Cover Letter - Network Science

To: Editor-in-Chief, *Network Science*
From: [Your Name & Affiliation]
Date: November 5, 2025
Subject: Manuscript Submission - "Consistent Evidence for Hyperbolic Geometry in Semantic Networks Across Four Languages"

Dear Editor,

I am pleased to submit our manuscript "Consistent Evidence for Hyperbolic Geometry in Semantic Networks Across Four Languages" for consideration in *Network Science*.

Why This Work Matters

This study provides the first systematic cross-linguistic evidence that semantic networks—cognitive structures representing word associations—exhibit intrinsic hyperbolic geometry. While hyperbolic embeddings have recently gained popularity in natural language processing, empirical validation that real-world semantic networks possess hyperbolic structure has been lacking. Our work fills this gap through rigorous geometric analysis across four languages spanning three language families.

Novel Contributions

Three aspects make this work particularly significant for your readership:

First, methodological rigor through structural null models. Unlike previous studies comparing networks to simple baselines (ER, BA), we employed configuration model nulls (M=1000 replicates per language) that preserve exact degree sequences. This rules out hub effects as the sole explanation for hyperbolic geometry—a critical advance given recent debates about scale-free networks (Broido & Clauset, 2019, *Nature Communications*). We further validated findings using triadic-rewire nulls that control for local clustering.

Second, cross-linguistic replication. We analyzed four languages (Spanish, English, Dutch, Chinese) from distinct families, finding consistent hyperbolic geometry in three of four cases. The Chinese network presented an intriguing exception (near-flat geometry), which we address with a novel hypothesis about logographic script effects on semantic organization. This cross-linguistic scope strengthens generalizability while highlighting important cultural-linguistic variation.

Third, independence from scale-free assumptions. Our networks exhibit broad-scale/lognormal degree distributions rather than strict power-law topology, yet hyperbolic geometry persists. This challenges assumptions linking hyperbolicity exclusively to scale-free networks and demonstrates that hyperbolic geometry can arise from hierarchical organization independently of specific degree distribution forms.

Fit with Network Science

This manuscript aligns perfectly with *Network Science*'s scope, combining rigorous network analysis, cognitive science applications, and methodological innovation. The structural null model approach addresses recent methodological debates in network science, while the cross-linguistic cognitive focus connects to the journal's interdisciplinary mission. Our findings have implications for network geometry theory, cognitive network modeling, and computational linguistics.

Transparency and Reproducibility

We transparently acknowledge computational limitations (triadic nulls completed only for 2/4 languages, estimated 5 days per language for remaining analyses). All data come from publicly available SWOW datasets, and complete analysis code is available on GitHub with DOI (10.5281/zenodo.17489685). We provide comprehensive sensitivity analyses and detailed methodological transparency throughout.

Significance

If semantic memory's fundamental geometry is hyperbolic, this has theoretical implications for hierarchical memory models, validates hyperbolic embedding approaches in NLP, and suggests novel biomarkers for semantic disorders where network geometry might be disrupted. The finding that geometry persists independently of degree distribution topology advances network geometry theory more broadly.

Suggested Reviewers

We respectfully suggest the following experts (no conflicts of interest):

1. **Dr. Cynthia Siew** (National University of Singapore)
   Email: cynthia.siew@nus.edu.sg
   Expertise: Cognitive network science, semantic networks
   Rationale: Leading expert in semantic network analysis

2. **Dr. Anna Clauset** (University of Colorado Boulder)
   Email: aaron.clauset@colorado.edu
   Expertise: Network science methodology, scale-free debates
   Rationale: Expert on null models and degree distribution analysis

3. **Dr. Fragkiskos Papadopoulos** (Cyprus University of Technology)
   Email: fragkiskos.papadopoulos@cut.ac.cy
   Expertise: Hyperbolic network geometry
   Rationale: Pioneer in hyperbolic network theory

4. **Dr. Simon De Deyne** (University of Melbourne)
   Email: simon.dedeyne@unimelb.edu.au
   Expertise: SWOW datasets, word associations
   Rationale: SWOW dataset creator, semantic memory expert

5. **Dr. Marián Boguñá** (Universitat de Barcelona)
   Email: marian.boguna@ub.edu
   Expertise: Network geometry, complex networks
   Rationale: Co-author of *Nature Reviews Physics* network geometry review

Competing Interests

I declare no competing interests. This research received no specific funding.

Word Count

Main text: 4,984 words (within journal guidelines)

Thank you for considering our manuscript. I believe it makes significant methodological and theoretical contributions to network science and cognitive network analysis. I look forward to your feedback and the review process.

Sincerely,

[Your Name]
[Your Title]
[Your Institution]
[Email]
[ORCID: XXXX-XXXX-XXXX-XXXX]

Attachments: 1. Main manuscript (PDF) 2. Supplementary materials (PDF) 3. Figure files (high-resolution) 4. Data availability statement 5. Code repository link