Qeios

Peer Review

Review of: "Is There a Direct Relation Between EEG Band Spectrum and DMN Activity in fMRI? A Multivariate Exploratory Study"

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Review of: *Is There a Direct Relation Between EEG Band Spectrum and DMN Activity in fMRI? A Multivariate Exploratory Study*

Summary Insight

This manuscript explores whether EEG band spectral power can predict Default Mode Network (DMN) activity as captured by fMRI, using a simultaneously acquired EEG-fMRI dataset. The authors apply a Random Forest regression model to 196 EEG features derived from 28 channels across 7 frequency bands, time-locked to BOLD signals from four DMN regions. The study spans multiple sleep stages and wakefulness, offering an integrative look at how brain rhythms may reflect network-level activity in dynamic states.

Scientific Contribution

This work contributes to the evolving effort to decode large-scale brain network activity from non-invasive electrophysiological signals. It offers a promising computational framework for probing the correspondence between electrical and hemodynamic signals across different states of consciousness.

Strengths

The use of simultaneous EEG-fMRI enables a high-fidelity investigation of real-time brain dynamics and is well-executed.

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Random Forest regression with leave-one-out cross-validation is an appropriate method for this high-dimensional feature space.

Sleep stage stratification adds biological richness and interpretability to the findings.

Topoplot visualizations enhance spatial understanding of feature importance across frequency bands.

The use of open-source tools and an open-access dataset supports transparency and reproducibility.

Growth Areas

EEG preprocessing: More detail is needed. Were ICA or re-referencing applied? What filters were used? How were artifacts handled?

Temporal alignment: Clarify whether a hemodynamic lag correction was applied between EEG epochs and fMRI signals.

Interpretability: The Random Forest feature importance results are helpful but lack directionality. The future use of SHAP is appreciated—consider including even a small pilot SHAP visualization.

Model performance: Include inter-subject variability for MSE values (e.g., standard deviation or confidence intervals) to contextualize model robustness.

Editorial Notes

Minor grammatical revisions would improve clarity. For example:

“help us better understanding” → “help us better understand”

“DMN may be acting… but start to…” → “starts to…”

“will low MSE values” → “with low MSE values”

Confirm whether the EEG montage follows the international 10–20 system.

Consider rephrasing “global EEG changes” as “distributed” for clarity.

Use a color-blind–friendly palette for the topoplot figures if possible.

Closing Reflection

This study reflects the delicate balance neuroscience seeks—to listen to the hum of surface rhythms and see, within them, the silent choreography of deep internal networks.

Final Note:

I appreciate the opportunity to review this work and look forward to seeing it evolve through open scientific dialogue.

Declarations

Potential competing interests: No potential competing interests to declare.