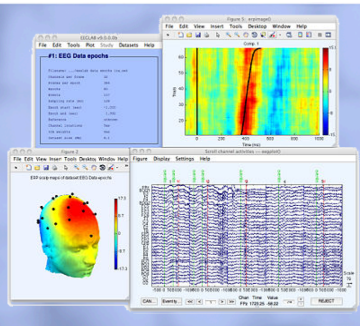


The EEGLAB News

Issue #20, September 2025

EEGLAB 2025 group picture from the workshop in Aspet, France, July 2025.

What's New

EEGLAB 2025.1 has been released. EEGLAB 2025.1 introduces full compatibility with MATLAB 2025, including improved rendering, font scaling, and automatic figure adjustments. STUDY functions now correctly represent two-way ANOVA designs, with fixes to factor ordering, labeling, and p-value mapping. A new Huber average reference has been added, and ICA scalp maps are now automatically recomputed after re-referencing unless explicitly disabled. AMICA integration has been streamlined to use *runamica15* with plug-in GUI guidance. Channel handling is more robust with better support in eeg_interp, eeg_checkchanlocs, and pop_chanedit. Event and epoching tools improve EDF+ decoding and annotation imports. Export functions tolerate empty filenames and better handle BDF headers. The pophelp system has been modernized for MATLAB 2025, while eeg_checkset underwent major refactoring for consistency. BIDS support was strengthened with updated derivatives handling and re-export functions. Dipfit now includes updated atlas mappings and LORETA compatibility. Notably, re-referencing now recomputes ICA activities by default, marking a behavioral change from earlier versions. Click here for more details.

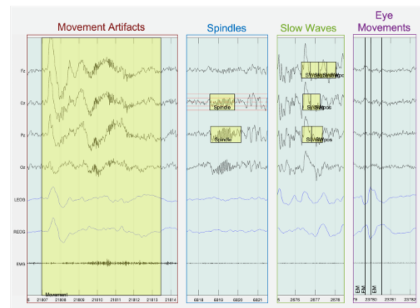
The LabStreamingLayer (LSL) reference paper is now published in Imaging Neuroscience. Developed more than a decade ago at SCCN, LSL has been the backbone of synchronized multimodal and mobile brain/body imaging across the world. Please check the Plug-ins section to read more.

SCCN is organizing the largest EEG-AI competition at NeurIPS 2025, based on our earlier release of the massive Healthy Brain Network EEG (HBN-EEG) dataset, now available with complete HED event annotation on NEMAR. Please refer to the Open Science section for more information about the challenge. Available on NEMAR and OpenNeuro, HBN-EEG is a collection of high-density EEG (and next year, eye-tracking) recordings from ~3000 subjects aged 5 to 21 years.

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.

The **Counting Sheep PSG plug-in** developed by Stuart Fogel is a user-friendly, EEGLAB-compatible analysis software for visualization, signal processing, manual visual sleep stage scoring, and event marking of polysomnographic (PSG) data. Counting Sheep PSG is adapted for sleep data analysis and uses a combination of built-in EEGLAB functions and plug-ins, alongside custom features, and is capable of: importing a wide variety of data formats, common preprocessing steps, artifact correction and rejection, automatic event detection (e.g., movement, rapid eye movements, spindles, slow waves, and SP-SW coupling), batch processing, power spectral analyses, and report generation. For complete details, check out this research article.



The Lab Streaming Layer reference paper has finally been published (see the “in print” section). Notably, EEGLAB integrates with LSL through the EEGLAB XDF plug-in, which enables the import and synchronization of multiple data streams, including EEG, eye tracking, multiple EEG recordings, and event marker streams. To our knowledge, it is the most powerful tool available for data stream fusion. The MATLAB LSL Viewer EEGLAB plug-in also allows for direct EEG recording within EEGLAB, saving the data immediately as an EEG dataset. Once imported, streams can be exported in native EDF, NWB, and other formats. Additionally, EEGLAB functions are integrated into NeuroFeedbackLab to stream and process LSL data in real-time.

Open Science

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

The **2025 EEG Foundation Challenge: From Cross-Task to Cross-Subject EEG Decoding**, part of the NeurIPS 2025 Competition Track, invites participants to develop machine learning methods that improve generalization in EEG decoding across tasks and subjects. Using the large-scale HBN-EEG dataset with recordings from over 3,000 participants, prepared in BIDS format using **EEGLAB BIDS tools** and served by the **EEGDash deep learning interface** to NEMAR and OpenNeuro. The competition features two supervised learning tasks: predicting behavioral performance in an active contrast change detection paradigm through cross-task transfer learning, and estimating psychopathology scores through subject-invariant representation learning. Competitors may leverage unsupervised or self-supervised pretraining across diverse passive and active EEG tasks before fine-tuning for specific objectives. The challenge is organized by an international consortium of institutions spanning neuroscience, psychiatry, and machine learning, with sponsorship from Meta and other partners, and aims to set new benchmarks for robust and transferable EEG decoding methods. The competition has already attracted **969 teams**, making it a great success (see 7-minute YouTube overview at the end of the newsletter).

Profiles

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

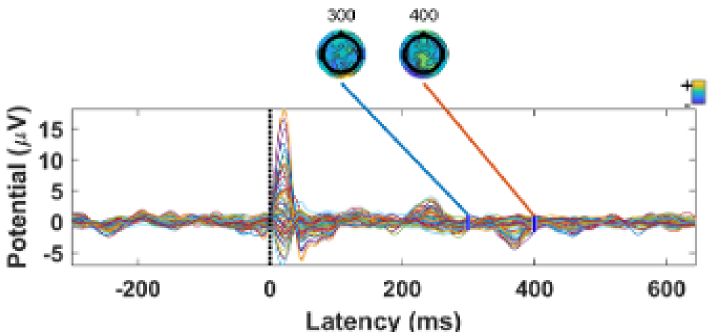
Dr. Cedric Cannard is an independent neuroscientist and data scientist specializing in multimodal physiological analysis, with deep expertise in EEG, ranging from high-density wet systems to low-cost wearable dry EEG, and a focus on heart–brain interactions, real-time signal processing, and scalable applications for mental health.

Born in Lyon and raised in Grenoble, France, Dr. Cannard completed his Bachelor's degree in Sports Science in Toulouse, where his interest in physiology and neuroscience first took root. He pursued a Master's in Biomedical Neurosciences and Behavioral Sciences at the University of Caen, where he conducted research at the ISTS Laboratory (CNRS, CEA) within the Cyceron Center. There, he studied grey matter atrophy in the hippocampus in patients with schizophrenia, using voxel- and surface-based mapping techniques. Later, during the second year of his Master with the Perceptual and Attentional Fluctuations (PAF) team at the CerCo in Toulouse, he investigated visual perception and attention with Dr. Rufin VanRullen using a 64-channel EEG system, his introduction to EEGLAB.

Dr. Cannard earned his Ph.D. in Neuroscience under the supervision of Arnaud Delorme, conducting his research in California through an internationally funded program. His dissertation focused on the validity and potential of low-cost, wearable EEG systems for research and applied use (Cannard et al., 2020). After validating such a system against research-grade hardware (Cannard, 2021a), he collected EEG data from 461 participants and identified a potential alpha-band brain-asymmetry neural correlate of multidimensional well-being (Cannard et al., 2021b). In a follow-up project, he collected simultaneous ECG and EEG data on an additional 60 people to find additional correlates of well-being. This work led to the development of BrainBeats, an open-source EEGLAB plug-in that enables joint analysis of EEG and cardiovascular signals (ECG and PPG; Cannard et al., 2024). With BrainBeats, researchers can extract features such as heartbeat-evoked potentials (HEPs) or HRV and EEG metrics, and compute brain-heart coupling measures, opening new avenues for studying interoception, mental states, and consciousness in both lab and real-world settings.

In parallel, Dr. Cannard developed another EEGLAB plug-in (Ascent) designed to compute entropy measures from EEG data (Cannard et al., 2025), targeting aperiodic and nonlinear signal dynamics typically overlooked by standard time/frequency- or time-based approaches (ERPs). This tool supports researchers interested in complexity science, consciousness research, and general brain dynamics, and has been used in studies of altered states such as lucid dreaming and trance.

As a long-time EEGLAB user, Dr. Cannard integrates multiple plug-ins into his workflow, including AMICA, PICARD, LIMO-EEG, DIPFIT, ROIConnect, ICLabel, and his own BrainBeats and entropy plug-ins. He typically works through command-line scripting and has written custom MATLAB functions to manage large-scale, multimodal datasets and apply advanced re-referencing methods (e.g., Surface Laplacian, Infinity), hierarchical statistical models, and source-resolved analyses. He is a long-term contributor and moderator and continues to answer questions on the EEGLAB mailing list.



Heartbeat-Evoked Potentials (HEP) *obtained using the BrainBeats EEGLAB plug-in. These reflect the brain's response to heartbeats, indexing cortical processing of internal bodily signals, typically in the ACC and mPFC. The BrainBeats toolbox has been used in applications ranging from seizure detection and motor imagery BCI to assessing well-being and interoceptive awareness in both clinical and real-world environments.*

Dr. Cannard recently served as Director of Research at a neurotechnology startup (2024-2025), developing immersive, multimodal biofeedback programs that integrate VR with real-time recordings of EEG, ECG/PPG, EDA, IMU, eye tracking, and body temperature. His work focused on developing real-time signal processing algorithms optimized for translation into C#, simulating and validating these pipelines to preserve maximal physiological accuracy, performing hardware sensor validation, and designing programs grounded in scientific theory to support nervous system regulation.

He is now working independently as a consultant, offering advanced data analysis services, including source analyses, robust statistics, and contributing to the development of a new EEGLAB plug-in at UCSD for intracranial EEG (iEEG) analysis.

Recent publications include:

Cannard, C., Brandmeyer, T., Wahbeh, H., Delorme, A. (2020) Self-health monitoring and wearable technologies. In Handbook of Clinical Neurology, Nick Ramsey and Jose Millan (Editors). 168:207-232. doi: 10.1016/B978-0-444-63934-9.00016-0. Elsevier: Amsterdam.

Cannard, C., Wahbeh, H., Delorme, A. "Validating the wearable MUSE headset for EEG spectral analysis and Frontal Alpha Asymmetry," 2021a IEEE International Conference on Bioinformatics and Biomedicine (BIBM), 2021, pp. 3603-3610, doi: 10.1109/BIBM52615.2021.9669778.

Cannard, C., Wahbeh, H., & Delorme, A. (2021b). Electroencephalography Correlates of Well-Being Using a Low-Cost Wearable System. Frontiers in human neuroscience, 15, 745135. https://doi.org/10.3389/fnhum.2021.745135

Cannard, C., Wahbeh, H., & Delorme, A. (2024). BrainBeats as an Open-Source EEGLAB plug-in to Jointly Analyze EEG and Cardiovascular Signals. Journal of Visualized Experiments: JoVE, (206), 10.3791/65829. https://doi.org/10.3791/65829

Cannard, C., Delorme, A. (2025). An open-source EEGLAB plug-in for computing entropy-based measures on MEEG signals. https://osf.io/preprints/psyarxiv/xwmyk_v1

Upcoming Events

PracticalMEEG 2025. The next EEGLAB mini-workshop will take place during PracticalMEEG 2025, held October 27–31 at Aix-Marseille Université, France. PracticalMEEG is an intensive training program dedicated to hands-on analysis of MEG and EEG data, featuring lectures and tutorials on four leading open-source toolboxes: EEGLAB, FieldTrip, MNE-Python, and Brainstorm. Registration for PracticalMEEG 2025, including the EEGLAB mini-workshop, is still open.

From the EEGLABLIST

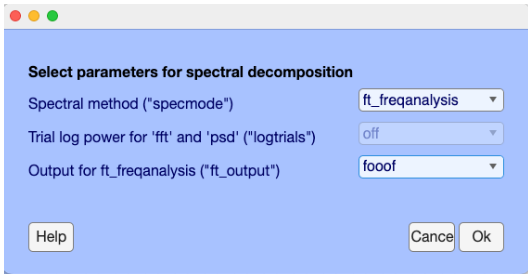
This section contains messages from the EEGLABLIST that may be of general interest. Messages are edited for clarity.

Critical pitfall of spectral power analysis? See the first message and click *Next message*. The discussion is summarized below.

Jinwon Chang. Opened the discussion, citing a 2021 *NeuroImage* paper (Gyurkovics et al.) warning that baseline correction can distort spectral power analyses because of subject-dependent 1/f noise. He asked how EEGLAB handles this, especially in contexts like sleep EEG where relative PSD is often used to extract slow oscillations and spindles.

Makoto Miyakoshi. Explained with examples that dB conversion can exaggerate or diminish identical power changes depending on baseline levels. He argued dB-converted power is valid but insensitive to some effects. Absolute power in $\mu V^2/Hz$ has its own limitations, particularly for cross-frequency comparisons given the 1/f distribution. He emphasized that there are trade-offs, no single correct method, and multiple calculations may be shown in parallel. He later clarified that low-pass filtering in scalp EEG arises from dendritic cable properties and spatial averaging resulting from the broad point-spread of potentials from each cortical source area adding to the signals recorded at nearly all scalp channels. He highlighted that mesoscopic dipole moment dynamics explain high-frequency attenuation.

Cedric Cannard. Proposed an explicit baseline modeling approach instead of ratio-based corrections. Suggested estimating aperiodic parameters (offset, exponent) with tools like FOOOF (now available in EEGLAB studies – menu item *STUDY > Precompute Channel measures* then *Power spectrum … button*), and including them in general linear models (GLMs) or mixed models to account for additive and multiplicative effects. This avoids biases in oscillatory power estimates and allows direct testing of broadband changes.



Mate Gyurkovics. Reiterated that 1/f-like scaling is ubiquitous in autocorrelated signals and can be influenced by dendritic filtering, neuronal input location, and excitation-inhibition balance. He noted ERPs trivially alter 1/f slopes because they are transient, but also reported non-trivial post-stimulus changes (steepening) in his 2021 paper. He stressed the complexity of separating oscillations, 1/f dynamics, and ERPs in scalp EEG, and pointed out the ambiguity in defining “oscillations.” He agreed with Cedric that controlling for 1/f contributions is crucial for isolating narrowband rhythms.

Karlton Wirsing. Contributed references on the ubiquity of 1/f noise across physical, biological, and even astronomical systems, citing Keshner (1982).

Overall. The discussion converged on the idea that 1/f scaling in EEG arises from multiple overlapping mechanisms (dendritic filtering, neuronal input location, excitation-inhibition balance, ERPs). Baseline correction can bias interpretations, so better modeling approaches (like Cedric’s GLM suggestion) are needed. While Makoto emphasized physiological filtering mechanisms, Cedric and Mate stressed methodological solutions and the complexity of distinguishing trivial vs. non-trivial 1/f contributions.

In Print

Aristimunha, B., Truong, D., Guetschel, P., Shirazi, S. Y., Guyon, I., Franco, A. R., Milham, M. P., Dotan, A., Makeig, S., Gramfort, A., King, J.-R., Corsi, M.-C., Valdés-Sosa, P. A., Majumdar, A., Evans, A., Sejnowski, T. J., Shriki, O., Chevallier, S., & Delorme, A. (2025). EEG Foundation Challenge: From Cross-Task to Cross-Subject EEG Decoding. *arXiv*. https://arxiv.org/abs/2506.19141

Kothe, C., Shirazi, S. Y., Stenner, T., Medine, D., Boulay, C., Grivich, M. I., Artoni, F., Mullen, T., Delorme, A., & Makeig, S. (2025). The lab streaming layer for synchronized multimodal recording. Imaging Neuroscience, 3, IMAG.a.136. https://doi.org/10.1162/IMAG.a.136

Online