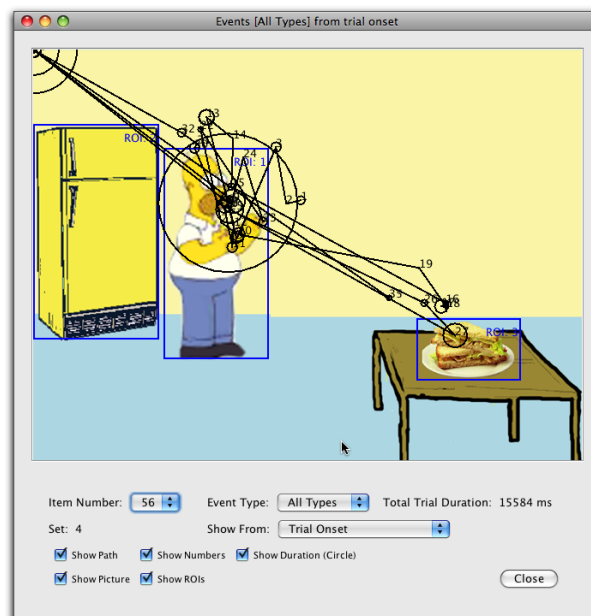


Figure 19. Event data.

Note that "All Types" events includes fixations, saccades, and blinks (coordinates: 0,0).

You can also only view the fixations from the critical window onset.

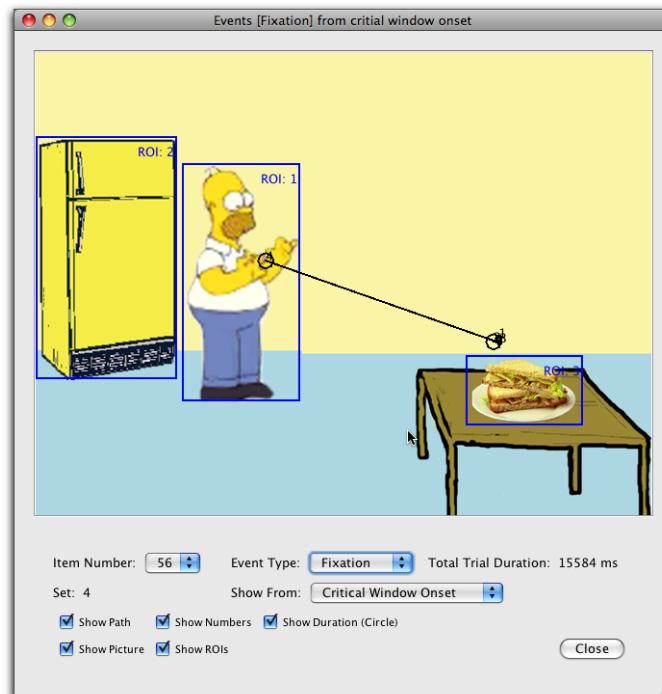


Figure 20. Event data from critical window onset.

2.5 Calculate number of fixations and total fixation durations in ROIs

Enter the Critical Time Window duration in the main window (e.g., 1000 ms) from the Critical Window Onset (see *Item Information* file, page 2). The Critical Time Window duration can also be set to the total duration of the item by using -1 for the Critical Time Window. This requires that the start time and end time of the items are defined in the *Item Information* file.

The program can also calculate the number of fixations and total fixation durations within the Critical Time Window by using a number of time steps (e.g., 2 or 5). If the Critical Time Window duration is 1000 ms and there are 5 time steps the calculations will be based on 5 time windows of 200 ms (0-200, 200-400, 400-600, 600-800, 800-1000).

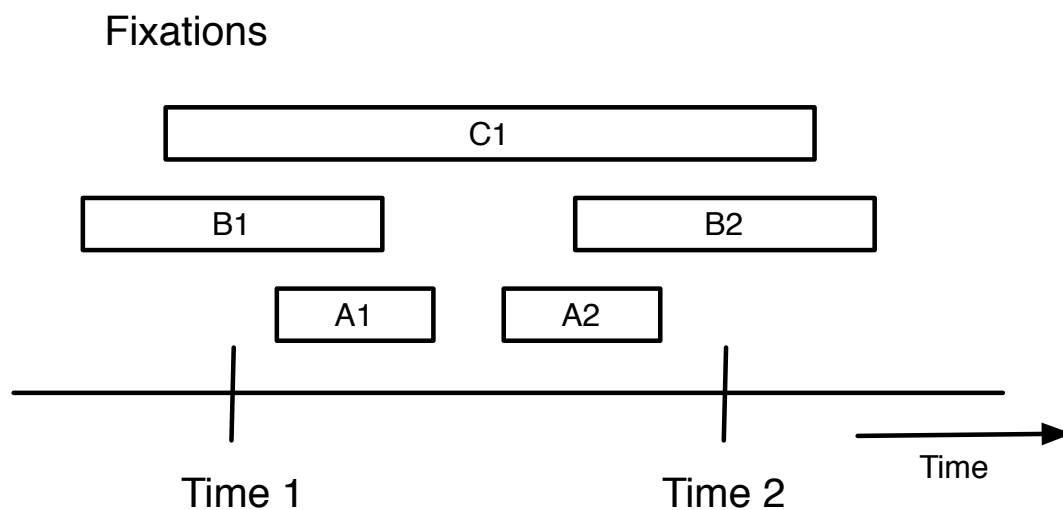


Figure 21. Fixation types for time window: Time 1 - Time 2.

The program includes in the calculations of the number of fixations and fixation durations in a time window (e.g., Time 1 - Time 2) fixations of type A (A1 and A2 both within the time window), type B (B1 starts before Time 1 and B2 ends after Time 2), and type C (fixation C1 start before Time 1 and ends after Time 2). The output file contains total durations for each time window and corrected total fixation durations per time window per region of interest (ROI). Corrected fixation durations take into account the duration of the time window (e.g., fixation duration fixation type B1 is in time window T1-T2 shorter, and for fixation time C the total duration is corrected to the length of the time window. Furthermore, the output also contains the percentage of fixations and percentage of corrected total durations for each ROI.

Note: ROIs are numbered from 1. Fixations outside any of the ROIs are coded as 0. Furthermore, the program assumes that ROIs are not overlapping.

roi_calculations.txt

| | | | | | | | | | | | | |
|-----|---|---|---|---|---|---|---|---|---|---|---|--------------|
| 128 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 129 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 130 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 131 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 132 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 133 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 134 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 135 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 136 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |

#

Fixations per Item in Critical Time Window: 200 - 400 ms.

#

Columns:

#

| #ITEMNR | SET | CRITICAL_ONSET | EVENT_TYPE | X | Y | START | END | DURATION | | COR_DUR | ROI_NUMBER | ITEM_CONDITION |
|---------|-----|----------------|------------|-----|-----|--------|--------|----------|-----|---------|--------------|----------------|
| # | | | | | | | | | | | | |
| 1 | 62 | 6541 | Fixation R | 299 | 295 | 232200 | 232314 | 113 | 22 | 0 | experimental | 1 3 4 2 |
| 1 | 62 | 6541 | Fixation R | 335 | 289 | 232318 | 232562 | 244 | 174 | 0 | experimental | 1 3 4 2 |
| 8 | 34 | 6479 | Fixation R | 544 | 96 | 128618 | 128723 | 105 | 96 | 0 | control | |
| 12 | 19 | 6587 | Fixation R | 103 | 173 | 74280 | 74864 | 584 | 152 | 0 | control | |
| 12 | 19 | 6587 | Fixation R | 108 | 181 | 74869 | 75894 | 1025 | 43 | 3 | control | |
| 16 | 68 | 6587 | Fixation R | 86 | 264 | 264717 | 264940 | 223 | 123 | 1 | experimental | |
| 16 | 68 | 6587 | Fixation R | 72 | 300 | 264944 | 265175 | 231 | 73 | 1 | experimental | |
| 20 | 65 | 6388 | Fixation R | 92 | 387 | 249415 | 250982 | 1568 | 200 | 3 | control | |
| 21 | 42 | 6685 | Fixation R | 82 | 155 | 162081 | 165691 | 3610 | 104 | 3 | experimental | |
| 21 | 42 | 6685 | Fixation R | 500 | 260 | 165746 | 165964 | 219 | 41 | 0 | experimental | |
| 24 | 59 | 6137 | Fixation R | 304 | 236 | 215826 | 215944 | 118 | 118 | 0 | control | |
| 30 | 49 | 6514 | Fixation R | 18 | 131 | 180619 | 181271 | 651 | 196 | 0 | control | |
| 31 | 96 | 6876 | Fixation R | 188 | 240 | 360490 | 360768 | 277 | 31 | 0 | experimental | |
| 31 | 96 | 6876 | Fixation R | 56 | 309 | 360789 | 361079 | 290 | 148 | 1 | experimental | |
| 35 | 82 | 6181 | Fixation R | 90 | 185 | 326893 | 327188 | 294 | 200 | 1 | experimental | |
| 56 | 4 | 6211 | Fixation R | 476 | 300 | 18022 | 18358 | 336 | 200 | 0 | | |
| 68 | 9 | 6334 | Fixation R | 226 | 142 | 42406 | 42999 | 593 | 200 | 2 | | |
| 72 | 77 | 6577 | Fixation R | 446 | 133 | 309599 | 310431 | 832 | 151 | 3 | | |
| 76 | 24 | 6455 | Fixation R | 79 | 73 | 92512 | 92915 | 403 | 200 | 0 | | |
| 80 | 55 | 5945 | Fixation R | 18 | 40 | 197267 | 197733 | 467 | 200 | 1 | | |
| 84 | 88 | 6603 | Fixation R | 290 | 104 | 343406 | 343902 | 496 | 200 | 2 | | |
| 88 | 30 | 5767 | Fixation R | 76 | 95 | 109126 | 109315 | 189 | 43 | 1 | | |
| 88 | 30 | 5767 | Fixation R | 266 | 167 | 109336 | 109529 | 193 | 136 | 0 | | |

#

Total number (count) and duration of [Fixation] events for each item (based on Event Output) in each ROI

#

Columns:

#

| #ITEMNR | COUNT | DURATION | CORRECTED_DURATION | | | ROI_0 | ROI_0_COR_DUR | ROI_1 | ROI_1_COR_DUR | ROI_2 | ROI_2_COR_DUR | ROI_3 |
|---------------|----------------|----------|--------------------|---|-----|-------|---------------|-------|---------------|-------|---------------|----------------------|
| ROI_3_COR_DUR | ITEM_CONDITION | | | | | | | | | | | |
| 1 | 2 | 357 | 196 | 2 | 196 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control a 10 testing |
| 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 8 | 1 | 105 | 96 | 1 | 96 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 12 | 2 | 1609 | 195 | 1 | 152 | 0 | 0 | 0 | 1 | 43 | | control |
| 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |
| 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 16 | 2 | 454 | 196 | 0 | 0 | 2 | 196 | 0 | 0 | 0 | 0 | experimental |
| 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | control |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | experimental |

Figure 22. An example of the analyses output.

The output file is a tab-delimited text file that can be opened with for example Microsoft Excel or a simple text editor.

The ROI analysis creates four columns for each ROI:

ROI_n_FIX: total number of fixations in ROI n

ROI_n_FIXPER: percentage of fixations in ROI n

ROI_n_CORDUR: corrected total duration of the fixations in ROI n

ROI_n_CORDUR_PERC: percentage of corrected total duration of the fixations in ROI n