Cover Letter – Nature Communications Submission

To: Editors, *Nature Communications*
From: Demetrios C. Agourakis
Date: 7 November 2025
Subject: Submission of "Boundary Conditions for Hyperbolic Geometry in Semantic Networks"

Dear Editors of *Nature Communications*,

I am pleased to submit the manuscript entitled **"Boundary Conditions for Hyperbolic Geometry in Semantic Networks"**, which identifies the quantitative balance of clustering and degree heterogeneity that gives rise to hyperbolic geometry in semantic association networks across four languages.

Using **Ollivier–Ricci curvature** on directed weighted graphs (Small World of Words data) and matching **configuration and triadic-rewire nulls**, we demonstrate that hyperbolicity is **not universal** but confined to a **moderate-clustering regime ($C \approx 0.02$–0.15)**. This "hyperbolic sweet spot" unites linguistic, cognitive, and clinical evidence: association networks of healthy cognition occupy this region, whereas pathological language (schizophrenia, depression, mania) deviates toward Euclidean or spherical extremes.

The work contributes both methodologically—by integrating curvature-based geometry with classical network statistics—and conceptually, by providing boundary conditions for functional network geometry. All data and code are open (Zenodo DOI 10.5281/zenodo.17531773), ensuring full reproducibility.

We believe this manuscript will interest readers of *Nature Communications* across complex-systems science, cognitive neuroscience, and applied mathematics.

Sincerely,

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Attachments - Manuscript (main text, PDF and source)
- Figures 1–4 (separate TIFF/PNG)
- Tables 1–3 (CSV + LaTeX)
- Supplementary materials (protocols, additional figures)
- Data & code archive (Zenodo DOI 10.5281/zenodo.17531773)