

Group of Subjects with Connectivity Multiplex Data

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September 8, 2023

For *connectivity multiplex data*, a connectivity matrix per subject is already available for different layers and can be directly imported into the relative analysis pipeline. For example, the connectivity matrix could correspond to white matter tracts obtained from dMRI or pre-calculated coactivations maps obtained from fMRI data. This Tutorial explains how to prepare and work with this kind of data.

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The screenshot displays three windows from the BRAPH 2 GUI. The leftmost window, titled 'Group - Group ID - BRAPH2', shows a table with columns: NAME, DESCRIPTION, TEMPLATE, ID, and LA. The middle window, titled 'Group - CON_MP_Group_1_XLS - BRAPH2', shows a table with columns: Subject ID, Subject LABEL, and Brain Atlas. The rightmost window, titled 'SubjectCON_MP - SubjectCON_MP_1 - BRAPH2', shows a table with columns: br1, br2, br3, br4, br5, br6, br7, and br8. Below the table, there are fields for 'Subject ID', 'Subject LABEL', 'Brain Atlas', 'Variables of Interest' (Age, Sex), 'Layer Number', and 'Layer Labels'. The 'Subject' window also includes a 'Connectivity DATA LAYERS' section with a table of values for each layer (br1 to br8).

	br1	br2	br3	br4	br5	br6	br7	br8
br1	0	0.5703	0.9143	0.7045	0.5715	0.9341	0	0
br2	0.7294	0	0.6871	0.7770	0.5501	0.5227	0.7223	0
br3	0.6059	0.7613	0	0.5367	0.8258	0.9381	0.8523	0
br4	0.5652	0.5551	0.7638	0	0.7568	0.9069	0.8169	0
br5	0.6062	0.9675	0.6608	0.8123	0	0.6767	0.8255	0
br6	0.5153	0.7453	0.9426	0.7270	0.6479	0	0.6849	0
br7	0	0.6896	0.8820	0.9442	0.7696	0.9593	0	0
br8	0	0	0.8555	0.5478	0.8179	0.6704	0.5040	0
br9	0	0	0	0.6834	0.8599	0.9863	0.5278	0
br10	0	0	0	0	0.9619	0.5074	0.8248	0
br11	0	0	0	0	0	0.7303	0.9035	0
br12	0	0	0	0	0	0	0.5402	0
br13	0	0	0	0	0	0	0	0
br14	0.7138	0	0	0	0	0	0	0
br15	0.9223	0.5033	0	0	0	0	0	0
br16	0.7488	0.8368	0.6347	0	0	0	0	0
br17	0.7161	0.9314	0.6132	0.6630	0	0	0	0

Figure 1: GUI for a group of subjects with connectivity multiplex data. Full graphical user interface to upload a group of subjects with connectivity multiplex 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.

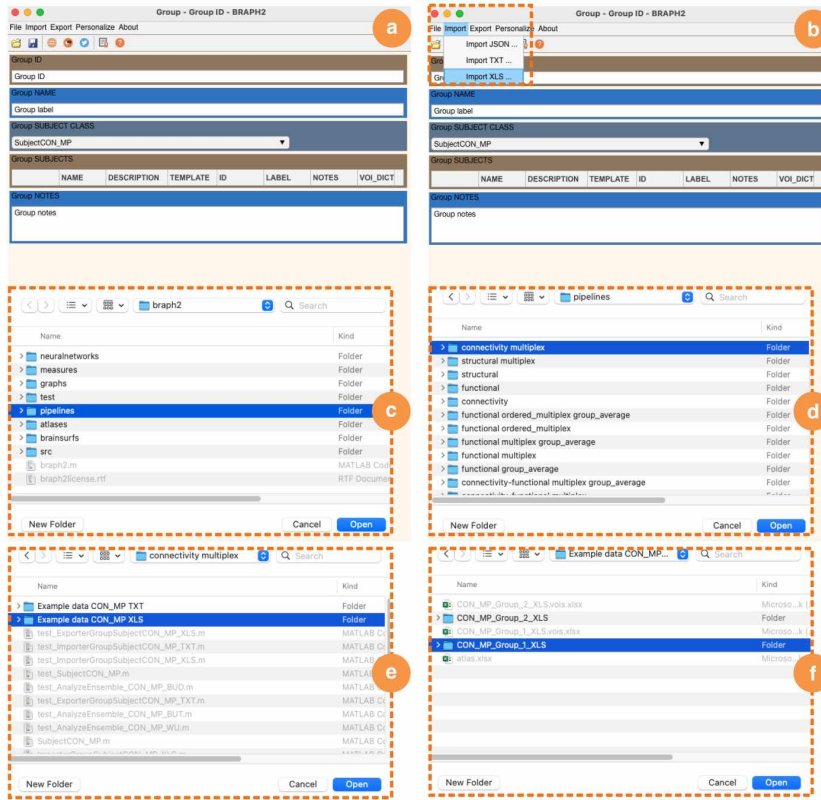


Figure 2: **Upload the data of a group of subjects.** Steps to upload a group of subjects with connectivity multiplex data using the GUI and an example dataset: **a** Open the group GUI. **b** Import a folder that contains one file per subject and layer with the connectivity matrix in XLS or TXT format (see below for details on their format). To upload the test connectivity multiplex data: **c-f** navigate to the BRAPH 2.0 folder pipelines, **d** connectivity multiplex, **e** Example data CON_MP XLS, and **f** select the folder containing the connectivity matrices of one group CON_MP_Group_1.XLS.

To open the GUI and upload the brain connectivity multiplex 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 group of subjects with connectivity multiplex data. This code can be used in the MatLab command line to launch the GUI to upload a group of subjects with connectivity multiplex data without having to open a pipeline.

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

① creates a new object Group with subjects with connectivity multiplex data, i.e., SubjectCON_MP.

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 CON_MP XLS folder inside connectivity 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 CON_MP XLS folder to the connectivity multiplex pipeline folder.

```
1 test_ImporterGroupSubjectCON_MP_XLS ①
2 test_ImporterGroupSubjectCON_MP_TXT ②
```

① generates the example connectivity multiplex XLS data folder.

② generates the example connectivity 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).

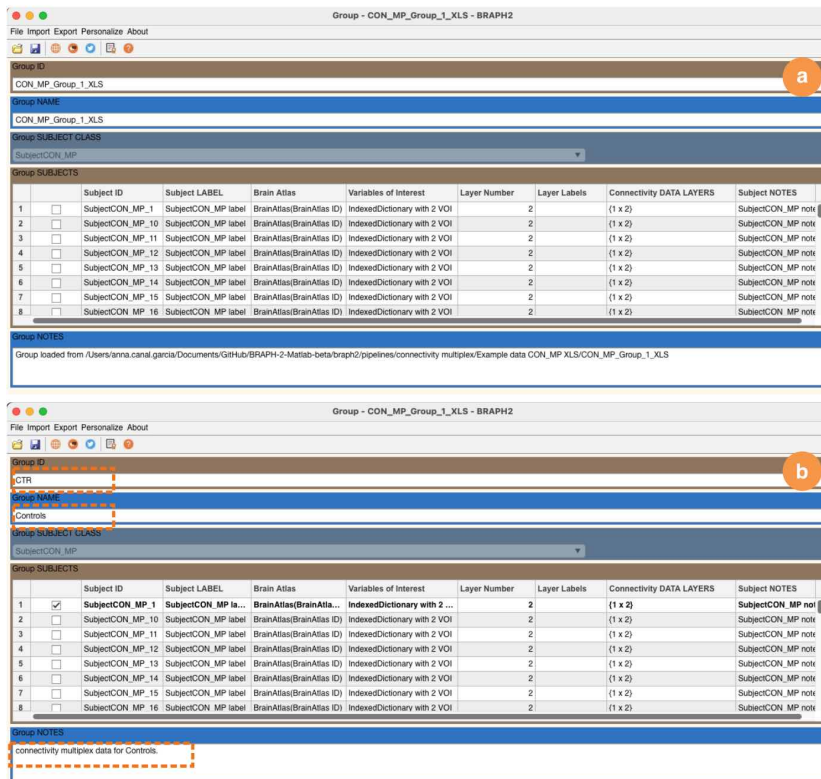


Figure 3: Edit the group metadata. a The GUI of the group's connectivity multiplex data. b The information you see on this GUI that can be changed. In this example, we have edited the ID, name, and notes of the group but can also change the subject's specific information.

Visualize Each Subject's Data

Finally, you can open each subject's connectivity multiplex data by selecting the subject, right click, and select "Open selection" (Figure 4a), which shows the matrix values from layer 1 (Figure 4b). Here, you

can also change the subject's metadata (ID, label, notes), its variables of interest, and the values of its connectivity multiplex data.

a

Group - CON_MP_Group_1_XLS - BRAPH2

File Import Export Personalize About

Group ID: CTR

Group NAME:

Controls:

Group SUBJECT CLASS: SubjectCON_MP

Group SUBJECTS:

	Subject ID	Subject LABEL	Brain Atlas	Variables of Interest	Layer Number	Layer Labels	Connectivity DATA LAYERS	Subject NOTES
1	<input checked="" type="checkbox"/>	SubjectCON_MP_1	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 ...	2		(1 x 2)	SubjectCON_MP not
2	<input type="checkbox"/>	Select All	SubjectCON_MP label	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 VOI	2	(1 x 2)	SubjectCON_MP note
3	<input type="checkbox"/>	Clear Selection	SubjectCON_MP label	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 VOI	2	(1 x 2)	SubjectCON_MP note
4	<input type="checkbox"/>	Invert Selection	SubjectCON_MP label	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 VOI	2	(1 x 2)	SubjectCON_MP note
5	<input type="checkbox"/>	Apply to Selection	SubjectCON_MP label	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 VOI	2	(1 x 2)	SubjectCON_MP note
6	<input type="checkbox"/>	Open Selection	SubjectCON_MP label	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 VOI	2	(1 x 2)	SubjectCON_MP note
7	<input type="checkbox"/>	Hide Selection	SubjectCON_MP label	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 VOI	2	(1 x 2)	SubjectCON_MP note
8	<input type="checkbox"/>	Hide All	SubjectCON_MP label	BrainAtlas(BrainAtlas ID)	IndexedDictionary with 2 VOI	2	(1 x 2)	SubjectCON_MP note

Group NOTES:

connectivity mul... Export to XLS

b

SubjectCON_MP - SubjectCON_MP_1 - BRAPH2

File Import Export Personalize About

Subject ID: SubjectCON_MP_1

Subject LABEL: SubjectCON_MP label

Brain Atlas: BrainAtlas(BrainAtlas ID)

Variables of Interest:

Age: 81

Sex: Male

Layer Number: 2

Layer Labels:

Connectivity DATA LAYERS:

layer 1

	br1	br2	br3	br4	br5	br6	br7	br8	br9	br10	br11	br12	br13	br14	br15	br16
br1	0	0.5703	0.9143	0.7045	0.5715	0.9341	0	0	0	0	0	0	0	0.8450	0.8280	0
br2	0.7294	0	0.6871	0.7770	0.5501	0.5227	0.7223	0	0	0	0	0	0	0	0.7332	0
br3	0.6059	0.7613	0	0.5367	0.8258	0.9381	0.8523	0.5242	0	0	0	0	0	0	0	0
br4	0.5652	0.5551	0.7638	0	0.7568	0.9069	0.8169	0.8267	0.8871	0	0	0	0	0	0	0
br5	0.6062	0.9675	0.6608	0.8123	0	0.6767	0.8255	0.8513	0.9477	0.5223	0	0	0	0	0	0
br6	0.5153	0.7453	0.9426	0.7270	0.6479	0	0.6849	0.7978	0.9950	0.9287	0.8841	0	0	0	0	0
br7	0	0.6896	0.8820	0.9442	0.7696	0.9593	0	0.8489	0.9704	0.7437	0.6890	0.6521	0	0	0	0
br8	0	0	0.8555	0.5478	0.8179	0.6704	0.5040	0	0.8387	0.5140	0.9624	0.6001	0.9680	0	0	0
br9	0	0	0	0	0.6834	0.8599	0.9863	0.5278	0.8201	0	0.6758	0.5166	0.6697	0.9604	0.9859	0
br10	0	0	0	0	0	0.9619	0.5074	0.8246	0.9376	0.8303	0	0.8950	0.7400	0.6885	0.6452	0.8919
br11	0	0	0	0	0	0	0.7303	0.9035	0.6914	0.6902	0.7652	0	0.8341	0.7943	0.5474	0.8481
br12	0	0	0	0	0	0	0	0.5402	0.8222	0.5006	0.7111	0.9847	0	0.6807	0.5671	0.9554
br13	0	0	0	0	0	0	0	0	0.8185	0.6760	0.5443	0.5712	0.8768	0	0.9404	0.7392
br14	0.7138	0	0	0	0	0	0	0	0	0.7301	0.8119	0.6982	0.7444	0.6182	0	0.5874
br15	0.9223	0.5033	0	0	0	0	0	0	0	0.8856	0.5761	0.6296	0.5119	0.7795	0	0
br16	0.7488	0.8368	0.6347	0	0	0	0	0	0	0	0.7477	0.8729	0.6092	0.5621	0.5262	0
br17	0.7161	0.9314	0.6132	0.6630	0	0	0	0	0	0	0	0.5772	0.5322	0.5675	0.8332	0

Subject NOTES:

SubjectCON_MP notes

Figure 4: **Edit the individual subject data.** **a** Each subject's connectivity multiplex data 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 connectivity multiplex data.

a

b

	A	B	C	D	E
1	Subject ID	Age	Sex	Education	
2			Female	low	
3	SubjectCON_MP_1	81	Male	middle	
4	SubjectCON_MP_2	86	Female	high	
5	SubjectCON_MP_3	56	Female	low	
6	SubjectCON_MP_4	34	Male	middle	
7	SubjectCON_MP_5	64	Male	low	
8	SubjectCON_MP_6	27	Male	high	
9	SubjectCON_MP_7	3	Male	high	
10	SubjectCON_MP_8	24	Male	high	
11	SubjectCON_MP_9	67	Male	low	
12	SubjectCON_MP_10	15	Female	high	

Figure 6: **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.

and with the same name as the folder followed by .vois (Figure 6a). 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.