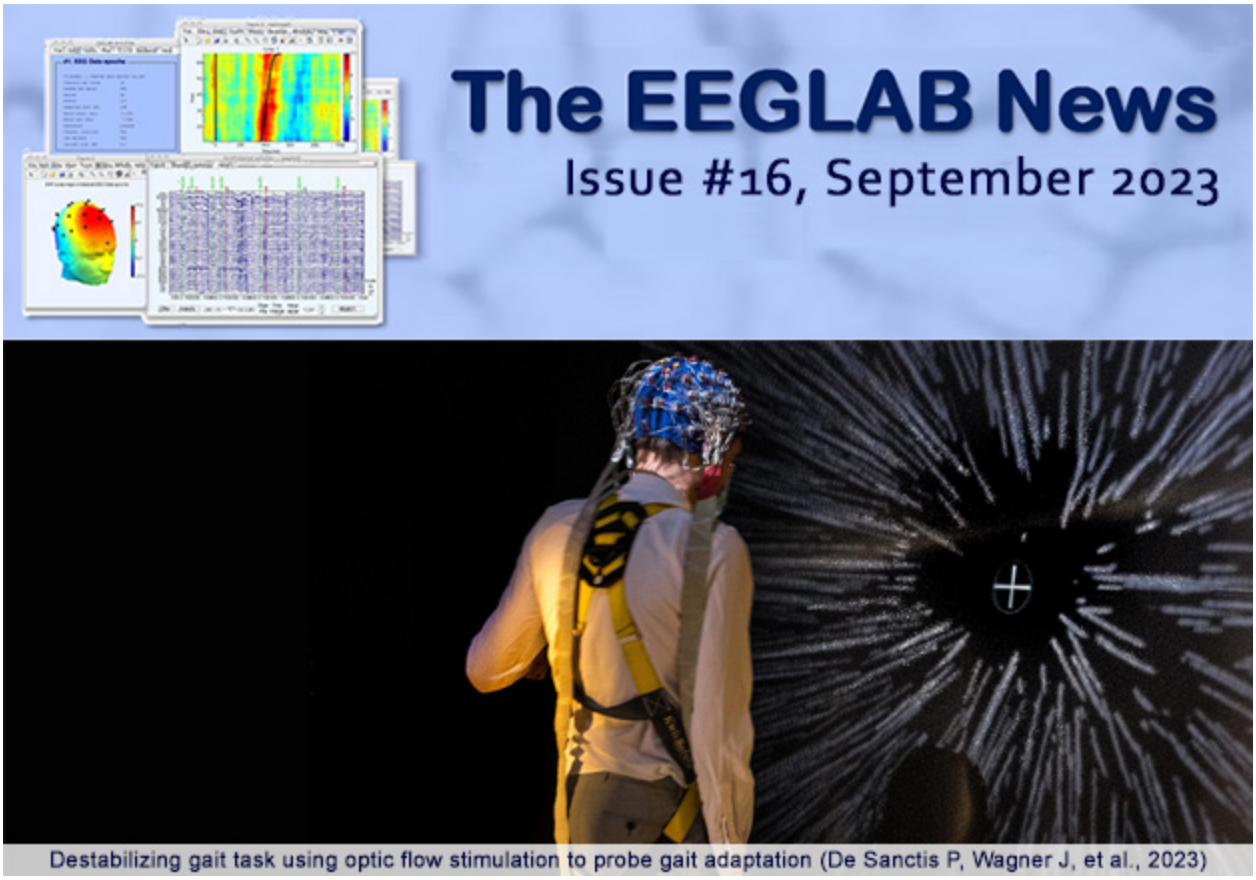


Destabilizing gait task using optic flow stimulation to probe gait adaptation (De Sanctis P, Wagner J, et al., 2023)

View this email in your browser

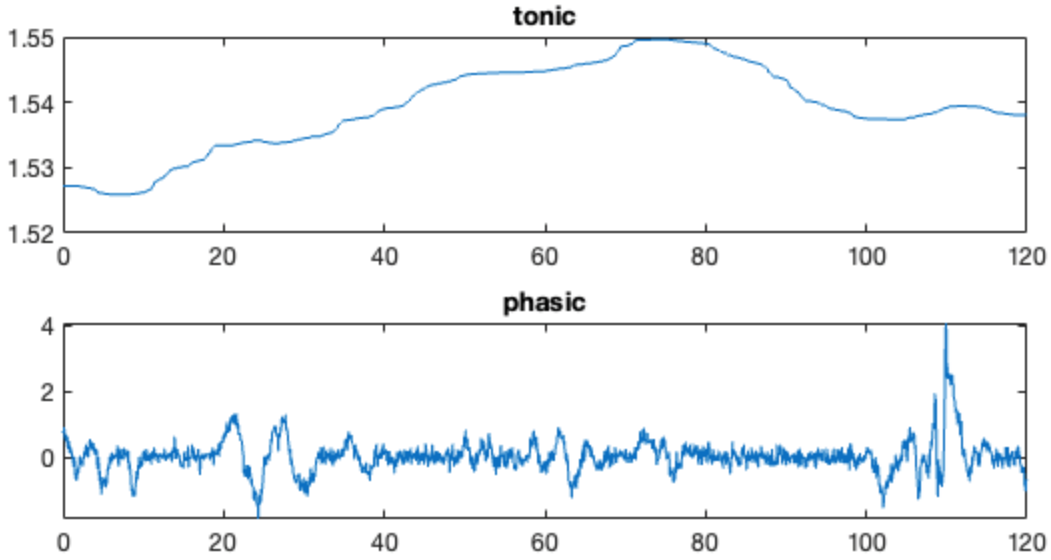
What's New

New EEGLAB version. A new version of EEGLAB, version 2023.1 has been released. Since the last EEGLAB version, 50 files were changed, including 99 commits comprising 957 additions and 395 deletions. This new version features bug fixes including processing removed channels and dealing with non-EEG channels and MEG data. It has now also become easier to change the '*EEG*' structure on the command line, as EEGLAB will automatically detect such changes. EEGLAB now has improved interoperability with *ERPLAB* and *LIMO*. We have also made some fixes to *SIFT* -- fixing some minor GUI issues and rewriting the tutorial, including new sections on computing statistics. We plan a careful comparison with another connectivity EEGLAB plug-in, *ROIconnect*, that will be released soon. Major upgrades have also been implemented in the *bids-matlab-io* plug-in. As usual, EEGLAB is released both as MATLAB source code and in compiled versions running on Mac and Windows. Additional EEGLAB version details are available here.

Plug-Ins

Here we highlight new EEGLAB plug-ins of possible wide interest to EEGLAB users. Please send descriptions of new plug-ins for consideration. These should have a brief lead introduction, and further text and images to be published on a continuation page.

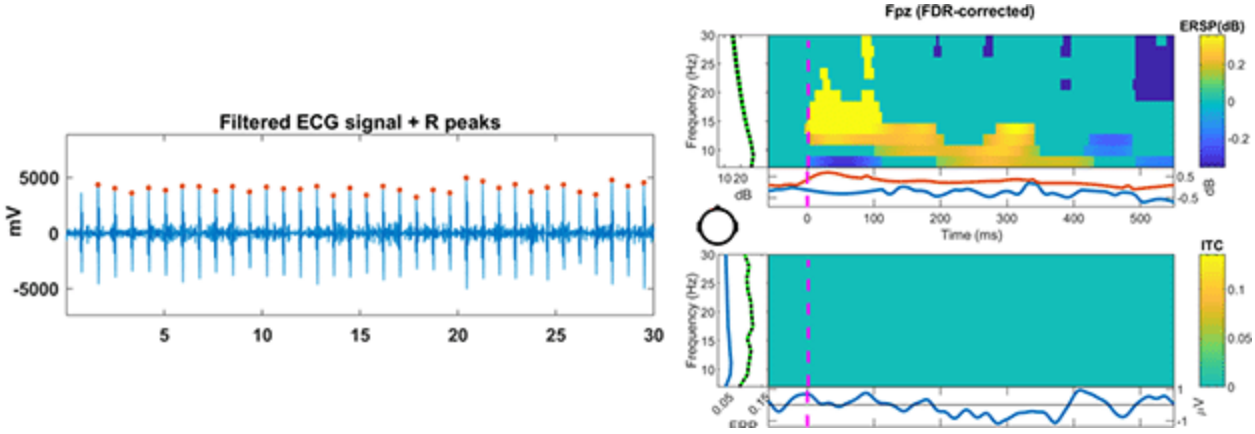
EDA tonic & phasic. ***EDAtonicphasic*** is a new plug-in for electrodermal data (EDA), also known as galvanic skin response (GSR). The plug-in extracts the GSR tonic and phasic components using two different methods. The figure below shows tonic and phasic information for a GSR record. This plug-in can be applied to one or more datasets.



The ***EEGstats*** plug-in computes spectral power in specified frequency bands (theta, alpha, etc.) as well as alpha peak frequency and alpha asymmetry. Outputs are given as a table displayed on screen or saved to disk. Can be applied to one or more datasets.

All_channels	FPz	EOG1	F3	Fz	F4	...
4.0-6.0 Hz	10.32874	14.22889	9.67149	12.15102	12.52194	...
8.0-12.0 Hz	14.34564	12.88388	8.29599	14.23616	14.09646	...
18.0-22.0 Hz	1.5314	1.7426	0.55711	3.41521	3.20146	...
30.0-45.0 Hz	-4.74193	-3.59272	-2.38355	-3.85762	-4.05003	...
Peak alpha frequency	9.68	8.5	NaN	9	8.5	
Alpha center of gravity	9.36	8.65	8.88	8.94	8.87	...
Alpha Asymmetry	0.62408					

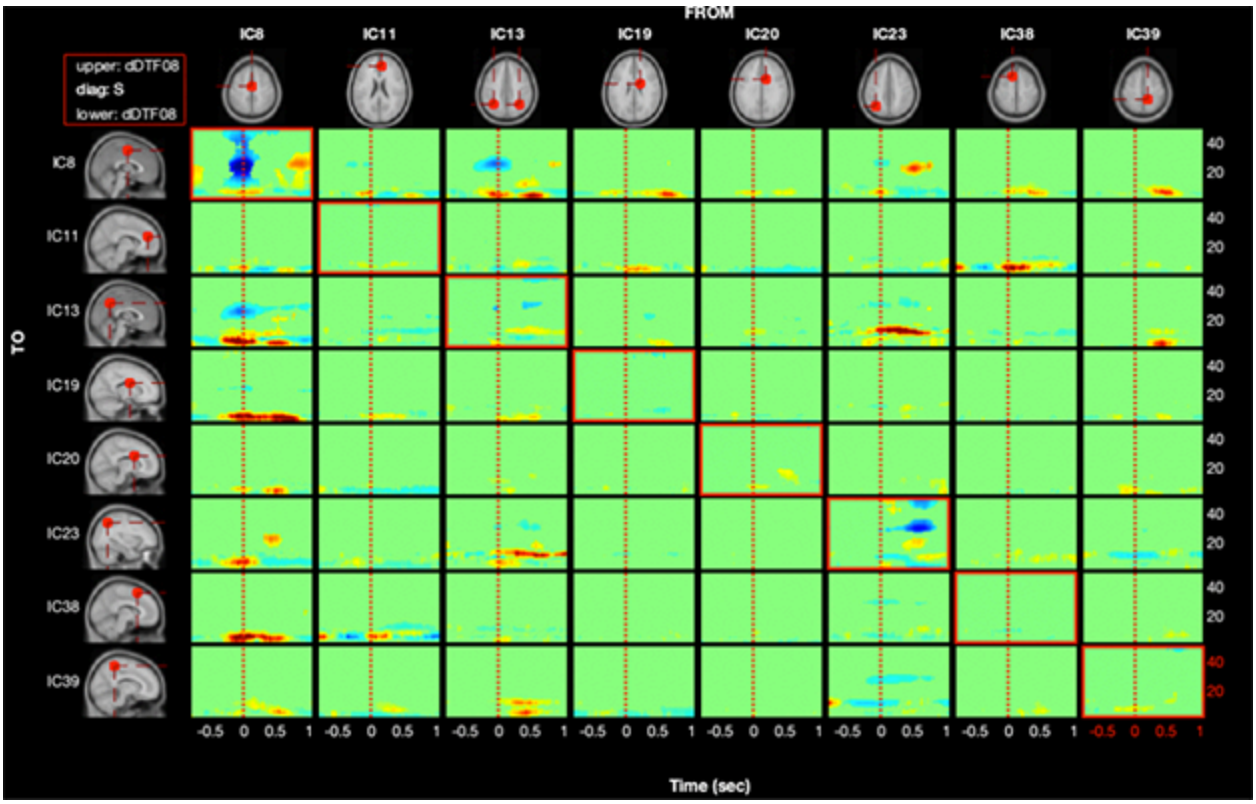
The ***BrainBeats*** toolbox is an open-source EEGLAB plug-in designed to jointly analyze EEG and cardiovascular (ECG/PPG) signals. The plug-in integrates three main features: 1) Heartbeat-evoked potentials (HEP) and oscillations (HEO); 2) EEG and HRV feature extraction; 3) Automated removal of heart artifacts from EEG signals. Graphic user interface (GUI) and command line interfaces are available. A tutorial with example data is provided to facilitate accessibility and reproducibility. This open-source toolbox offers a valuable resource for clinicians and researchers studying brain-heart interactions, and can be tailored to unique research needs. Read the preprint »



(Left) Filtered and smoothed ECG signal with (red dot) identified R-peaks.
(Right) heartbeat-induced oscillatory perturbations (HEO) following false discovery

rate (FDR) correction, from EEG data recorded in an 'Fpz' channel during 5 minutes of a mind-wandering experiment.

***SIFT**,* the Source Information Flow Toolbox by Tim Mullen, is an extensive EEGLAB toolbox plug-in for performing all types of multivariate quasi-Grainger connectivity ananlysis of EEG data. We have updated some functions to be more compatible with recent versions of MATLAB (up to 2023a) and have also rewritten its online tutorial, adding some sections on how to compute statistics, and have added a tutorial video to the EEGLAB YouTube channel. Thus it has never been easier to use SIFT.



A plot created using the Source Information Flow Toolbox (SIFT) showing spectral perturbations involved in event-related multivariate Grainger-causal interactions between maximally independent components of a high-density EEG recording taken during a Flanker task experiment (whose source location estimates shown on the top and left margins).

Open Science

Here we highlight news of open EEG and related data, tools, and other resources.

NEMAR.org - the EEG, MEG, and iEEG open data portal and free integrated high-performance computing resource. The NEMAR resource now comprises 23.5TB of EEG, MEG, and iEEG data from over 12,600 participants collected in 233 different experiments. For each dataset, an automated EEGLAB pipeline including artifact rejection and ICA decomposition is being applied to produce and offer for inspection several plots and data quality-related statistics. In the next years, the preprocessed datasets will also be made available as BIDS derived-data datasets.

Profiles

This section contains personal profiles of EEGLAB developers and/or users, with a description of how they use EEGLAB in their research.

Pierfilippo De Sanctis, Ph.D.

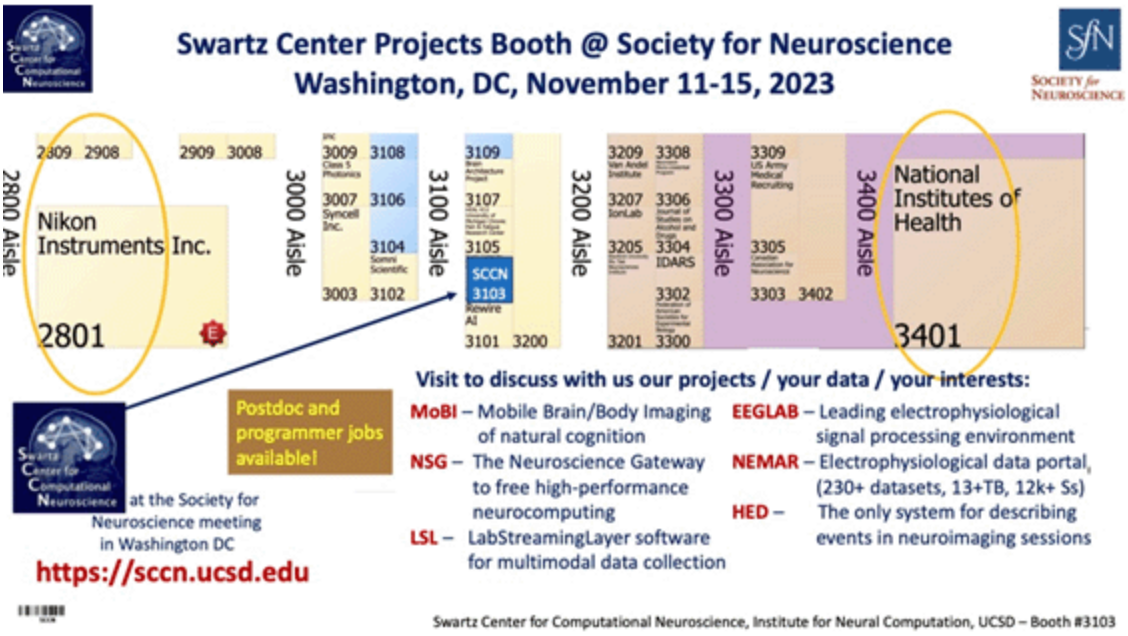
Assistant Professor, Department of Pediatrics and Neurology; Assistant Professor, The Saul R. Korey Department of Neurology; Project Director, Cognitive Aging & Research, Albert Einstein College of Medicine

Imagine walking on a treadmill in a darkened room while lights are projected onto the front wall, and simultaneously being asked to perform cognitive tasks. What would be happening in your brain? That is what Dr. Pierfilippo De Sanctis and colleagues in the Division of Cognitive and Motor Aging (DCMA) and the Cognitive Neurophysiology Laboratory (CNL) at Albert Einstein College of Medicine aim to find out. Dr. De Sanctis wants to better understand how normal and pathological aging affect cognition and locomotion, and is especially interested in studying brain function when individuals divide their attention across two or more tasks while walking. He and his team have validated a novel Mobile Brain-Body Imaging (MoBI) system for parallel and integrated recordings of neurophysiological and 3D body kinematic data while participants are performing complex gait tasks. Read more! »

Upcoming Events

This section contains announcements of future events of possible interest to EEGLAB users. Please submit brief descriptions.

› **Ongoing weekly SCCN office Hours**: Sign up for (EEGLAB/data analysis) office hours chats with Yahya Shirazi (view calendar) and for (NEMAR/BIDS/HED) office hours with Annalisa Salazar (view calendar).



*Map showing the location of the SCCN B**ooth #3031** in the Washington Convention Center poster hall during the upcoming Society for Neuroscience meeting in November. Click here for a printable copy.*

› **SCCN will host BOOTH #3103 at the Society for Neuroscience meeting!**

This year the EEGLAB team and other members of the Swartz Center for Computational Neuroscience (SCCN), UCSD, have reserved an exhibition booth #3103 at the Society for Neuroscience meeting in Washington, D.C. (Saturday, November 11 – Wednesday, November 15, 2023). Look for us on the

entrance side of the poster hall between the large National Institutes of Health and Nikon Instruments booths. **Please come chat with us about any of our neuroinformatics project**s:

- **EEGLAB** - Worldwide leading electrophysiology data analysis environment by Arnaud Delorme and Scott Makeig with contributions from many others, running on MATLAB. Questions? Suggestions? Comments? We'd love to discuss with you. [NIH supported]

- **BIDS** and **BIDS EEG**, the widely-used, NIH-supported neuroimaging data formatting standards, now supported in EEGLAB by BIDS data import/export tools. [NIH supported]

- **HED** (Hierarchical Event Descriptors, hedtags.org) - the only system developed to record, in detail, '***What did the participants experience and do?***' during any neuroimaging recording. Use HED to annotate, store, share, and analyze BIDS-formatted data. Online and EEGLAB tools available. [NIH supported].

- **NEMAR.org** - the EEG/MEG/iEEG data portal to the OpenNeuro archive — now serving more than 23TB of data shared openly from 233 experiments involving more than 12,600 participants. [NIH supported]

- **NSG**, The Neuroscience Gateway - offers ***free supercomputing*** to EEGLAB and NEMAR users! Compute on your own uploaded data - or on NEMAR-housed data with no data transfers required. Use EEGLAB plug-in NSGPORTAL to submit and monitor NSG jobs from an EEGLAB session. [NIH & NSF supported]

- **LSL** (Lab Streaming Layer) is a software framework developed at SCCN by Christian Kothe for collecting, storing, and analyzing data ***synchronously*** from any number of devices. Now with drivers for over 100 acquisition systems. [open source on Github]

- **MoBI** (Mobile Brain/Body Imaging) - The concept we first proposed in 2009 to record, in neuroimaging experiments, '***What the brain does***' (using EEG, etc.), '***What the body does***' (using eye tracking and/or body motion capture, etc.), and '***What the participants experience***' (through experiment event HED annotations, audio & video recording, etc.). We believe MoBI framework studies are now becoming central in basic and clinical cognitive neuroscience. EEGLAB includes a **MoBILAB** data browser by Alejandro Ojeda for LSL-acquired data.

We are also looking to meet potential SCCN members, either postdoc or computational. Stop by the booth to chat, or sign up for a chat on your topics of interest (to be circulated in October via the eeglablist mailing list).

From the EEGLABLIST

(… the EEGLABLIST email list) *This section contains questions and answers from the eeglablist archives or elsewhere.*

Q1: *Is conversion to average reference not recommended for data collected in a 10-20 system?*

A: Yes, conversion to average reference is sometimes recommended with less than 64 channels (see References section below). However, some others recommend against using average reference with less than 128 channels (see for example Nunez and Srinivasan, 2006). You'd need electrodes all around the brain for the mathematical assumption of mean-zero potential to be fully valid. The reference-to-infinity (*REST*) plug-in has been validated for use with 32 channels or more and is preferred by some, but average reference is generally acceptable. All reference schemes have their

own limitations -- and none cancels the severe effects of mixing of source activities across scalp channels by far-spreading volume conduction (to do this, study ICA decomposition or beamforming). The *REST* plug-in is available from the EEGLAB Extension Manager. Currently, it can only be applied using its GUI. Write Cedric Cannard if you need code for command line calling -- he plans to submit it as a plug-in soon. (For more details and discussion of the referencing issue by Scott Makeig, Arnaud Delorme, and Makoto Miyakoshi, **read here**).

Q2: *What is the logic behind using ICLABEL to reject components?*

A: *ICLABEL* uses a machine learning-trained model to compare properties of independent components (ICs) of your data (e.g., the IC scalp projection maps and power spectra) with those its large training set (mainly labeled and unlabeled datasets from our over 20-yr history of applying ICA decomposition to EEG data at SCCN). *ICLABEL* uses ICs you have computed. Note that ICA decomposition can be negatively affected by several factors: too little data, abundant, non-stereotyped, non-brain noise in the data, choice of ICA algorithm, etc. - and by the conditions under which it was recorded (e.g., *Were participants moving? Were the electrodes securely placed?* etc.).

So the first thing I would suggest you look at is whether your data preprocessing and data rejection process was adequate for the data. Next, I would suggest you see how much of the data is accounted for by the *ICLABEL*-labeled likely 'Brain' components, plus the non-brain labeled components of known origin (e.g., Eye-Movement, Muscle, and Line noise ICs). Many times unlabeled components (labeled as 'Other' by *ICLABEL,* together with Single-channel ICs) together account for quite little of the data - and can be said to form the *de facto* ICA decomposition data noise subspace.

If you perform PCA decomposition on your dataset and look at the values of the resulting eigenvalue spectrum, you will typically find that a large proportion of EEG data 'lives' in relatively few large-eignvalue dimensions - ICA decompositions finds a basis for the data such that each basis element (Independent Component) is as temporally distinct from the others as possible -- and is thereby typically *functionally* as well as *source-location* distinct from others. - Scott Makeig (For additional discussion from Scott Makeig and Makoto Miyakoshi, read here).

In Print

Here we list recent papers highlighting EEGLAB function and plug-in capabilities. Please submit suggested papers, including a one-sentence summary description.

De Sanctis P, Wagner J, Molholm S, Foxe JJ, Blumen HM, Horsthuis DJ. Neural signature of mobility-related everyday function in older adults at-risk of cognitive impairment. Neurobiol Aging. 2023 Feb;122:1-11. doi: 10.1016/j.neurobiolaging.2022.11.005. Epub 2022 Nov 9. PMID: 36463848.

Verghese J, De Sanctis P, Ayers E. Everyday function profiles in prodromal stages of MCI: Prospective cohort study. *Alzheimers Dement*. 2023 Feb;19(2):498-506. doi: 10.1002/alz.12681. Epub 2022 Apr 26. PMID: 35472732; PMCID: PMC9596617.

De Sanctis P, Solis-Escalante T, Seeber M, Wagner J, Ferris DP, Gramann K. Time to move: Brain dynamics underlying natural action and cognition. *Eur J Neurosci*. 2021 Dec;54(12):8075-8080. doi: 10.1111/ejn.15562. PMID: 34904290.

Nakanishi M, Miyakoshi M. Revisiting Polarity Indeterminacy of ICA-Decomposed ERPs and Scalp Topographies. *Brain Topogr*. 2023 Mar;36(2):223-229. doi: 10.1007/s10548-023-00944-1. Epub 2023 Feb 25. PMID: 36840814.

Simfukwe C, Youn YC, Kim MJ, Paik J, Han SH. CNN for a Regression Machine Learning Algorithm for Predicting Cognitive Impairment Using qEEG. *Neuropsychiatr Dis Treat.* 2023 Apr 12;19:851-863. doi: 10.2147/NDT.S404528. Erratum in: Neuropsychiatr Dis Treat. 2023 May 24;19:1251-1252. PMID:

37077704; PMCID: PMC10106803.

Online

What is the optimal automated EEG pipeline?
Dr. Arnaud Delorme, May 2023