Group of Subjects with Structural Data

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For *structural data*, we will upload a file containing the structural values 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. Then a connectivity matrix is computed using correlations in structural values between each pair of brain regions. This Tutorial explains how to prepare and work with this kind of data.

Contents

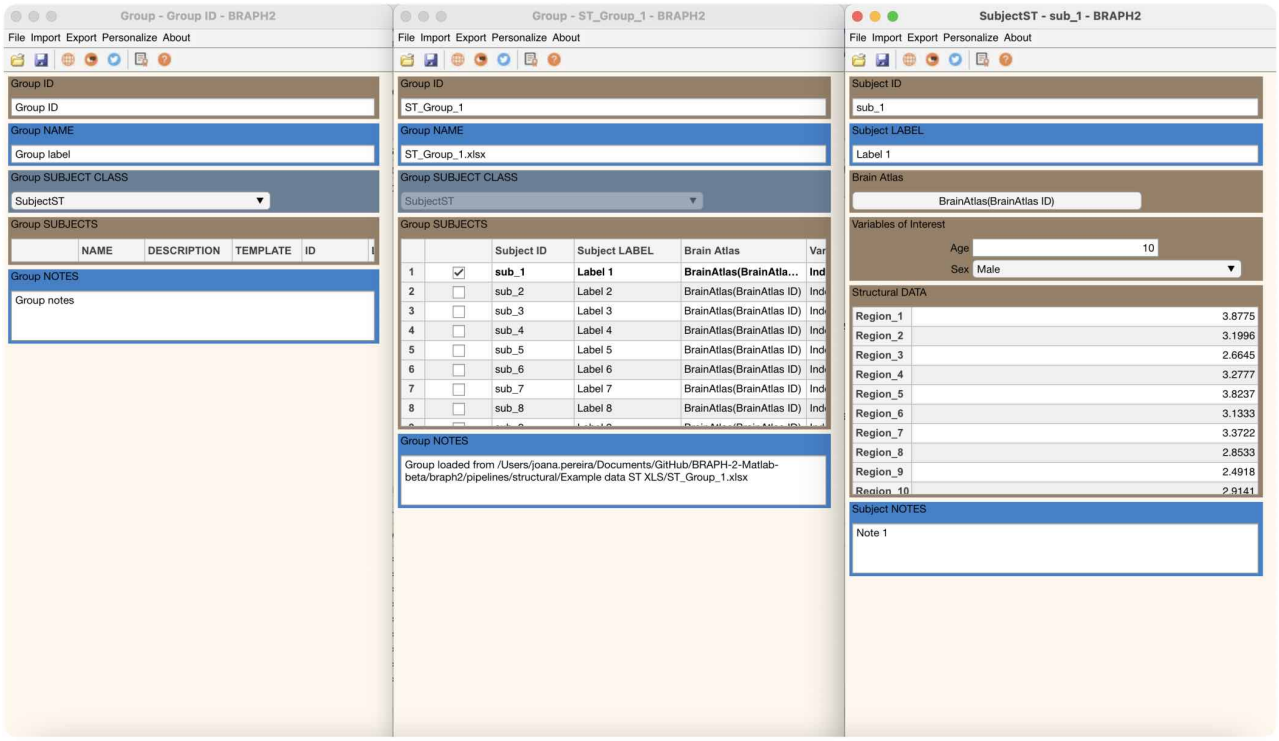


Figure 1: **GUI for a group of subjects with structural data.** Full graphical user interface to upload a group with structural data in BRAPH 2.0.

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 the 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, as shown in Figure 2.

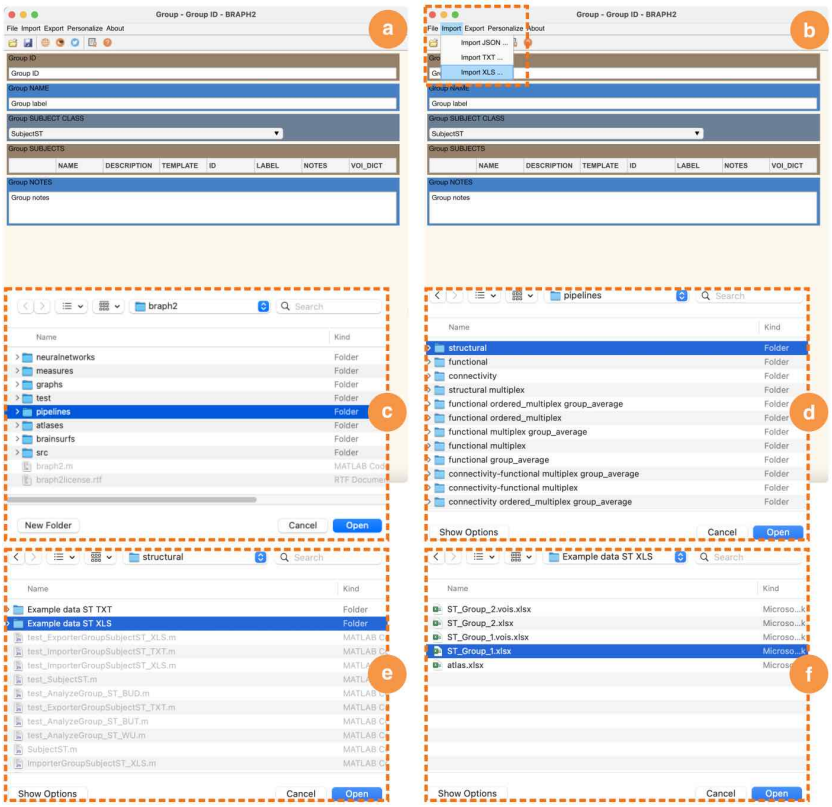


Figure 2: **Upload the data of a group of subjects.** Steps to upload a group of subjects with structural data using the GUI and an example dataset: **a** Open the group GUI. **b** Import the structural values in XLS or TXT format (see below for details on their format). To upload the test structural data: **c-f** navigate to the BRAPH 2.0 folder `pipelines`, **d** `structural`, **e** `Example data ST XLS`, and **f** select the structural values of one group `ST_Group_1_XLSX`.

To open the GUI and upload the brain structural data, you can also do it from the command line (i.e., without opening an analysis pipeline) by typing the commands in Code 1.

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

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

(1) creates a new object `Group` to use structural values for assessing connectivity i.e., `SubjectST`.

(2) creates a GUI to upload the group data.

(3) draws the GUI.

(4) shows the GUI.

Moreover, if you don't have the `Example data ST XLS` folder inside `structural`, 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 XLS` folder to the `structural` pipeline folder.

```
1 test_ImporterGroupSubjectST_XLS (1)
2 test_ImporterGroupSubjectST_TXT (2)
```

(1) generates the example structural XLS data folder.
(2) generates the example structural 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).

Visualize Each Subject's Data

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

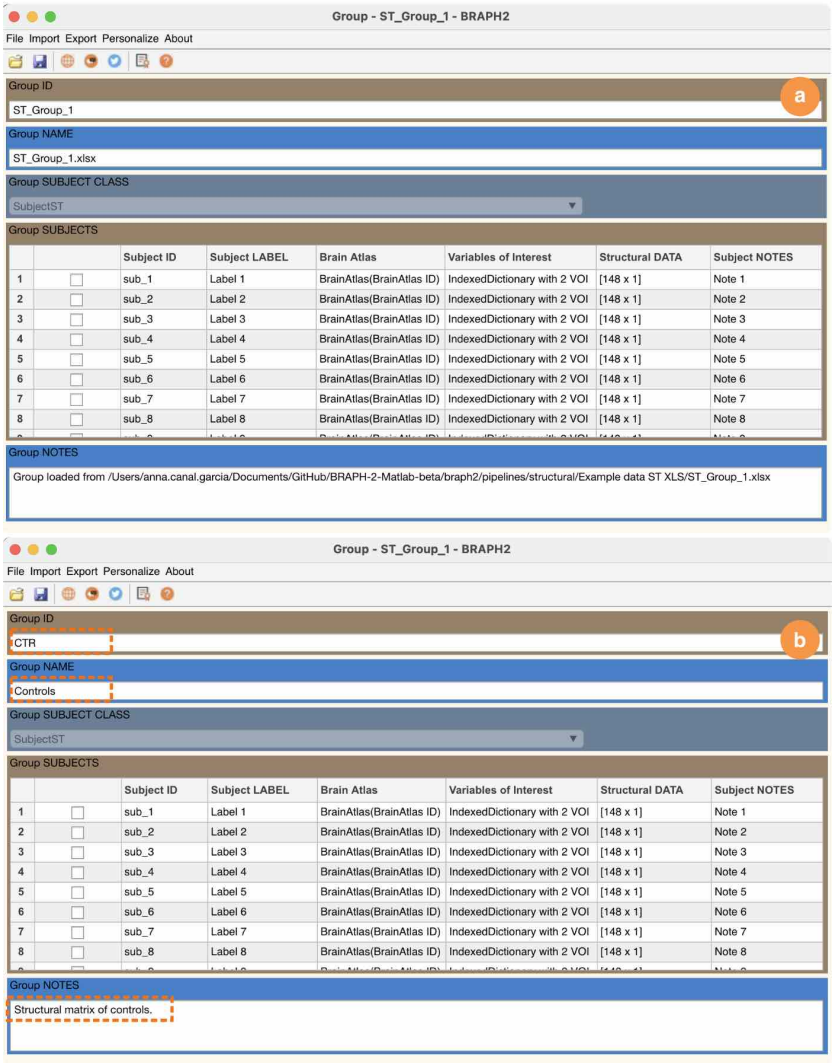


Figure 3: **Edit the group metadata. a** The GUI of the group's structural data. **b** The information you see on this GUI that can be changed. In this example, we have edited the ID, name, and notes of the group but can also change the subject's specific information.

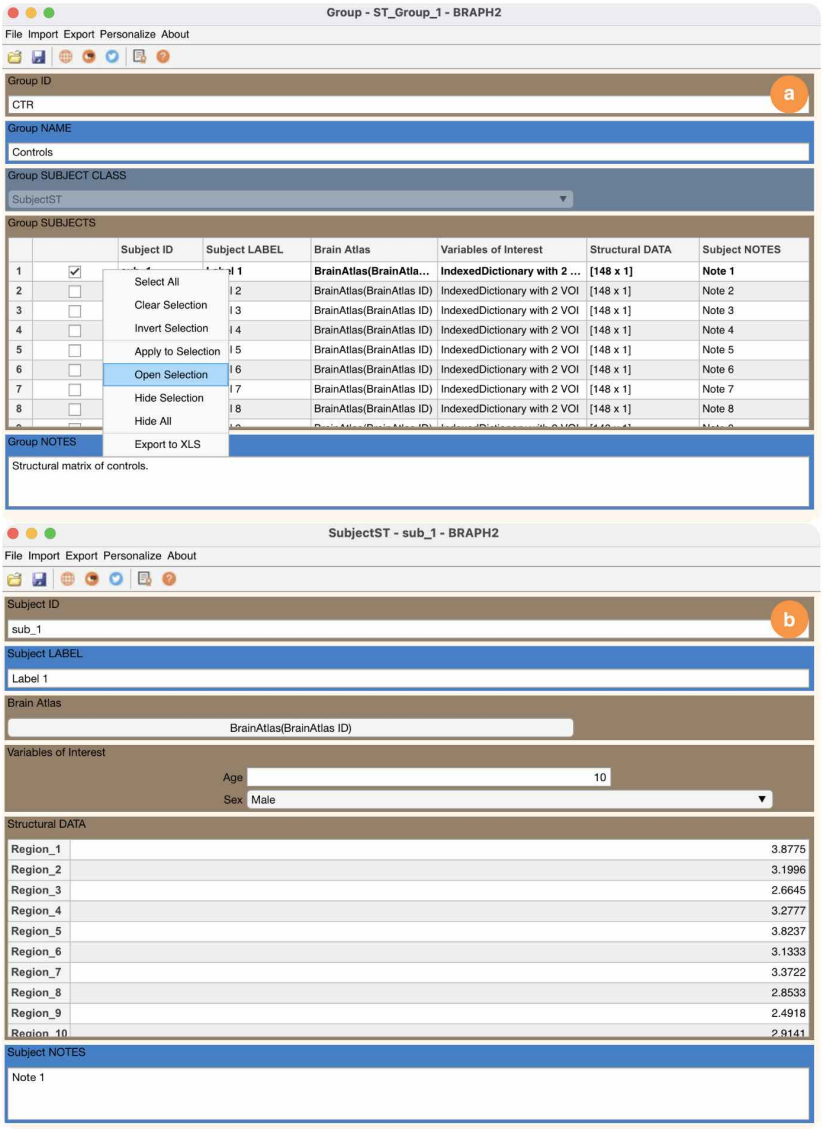
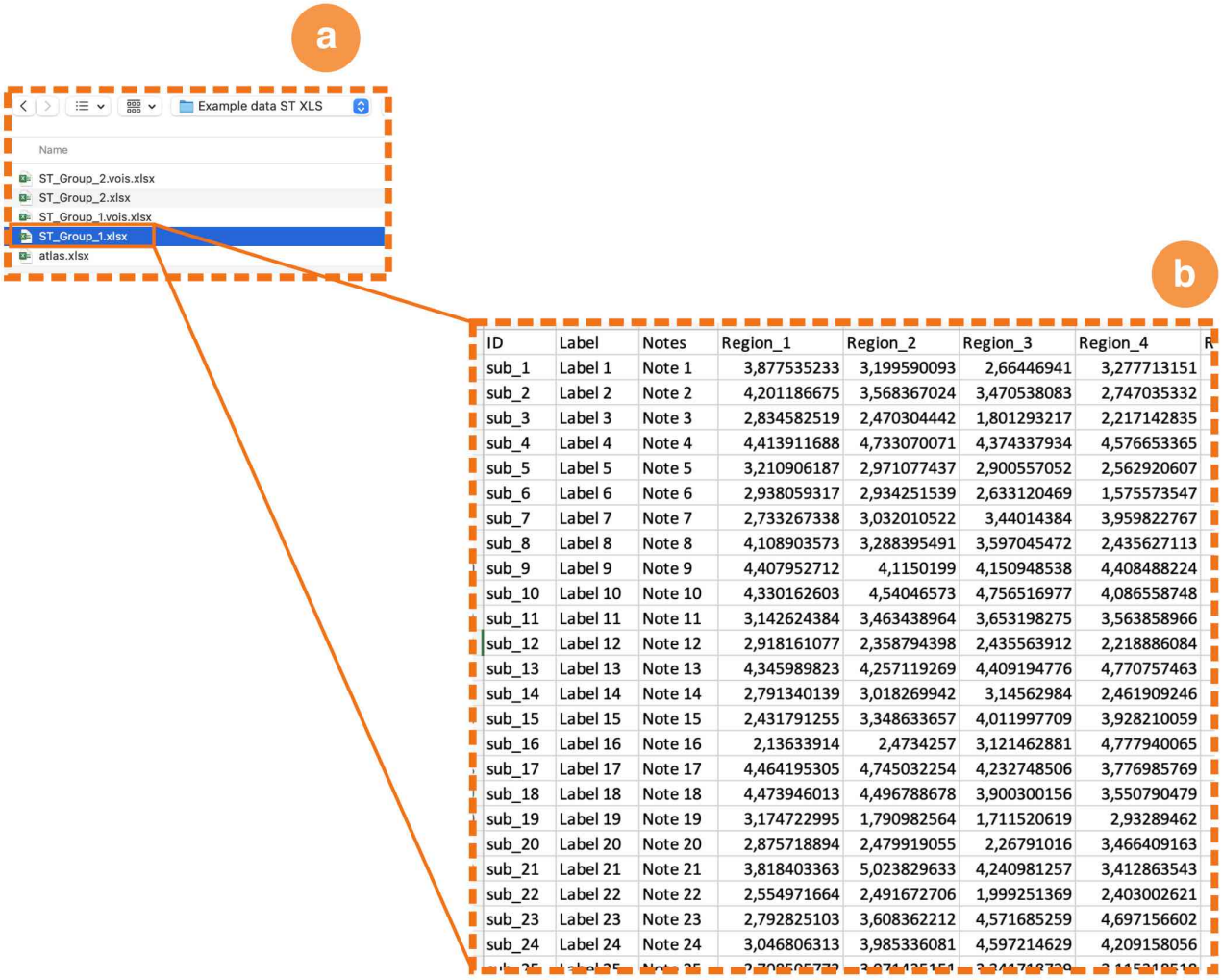


Figure 4: **Edit the individual subject data. a** Each subject's structural values can be opened by selecting the subject, right click, and select "Open selection" **b** In this subject GUI, it is possible to view and edit the metadata of the subject (ID, label, notes), its variables of interest (in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

Preparation of the Data to be Imported

To be able to import structural data into BRAPH 2.0, you need to include the structural values for all subjects in a single file in excel or text format. Below you can see how this file should look like.

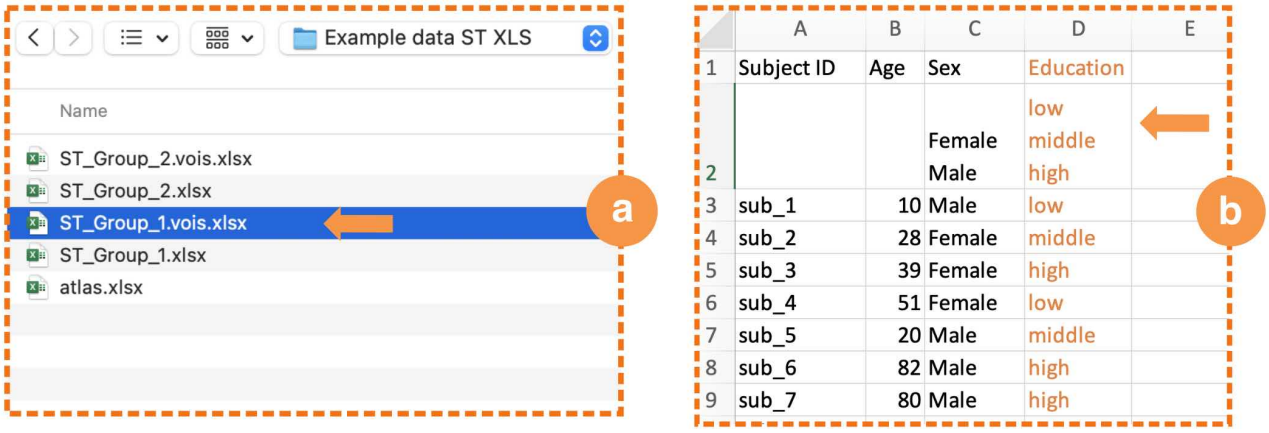


ID	Label	Notes	Region_1	Region_2	Region_3	Region_4	R
sub_1	Label 1	Note 1	3,877535233	3,199590093	2,66446941	3,277713151	
sub_2	Label 2	Note 2	4,201186675	3,568367024	3,470538083	2,747035332	
sub_3	Label 3	Note 3	2,834582519	2,470304442	1,801293217	2,217142835	
sub_4	Label 4	Note 4	4,413911688	4,733070071	4,374337934	4,576653365	
sub_5	Label 5	Note 5	3,210906187	2,971077437	2,900557052	2,562920607	
sub_6	Label 6	Note 6	2,938059317	2,934251539	2,633120469	1,575573547	
sub_7	Label 7	Note 7	2,733267338	3,032010522	3,44014384	3,959822767	
sub_8	Label 8	Note 8	4,108903573	3,288395491	3,597045472	2,435627113	
sub_9	Label 9	Note 9	4,407952712	4,1150199	4,150948538	4,408488224	
sub_10	Label 10	Note 10	4,330162603	4,54046573	4,756516977	4,086558748	
sub_11	Label 11	Note 11	3,142624384	3,463438964	3,653198275	3,563858966	
sub_12	Label 12	Note 12	2,918161077	2,358794398	2,435563912	2,218886084	
sub_13	Label 13	Note 13	4,345989823	4,257119269	4,409194776	4,770757463	
sub_14	Label 14	Note 14	2,791340139	3,018269942	3,14562984	2,461909246	
sub_15	Label 15	Note 15	2,431791255	3,348633657	4,011997709	3,928210059	
sub_16	Label 16	Note 16	2,13633914	2,4734257	3,121462881	4,777940065	
sub_17	Label 17	Note 17	4,464195305	4,745032254	4,232748506	3,776985769	
sub_18	Label 18	Note 18	4,473946013	4,496788678	3,900300156	3,550790479	
sub_19	Label 19	Note 19	3,174722995	1,790982564	1,711520619	2,93289462	
sub_20	Label 20	Note 20	2,875718894	2,479919055	2,26791016	3,466409163	
sub_21	Label 21	Note 21	3,818403363	5,023829633	4,240981257	3,412863543	
sub_22	Label 22	Note 22	2,554971664	2,491672706	1,999251369	2,403002621	
sub_23	Label 23	Note 23	2,792825103	3,608362212	4,571685259	4,697156602	
sub_24	Label 24	Note 24	3,046806313	3,985336081	4,597214629	4,209158056	

Figure 5: **Data preparation.** The data should be organised in the following format: **a** The structural values from each subject belonging to the same group should be included in a single file (for example, `ST_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 148 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 in the same directory as the group's structural data and with the same name as this data followed by `.vois` (Figure 6a). This file should have a specific format (Figure 6b):



	A	B	C	D	E
1	Subject ID	Age	Sex	Education	
				low	
			Female	middle	
2			Male	high	
3	sub_1	10	Male	low	
4	sub_2	28	Female	middle	
5	sub_3	39	Female	high	
6	sub_4	51	Female	low	
7	sub_5	20	Male	middle	
8	sub_6	82	Male	high	
9	sub_7	80	Male	high	

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.

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.