

Pipeline for Comparison of Weighted Structural Data between Groups of Subjects

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In this tutorial, we will upload a file containing the pipeline with the different steps to compare two groups of subjects using *structural data* (check tutorial *Group of Subjects with Structural Data*) and weighted undirected graphs. This Tutorial explains how to perform group analyses and comparisons with this kind of data.

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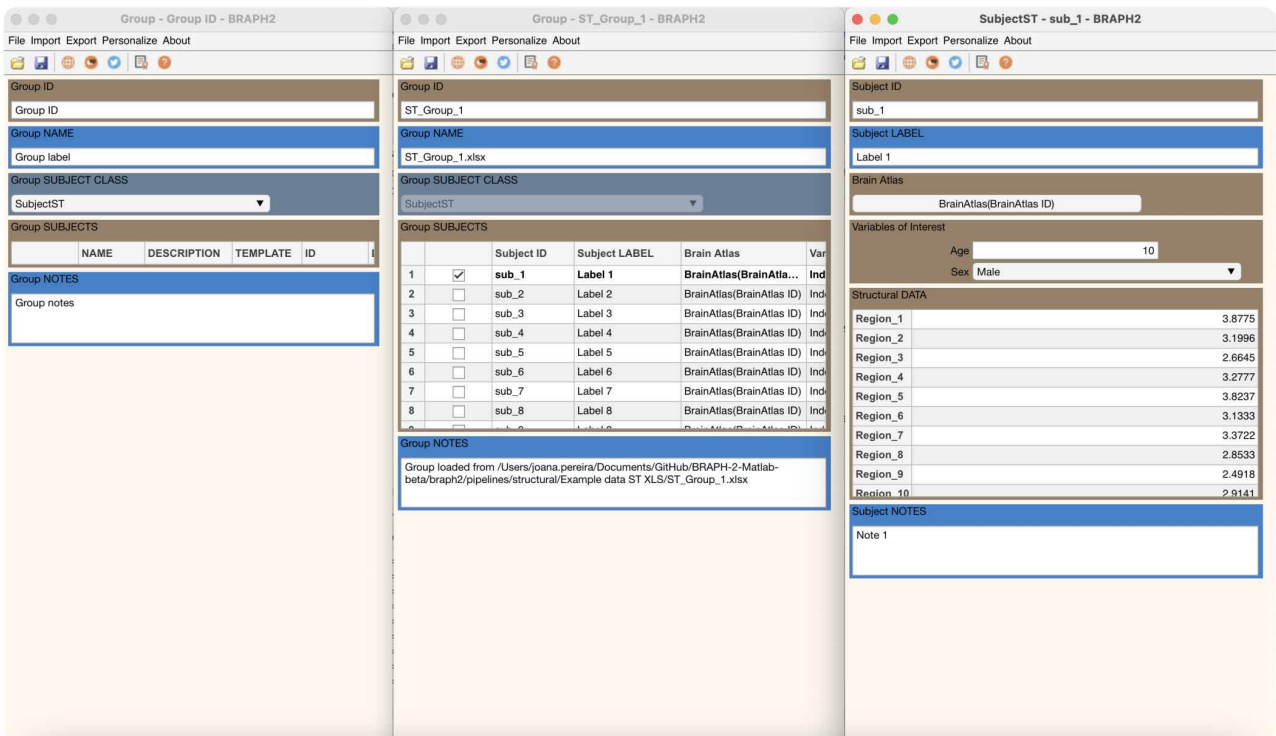


Figure 1: GUI for working with the pipeline to compare two groups of subjects with *structural data* using a weighted undirected analysis. Full graphical user interface to perform group comparisons with *structural data* in BRAPH 2.0.

Open the GUI

The pipeline GUI can be opened by typing `braph2` in MatLab's terminal, which allows you to select a pipeline, in this case, `pipeline_structural_comparison_wu.braph2` (containing the steps required to perform your analysis).

To open the GUI and upload the structural comparison pipeline, you can also do it from the command line by typing the commands in Code 1.

Code 1: Code to launch the GUI to upload a pipeline file to compare two groups of subjects. This code can be used in the MatLab command line to launch the GUI to upload a pipeline file.

```
1 pip = Pipeline(); ①
2
3 gui = GUIElement('PE', pip); ②
4 gui.get('DRAW') ③
5 gui.get('SHOW') ④
```

① creates a new object Pipeline to upload the steps to perform an analysis or comparison.

② creates a GUI to upload the files into the pipeline.

③ draws the GUI.

④ shows the GUI.

Once the pipeline is uploaded, you can see a GUI that contains different steps: to upload a brain atlas, to upload the structural data of two groups, analyze them, and finally, to compare the groups (Figure 2a).

Step 1: Load the Brain Atlas

Figure 2 shows how to upload and plot the brain atlas that you used to extract the *structural data* for your analysis. For more information on where to find different atlases or how to change plotting settings on the brain surface, check the *Brain Atlas* tutorial.

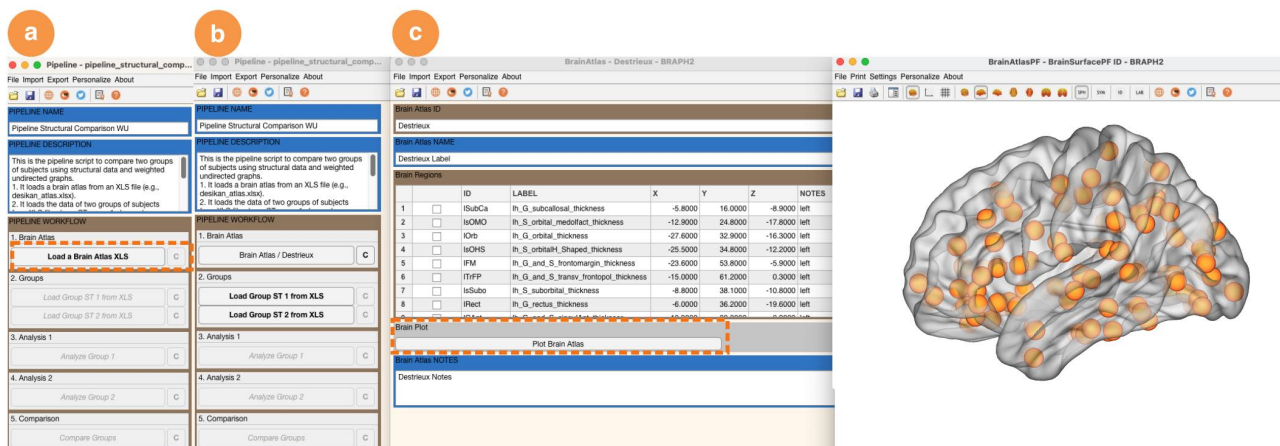


Figure 2: Uploading the Brain Atlas. Steps to upload the brain atlas: **a** Click on Load Atlas from the pipeline GUI. **b** Navigate to the BRAPH 2.0 folder atlases and select one of the atlas files, in this example the `destrieux_atlas.xlsx`. **c** You can also plot the brain atlas by pressing Plot Brain Atlas.

Step 2: Load the Structural Group Data

After you loaded the brain atlas, you can upload the *structural data* for each group as shown in Figure 3. A new interface will be shown containing the data for the group you just selected. You can open each subject's structural values by selecting the subject, right click, and select "Open selection" (for more information check tutorial *Group of Subjects with Structural Data*).

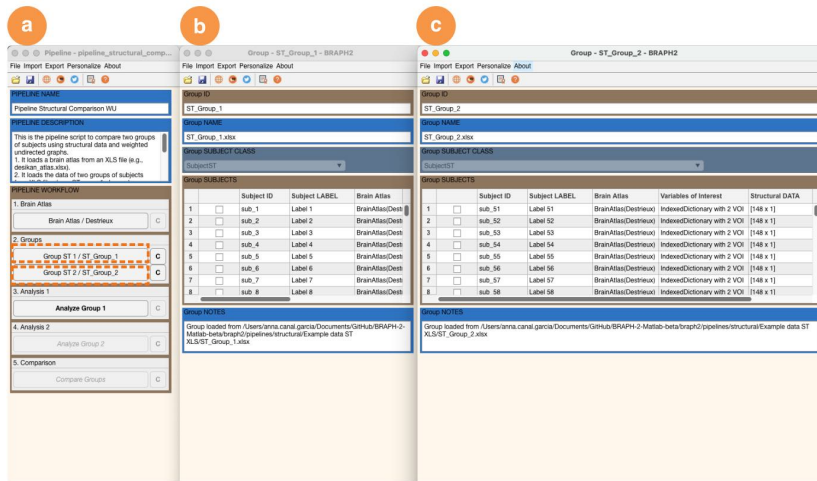


Figure 3: **Loading the Groups Data.** **a** From the pipeline GUI, click on Load Group ST 1 XLS to load the data of group 1, and Load Group ST 2 XLS to load the data of group 2. **b** Data for group 1 is uploaded. **c** Data for group 2 is uploaded.

Step 3: Analysing the Data of Group 1

After you have loaded the data, you can analyze the data of your first group by clicking on Analyze Group 1 (Figure 4a). A new interface will be shown that allows you to pre-calculate network measures for each group and explore them (Figure 4b-c). First of all, you can specify the parameters for constructing the graph from the structural group data: you can select the statistical test to calculate correlations in structural values between pairs of brain regions (Figure 4d), and you can decide how you want to analyze the negative weights from the correlation.

Importantly, the parameters you select for this analysis (graph and measures parameters) will be fixed for the analysis of the second group and for the group comparisons.

After setting these parameters, you can calculate some graph measures (Figure 5), which might be useful to get an insight on what these measures look like for the group. Once calculated, the graph parameters will be blocked and a C will appear next to the measures. You can visualize the results by selecting the measures, right click and plot the

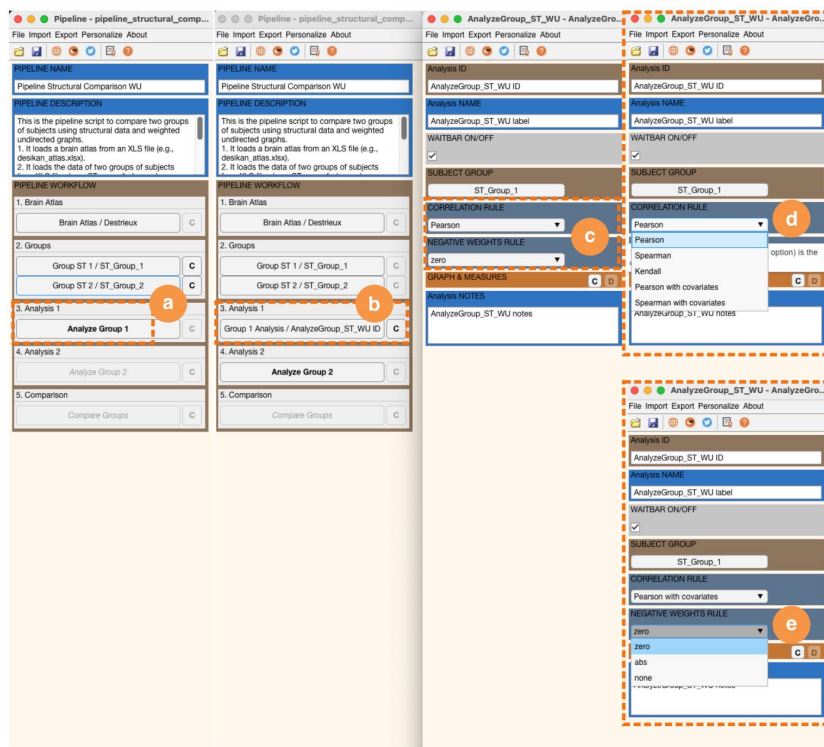


Figure 4: **Analyze the Group Data.** **a** Click on Analyze Group 1 in the pipeline's GUI. **b** After clicking on Analyze Group 1 in the pipeline's GUI, a new window will appear where first you can select the parameters for the graph construction **c**. In this pipeline, you can select the statistical test to be used for the correlations **d**, and what you want to do with the negative correlation weights **e**.

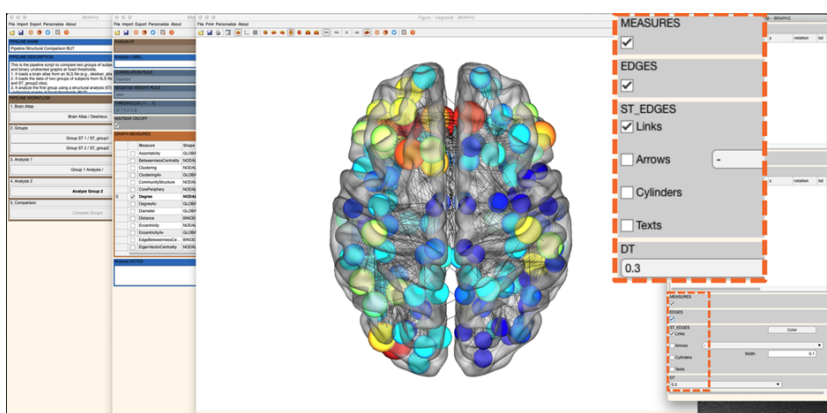


Figure 5: **Calculate and visualize a connectivity measure in a brain plot.** **a** Click on Analyze Group 1 in the pipeline's GUI. **b** After clicking on Analyze Group 1 in the pipeline's GUI, a new window will appear where first you can select the parameters for the graph construction **c**.

selected measures. In settings, you can change the visualization of the plots and save them. We can also first press “Data Selected Measures” from the same menu mentioned earlier GRAPH & MEASURES, and then a figure will open showing the array of values for the measure (Figure 6).

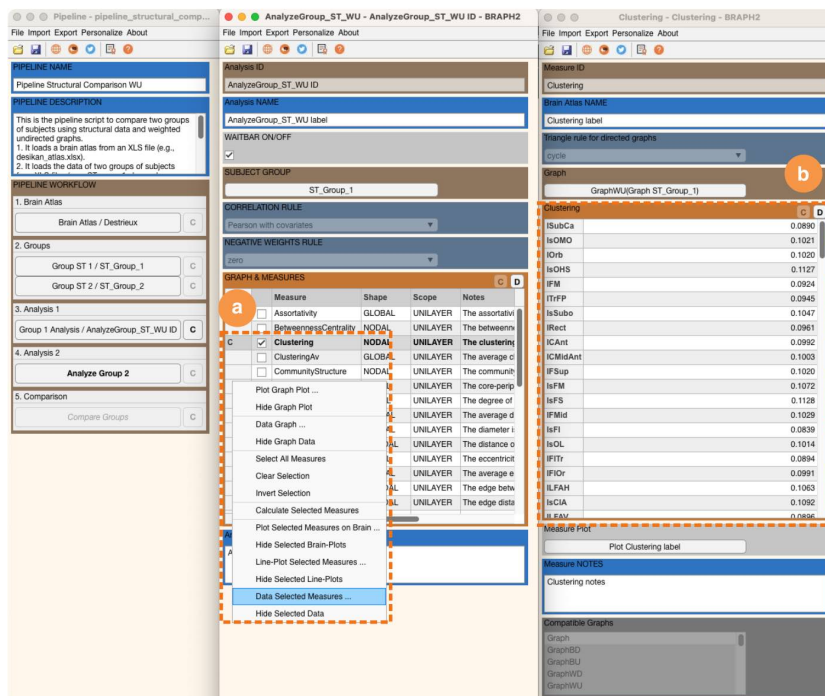


Figure 6: **Compare the Group Data.** **a** Click on Data Selected Measures after selecting the measure. **b** This new window shows the array of values for the measure, in this case Clustering.

When you do right click, in the GRAPH & MEASURES panel, there are other options you can explore such as Plot Graph Plot (connectivity adjacency matrix) as well as Data Graph (labels of brain regions, values of the adjacency matrix, options to plot matrix and histogram), all of which can also be saved.

Step 4: Analysing the Data of Group 2

After the analysis of group 1, you can proceed with the analysis of the second group by clicking on Analyze Group 2. You will notice that, in the new window that is shown, the parameters you selected for group 1 are already selected and fixed for this analysis. If you realize that some of the options you previously selected are not the ones you would like, you can reset the analysis parameters of group 1 by clicking on the C checkbox next to it.

Step 5: Comparing Groups

Once you have explored the network measures for each group, you can proceed with their statistical comparison. To do this, you should click on Compare Groups (Figure 7a) and in the new window select if you want a waiting bar and verbose functions ON while you wait for the analysis to finish Figure 7b. You can also decide how many permutations you want to use to assess differences between groups Figure 7c and, if the groups are not independent but represent the same subjects in two different points in time, you can select the longitudinal comparison option, which will permute the values within each subject Figure 7d. Finally, you can select the graph measures you want to compare between groups Figure 7e and once you have selected all the measures you are interested in, you should right click and select Calculate all selected comparisons Figure 7f. If you turn ON the wait bar and verbose functions, two window bars will open that show you at which point in time the analysis is. There is one last option on this GUI that you can select to save intermediate results during the permutations.

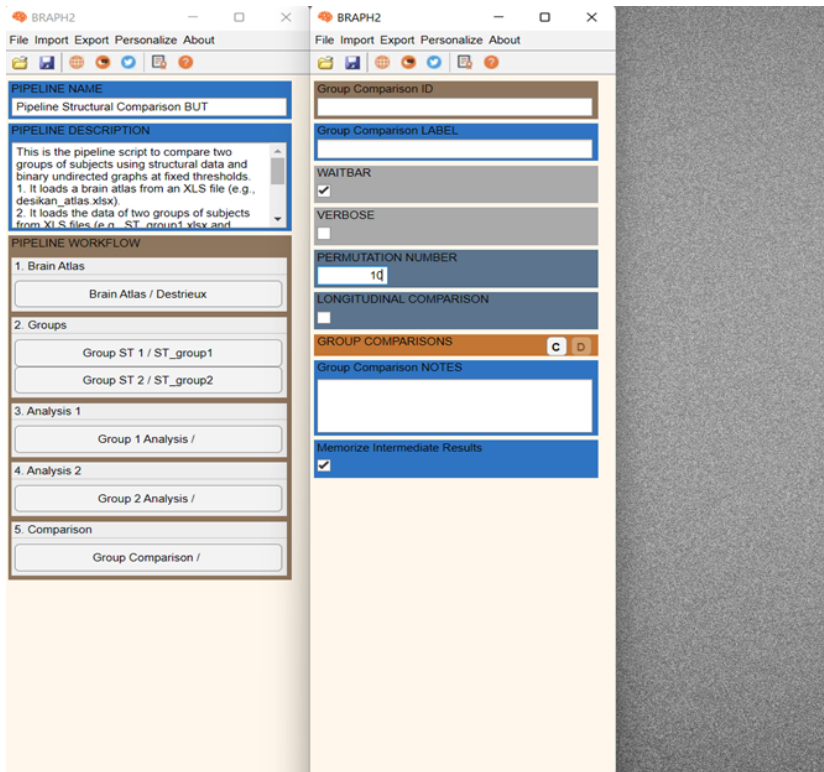


Figure 7: **Compare the Group Data.** **a** Click on Compare Groups in the pipeline's GUI. **b** In this new window, you can select what to turn ON/OFF the wait bar and verbose functions **c**, you can change the number of permutations **d**, whether to perform a longitudinal group comparison **e**, compare some graph measures between groups **f**, or memorize intermediate steps **f**.