

Peer Review

Review of: "The Evolving Landscape of Neuroscience"

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This paper presents a comprehensive, data-driven analysis of the structural and thematic evolution of neuroscience over the past 25 years. By leveraging large-scale text embedding, clustering, and citation network analysis, the author maps the field's intellectual landscape and identifies key trends, domains, and challenges. The study is timely and relevant, offering valuable insights into the organization, integration, and trajectory of neuroscience research.

The author analyzed 461,316 articles from 375 journals (1999–2023), using advanced text embedding, semantic clustering, and large language models (LLMs) to identify 175 research clusters. Key findings include:

- A shift from fundamental to applied research, with translational and clinical domains growing faster.
- Neuroscience is highly interdisciplinary, but theoretical integration remains limited.
- Citation network analysis reveals intellectual hubs and isolated clusters, highlighting the field's structural dynamics.
- The study identifies emerging trends, transcendental questions, and necessary developments, such as the integration of multi-omics, AI, and neuromodulation techniques.

Strengths of the Paper

- **Innovative Methodology:** Combines semantic embeddings, clustering, and LLMs to analyze a vast dataset.
- **Comprehensive Scope:** Covers 25 years of neuroscience literature across multiple journals and subfields.
- **Insightful Trends Analysis:** Identifies growth and decline patterns, thematic shifts, and methodological evolution.

- **Open Data and Code:** Provides access to datasets and code, promoting transparency and reproducibility.
- **Clear Visualizations:** Figures and tables effectively communicate complex patterns and metrics.

Weaknesses and Limitations

- **Limited Theoretical Depth:** While the paper critiques the lack of overarching theories, it does not propose concrete frameworks or alternatives.
- **LLM Dependency:** Heavy reliance on LLMs for cluster characterization and trend synthesis may introduce bias or oversimplification.
- **Citation Metrics Interpretation:** The use of Krackhardt coefficients and PageRank is insightful but could benefit from more nuanced interpretation.
- **Supplementary Material Reliance:** Key insights (e.g., cluster definitions, open questions) are relegated to supplementary tables, limiting accessibility.

Suggestions for Improvement

- **Expand Theoretical Discussion:** Propose or evaluate candidate frameworks that could unify neuroscience domains.
- **Validate LLM Outputs:** Include manual or expert validation of LLM-generated cluster summaries and trends.
- **Enhance Accessibility:** Summarize key findings from supplementary materials within the main text.
- **Explore Funding Dynamics:** Investigate how funding trends may influence the shift toward applied research.

Overall Assessment

This paper is a **valuable contribution** to meta-research in neuroscience, offering a robust framework for understanding the field's evolution. It is **well-suited for publication** in a high-impact journal, especially those focused on neuroscience, scientometrics, or interdisciplinary science. The study's insights into structural integration, thematic shifts, and methodological trends are likely to inform future research and policy decisions.

Recommendation: Accept with minor revisions

Declarations

Potential competing interests: No potential competing interests to declare.