

Group of Subjects with Structural Multiplex Data

The BRAPH 2 Team

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For *structural multiplex data*, we will upload a folder containing the structural files from different modalities (layers) for different brain areas across subjects that belong to the same group. For example, the structural values could correspond to cortical thickness or gray matter volumes obtained from T1-weighted MRI data, brain perfusion in ASL, or abnormal protein deposition in static PET data. Then a connectivity matrix is computed using correlations in structural values between each pair of brain regions for each layer, and then the layers will be integrated in a multiplex graph. This Tutorial explains how to prepare and work with this kind of data.

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Group - Group ID - BRAPH2

File Import Export Personalize About

Group ID

Group ID

Group NAME

Group label

Group SUBJECT CLASS

SubjectST_MP

Group SUBJECTS

	NAME	DESCRIPTION	TEMPLATE	ID	LABEL
Group NOTES					
Group notes					

Group - ST_MP_Group_1_XLS - BRAPH2

File Import Export Personalize About

Group ID

CTR

Group NAME

Controls

Group SUBJECT CLASS

SubjectST_MP

Group SUBJECTS

	Subject ID	Subject LABEL	Brain Atlas
1	<input checked="" type="checkbox"/> sub_1	Label 1	BrainAtlas(BrainAtla...
2	<input type="checkbox"/> sub_2	Label 2	BrainAtlas(BrainAtlas ID)
3	<input type="checkbox"/> sub_3	Label 3	BrainAtlas(BrainAtlas ID)
4	<input type="checkbox"/> sub_4	Label 4	BrainAtlas(BrainAtlas ID)
5	<input type="checkbox"/> sub_5	Label 5	BrainAtlas(BrainAtlas ID)
6	<input type="checkbox"/> sub_6	Label 6	BrainAtlas(BrainAtlas ID)
7	<input type="checkbox"/> sub_7	Label 7	BrainAtlas(BrainAtlas ID)
8	<input type="checkbox"/> sub_8	Label 8	BrainAtlas(BrainAtlas ID)

Group NOTES

Structural multiplex data (amyloid-PET and cortical thickness) of controls.

SubjectST_MP - sub_1 - BRAPH2

File Import Export Personalize About

Subject ID

sub_1

Subject LABEL

Label 1

Brain Atlas

BrainAtlas(BrainAtlas ID)

Variables of Interest

Age

23

Sex

Female

Layer Number

2

Layer Labels

Structural DATA LAYERS

Region_1	14.5389
Region_2	13.9949
Region_3	14.4456
Region_4	11.4848
Region_5	9.4481
Region_6	10.7205
Region_7	10.2468
Region_8	11.1098
Region_9	12.3228
Region_10	10.8157
Region_11	9.5482
Region_12	11.1719
Region_13	9.2663
Region_14	13.1697
Region_15	14.2824
Region_16	14.2616
Region_17	13.3864
Region_18	18.0401
Region_19	13.9982

Subject NOTES

Note 1

Figure 1: GUI for a group of subjects with structural multiplex data. Full graphical user interface to upload a group with structural multiplex data in BRAPH 2.o.

Open the GUI

In most analyses, the group GUI is the second step after you have selected a brain atlas. You can open it by typing `braph2` in MatLab's terminal, which allows you to select a pipeline containing the steps required to perform your analysis and upload a brain atlas. After these steps have been completed you can upload your group's data directly (Figure 2c-f) after clicking "Load Group".

You can also open the GUI and upload the brain structural multiplex data using the command line (i.e., without opening an analysis pipeline) by typing the commands in Code 1. In that case, you can upload the data as shown in Figure 2a-f.

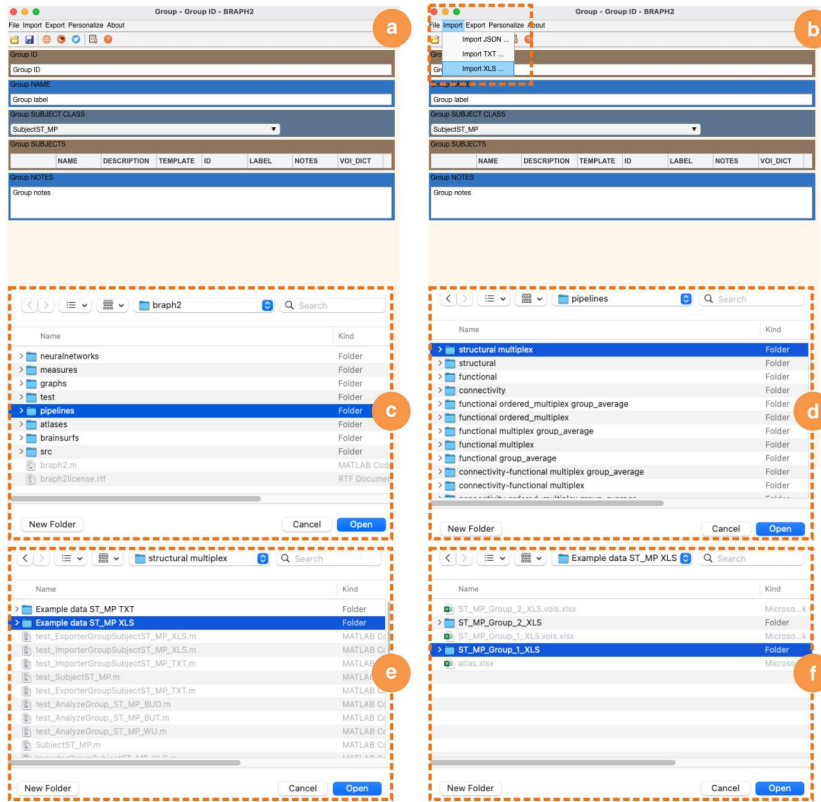


Figure 2: Upload the data of a group of subjects. Steps to upload a group of subjects with structural multiplex data using the GUI and an example dataset: **a** Open the group GUI. **b** Import the folder with the structural multiplex files in XLS or TXT format (see below for details on their format). To upload the test structural multiplex data: **c-f** navigate to the BRAPH 2.0 folder pipelines, **d** structural multiplex, **e** Example data ST_MP XLS, and **f** select the folder with structural multiplex values of one group ST_MP_Group_1_XLS.

Code 1: Code to launch the GUI to upload a group of subjects with structural multiplex data. This code can be used in the MatLab command line to launch the GUI to upload a group of subjects with structural multiplex data without having to open a pipeline.

```
1 gr = Group('SUB_CLASS', 'SubjectST_MP'); ①
2
3 gui = GUIElement('PE', gr); ②
4 gui.get('DRAW') ③
```

① creates a new object Group to use structural multiplex values for assessing connectivity i.e., SubjectST_MP.

② creates a GUI to upload the group data.

③ draws the GUI.

5 `gui.get('SHOW')` ④

④ shows the GUI.

Moreover, if you don't have the Example data ST_MP XLS folder inside structural multiplex, then you can generate it by running the commands in Code 2.

Code 2: Code to generate the example data folder. This code can be used in the MatLab command line to generate the Example data ST_MP XLS folder to the structural multiplex pipeline folder.

```
1 test_ImporterGroupSubjectST_MP_XLS ①
2 test_ImporterGroupSubjectST_MP_TXT ②
```

① generates the example structural multiplex XLS data folder.

② generates the example structural multiplex TXT data folder.

Visualize the Group Data

After completing the steps described in Figure 2, you can see the data (Figure 3a), and change the Group ID, name, and notes (Figure 3b).

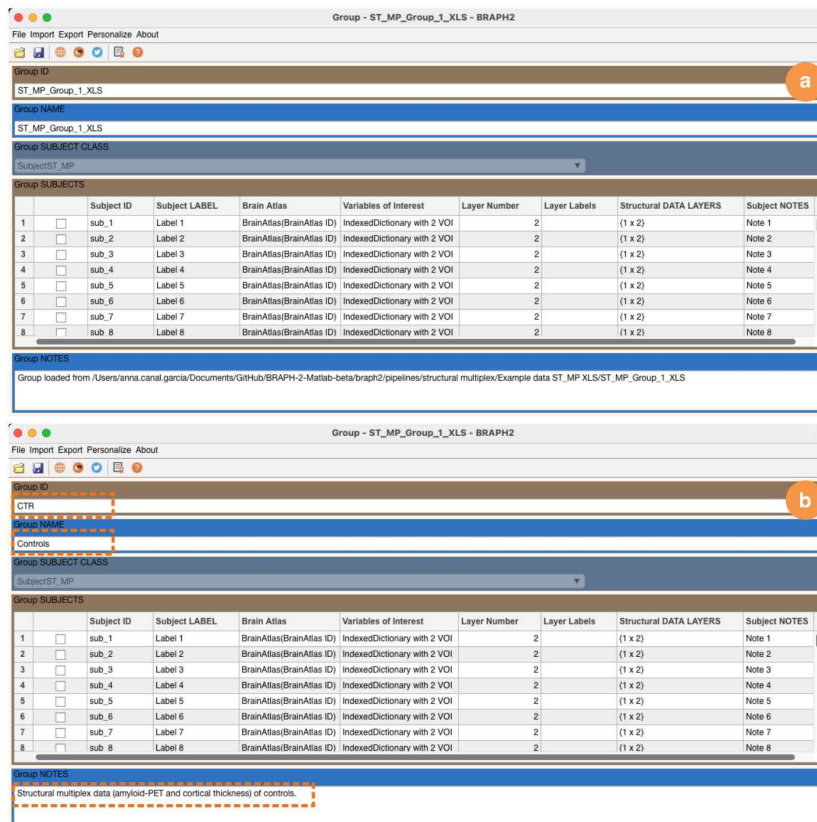


Figure 3: Edit the group metadata. **a** The GUI of the group's structural multiplex data. **b** The information you see on this GUI that can be changed. In this example, we have edited the ID, name, and notes of the group but can also change the subject's specific information.

Visualize Each Subject's Data

Finally, you can open each subject's structural multiplex values by selecting the subject, right click, and select "Open selection" (Figure 4a), which shows the structural values from layer 1 (Figure 4b). Here, you can also change the subject's metadata (ID, label, notes), its variables of interest, and the structural multiplex values.

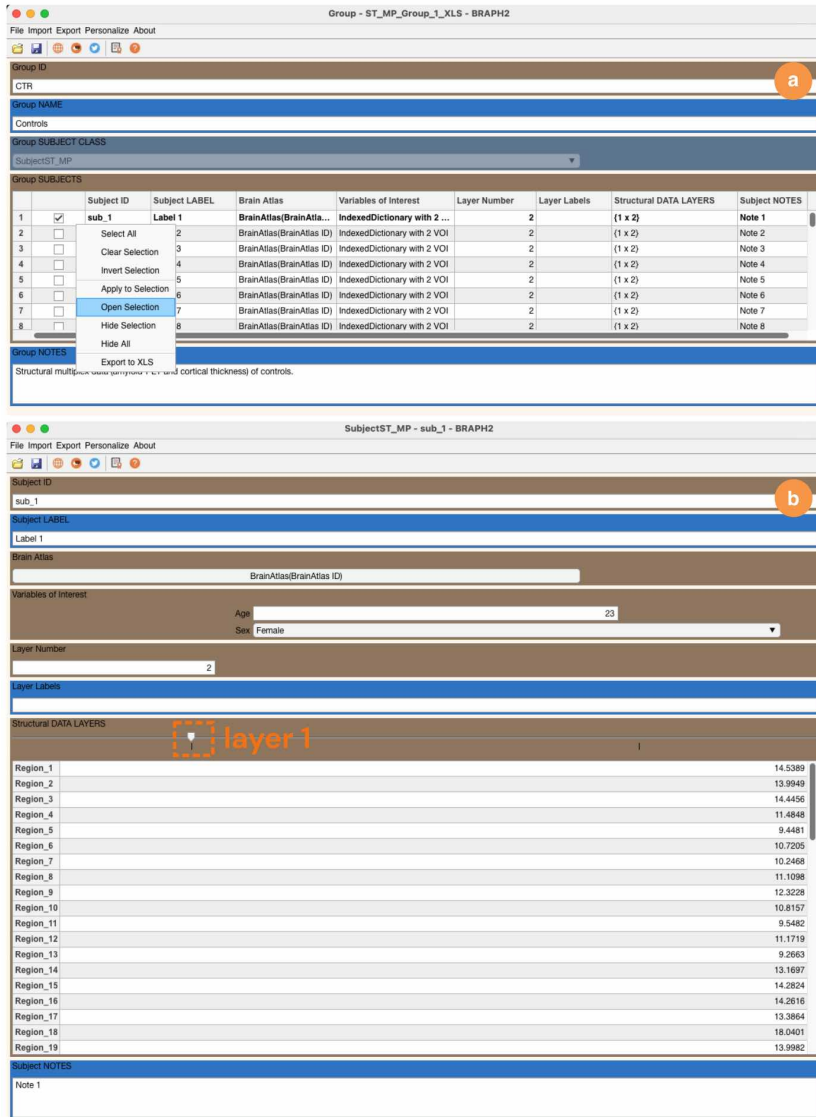


Figure 4: **Edit the individual subject data.** **a** Each subject's structural multiplex values can be opened by selecting the subject, right click, and select "Open selection". **b** In this subject GUI, it is possible to view and edit the metadata of the subject (ID, label, notes), its variables of interest (in this case, age and sex), and the structural multiplex values.

Preparation of the Data to be Imported

To be able to import structural multiplex data into BRAPH 2.0, you need to include the structural values of each layer for all subjects in a single file in excel or text format. All structural layers' files should be inside one group folder. Below you can see how this file should look like.

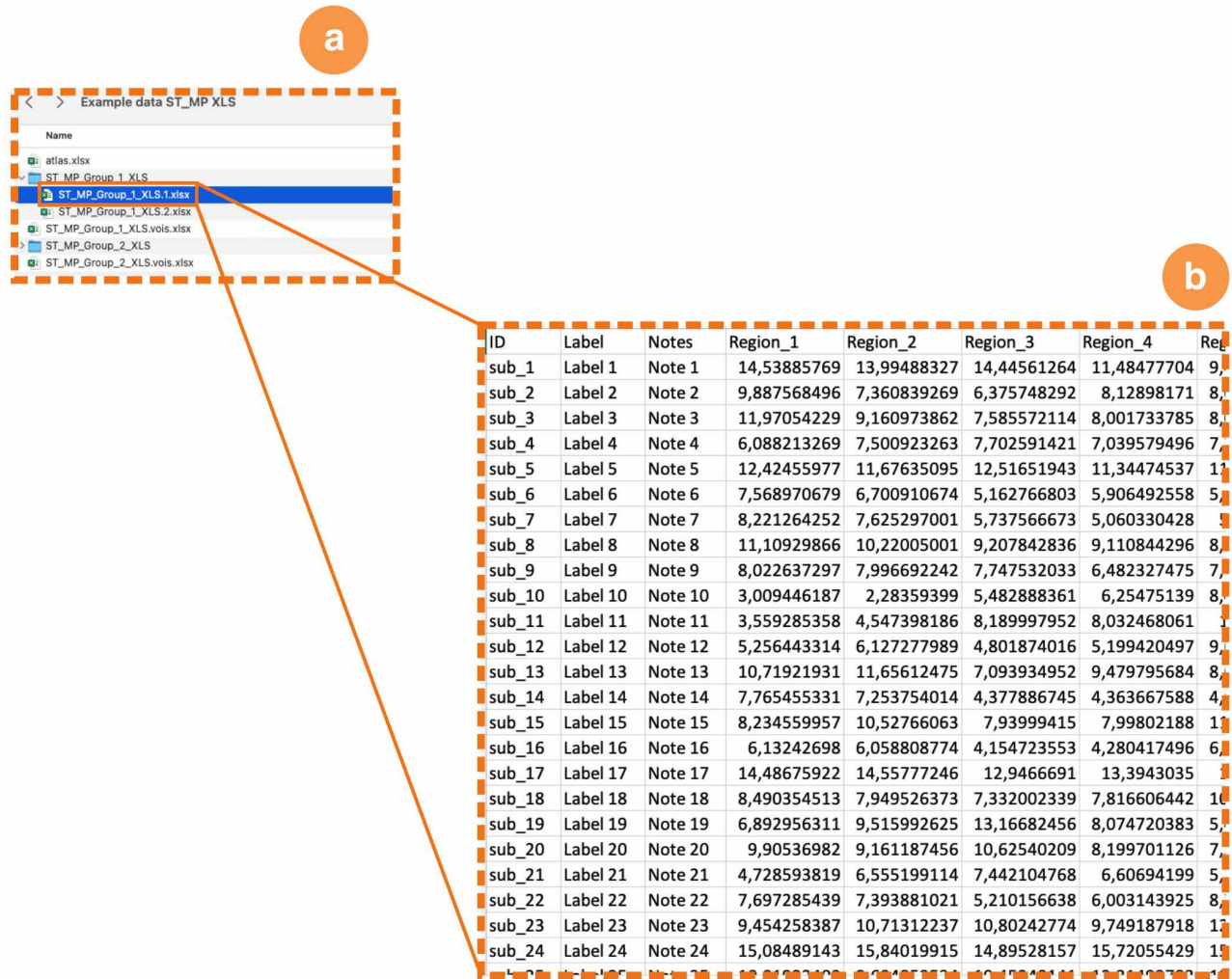


Figure 5: **Data preparation.** The data should be organised in the following format: **a** The structural values of one layer from each subject belonging to the same group should be included in a single file (for example, ST_MP_Group_1.xlsx). **b** This file should contain the subject's IDs, label and any relevant notes, followed by the structural values for each brain region belonging to a brain atlas. In this example, the (simulated) values correspond to the cortical thickness of 68 brain regions derived from T1-weighted MRI.

Adding Covariates

It is very common to have *variables of interest* (i.e., *covariates* and *correlates*) in an analysis. In BRAPH 2.0, these variables of interest should be included in a separate excel file placed just outside the group's folder and with the same name as the folder followed by .vois (Figure 6a).

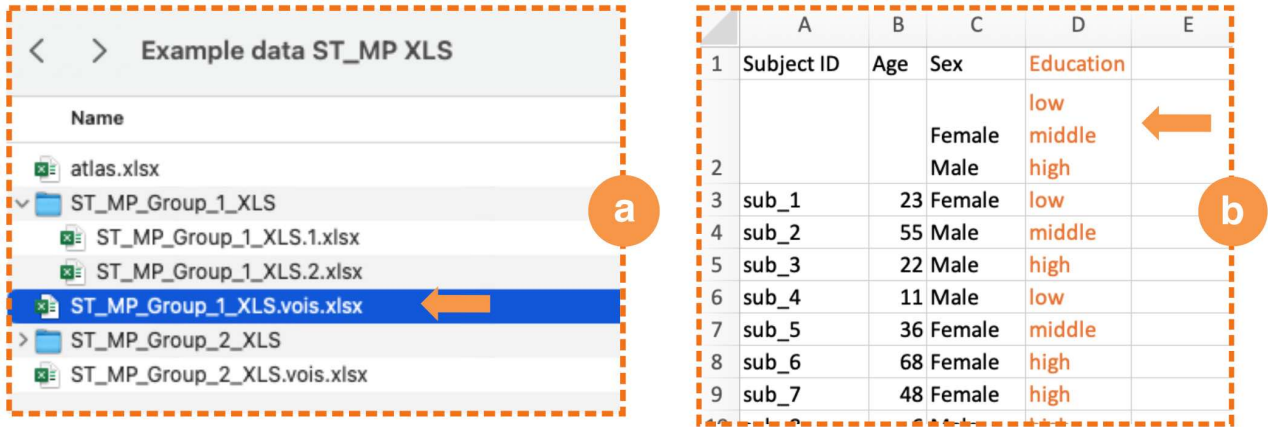


Figure 6: **Edit the Covariates.** Information that can be changed in the Covariates file: **a** The values of the variables of interest (vois). **b** In case the vois are categorical, you can state which categories they have.

This file should have a specific format (Figure 6b):

Subject IDs (column A). Column A should contain the subject IDs starting from row 3.

Variables of interest (column B and subsequent columns). Column B (and subsequent columns) should contain the variables of interest (one per column). In this example we have “Age” and “Sex”, as in the example file, as well as the additional “Education”. In each column, row 1 should contain the name of the variable of interest, row 2 should contain the categories separated by a return (only for categorical variables of interest, like “Sex” and “Education”), and the subsequent rows the values of the variable of interest for each subject.