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# Data sharing: towards large open datasets in brain imaging

Camille Maumet

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**HAL Id: hal-04534429**

**<https://inria.hal.science/hal-04534429v1>**

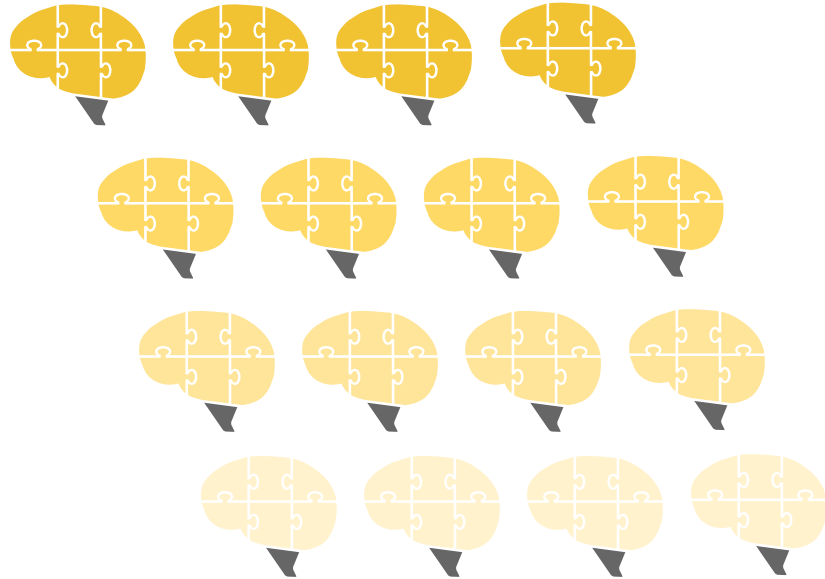
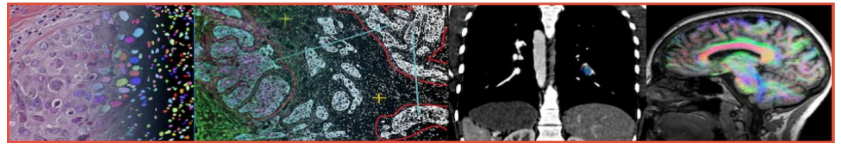
Submitted on 5 Apr 2024

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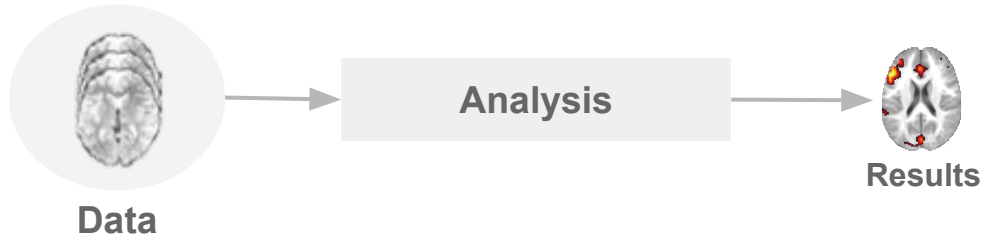
Partage de données : vers de  
larges bases de **données**  
**ouvertes** en neuroimagerie

—  
Data sharing: towards large **open**  
**datasets** in brain imaging

Camille Maumet

Inria, Univ Rennes, Inserm, CNRS, IRISA

# Reproducible research



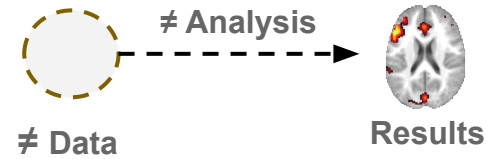
# Reproducible research

Original study



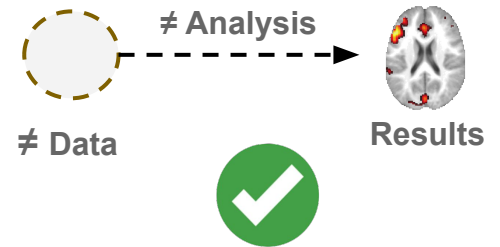
# Reproducible research

## Original study



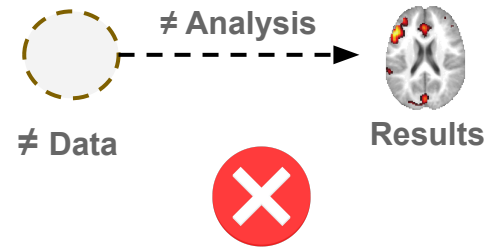
# Reproducible research

Original study

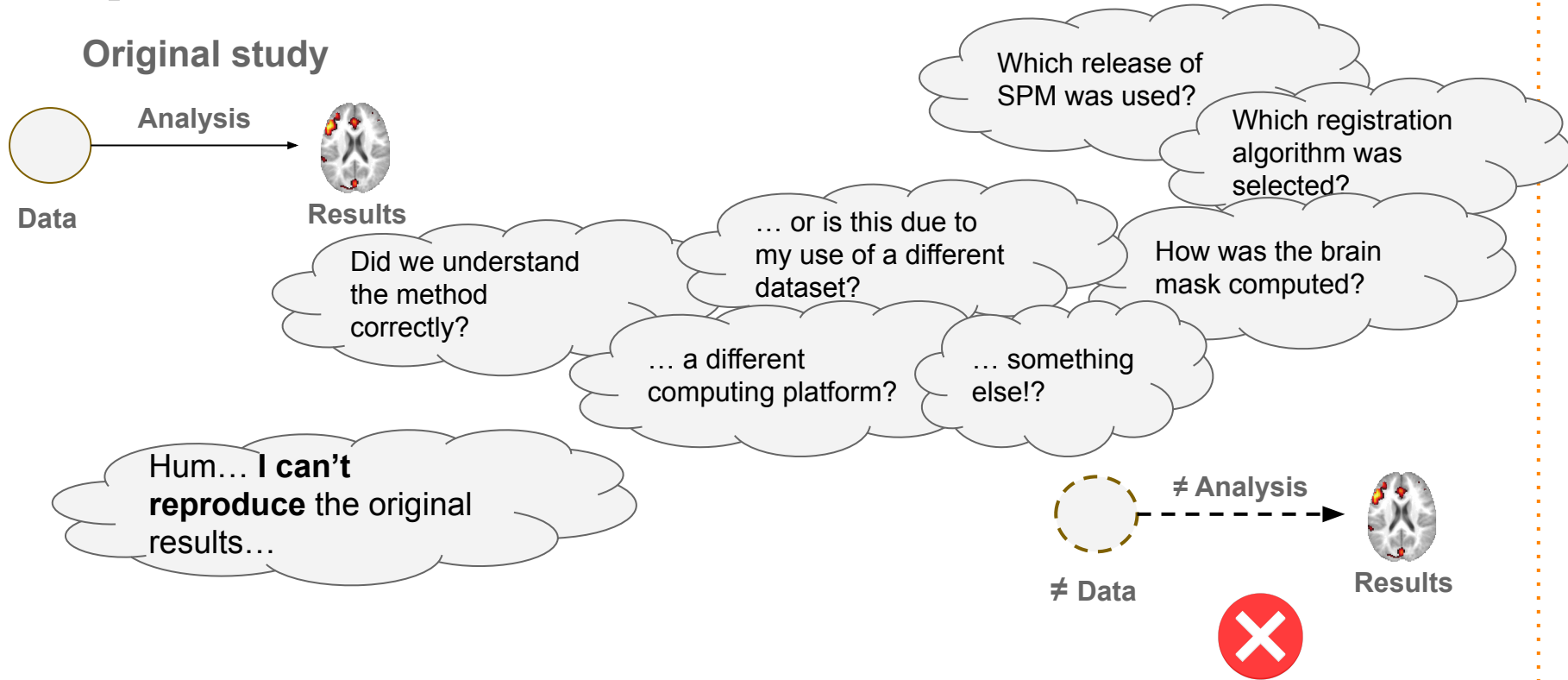


# Reproducible research

Original study

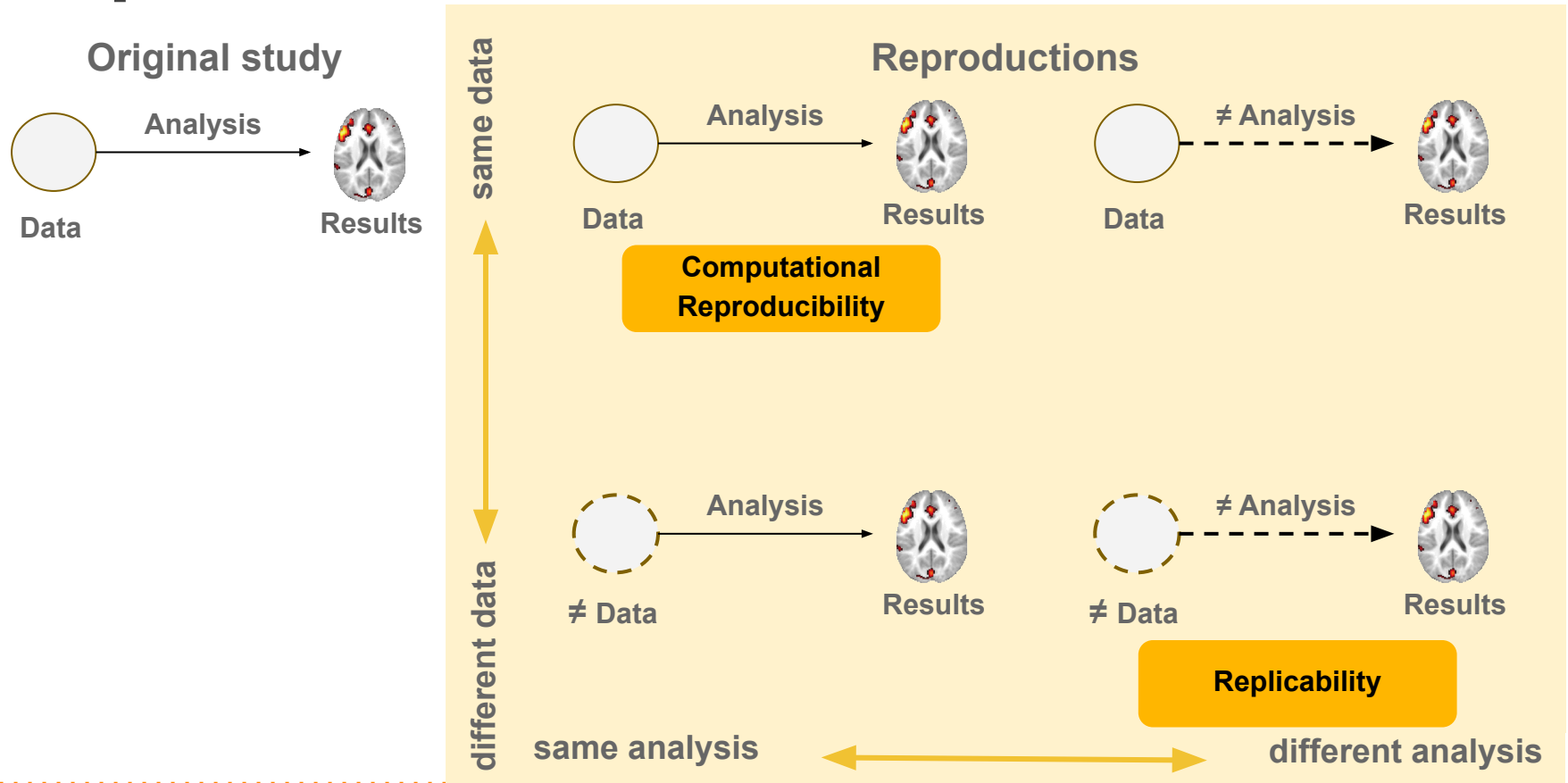


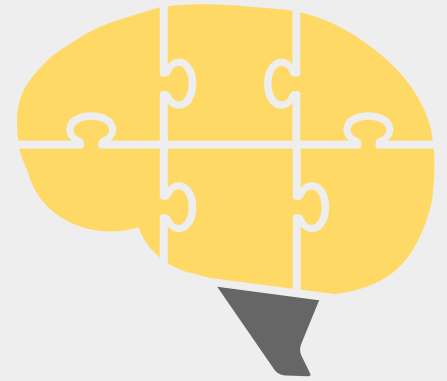
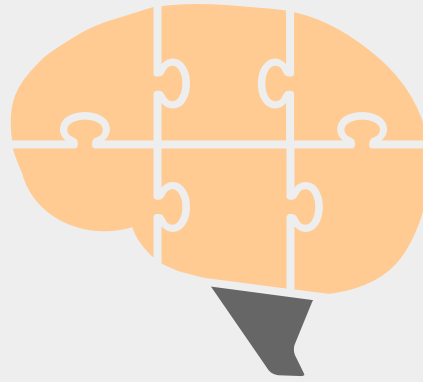
# Reproducible research





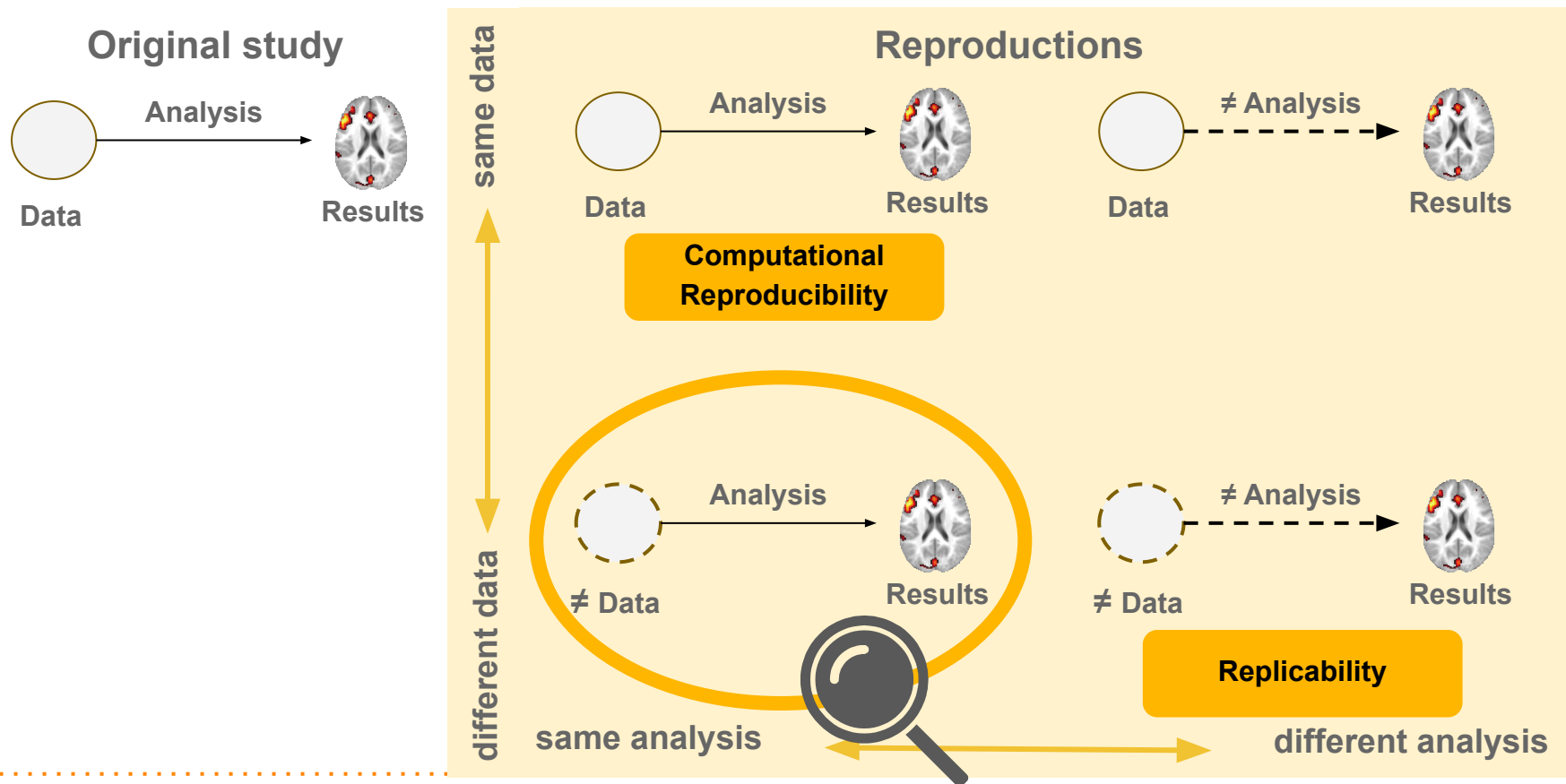
# Reproducible research





On our way to fix  
**reproducibility...**

# Reproducible research

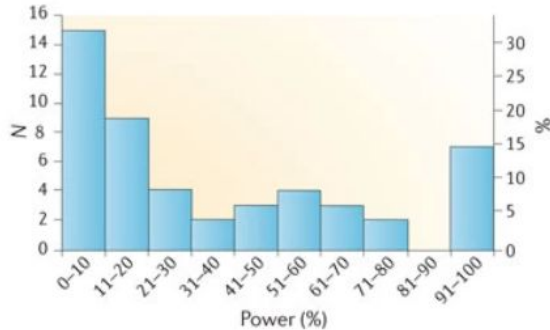


# Fixing reproducibility for different data

## Small samples

## Low statistical power

Power of neuroscience studies



(Button, Nat. Rev. Neurosci. 2013)

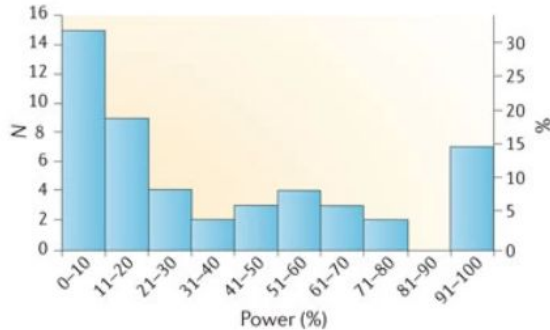
High rate of **false positives** in  
the literature

# Fixing reproducibility for different data

## Small samples

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(Button, Nat. Rev. Neurosci. 2013)

High rate of **false positives** in the literature

## Lack of representativity and diversity of the samples

X-ray: Lung opacity detection

Model trained on male images, tested on female images



(Larrazabal, PNAS 2020)

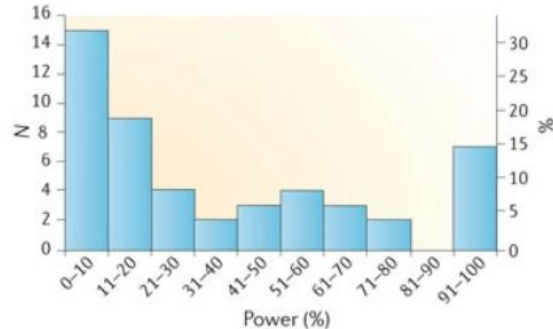
Lack of **generalisability** and **fairness**

# Fixing reproducibility for different data

## Small samples

## Low statistical power

Power of neuroscience studies



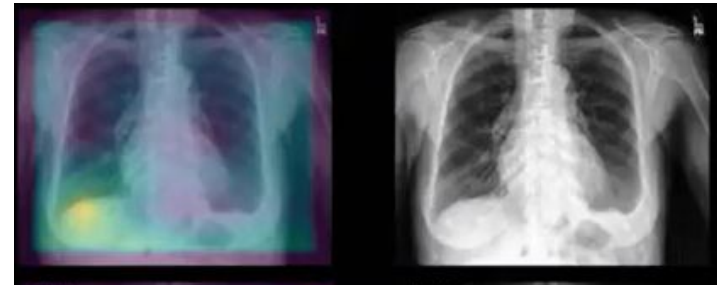
(Button, Nat. Rev. Neurosci. 2013)

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## Lack of representativity and diversity of the samples

X-ray: Lung opacity detection

Model trained on male images, tested on female images



(Larrazabal, PNAS 2020)

Lack of **generalisability** and **fairness**

**Solution: Data Sharing**

# Neuroimaging data sharing

## Single study

30 sub.



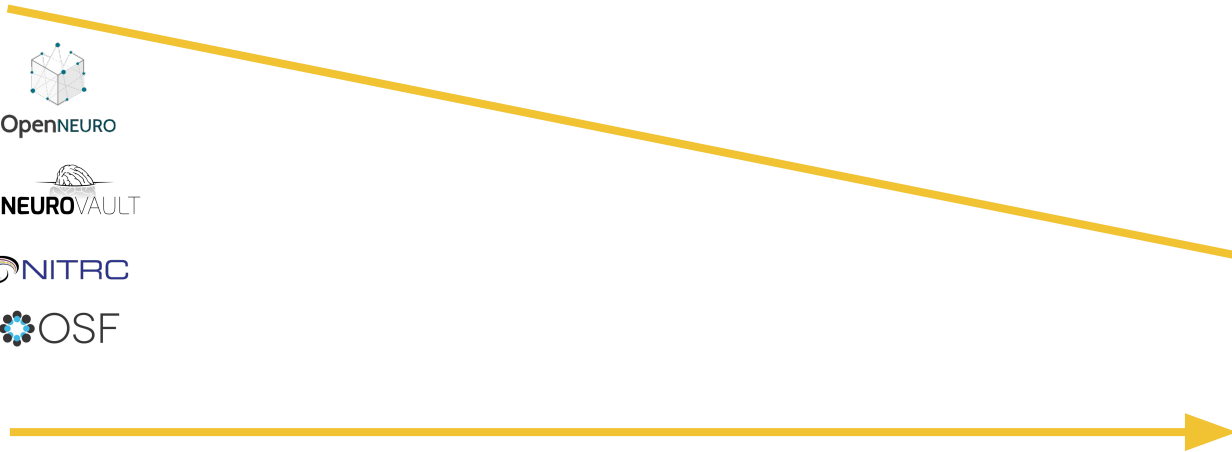
OpenNEURO



NEUROVAULT

NITRC

OSF



# Neuroimaging data sharing

## Single study

30 sub.



OpenNEURO



NEUROVAULT

NITRC



OSF

## Consortium

1000 sub.



ABIDE  
Autism Brain Imaging  
Data Exchange



CORR  
CONSORTIUM FOR  
RELIABILITY AND  
REPRODUCIBILITY



1000 Functional  
Connectomes Project



# Neuroimaging data sharing

## Single study

30 sub.



OpenNEURO



NEUROVAULT



## Consortium

1000 sub.



ABIDE  
Autism Brain Imaging  
Data Exchange



CORR  
CONSORTIUM FOR  
RELIABILITY AND  
REPRODUCIBILITY



1000 Functional  
Connectomes Project



HUMAN  
Connectome  
PROJECT



Adolescent Brain Cognitive Development®  
Teen Brains. Today's Science. Brighter Future.

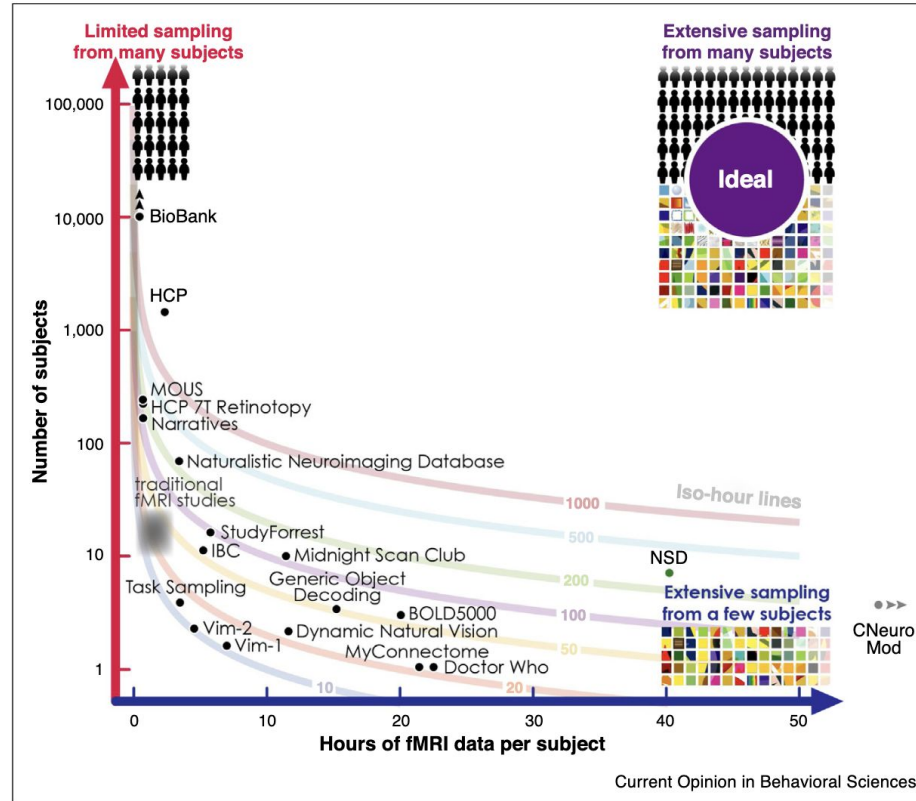
## Cohort

100 000 sub.

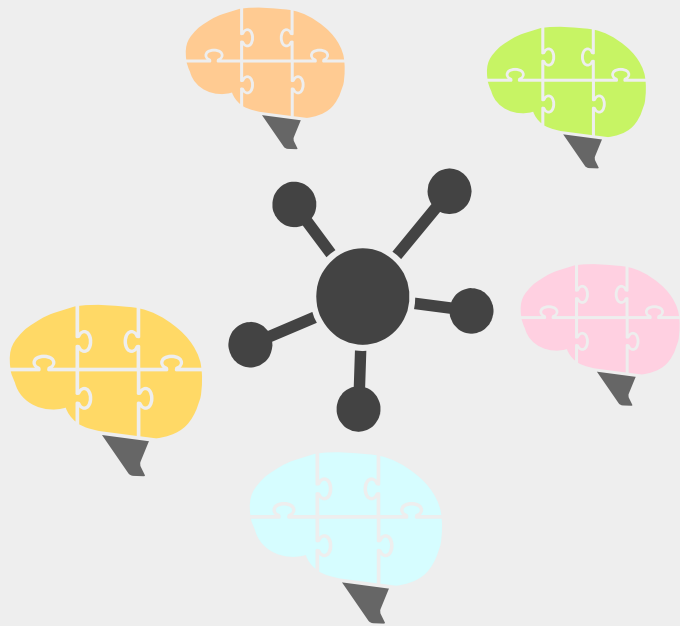


++ participants  
++ homogeneous  
-- instances

# Neuroimaging data sharing



(Nasalaris, Curr. Opin. Behav. Sci. 2021)



# Opening up neuroimaging data

# Sharing FAIR datasets



# Sharing FAIR datasets



OpenNEURO



LORIS

*Donders Repository*



**Findable** we can search for open datasets in common repositories

# Sharing FAIR datasets



OpenNEURO



LORIS

*Donders Repository*



**Findable** we can search for open datasets in common repositories



**Accessible** Direct download (e.g. *Openneuro*) or with Data User Agreement (e.g. *Donders*)

# Data sharing and privacy

Are neuroimages anonymous?



Cyril Pernet  
Copenhagen Uni Hosp  
(Denmark)



Stephan Heunis  
Hosp Rsrch Ctr Jülich  
(Germany)

(Open Brain Consent, HBM 2021)

# Data sharing and privacy

## Are neuroimages anonymous?



Name: Depont  
First : Nathalie  
Birth date : 10/11/1995  
...



Cyril Pernet  
Copenhagen Uni Hosp  
(Denmark)



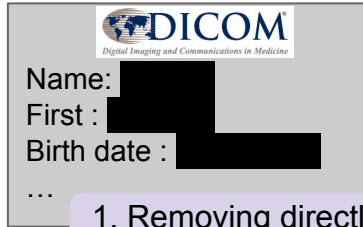
Stephan Heunis  
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# Data sharing and privacy

## Are neuroimages anonymous?



1. Removing directly identifiable information



Cyril Pernet  
Copenhagen Uni Hosp  
(Denmark)

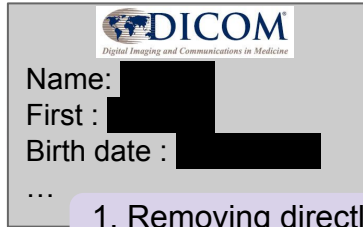


Stephan Heunis  
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# Data sharing and privacy

## Are neuroimages anonymous?



1. Removing directly identifiable information



2. Defacing



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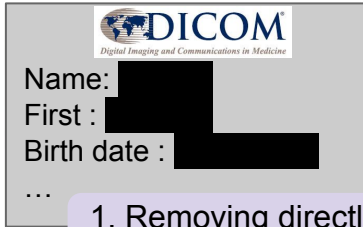
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## Are neuroimages anonymous?



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Anonymous (USA)

(Open Brain Consent, HBM 2021)

# Data sharing and privacy



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## Are neuroimages anonymous?



1. Removing directly identifiable information



2. Defacing



Anonymous (USA)

Not anonymous (EU)

**General Data Protection Regulation (GDPR)** → Individualisation

(Open Brain Consent, HBM 2021)

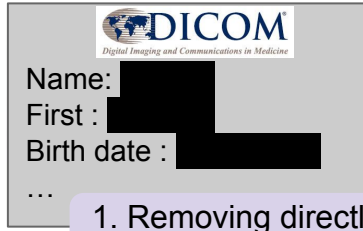
# Data sharing and privacy



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Copenhagen Uni Hosp Rsrch Ctr Jülich  
(Denmark)

Stephan Heunis  
Copenhagen Uni Hosp Rsrch Ctr Jülich  
(Germany)

## Are neuroimages anonymous?



1. Removing directly identifiable information



2. Defacing



Anonymous (USA)

Not anonymous (EU)

**General Data Protection Regulation (GDPR)** → Individualisation

## Open Brain Consent GDPR edition

### Consent form

Signed by participants

“[...] **data might also be used for other future research projects** in the field of medical and cognitive neuroscience.”

### Data User Agreement

Signed by researchers

“[...] I will **not attempt to [...] retrieve the identity** of the study participants.”

(Open Brain Consent, HBM 2021)

French



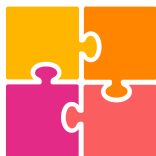
Anne Hespel  
CHU Rennes



Elise Bannier  
CHU Rennes

**13 languages:** Bosnian, Czech, German, Greek, Spanish, Finnish, French, Italian, Dutch, Norwegian, Portuguese, Turkish

# Sharing FAIR datasets



**Interoperable?**



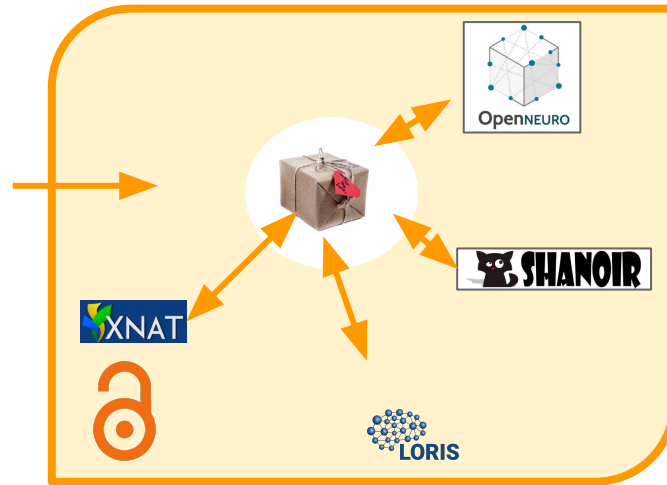
**Findable** we can search for open datasets in common repositories



**Accessible** Direct download (e.g. Openneuro) or with Data User Agreement (e.g. Donders)

# Standards for data sharing

- Data and **meta-data**
- A common “language”





# Community standardization efforts



Chris  
Gorgolewski  
Stanford Uni. (USA)



**Brain Imaging Data Structure**  
File naming conventions + JSON sidecars

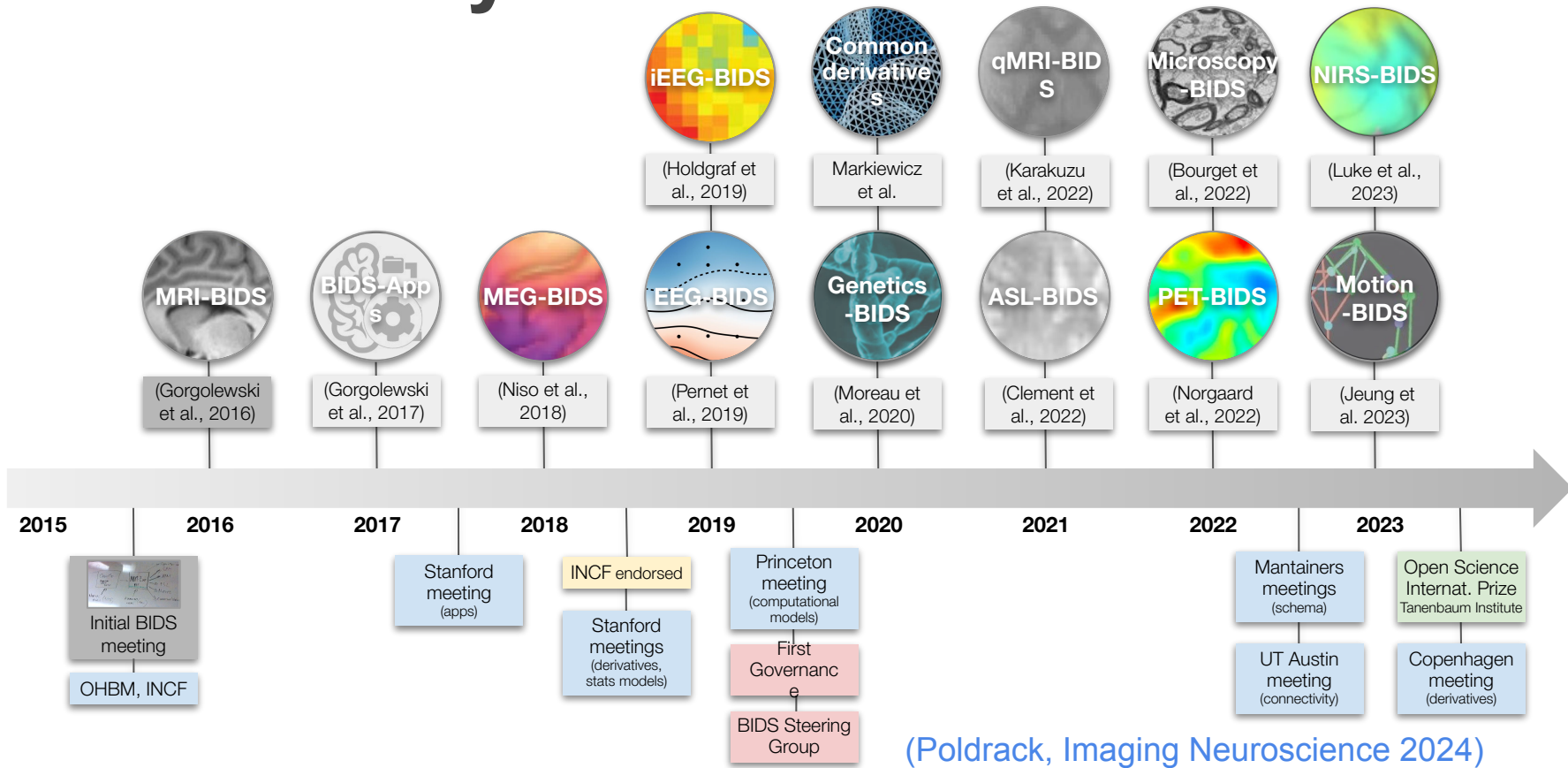
```
my_dataset/
├── participants.tsv
├── sub-01/
│   ├── anat/
│   │   └── sub-01_T1w.nii.gz
│   ├── func/
│   │   ├── sub-01_task-rest_bold.nii.gz
│   │   └── sub-01_task-rest_bold.json
│   └── dwi/
│       ├── sub-01_dwi.nii.gz
│       ├── sub-01_dwi.json
│       ├── sub-01_dwi.bval
│       └── sub-01_dwi.bvec
├── sub-02/
└── sub-03/
```

>1 million BIDS-compliant  
images in 2024

Source: [MRIQC Api](#)

(Gorgolewski, *Sci. Data* 2016)

# BIDS history timeline

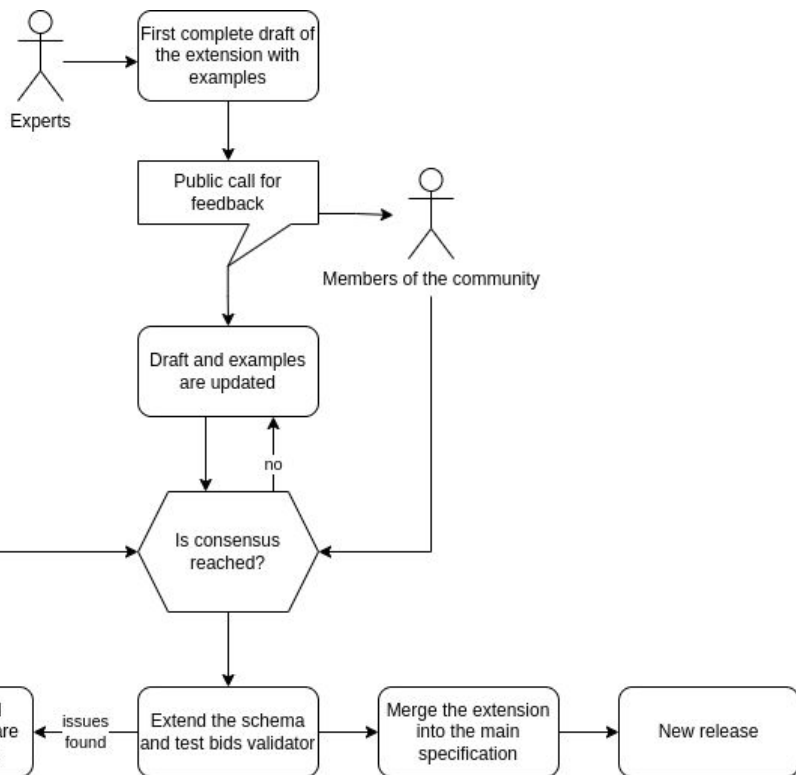


# Extending BIDS

## BIDS maintainers



## BIDS steering



<https://bids-extensions.readthedocs.io/en/latest/guide/>

# Sharing FAIR datasets

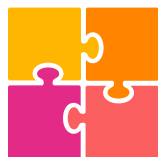


OpenNEURO



LORIS

*Donders Repository*



**Interoperable?**



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# Sharing FAIR datasets

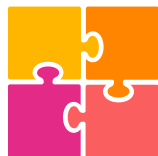


OpenNEURO



LORIS

*Donders Repository*



**Interoperable** BIDS can act as a common languages across tools



**Findable** we can search for open datasets in common repositories



**Accessible** Direct download (e.g. Openneuro) or with Data User Agreement (e.g. Donders)

# Sharing FAIR datasets

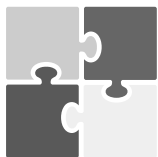


OpenNEURO



LORIS

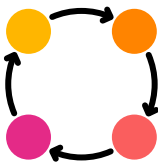
*Donders Repository*



**Interoperable** BIDS can act as a common languages across tools



**Findable** we can search for open datasets in common repositories



**Reusable** Metadata in BIDS were selected to enable reuse. *e.g. onsets of the task for task-based fMRI.*



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# Sharing FAIR datasets



OpenNEURO

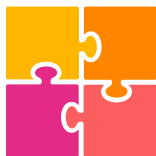


LORIS

*Donders Repository*



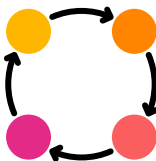
Findable **A**ccessible **I**nteroperable **R**eusable



**Interoperable** BIDS can act as a common languages across tools



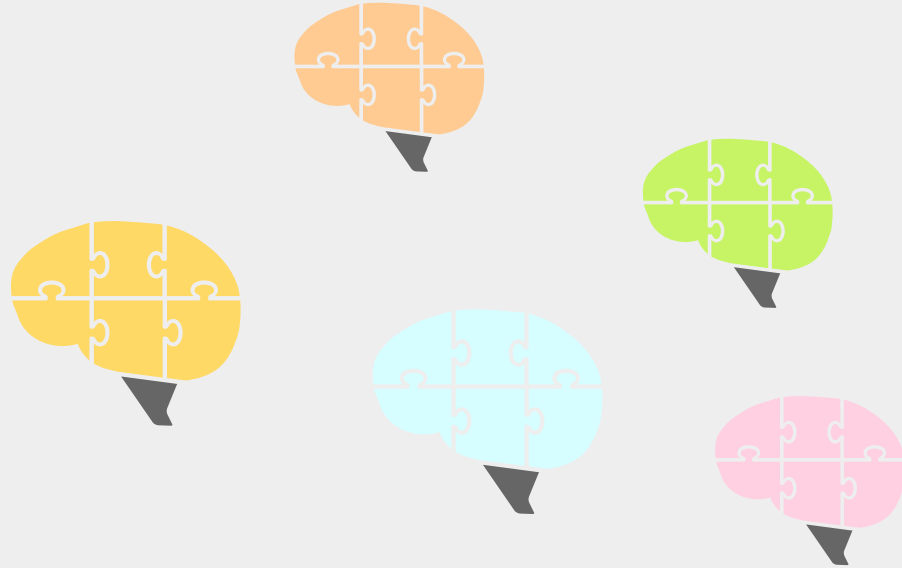
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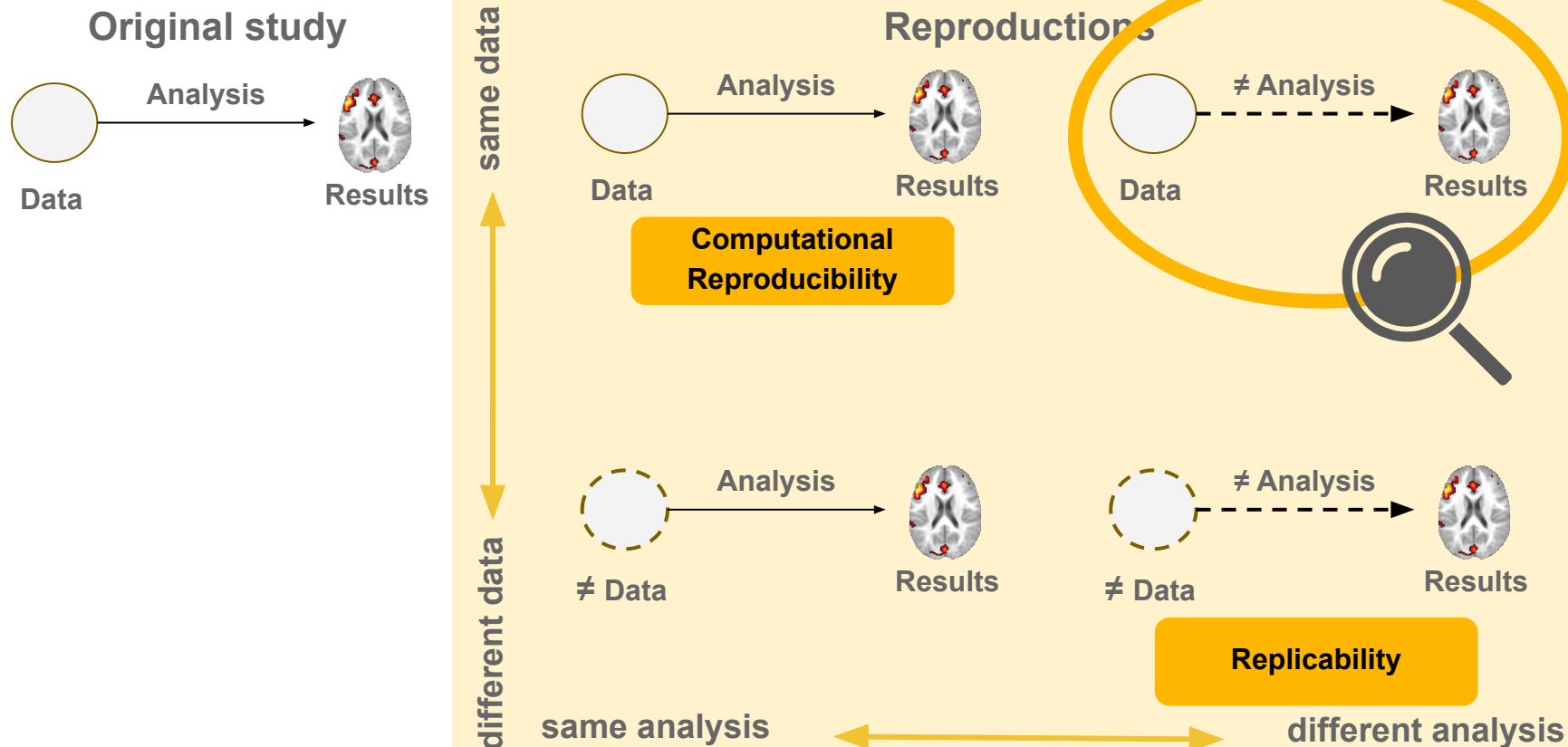
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**More on** reproducibility...



# Reproducible research

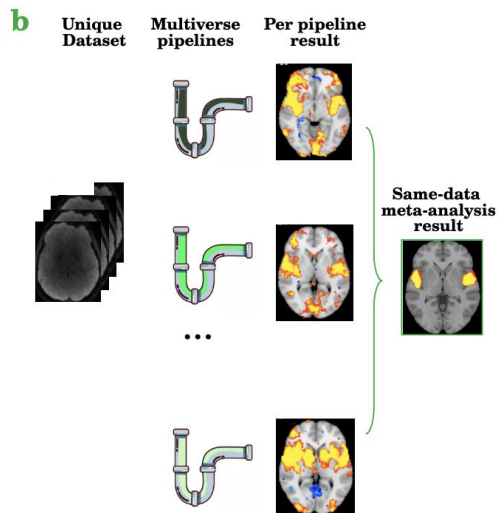


# Dealing with analytical variability

## Multiverse analyses



Jérémy  
Lefort-Besnard

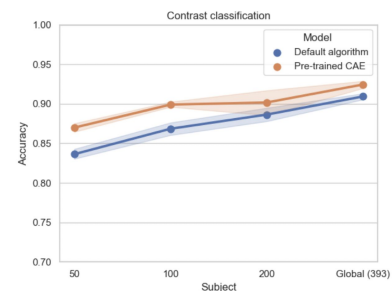
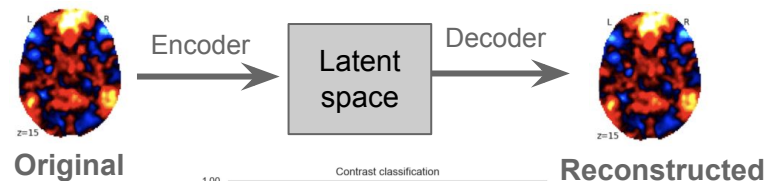


(Lefort-Besnard, OHBM 2024)

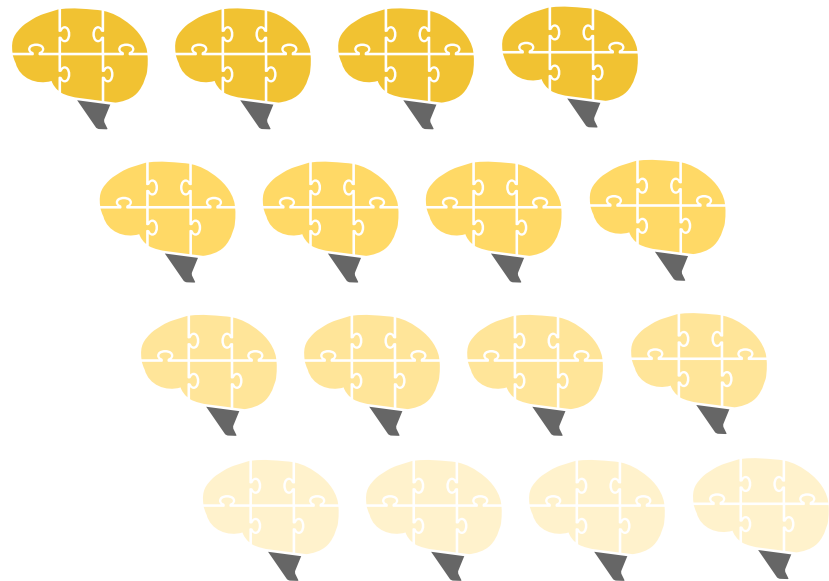
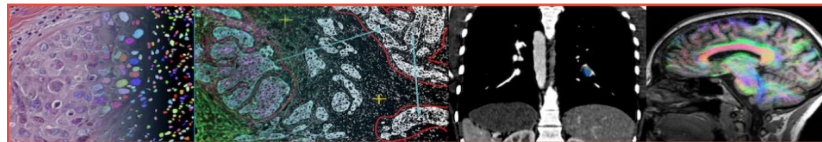
## Leveraging large and open datasets



Elodie  
Germani



(Germani, Gigascience 2023)



Data sharing towards  
building large **open**  
**datasets** in brain imaging

**Camille Maumet**

Thank you!

**Supported by:** Inria Aex, Région Bretagne, ANR JCJC

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[SlidesCarnival](#), adapted

 [@cmaumet@fediscience.org](mailto:@cmaumet@fediscience.org)

 [@cmaumet.bsky.social](#)