

# STANDARDIZATION OF NEUROIMAGING DATA IN SYNAPSY

Synapsy DMP Online Meeting

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April 21, 2021

# WHY IS IT USEFUL?

# EXECUTION OF DMP SATISFYING OPEN SCIENCE REQUIREMENTS

- SNSF expects all its funded researchers:
  - to **store the research data** they have worked on and produced during the course of their research work
  - to **share these data** with other researchers, unless they are bound by legal, ethical, copyright, confidentiality or other clauses
  - to **deposit their data and metadata onto existing public repositories** in formats that anyone can find, access and reuse without restriction, conformed with the **Findable Accessible Interoperable Reusable (FAIR) principles**

Art 47 SNSF Funding Regulations and SNSF Open Research Data Policy

# ADVANTAGES OF ADOPTING A STANDARD

- Ease of sharing and reuse - No need to spend a considerable amount of time to understand data organization and adapt code to each researcher or lab.
- Automated processing pipelines can be built to analyze data
- Meta-analysis across datasets become possible

# HOW?

# KEYS TOWARDS FAIR NEUROIMAGING DATA IN SYNAPSY

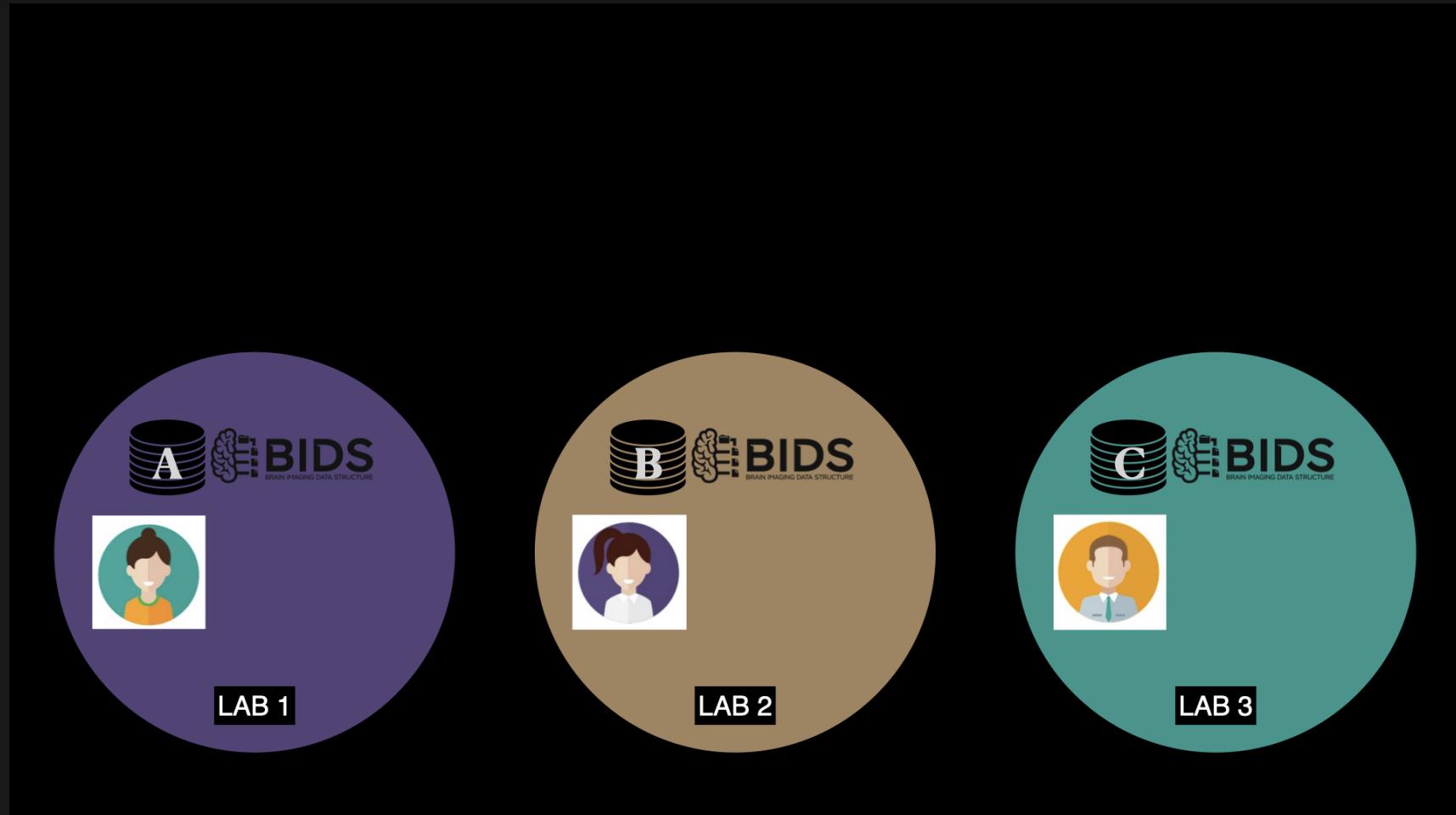
- Standard to organize and describe neuroimaging data along with metadata: Brain Imaging Data Structure (BIDS) - <https://bids.neuroimaging.io/>
- Distributed data versioning and management system tailored to neuroimaging data: Datalad - <https://www.datalad.org/>
- Distributed storage of neuroimaging data accross the different institution servers with access controlled by PIs

# THE ROAD MAP

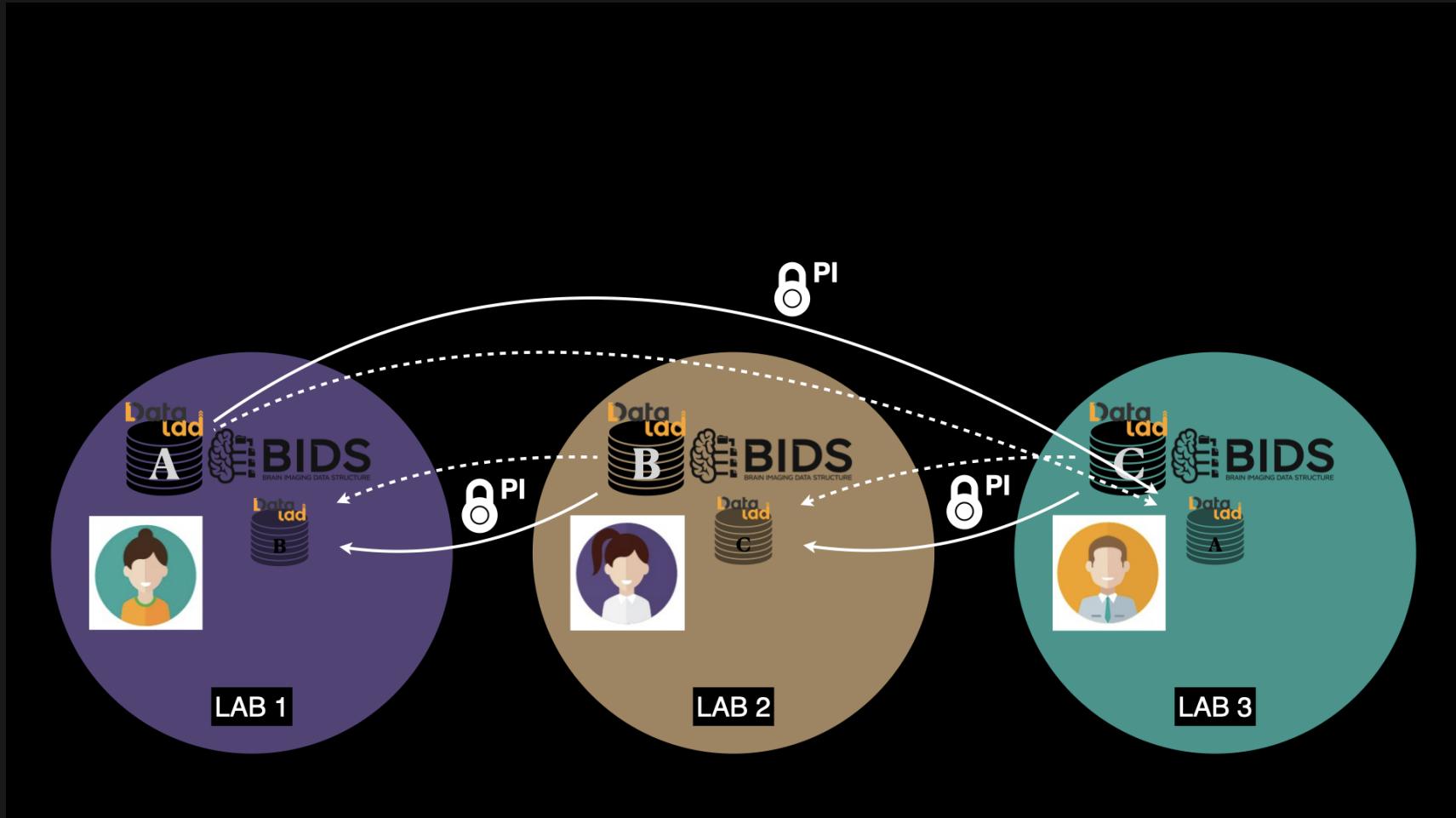
# STEP 1: UNDERSTANDING HOW DATASETS ARE ORGANIZED IN EACH LAB



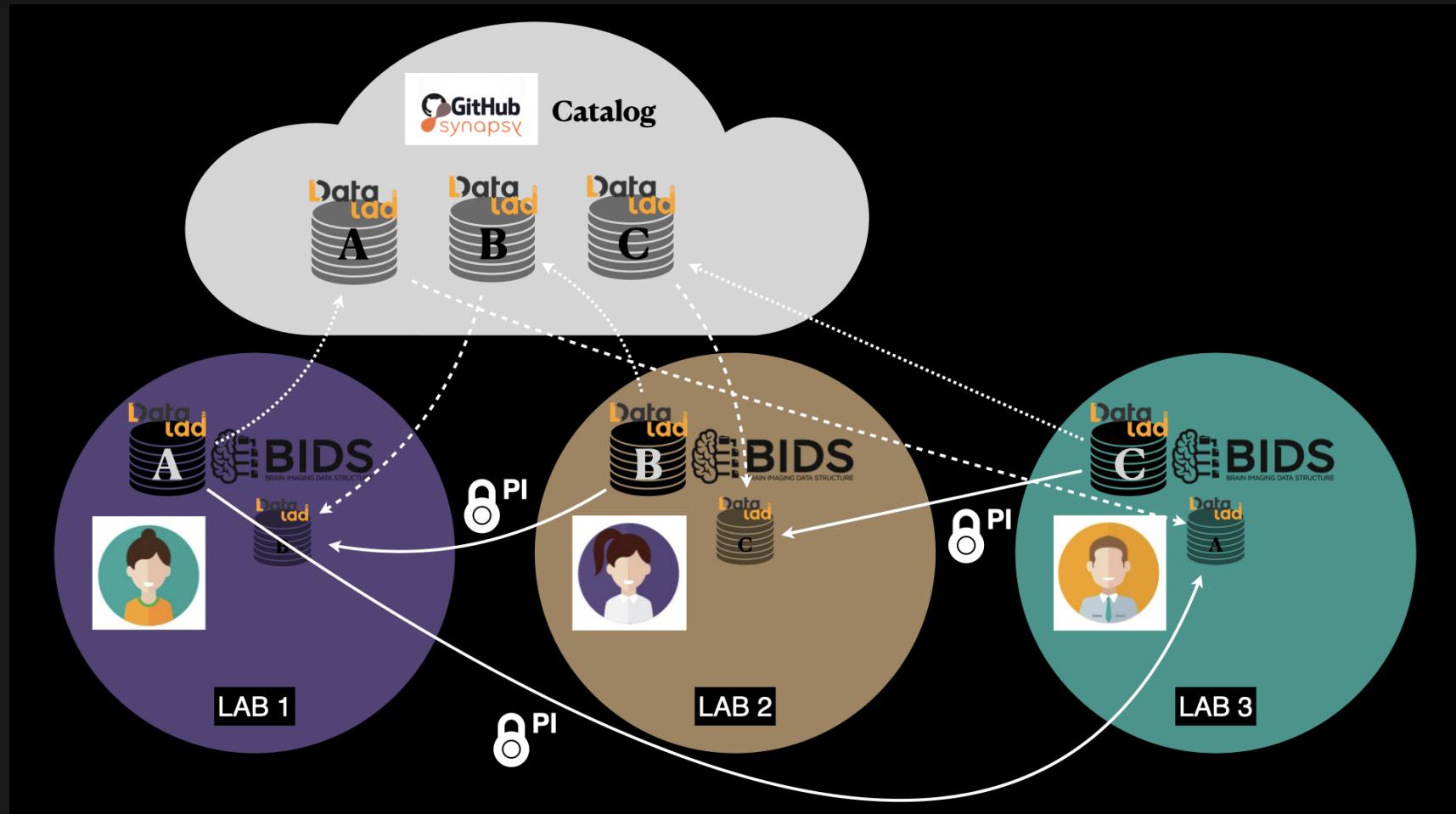
# STEP 2: CREATION OF BIDS DATASETS FOR RAW DATA



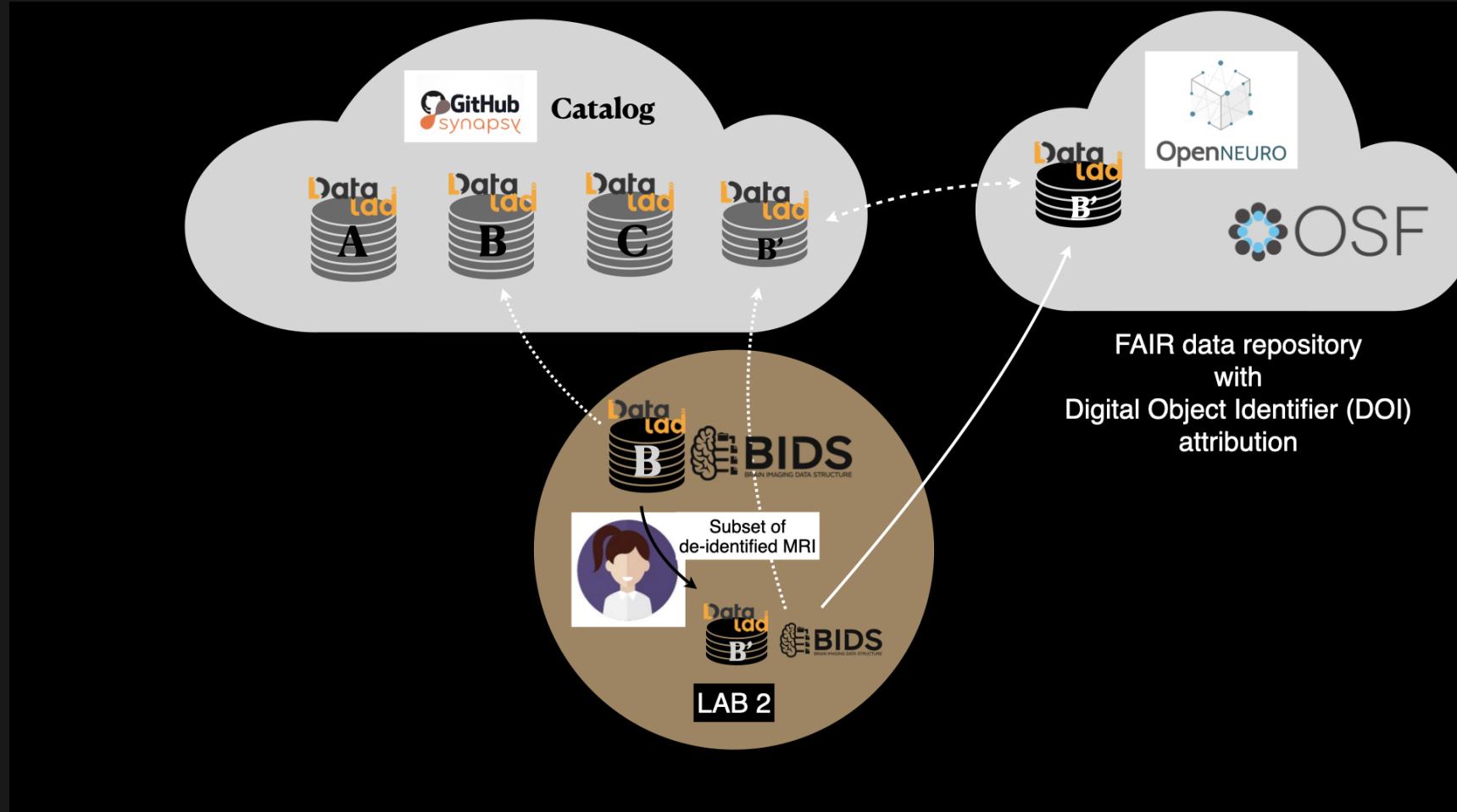
# STEP 3: ADOPTION OF DATALAD



# STEP 4: CREATION OF DATASET CATALOG



# STEP 5: DATASET PUBLICATION



# WHAT IS BIDS?

# SPECIFICATIONS TO ORGANIZE AND DESCRIBE NEUROIMAGING DATA THAT COMPLIES WITH THE FAIR CONCEPT

## SCIENTIFIC DATA

A graphic consisting of four rows of binary digits (0s and 1s) in blue, arranged vertically. The first row is 110110, the second is 0111101, the third is 11011110, and the fourth is 011101101.

OPEN

### SUBJECT CATEGORIES

- » Data publication and archiving
- » Research data

Received: 18 December 2015

Accepted: 19 May 2016

Published: 21 June 2016

**The brain imaging data structure, a format for organizing and describing outputs of neuroimaging experiments**

Krzysztof J. Gorgolewski<sup>1</sup>, Tibor Auer<sup>2</sup>, Vince D. Calhoun<sup>3,4</sup>, R. Cameron Craddock<sup>5,6</sup>, Samir Das<sup>7</sup>, Eugene P. Duff<sup>8</sup>, Guillaume Flandin<sup>9</sup>, Satrajit S. Ghosh<sup>10,11</sup>, Tristan Glatard<sup>7,12</sup>, Yaroslav O. Halchenko<sup>13</sup>, Daniel A. Handwerker<sup>14</sup>, Michael Hank<sup>15,16</sup>, David Keator<sup>17</sup>, Xiangrui Li<sup>18</sup>, Zachary Michael<sup>19</sup>, Camille Maumet<sup>20</sup>, B. Nolan Nichols<sup>21,22</sup>, Thomas E. Nichols<sup>20,23</sup>, John Pellman<sup>6</sup>, Jean-Baptiste Poline<sup>24</sup>, Ariel Rokem<sup>25</sup>, Gunnar Schaefer<sup>1,26</sup>, Vanessa Sochat<sup>27</sup>, William Triplett<sup>1</sup>, Jessica A. Turner<sup>3,28</sup>, Gaël Varoquaux<sup>29</sup> & Russell A. Poldrack<sup>1</sup>

<https://doi.org/10.1038/sdata.2016.44>

# COMPREHENSIBLE ORGANIZATION AND NAMING WITH WELL-ACCEPTED FORMATS

dicomdir/

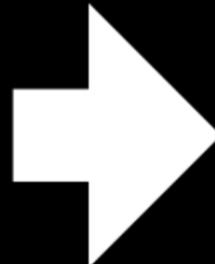
1208200617178\_22/

- 1208200617178\_22\_8973.dcm
- 1208200617178\_22\_8943.dcm
- 1208200617178\_22\_2973.dcm
- 1208200617178\_22\_8923.dcm
- 1208200617178\_22\_4473.dcm
- 1208200617178\_22\_8783.dcm
- 1208200617178\_22\_7328.dcm
- 1208200617178\_22\_9264.dcm
- 1208200617178\_22\_9967.dcm
- 1208200617178\_22\_3894.dcm
- 1208200617178\_22\_3899.dcm

1208200617178\_23/

1208200617178\_24/

1208200617178\_25/



my\_dataset/

participants.tsv

sub-01/

anat/

sub-01\_T1w.nii.gz

func/

sub-01\_task-rest\_bold.nii.gz

sub-01\_task-rest\_bold.json

dwi/

sub-01\_dwi.nii.gz

sub-01\_dwi.json

sub-01\_dwi.bval

sub-01\_dwi.bvec

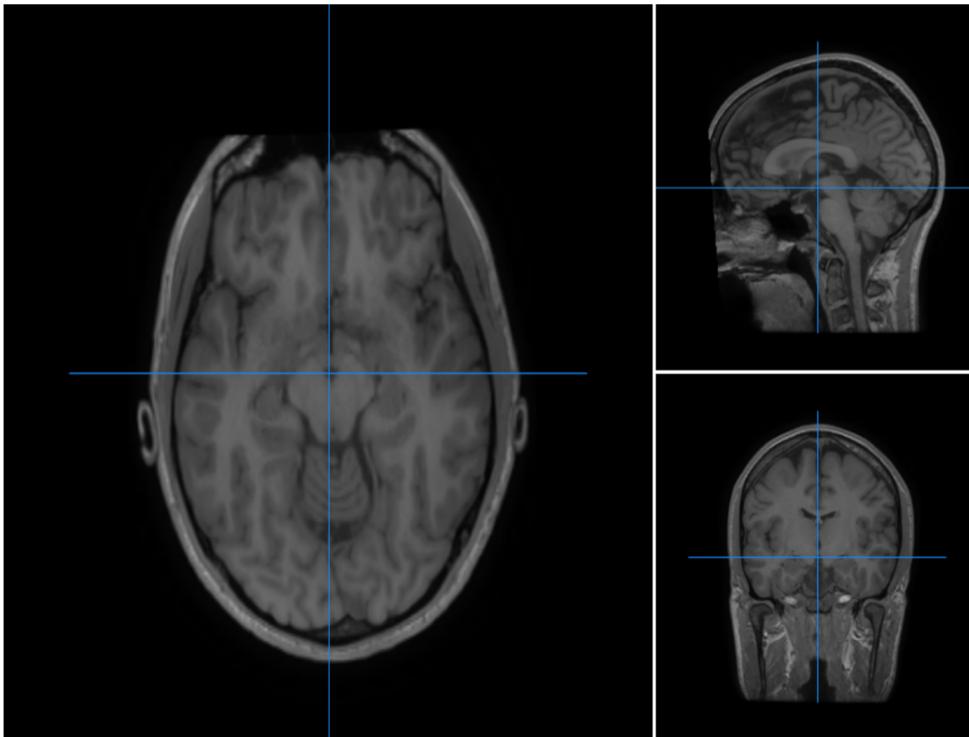
sub-02/

sub-03/

sub-04/

# CONSISTENT IMAGE ACQUISITION METADATA

DS003505 - SUB-01 - ANAT - SUB-01\_T1W.NII.GZ  [DOWNLOAD](#)



DS003505 - SUB-01 - ANAT - SUB-01\_T1W.JSON  [DOWNLOAD](#)

## Tree

```
▼ root: {} 20 keys
  Manufacturer: "GE"
  ManufacturersModelName: "DISCOVERY_MR750"
  AcquisitionNumber: 1
  InstitutionName: "HFR_Hopital_Cantonal_Fribourg"
  DeviceSerialNumber: "000000475290MR01"
  SoftwareVersions: "25_LX_MR_Software_release:DV25.0_R01_1451.a"
  ScanningSequence: "GR"
  SequenceVariant: "SS_SK"
  SeriesDescription: "COR_FSPGR_BRAVO"
  ProtocolName: "COR_FSPGR_BRAVO"
  ▶ ImageType: [] 3 items
    AcquisitionTime: "19:04:55.000000"
    MagneticFieldStrength: 3
    FlipAngle: 9
    EchoTime: 0.002812
    RepetitionTime: 0.007276
    InversionTime: 0.9
    PhaseEncodingLines: 256
    ConversionSoftware: "dcm2niix"
    ConversionSoftwareVersion: "v1.0.20170624 (OpenJPEG build) MSC1900"
```

# CONSISTENT DATASET DOCUMENTATION AND EXPERIMENT METADATA

### Dataset File Tree

VEPCON: Source imaging of high-density visual evoked potentials with multi-scale brain parcellations and connectomes

- + ADD FILES + ADD DIRECTORY ⌂ DELETE
- CHANGES  
  ↳ DOWNLOAD ⌂ VIEW ⌂ UPDATE ⌂ DELETE
- dataset\_description.json  
  ↳ DOWNLOAD ⌂ VIEW ⌂ UPDATE
- participants.json  
  ↳ DOWNLOAD ⌂ VIEW ⌂ UPDATE ⌂ DELETE
- participants.tsv  
  ↳ DOWNLOAD ⌂ VIEW ⌂ UPDATE ⌂ DELETE
- README  
  ↳ DOWNLOAD ⌂ VIEW ⌂ UPDATE ⌂ DELETE

DS003505 - DATASET\_DESCRIPTION.JSON ⌂ DOWNLOAD

### Tree

```
root: {} 10 keys
  Name: "VEPCON: Source imaging of high-density visual evoked potentials with multi-scale brain parcellations and connectomes"
  BIDSVersion: "1.4.2"
  License: "CC0"
  Authors: [] 6 items
    Acknowledgements: "say here what are your acknowledgements"
    HowToAcknowledge: "Please cite the associated dataset"
  Funding: [] 1 item
  ReferencesAndLinks: [] 3 items
    DatasetDOI: "10.18112/openneuro.ds003505.v1.0.0"
  EthicsApprovals: [] 1 item
```

### DS003505 - CHANGES ⌂ DOWNLOAD

Initial upload of raw and cmp-derived MRI data  
Update with defaced raw and cmp-derived MRI data  
Upload of EEG data  
Upload of MRIQC derivatives for quality assessment of T1w MRI data  
Update main README, CHANGES and dataset\_description.json

### DS003505 - PARTICIPANTS.JSON ⌂ DOWNLOAD

#### Tree

PARTICIPANT_ID	SEX	AGE
sub-01	M	26
sub-02	M	29
sub-03	F	23
sub-04	M	29
sub-05	F	20
sub-06	F	23
sub-07	F	32
sub-08	F	20
sub-09	F	20
sub-10	F	22
sub-11	F	24
sub-12	F	26
sub-13	F	24
sub-14	F	23
sub-15	F	22

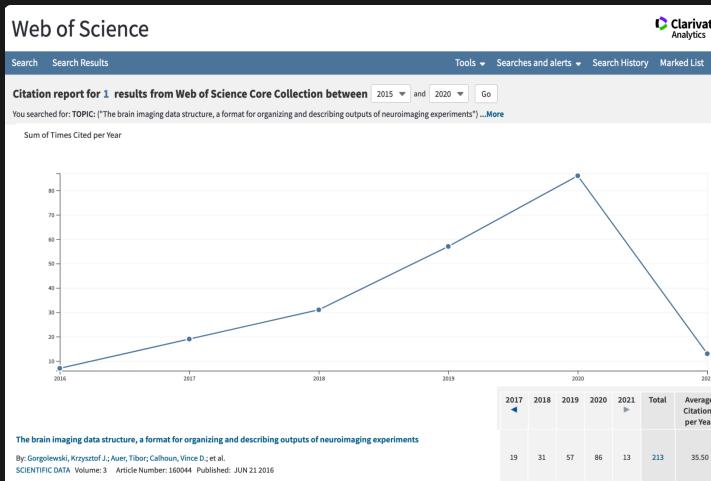
### DS003505 - PARTICIPANTS.TSV ⌂ DOWNLOAD

This dataset can contribute to multimodal methods development, studying structure-function relations, as well as unimodal optimization of source imaging and graph analysis for deriving time-series of activity in each participant and derivatives.

# WHY BIDS?

# NEUROIMAGING DATA STANDARD ORIGINATING FROM MRI

- Arrived at the time researchers are incentivized to share more their data



Results from [www.webofknowledge.com](http://www.webofknowledge.com) (Date: March 07, 2021)

- Focused on community, inter-operability, simplicity, extensibility and evolution
- Supported by the International Neuroinformatics Coordinating Facility (INCF) and encouraged by the COBIDAS report on Best Practices in Data Analysis and Sharing in Neuroimaging using MRI

ALLOW USE TO MAKE SYNAPSY  
NEUROIMAGING DATA FAIR AND READY  
TO BE COMPLIANT WITH THE SNSF  
REQUIREMENTS

**MAKE DATA FULLY UNDERSTANDABLE BY  
ITSELF THANKS TO ITS CONSISTENT  
METADATA AND DOCUMENTATION**

**FACILITATE DATA SHARING BETWEEN LAB  
MEMBERS AND COLLABORATORS PART  
OF SYNAPSY**

**MAKE CODE INTEROPERABLE BETWEEN  
PROJECTS, LAB MEMBERS, AND  
COLLABORATORS PART OF SYNAPSY**

# VERY LITTLE EFFORT TO DEPOSIT NEUROIMAGING SYNAPSY NEUROIMAGING DATA TO OPEN DATABASES



**OpenNEURO**

MY DASHBOARD PUBLIC DASHBOARD SUPPORT FAQ [UPLOAD DATASET](#)

A free and open platform for sharing MRI, MEG, EEG, iEEG, and ECoG data

View more information about [Stanford Center for Reproducible Neuroscience](#)

Brain Imaging Data Structure (BIDS)

A Validator for the Brain Imaging Data Structure  
Read more about the [BIDS specifications](#)

Want to contribute to BIDS?  
Visit the [Google discussion group](#) to contribute.

Databases such as [OpenNeuro](#), [LORIS](#), [COINs](#), [XNAT](#), [SciTran](#) and others accept and export datasets

# BENEFIT OF DEDICATED AND WELL DOCUMENTED TOOLS

# FOR VALIDATION AND DATA CURATION SUPPORT

<https://bids-standard.github.io/bids-validator>

# FOR DATASET QUERY

- In Python: <https://github.com/bids-standard/pybids>

```
>>> from bids import BIDSLayout  
>>> layout = BIDSLayout('/home/data/ds000117')  
>>> layout.get_subjects()
```

- In Matlab: <https://github.com/bids-standard/bids-matlab>

```
>>> BIDS = bids.layout('/home/data/ds000117');  
>>> bids.query(BIDS, 'subjects')
```

# FOR ANALYSIS

A number of processing pipelines handling BIDS datasets (BIDS Apps) are available, ranging from quality control to preprocessing, connectome mapping, and statistical analysis

The screenshot shows the BIDS Apps website interface. On the left, there's a dark background image of a forest and mountains, with a white circular icon containing a gear symbol. To the right of the icon, the text "BIDS Apps" is displayed. Below this, a subtitle reads "portable neuroimaging pipelines that understand BIDS datasets". At the bottom, there are three buttons: "About", "Tutorials", and "Apps". On the right side of the screenshot, a list of BIDS Apps is shown in two columns. Each item includes the app name in red, its version in blue, and the number of open issues in a yellow box.

poldracklab/mriqc	version v0.16.1	open issues 131
BIDS-Apps/QAP	version v0.0.1	open issues 5
BIDS-Apps/CPAC	version v1.0.1a_22	open issues 10
BIDS-Apps/hyperalignment	version v0.0.5	open issues 0
BIDS-Apps/mindboggle	version v0.0.4-1	open issues 8
BIDS-Apps/MRtrix3_connectome	version v0.5.0	open issues 18
BIDS-Apps/rs_signal_extract	version v0.1	open issues 0
BIDS-Apps/aa	version v0.2.0	open issues 2
BIDS-Apps/niak	version v1.0	open issues 3
BIDS-Apps/oppni	version v0.7.0-1	open issues 5
poldracklab/fmriprep	version v20.2.1	open issues 226

<https://bids-apps.neuroimaging.io/apps/>

# HOW DOES BIDS APPLY FOR EEG?

# BIDS EXTENSION FOR EEG

# SCIENTIFIC DATA

A graphic of binary code (1s and 0s) arranged in a grid pattern, with the digits colored in shades of blue and green.

OPEN

COMMENT

## EEG-BIDS, an extension to the brain imaging data structure for electroencephalography

Received: 16 January 2019

Accepted: 7 May 2019

Published online: 25 June 2019

Cyril R. Pernet<sup>1</sup>, Stefan Appelhoff<sup>1</sup>, Krzysztof J. Gorgolewski<sup>1</sup>, Guillaume Flandin<sup>4</sup>, Christophe Phillips<sup>1</sup>, Arnaud Delorme<sup>6,7</sup> & Robert Oostenveld<sup>1,8,9</sup>

The Brain Imaging Data Structure (BIDS) project is a rapidly evolving effort in the human brain imaging research community to create standards allowing researchers to readily organize and share study data within and between laboratories. Here we present an extension to BIDS for electroencephalography (EEG) data, EEG-BIDS, along with tools and references to a series of public EEG datasets organized using this new standard.

<https://doi.org/10.1038/s41597-019-0104-8>

# AN OVERVIEW

Follow the general BIDS data structure originating from MRI with some modifications to accommodate EEG data types

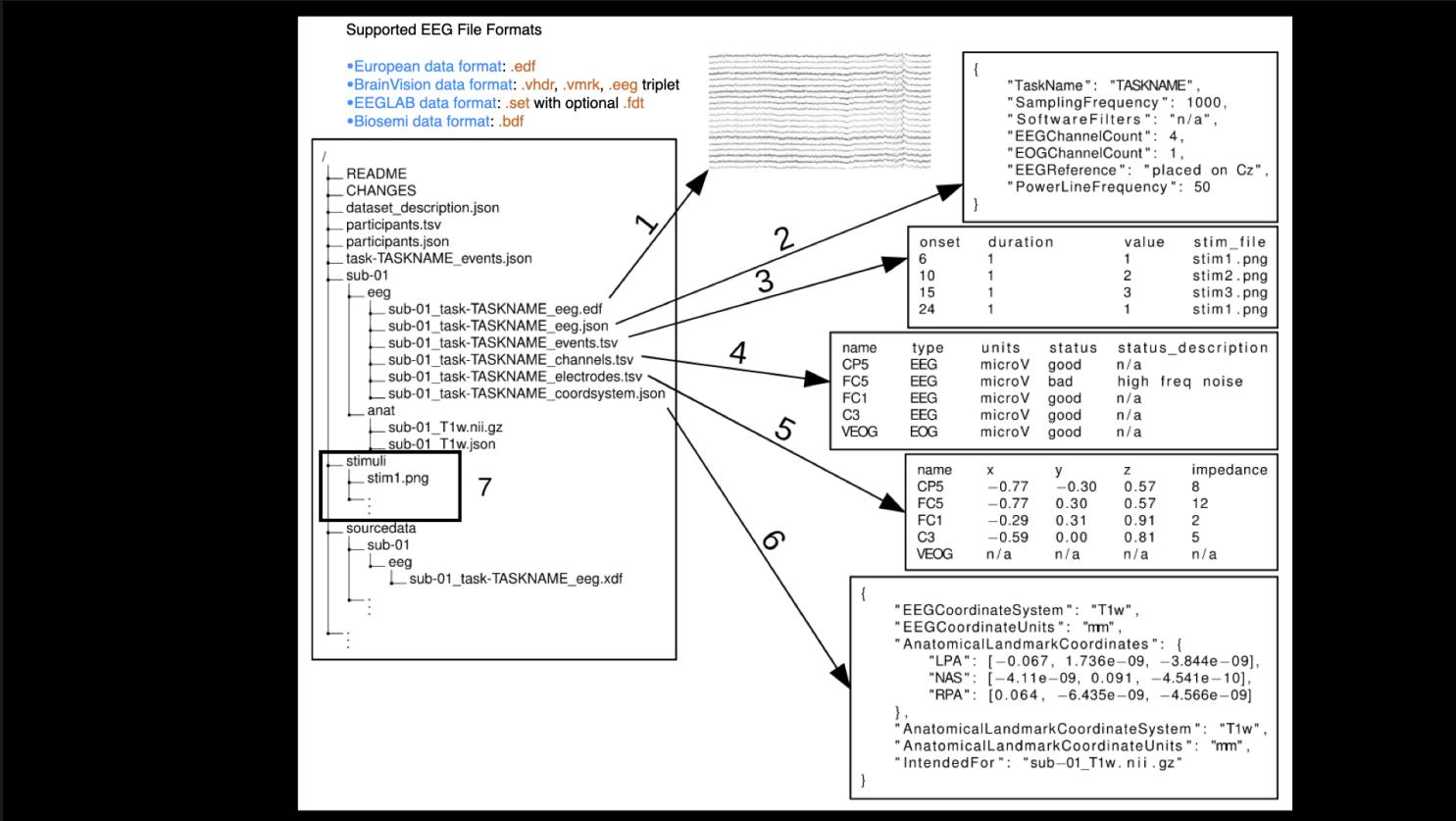


Figure adapted from <https://doi.org/10.1038/s41597-019-0104-8>

# EEG TOOLS SUPPORTING BIDS



- [MNE-BIDS](#): Python package that allows you to read and write BIDS-compatible datasets with the help of MNE-Python.
- [FieldTrip](#): Can read data from all EEG and MRI file formats that are supported in BIDS and includes the `data2bids` function to convert data to the BIDS structure.
- [bids-matlab-tools](#): Collection of functions to import and export BIDS-formatted experiments, tailored for use as an EEGLAB plugin

# PROGRESS

	BIDS BRAIN IMAGING DATA STRUCTURE	Data Lad	GitHub synapsy
<b>Onboard</b>			
<b>MRI / EEG Cohort : Autism</b> PI: Marie Schaer / Data manager: Nada Kojovic	✓ MRI    ↗ EEG	-	-
<b>MRI Cohort : 22q11.2 deletion syndrome</b> PI: Stephan Eliez / Data manager: Farnaz Delavari	↗	-	-
<b>MRI Cohort : Early psychosis</b> PI: Patric Hagmann / Data manager: Sebastien Tourbier	✓	✓	-
<b>New onboard</b>			
<b>MRI Cohort : Bipolar disorders</b> PI: Camille Piguet / Data manager: To be determined	-	-	-
	Goal in 1 year		

Not listed but wish to join? Please contact us!  
**Any MRI or EEG cohort is welcome!**

**THANK YOU FOR YOUR ATTENTION!**