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## Optimizing LLM Embeddings for Automatic Item Development and Validation

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Large Language Models (LLMs) have shown promise in text clustering and dimensionality analysis through embeddings, yet their potential for optimization remains largely unexplored. We conducted a comprehensive simulation study to enhance the accuracy of LLM embeddings in trait mapping using Dynamic Exploratory Graph Analysis (Dynamic EGA). The simulation generated 200 items across 4 traits of Narcissistic Personality, randomly selecting 3-40 items per dimension. We analyzed 1,040,000 combinations across 260 embedding values (3-1300) in a 1536-dimensional space. Performance was evaluated using Total Entropy Fit Index (TEFI) and Normalized Mutual Information (NMI). Vector field analysis revealed complex dynamics between TEFI and NMI, with optimal performance occurring in regions of moderate TEFI values and NMI above 0.5. The number of items per dimension showed peak performance between 10-20 items, while embedding dimensions exhibited non-linear relationships with both metrics. A weighted scoring system prioritizing NMI (70%) over TEFI (30%) significantly outperformed traditional cross-sectional embedding approaches. The optimization demonstrated improved accuracy in concept mapping while maintaining structural stability, suggesting a promising direction for enhancing LLM-based text analysis methods.

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