Open Neuroscience

Practical suggestions for conducting open neuroscience research

Presented by Danielle Lauren Kurtin, PhD
Why care about neuroscience?

- We all have brains, and they often don’t work how we’d like them do

- Neurological and neuropsychiatric disorders are often debilitating and are one of the greatest contributors (28%) to Global Burdens of Disease (Patel et al., 2016)

- Better neuroscience = better health

Diagram: Years Living with Disability

- Neurological disorders: 5.6%
- Mental disorders: 18.9%
- Substance use disorders: 3.9%
- Injuries: 5.9%
- Non-communicable diseases (excluding MNS disorders): 50.2%
- Communicable diseases: 15.5%
Why am I presenting this to non-neuro-nerds?

- Neuroscience is extremely computationally intensive and interdisciplinary
  - Computers and brains have been learning from each other since the inception of both fields.
Why am I presenting this to non-neuro-nerds?

• Neuroscience is extremely computationally intensive and interdisciplinary
  • Computers and brains have been learning from each other since the inception of both fields.

• Why **Open** Neuroscience?
  • Reproducibility crisis – bad neuroscience = delays in treatment
  • Funders require/like it ([Spikes-Jones et al., 2016](https://example.com))
  • Synergy between industry and academia
  • Many principals I’ll discuss today are transdisciplinary
Neuroimaging data

Enables in-vivo measurement of brain function
Neuroimaging data

- Common measurements: EEG, MRI, MEG

- Challenges: differing spatiotemporal scales of measurement, accessibility, interpretability

Enables in-vivo measurement of brain function
Option 1 – collecting data

Collect in an open and reproducible manner

• Include a section about data sharing in your consent forms ([Gorgolewski and Poldrack, 2016](#))
• Address gender bias in research samples (unless you should!)
• Break the WEIRD cycle – champion diverse recruitment
  • Use census data for demographic and education proportions
  • Advertise beyond your university or research institution
  • Break barriers to participation – extra remuneration for BAME participants
Pros and cons of collecting data

**Pros**
- Customisable to your paradigm/research question
- Intimate knowledge of your data

**Cons**
- Time and resource expensive

**Tip!**
Test your analysis pipeline using a pilot cohort before conducting full data collection!
GOOD FOR REGISTERED REPORTS!
Data anonymisation

Excellent resource ([White et al 2020](#))

(Eke et al 2021)
Option 2 – available data

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug-and-play</td>
<td>Limited study populations and imaging conditions, modalities, behavioural measures, etc.</td>
</tr>
<tr>
<td>Well-validated</td>
<td></td>
</tr>
<tr>
<td>Easily citable</td>
<td></td>
</tr>
</tbody>
</table>

**Tip!**
Utilise the Human Connectome Project and Chinese Human Connectome Project as test-retest datasets.
Preprocessing and analysis
Choosing a toolbox can feel like an analysis multiverse.
Choosing a toolbox can feel like an analysis multiverse
Preprocessing and analysis

- Utilise Brain Imaging Data Structure (BIDS)
- Use toolboxes that use open-source software
- Cool resources: Neurosynth, The Virtual Brain
  - Tip: Neurosynth is an excellent Region of Interest (ROI) selection tool!!
Dissemination
Papers

• The for-profit publishing industry is an unpleasant reality

• Non-traditional DOI generators for your hungry CV/alternative means of contributing to scientific literature:
  • Preprints
  • Protocol papers
  • Registered reports

https://paywallthemovie.com/
## A brief overview of open access

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gold OA</strong></td>
<td>Journals do not charge subscription fees and authors pay the article processing charges (APC).</td>
</tr>
<tr>
<td><strong>Green OA</strong></td>
<td>Also known as self-archiving, authors deposit pre or post-prints to an OA digital repositories and pay no fee (with 6-24 months embargo). This can be an institutional or a disciplinary repository such as PubMed Central.</td>
</tr>
<tr>
<td><strong>Hybrid OA</strong></td>
<td>A subscription journal in which some of the articles are open access. It is a mixed revenue model of subscription charges and pay-to-publish options. Authors pay a subscription-based journal a publication fee to make their individual article open access immediately upon its release. Hybrid OA remains significantly more expensive than full OA (~50% more per APC).</td>
</tr>
<tr>
<td><strong>Bronze OA</strong></td>
<td>Delayed OA. Free to read on the publisher’s website. The publisher controls copyrights.</td>
</tr>
<tr>
<td><strong>Platinum/Diamond OA</strong></td>
<td>Free to the authors and free to the readers. Usually sponsored and published by nonprofit societies and associations, e.g., the Beilstein-Institut and the Electrochemical Society.</td>
</tr>
</tbody>
</table>
Example: “An Approximate Neuro-Optimal Solution of Discounted Guaranteed Cost Control Design”

Other means of dissemination

Code ➔ SOURCEFORGE

NITRC: Neuromaging Tools & Resources Collaboratory

zenodo
Other means of dissemination

<table>
<thead>
<tr>
<th>Data format</th>
<th>Repository</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article file</td>
<td>PubMed Central</td>
<td><a href="http://www.ncbi.nlm.nih.gov/pmc">http://www.ncbi.nlm.nih.gov/pmc</a></td>
</tr>
<tr>
<td></td>
<td>ResearchGate</td>
<td><a href="https://www.researchgate.net">https://www.researchgate.net</a></td>
</tr>
<tr>
<td></td>
<td>OpenAIRE</td>
<td><a href="https://www.openaire.eu">https://www.openaire.eu</a></td>
</tr>
<tr>
<td>All data formats</td>
<td>Figma</td>
<td><a href="https://figshare.com">https://figshare.com</a></td>
</tr>
<tr>
<td></td>
<td>Dryad</td>
<td><a href="http://datadryad.org">http://datadryad.org</a></td>
</tr>
<tr>
<td></td>
<td>Zenodo</td>
<td><a href="http://zenodo.org">http://zenodo.org</a></td>
</tr>
<tr>
<td></td>
<td>Synapse</td>
<td><a href="https://www.synapse.org/#">https://www.synapse.org/#</a></td>
</tr>
<tr>
<td>Genetic data</td>
<td>INSDC</td>
<td><a href="http://www.insdc.org">http://www.insdc.org</a></td>
</tr>
<tr>
<td></td>
<td>PGC</td>
<td><a href="https://www.med.unc.edu/pgc">https://www.med.unc.edu/pgc</a></td>
</tr>
<tr>
<td></td>
<td>GenomeRNAi</td>
<td><a href="http://www.genomernai.org">http://www.genomernai.org</a></td>
</tr>
<tr>
<td>Imaging data</td>
<td>HCP</td>
<td><a href="http://www.humanconnectomeproject.org">http://www.humanconnectomeproject.org</a></td>
</tr>
<tr>
<td></td>
<td>OpenfMRI</td>
<td><a href="https://openfmri.org">https://openfmri.org</a></td>
</tr>
<tr>
<td></td>
<td>COINS</td>
<td><a href="http://coins.mrn.org">http://coins.mrn.org</a></td>
</tr>
<tr>
<td></td>
<td>NITRC</td>
<td><a href="https://www.nitrc.org">https://www.nitrc.org</a></td>
</tr>
<tr>
<td>Electrophysiological recordings</td>
<td>CRCNS</td>
<td><a href="https://crcns.org">https://crcns.org</a></td>
</tr>
<tr>
<td></td>
<td>Carmen</td>
<td><a href="http://www.carmen.org.uk">http://www.carmen.org.uk</a></td>
</tr>
<tr>
<td></td>
<td>Neuroelectro</td>
<td><a href="http://www.neuroelectro.org">http://www.neuroelectro.org</a></td>
</tr>
<tr>
<td>Morphological reconstructions</td>
<td>Neuromorpho</td>
<td><a href="http://neuromorpho.org">http://neuromorpho.org</a></td>
</tr>
<tr>
<td></td>
<td>BigNeuron</td>
<td><a href="http://alleninstitute.org/bigneuron">http://alleninstitute.org/bigneuron</a></td>
</tr>
<tr>
<td>Computational models</td>
<td>ModelDB</td>
<td><a href="https://senselab.med.yale.edu/modeldb">https://senselab.med.yale.edu/modeldb</a></td>
</tr>
</tbody>
</table>

(Spires-Jones et al., 2016)
Other means of dissemination

Code

Data

Funding agencies
Pros:
• Better return for their money
• Increased number of scientific discoveries
Cons:
• Data sharing requires extra financial resources

Researchers
Pros:
• Can address scientific questions not possible with data from a single lab
• Allows researchers without the financial resources to conduct neuroimaging studies to analyze the data
• Fosters collaboration
• Data paper citations
• Recognition from peers for data sharing
• Seeing fruits from data collection
Cons:
• It requires considerable work to prepare the data for sharing
• Other researchers can scoop us with the data we’ve collected
• Other researchers receive credit for your work
• Other researchers might get grants instead of you to work with your data

Public
Pros:
• Quicker scientific advances
Cons:
• The data can be used to re-identify individuals
• The data can be used for harmful purposes

(White et al., 2020)
Parting words
Open neuroscience benefits everyone!

Thank you for your time and attention 😊