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Comparative Analysis of EEG Acquisition Systems: Neuroscan with EasyCap vs. OpenBCI with Florida Research Cap

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Poster

Comparative Analysis of EEG Acquisition Systems: Neuroscan with EasyCap vs. OpenBCI with Florida Research Cap

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Abstract

Introduction:
Electroencephalography (EEG) is vital for cognitive neuroscience, traditionally using wet electrode systems like Neuroscan with EasyCap for high signal fidelity and broad scalp coverage. Recently, dry electrode systems such as OpenBCI with the Florida Research Cap have emerged, offering rapid setup and improved participant comfort. This study directly compared these two systems in both resting-state and Go/NoGo task paradigms.
Methods:
Twenty participants (Mage = 20.1, SD = 2.07) completed two EEG sessions on the same day. Participants first underwent a recording with the OpenBCI dry-electrode system (16 channels), followed by a session with the Neuroscan wet-electrode system (62 channels). To ensure comparability, Neuroscan data were downsampled from 500 Hz to 125 Hz, and analysis was restricted to the matching 16 channels. Resting-state recordings included 3 minutes with eyes open and 7 minutes with eyes closed to capture baseline neural oscillations. The Go/NoGo task consisted of 200 trials (80% Go, 20% NoGo) to evaluate reaction times and error rates as measures of inhibitory control. Data were bandpass-filtered (0.5–45 Hz) with a 50 Hz notch filter to remove line noise, and Independent Component Analysis was used to eliminate eye movement and muscle artifacts before segmenting data for ERP analysis (e.g., N2, P3 components) and power spectral density estimation.
Results:
The Neuroscan wet-electrode system demonstrated higher signal-to-noise ratios, lower impedance levels, and more robust ERP components (notably a stronger N2 amplitude) during the Go/NoGo task, with fewer discarded epochs due to artifacts. In contrast, the OpenBCI system offered faster setup times (typically under 10 minutes) and was rated as more comfortable by most participants. Although the dry electrodes were slightly more susceptible to motion and other artifacts, the topographic distributions and temporal characteristics of the EEG signals were comparable across systems. Additionally, time-frequency analysis of the resting-state data yielded comparable results for both systems.
Discussion and Conclusion:
These findings highlight a trade-off between signal quality and ease of use. Neuroscan's wet system is preferable for high-precision applications requiring extensive scalp coverage and minimal noise, such as source analysis and connectivity studies, albeit with longer preparation and the need for specialized gel application. The OpenBCI dry system, while exhibiting minor reductions in SNR and a higher risk of artifacts, provides a quick, user-friendly alternative ideal for portable setups, mobile brain-computer interfaces, and large-scale

field studies. Future research should focus on enhancing dry electrode materials, refining artifact suppression algorithms, and increasing channel counts to further bridge the performance gap between dry and wet EEG systems in both clinical and research environments.

Keywords

EEG, Neuroscan, OpenBCI, Go/NoGo, Resting-State

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