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Towards large-scale brain imaging studies: How to deal with analytic variability?

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Towards large-scale brain imaging studies: How to deal with analytic variability?

April 19th, 2018

Camille Maumet



Outline

Introduction: VisAGeS and AI

Large-scale brain imaging studies

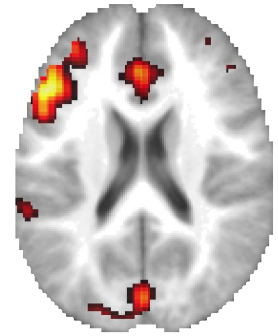
Analytic variability

Introduction

VisAGeS and AI

VisAGeS research objectives

Understand the brain under **typical** and **pathological** conditions with **brain imaging**



Team leader: Christian Barillot

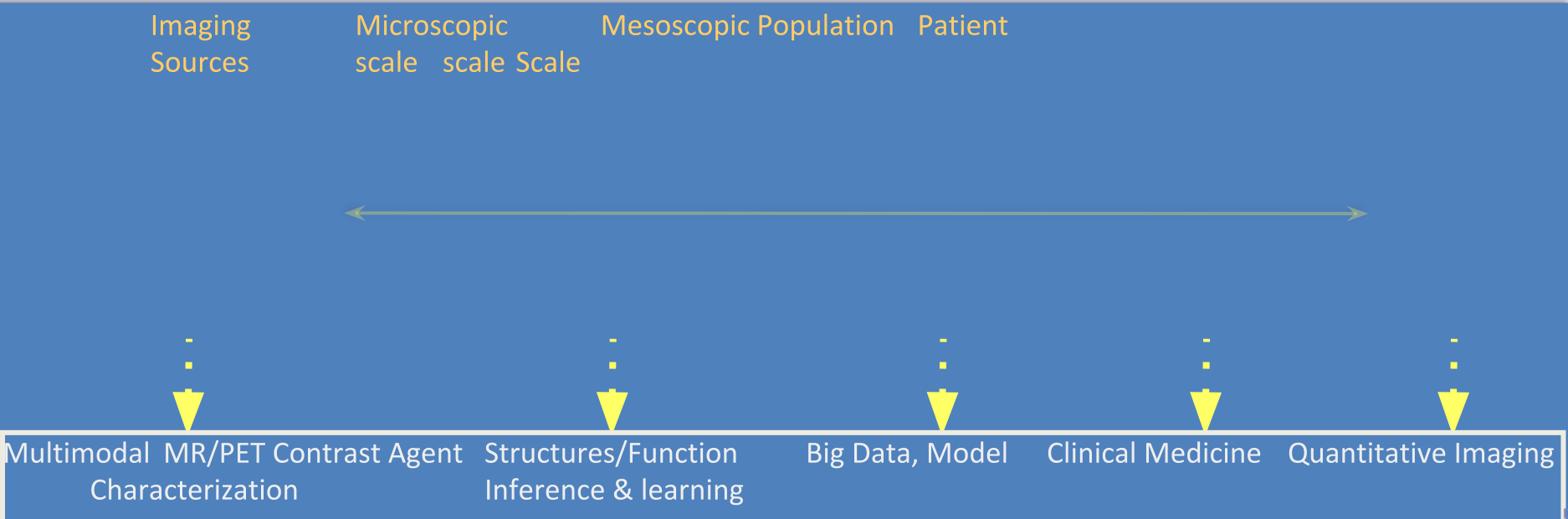
Goals

- Early Diagnosis
- Therapeutic choices
- New therapeutic protocols

Multiple sclerosis, Psychiatry, Parkinsonian disorders, Dementia, Stroke

(Slide content from Christian Barillot, adapted)

Multiscale «Brain Imaging Biomarkers»



Majors challenges

- Models and algorithms to reconstruct, analyze and transform
- Mass of data to store, distribute and "semantize"

Contributions & skills

- Model Inference
- Statistical Analysis & Modeling
- Sparse Representation (*compressed sensing, dictionary learning*)
- Machine Learning (*supervised/ unsupervised classification, discrete model learning*)
- Data fusion (*multimodal integration, registration, patch analysis, ...*)
- High dimensional optimization
- Data integration
- Brain computer interface
- ...

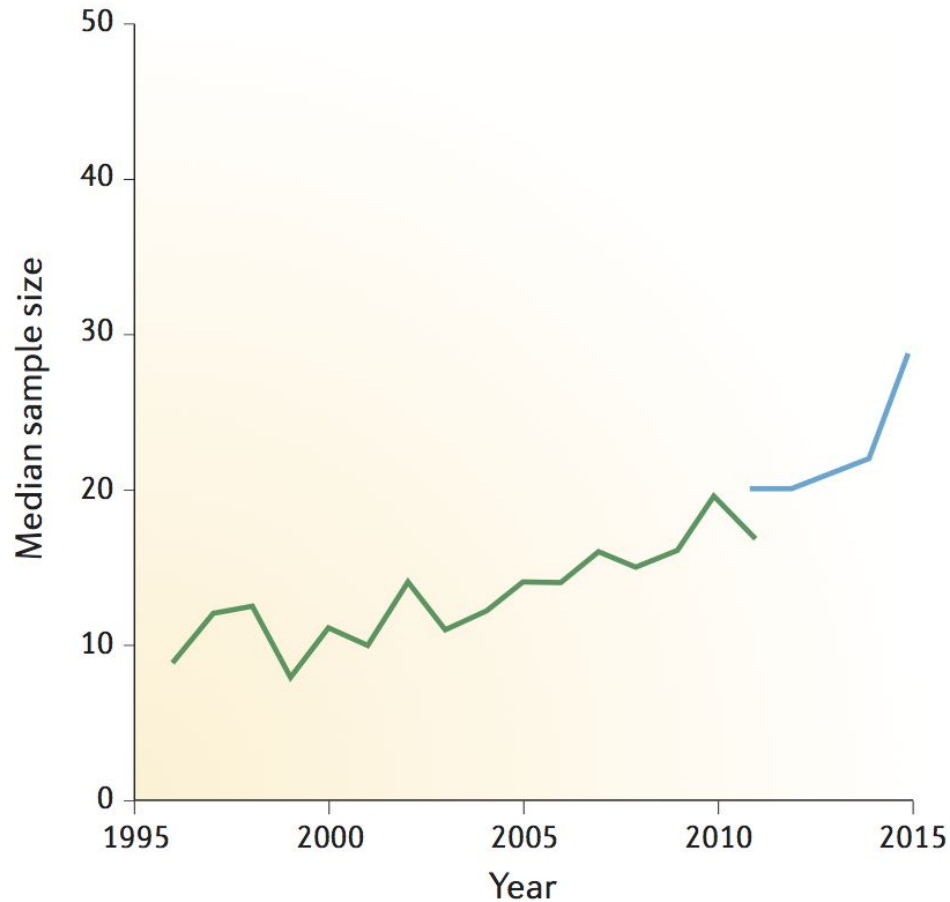
(Slide from Christian Barillot, adapted)

VisAGeS in AI



Towards large-scale brain imaging studies

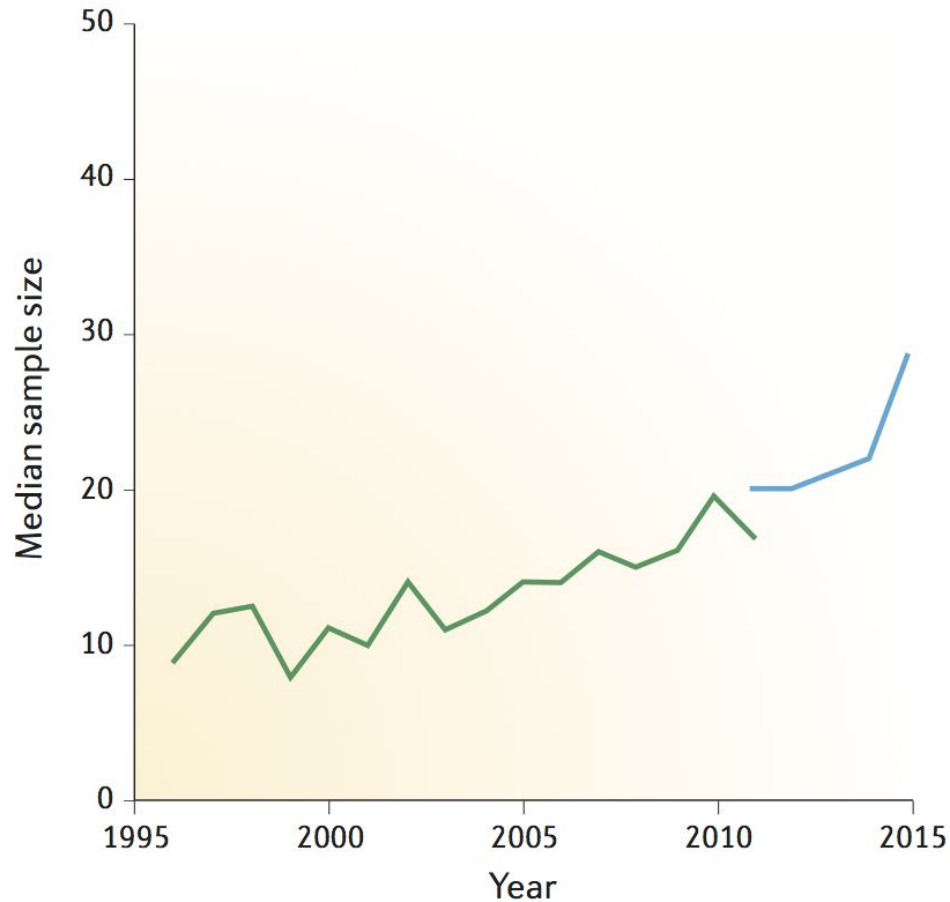
Sample sizes in brain imaging research



2015: 30 subjects / study

[Poldrack et. al, Nature Neuroscience 2017]

Sample sizes in brain imaging research



2015: 30 subjects / study

Low diversity &
Low statistical power

[Poldrack et. al, Nature Neuroscience 2017]

More and more open data are available!



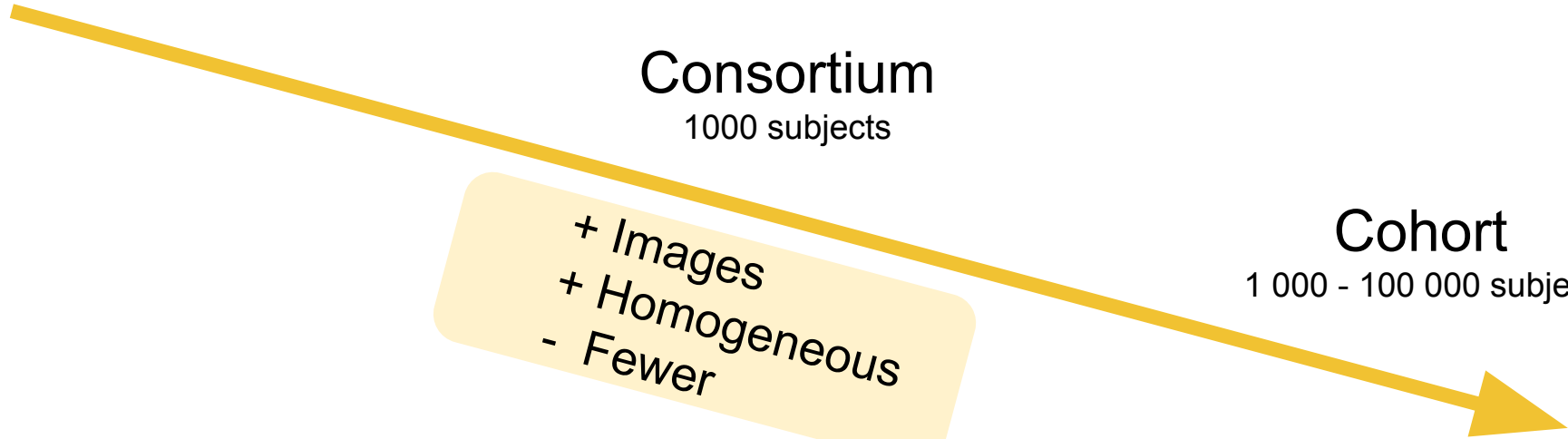
Photo de Neil Conway

Single study
30 subjects

Consortium
1000 subjects

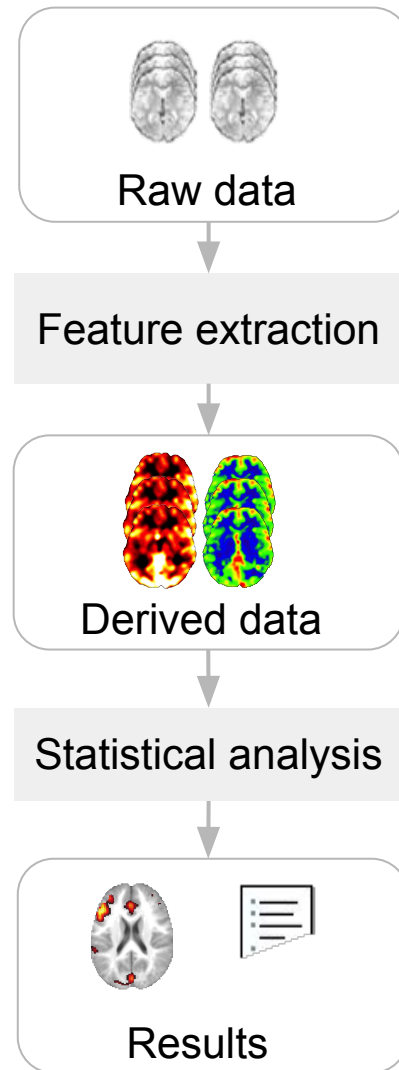
+ Images
+ Homogeneous
- Fewer

Cohort
1 000 - 100 000 subjects

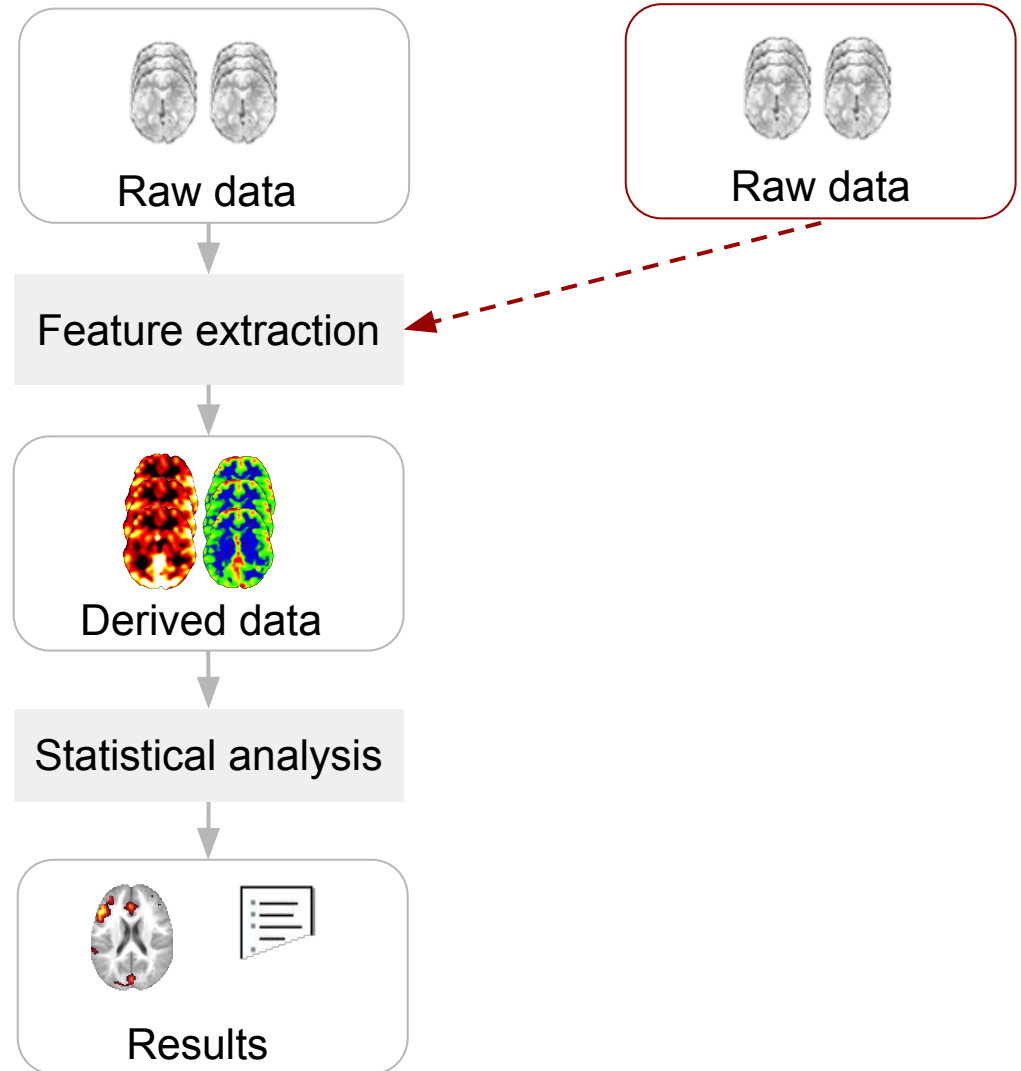


How to deal with analytic variability?

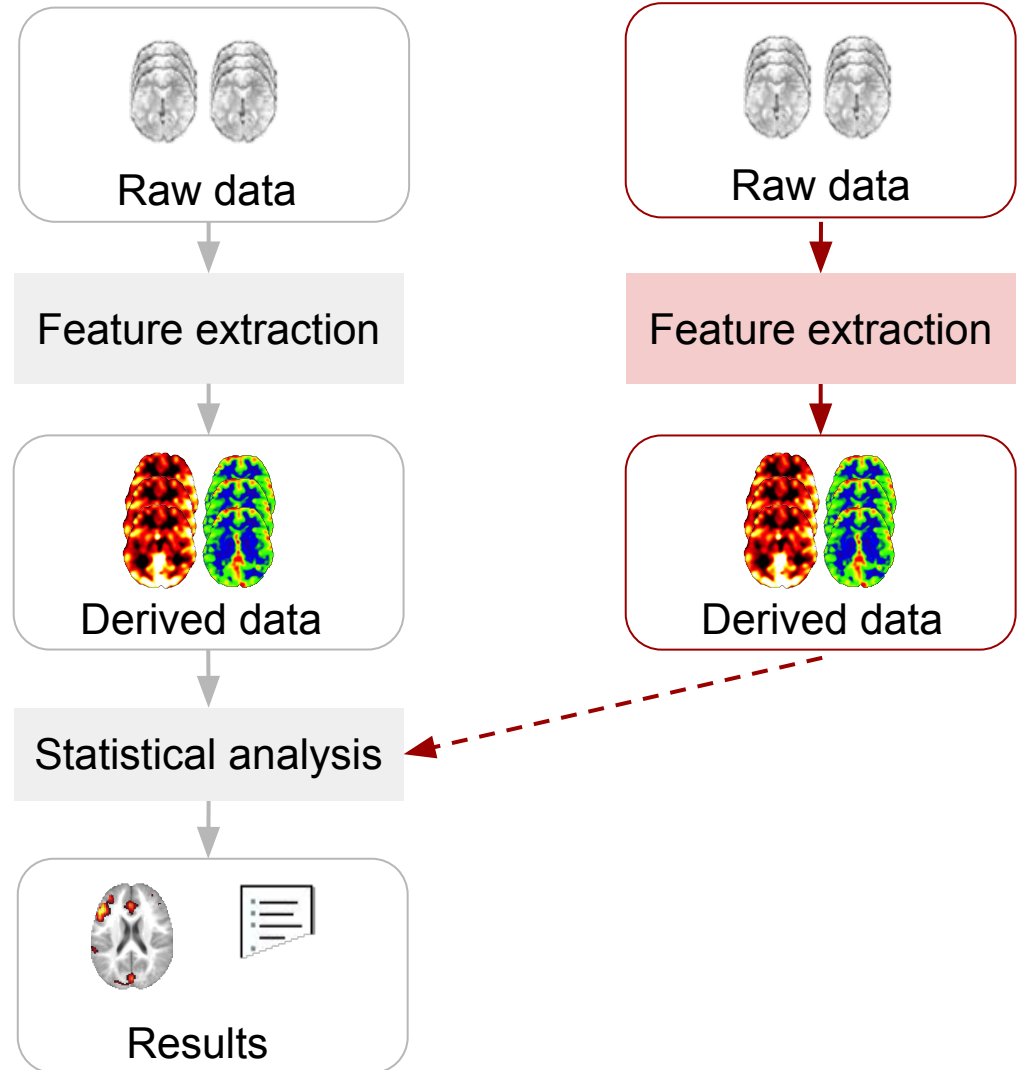
Challenge: analytical variability



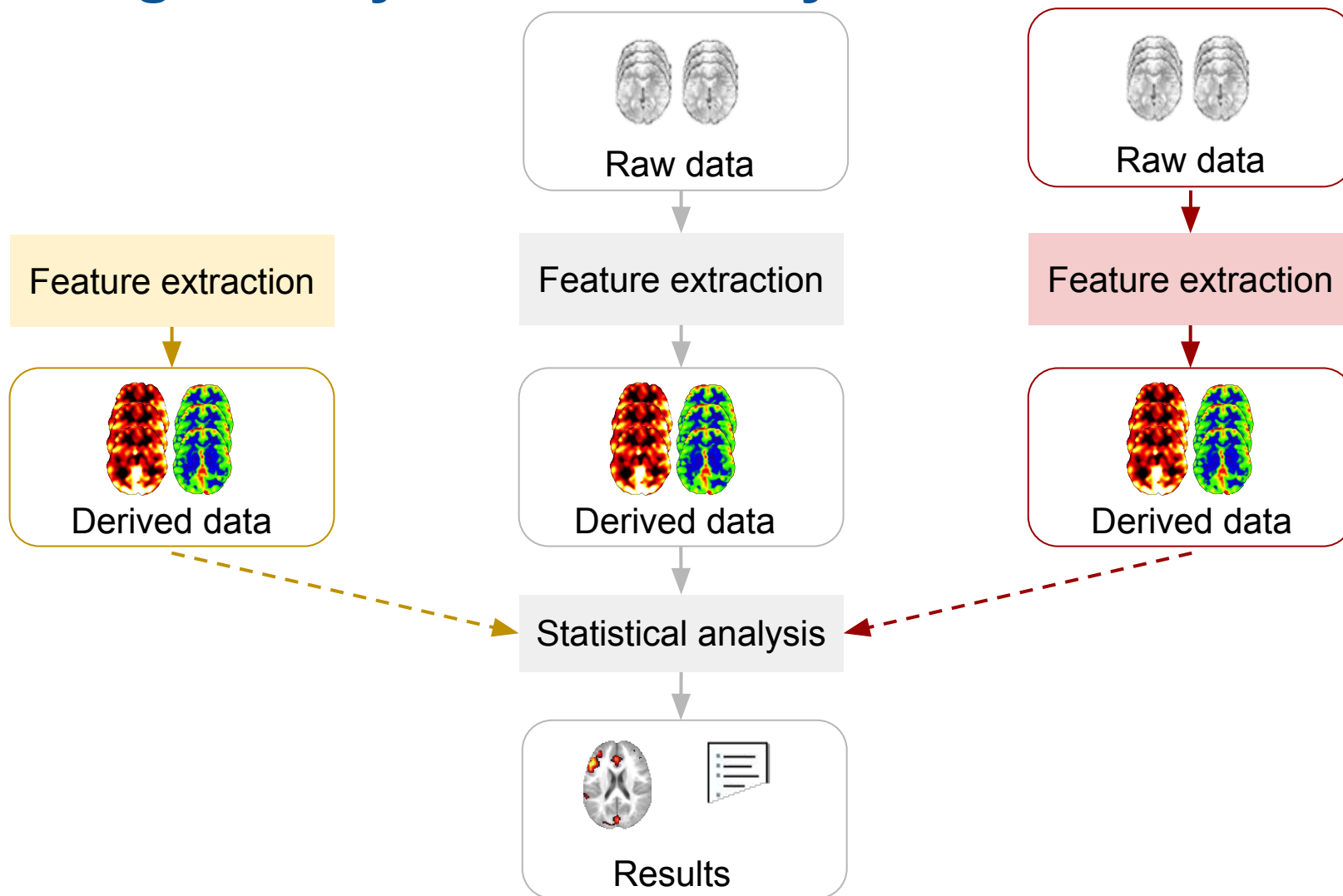
Challenge: analytical variability



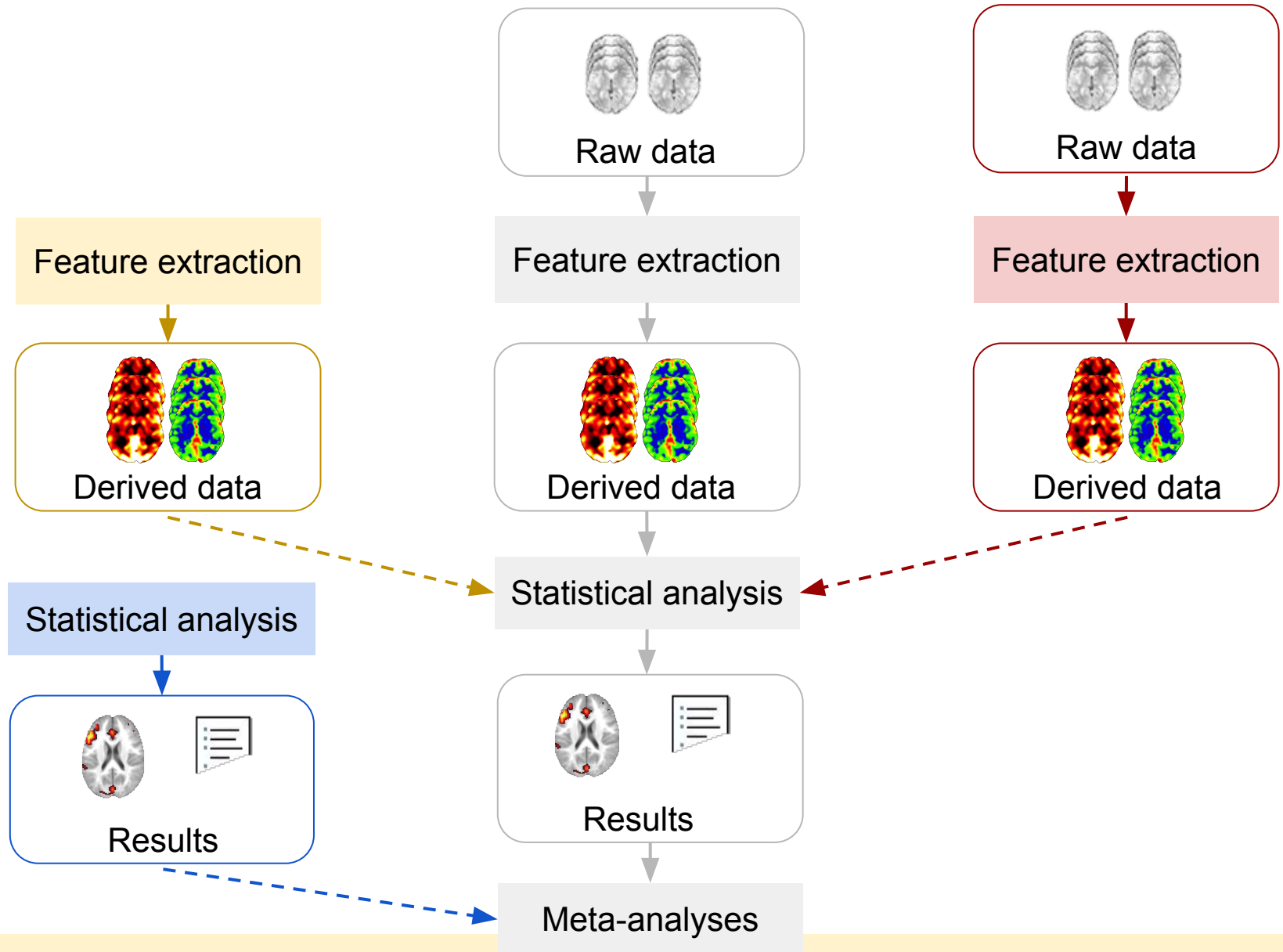
Challenge: analytical variability



Challenge: analytical variability



Challenge: analytical variability



Quantify
Estimate variations
across pipelines

Compensate
Remove unwanted
"pipeline effect"

Quantify
Estimate variations
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Remove unwanted
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Impact of Analysis Software on Task fMRI Results

- 3 published studies
- Reanalysed with 3 fMRI tools
- Reusing the same data

SPM

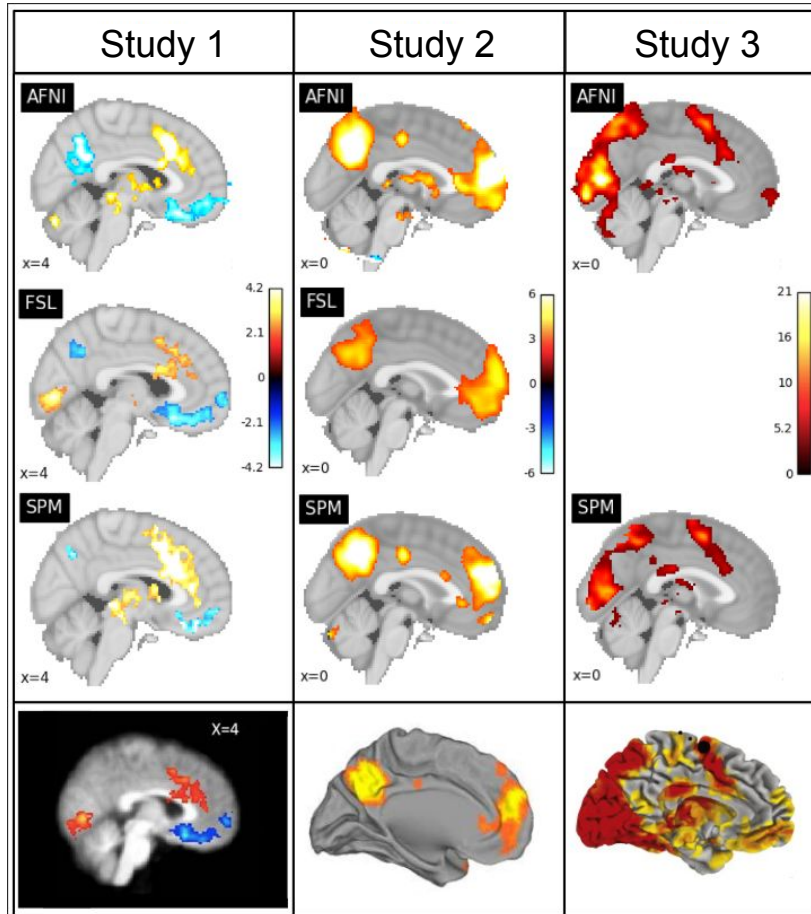


 OpenfMRI

Research question: how choice of software package impacts on analysis results?

Impact of Analysis Software on Task fMRI Results

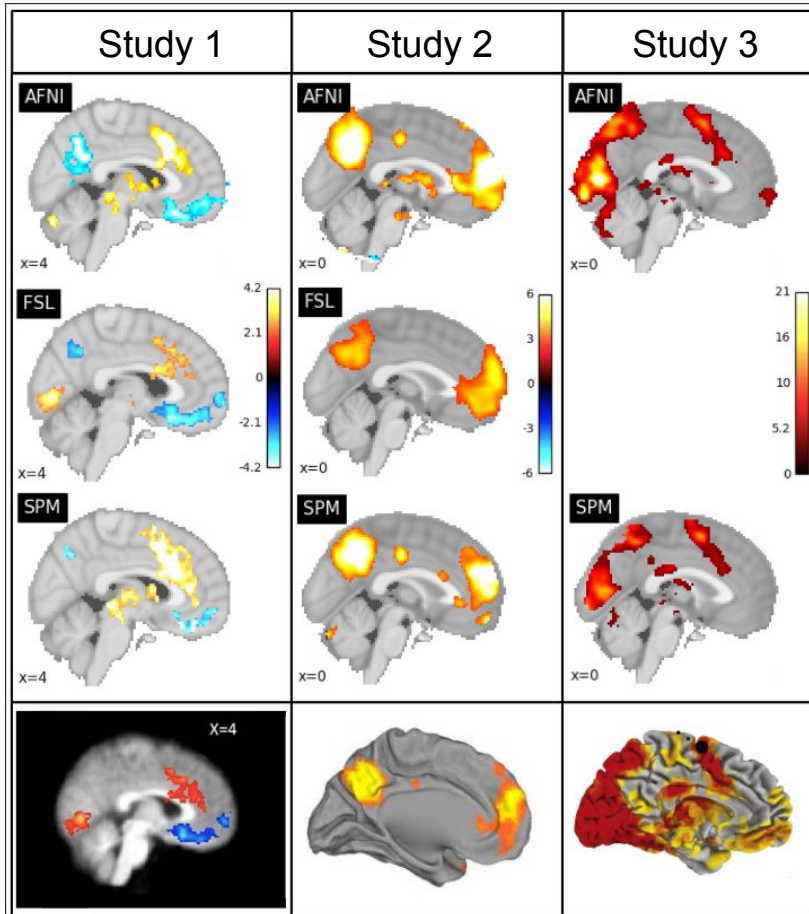
Reproducing the main figure



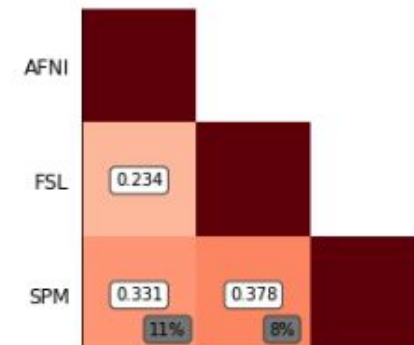
Preprint: Bowring, Maumet* and Nichols*, 2018. www.hal.inserm.fr/inserm-01760535

Impact of Analysis Software on Task fMRI Results

Reproducing the main figure



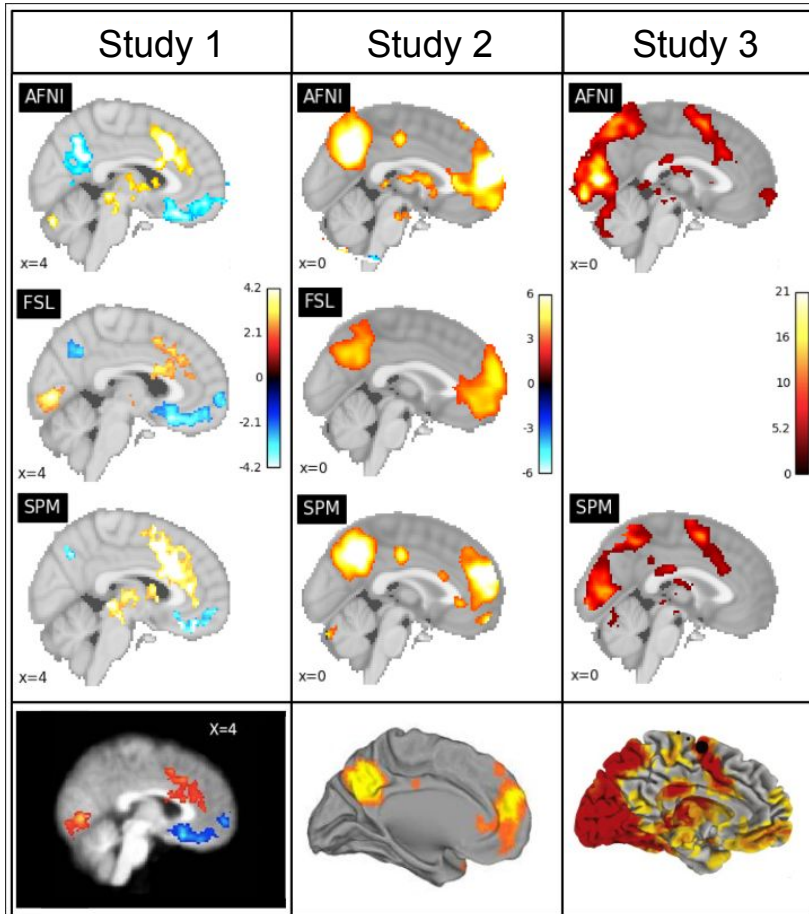
Dice coefficients: 0.23 - 0.38



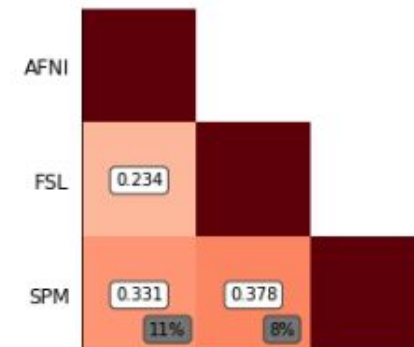
Preprint: Bowring, Maumet* and Nichols*, 2018. www.hal.inserm.fr/inserm-01760535

Impact of Analysis Software on Task fMRI Results

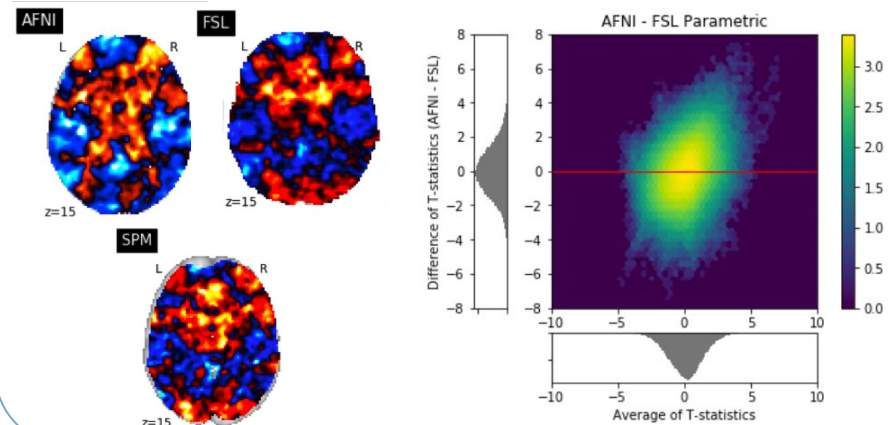
Reproducing the main figure



Dice coefficients: 0.23 - 0.38



Unthresholded statistics



Preprint: Bowring, Maumet* and Nichols*, 2018. www.hal.inserm.fr/inserm-01760535

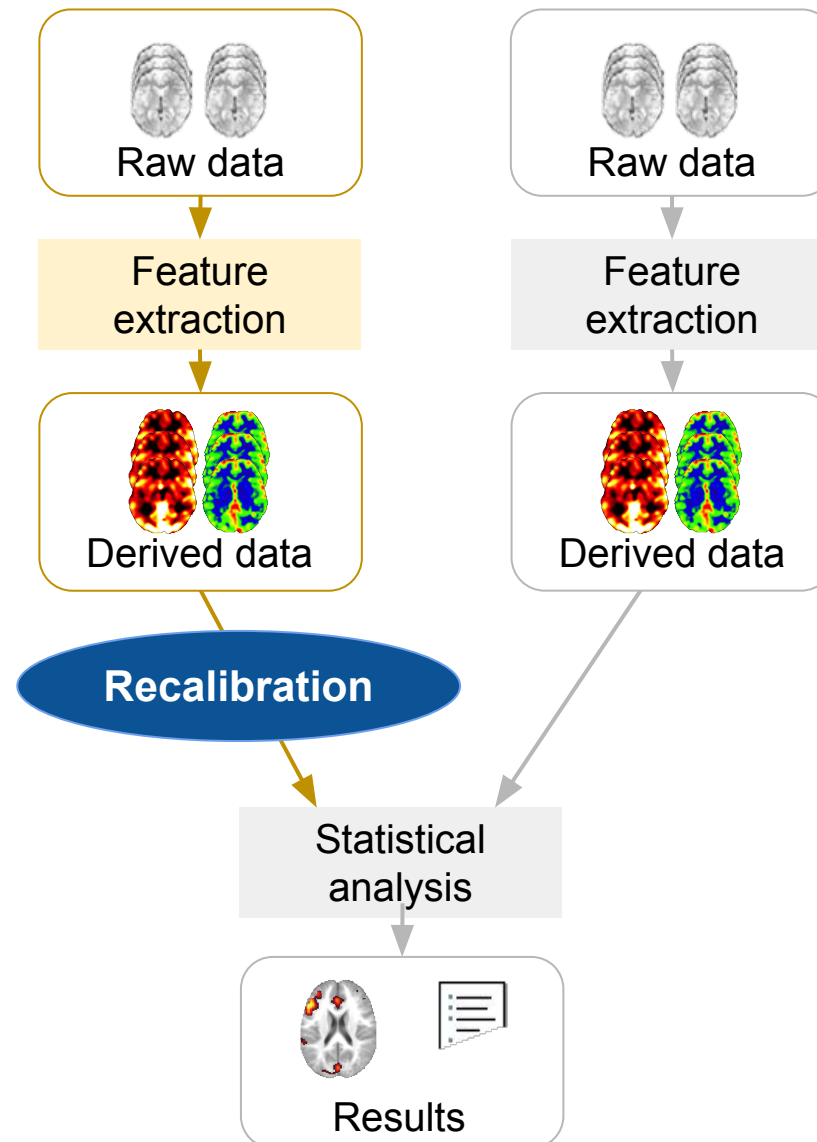
Impact of Analysis Software on Task fMRI Results

- Challenges
 - Use the "same" pipeline across fMRI tools
 - Implementation details ↔ Methodological differences
 - How much difference is too much?
 - "Compatibility" across pipelines

Quantify
Estimate variations
across pipelines

Compensate
Remove unwanted
"pipeline effect"

2. Remove unwanted "pipeline effect"



Camille Maumet

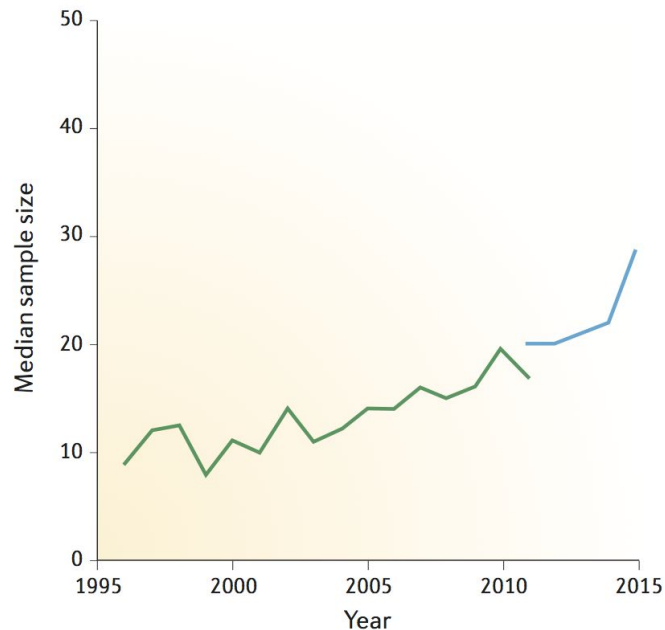


Photo de Neil Conway

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