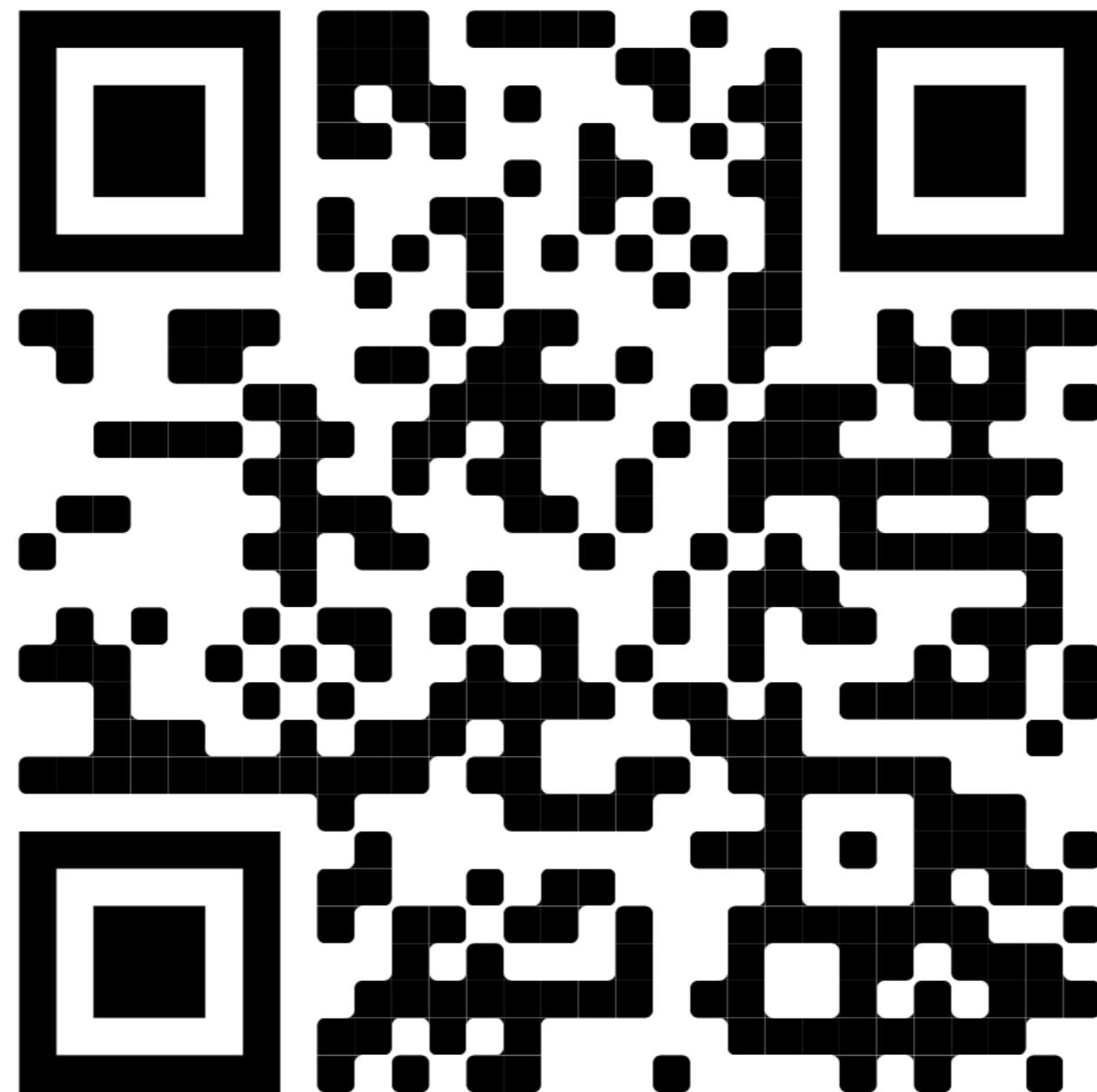
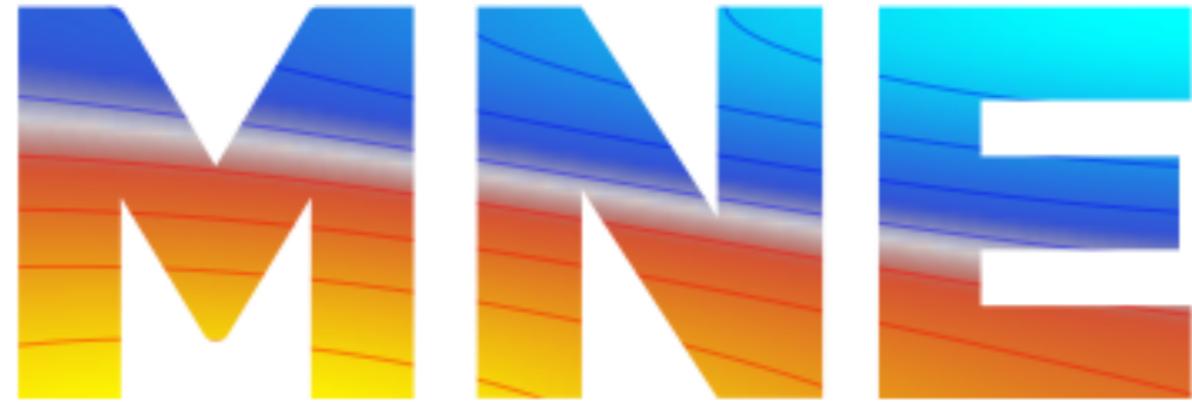


Download workshop material

https://bit.ly/cuttingeq_mne_tutorial





MEG/EEG data processing in Python



<https://mne.tools>

Alexandre Gramfort

<http://alexandre.gramfort.net>



@agramfort



@agramfort

Richard Höchenberger

<https://hoechenberger.net>



@hoechenberger

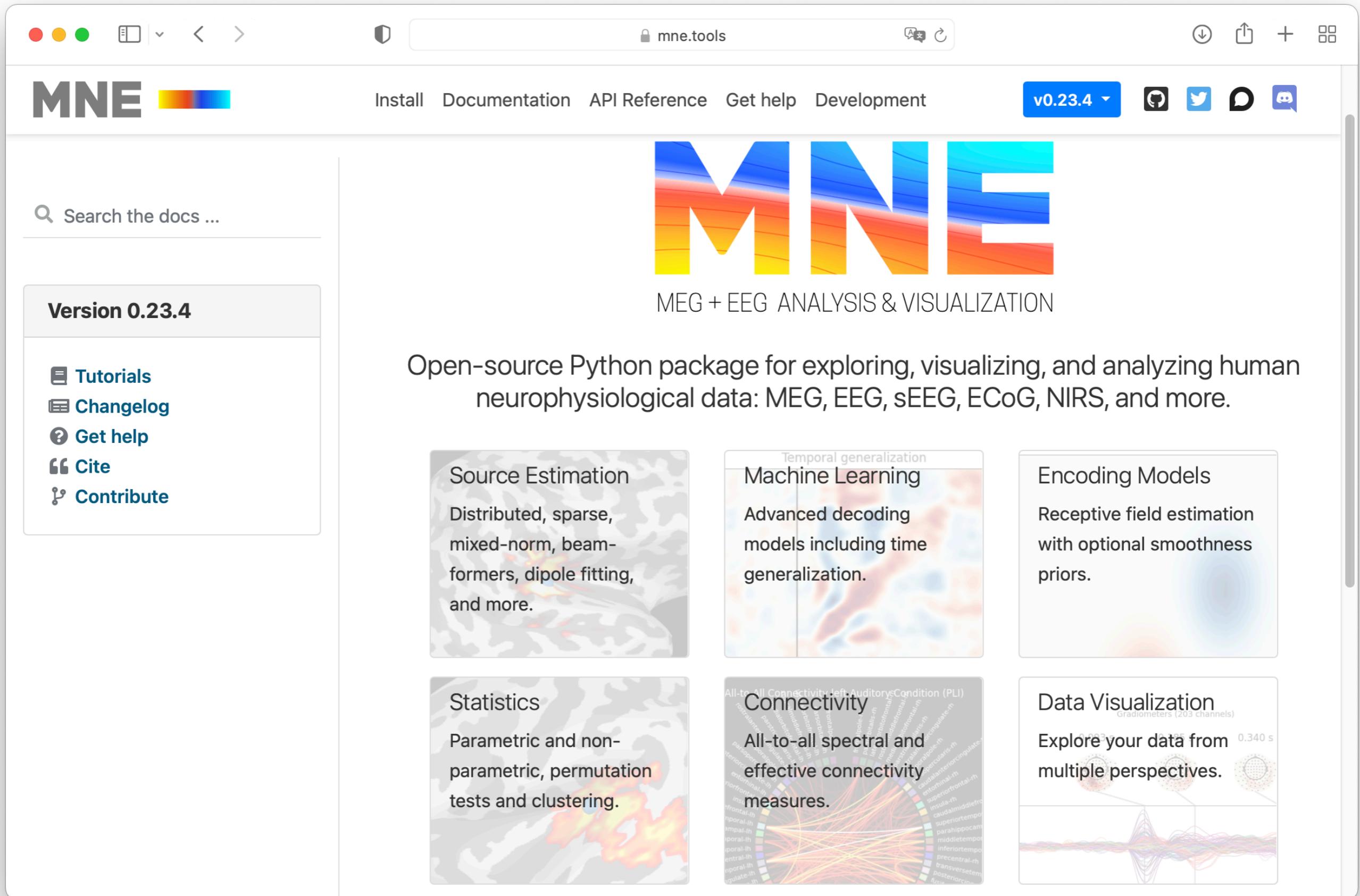


@RHoechenberger

MNE software for processing MEG and EEG data, A. Gramfort, M. Luessi, E. Larson, D. Engemann, D. Strohmeier, C. Brodbeck, L. Parkkonen, M. Hämäläinen, Neuroimage, 2014



<https://mne.tools>



The screenshot shows the official website for the MNE (Measuring and Normalizing Electrophysiology) Python package. The URL in the browser bar is <https://mne.tools>. The page header includes the MNE logo, a color bar, and navigation links for Install, Documentation, API Reference, Get help, and Development. A dropdown menu shows the version v0.23.4. Social media icons for GitHub, Twitter, Discourse, and Gitter are also present.

MNE 

Install Documentation API Reference Get help Development v0.23.4 

Search the docs ...

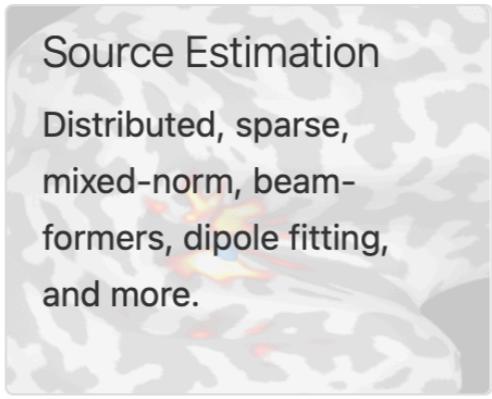
Version 0.23.4

- [Tutorials](#)
- [Changelog](#)
- [Get help](#)
- [Cite](#)
- [Contribute](#)

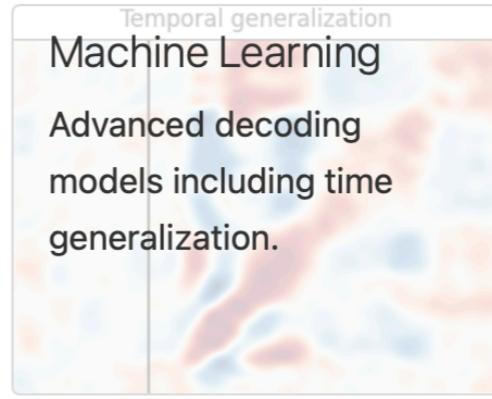
MNE
MEG + EEG ANALYSIS & VISUALIZATION

Open-source Python package for exploring, visualizing, and analyzing human neurophysiological data: MEG, EEG, sEEG, ECoG, NIRS, and more.

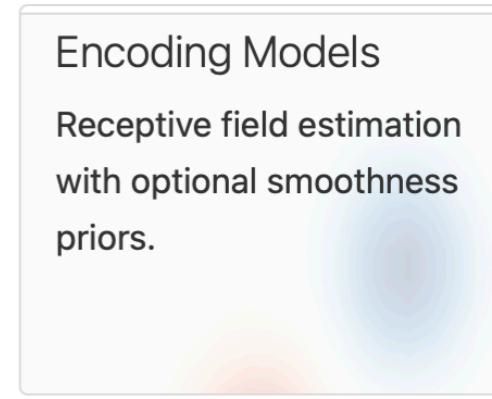
Source Estimation
Distributed, sparse, mixed-norm, beamformers, dipole fitting, and more.



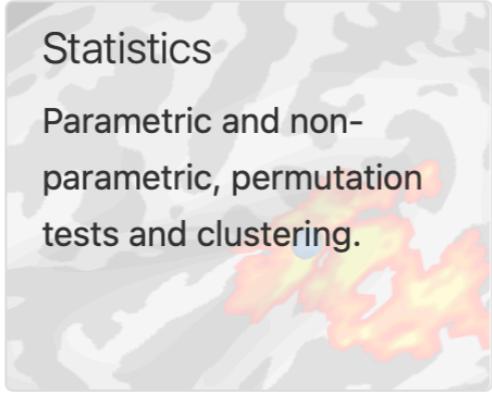
Machine Learning
Advanced decoding models including time generalization.



Encoding Models
Receptive field estimation with optional smoothness priors.



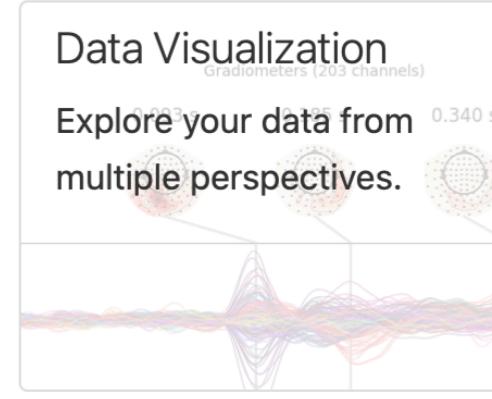
Statistics
Parametric and non-parametric, permutation tests and clustering.

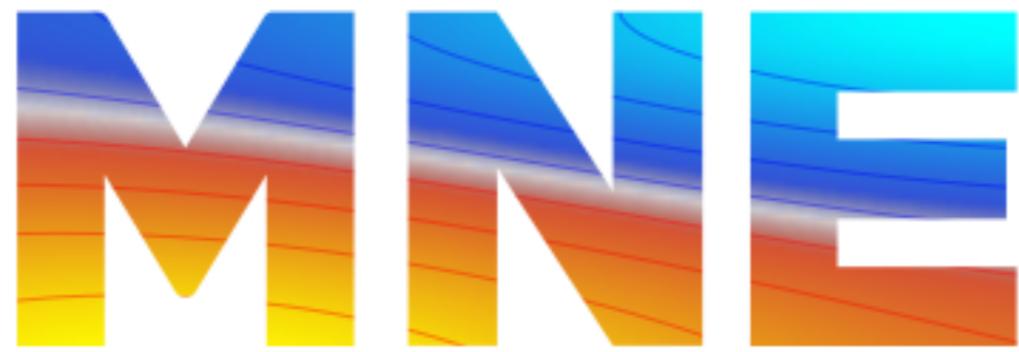


Connectivity
All-to-all spectral and effective connectivity measures.



Data Visualization
Explore your data from multiple perspectives.





built on top of the scientific Python ecosystem



<https://github.com/mne-tools/mne-python>

mne-tools / mne-python Public Unwatch 78 Unstar 1.7k Fork 967

Code Issues 322 Pull requests 43 Actions Projects Wiki ...

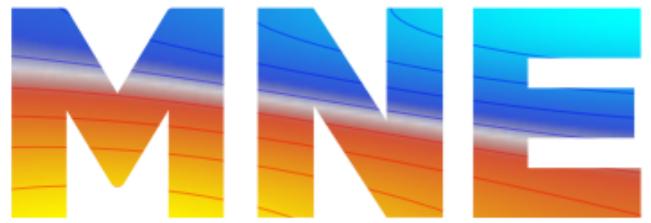
main Unwatch 78 Unstar 1.7k Fork 967

jbteves and larsoner [ENH] Add pooch ...	2 days ago	16,301
.circleci	MRG, CI: Fix issue with Sphinx-Windo...	4 days ago
.github	WIP: Add CODEOWNERS? (#9692)	last month
doc	[ENH] Add pooch sys info (#9801)	2 days ago
examples	[ENH, MRG] Update ECoG dataset ex...	4 days ago
logo	[MRG] DOC, Style: Use editor compat...	3 months ago
mne	[ENH] Add pooch sys info (#9801)	2 days ago
tools	MRG, CI: Fix issue with Sphinx-Windo...	4 days ago
tutorials	MRG, ENH: Add Otaniemi phantom ba...	2 days ago
.coveragerc	MNT: Migrate VTK Widgets (#8862)	7 months ago

MNE:
Magnetoencephalography (MEG) and
Electroencephalography (EEG) in Python

mne.tools

visualization python
machine-learning
statistics
neuroscience meg
eeg neuroimaging
electroencephalography
magnetoencephalography
electrocorticography



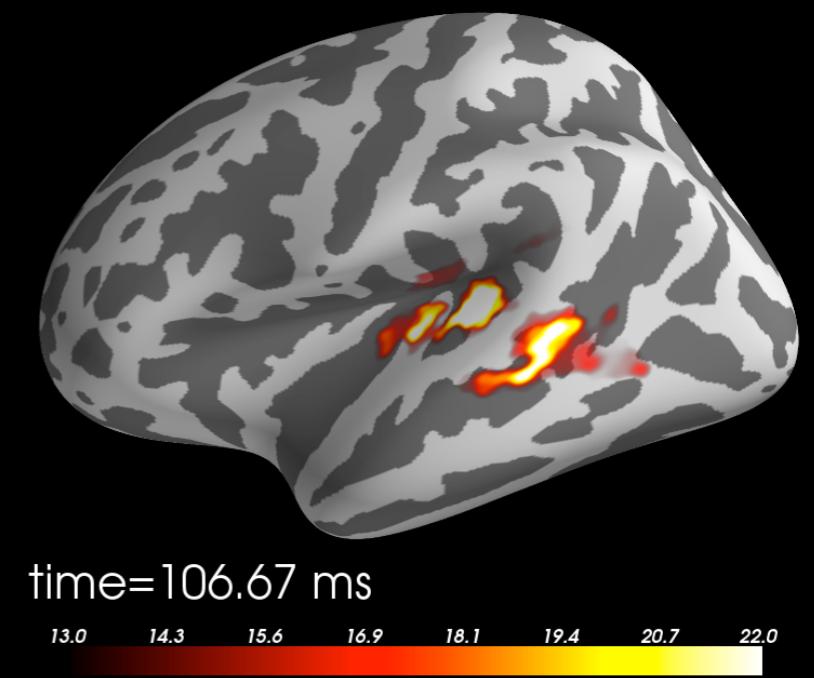
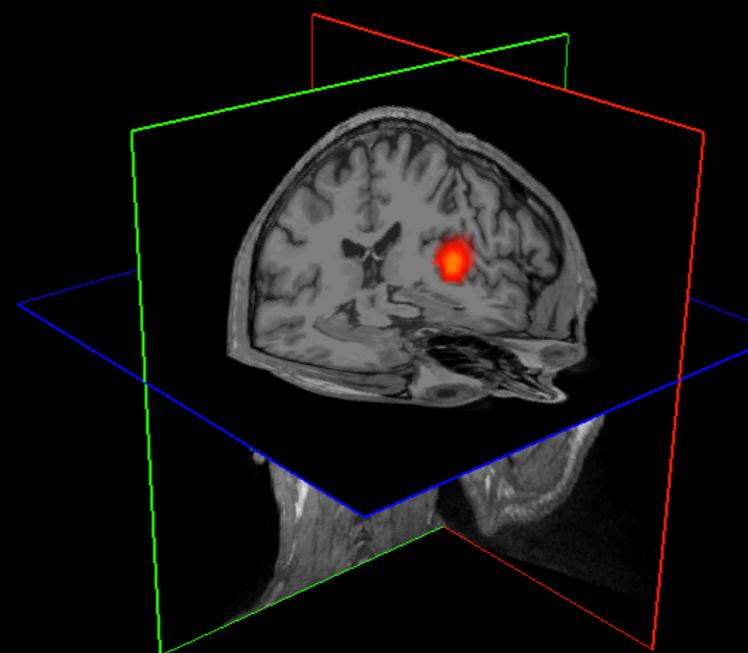
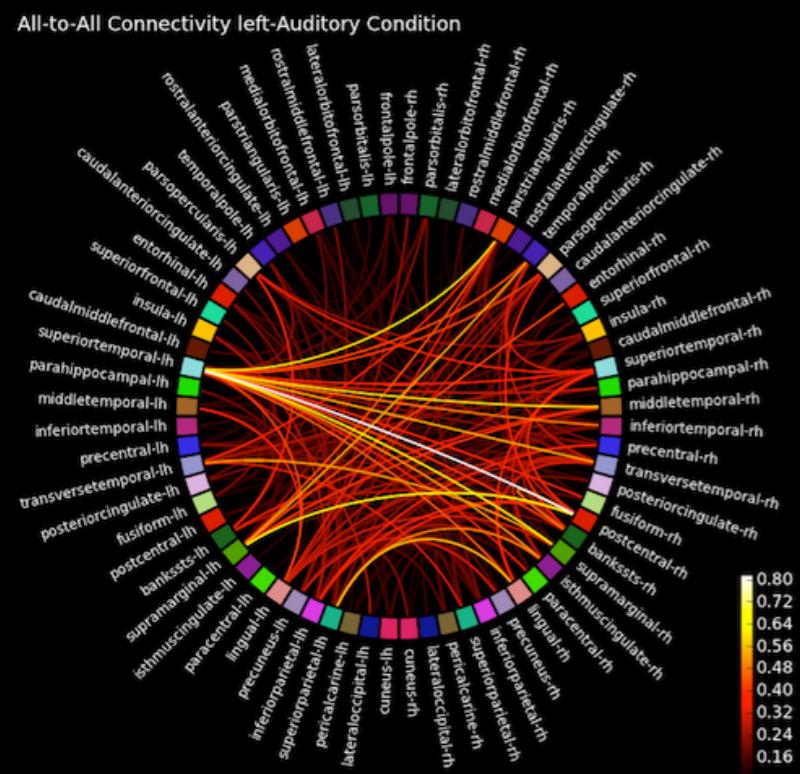
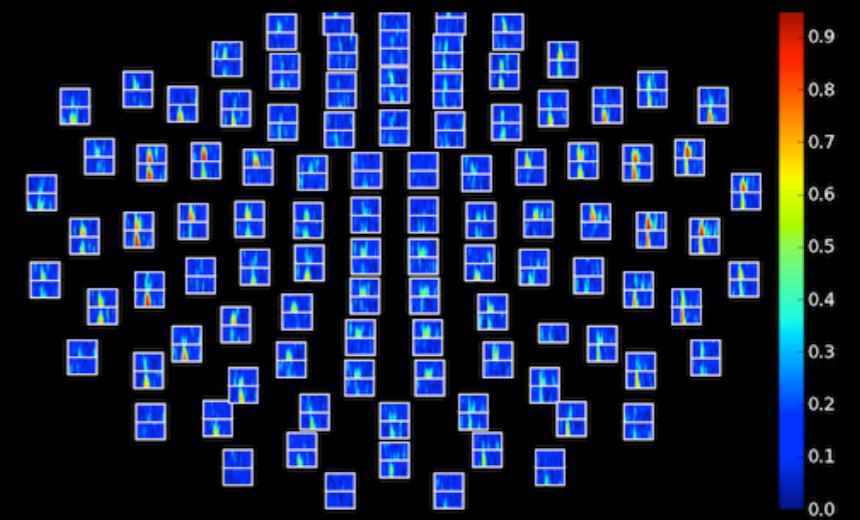
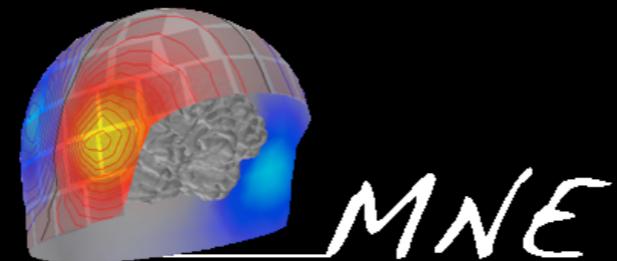
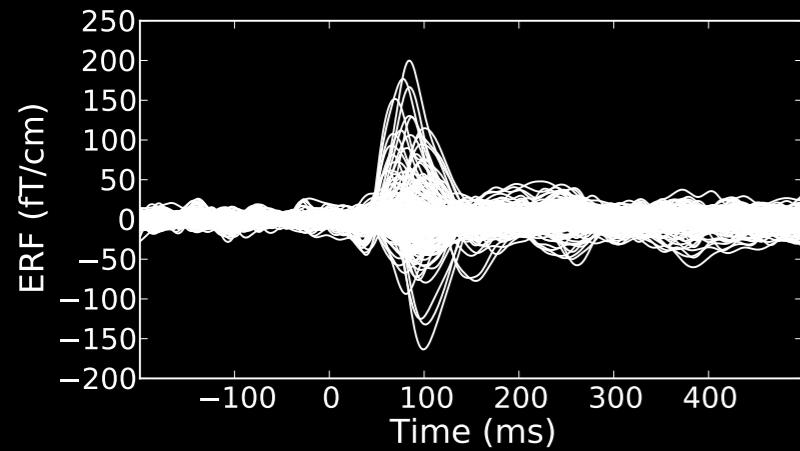
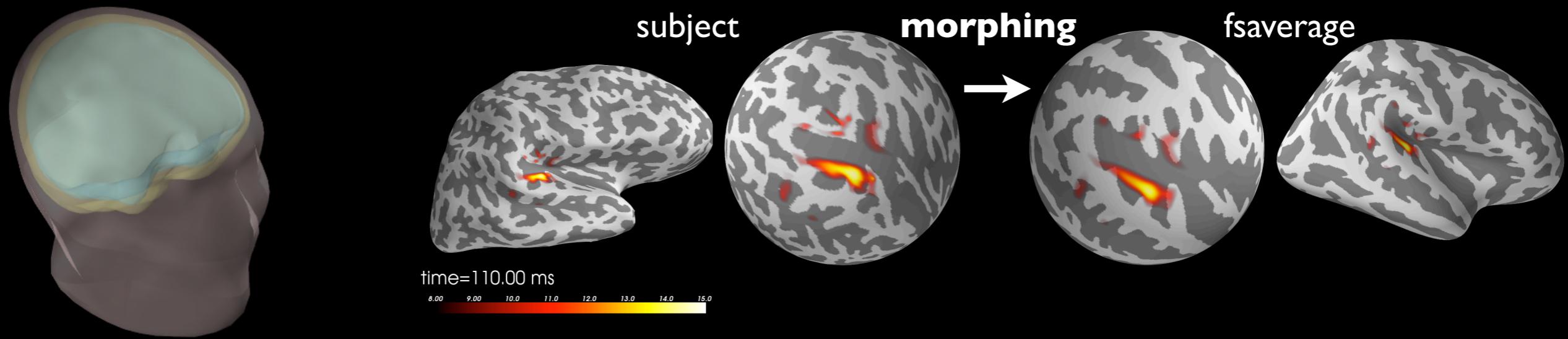
Distributed development



**Vision: Implement, share, document
the best methods from all labs**

A young girl with light brown hair in two pigtails, wearing a pink long-sleeved shirt, is looking upwards with her arms outstretched. An orange speech bubble originates from her hands and points towards the text.

What can I do
with MNE?



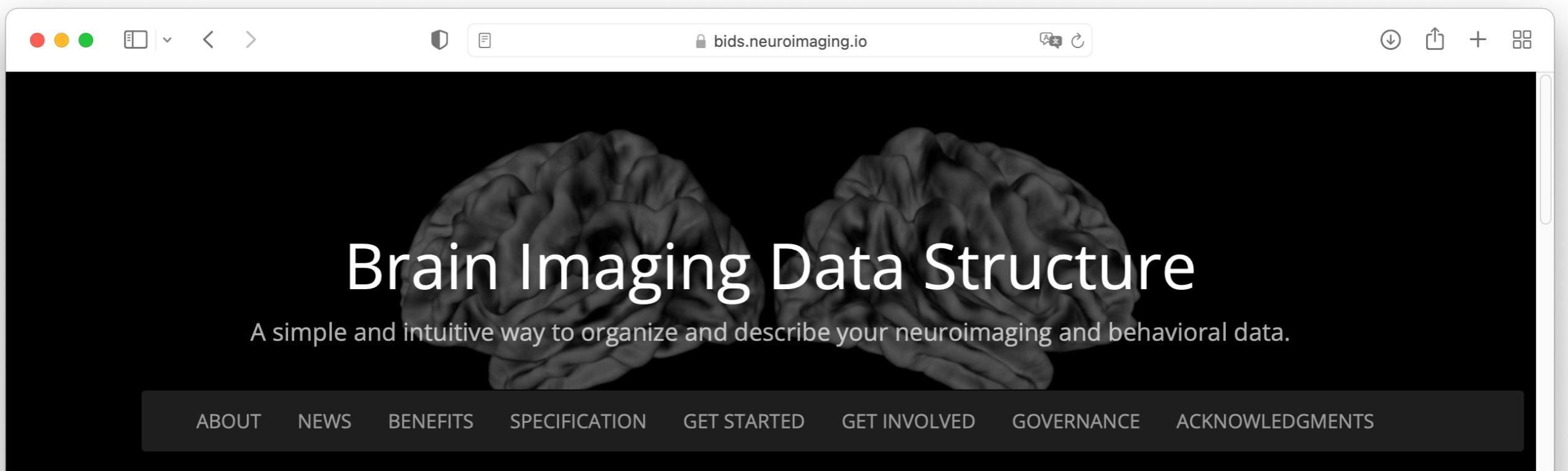
Before we start . . .

Before we start ...

... a little field trip.

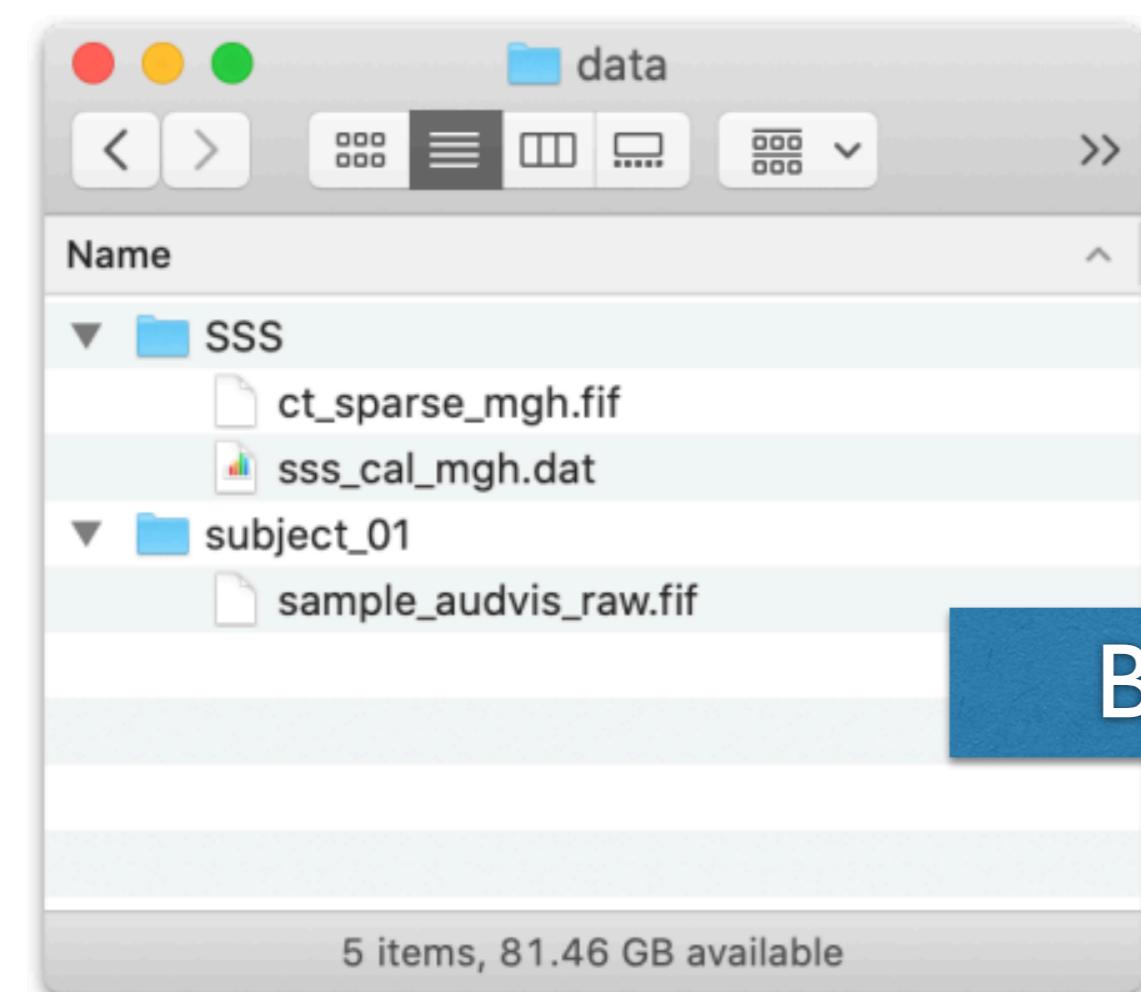


BIDS



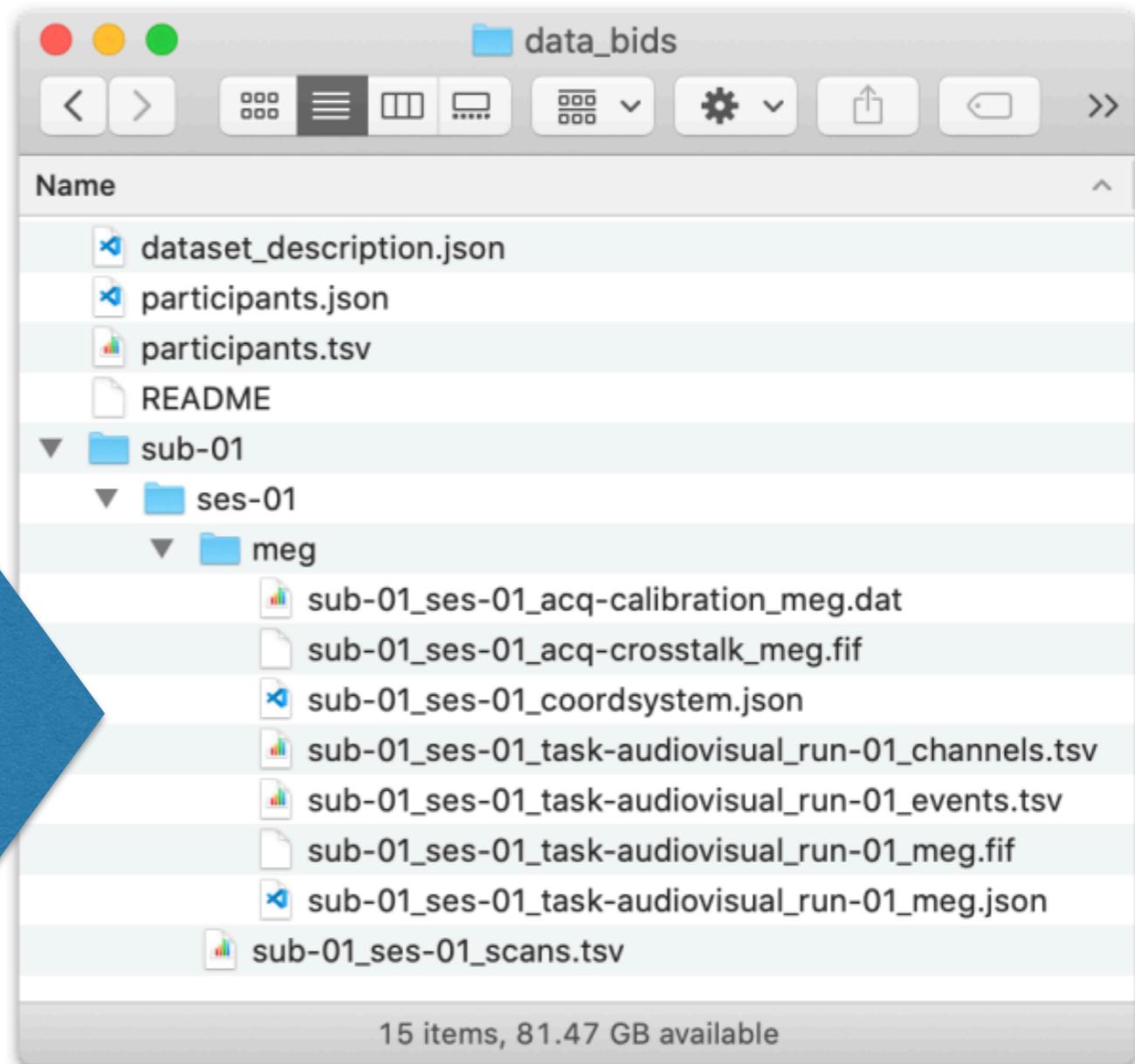
A screenshot of a web browser displaying the BIDS website. The page features a large, stylized brain image in grayscale against a black background. Overlaid on the brain image is the word "BRAIN" in large, bold, white capital letters. Below the brain image, the text "Brain Imaging Data Structure" is displayed in a large, white, sans-serif font. Underneath that, a subtitle reads "A simple and intuitive way to organize and describe your neuroimaging and behavioral data." At the bottom of the page is a dark navigation bar containing links for "ABOUT", "NEWS", "BENEFITS", "SPECIFICATION", "GET STARTED", "GET INVOLVED", "GOVERNANCE", and "ACKNOWLEDGMENTS". The browser's address bar shows the URL "bids.neuroimaging.io".

<https://bids.neuroimaging.io>



Arbitrarily organized data

BIDS



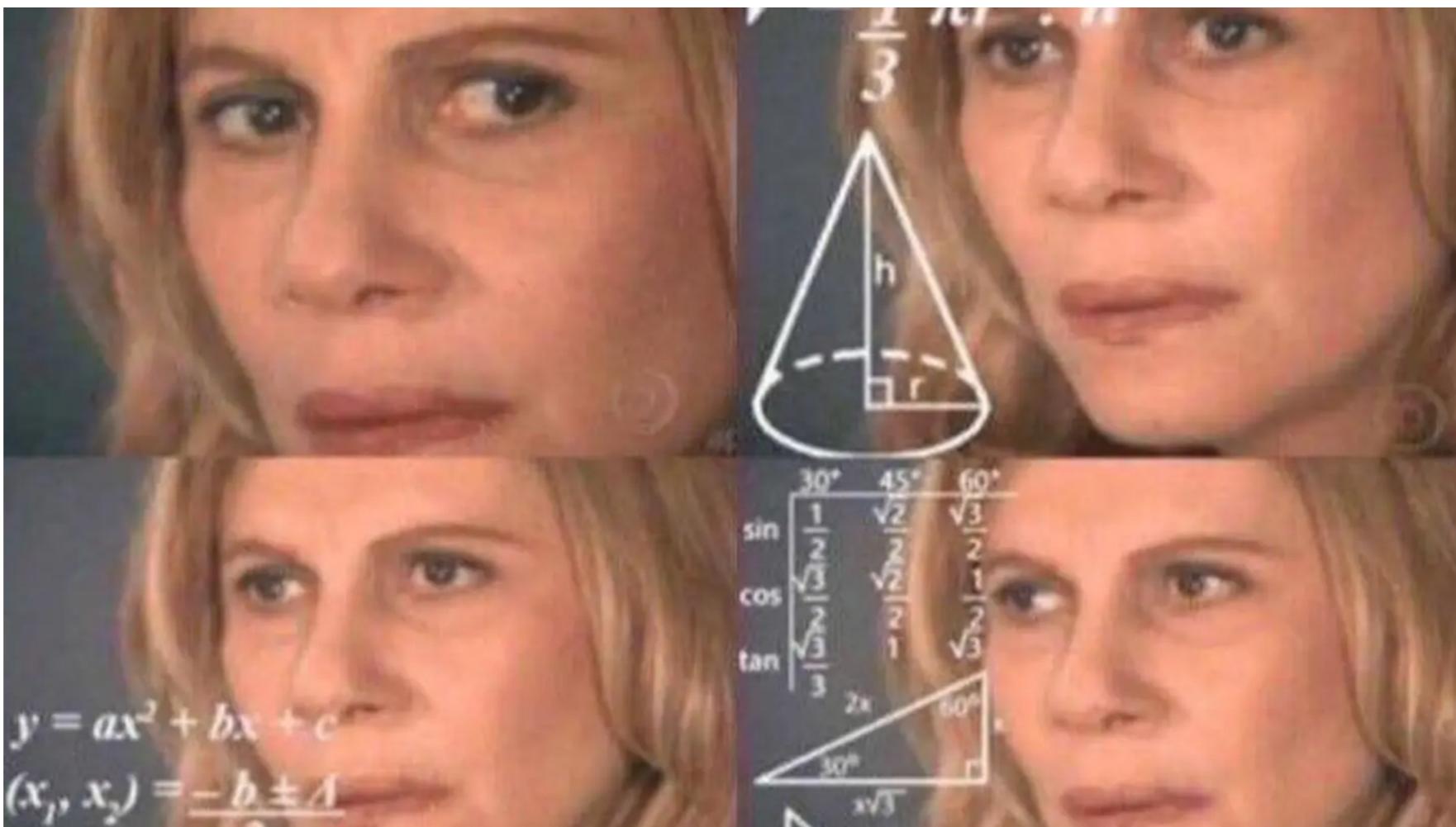
BIDS-compliant dataset

A BIDS Path

```
/data/projects/myproject/sub-01/ses-pre/  
eeg/sub-01_ses-pre_task-visual_  
run-01_eeg.vhdr
```

A BIDS Path

/data/projects/myproject/sub-01/ses-pre/eeg/sub-01_ses-pre_task-visual_run-01_eeg.vhdr



A BIDS Path

```
/data/projects/myproject/  
  sub-01/  
    ses-pre/  
      eeg/  
        sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```

A BIDS Path

```
/data/projects/myproject/  
  sub-01/  
    ses-pre/  
      eeg/  
        sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```

BIDS root

A BIDS Path

```
/data/projects/myproject/  
sub-01/  
ses-pre/  
eeg/  
    sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```

Subject ID

A BIDS Path

```
/data/projects/myproject/  
sub-01/  
ses-pre/  
eeg/  
    sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```

Experimental
session

A BIDS Path

```
/data/projects/myproject/  
sub-01/  
ses-pre/  
eeg/  
    sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```

Data type

A BIDS Path

```
/data/projects/myproject/  
  sub-01/  
    ses-pre/  
      eeg/  
        sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```

A BIDS Path

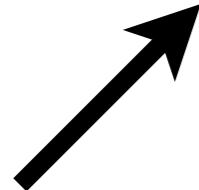
/data/projects/myproject/

sub-01/

ses-pre/

eeg/

sub-01_ses-pre_task-visual_run-01_eeg.vhdr



Subject ID

A BIDS Path

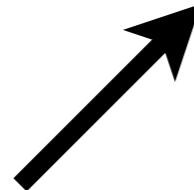
/data/projects/myproject/

sub-01/

ses-pre/

eeg/

sub-01_ses-pre_task-visual_run-01_eeg.vhdr



Experimental
session

A BIDS Path

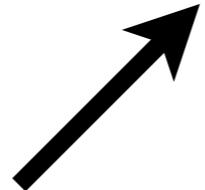
/data/projects/myproject/

sub-01/

ses-pre/

eeg/

sub-01_ses-pre_task-visual_run-01_eeg.vhdr



Experimental
task

A BIDS Path

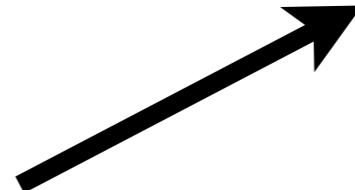
/data/projects/myproject/

sub-01/

ses-pre/

eeg/

sub-01_ses-pre_task-visual_run-01_eeg.vhdr



Acquisition
run

A BIDS Path

/data/projects/myproject/

sub-01/

ses-pre/

eeg/

sub-01_ses-pre_task-visual_run-01_eeg.vhdr



Suffix

A BIDS Path

/data/projects/myproject/

sub-01/

ses-pre/

eeg/

sub-01_ses-pre_task-visual_run-01_eeg.vhdr



Extension

A BIDS Path

```
/data/projects/myproject/  
  sub-01/  
    ses-pre/  
      eeg/  
        sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```

A BIDS Path

/data/projects/myproject/

sub-01/

ses-pre/

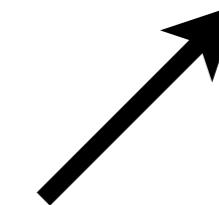
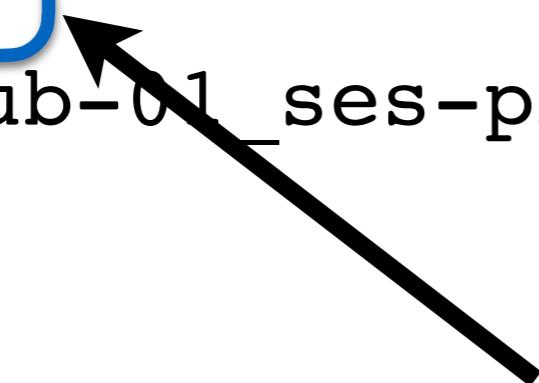
eeg/

sub-01_ses-pre_task-visual_run-01_eeg.vhdr

Data type

may differ from

Suffix



A BIDS Path

/data/projects/myproject/

sub-01/

ses-pre/

eeg/

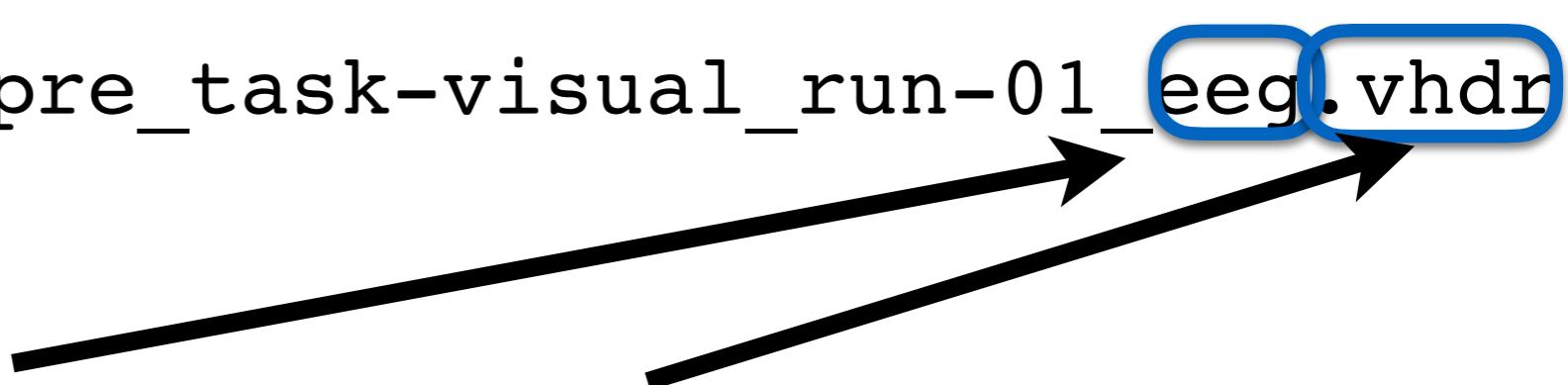
sub-01_ses-pre_task-visual_run-01_eeg.vhdr

Don't confuse

Suffix

and

Extension



A BIDS Path

```
/data/projects/myproject/  
sub-01/  
    ses-pre/  
        eeg/  
            sub-01_ses-pre_task-visual_run-01_eeg.vhdr
```



MNE-BIDS

MNE-BIDS is a Python package that allows you to read and write **BIDS**-compatible datasets with the help of **MNE-Python**.

Arbitrarily organized data

MNE-BIDS

BIDS-compliant dataset

dataset_description.json
participants.json
participants.tsv
README
sub-01
 ses-01
 meg
 sub-01_ses-01_acq-calibration_meg.dat
 sub-01_ses-01_acq-crosstalk_meg.fif
 sub-01_ses-01_coordsystem.json
 sub-01_ses-01_task-audiovisual_run-01_channels.tsv
 sub-01_ses-01_task-audiovisual_run-01_events.tsv
 sub-01_ses-01_task-audiovisual_run-01_meg.fif
 sub-01_ses-01_task-audiovisual_run-01_meg.json
 sub-01_ses-01_scans.tsv

<https://mne.tools/mne-bids>

```
>>> import mne
```



https://bit.ly/cuttingeq_mne_tutorial



The MNE-BIDS-Pipeline is under active development. If you encounter any issues, please do let us know.

What is the MNE-BIDS-Pipeline?



The MNE-BIDS-Pipeline is a full-fledged processing pipeline for your MEG and EEG data.

It operates on raw data stored according to the Brain Imaging Data Structure (BIDS). Processing is controlled using a simple human-readable configuration file.

[Learn more](#)[Get started](#) [Next](#)[What's new](#)

<https://mne.tools/mne-bids-pipeline>

```
study_name = 'ds000248'
bids_root = '~/.mne_data/ds000248'
deriv_root = '~/.mne_data/derivatives/mne-bids-pipeline/ds000248'
subjects_dir = f'{bids_root}/derivatives/freesurfer/subjects'

subjects = ['01']
rename_events = {'Smiley': 'Emoji',
                 'Button': 'Switch'}
conditions = ['Auditory', 'Visual', 'Auditory/Left', 'Auditory/Right']
contrasts = [(['Visual', 'Auditory'],
              ('Auditory/Right', 'Auditory/Left'))]

time_frequency_conditions = ['Auditory', 'Visual']

ch_types = ['meg']
mf_reference_run = '01'
find_flat_channels_meg = True
find_noisy_channels_meg = True
use_maxwell_filter = True
process_er = True
noise_cov = 'emptyroom'

spatial_filter = 'ssp'
n_proj_eog = dict(n_mag=1, n_grad=1, n_eeg=1)
n_proj_ecg = dict(n_mag=1, n_grad=1, n_eeg=0)
ecg_proj_from_average = True
eog_proj_from_average = False
```

... is all that's needed.

sub-01, task-audiovisual

covariance epochs evoked forward inverse raw ssp trans bem Data Quality Events TFR Evoked
Contrast Decoding Sources Empty-Room ✕

Condition: AuditoryLeft

CONTENTS

- sub-01_task-audiovisual_cov.fif
- sub-01_task-audiovisual_epo.fif
- sub-01_task-audiovisual_proc-clean_epo.fif
- sub-01_task-audiovisual_proc-ssp_epo.fif
- sub-01_task-audiovisual_ave.fif

0.50 ×
Auditory/Left +
0.50 ×
Auditory/Right
0.51 ×
Visual/Left +
0.49 ×
Visual/Right

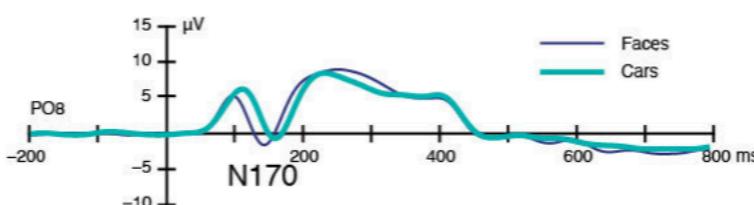
The figure displays two lateral brain surface renderings showing regions of significant activation. A color scale bar on the left indicates activation values from 13.1 to 70.6. Below the surfaces is a time-series plot titled "time=0.080s" showing Activation (AU) over Time (sec). The plot features several curves: a sharp orange peak reaching ~120 AU at 0.08s, a blue curve peaking around 0.1s, and a red curve peaking around 0.2s.

Created on August 21, 2021.

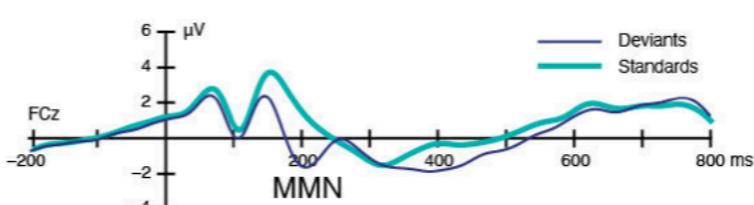
<https://mne.tools/mne-bids-pipeline/examples/ds000248>

ERP CORE

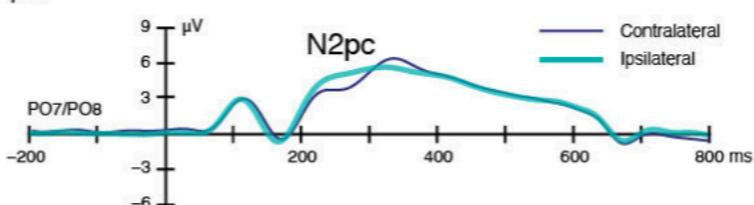
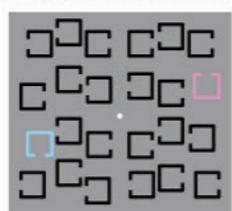
Face Perception N170



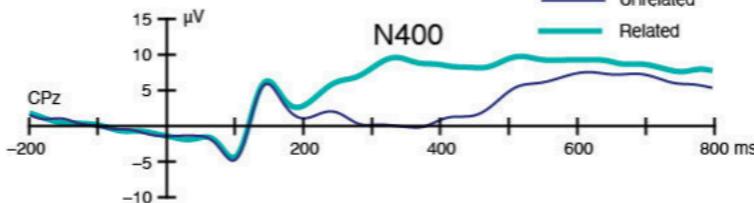
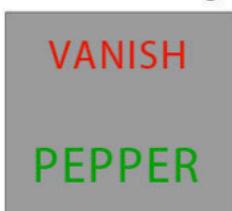
Passive Auditory Oddball MMN



Visual Search N2pc



Word Pair Judgment N400



We promote best practices in ERP research via workshops, software, books, advice, data sharing, & methods development.

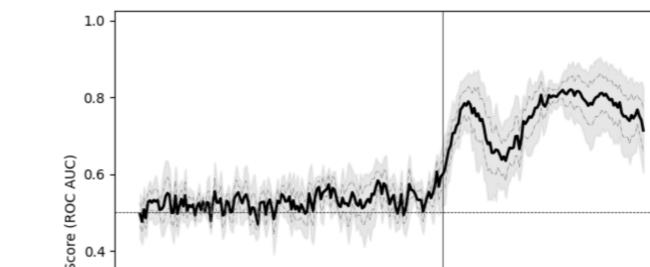
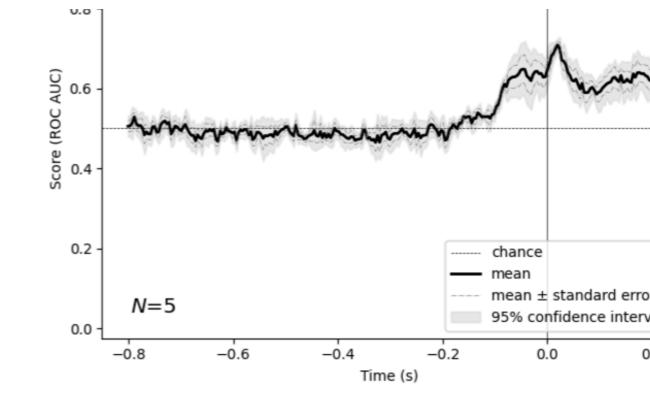
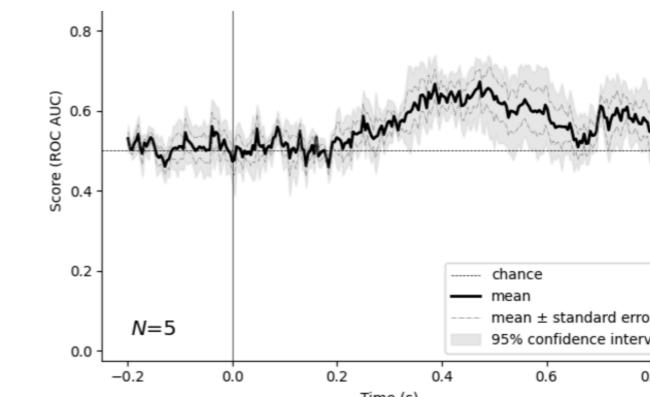
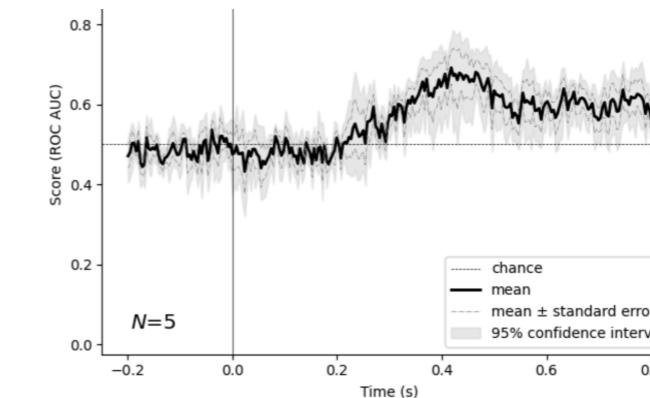
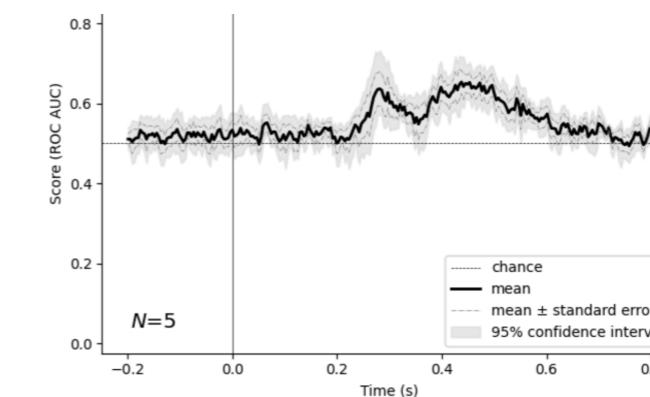
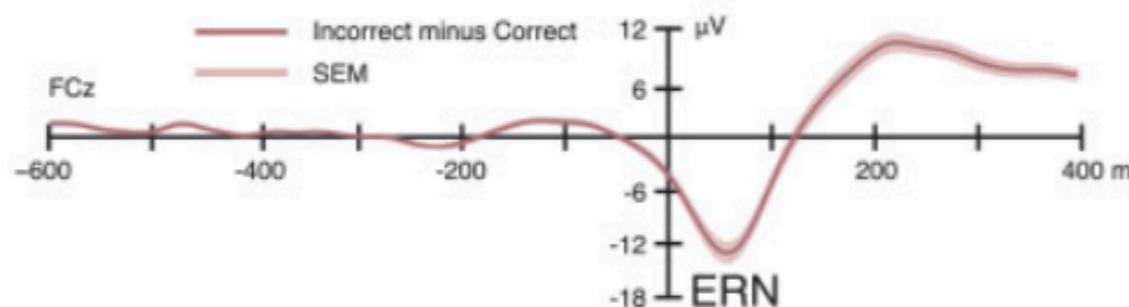
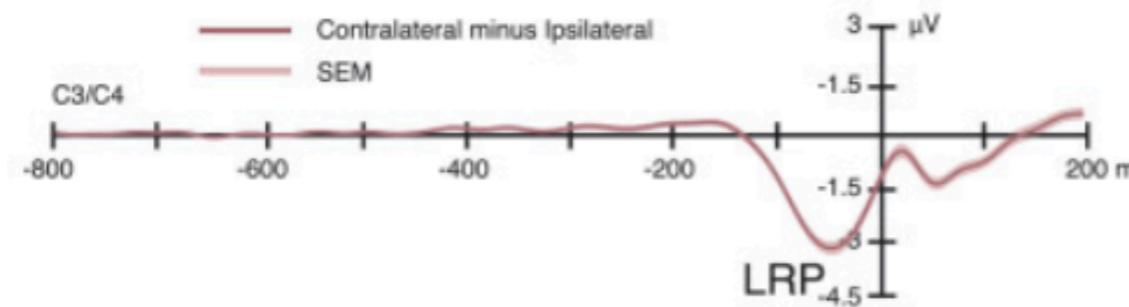
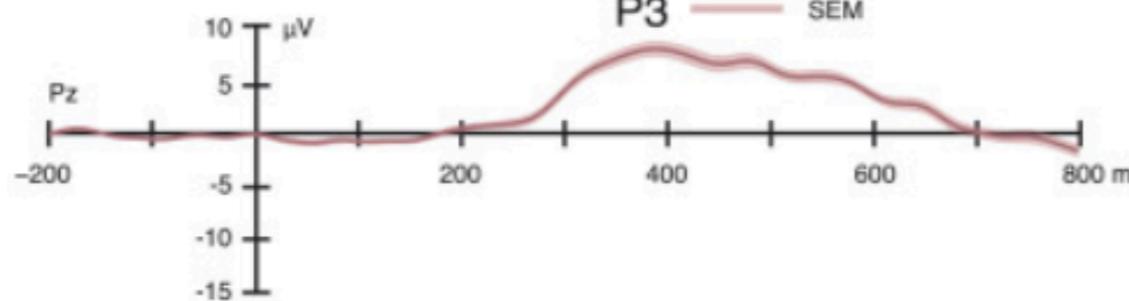
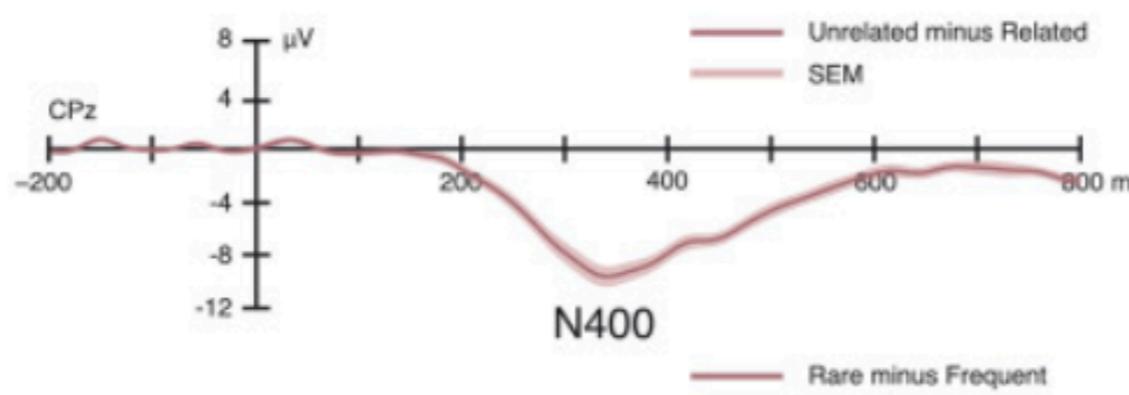
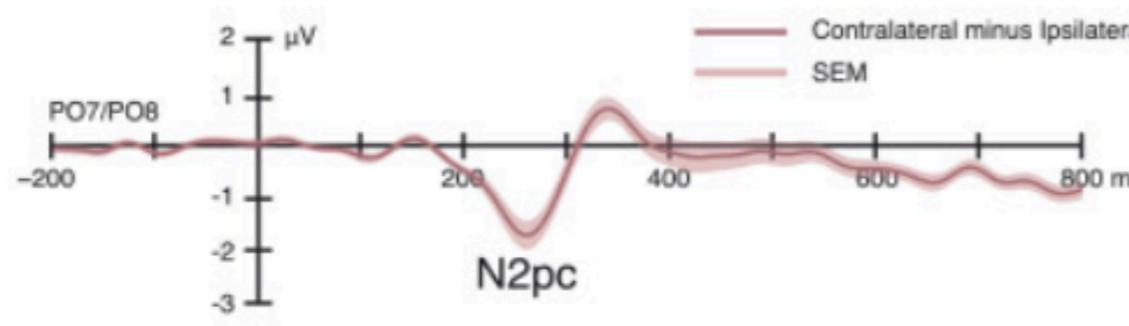
Steve Luck

lucklab.ucdavis.edu
mindbrain.ucdavis.edu/people/sjluck
@stevenjluck
Google Scholar Profile

Emily Kappenman

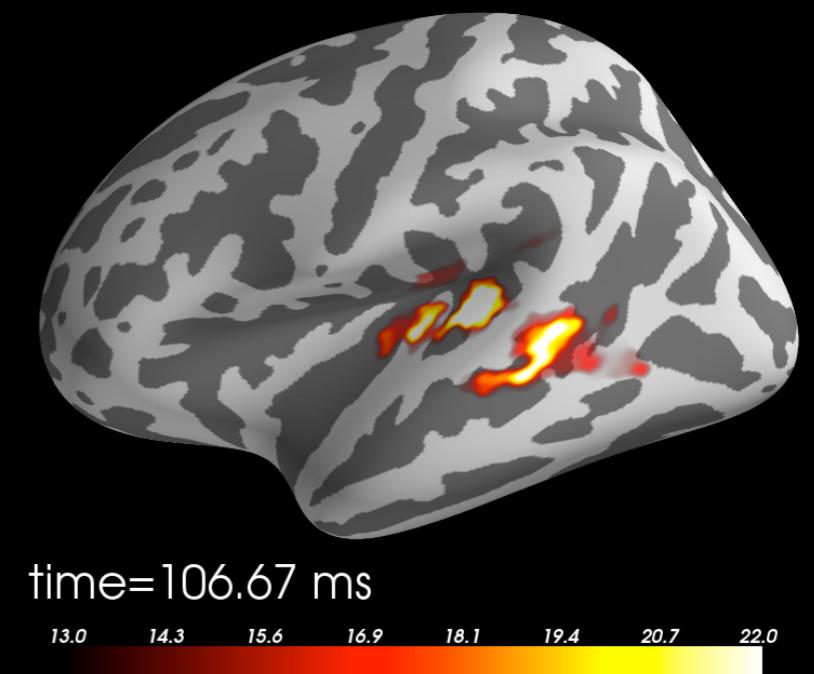
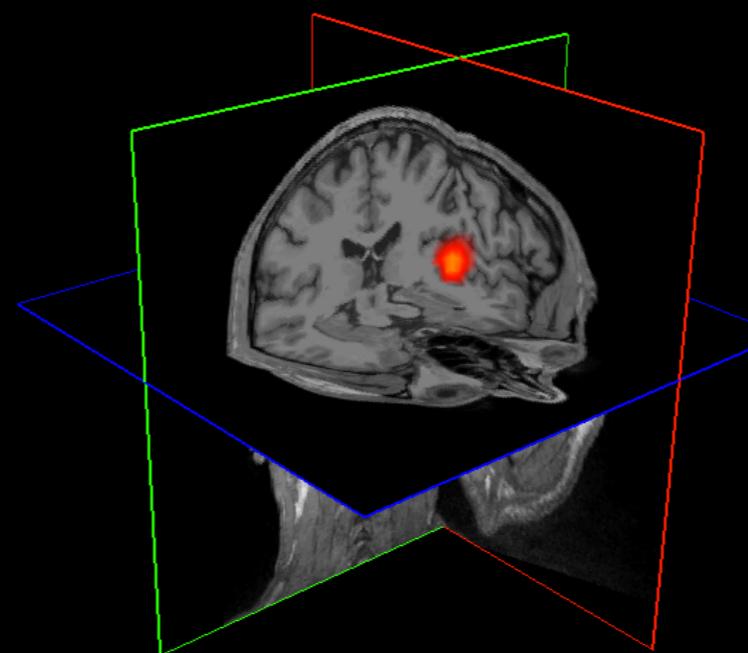
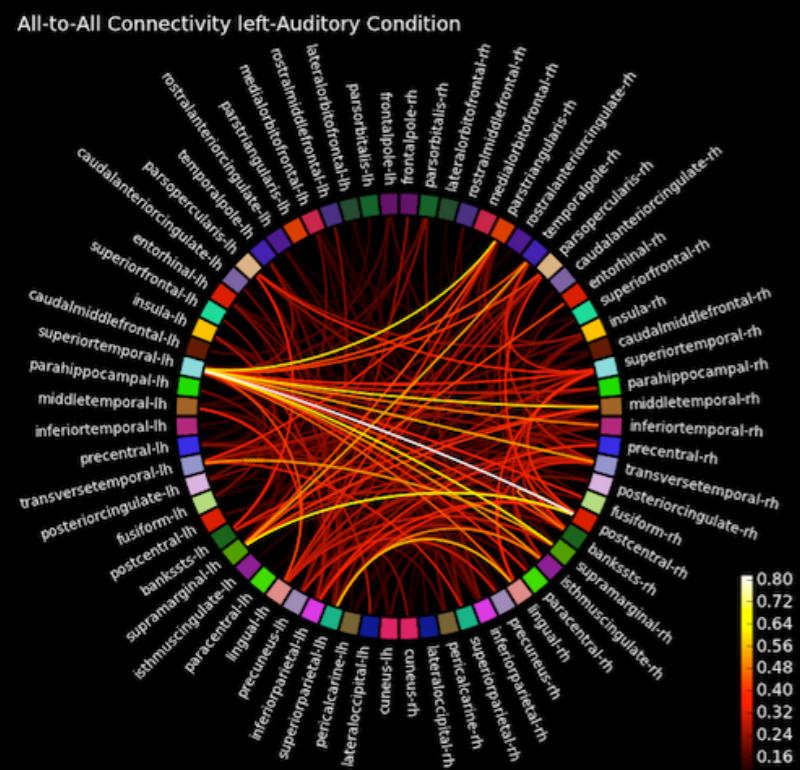
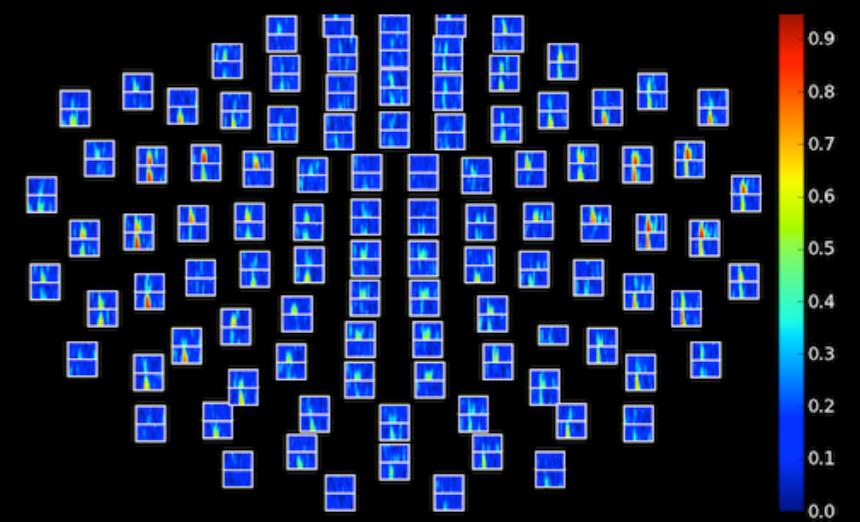
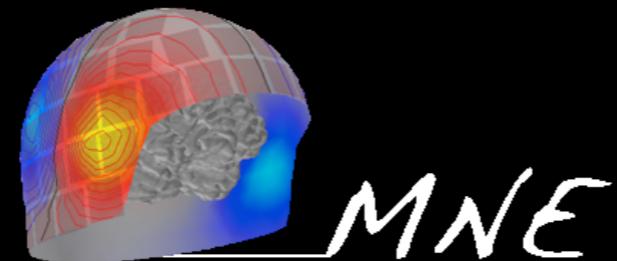
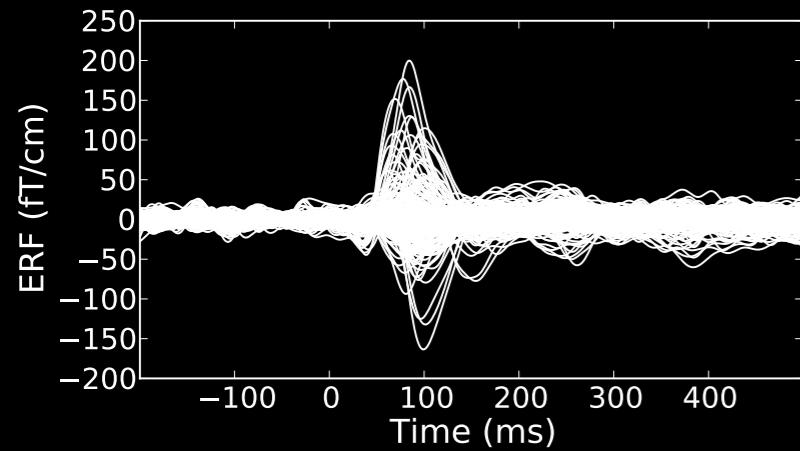
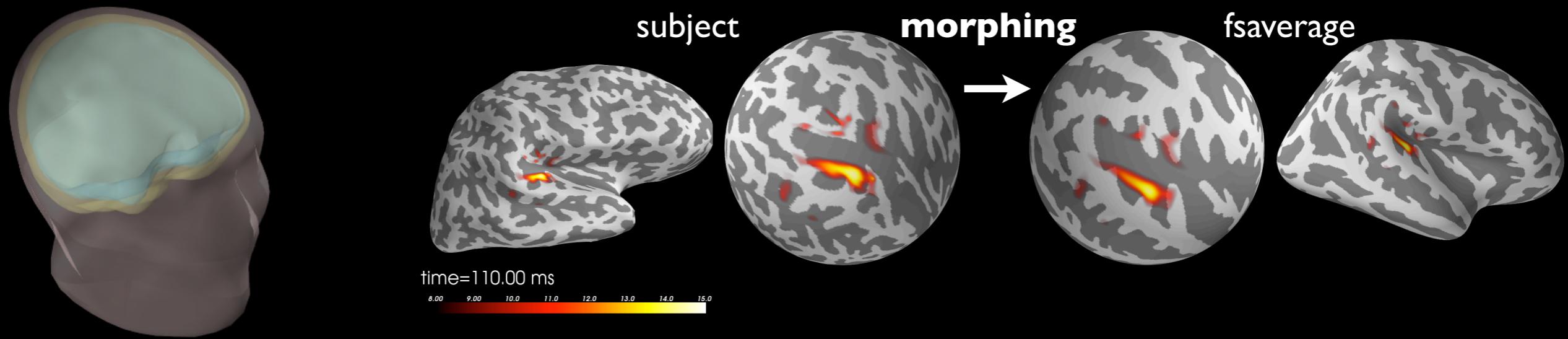
emilykappenman.org
@emilykappenman
Google Scholar Profile

<https://erpinfo.org/erp-core>



A young girl with light brown hair in two pigtails, wearing a pink long-sleeved shirt, is looking upwards with her arms outstretched. An orange speech bubble originates from her hands and points towards the text.

What can I do
with MNE?



A close-up photograph of a young girl with light brown hair styled in two pigtails. She is wearing a long-sleeved pink shirt. Her arms are extended wide to her sides, palms facing forward. She is looking upwards and slightly to the right with a neutral expression. The background is plain white.

And if I need
help?

Getting help

The screenshot shows a web browser window with the URL mne.discourse.group. The page title is "MNE". The navigation bar includes links for "all categories", "all tags", "Categories" (which is highlighted in blue), "Latest", and "Top". There are also buttons for "New Topic" and a gear icon. The left sidebar lists four categories: "Support & Discussions" (592 topics), "Announcements" (31 topics), "Job Opportunities" (9 topics), and "Mailing List Archive (read-only)" (2.4k topics). The main content area shows a list of topics under "Latest". The first topic is "steps to clean noisy data and artifacts" by user "I", posted 2d ago. The second topic is "Cannot manually select tracing on the plotted source space estimate (plotted stc object)" by user "A", posted 2d ago. The third topic is "Postdoc position - Auditory Predictions with iEEG and Single-Unit recordings in humans" by user "A", posted 2d ago.

Category	Topics	Latest
Support & Discussions Post your questions here – ideally after searching for existing answers!	592	 I steps to clean noisy data and artifacts 2 Support & Discussions 2d
Announcements Announcements of new software releases, workshops, etc.	31	 A Cannot manually select tracing on the plotted source space estimate (plotted stc object) 8 Support & Discussions 2d visualization meg source-localization
Job Opportunities This is the place to post about interesting job opportunities.	9	 A Postdoc position - Auditory Predictions with iEEG and Single-Unit recordings in humans 0 Job Opportunities ieeg-and-ecog 2d
Mailing List Archive (read-only) An archive of the mne_analysis mailing list.	2.4k	

<https://mne.discourse.group>

Getting help

The screenshot shows a web browser window with the URL mne.discourse.group. The page displays an announcement titled "Next Office Hour and Calendar". The announcement is locked and was posted by Richard Höchenberger. It includes a reminder about the next office hour on Friday, October 1, 2021, from 5:00 PM to 6:00 PM on Discord. To the right, there is a sidebar showing a calendar for September 27 to 28, indicating the event on Sep 28. Below the announcement, there is a "MNE Office Hours" section listing events for October 15, 29, and November 12, all at 17:00. A "Google Agenda" link is also present.

Richard Höchenberger

2 6d

Sep 28
1 / 4
Sep 27

vendredi, 15 octobre
17:00 MNE Office Hour

vendredi, 29 octobre
17:00 MNE Office Hour

vendredi, 12 novembre
17:00 MNE Office Hour

Événements affichés dans le fuseau horaire : Heure d'Europe centrale - Berlin

Google Agenda

1d ago

<https://mne.discourse.group>

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And if I want to
help?

Red Yellow Green

< >

mne.tools

MNE



Install Documentation API Reference

Search the docs ...

Version 0.23.4

- Tutorials
- Changelog
- Get help
- Cite
- Contribute

Open-source Python pack
human neurophysiological data

Source Estimation

The screenshot shows the homepage of the MNE (Measuring Neuronal Activity) website. At the top, there's a navigation bar with standard browser controls (red, yellow, green buttons, back/forward arrows), a shield icon, and a URL bar showing "mne.tools". Below the header, the "MNE" logo is displayed next to a color gradient bar. A main menu includes links for "Install", "Documentation", and "API Reference". A search bar is present. On the left, a sidebar lists "Version 0.23.4" and links for "Tutorials", "Changelog", "Get help", "Cite", and "Contribute", with "Contribute" being highlighted by a red rounded rectangle. The main content area features a large "M" logo composed of horizontal bars in a blue-to-red gradient, with the text "MEG + EEG" below it. A descriptive paragraph starts with "Open-source Python pack...". At the bottom, a "Source Estimation" button is visible.

The screenshot shows a web browser displaying the MNE Python documentation website at mne.tools. The top navigation bar includes links for 'Install', 'Documentation', and 'API Reference'. Below this, a secondary navigation bar for the 'Development' section shows the current version as 'v0.23.4' and includes social media sharing icons for GitHub, Twitter, and Discourse.

Contributing guide

This page has details on the preferred contribution workflow and how best to configure your system for a smooth experience contributing to MNE-Python.

[Want an example to work through?](#)

Overview of contribution process

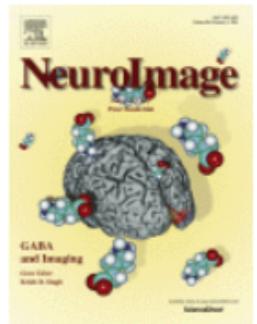
Changes to MNE-Python are typically made by [forking](#) the MNE-Python repository, making changes to your fork (usually by [cloning](#) it to your personal computer, making the changes locally, and then [pushing](#) the local changes up to your fork), and finally creating a [pull request](#) to incorporate your changes back into the shared “upstream” version of the codebase.

In general you’ll be working with three different copies of the MNE-Python codebase: the official remote copy at <https://github.com/mne-tools/mne-python> (usually called [upstream](#)), your remote [fork](#) of the upstream repository (similar URL, but with your username in place of [mne-tools](#), and usually called [origin](#)), and the local copy of the codebase on your computer. The typical contribution process is to:

1. synchronize your local copy with [upstream](#)
2. make changes to your local copy

MNE People

Achilleas Koutsou, Alan Leggitt, Alejandro Weinstein, Alexander Kovrig, Alexander Rudiuk, Alexandre Barachant, Alexandre Gramfort, Andrew Dykstra, Annalisa Pascarella, Anne-Sophie Dubarry, Antoine Gauthier, Antti Rantala, Asish Panda, Basile Pinsard, Brad Buran, Britta Westner, Bruno Nicenboim, Burkhard Maess, Camilo Lamus, Cathy Nangini, Chris Bailey, Chris Holdgraf, Christian Brodbeck, Christoph Dinh, Christopher Holdgraf, Christopher J. Bailey, Christopher Mullins, Claire Braboszcz, Clemens Brunner, Clément Moutard, Cristóbal Moënne-Locoz, Dan G. Wakeman, Daniel McCloy, Daniel Strohmeier, David Haslacher, David Sabbagh, Denis A. Engemann, Desislava Petkova, Dirk Gütlin, Dominik Krzemiński, Emanuele Olivetti, Emily P. Stephen, Emily Stephen, Eric Larson, Erik Hornberger, Erkka Heinila, Evgenii Kalenkovich, Ezequiel Mikulan, Fede Raimondo, Federico Raimondo, Félix Raimundo, Guillaume Dumas, Guillaume Favelier, Hafeza Anevar, Hari Bharadwaj, Henrich Kolkhorst, Hermann Sonntag, Hubert Banville, Ingoo Lee, Ivana Kojcic, Jaakko Leppakangas, Jair Montoya, Jakub Kaczmarzyk, Jasper J.F. van den Bosch, Jean-Baptiste SCHIRATTI, Jean-Remi King, Jeff Hanna, Jen Evans, Jesper Duemose Nielsen, Joan Massich, Johan van der Meer, Johannes Kasper, Johannes Niediek, Jon Houck, Jona Sassenhagen, José C. García Alanis, Juergen Dammers, Jussi Nurminen, Kambiz Tavabi, Katarina Slama, Katrin Leinweber, Keith Doelling, Kostiantyn Maksymenko, Laetitia Grabot, Larry Eisenman, Laura Gwilliams, Legrand Nicolas, Leonardo S. Barbosa, Lorenz Esch, Lorenzo Alfine, Lorenzo De Santis, Louis Thibault, Luke Bloy, Lukáš Hejtmánek, Mads Jensen, Mainak Jas, Manfred Kitzbichler, Manoj Kumar, Manu Sutela, Marcin Koculak, Marian Dovgialo, Marijn van Vliet, Mark Wronkiewicz, Marmaduke Woodman, Martin Billinger, Martin Luessi, MartinBaBer, Mathurin Massias, Matt Boggess, Matt Tucker, Matteo Visconti dOC, Matti Hamalainen, Michael Krause, Mikolaj Magnuski, Natalie Klein, Nathalie, Nathalie Gayraud, Nick Foti, Nick Ward



MNE software for processing MEG and EEG data

Alexandre Gramfort ^{a, b, c, d, e}  , Martin Luessi ^{b, c}, Eric Larson ^f, Denis A. Engemann ^{g, h}, Daniel Strohmeier ⁱ, Christian Brodbeck ^j, Lauri Parkkonen ^{k, l}, Matti S. Hämäläinen ^{b, c}

METHODS ARTICLE

Front. Neurosci., 26 December 2013 | <https://doi.org/10.3389/fnins.2013.00267>

MEG and EEG data analysis with MNE-Python

 **Alexandre Gramfort**^{1,2,3*},  **Martin Luessi**²,  **Eric Larson**⁴,  **Denis A. Engemann**^{5,6},  **Daniel Strohmeier**⁷,  **Christian Brodbeck**⁸,  **Roman Goj**⁹,  **Mainak Jas**^{10,11},  **Teon Brooks**⁸,  **Lauri Parkkonen**^{10,11} and  **Matti Hämäläinen**^{2,11}

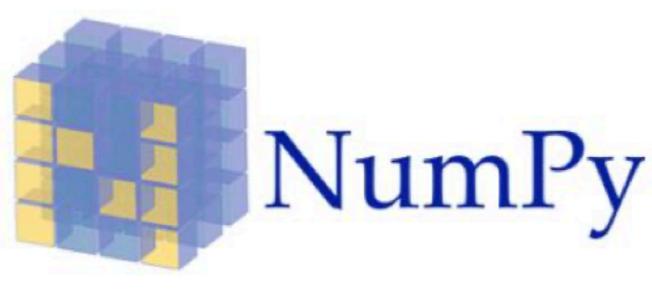
Don't forget to give us academic credit



Thanks !



European
Research
Council



Google
Summer of Code



Mayavi



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