



Universidad Nacional Autónoma de México
Facultad de Psicología
Instituto Nacional de Psiquiatría
“Ramón de la Fuente Muñiz”



Uso de bases de datos libres y reproducibilidad

Presenta:
Josué Mendoza Arredondo.

Reproducibilidad

Repetible: Mismo laboratorio, mismos datos, mismo código, ¿mismos resultados?

Reproducible: Diferente laboratorio, mismos datos, mismo código, ¿mismos resultados?

Generalizable (Replicable): Diferente muestra, condiciones similares ¿mismas conclusiones?

Crisis de reproducibilidad

The screenshot shows a news article from the journal **nature**. The header includes the word "nature" in large white letters and "International weekly journal of science" in smaller white letters. Below the header is a navigation bar with links: Home, News & Comment, Research, Careers & Jobs, Current Issue, Archive, Audio & Video, and For Authors. A secondary navigation bar shows the article's path: News & Comment > News > 2017 > December > Article. The main title of the article is "Over half of psychology studies fail reproducibility test". Below the title is a subtitle: "Largest replication study to date casts doubt on many published positive results." The author is listed as "Monya Baker". The publication date is "27 August 2015". At the bottom right of the article area are sharing and printing icons.

nature International weekly journal of science

Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video | For Authors

News & Comment > News > 2017 > December > Article

NATURE | NEWS

Over half of psychology studies fail reproducibility test

Largest replication study to date casts doubt on many published positive results.

Monya Baker

27 August 2015

Crisis de reproducibilidad

The screenshot shows the homepage of the **nature** journal website. The header features the **nature** logo and the tagline "International weekly journal of science". Below the header is a navigation bar with links to Home, News & Comment, Research, Careers & Jobs, Current Issue, Archive, Audio & Video, and For Authors. A green banner across the page indicates the current section is "Essay". The main article title is "Why Most Published Research Findings Are False" by Monya Baker, published on 27 August 2015. The PLoS Medicine logo and URL are visible at the bottom left, along with the identifier 0696 and the publication details "August 2005 | Volume 2 | Issue 8 | e124".

nature International weekly journal of science

Home | News & Comment | Research | Careers & Jobs | Current Issue | Archive | Audio & Video | For Authors

News & Comment | Monya Baker | 2015 | December | Article

Essay

Why Most Published Research Findings Are False

PLoS Medicine | www.plosmedicine.org

0696

August 2005 | Volume 2 | Issue 8 | e124

Monya Baker

27 August 2015

Crisis de reproducibilidad

The image shows the cover of a scientific journal issue. At the top, there is a red horizontal bar with the word "nature" in white lowercase letters. Below this, the word "ANALYSIS" is written in large green capital letters. To the left of the main title, there is a green rectangular box with the word "Essay" in white. On the right side, there is a vertical decorative element consisting of several colored rectangles (green, white, grey, and red) with the letter "Au" visible. The main title "Power failure: why small sample size undermines the reliability of neuroscience" is centered in a white box with a green border. Below the title, the authors' names are listed: Katherine S. Button^{1,2}, John P. A. Ioannidis³, Claire Mokrysz¹, Brian A. Nosek⁴, Jonathan Flint⁵, Emma S. J. Robinson⁶ and Marcus R. Munafò¹. The journal's logo, "NATURE REVIEWS NEUROSCIENCE", is at the bottom left, and the volume information "VOLUME 14 | MAY 2013 | 365" is at the bottom right.

nature

ANALYSIS

Essay

**Why
Are**

Power failure: why small sample size undermines the reliability of neuroscience

**Katherine S. Button^{1,2}, John P. A. Ioannidis³, Claire Mokrysz¹, Brian A. Nosek⁴,
Jonathan Flint⁵, Emma S. J. Robinson⁶ and Marcus R. Munafò¹**

NATURE REVIEWS | NEUROSCIENCE

VOLUME 14 | MAY 2013 | 365

¿Por qué es importante?

- Impacto de la investigación (e.g., tratamientos, políticas públicas).
- Naturaleza acumulativa de la ciencia.

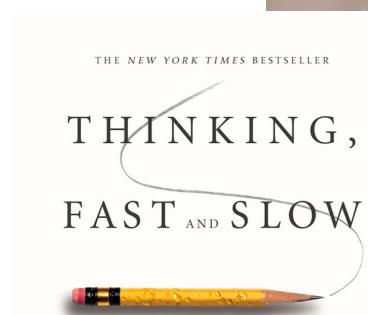
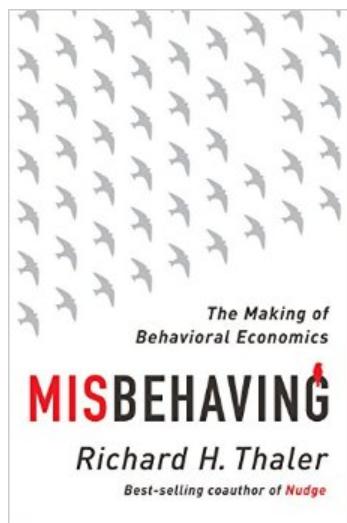
¿Qué hace a un campo de estudio particularmente vulnerable?

- Tamaños de muestra pequeños.
- Tamaños del efecto pequeños.
- Número de hipótesis puestas a prueba.
- Flexibilidad del diseño y análisis.
- Estructura de incentivos.

¿Qué hace a un campo de estudio particularmente vulnerable?

¿Alternativas?

Es “natural”



DANIEL
KAHNEMAN

WINNER OF THE NOBEL PRIZE IN ECONOMICS

"[A] masterpiece... This is one of the greatest and most engaging collections of insights into the human mind I have read."—WILLIAM EASTERLY, *Financial Times*

Efecto del diseño



ANALYSIS

Scanning the horizon: towards transparent and reproducible neuroimaging research

¿Cómo diseñamos ciencia más reproducible?



ESTADÍSTICA

Potencia estadística y tamaño del efecto (Problema I)

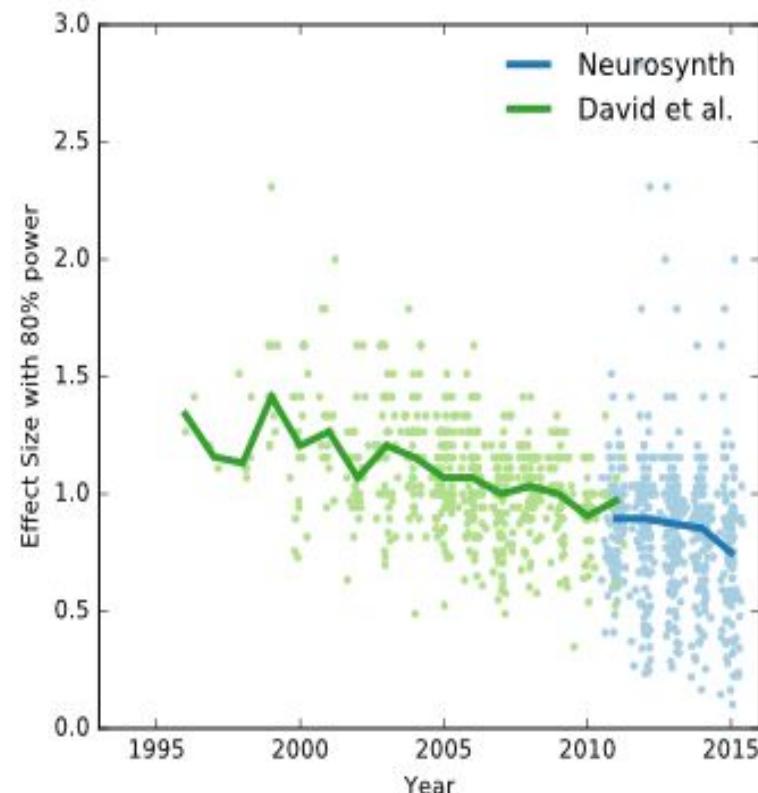
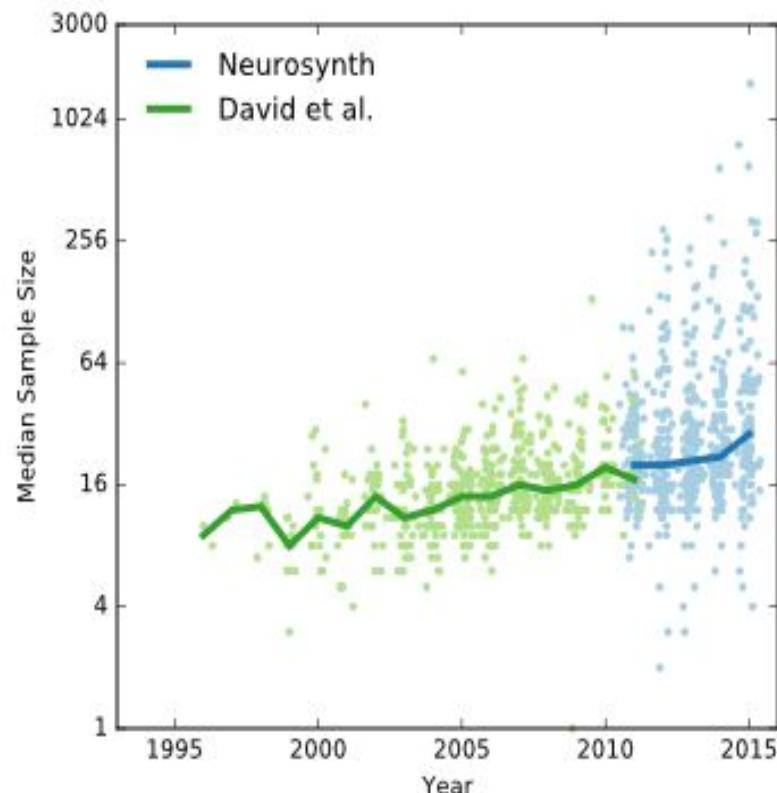
$$\text{power} = \mathbb{P}(\text{reject } H_0 \mid H_1 \text{ is true})$$

Capacidad de una prueba para **detectar evidencia**.

Una potencia baja no sólo **reduce** la probabilidad de encontrar un resultado si este existe, sino que también **aumenta** la probabilidad de que cualquier resultado que encuentres, sea falso.

Potencia estadística y tamaño del efecto (Problema I)

Análisis de tamaño de muestra y tamaño del efecto con potencia .80 en los últimos 20 años.



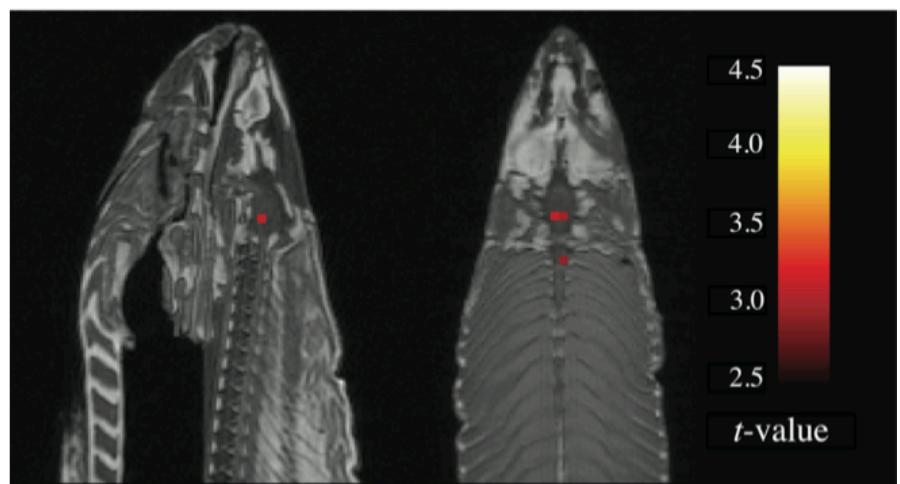
Potencia estadística (Problema I)

- El tamaño medio de los estudios para fMRI en 2015 con múltiples grupos, fue de 19 sujetos, lo cual es menor a el mínimo estipulado de 20 por grupo (Simmons, et. al.).

Múltiples comparaciones (Problema II)

La aproximación más común en análisis de fMRI es hacer pruebas **univariadas masivas**; es decir, se hace una prueba de hipótesis en cada voxel.

Si no se hace una corrección por múltiples comparaciones **la tasa de falsos positivos se infla**.



¿Soluciones?

Potencia estadística (Solución)

- Calcular tamaño de muestra con base a análisis de poder previo.

Por ejemplo...

<http://neuropowertools.org/>

O

<http://fmripower.org/>

Potencia estadística (Solución)



International Neuroimaging
Data-Sharing Initiative

Colaboraciones con investigadores que
hagan observaciones independientes

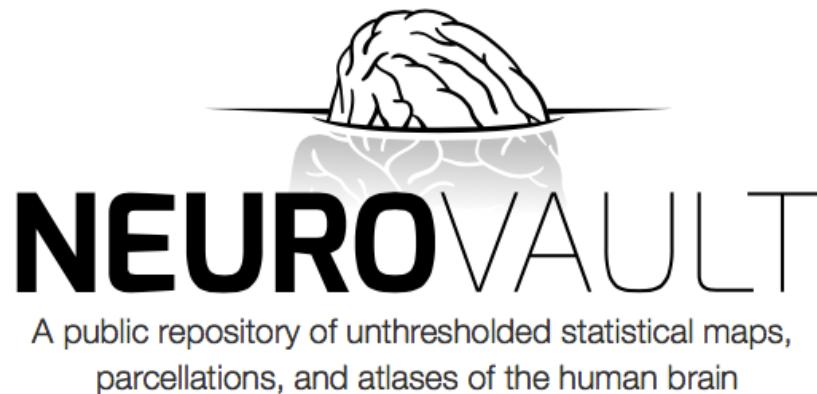
Restringir la búsqueda a una cantidad
pequeña de regiones de interés (**ROIs**).

Evitar SHARKing

SHARKing...
(selecting hypothesized areas after results are known).

Múltiples Comparaciones (Solución)

- Corrección estadística (e.g., Bonferroni).
- Aproximaciones multivariadas.
- Compartir mapas sin los umbrales estadísticos.



<https://neurovault.org>

FLEXIBILIDAD EN EL ANÁLISIS

Flexibilidad en el análisis (Problema)

- El análisis de datos en fMRI implica una gran cantidad de pasos de preprocesamiento y análisis posterior.
- **Hasta 6,912 combinaciones diferentes de opciones en SPM y FSL.**

Flexibilidad en el análisis (Problema)

Despiking

Despiking using AFNI

No despiking

Slice-timing correction

Slice-timing correction

No slice-timing correction

Spatial normalization

Normalization of
functional images to
the SPM EPI template

Normalization of
anatomical images to
the SPM T1 template

Normalization with
segmentation using
unified normalization

Spatial smoothing

Smoothing with kernel
of 4 mm FWHM

Smoothing with kernel
of 8 mm FWHM

Smoothing with kernel
of 12 mm FWHM

Flexibilidad en el análisis (Problema)

Normalization-modeling order

Normalize before modeling Model before normalization

High-pass filtering

High-pass filtering No high-pass filtering
using a cutoff of 128 s

Temporal autocorrelation correction

AR(1) modeling No correction for temporal
autocorrelation

Run concatenation

Runs concatenated No run concatenation
before model estimation

Model basis set

Hemodynamic Finite impulse response¹, Finite impulse response¹,
response function time points 3–4 time by condition
 versus baseline interaction

Head motion regression

Six regressors² Twelve Twenty-four No motion
 regressors³ regressors⁴ regression

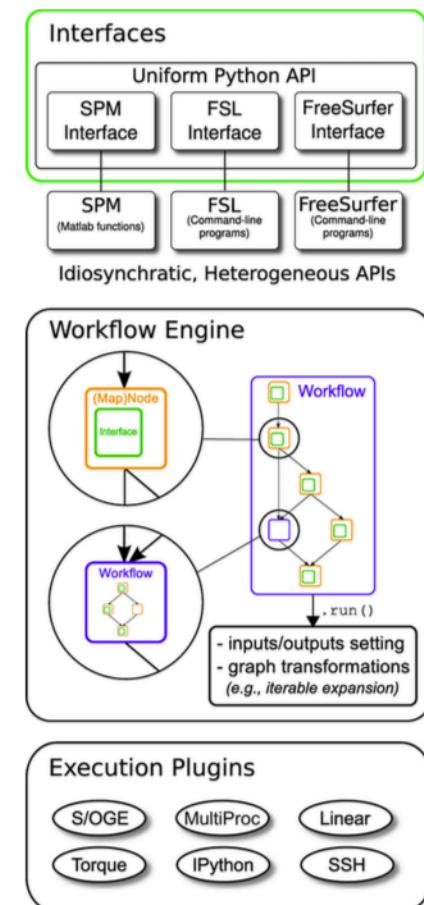
Flexibilidad en el análisis (Solución)

- Describir claramente todos los pasos empleados



Nipype:
Neuroimaging in Python
Pipelines and Interfaces

<http://nipype.readthedocs.io/en/latest/>



Flexibilidad en el análisis (Solución)

The screenshot shows the Open Science Framework (OSF) homepage. The top navigation bar includes links for OSFHOME, Search, Support, Donate, Sign Up, and Sign In. Below the bar, there are tabs for Reproducibility Project: Psychology, Files, Wiki (which is selected), Analytics, Registrations, and Forks. A search bar and a message icon are also present. On the left, a sidebar menu shows 'Project Wiki Pages' with 'Home' selected, and 'Component Wiki Pages' including 'Estimating the Reproducibility of Psychological Science', 'Analysis', 'Replicator Resources', 'Presentations', 'Post-Publication Additions and Replications', 'Comments', 'Replication of Janiszewski & Uy (2012)', 'Replication of Reynolds & Besner (2012)', 'Replication of Richeson & Trawalter (2012)', and 'Replication of Payne, Burkley & St. John (2012)'. The main content area displays the title 'Estimating the Reproducibility of Psychological Science' and the subtitle 'Open Science Collaboration'. It features an abstract, citation information, and sections for 'Contents', 'Summary Report', 'Supplement only', and 'Replicated Studies'.

OSFHOME ▾

Reproducibility Project: Psychology Files Wiki Analytics Registrations Forks

Home

View Wiki Version: (Current) Mallory C. Kidwell: 2016-03-03 19:38:23+00:00 UTC

Estimating the Reproducibility of Psychological Science

Open Science Collaboration

Abstract: Reproducibility is a defining feature of science, but the extent to which it characterizes current research is unknown. We conducted replications of 100 experimental and correlational studies published in three psychology journals using high-powered designs and original materials when available. Replication effects ($Mr = .197$, $SD = .257$) were half the magnitude of original effects ($Mr = .403$, $SD = .188$), representing a substantial decline. Ninety-seven percent of original studies had significant results ($p < .05$). Thirty-six percent of replications had significant results; 47% of original effect sizes were in the 95% confidence interval of the replication effect size; 39% of effects were subjectively rated to have replicated the original result; and, if no bias in original results is assumed, combining original and replication results left 68% with significant effects. Correlational tests suggest that replication success was better predicted by the strength of original evidence than by characteristics of the original and replication teams.

Citation: Open Science Collaboration. (2015). *Estimating the reproducibility of psychological science*. *Science*, 349(6251), aac4716. doi: 10.1126/science.aac4716

Contents

Summary Report: Read the [Science article](#) and supplementary material summarizing the results of the Reproducibility Project: Psychology. Or, read the [Green OA version with supplementary information](#) in the same file.

Supplement only. Supplementary materials to "Estimating the Reproducibility of Psychological Science." Includes additional graphs and details on analyses.

Replicated Studies: Explore the preregistrations, materials, data, and result reports of the individual replication projects.

Flexibilidad en el análisis (Solución)

- Pre - registro

 U.S. National Library of Medicine
ClinicalTrials.gov

Find Studies ▾ About Studies ▾ Submit Studies ▾ Resources ▾ About Site ▾

[Home](#) > [Search Results](#) > Study Record Detail Save this study Saved Studies (0)

Trial record **3 of 7** for: transcranial | Mexico
[◀ Previous Study](#) | [Return to List](#) | [Next Study ▶](#)

Treatment With Transcranial Magnetic Stimulation for Cocaine Addiction: Clinical Response and Functional Connectivity. (TMS_COCA_CONN)

This study is currently recruiting participants.

See  [Contacts and Locations](#)

Verified July 2017 by Jorge J. González Olvera, Instituto Nacional de Psiquiatría Dr. Ramón de la Fuente

Sponsor:
Instituto Nacional de Psiquiatría Dr. Ramón de la Fuente

ClinicalTrials.gov Identifier:
NCT02986438

First Posted: December 8, 2016
Last Update Posted: July 24, 2017

⚠ The safety and scientific validity of this study is the responsibility of the study sponsor and investigators. Listing a study does not mean it has been evaluated by the U.S. Federal Government. [Know the risks and potential benefits](#) of clinical studies and talk to your health care provider before participating. Read our [disclaimer](#) for details.

Collaborator:

National Council of Science and Technology, Mexico

Information provided by (Responsible Party):

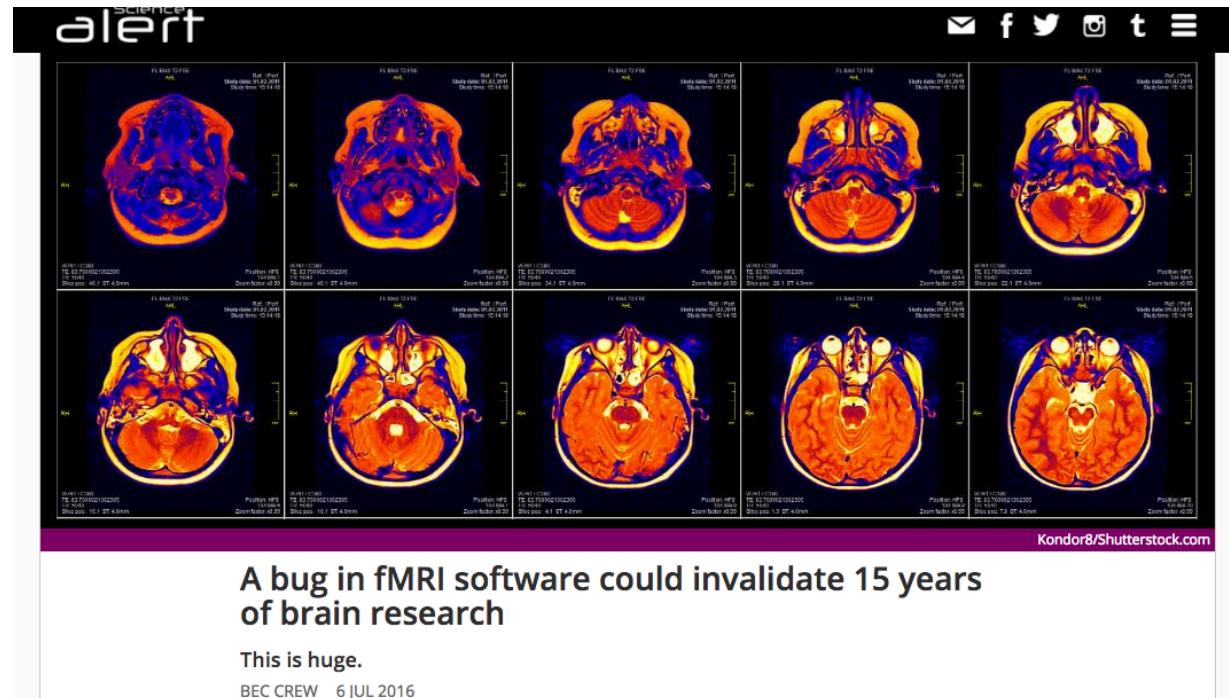
Jorge J. González Olvera, Instituto Nacional de Psiquiatría Dr. Ramón de la Fuente

ERRORES DE SOFTWARE

Errores de software (Problema)

Conforme la **complejidad** del software que se usa **incrementa**, la probabilidad de '**bugs**' sin ser notados rápidamente aumenta también.

En un paquete de AFNI (*3dClustSim*), se econtró un error con 15 años de antigüedad, que inflaba el error de tipo I.



Errores de software (Solución)

- Entrenamiento en programación.
- Entender qué hace el software (principalmente defaults).
- Código abierto.



REPORTES INSUFICIENTES

Reportes insuficientes (Problema)

Con el fin de evaluar si los análisis e inferencias son adecuados, los métodos deben de ser reportados con suficiente detalle.

Desafortunadamente, los estándares de reportes en fMRI siguen siendo pobres.

Múltiples comparaciones

Conclusiones sin soporte metodológico ni estadístico

Inferencia causal

Reportes insuficientes (Solución)

Proponer nuevos estándares para el reporte de estudios.

Cuidar que cada conclusión tenga soporte correspondiente.

Compartir el código de análisis.

Best Practices in Data Analysis and Sharing in Neuroimaging using MRI

Thomas E. Nichols^{1,*}, Samir Das², Simon B. Eickhoff³, Alan C. Evans², Tristan Glatard², Michael Hanke⁴, Nikolaus Kriegeskorte⁵, Michael P. Milham⁶, Russell A. Poldrack⁷, Jean-Baptiste Poline⁸, Erika Proal⁹, Bertrand Thirion¹⁰, David C. Van Essen¹¹, Tonya White¹², B.T. Thomas Yeo¹³

¹University of Warwick; ²McGill University; ³Heinrich-Heine University Düsseldorf;

⁴Otto-von-Guericke-University Magdeburg; ⁵MRC Cognition and Brain Sciences Unit; ⁶Child Mind Institute; ⁷Stanford University; ⁸University of California, Berkeley;

⁹Instituto Nacional de Psiquiatría Ramón de la Fuente Muñiz & Neuroingenia; ¹⁰Inria, Paris-Saclay University; ¹¹Washington University in St. Louis; ¹²Erasmus University Medical Center; ¹³National University of Singapore.

*Correspondence: t.e.nichols@warwick.ac.uk.

Abstract

Acquisition Reporting

Subject preparation. Mock scanning. Special accommodations. Experimenter personnel.

MRI system description. Scanner. Coil. Significant hardware modifications. Software version.

MRI acquisition. Pulse sequence type. Imaging type. Essential sequence & imaging parameters.

Phase encoding. Parallel imaging method & parameters. Multiband parameters. Readout parameters. Fat suppression. Shimming. Slice order & timing. Slice position procedure. Brain coverage. Scanner-side preprocessing. Scan duration. Other non-standard procedures. T1 stabilization. Diffusion MRI gradient table. Perfusion: Arterial Spin Labeling MRI. Perfusion: Dynamic Susceptibility Contrast MRI.

Preliminary quality control. Motion monitoring. Incidental findings.

Preprocessing Reporting

General. Intensity correction. Intensity normalization. Distortion correction. Brain extraction.

Segmentation. Spatial smoothing. Artifact and structured noise removal. Quality control reports.

Intersubject registration.

Temporal/Dynamic. Motion correction.

fMRI. T1 stabilization. Slice time correction. Function-structure (intra-subject) coregistration.

Function-structure (intra-subject) coregistration. Volume censoring. Resting state fMRI feature.

Diffusion. Gradient distortion correction. Diffusion MRI eddy current correction. Diffusion estimation.

Diffusion processing. Diffusion tractography.

Perfusion. Arterial Spin Labeling. Dynamic Susceptibility Contrast MRI

Statistical Modeling & Inference

Mass univariate analyses. Variable submitted to statistical modeling. Spatial region modeled.

Independent variables. Model type. Model settings. Inference: Contrast/effect. Inference: Search region. Inference: Statistic type. Inference: P-value computation. Inference: Multiple testing correction.

Functional connectivity. Confound adjustment & filtering. Multivariate method: Independent Component Analysis. Dependent variable definition. Functional connectivity measure/ model. Effectivity connectivity. Graph analysis.

Multivariate modeling & predictive analysis. Independent variables. Features extraction and dimension reduction. Model. Learning method. Training procedure. Evaluation metrics: Discrete response. Evaluation metrics: Continuous response. Evaluation metrics: Representational similarity analysis. Evaluation metrics: Significance. Fit interpretation.

Results Reporting

Mass univariate analysis. Effects tested. Extracted data. Tables of coordinates. Thresholded maps. Unthresholded maps. Extracted data. Spatial features.

Functional connectivity. ICA analyses. Graph analyses: Null hypothesis tested.

Multivariate modeling & predictive analysis. Optimized evaluation metrics.

Data Sharing

Define data sharing plan early. Material shared. URL (access information). Ethics compliance. Documentation. Data format.

Database for organized data. Quality Control procedures. Ontologies. Visualization. De-identification. Provenance and history. Interoperability. Querying. Versioning. Sustainability plan (funding).

Reproducibility

Documentation. Tools used. Infrastructure. Workflow. Provenance trace. Literate program implementing results. English language version.

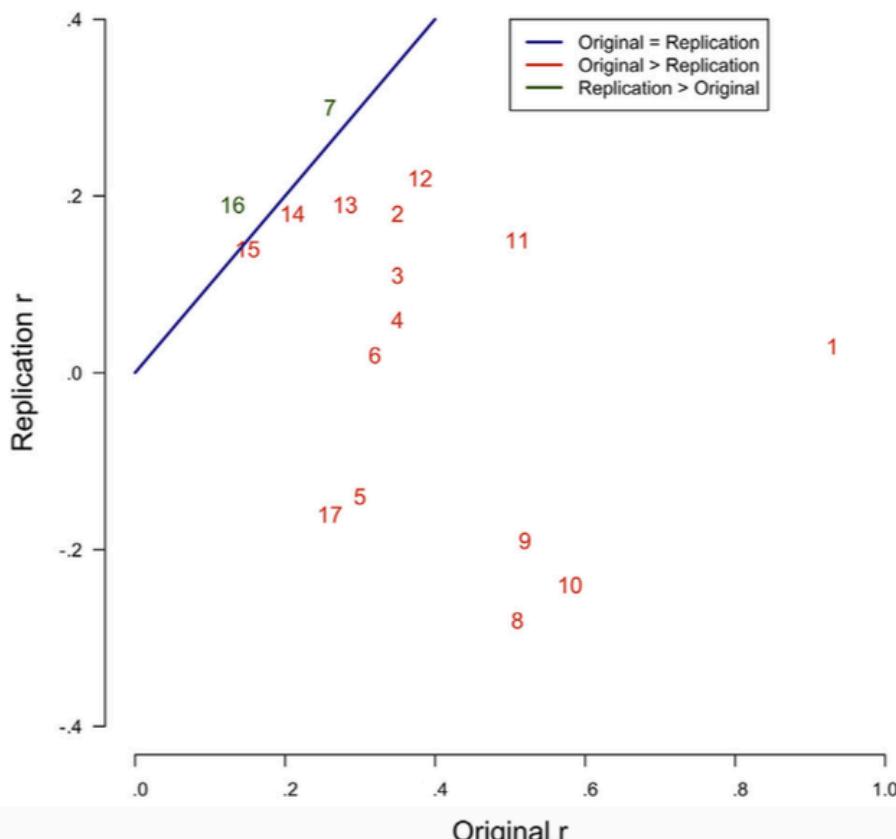
Archiving. Tools availability. Virtual appliances.

Citation. Data. Workflow.

INCENTIVOS

Incentivos (Problema)

Existen pocos casos de replicabilidad directa en neuroimagen, debido al alto costo de este tipo de estudios; aunado al excesivo énfasis de la mayoría de las revistas con alto impacto en novedad más que en informatividad.

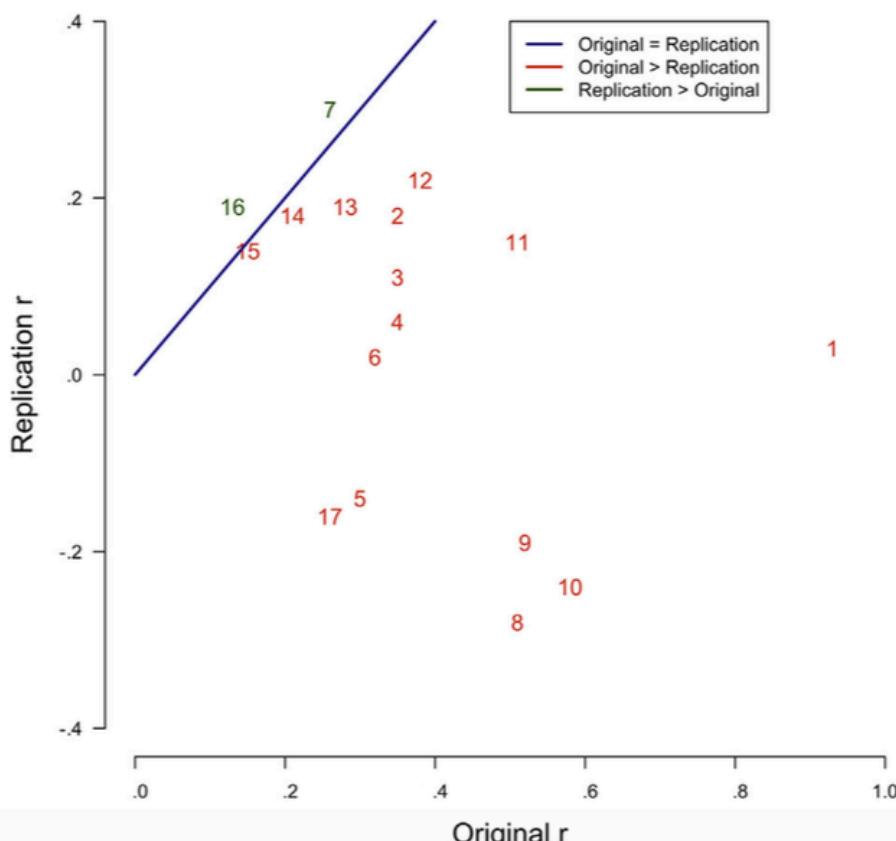


Sólo 2 de los 17 de los intentos mostraron mayor evidencia de un tamaño del efecto igual o mayor al estudio original; mientras que 8 aportaron evidencia de efecto nulo.

Esto sugiere que la replicabilidad de hallazgos en neuroimagen (particularmente correlaciones cerebro – comportamiento) son muy bajas.

Incentivos (Problema)

Existen pocos casos de replicabilidad directa en neuroimagen, debido al alto costo de este tipo de estudios; aunado al excesivo énfasis de la mayoría de las revistas con alto impacto en novedad más que en informatividad.

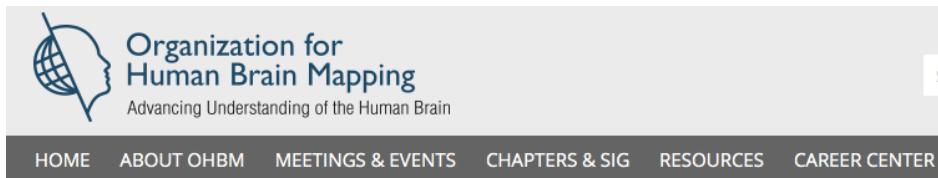


Sólo 2 de los 17 de los intentos mostraron mayor evidencia de un tamaño del efecto igual o mayor al estudio original; mientras que 8 aportaron evidencia de efecto nulo.

Esto sugiere que la replicabilidad de hallazgos en neuroimagen (particularmente correlaciones cerebro – comportamiento) son muy bajas.

Incentivos (Solución)

- Volver a la replicabilidad más “atractiva”.



The image shows the header of the Organization for Human Brain Mapping (OHBM) website. It features a logo of a stylized brain with a globe, followed by the text "Organization for Human Brain Mapping" and the tagline "Advancing Understanding of the Human Brain". A search bar is partially visible on the right. Below the header is a navigation menu with links to "HOME", "ABOUT OHBM", "MEETINGS & EVENTS", "CHAPTERS & SIG", "RESOURCES", and "CAREER CENTER".

Replication Award

The Organization for Human Brain Mapping, is pleased to announce the Call for Nominations for the Replication Award. The OHBM Replication Award recognizes the best replication study and highlights OHBM's commitment to reproducibility in neuroimaging research and helps begin to reshape the incentives towards replication.

Please submit your nomination [here](#) by Friday, January 12, 2018.

Award Criteria:

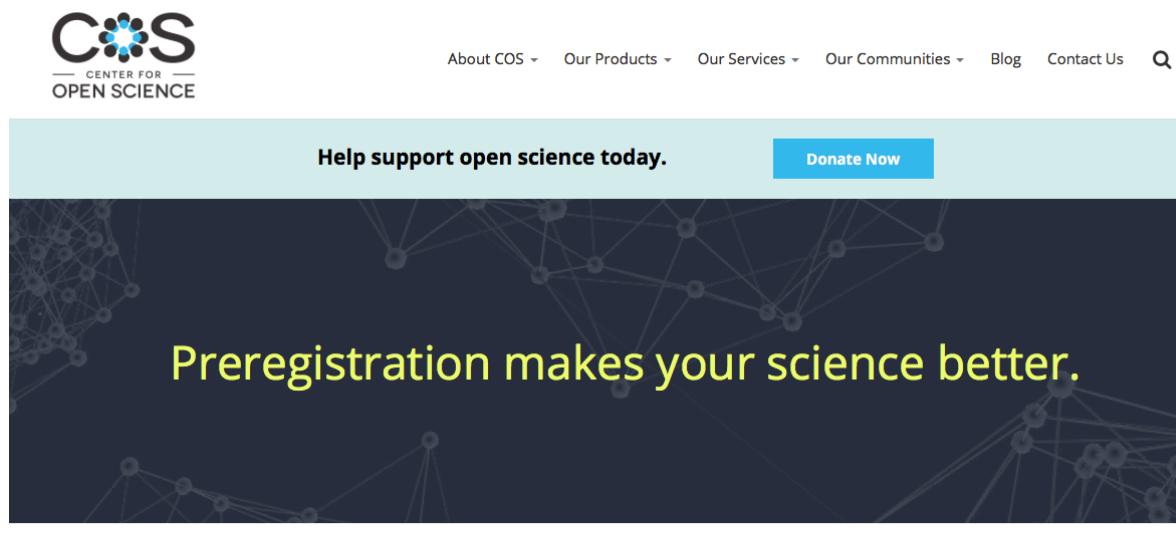
1. The study must meet the below definition of a replication study be relevant to the field of human neuroimaging
2. The study must be published in a peer-reviewed journal or deposited into a recognized preprint archive (such as biorXiv and arXiv) before the submission deadline- January 12, 2018.
3. **Please note: Current OHBM elected leadership are ineligible to receive OHBM Awards.**

What is a Replication Study?

A replication study is a repetition of a published study procedure with minor changes to variables assumed not to be important for the measured phenomena (this depends on the experiment, but could include demographics, scanner model, visual stimuli delivery system, analysis strategy, etc.). Replication studies usually (but not always) have a larger sample size than the original study for appropriate statistical power, and are performed by a different team than the original study (but planning of a replication study can benefit from involvement of the original researchers). Even though minor changes between the original study and its replication are inevitable they should be minimized as much as possible.

Incentivos (Solución)

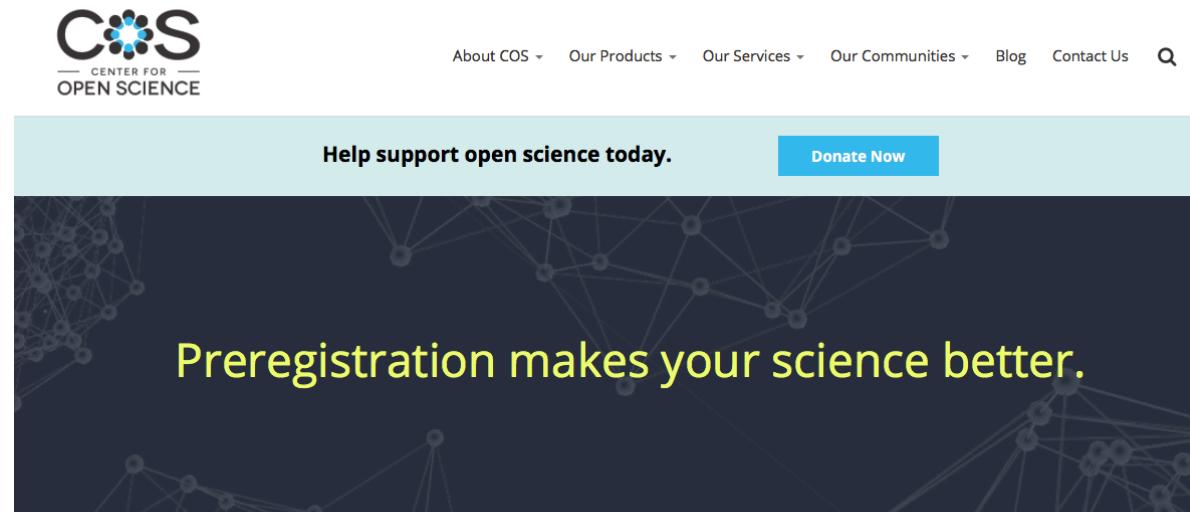
- Volver a la replicabilidad más “atractiva”.



If you have a project that is entering the planning or data collection phase, we'd like you to try out a preregistration. Through our **\$1 Million Preregistration Challenge**, we're giving away \$1,000 to 1,000 researchers who preregister their projects before they publish them. It's straightforward to complete and will really enhance your research output.

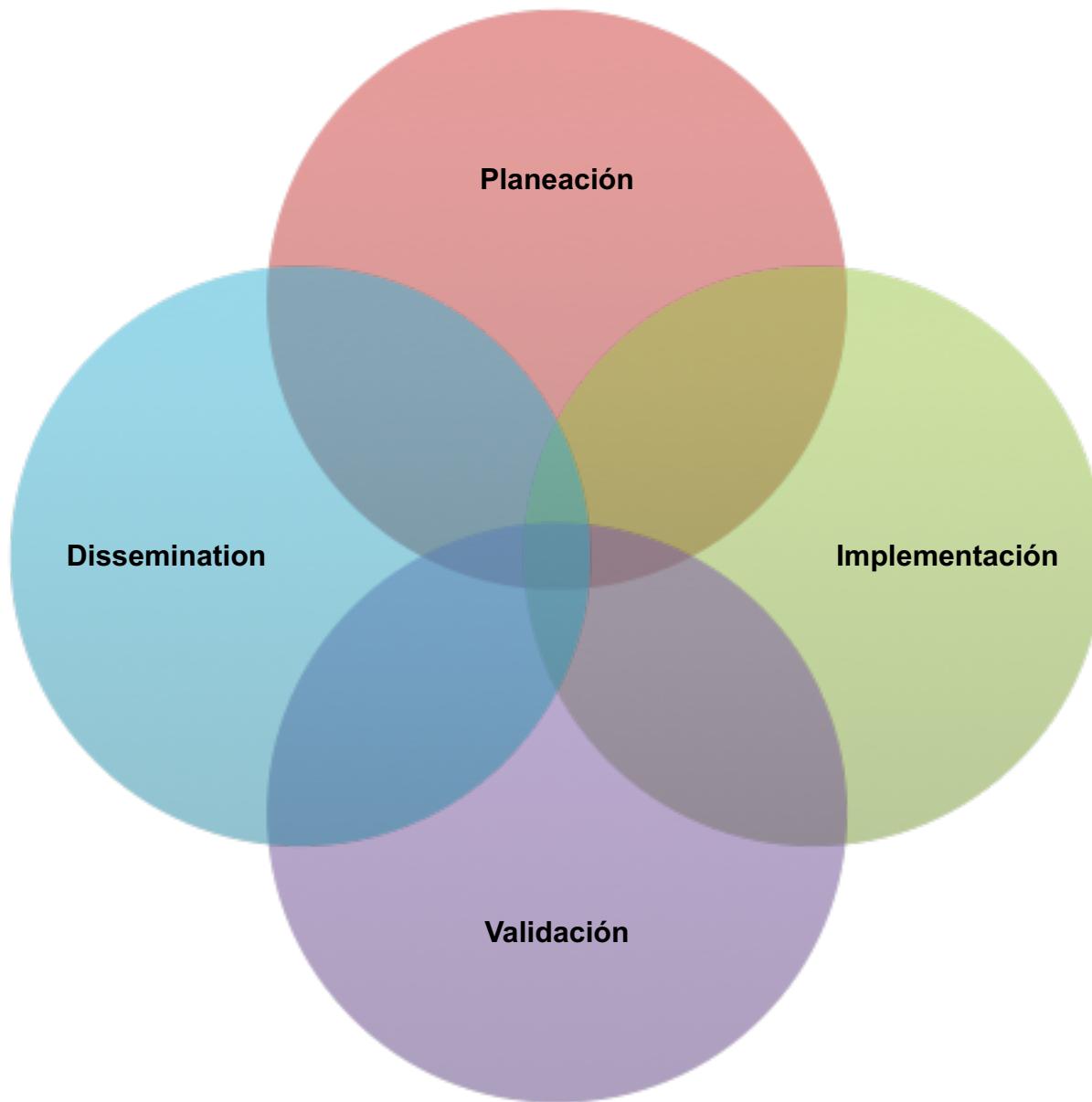
Incentivos (Solución)

- Volver a la replicabilidad más “atractiva”.
- Revistas y revisores pidan prácticas de reproducibilidad como requisito.



If you have a project that is entering the planning or data collection phase, we'd like you to try out a preregistration. Through our **\$1 Million Preregistration Challenge**, we're giving away \$1,000 to 1,000 researchers who preregister their projects before they publish them. It's straightforward to complete and will really enhance your research output.

Diseño ideal: *Towards the neuroimaging paper of the future*



Planeación

- Análisis de poder estadístico – tamaño de muestra.
- Pre-registro (hipótesis, objetivos, métodos).

The screenshot shows the NeuroPower software interface. At the top, there is a dark red header bar with the following navigation links: NeuroPower, Home, NeuroPower, Tutorial, Methods, and FAQ. Below the header is a row of tabs: OVERVIEW, START, VIEWER, PEAK TABLE, MODEL FIT, POWER CALCULATION, POWER TABLE, and a red RESET button. The main content area features a large "Welcome!" heading. Below it, a paragraph of text provides instructions for first-time users. Underneath the text is a section titled "Overview of the different steps" which contains five numbered steps, each enclosed in a colored box:

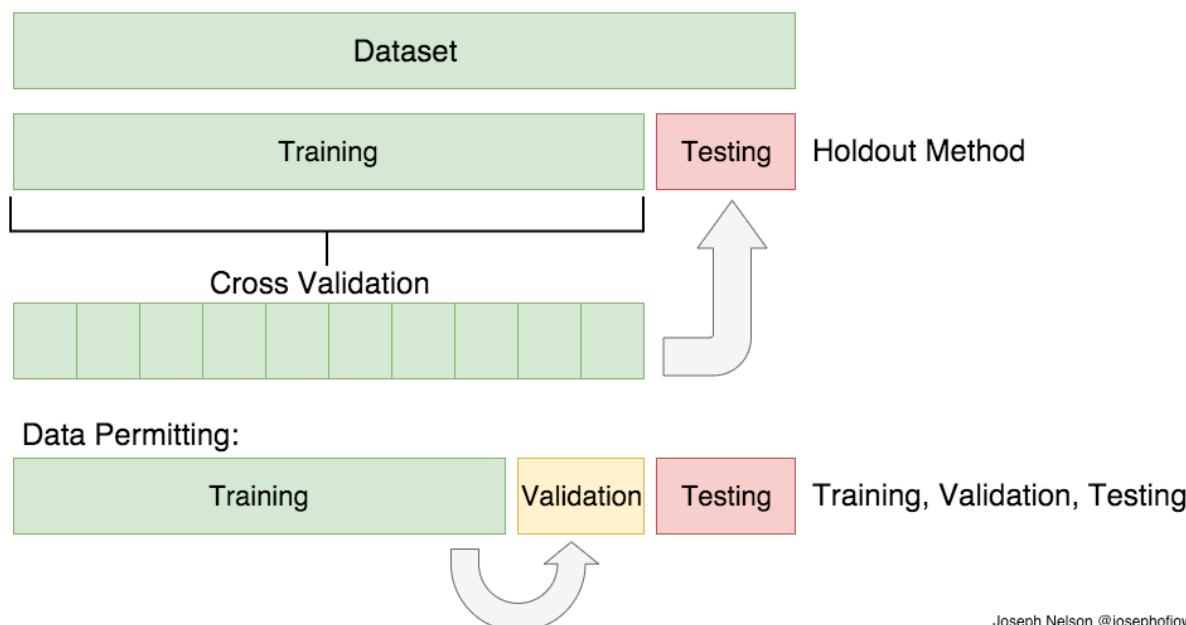
- PILOT DATA** (Red box): Before using this toolbox for power calculations, you need a pilot dataset. There are some important rules about what you can and cannot do with these data. Read the instructions carefully to make sure you don't harm the false positive rate of your study.
- 1. SPECIFY THE DATA** (Orange box): In the tab input you'll need to specify some parameters about the data and the experiment conducted. You can either upload data or link to an existing dataset.
- 2. LOOK AT THE DATA** (Yellow box): In the tab viewer you'll be able to see your dataset (if you have linked to your data). This allows you to confirm that we've obtained the right data.
- 3. EXTRACT PEAKS** (Green box): Our power calculations are based on the local maxima in the data. When you go to the peak table tab, the toolbox will extract the local maxima of your map and show you a table. Please allow a minute or two for this step to complete.
- 4. COMPUTE MODEL** (Green box): The key step of this toolbox is the estimation of the alternative distribution. In the tab model fit, you can visually inspect the fit of the model.
- 5. POWER ANALYSIS** (Blue box): In the tab power analysis you can see the power curves for your data, and you can specify your sample size and desired power. In the tab power table you'll then find a table with sample sizes and power.

Implementación

- Código abierto.
- Control de versiones.
- Todos los pasos empleados en el análisis.

Validación

- Validación interna y externa.
- Replicaciones independientes.

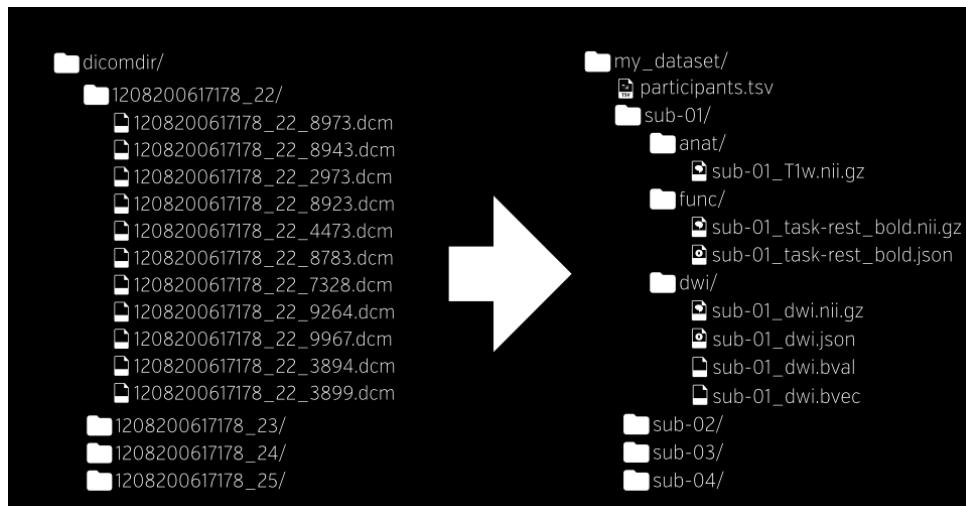
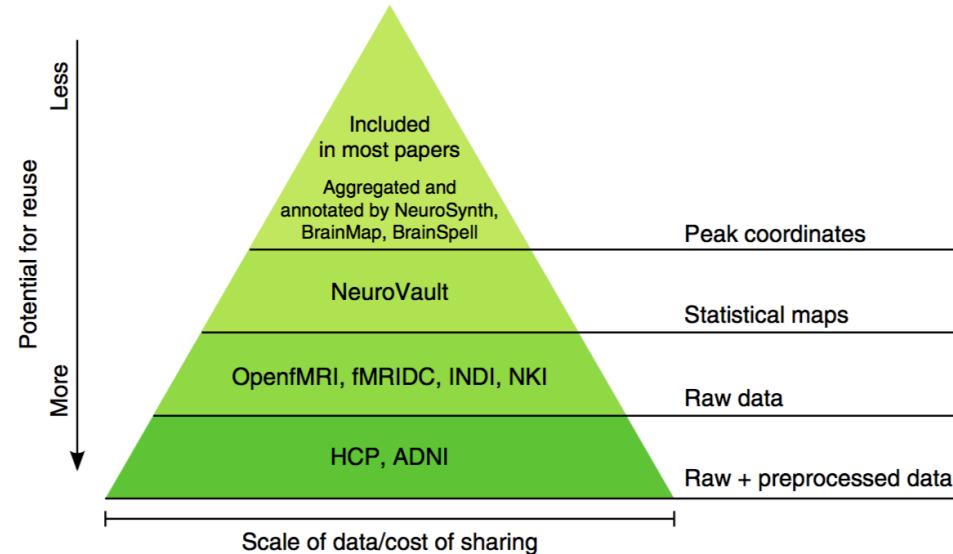


Divulgación

- Reporte siguiendo estándares de transparencia y reproducibilidad.
- Compartir código de análisis y bases de **datos** (tanto procesados como crudos).

Bases de datos abiertas

- Su rol en reproducibilidad.
- Estándares.



<http://bids.neuroimaging.io/>

Ventajas

- Evaluación de replicabilidad.
- Colaboración (n mayores).
- Validación de resultados (e.g., CV en Machine-Learning).
- Evaluación de generalizabilidad de los resultados.
- Punto de partida para principiantes y sin recursos para pagar estudios con fMRI y n grandes.

Algunas bases de datos

- OASIS: <http://www.oasis-brains.org>
- Child Mind Institute: http://fcon_1000.projects.nitrc.org
- NKI: http://fcon_1000.projects.nitrc.org/indi/pro/nki.html
- ABIDE: http://fcon_1000.projects.nitrc.org/indi/abide/
- Neurovault: <https://neurovault.org>
- OpenfMRI: <https://openfmri.org>
- HCP: <https://www.humanconnectome.org/study/hcp-young-adult/data-releases>
- ADNI: <http://adni.loni.usc.edu>

Referencias

- Button, K. S., Ioannidis, J. P., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience*, 14(5), 365-376.
- Ioannidis, J. P. (2005). Why most published research findings are false. *PLoS medicine*, 2(8), e124.
- Nichols, T. E., Das, S., Eickhoff, S. B., Evans, A. C., Glatard, T., Hanke, M., ... & Proal, E. (2017). Best practices in data analysis and sharing in neuroimaging using MRI. *Nature Neuroscience*, 20(3), 299-303.
- Poldrack, R. A., Baker, C. I., Durnez, J., Gorgolewski, K. J., Matthews, P. M., Munafò, M. R., ... & Yarkoni, T. (2017). Scanning the horizon: towards transparent and reproducible neuroimaging research. *Nature Reviews Neuroscience*, 18(2), 115-126.
- Poldrack, R. A., & Gorgolewski, K. J. (2014). Making big data open: data sharing in neuroimaging. *Nature neuroscience*, 17(11), 1510-1517.
- Simmons, J. P., Nelson, L. D. & Simonsohn, U. Falsepositive psychology: undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychol. Sci.* 22, 1359–1366 (2011).

¡Gracias!

[https://github.com/JosueMA/Curso
Neuroimagen Reproducibilidad](https://github.com/JosueMA/Curso_Neuroimagen_Reproducibilidad)