Reporting in Neuroimaging Studies

Educational Workshop: Human Brain Mapping Meeting

June x, 2016

Tonya White, MD, PhD
Associate Professor
Child and Adolescent Psychiatry & Radiology
Erasmus University Medical Centre
Franz Joseph Gall (1758-1828)

Considered as the founder of phrenology.

Based on observations of skull sizes and facial features of his classmates, Gall developed a theory that the brain consists of a collection of independent entities that form the mind.

Gall believed that the bumps and uneven geography of the human skull were a result of pressure from the brain underneath.
THE PHRENOLOGIST.
Jean Pierre Flourens (1794-1867)

Was a pioneer in performing lesion studies, using rabbits and pigeons and carefully recording the effects on sensorimotor and behavior.

One of the goals was to investigate localism, since Gall was not following proper scientific approaches. He was thus charged by the Academy of Sciences in Paris, acting on order of Napoleon Bonaparte, to investigate this further.
• “Most published research findings are false.”
  – John Ioannidis (2005)

• 39 of 100 psychology studies replicated
  – Open Science Collaboration (2015)
Committee on Best Practices in Data Analysis and Sharing (COBIDAS)

OHBM Council Statement on Neuroimaging Research and Data Integrity

COBIDAS

i. Identify best practices of data analyses and data sharing in the brain mapping community
ii. Prepare a white paper organizing and describing these practices
iii. Obtain input from the OHBM community
iv. Publish the recommendations

OHBM Vote (153 vs. 6) for COBIDAS

Ten Tips for Good Reporting and Data Sharing

*Primarily consolidated from the COBIDAS report*

- Reproducibility
- Replication
- Understanding how the results generalize to different populations
Tip #10

The Top 10 tips for good reporting

• Provide enough information for the reader to understand potential bias in your study
  – Demographics
  – Clinical confounding

• Note: The best time to think about reducing potential bias is during the design of the study
Types of Bias

- **Selection bias**
  - Individuals are more likely to be selected than others
  - All participants – generalizability
  - One group - confounding

- **Reporting bias**
  - Certain observations are more commonly reported

- **Analytical bias**
  - Bias due to the way that the data is analyzed

- **Exclusion bias**
  - Systematic exclusion of certain individuals

- **Attrition bias**
  - Loss of participants in a non-random fashion

- **Funding bias**
  - Selection of important variables that favor the financial sponsor of the study

- **Career Propagation Bias**
  - Playing with data until you come up with a positive result.
Tip #9

The Top 10 tips for good reporting

• Think carefully about the assumptions that you are making when designing, analyzing reporting the study
  – Physiologic
  – Distribution of the data
  – Modeling
Tip #8

The Top 10 tips for good reporting

• Established fixed pre-processing and processing pipelines if possible
  – Justify deviations from these pipelines
    • Linear / non-linear registrations
    • Differences in brain Templates
    • Computer, software & software versions
    • Motion correction algorithms, excluding outliers, data scrubbing
    • Temporal & spatial filtering
    • Thresholds
    • Parcellations and definition of regions of interest
    • Dimensionality (ICA)
  – Utilize provenance algorithms to document data processing
    – Loni pipeline, CBRAIN, NiPype all have provenance built in
Tip #7
The Top 10 tips for good reporting

• In the statistical methods section, make clear:
  – Dependent variables
  – Independent variables
  – Model used
  – Inference testing
  • Consider analyses that make fewer assumptions about the data, while still providing the needed inference.
    – Permutation or Bootstrapping
Tip #6
The Top 10 tips for good reporting

• Provide the rationale for the choice of (or lack of) correction for multiple testing
  – Bonferroni
  – Family-wise error
  – False Discovery Rate
  – Permutation or Bootstrapping techniques

• Only 59% of fMRI studies corrected for multiple testing
  – Carp (2012) NeuroImage
Tip #5

The Top 10 tips for good reporting

• If possible, perform a replication in your study
  – Independent sample
  – Within sample
    • Split n
    • Resampling
Resting-State Networks in School-Age Children

Muetzel et al. (in revision)
Tip #4

The Top 10 tips for good reporting & data sharing

• Provide enough information so that your study could be both reproduced and replicated.
  – Reproducibility: An investigator independently obtains the same results with the same data.
  – Replication: A different investigator independently obtains similar results with different data.
Tip #3

The Top 10 tips for good reporting and data sharing

- If possible, make your data available for other researchers to use
  - It’s best to think about data sharing before you start your study
    - When you’re writing your IRB or medical ethics document
    - Put funding to support data sharing in your grant
The only borders in science should be between what we know, and what we don’t know.
Share Neuroimaging Data

Bring the earths FA back to zero
Data Sharing

Because we also ask our participants to be altruistic.
Funding Agencies & Public

Pros
i. Better return for money
ii. Quicker scientific advances

Cons
i. Privacy issues
ii. Use of data for nefarious reasons

Researchers

Pros
i. Can address research questions not possible with data from a single lab
ii. Data paper citations
iii. Recognition from peers for data sharing
iv. Seeing fruits of data collection
v. Fosters collaboration

Cons
i. Other researchers publish with hypotheses you wanted to test
ii. Other researchers receive credit for your efforts
iii. Other researchers may obtain grant support in place of you based on data that you’ve collected, thus the work in your lab is not unique
Tip #2

The Top 10 tips for good reporting

- If your study design and analyses are solid, and you obtain a negative result, publish a negative paper.
  - Make sure that a power analysis is included.
  - At least try…

+ to – ratio: 9:1
Tip #1

The Top 10 tips for good reporting

• Be transparent
  – No study is perfect
“Most published research findings are false.”

- John Ioannidis (2005)

“Most published research findings have bits of truth.”
Conclusions

Hypothesis → Study → Peer Review → Publication

COBIDAS
COBIDAS

How in the #&!♫∞ do we use the COBIDAS document?
COBIDAS

• How in the #&!! do we use this document?
  – Writing your own papers
  – Reviewing papers for peer review
  – Trying to make sense of discrepant results between studies
“All models are wrong, but some are useful.”
- George Box

“All studies have bias, but some provide useful information.”