Cumulus

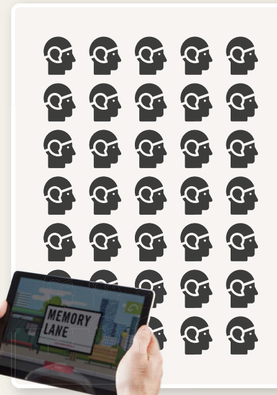
This poster was originally published under the BrainWaveBank brand name.

# Comparing conventional wet EEG vs dry-sensor wireless EEG to probe sensory processing and neuronal function in the aging brain

## SUITE OF TOOLS FOR EEG DATA COLLECTION AT SCALE

Gamified
EEG collection
in-home, at-clinic



- Data Preprocessing
- Feature Extraction and Generation
- Data Modelling
- Predictive Results



Dashboard

- Secure, online patient monitoring
- Real-time data review & quality assessment
- Rich data visualisation

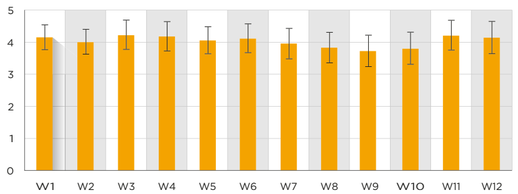
## Field-Tested at Scale

**Previous research conducted by BrainWaveBank has shown...**

**92%** of users said the headset was easy to use at-home.

**74%** of users said the games were motivating and engaging.

- High user adherence
- High quality data
- Powerful predictive capabilities




Bar chart illustrating adherence to trial protocol after 3 months of use in a group of healthy adults aged 55-79. Mean number of sessions per week, error bars represent 95% CI.

## METHODS

- 8 healthy adult male participants (28+ years).
- Controlled lab environment.
- Two daily sessions, ~7 days apart, with wet/dry recordings on each in counterbalanced order.
- Grand average EP calculated across all sessions per system, and Power Spectral Densities (PSDs) computed using grand average.
- 100-wise Monte Carlo estimation of confidence intervals.
- Wet EEG: Biosemi ActiveTwo at 512Hz.
- Dry data: Brainwavebank headset at 250Hz.
- Matched processing: filtering, 0.25 – 85Hz with notch at 50Hz.

## BACKGROUND

- Neurodegenerative conditions can develop slowly and need to be monitored repeatedly over time.
- Wet EEG is very costly, time-consuming, cumbersome.
- Wireless Dry EEG could provide an easy-to-use, scalable and objective measure of brain function.
- Steady-State Visual Evoked Potentials (SSVEPs) are simple, highly repeatable brain responses, making them suitable for a comparison study.
- Steady-state responses are increasingly used in observational and interventional studies to measure the integrity of brain networks.

## STIMULUS

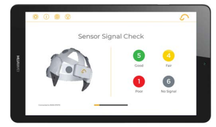
- A white-circle visual stimulus on grey background on a lab-grade CRT screen.
- 4 conditions: static VEP, 42.5Hz, 21.25Hz, and 14.167Hz steady-state SSVEP.
- 185 trials: 46 per stimulus, randomly ordered.
- Session length 20 minutes.

## OUR PLATFORM

**Affordable, easy to use, wireless 16 channel EEG headset**



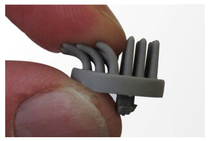
EEG signals synchronised to game events.




Montage and calibration in <5 mins.



16 channels, fits range of head sizes.



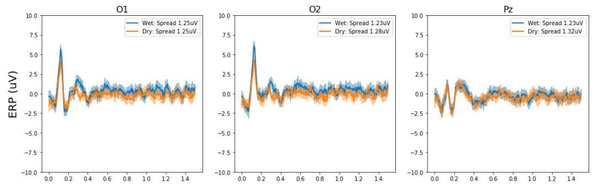
Durable soft dry sensor technology.



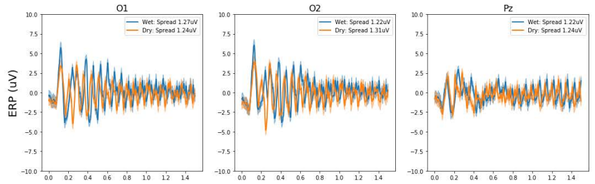
Biosemi wet system (top) and BWB dry system (bottom).

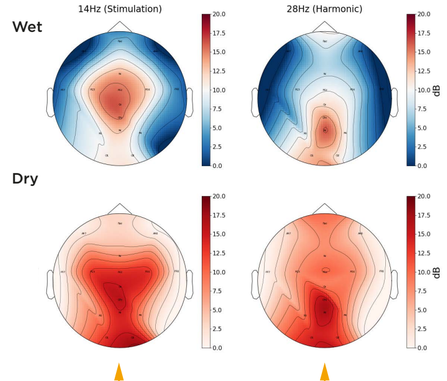
## RESULTS

### Static VEP




### 14Hz SSVEP




- The 14Hz response, displayed, has the highest amplitude. The 22.5Hz response follows the same patterns, with smaller amplitude. The 42.5Hz stimulus did not elicit a reliable response on either system.
- Topographic maps show similar spatial/topographic distribution of the SSVEP in wet/dry systems, with a slightly higher overall signal amplitude in the dry system.
- EP temporal profile is also similar, with comparable confidence intervals (spread). An offset between wet/dry is noted in the 14Hz stimulus that was due to an unnoticed delay between first and second frames caused by technical differences in the marker transmission method between the two systems.
- Difference in spectral power between Static VEP and 14Hz SSVEP shows peaks and harmonics of equivalent amplitude for both systems. Confidence interval/spread of spectral difference values are also similar for both systems.

PSD of Grand Averages
Signal minus Reference, Mean Across Channels
Dry and Wet

## CONCLUSIONS

- ERP analyses based on dry mobile EEG yield data with comparable waveform morphology and scalp topography to a state-of-the-art wet EEG system.
- In this controlled environment, evoked potential quality is indistinguishable.
- With short setup and wrap-up time (<5 mins, vs 30+ minutes for Biosemi 128-channel) provides opportunity for quick and low-burden of passive and task-driven EEG in distributed supervised environments like university labs (e.g. longitudinal cohort studies) and small clinics (in future primary care applications).
- Previous studies have shown that research and clinically relevant data can be gathered in the home also.

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**REFERENCES**

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3 Murphy et al 2019 Replicating Lab Electrophysiology with Older Users in the Home, Using Gamified Dry EEG, AAIC, Los Angeles