Group of Subjects with Structural Multiplex Data

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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.
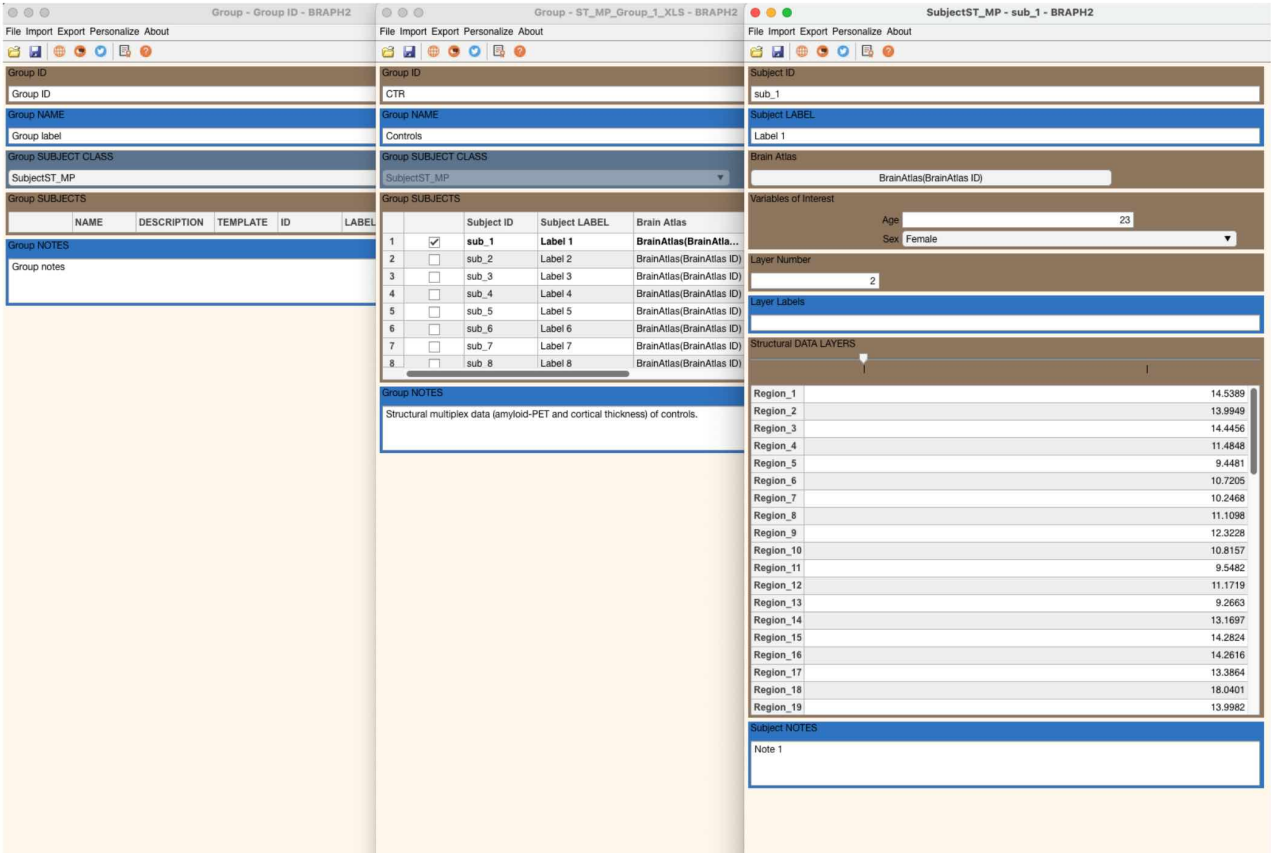
Contents

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 2.0.

Open the GUI

In most analyses, the group GUI is the second step after you have se-
lected a brain atlas. You can open it by typing `braph2` in MatLab's
terminal, which allows you to select a pipeline containing the steps re-
quired 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 com-
mands in Code 1. In that case, you can upload the data as shown in
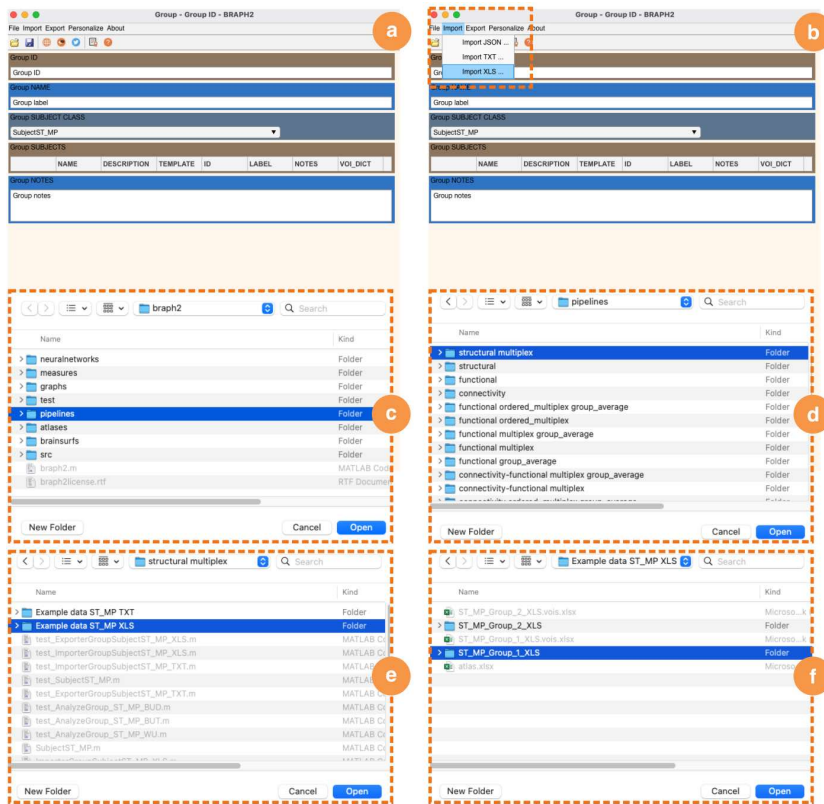Figure 2a-f.

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 de-
tails 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 com-
mand line to launch the GUI to upload a group of subjects with struc-
tural 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).
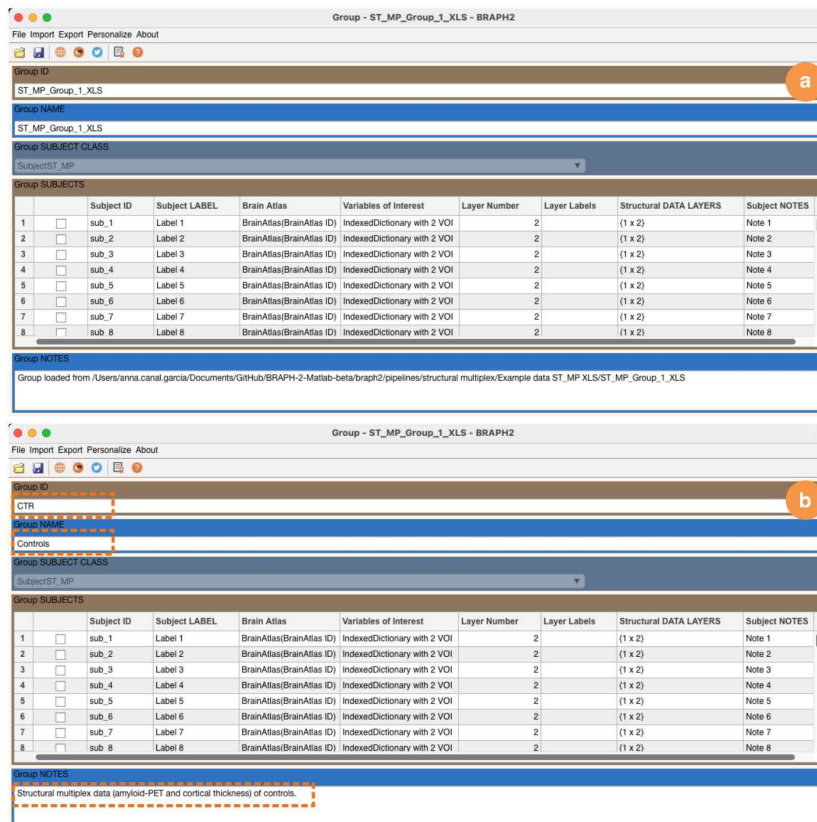
Figure 3: **Edit the group metadata. a** The GUI of the group's structural multiplex data. **b** The information you see on this GUI that can be changed. In this example, we have edited the ID, name, and notes of the group but can also change the subject's specific information.

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

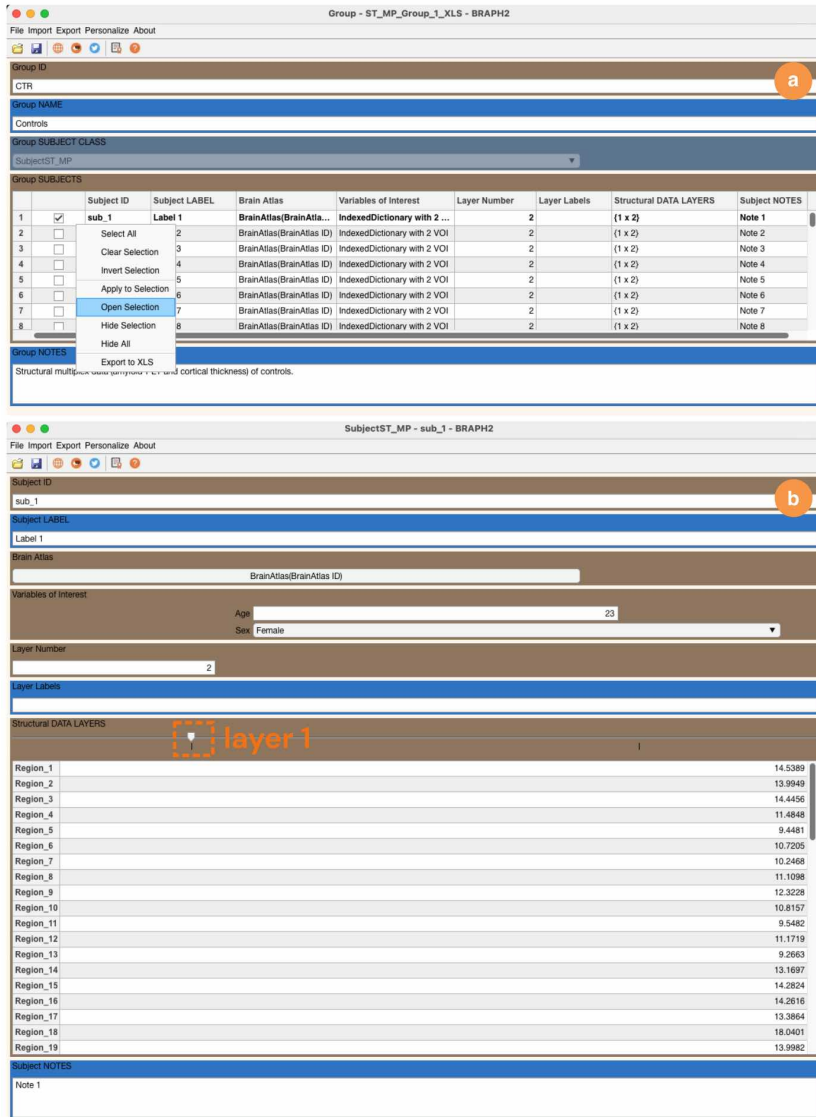To be able to import structural multiplex data into BRAPH 2.0, you need to include the structural values of each layer for all subjects in a single file in excel or text format. All structural layers' files should be inside one group folder. Below you can see how this file should look like.

ID	Label	Notes	Region_1	Region_2	Region_3	Region_4	Reg
sub_1	Label 1	Note 1	14,53885769	13,99488327	14,44561264	11,48477704	9,
sub_2	Label 2	Note 2	9,887568496	7,360839269	6,375748292	8,12898171	8,
sub_3	Label 3	Note 3	11,97054229	9,160973862	7,585572114	8,001733785	8,
sub_4	Label 4	Note 4	6,088213269	7,500923263	7,702591421	7,039579496	7,
sub_5	Label 5	Note 5	12,42455977	11,67635095	12,51651943	11,34474537	11
sub_6	Label 6	Note 6	7,568970679	6,700910674	5,162766803	5,906492558	5,
sub_7	Label 7	Note 7	8,221264252	7,625297001	5,737566673	5,060330428	5
sub_8	Label 8	Note 8	11,10929866	10,22005001	9,207842836	9,110844296	8,
sub_9	Label 9	Note 9	8,022637297	7,996692242	7,747532033	6,482327475	7,
sub_10	Label 10	Note 10	3,009446187	2,28359399	5,482888361	6,25475139	8,
sub_11	Label 11	Note 11	3,559285358	4,547398186	8,189997952	8,032468061	1
sub_12	Label 12	Note 12	5,256443314	6,127277989	4,801874016	5,199420497	9,
sub_13	Label 13	Note 13	10,71921931	11,65612475	7,093934952	9,479795684	8,
sub_14	Label 14	Note 14	7,765455331	7,253754014	4,377886745	4,363667588	4,
sub_15	Label 15	Note 15	8,234559957	10,52766063	7,93999415	7,99802188	11
sub_16	Label 16	Note 16	6,13242698	6,058808774	4,154723553	4,280417496	6,
sub_17	Label 17	Note 17	14,48675922	14,55777246	12,9466691	13,3943035	1
sub_18	Label 18	Note 18	8,490354513	7,949526373	7,332002339	7,816606442	1(
sub_19	Label 19	Note 19	6,892956311	9,515992625	13,16682456	8,074720383	5,
sub_20	Label 20	Note 20	9,90536982	9,161187456	10,62540209	8,199701126	7,
sub_21	Label 21	Note 21	4,728593819	6,555199114	7,442104768	6,60694199	5,
sub_22	Label 22	Note 22	7,697285439	7,393881021	5,210156638	6,003143925	8,
sub_23	Label 23	Note 23	9,454258387	10,71312237	10,80242774	9,749187918	1
sub_24	Label 24	Note 24	15,08489143	15,84019915	14,89528157	15,72055429	1

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).
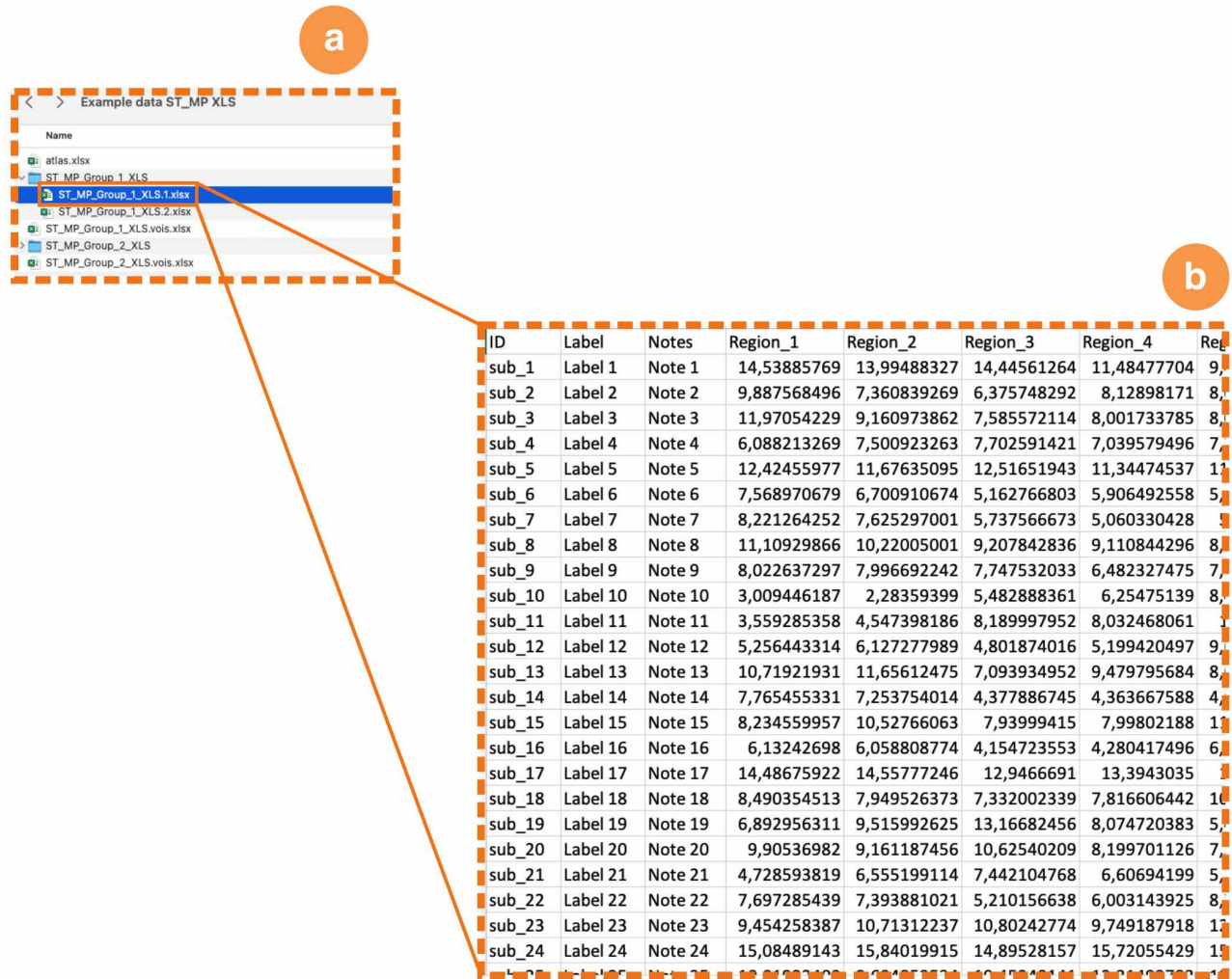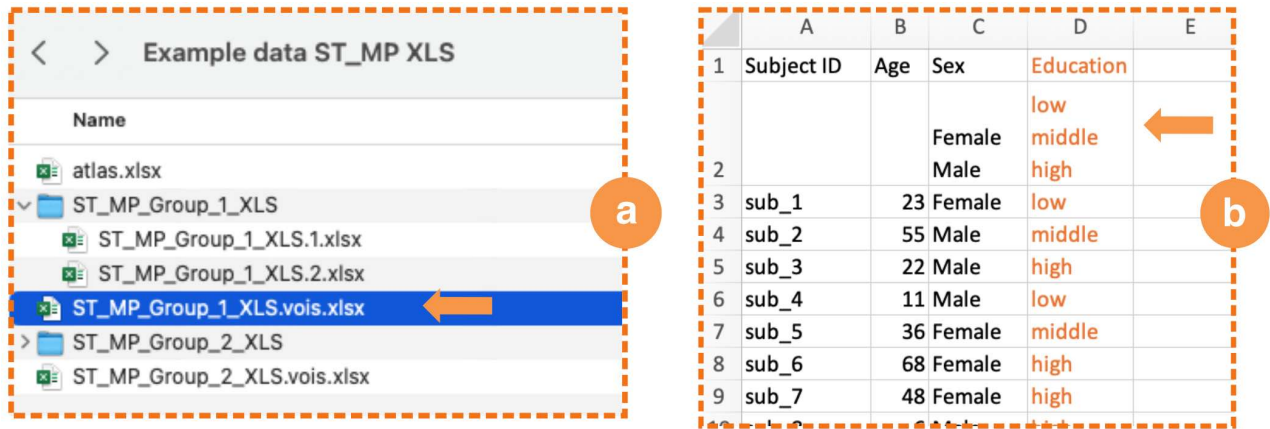
Figure 5: **Data preparation.** The data should be organised in the following format: **a** The structural values of one layer from each subject belonging to the same group should be included in a single file (for example, ST_MP_Group_1_xlsx). **b** This file should contain the subject's IDs, label and 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.

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.