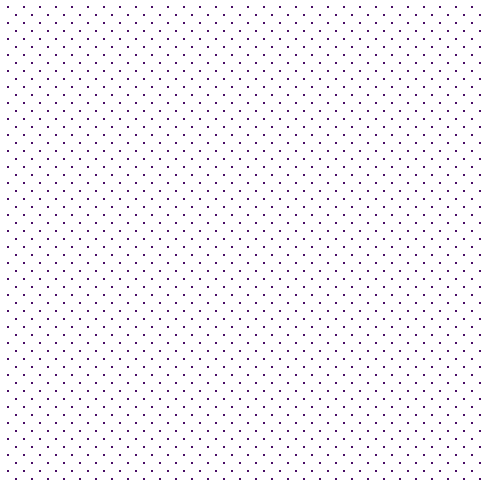


# Prioritizing Knowledge Frontiers in Alzheimer's Disease Using a Graph-Based Semantic Potential Framework

Abstract #13920

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A semantic-potential and gradient-traversal framework converts an Alzheimer's knowledge graph into an exploration map, revealing high-value knowledge frontiers and gradient-guided pathways for hypothesis generation.

| INTRODUCTION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | METHODS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | RESULTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | CONCLUSIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | REFERENCES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
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| <p><b>Beyond Representation: Exploration Maps</b></p> <p>Alzheimer's disease (AD) research remains fragmented across molecular, biomarker, imaging, and clinical domains. Knowledge graphs can integrate heterogeneous evidence, but most applications remain descriptive and do not indicate where scientific exploration should be prioritized.</p> <p>There is a need for graph-based methods that identify high-value knowledge frontiers and guide exploration toward regions with the greatest potential for integrative discovery.</p> | <p><b>Semantic Landscape Construction</b></p> <p><math>\phi</math> Scalar Semantic Potential: each node is assigned a potential combining evidence support, centrality, mechanistic coherence, translational relevance, and uncertainty.</p> <p><math>\nabla</math> Discrete Gradient &amp; Curvature: first-order variation represented by a discrete gradient; second-order structure by neighborhood-based curvature.</p> <p><math>\gamma</math> Gradient-Guided Traversal: knowledge-gain trajectories detected across the graph by following gradient ascent from peripheral nodes toward high-value cores.</p> <p><b>Semantic Potential Components</b></p> <p>Evidence strength (E) · Graph centrality (C) · Mechanistic coherence (M) · Translational relevance (T) · Uncertainty (U)</p> | <p><b>Semantic Anchors — Top-Ranked Nodes by Semantic Potential</b></p> <ol style="list-style-type: none"><li>Alzheimer's Disease — disease anchor, central hub</li><li>Amyloid PET — imaging biomarker</li><li>Baseline — temporal structure</li><li>Cognitive decline — clinical outcome</li><li>Follow-up — temporal structure</li><li>Plasma p-tau217 — fluid biomarker, high translational value</li></ol> <p><b>Top-Priority Semantic Regions</b></p> <p>1. Community 11 (community) · 2. Interface 17&lt;-&gt;19 · 3. Interface 19&lt;-&gt;29 · 4. Interface 13&lt;-&gt;17 · 5. Interface 13&lt;-&gt;29 (interfaces)</p> <p>Cross-community interfaces dominate the top-priority regions, highlighting zones where cross-domain integration and knowledge expansion are most strategically valuable.</p> <p><b>Knowledge-Gain Paths — Gradient-Guided Traversal Results</b></p> <p>Path 1: Olfactory Identification → Alzheimer's Disease</p> <p>Path 2: Cognitive decline → Baseline</p> <p>These paths suggest candidate routes for targeted hypothesis generation and cross-domain exploration in AD research.</p> | <p>A graph-based semantic potential framework can transform an evidence-linked AD knowledge graph into an exploration map that prioritizes high-value knowledge frontiers.</p> <p>This approach extends knowledge graph utility beyond representation and ranking by identifying where integrative investigation is most likely to yield meaningful scientific gains. Such semantic landscape methods may support biomarker discovery, target prioritization, and strategic navigation of complex Alzheimer's disease research spaces.</p> | <p>Source corpus and full evidence linkage tables available upon request from the authors.</p> <div><div>CONTACT</div><div><div><p><b>Jesus Domech More</b></p><p>AAIC 2026 · Developing Topics: Biomarkers</p><p>Exhibit Hall · In-Person Poster</p><p>Abstract #13920</p></div></div><div></div></div> |