O6 Nomological decomposition of 17,180 behavioral medicine indicators using a PROMIS-finetuned large language model

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Objective: Psychological and medical research relies on measurement frameworks to ensure validity across studies, yet no large-scale, integrated nomological network exists in behavioral medicine. Cronbach and Meehl's (1955) concept of nomological validity has remained largely theoretical due to the absence of operationalized methods. We introduce ALIGNS, a fine-tuned large language model (LLM) trained to decompose and structure measurement indicators using measurement theory principles. Our approach is explicitly guided by 132 short PROMIS item banks, ensuring that the decomposition adheres to established psychometric validation principles.

Methods: We developed ALIGNS as a specialized LLM trained on inferred empirical data to recognize latent structures within behavioral medicine item banks. PROMIS item bank membership informed the decomposition, which suggested an optimal dimensionality of 1,100 factors using principal component analysis with promax rotation. The model was evaluated against and outperformed commercial LLMs, including OpenAI's GPT-4o and Claude, and tested for its ability to establish construct coherence, implicit definitions, and cross-indicator alignment within the PROMIS framework.

Results: ALIGNS successfully structured behavioral medicine indicators into a coherent 1,100-dimensional space, capturing the latent structure of 17,180 indicators from behavioral medicine and extending them to broader psychometric constructs. The model demonstrated high alignment with PROMIS-derived latent constructs, supporting its validity as a framework for large-scale indicator decomposition and measurement generalization.

Conclusions: By integrating PROMIS measurement theory with a fine-tuned LLM, ALIGNS represents the first large-scale, systematic decomposition of behavioral medicine indicators into a structured nomological network. This approach provides an empirical foundation for construct validation, offering a scalable and replicable method for integrating psychometric indicators across behavioral medicine and understanding which item banks may be missing from PROMIS. ALIGNS sets the stage for a unified measurement discipline, addressing long-standing cross-study validity and measurement coherence challenges.