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Reproductibilité en neuroimagerie: état des lieux

Camille Maumet

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Réseau de la recherche reproductible
Journées Recherche reproductible: état des lieux

Reproductibilité en
neuroimagerie:
état des lieux

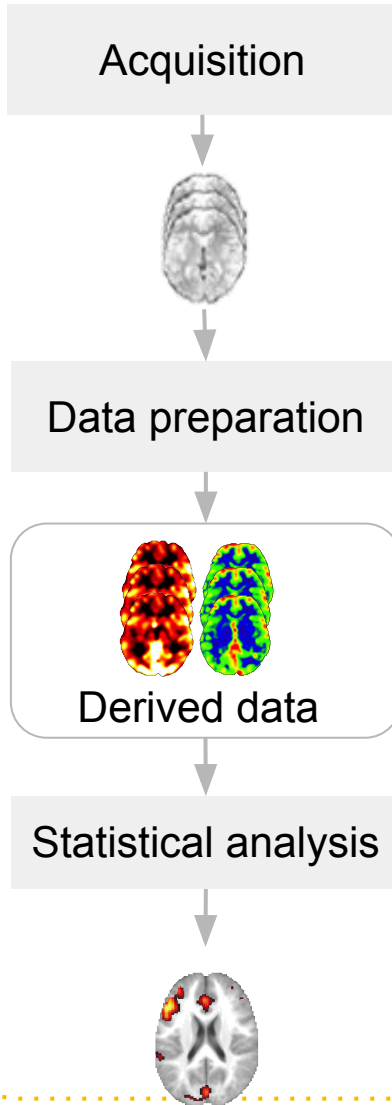
8 mars 2023

Camille Maumet

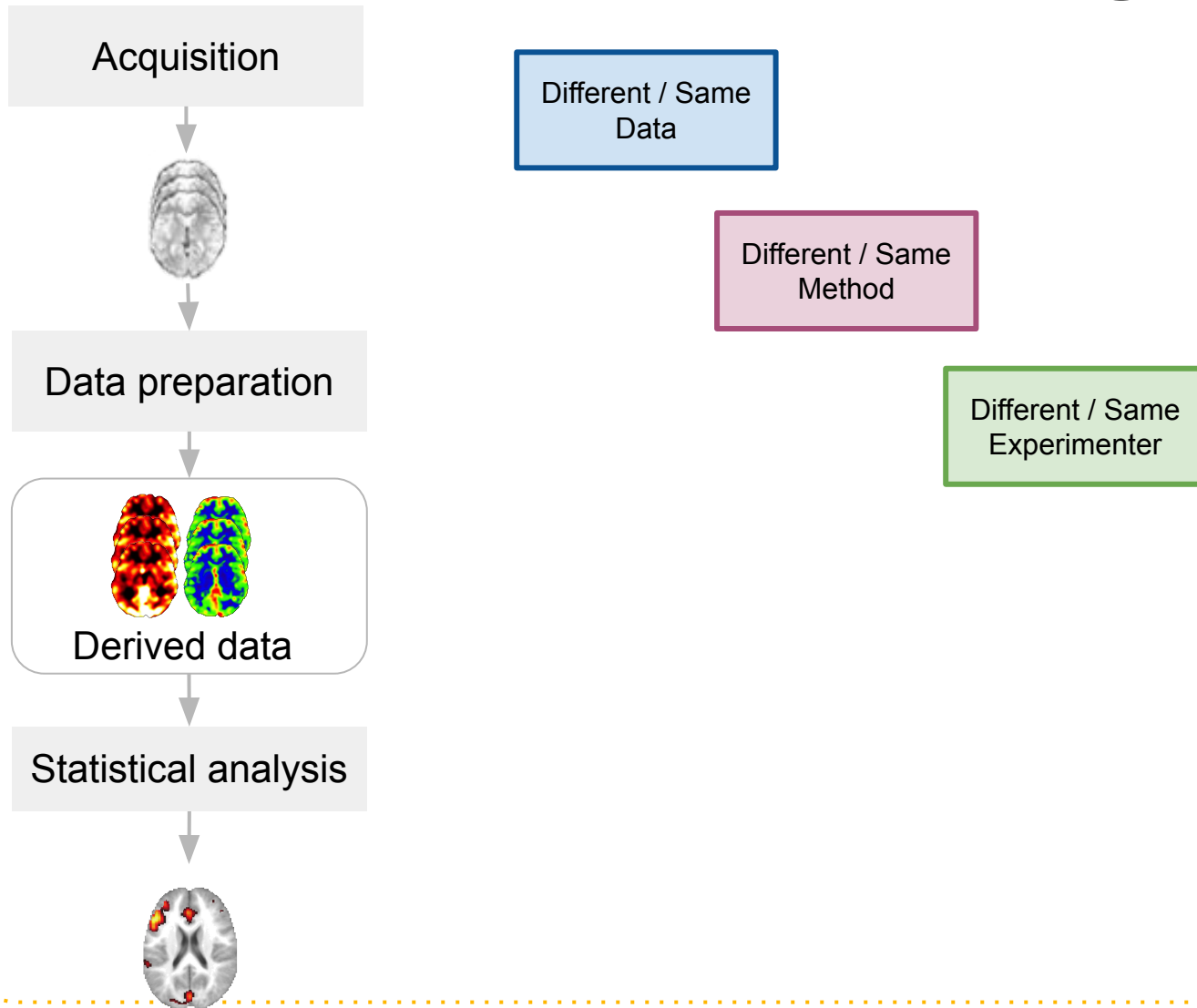
Univ Rennes, Inria, CNRS, Inserm

IL
ECINE • NEUROSCIENCE • MATHEMATIQUES
ISTOIRE • DROIT • ECONOMIE • PHILOSOPHIE
S • GENETIQUE • ASTRONOMIE • ECOLOGIE
ANTHROPOLOGIE • PSYCHOLOGIE • PHYSIQUE
CHIMIE • BIOLOGIE • SOCIOLOGIE • INFORMATIQUE
• MEDECINE • NEUROSCIENCE • CHIMIE
JE • HISTOIRE • DROIT • ECONOMIE • CHIMIE
E • RECHERCHE-REPRODUCTIBLE • FR • PH
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DECINE • NEUROSCIENCE • ECONOMIE • A
PIDEMIOLOGIE • HISTOIRE • ECONOMIE • A
HEMATIQUES • MECANIQUE • GENETIQUE • A
INSTITUT PASTEUR
8 & 9 MARS 2023
IENCE • RECHERCHE • ROBUSTE • REPLICABLE
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E • SCIENCE • ETAT • ECHANTILLON • ROBU
ICABLE • GENERALISABLE • STATISTIQUES • ANALYSE
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NEES • EXPERIENCE • REPLICABLE • ROBU
RECHERCHE • SCIENCE • REPLICABLE • EXPERIENCE
GENERALISABLE • ANALYSE

Reproducible brain imaging



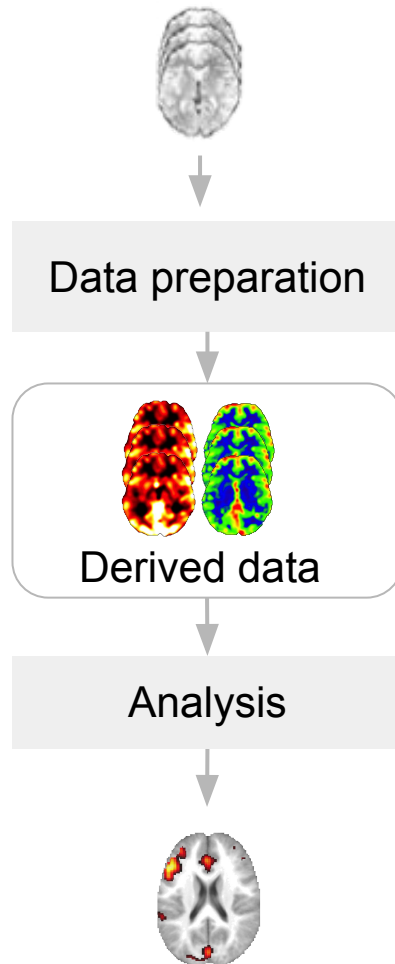
Reproducible brain imaging



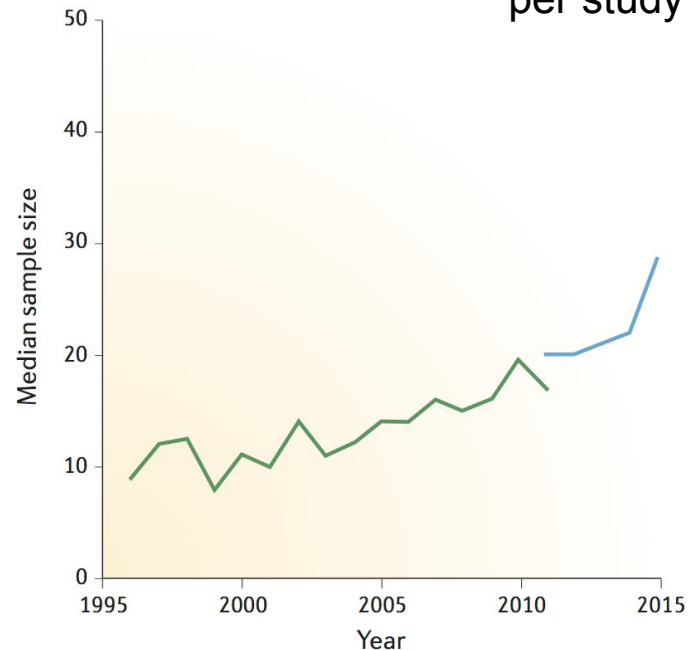
Towards **reproducible** neuroimaging

Irreproducible with...

Different Data



about 30 participants
per study



[Poldrack et. al, Nature Neuroscience 2017]

Towards **reproducible** neuroimaging

Irreproducible with...

Different Data

Towards **reproducible** neuroimaging

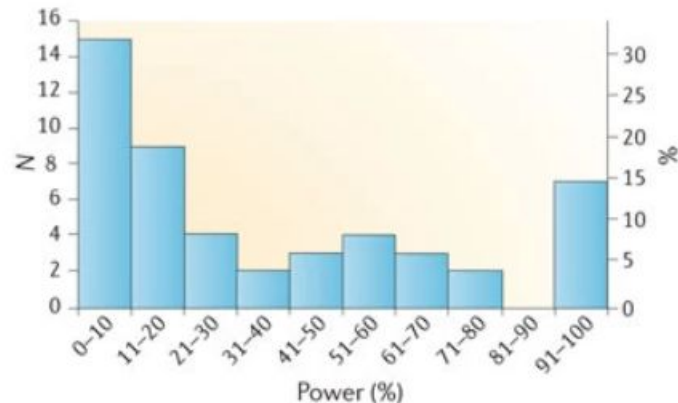
Irreproducible with...

Different Data

Lack of power

Power of neuroscience studies

Power = Prob. to correctly find a significant effect when a the alternative hypothesis is true.



[Button et. al, Nat Rev Neurosci 2013]

We need bigger datasets

Towards **reproducible** neuroimaging

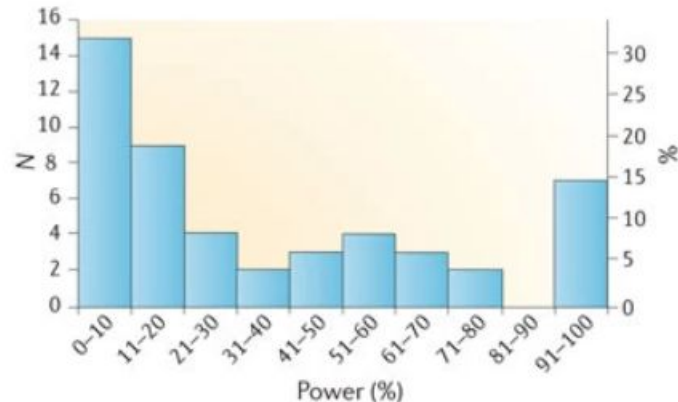
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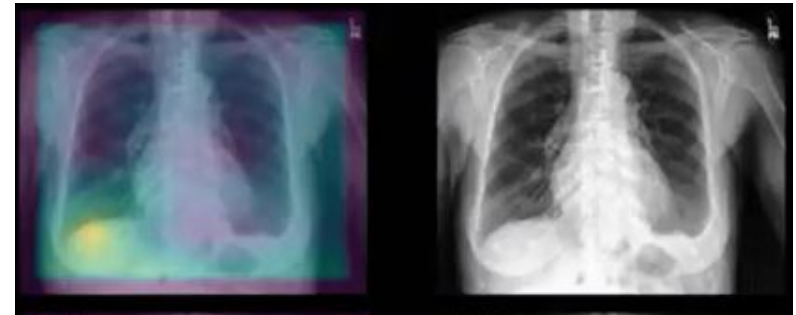


[Button et. al, Nat Rev Neurosci 2013]

Generalizability and fairness

X-ray: Lung opacity detection

Model trained on male images, tested on female images



[Larrazabal et. al, PNAS 2020]

We need bigger datasets

We need representative and diverse datasets



Open data

Unique study
30 participants



OpenNEURO

studyforrest.org



NEUROVAULT

L I E L N L F T Q K T Q R V
S M Y C O N N E C T O M E Q
G S P K K W A R R G K E H R

NITRC

OSF

- + Images
- + Homogenous
- Datasets



Open data

Unique study
30 participants



OpenNEURO

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L I E L N L F T Q K T Q R V
S M Y C O N N E C T O M E Q
G S P K K W A R R G K E H R

Consortium
1000 participants



ABIDE
Autism Brain Imaging
Data Exchange

1000 Functional
Connectomes Project



CORR
CONSORTIUM FOR
RELIABILITY AND
REPRODUCIBILITY



NITRC

OSF

- + Images
- + Homogenous
- Datasets



Open data

Unique study
30 participants



OpenNEURO

studyforrest.org

Consortium
1000 participants



ABIDE
Autism Brain Imaging
Data Exchange

1000 Functional
Connectomes Project



CORR
CONSORTIUM FOR
RELIABILITY AND
REPRODUCIBILITY



Cohort
100 000 participants



HUMAN
Connectome
PROJECT

biobank^{uk}
Improving the health of future generations

NEUROVAULT

L I E L N L F T Q K T Q R V
S M Y C O N N E C T O M E Q
G S P K K W A R R G K E H R

NITRC

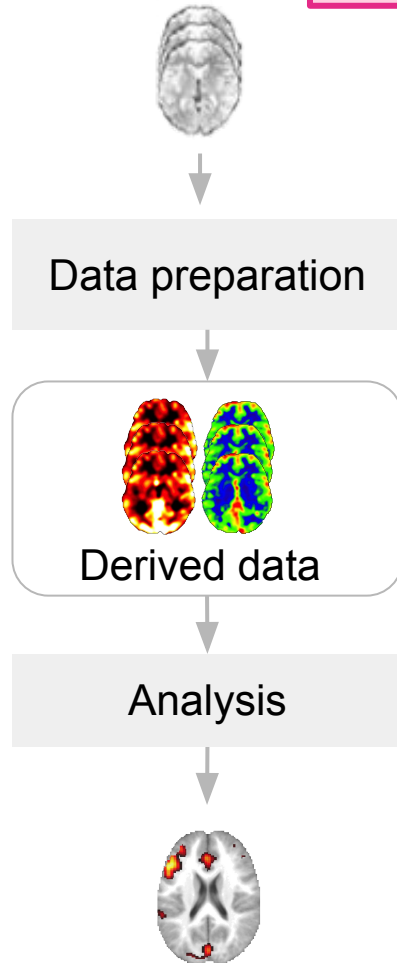
OSF

- + Images
- + Homogenous
- Datasets

On our way **to fix irreproducibility**

Irreproducible with...

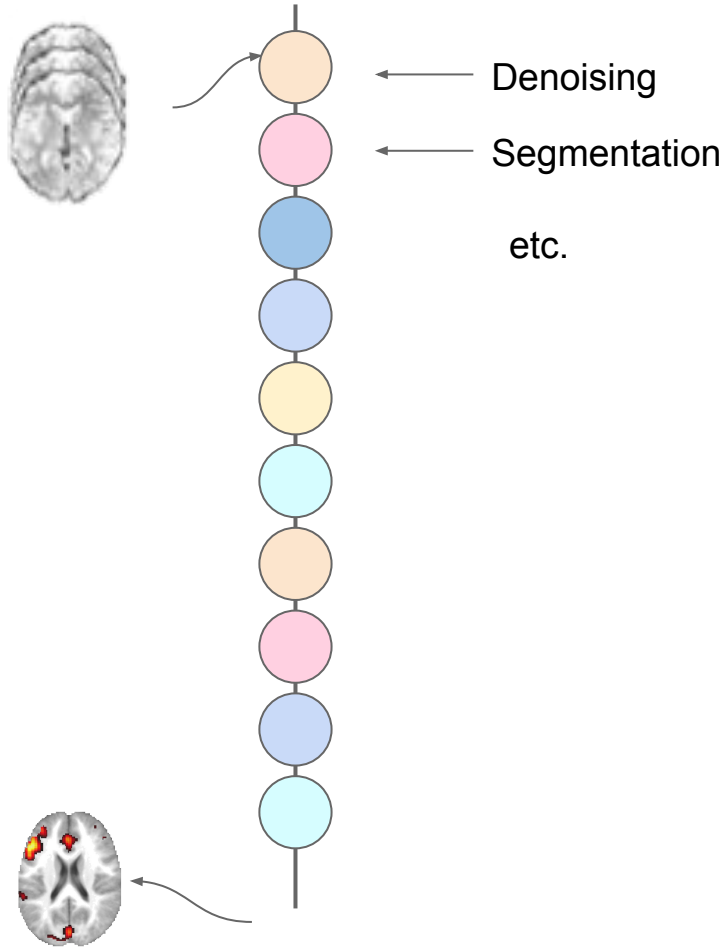
Different Post-processing Methods



On our way **to fix irreproducibility**

Irreproducible with...

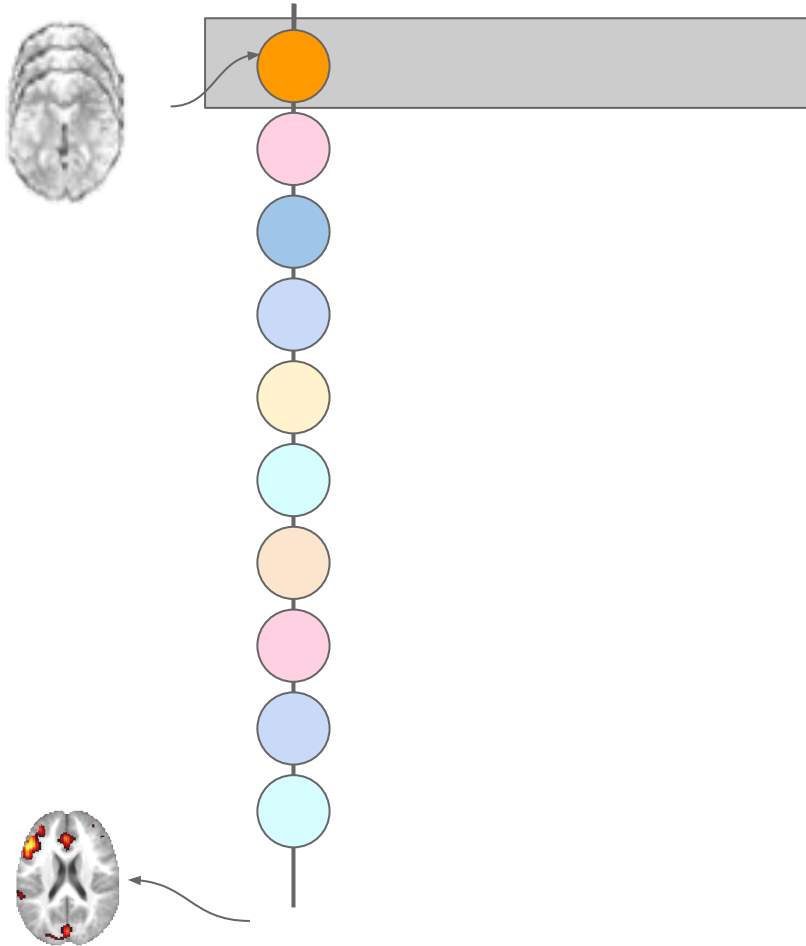
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On our way **to fix irreproducibility**

Irreproducible with...

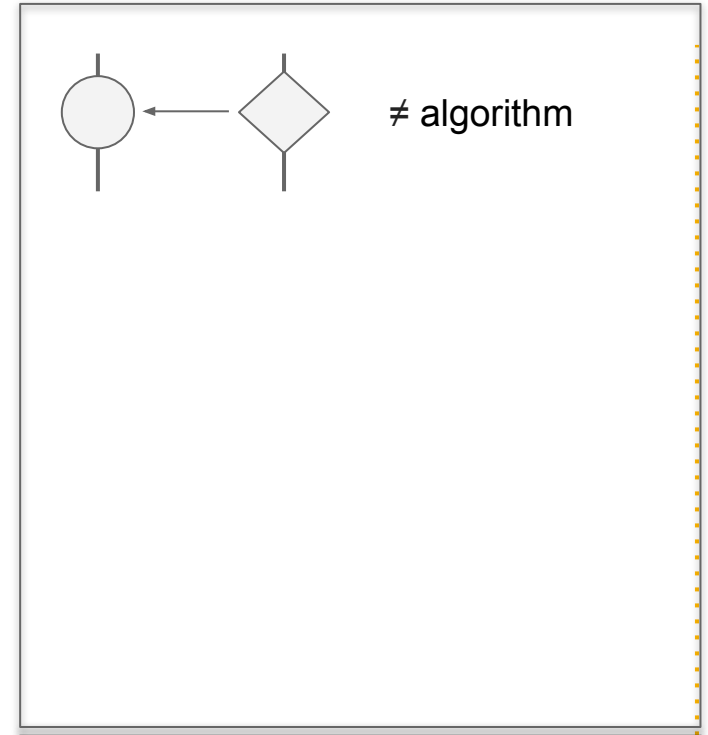
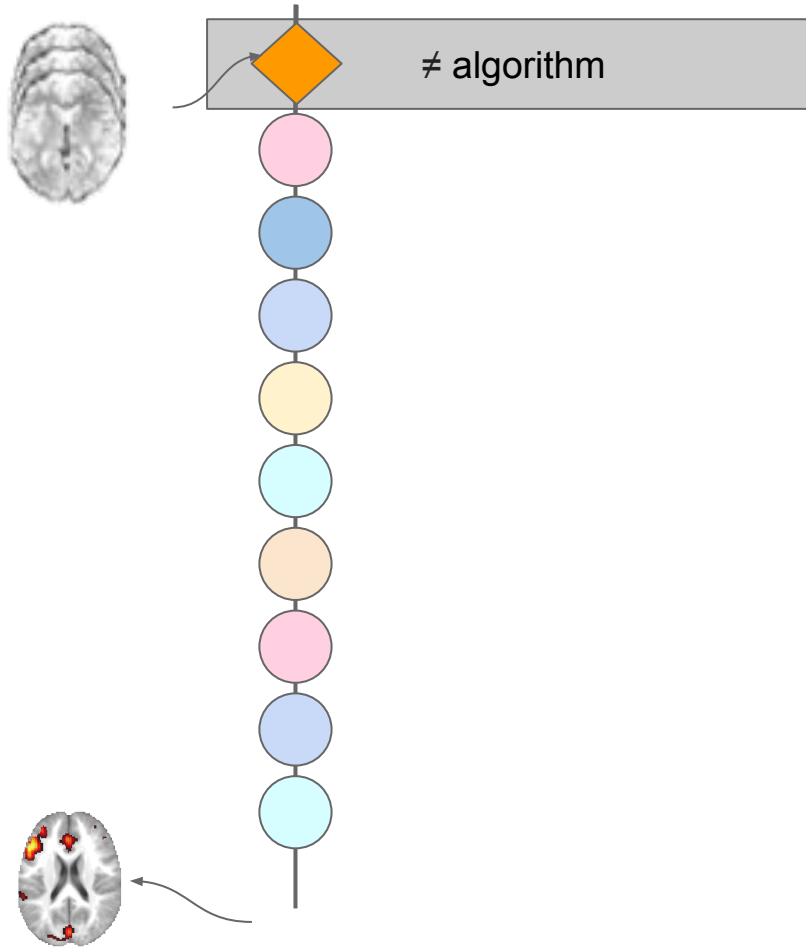
Different Post-processing Methods



On our way **to fix irreproducibility**

Irreproducible with...

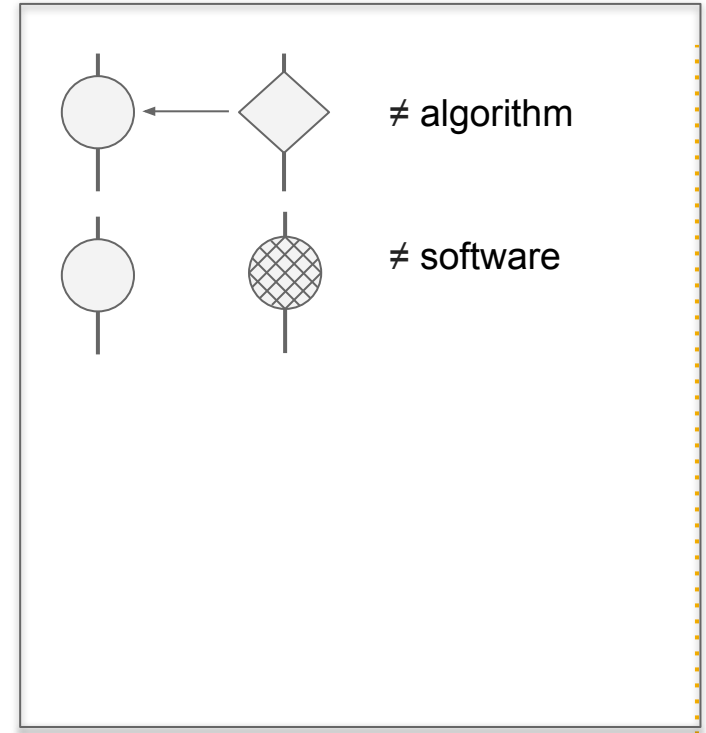
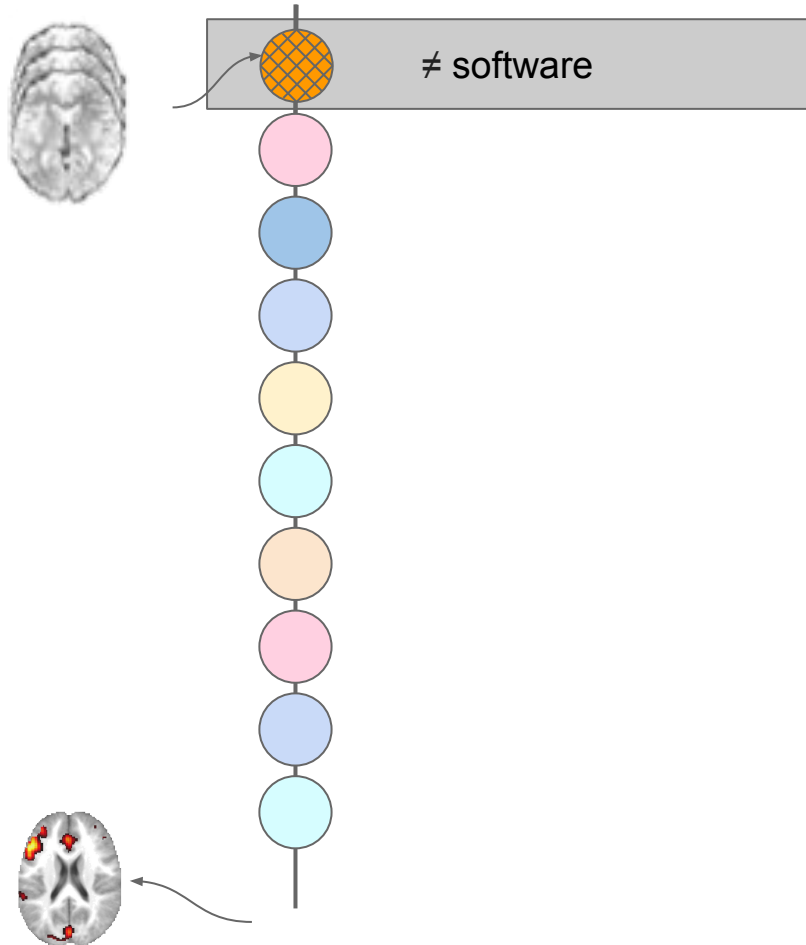
Different Post-processing Methods



On our way **to fix irreproducibility**

Irreproducible with...

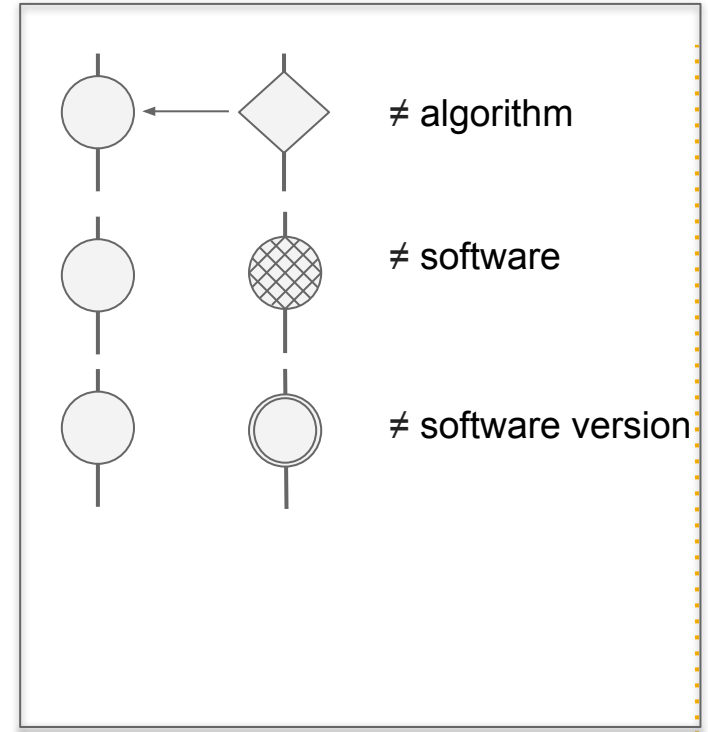
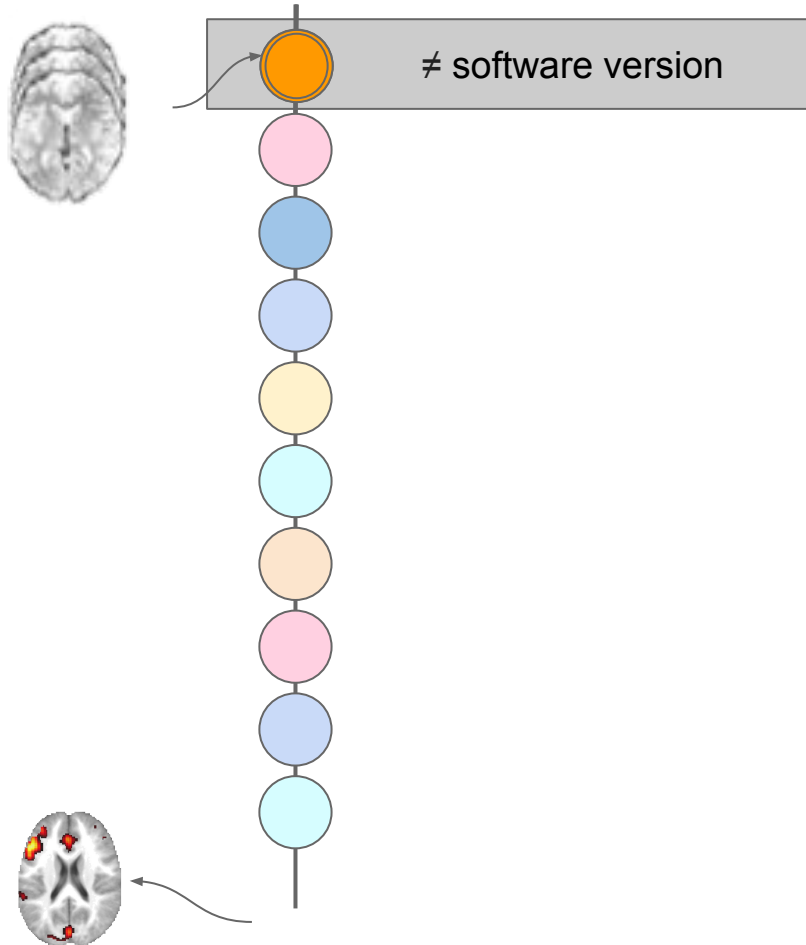
Different Post-processing Methods



On our way **to fix irreproducibility**

Irreproducible with...

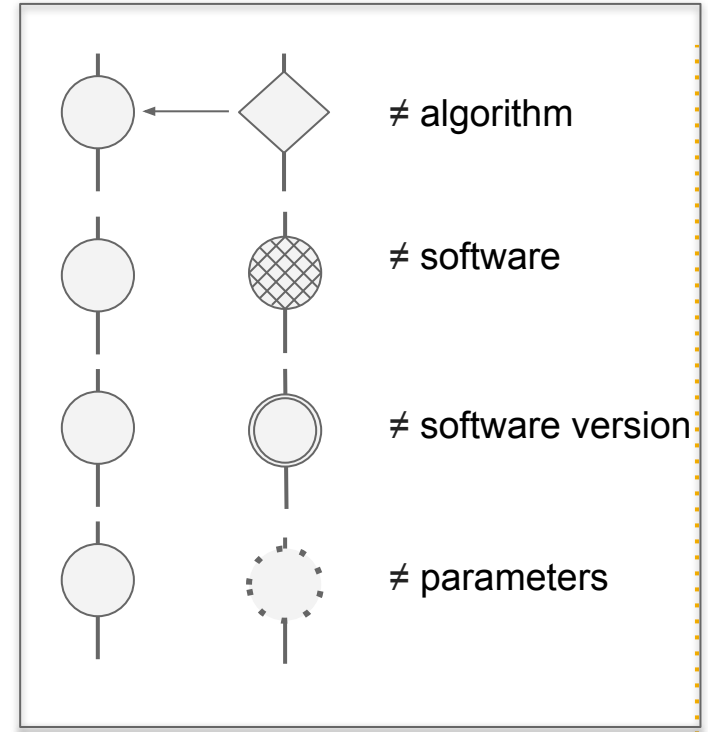
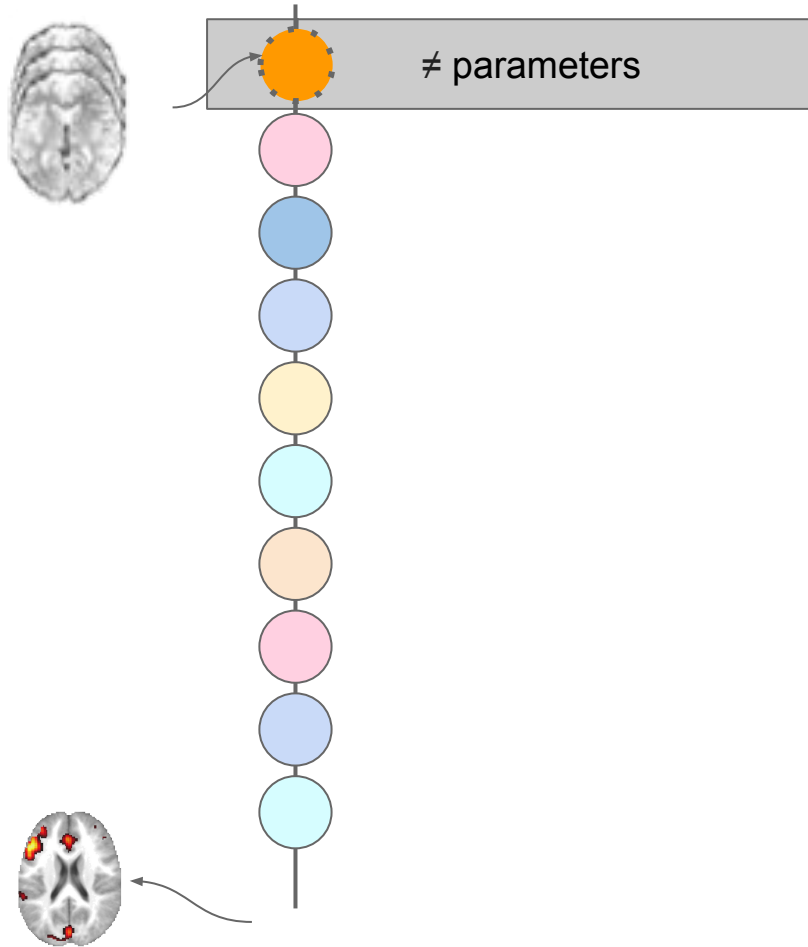
Different Post-processing Methods



On our way **to fix irreproducibility**

Irreproducible with...

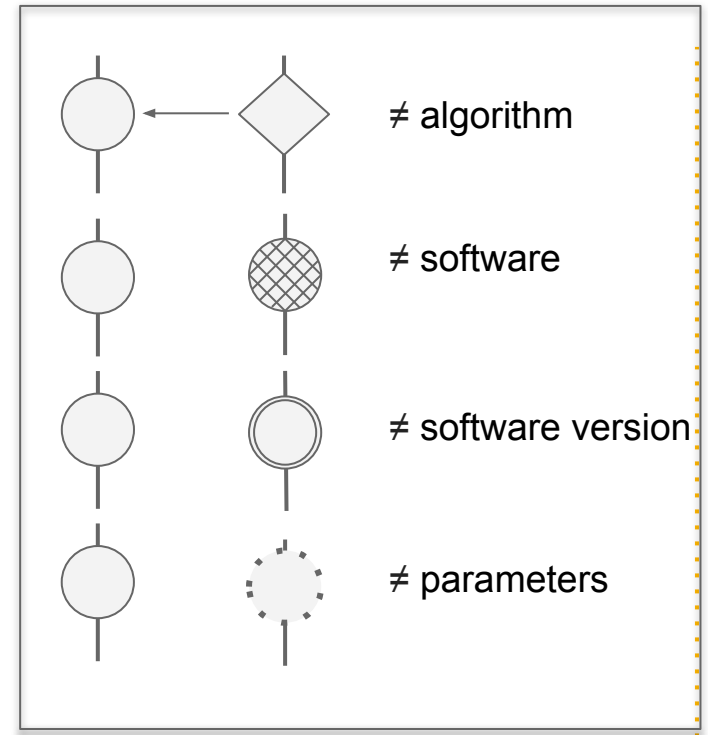
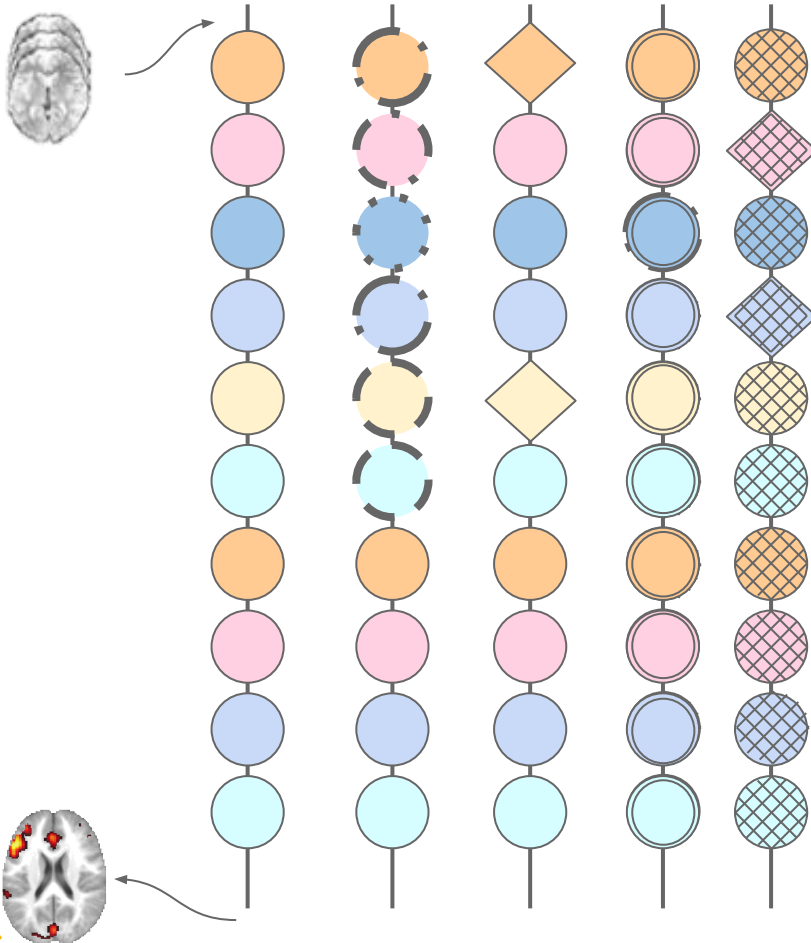
Different Post-processing Methods



On our way to fix irreproducibility

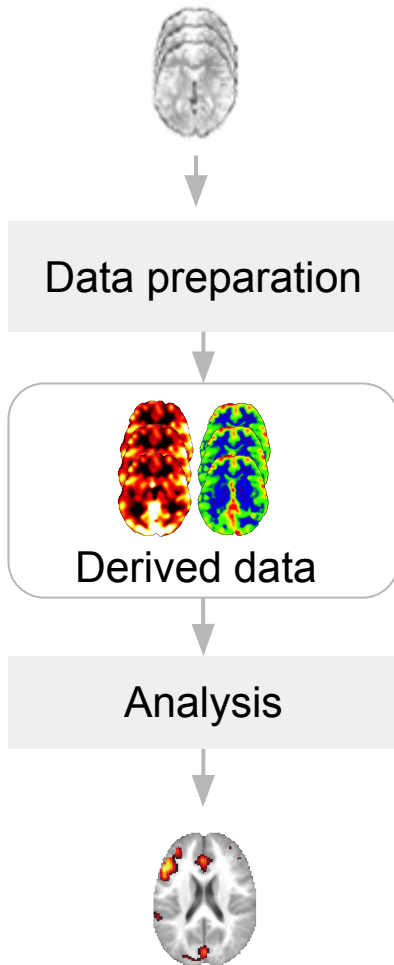
Irreproducible with...

Different Post-processing Methods

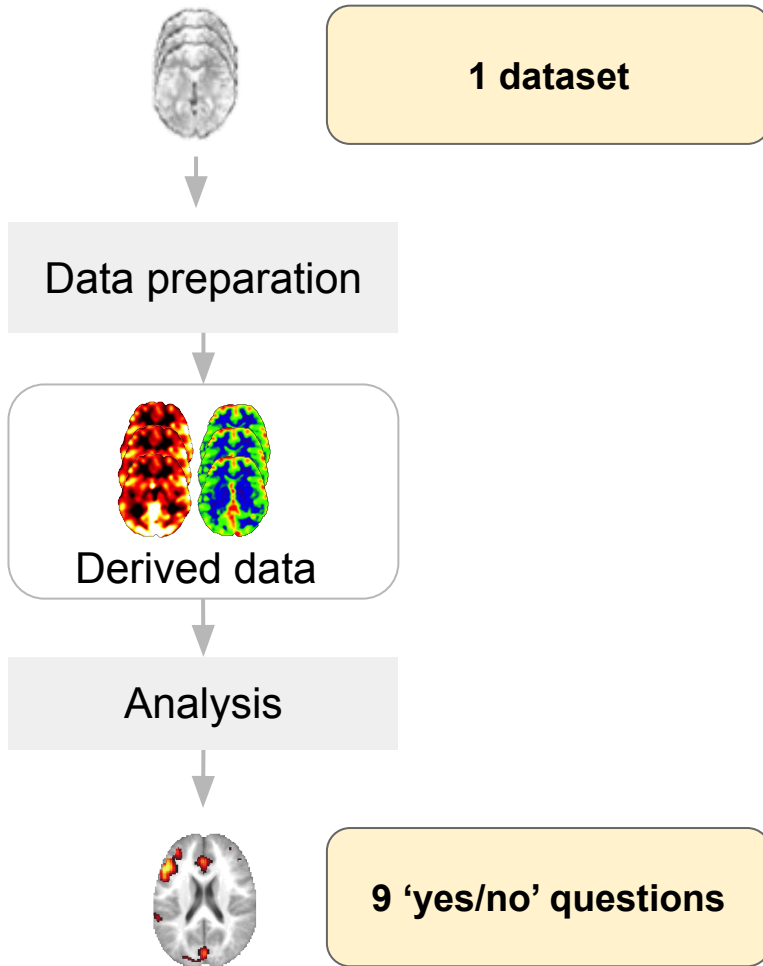


A family of acceptable pipelines
over 10^{30} combinations...

Many analysts project : NARPS

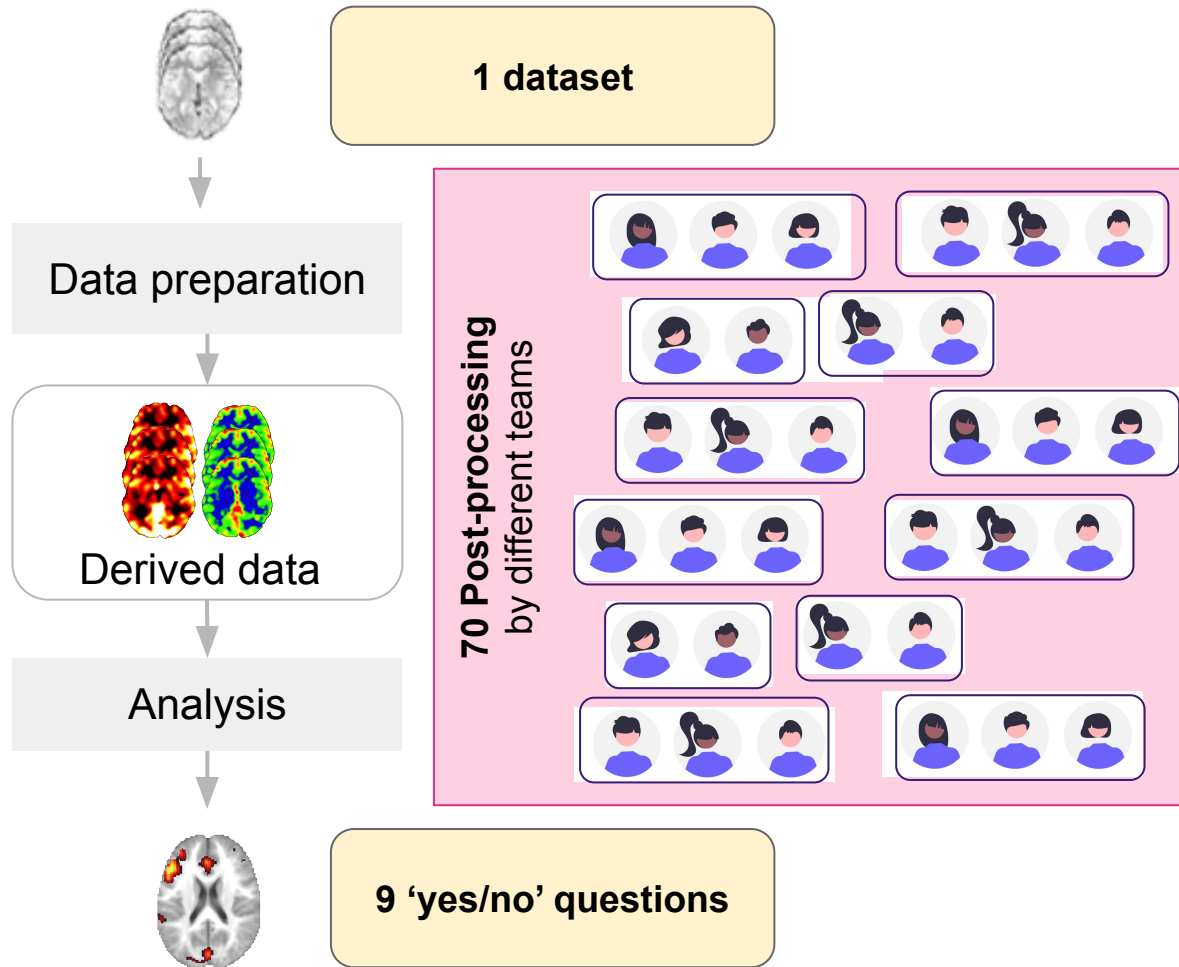


Many analysts project : NARPS



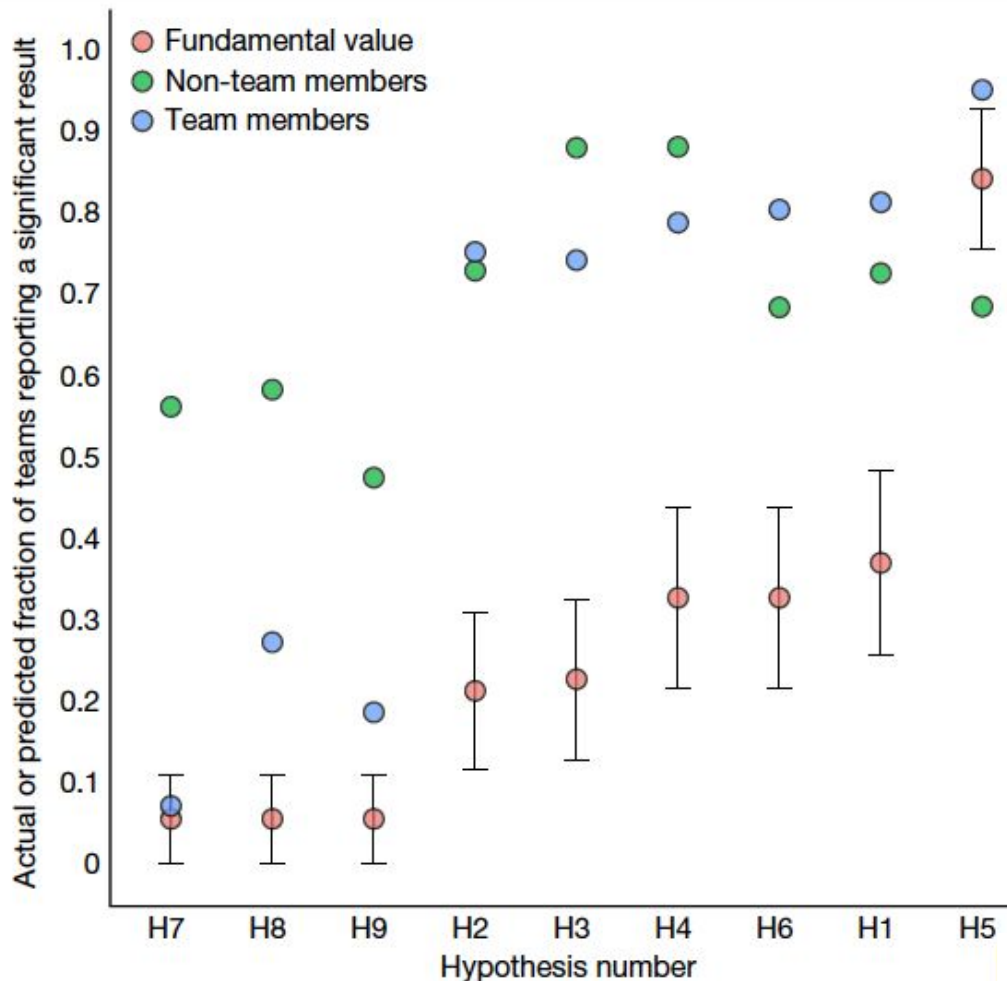
*e.g. Is there a parametric effect of gain:
Positive effect in ventromedial PFC -
for the equal indifference group?*

Many analysts project : NARPS



Many analysts project : NARPS

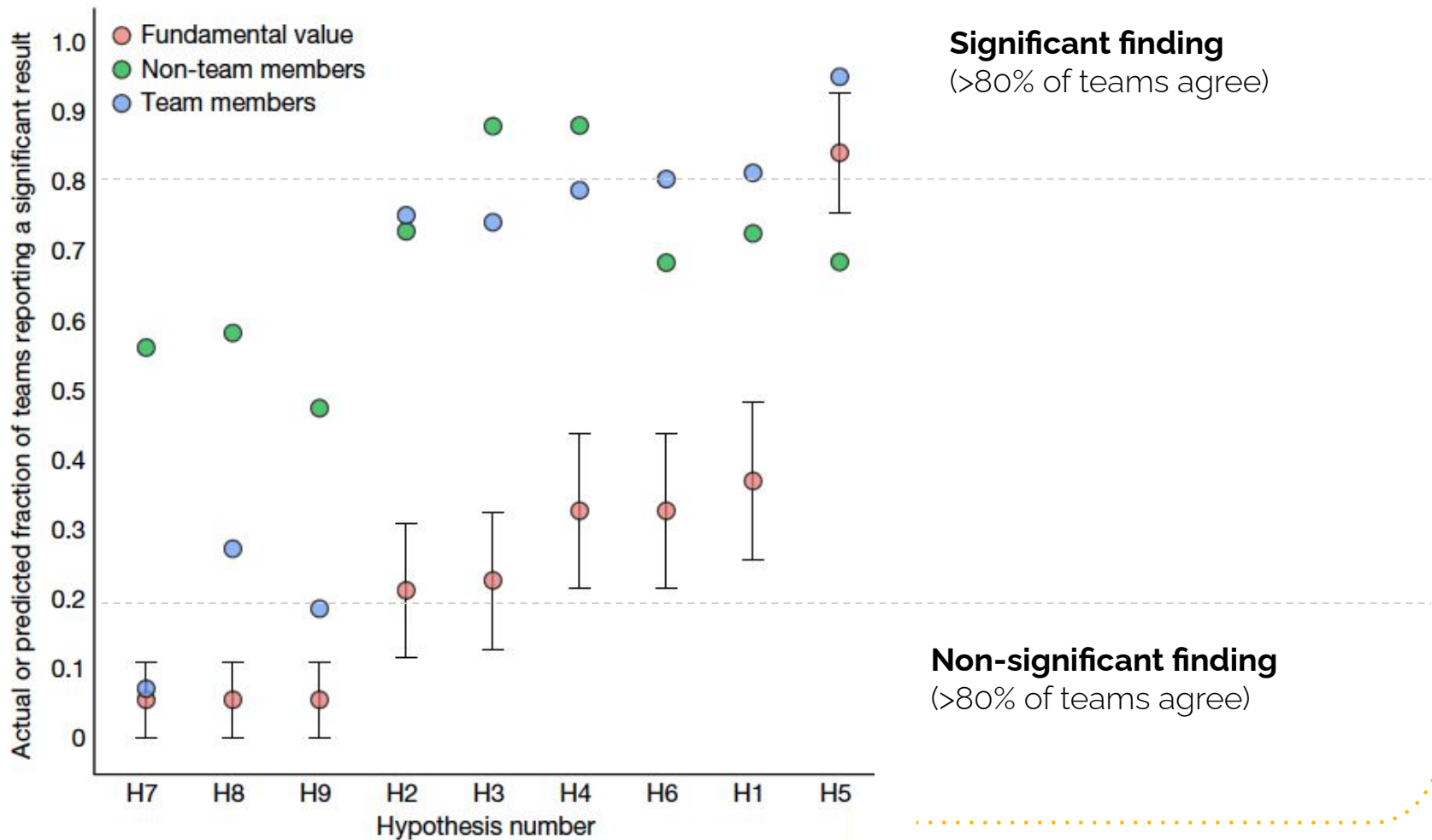
Results over the **70 post-processing pipelines:**



[Botvinik-Nezer et. al, Nature 2020]

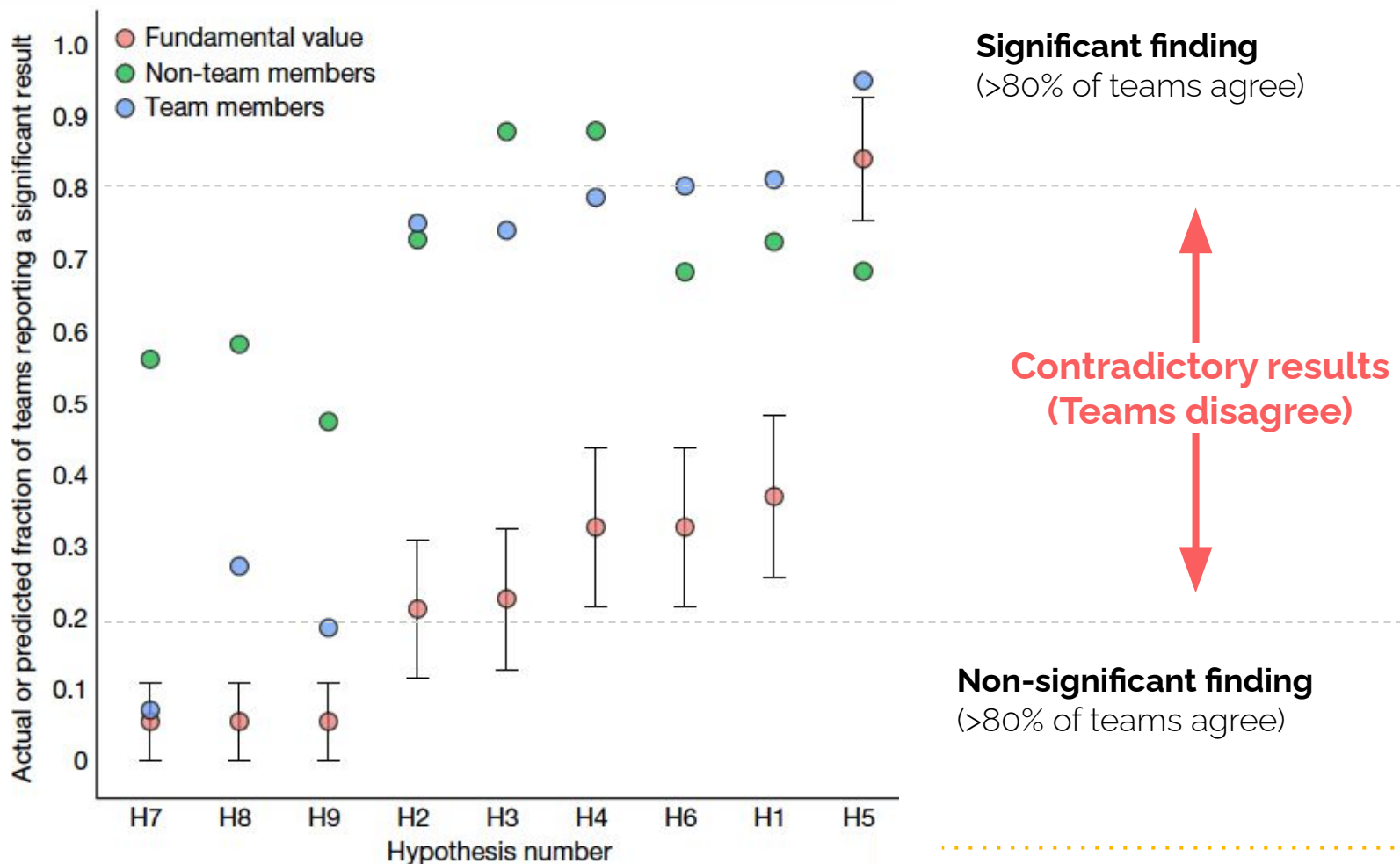
Many analysts project : NARPS

Results over the **70 post-processing pipelines**:



Many analysts project : NARPS

Results over the **70 post-processing pipelines**:



Different levels of variability in post-processing pipelines

- Different end-to-end pipelines [Carp 2013]
- Different Software Version [Gronenschild 2012]
- Different operating system [Glatard 2015]

- Different **post-processing software packages** [Bowring 2019, 2021]

Open questions

Stratégie adoptée par votre communauté

- **sur le plan technique**
 - Partage de code
- **pour les carrières**
 - Data papers
- **en terme d'Animation**
 - Open science community (OHBM open science SIG, Brainhack)
 - Hackathons collaboratifs "Brainhack"

Exemple de problèmes techniques et scientifiques

- Open data in Europe (GDPR, infrastructures)
- Causes of analytical variability (different methods) not well understood

Réseau de la recherche reproductible Journées Recherche
reproductible: état des lieux

March 8, 2023

Reproductibilité computationnelle en **neuroimagerie**:
état des lieux

Camille Maumet

Merci



Credit: Sculpture by Malin Bjornsdotter "Cerebia", [OHBM Brain Art SIG](#); Presentation template by [SlidesCarnival](#), adapted

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