

Exporting Data in Data Viewer

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¹I am not a representative of SR Research. The information contained in this document is simply a compilation of my own personal experience with the EyeLink systems. This manual is neither produced nor endorsed by SR Research.

Overview

This manual is intended to get you started exporting data from DataViewer. All of this information can be found on the SR Research manuals. What I have done here is to simply streamline this information to what is most relevant to our field, and add in some additional explanation of things that are common in the types of analyses we do. I have additionally added in some of my own personal experience in the field when relevant to give context. This manual covers basic four picture/word visual world and reading data. I hope you find it useful to you and your work.

Happy Tracking!

Katrina

1 Data Viewer

This manual is intended for someone who is just starting out with Data Viewer and needs to output the data based on someone's instructions. Outputting the data is a process that relies heavily on a deep understanding of the goals of the experiment and especially on the design of the experiment in Experiment Builder, so there are decisions that will need to be made that I can't explain here. What I will do here is show you the basic process of exporting data from Data Viewer and highlight the places where you will need to ask for directions from your PI or make decisions yourself if this is your own experiment.

If you were to navigate to the deployed version of your experiment, you would see a folder there named results. You may be tempted to go here to find your data first, but do not move or open the files within that folder directly. The correct way to access the eye-tracking data is through the SR Research program DataViewer.

Important Note: License Key

In order to open the DataViewer (DV), you will need the DV license key plugged into the computer.

Go ahead and open up DV. You should see a screen like that in Figure 1.

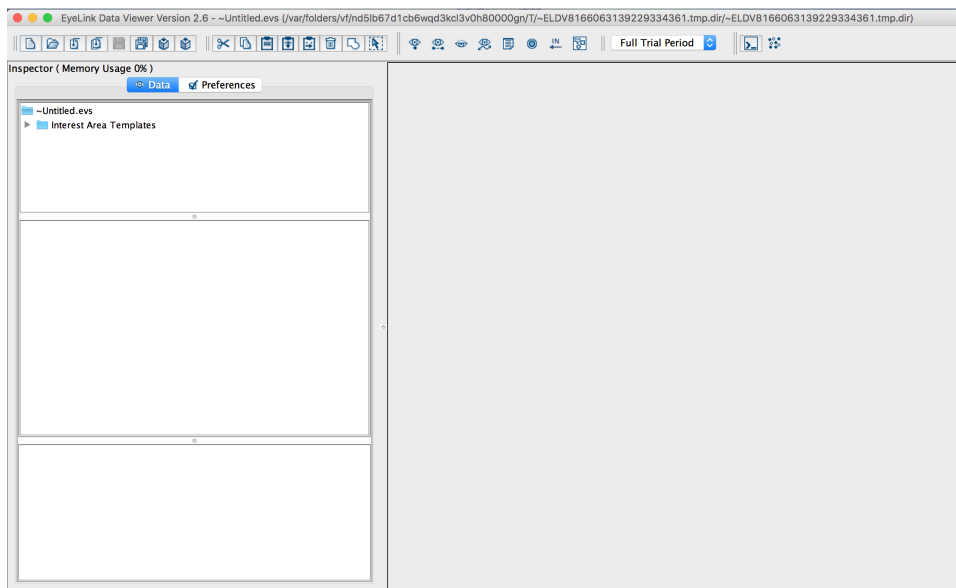


Figure 1: Data Viewer Opening Screen

2 Loading Data

Import EyeLink Data File vs. Import Multiple EyeLink Files

I highly recommend importing all of your data at once using the Multiple Files option. It saves you a ton of time and also helps ensure that your data is consistent. I always recommend importing all of the data together and then going through the process of exporting once very carefully to ensure you don't make any mistakes.

To begin, you will need to load the data into the program.

Click FILE → IMPORT DATA → MULTIPLE EYELINK DATA FILES as seen in Figure 2.

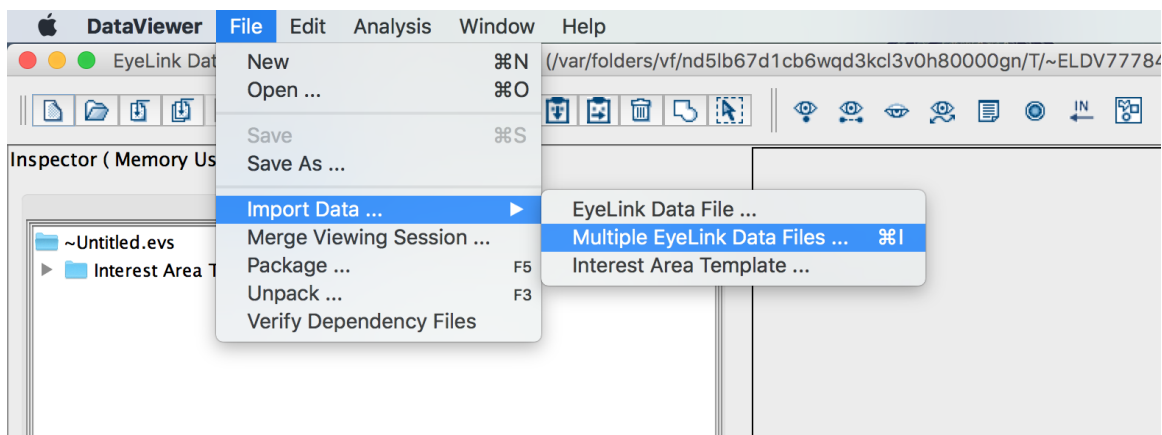


Figure 2: Opening ET Files Step 1

After you click MULTIPLE EYELINK DATA FILES, you will see a small window appear for you to select the data files as seen in Figure 3. Click on the ... button highlighted in Figure 3. Here, navigate to the folder with the **DEPLOYED** version of the experiment and find the RESULTS folder.

DO NOT go into this folder, just click it once to highlight it and click OPEN. This will select all of data files within that highlighted folder. If there are files you don't want in there as well, that's OK. You will have the option of choose which files from that folder you want to actually load in the next step.

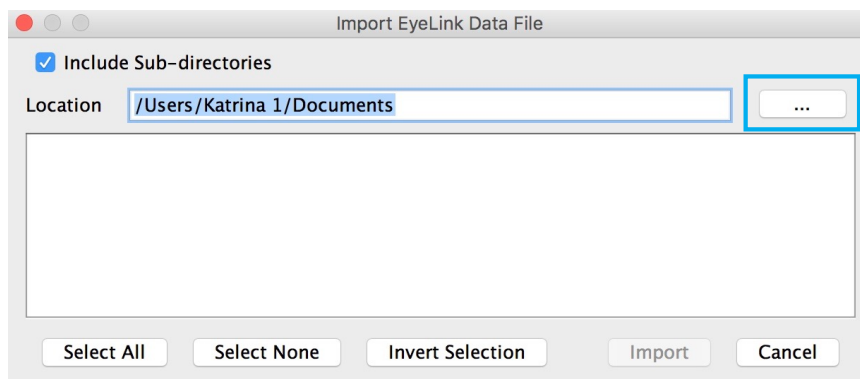


Figure 3: Opening ET Files Step 2

The window will now show the available files to load in the window, as seen in Figure 4. Here, if there are any data files you do not wish to import, simply un-select them. When ready, click IMPORT. If there are more files you would like to import from a different folder from the same experiment, simply click IMPORT to import these files and then repeat the process until you have all of the desired files loaded into Data Viewer.

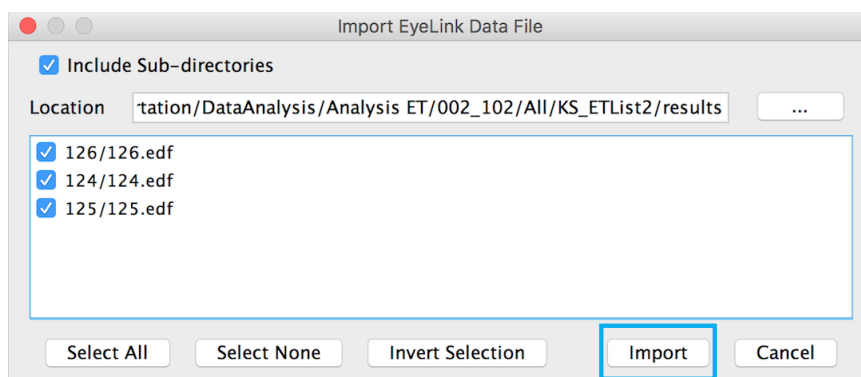


Figure 4: Opening ET Files Step 3

Figure 5 shows an example of what you may see when the data is opened. As a quick introduction to the screen, the right window shows you a representation of what was present on the screen during the eye-tracking recording, with the fixations superimposed as blue circles. I won't be going through what each of the options at the top of that window do, but feel free to try them out. They are simply different ways of viewing the data.

On the left you will have several windows. The top window gives you a hierarchical structure of the imported data, with each file and then each individual trial for each of those files. Feel free to click through to view different trials for different participants. The window below that will have a list of each of the fixations within the selected trial from the top window. The bottom window will give you additional information about the selected trial.

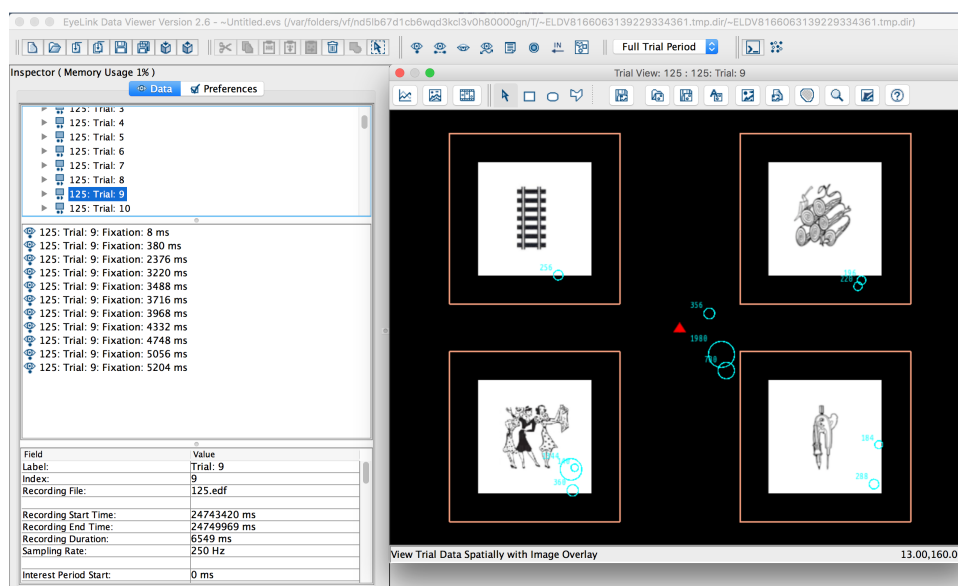


Figure 5: Opened Data

SAMPLE MATERIAL

Some pages removed

4 Reports

Now that you have restricted the data to a workable frame, it is now time to export the data. This is done by creating a REPORT, as shown in Figure 17. Go to ANALYSIS → REPORTS. Here you will see a lot of options. Each of these reports will export the data in different ways. For a more detailed description of each, I recommend you see the DataViewer Manual by SR Research. As a brief introduction, the name of each of these reports tells you what will be included in a single row of the final data sheet. So, the FIXATION report will give you a data set with each row including data for every fixation (when the eye is focusing on a fixed point) in the data set. The SACCADE report will give you a data set with each row containing information about each saccade (eye-movement), and so on for each type of report. Which report you choose depends on what you want to do with the data, so once again, I cannot tell you how to choose which report. Each experiment needs a different type of data, and that is something you or your PI will have to decide.

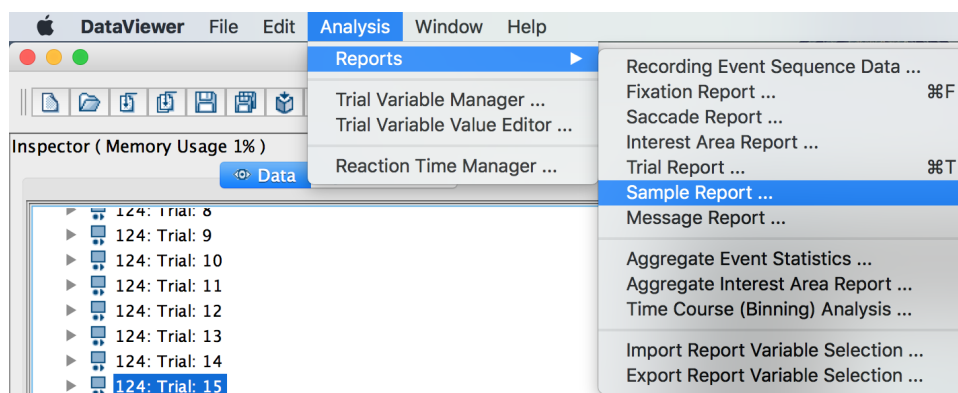


Figure 17: Reports

That being said, if what you care about is something happening over time or are looking at some very time sensitive effect, you will likely want the SAMPLE report. The eye tracker records data by taking a sample of the of the gaze location at a certain rate. This is the recording frequency of the tracker, measured in Hz. Recall your science classes, where Hz is cycles per second. So, if the tracker is recording at 1000 Hz, this means that the eye-tracker is taking a sample of the gaze location 1000 times every second. When you output the sample report, this is what you are getting. There will be a row of data for every millisecond of the eye movement recording. This will give you VERY time sensitive data, but also a lot of data, so be aware of how large your data file will be. If you are using the sample report, I highly suggest using as small of an Interest Period as possible to reduce the data size.

Which Report Should I use?

If you aren't sure which report you should use, I suggest that you first read through the more detailed information in the SR Research Manuals. In fact, I suggest you do this anyway because you should know exactly what the report you are using is doing to your data. But, I also suggest that you play around with it. Try each report and see what you get. I find this to be one of the best ways to learn. You could output one of each of the reports if you wanted it. It's up to you.

4.1 Visual World

For visual world data, SR research has a specific report that is designed for the kinds of analyses we will want called the TIME COURSE (BINNING) ANALYSIS report. This report is wonderful, and I highly recommend using it.

4.1.1 What is BINNING and why should I do it?

In this section I will explain Binning. If there is one thing I really want you to understand the mechanisms of in a visual world analysis, it is binning. So, please read this section carefully so you can understand hat this report does to your data.

Lets say that we have a display with 4 colors on it like that below. The participant sees 4 colors and is asked to click on the color they hear. In this case let's say our target is Blue, and our competitor is Green.

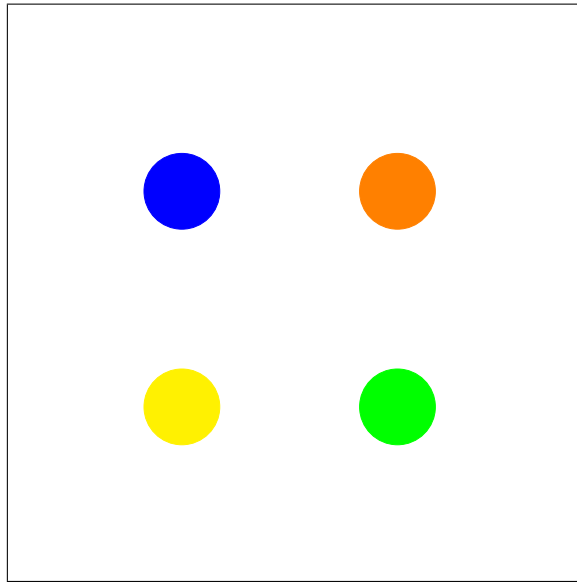


Figure 18: Binning Explanation Sample Display

Samples vs. Fixations

In order to discuss the binning report, we first need to talk about the difference between a *sample* and a *fixation*. The tracker takes recordings of the eye moments at a certain frequency. These recordings are called samples. This is the recording frequency of your eye tracker, reported in Hertz, samples per second. Many eye trackers are now recording up to 1000Hz, or 1000 samples a second. Figure [19](#) below shows our display with the samples represented with gray circles, with the number indicating the order in which the sample was taken. So, from this we can see that the participant looked at Green, then Orange, then Blue, and then Yellow. We can also see that some samples seem to be clumped together in time and space. Looking at the Orange circle, we can see that samples 6-8 seem to be separate from samples 9 and 10, in that the participant was looking at a slightly different area of the Orange circle, whereas all 5 samples to Green seem to be clumped together. These clumps of samples are what we call FIXATIONS. Fixations, are groups of samples that occur together in SPACE and TIME. This means in order to be a fixation, they have to be in order in time, and to a similar space on the screen. This is why 6-8 and 9-10 are counted as separate fixations, because they are far enough away from each other to count as a new fixation. SR research has an algorithm for determining what samples count together as fixations. If you are interested, I suggest you read their full manual for the details. Here, what we will be discussing is *samples*, not fixations.

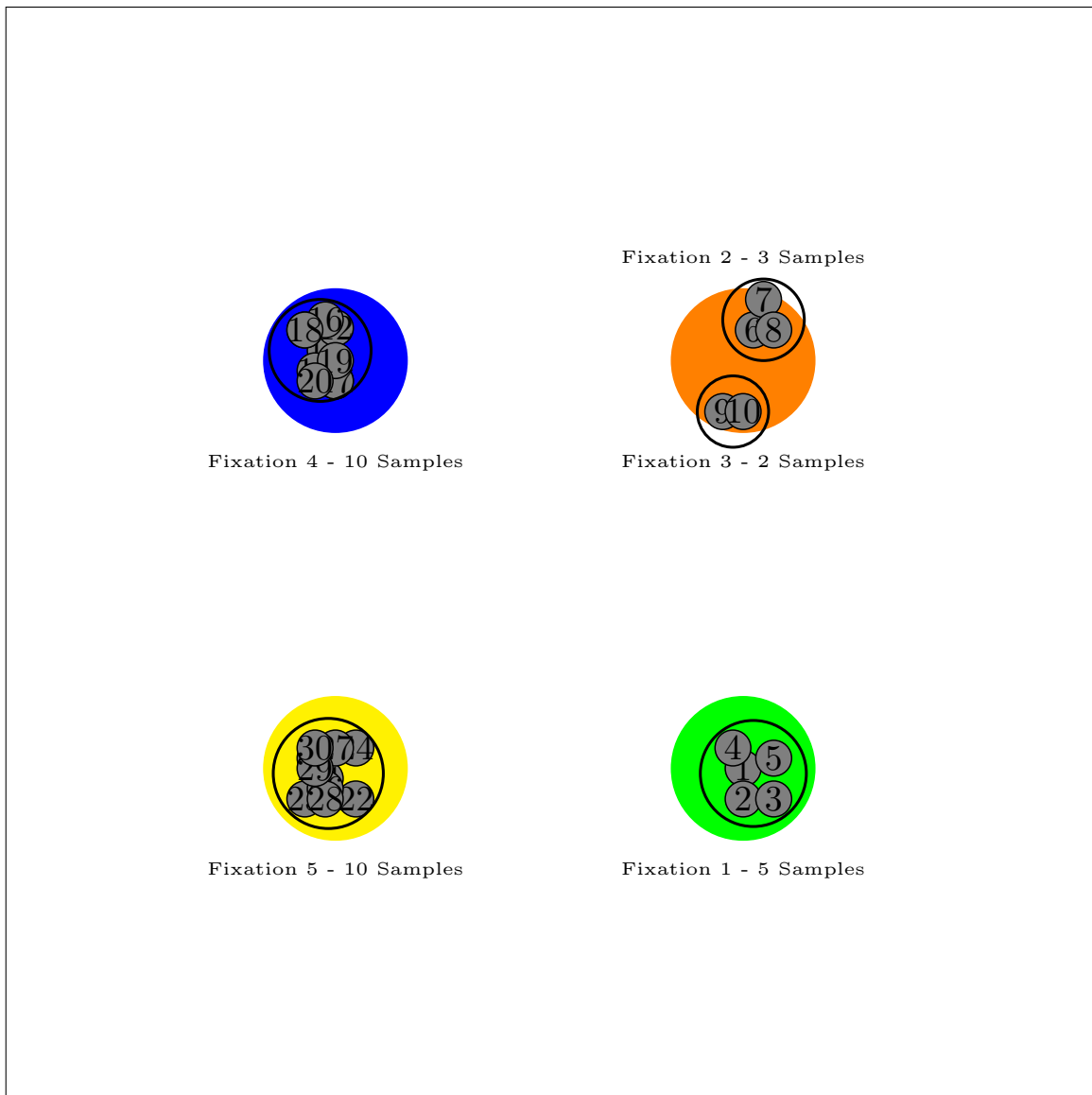


Figure 19: Samples vs. Fixations

Binning

If we were to represent the items the participant above was looking at sequentially in time, we would get something like Figure 20. This figure is representing that at the start of the trial, the participant was looking at Green for the first 5 samples, at which point they looked at Orange for the next 5 samples, then Blue for 10 samples and Yellow for 10 samples. When we BIN the data, we are going to create artificial breaks in the data to create the BINS.

For examples sake, I am going to use 10 ms bins. What this means is that every 10 ms of data will be grouped together into a bin, as shown in Figure 30. In DataViewer, the Bins always begin labeled at 0, so we have Bins 0, 1, and 2 for the three bins of time we have in our example. As a reminder, we have 3 bins, because I chose 10 ms bins, and we are working with 30ms of data.

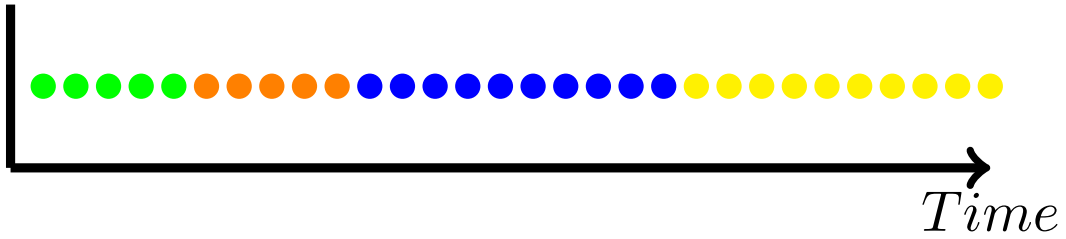


Figure 20: Samples Over Time

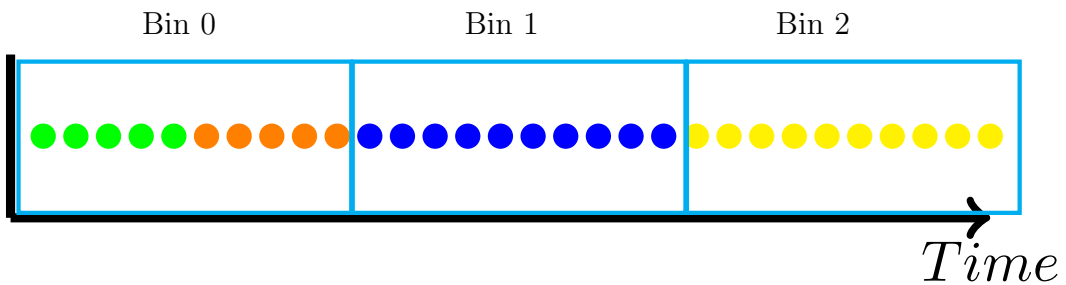


Figure 21: Samples Over Time Binned

Why are we Binning that data in the first place?

We bin our data for 2 reasons.

1. Most often we don't need millisecond precision in our time variable, and so binning the data helps reduce the data file size
2. We can calculate proportion of fixations to each object across the bin.

Now that the data is binned, we can now calculate the proportion of fixations to each of our 4 colors for each bin. To do this we will use a very simple formula.

$$\text{Proportion fixation to item in Bin} = \frac{\text{Number of samples to item being calculated}}{\text{Total number of samples in the Bin}}$$

For Bin 0, there were 5 samples to Green and 5 samples to Orange. This means that 5 out of 10 samples were to Green, 5 out of 10 samples were to Orange, and 0 out of 10 samples were to Blue and Yellow. You will see these fractions if you look across from left to right in the table on the left below for the row for Bin 0. The for Bin 1, 10 out of the 10 samples were to Blue, and so all the other all had 0 out of 10 samples. When we divide the numerator by the denominator, we get the proportion of fixations to that color for that bin, shown in the corresponding table on the right.

samples to item divided by samples in Bin. . . . gives rise to the proportion fixations

Bin	Green	Orange	Blue	Yellow		Bin	Green	Orange	Blue	Yellow
0	5/10	5/10	0/10	0/10	→	0	.5	.5	0	0
1	0/10	0/10	10/10	0/10		1	0	0	1	0
2	0/10	0/10	0/10	10/10		2	0	0	0	1

How does this translate to a graph?

All that's left to do is plot out the results. If we plot the proportion fixation for each item at each time bin, we get the following graph. Keep in mind, this graph is for 30 seconds of data, from one (made up) participant for one trial. In real data, we would have many trials for many participants. When we average the proportion fixation to each item on the screen for multiple trials and multiple participants, we will end up with the beautiful spaghetti plot you may have been expecting. We then convert the time variable of Bin to Time MS, but that is done in R, so we won't worry about that here.

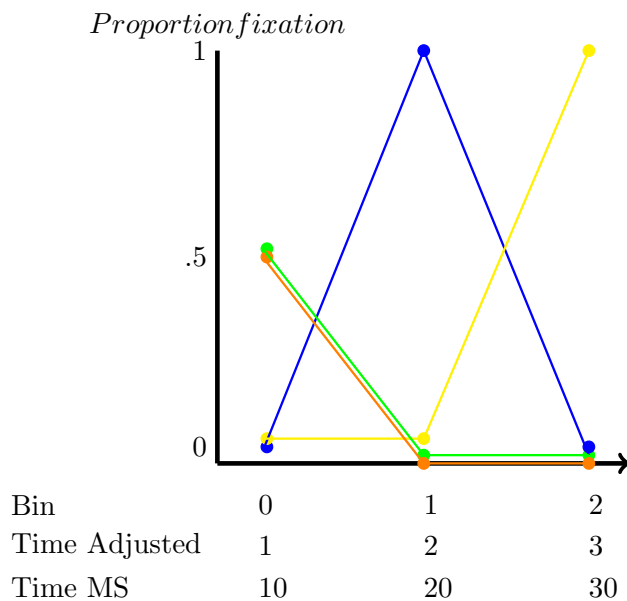


Figure 22: Graph of Sample Data

So, now that you (hopefully) understand binning, let's get back to the binning report.

4.1.2 The Time Course (Binning) Report

Variable Selection and Interest Areas

Once you select the desired report, a window shown in Figure 33 will open. Here is where you will choose the variables you want to include in the final output. The variables listed in the left window are the possible variables to add, and those in the right window are the ones that will be included in the final data set. To include the variables, select the desired variables in the window to the left, use ctrl or cmd to select multiple, and click on the >> arrow to shift them to the right window. If you aren't sure which ones you should include, I recommend highlighting them all and including all of them. You can exclude unwanted variables later when processing the data, but it will be harder to add them if you leave them out.

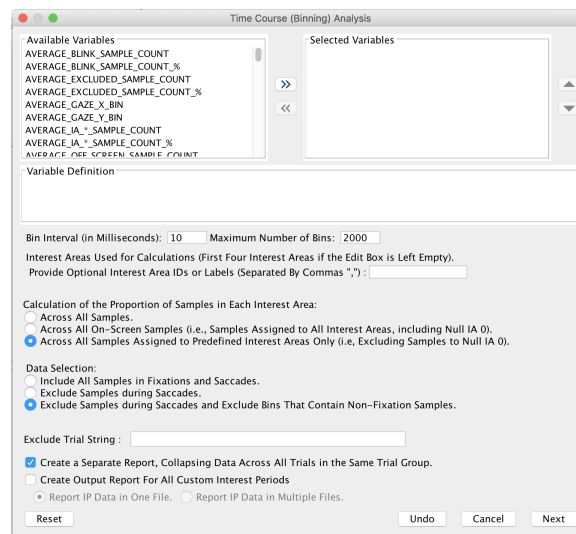


Figure 23: Binning Reports Step 1

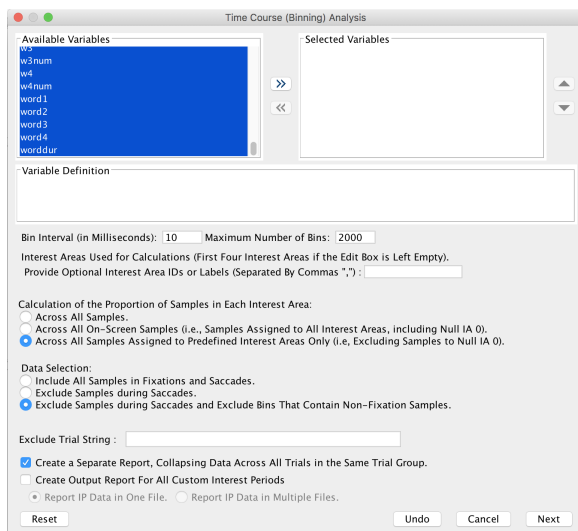


Figure 24: Binning Reports Step 2

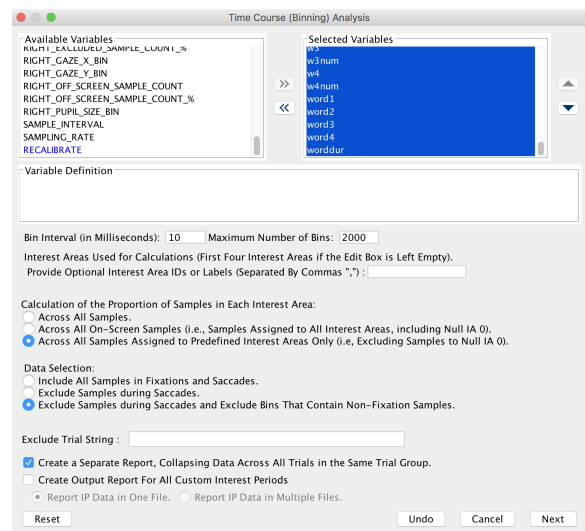


Figure 25: Binning Reports Step 3

There is also a way to save your variable selection to re-import later into a different session. If you add in the variables you need and save the session, they will be there the next time you open that session, but what if you have another analysis to conduct, say on a different group, and you need to do that in a separate viewing session? You can select the variables you want, export them to a file, and then import that file. This is also ideal when different labs are conducting analyses on different portions of the data, as it ensures that you are including the same variables. To do this, add in all of the variables you want and save the viewing session. Now click on ANALYSIS → REPORTS. At the bottom of this menu you will see an option EXPORT REPORT VARIABLE SELECTION (shown in Figure 26). Click this and save the file as something informative so you know what variables are included. To import this to a new session, simply follow the same steps expect click on IMPORT REPORT VARIABLE SELECTION, and this will import the variables you selected to the current viewing session.

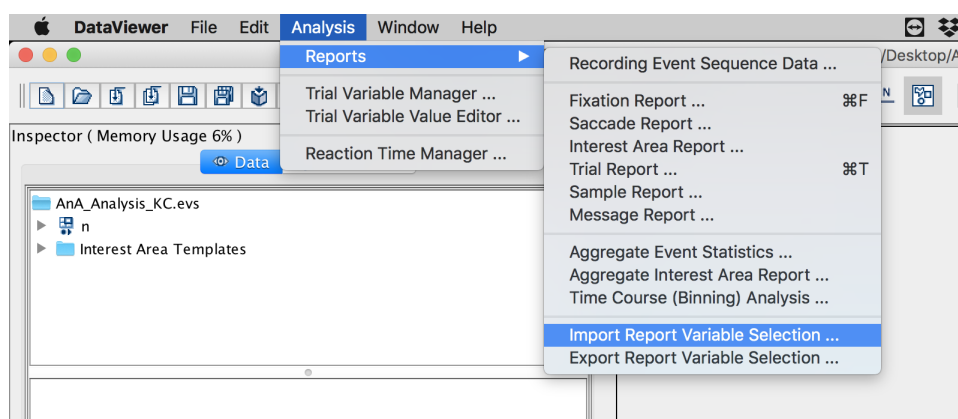


Figure 26: Import/Export Variable Selection

Below where you add the variables, you will now have 4 places where you need to make some choices. The first is shown in Figure 27 below. In the above explanation, I used a bin size of 10, but you can set how large you would like your bins to be. When choosing the bin size, make sure you take into consideration the sampling frequency of your tracker. When recording at 1000Hz, I typically set this to 10, which will put 10 samples into each bin, making each bin equivalent to 10 ms of data. If you are doing time-course analyses, I would not recommend bins any longer than that. When I was using a 250Hz tracker, I used 8ms bins, which put 4 samples in each bin. You basically just want to make sure you calculate how many samples will be in each bin and make sure it is enough to calculate your proportions. You also want to make sure that the number of samples in each bin will be a whole number. What I mean is if you had a 250Hz tracker, and you set the bin size to be 10 ms, you would end up with 2.5 samples in each bin, which doesn't make sense.

Below that, you will list the IA IDs, if you have more than 4. It will include the first 4 automatically, but if you have more, simply list their ID numbers and separate with a comma.

Bin Interval (in Milliseconds): Maximum Number of Bins:

Interest Areas Used for Calculations (First Four Interest Areas if the Edit Box is Left Empty).
 Provide Optional Interest Area IDs or Labels (Separated By Commas ",") :

Figure 27: Binning Your Data

Calculating Proportions

The next choice you will need to make is how to calculate the proportions. There are three options, shown in Figure 28.

Calculation of the Proportion of Samples in Each Interest Area:

- Across All Samples.
- Across All On-Screen Samples (i.e., Samples Assigned to All Interest Areas, including Null IA 0).
- Across All Samples Assigned to Predefined Interest Areas Only (i.e., Excluding Samples to Null IA 0).

Figure 28: Calculating Proportions

These options change the denominator when calculating the proportions. Let's take a look at that. The example of calculating the proportions above (Section 4.1.1) assumed that all fixations fell directly on an item, and so, inside one of the IAs surrounding an image. This is never the case, and there will always be fixations that fall outside of the predefined IAs, or even off screen. These options are simply asking you how you would like to treat these samples when calculating the proportions. So, in Figure 29 below, we see that fixations 5, 6, 21, and 22 fall between IAs in blank space, and sample 30 falls off the screen.

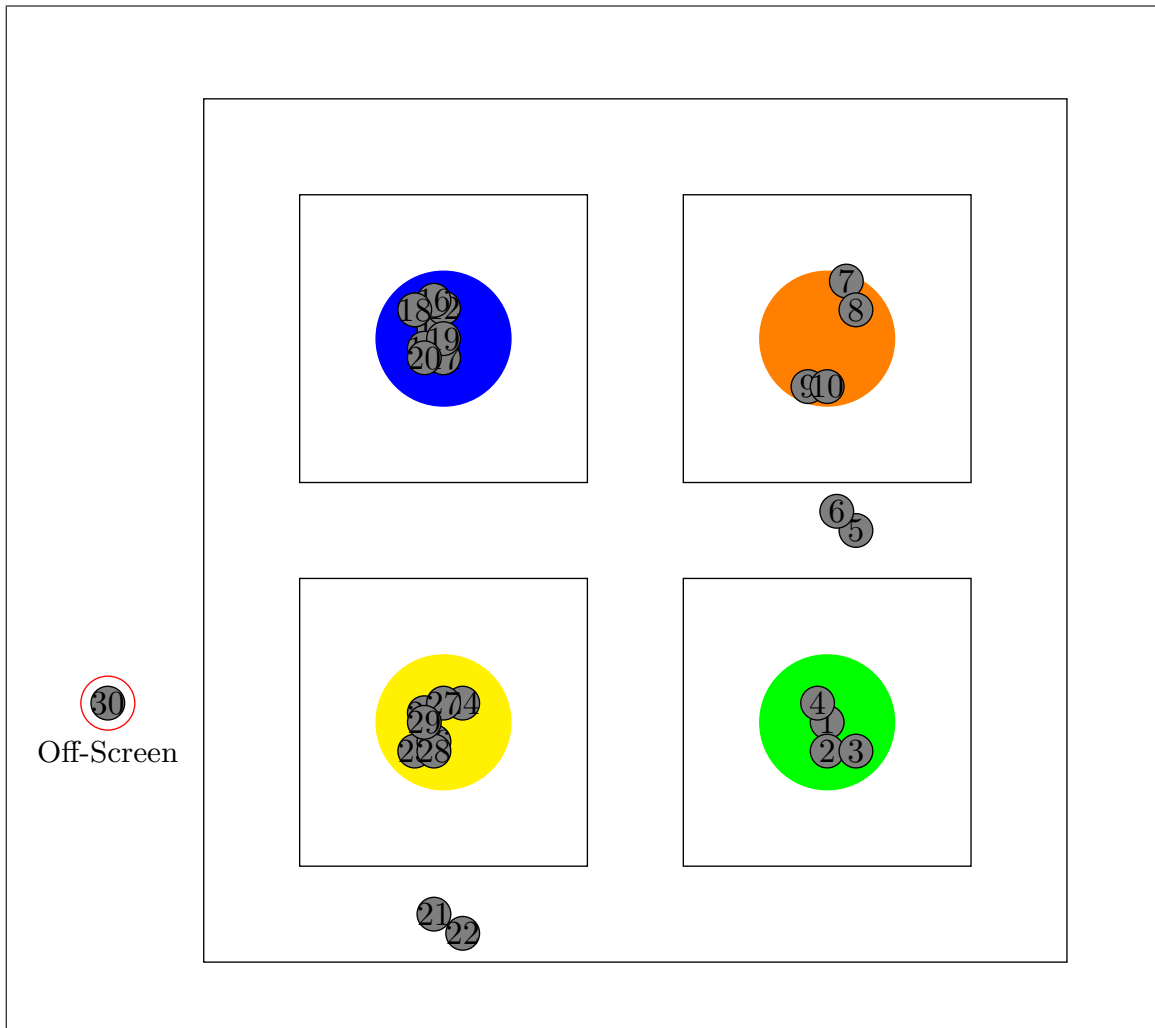


Figure 29: Samples vs. Fixations Example 2

If we once again plot out these fixations over time, we see that there are 2 samples in Bin 0 that are not to any of the pre-defined IAs, shown in gray, two more in Bin 2, and then 1 sample in Bin 2 that falls off the screen, highlighted in red in Figure 29. The options above will decide how these samples get factored into the calculations in the formula we discussed earlier, specifically changing what samples get counted as part of the denominator in our equation, so **Total number of samples in the Bin**. Let's take a look at each.

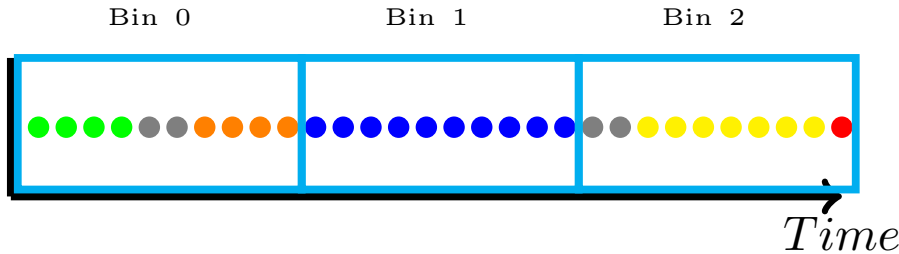


Figure 30: Samples Over Time Binned Example 2

Option 1: Across All Samples Returning to Option 1, this option would include **all** samples in the denominator, including those outside the IAs and off-screen. Our denominator in this case would *always* be 10, since we set each bin to have 10 samples.

Bin	Green	Orange	Blue	Yellow
0	4/10	4/10	0/10	0/10
1	0/10	0/10	10/10	0/10
2	0/10	0/10	0/10	7/10

→

Bin	Green	Orange	Blue	Yellow
0	.4	.4	0	0
1	0	0	1	0
2	0	0	0	.7

Option 2: Across All On-Screen Samples When we calculate the proportions across all samples on screen, those sample that fall in the blank space are included in the denominator, and so your denominator remains as 10 for bin 0 and 1, which lowers our proportion fixation to the colors from the previous example, since only 4 out of 10 samples were to Green and Orange respectively in this case. However, the denominator does not remain as 10 in Bin 2, since there is a sample the fell off-screen. Under Option 2, only on-screen samples are counted, and so for this bin, the denominator is 9. In this bin, 7 of the 9 on-screen samples were to Yellow, and so our proportion fixation to Yellow is 7/9, or .8, as shown in the table below.

Bin	Green	Orange	Blue	Yellow
0	4/10	4/10	0/10	0/10
1	0/10	0/10	10/10	0/10
2	0/9	0/9	0/9	7/9

→

Bin	Green	Orange	Blue	Yellow
0	.4	.4	0	0
1	0	0	1	0
2	0	0	0	.8

Option 3: Across All Samples Assigned to Predefined IAs For the third option, only the samples that fall within **pre-defined interest areas** are used in the denominator. So in this case, in Bin 0, there are only 8 samples that fell in a pre-defined IA, and so our denominator for Bin 0 is 8. Since 4 our of 8 samples (to IAs in the bin) were to Green, the proportion fixation to Green in Bin 0 was .5. In Bin 1, 10 out of 10 samples were to a pre-defined IA, and they all happened to be to Blue, leading to a proportion fixation of 1. Finally for Bin 2, we had 1 sample fall off screen, which is not included in our denominator. Additionally, under this option only samples that fell to pre-defined IAs are included, which gives us a denominator of 7 for Bin 2.

Bin	Green	Orange	Blue	Yellow
0	4/8	4/8	0/8	0/8
1	0/10	0/10	10/10	0/10
2	0/7	0/7	0/7	7/7

→

Bin	Green	Orange	Blue	Yellow
0	.5	.5	0	0
1	0	0	1	0
2	0	0	0	1

How to Chose?

I know researchers who prefer the second and third options. I believe either is fine, but you should report what choice you made in your paper. Like I said, I don't know anyone who would choose the first, so I would not recommend this option. The argument for using Option 2 is that using Option 1 can inflate your results. As you saw above, with the same data, Option 3 results in high proportion fixations to the items on screen by ignoring the other fixations on the screen. Some researchers don't like this, and feel it manipulates the data. Others feel that the fixations in between IAs are difficult to interpret, and should not be included in the calculations. Additionally, researchers who prefer Option 3 feel that the question you are trying to answer matters. In this made up experiment, we didn't care if they actually looked at Blue more than elsewhere, we cared if they looked at Blue more than they looked at Green. If this is the question, then it makes sense to calculate the proportions based only on the items present on the screen, to the exclusion of elsewhere on the screen. So this choice is up to you. As long as you can defend why you did what you did and you report it.

Blinks and Saccades

The next set of options will deal with how to treat blinks and saccades. The options shown in Figure 31 below are rather self-explanatory, so I won't spell them out. I will tell you that the visual world researchers I know all recommend the last option to exclude all non-fixation samples. If you are doing pupilometry, some researchers include them and interpolate, but there is simply no reason to do so for visual world, so it is best to exclude them.

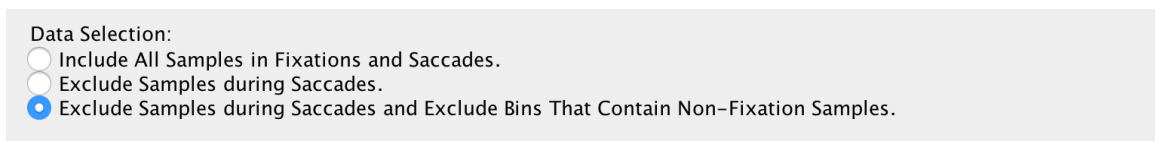


Figure 31: Blinks and Saccades

Example Write-up Statement

The data was exported using SR Research Data Viewer software. An interest period was set from ____ to _____. A Time Course (Binning) report was used to export the data. This report binned time into XXms bins, **INSERT OPTION BELOW**, and excluded blinks and saccades.

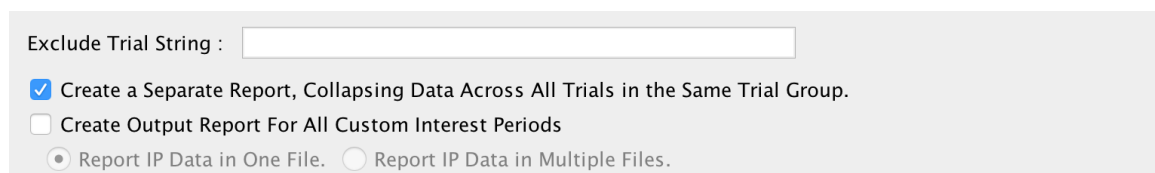
1. included all samples recorded (on and off screen)
2. included all on-screen samples
3. included only samples that fell inside the pre-defined interest areas

Report Options

The final set of options are shown in Figure 32 below are about how the final report(s) will be formatted.

1. **Create a separate report, collapsing across all trials in the same Trial Group:**
This report will create a separate report for each level of a Trial Grouping that you can set, which I did not discuss here. For most visual world purposes, you will not want this option.
2. **Create Output for all Custom IAs:** This will export all of your data for each of the IPs you set before hand. There are two ways it can do this.
 - (a) Report IP data in 1 file giving you a new column to delineate which rows of data fell into which IP
 - (b) Report IP data in separate files, one for each individual IP you set.

For visual world, I tend to prefer to have it all in one file, and to separate out in R later when needed. For pupilometry data however, I believe the common practice is to export them separately.



Exclude Trial String :

Create a Separate Report, Collapsing Data Across All Trials in the Same Trial Group.

Create Output Report For All Custom Interest Periods

Report IP Data in One File. Report IP Data in Multiple Files.

Figure 32: File Exporting

After you have set all of your options the way you want them, click NEXT and you will be prompted to save 2 files. First it will ask you to save an .EVS file. This will save your viewing session. It's a good idea to save this as it will save the interest period and everything, so if later you want to go back and export a different report, you can open this viewing session and have everything just the way it was. When asked 'Do you want to save changes to Untitled.evs?', click OK and use the ... button to navigate to where you want to save it (NOT in the deployed folder. I recommend you make another folder called STUDYNAME_ViewingSession). Change the name of the file to something that will be informative so you know what it is later.

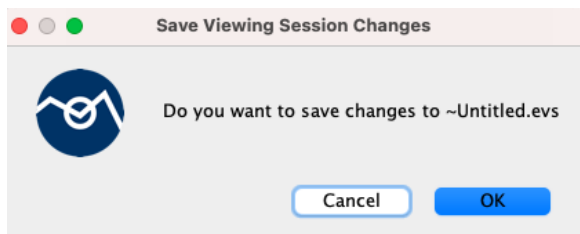


Figure 33: Save Viewing Session (VS) Prompt

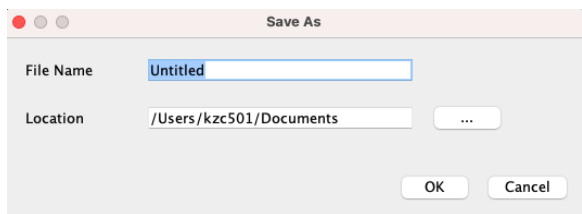


Figure 34: Initial Save VS Window

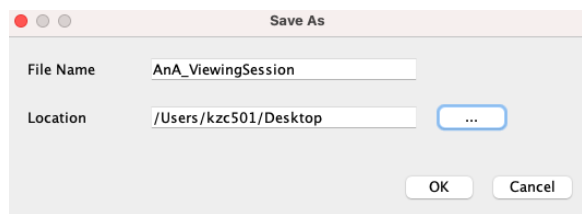


Figure 35: Edited Save VS Window

After the session is saved, a second window will open. This window is asking where you want to save the actual exported data file. Do not change the location of where it will save, just give it an informative name so that you will know what it is and save it. Depending on the size of your data file, it may take up to 5 min or so to create and export the report, so be patient.

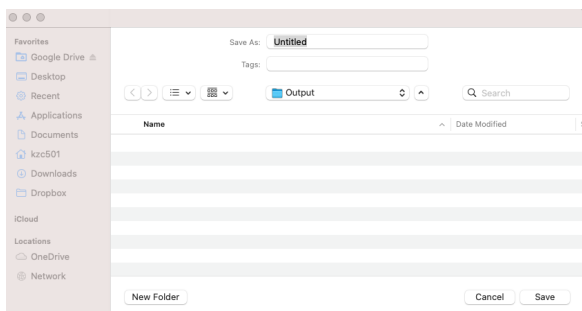


Figure 36: Initial Output Window

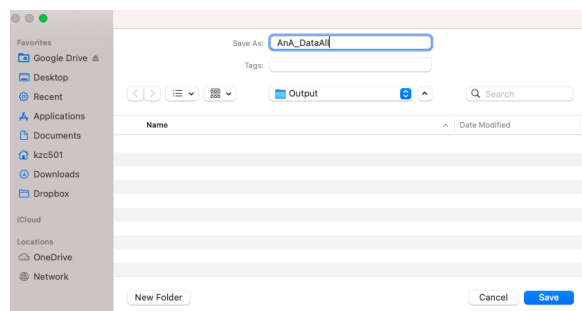


Figure 37: Edited Save Output Window

SAMPLE MATERIAL

Some pages removed

5 Saving & Packaging the Viewing Session

If you need to transfer your viewing session off of the computer it was made on to back it up or send it to someone, you should be *packaging* the viewing session. If you have packaged Experiment Builder scripts, this is the same thing. It basically just wraps up the session and all it's corresponding files to make it save to transport it so nothing gets lost on the way.

To package a viewing session, you must first save it. To do this, go to FILE->Save. Change the name of the file to something that will be informative so you know what it is later and use the ... button to navigate to where you want to save it (NOT in the deployed folder. I recommend you make another folder called STUDYNAME_ViewingSession).

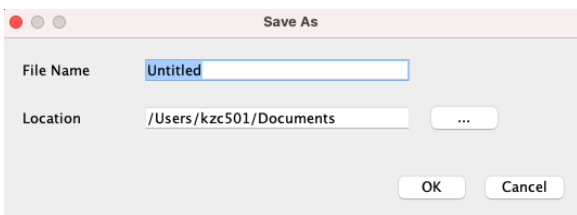


Figure 41: Initial Save VS Window

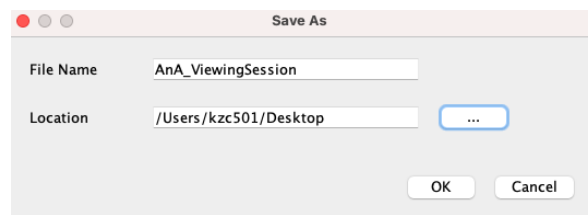


Figure 42: Edited Save VS Window

Once you have saved your viewing session, click FILE->PACKAGE. Just like when saving a window will come up asking what you want to call it and where to save it. I recommend leaving the name the same as what you saved it as. The for where to save it, I would save it in the Viewing Session folder you made, so you always know where to find it. It can also be helpful to add the date to the file name.

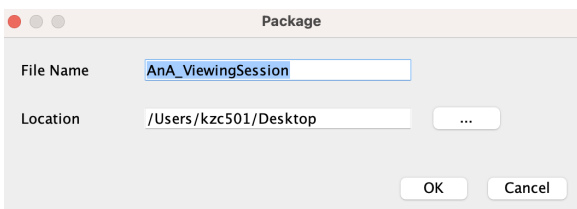


Figure 43: Initial Package Window

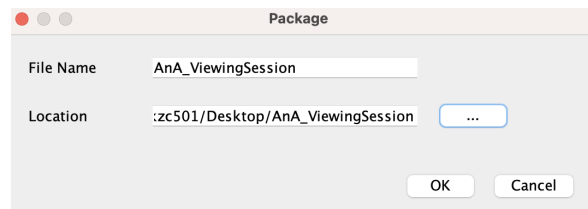


Figure 44: Edited Package Window

6 Finding & Opening the Data

To find your data file, simply navigate to where you saved the viewing session on the computer. In that folder you will see a .evs file, which is your viewing session, and then you will see a folder called "OUTPUT". Your data file will be there, named whatever you named it.

As a final note, if you are exporting the results from a full study (25+ participants on a 30+ min experiment), the resulting file will very likely be quite large, so you may not be able to open it in Excel. If you used the TRIAL or INTEREST AREA reports, you *may* be able to open it in Excel, but if you use the SAMPLE or TIME COURSE reports, I **do not** recommend even trying to open the file in Excel. It *will* crash. So, I recommend opening the file in R, which can handle any size data set you give it. I have never worked with eye-tracking data in SPSS, so I can't speak to its ability to handle the data size. So, before you open the file in any program except R, save everything else you are working on, because there is a chance that it will be so large that it could crash the program and you may end up needing to restart your computer (and if that sounds like I'm saying that from experience, you are correct, which is why I now use R for all of my data processing).

If you are going to be working with eye-tracking data in the future, I highly recommend you begin learning R or another more advanced data processing and statistical analysis software. You won't regret it.

Data Exporting Cheat Sheet

1. Load data files

- File -> Import Data -> Import Multiple EyeLink Files

2. Set Interest Period

- Full Trial Period -> Edit -> Blank Page Icon
- Set Interest Period Start Event
- Set Interest Period End Event

3. Create Report

- Analysis -> Reports
- Select desired report
- Select desired variables
- Click >> to move variables to right window
- Save .evs
- Save results file