

Prepare brain connectivity data

The BRAPH 2 Developers

July 2, 2023

This Tutorial explains how to prepare and work with brain connectivity data, where we have one connectivity matrix per subject such as in the case of diffusion weighted imaging tractography.

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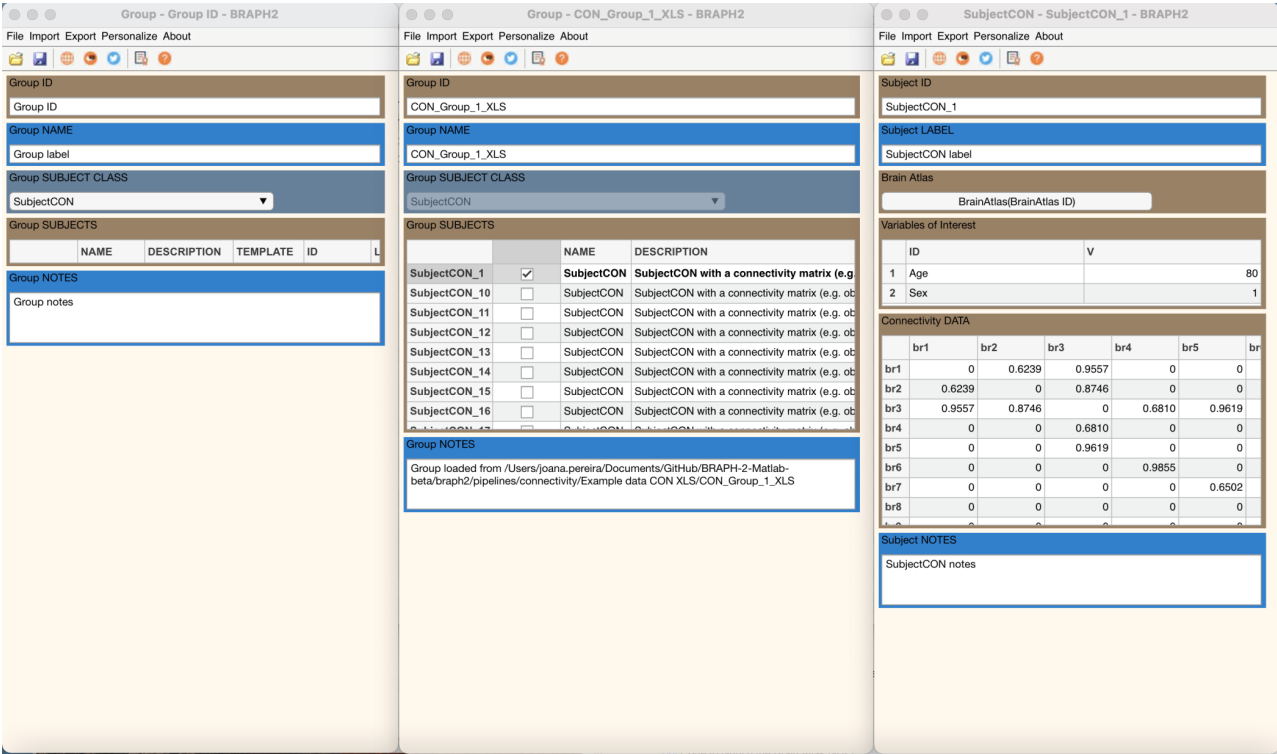
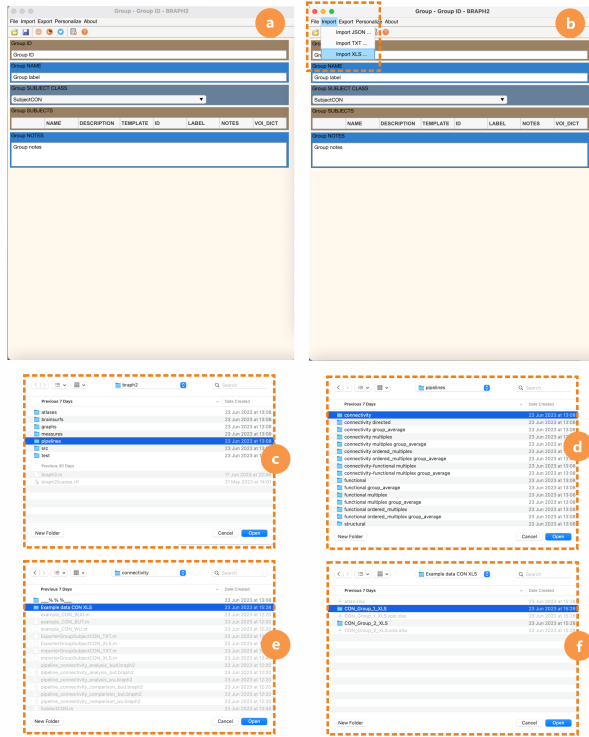


Figure 1: **Brain Connectivity Group** GUI. Full graphical user interface to work with brain connectivity group data in BRAPH 2.0.

Open the GUI

The group GUI is the second step in an analysis 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 2a.



To open the GUI and upload the brain connectivity 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 Brain Connectivity Group GUI. This code can be used in the MatLab command line to launch the Brain Connectivity Group without having to open a pipeline.

```
1 gr = Group('SUB-CLASS', 'SubjectCON'); ①
2
3 gui = GUIElement('PE', gr); ②
4 gui.get('DRAW') ③
5 gui.get('SHOW') ④
```

Figure 2: Upload a brain atlas. The different steps you need to follow to open brain connectivity data using the GUI and an example dataset: **a** Open the group GUI. **b** Import a folder containing the connectivity matrices in XLS or TXT format. **c** Navigate to the BRAPH 2.0 folder pipelines. **d** Navigate to the BRAPH 2.0 folder connectivity. **e** Navigate to the BRAPH 2.0 folder Example data CON XLS. **f** Select the folder containing the connectivity matrices of one group `CON_Group_1_XLS`. ① creates a new object `Group`. ② creates a GUI to upload the group data. ③ draws the GUI. ④ shows the GUI.

Visualize the Brain Connectivity Group data

After launching the previous steps (Figure 2), you can visualize the data (Figure 3a), change the Group ID, name and notes (Figure 3b).

Finally you can open a subject's connectivity matrix by selecting the subject, right click and select "Open selection" (Figure 4a), which will show the matrix values (Figure 4b). You can also change the ID, label, age, sex and even the values of your connectivity matrix.

Adding covariates

It is very common to have covariates in an analysis. In BRAPH 2.0 these covariates should be included in a separate excel file placed outside the group's folder and have the same name as the folder in addition to ".vois" as shown in Figure 5a), where "vois" stand for variables of interest. This covariates file should have a specific format, where the first two rows have the following information:

- Covariates names (row 1, column 1). For example: Subject ID, Age and Sex. In this example we have added a new covariate: Education.
- Covariates values (row 2, column 1). For example: Female and Male (Sex) or Low and High (Education).

Then, from row 3, you should include the IDs of your subjects (1st column) and the values for the different covariates: age (2nd column), sex (3rd, 4th, and 5th columns), and educational level (6th column) Figure 5b).

Group - CON_Group_1_XLS - BRAPH2

File Import Export Personalize About

Group ID
CON_Group_1_XLS

Group NAME
CON_Group_1_XLS

Group SUBJECT CLASS
SubjectCON

Group SUBJECTS

		NAME	DESCRIPTION	TEMPLATE	ID	LABEL	NOTES	VOI_DICT	BA
SubjectCON_1	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_1	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_10	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_10	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_11	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_11	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_12	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_12	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_13	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_13	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_14	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_14	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_15	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_15	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_16	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_16	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)

Group NOTES
Group loaded from /Users/joana.pereira/Documents/GitHub/BRAPH-2-Matlab-beta/braph2/pipelines/connectivity/Example data CON XLS/CON_Group_1_XLS

Group ID
CTR

Group NAME
Controls

Group SUBJECT CLASS
SubjectCON

Group SUBJECTS

		NAME	DESCRIPTION	TEMPLATE	ID	LABEL	NOTES	VOI_DICT	BA
SubjectCON_1	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_1	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_10	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_10	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_11	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_11	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_12	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_12	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_13	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_13	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_14	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_14	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_15	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_15	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_16	<input type="checkbox"/>	SubjectCON	SubjectCON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_16	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)

Group NOTES
Control group for the analysis of DWI connectivity matrices.

Figure 3: **Edit the Brain Connectivity Group data.** Information that can be changed in the Brain Connectivity Group GUI: **a** The ID, name, and notes. **b** The values of the connectivity matrix.

Group - CON_Group_1_XLS - BRAPH2

File Import Export Personalize About

Group ID
CTR

Group NAME
Controls

Group SUBJECT CLASS
SubjectCON

Group SUBJECTS

	NAME	DESCRIPTION	TEMPLATE	ID	LABEL	NOTES	VOI_DICT	BA
SubjectCON_1	<input checked="" type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_1	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_10	<input type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_10	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_11	<input type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_11	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_12	<input type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_12	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_13	<input type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_13	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_14	<input type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_14	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_15	<input type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_15	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)
SubjectCON_16	<input type="checkbox"/>	CON with a connectivity matrix (e.g. obtained...	ConcreteElement(ConcreteElement ID)	SubjectCON_16	SubjectCON label	SubjectCON notes	IndexedDictionary with 2 VOI	BrainAtlas(BrainAtlas ID)

Group NOTES
Control group for the analysis of DWI connectivity matrices.

SubjectCON - SubjectCON_1 - BRAPH2

File Import Export Personalize About

Subject ID
SubjectCON_1

Subject LABEL
SubjectCON label

Brain Atlas
BrainAtlas(BrainAtlas ID)

Variables of Interest

ID	V
1 Age	80
2 Sex	1

Connectivity DATA

	br1	br2	br3	br4	br5	br6	br7	br8	br9	br10	br11	br12	br13	br14	br15	br16	br17	br18	br
br1	0	0.6239	0.9557	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
br2	0.6239	0	0.8746	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
br3	0.9557	0.8746	0	0.6810	0.9619	0	0	0	0	0	0	0	0	0	0	0	0	0	0
br4	0	0	0.6810	0	0	0.9855	0	0	0	0	0	0	0	0	0	0	0	0	0
br5	0	0	0.9619	0	0	0	0.6502	0	0	0	0	0	0	0	0	0	0	0	0
br6	0	0	0	0.9855	0	0	0.7929	0.7287	0	0	0	0	0	0	0	0	0	0	0
br7	0	0	0	0	0.6502	0.7929	0	0.7205	0.9658	0	0	0	0	0	0	0	0	0	0
br8	0	0	0	0	0	0.7287	0.7205	0	0.9725	0.9237	0	0	0	0	0	0	0	0	0

Subject NOTES
SubjectCON notes

Figure 4: **Individual Brain Connectivity Data GUI.** Visualising and editing a brain connectivity matrix of a single subject.

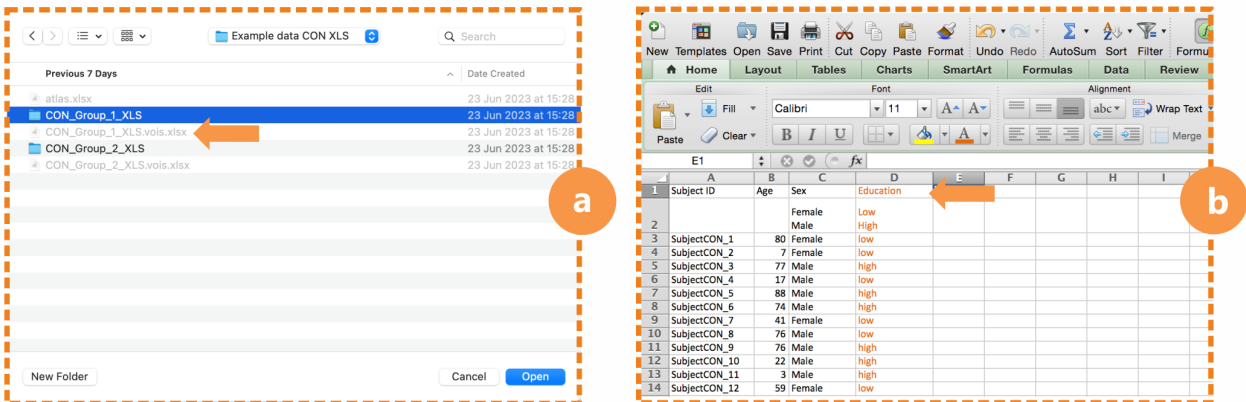


Figure 5: **Edit the Covariates.** Information that can be changed in the Covariates file: **a** The names of the variables of interest (vois). **b** In case the vois are categorical, you can state which categories they have.