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# Exploring Cognitive Diversity and Dynamics for Effective Language Memory Retention

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## Abstract

Spaced repetition, key for long-term memory retention through optimized review schedules based on predicted memory retention, is increasingly vital for effective language learning. Traditional methods, however, often fail to account for individual cognitive variations and material difficulty, resulting in a lack of high adaptability and effectiveness. To address this, our study introduces the Multidimensional Cognition Regression (MCR) model. MCR incorporates the Difficulty Engineering (DE) module, which integrates both objective and subjective factors to evaluate the intricacy of the content. Moreover, MCR further leverages a variety of user memory and cognitive characteristics, combined with psychological insights and machine learning techniques, to predict the memory “half-life” of material. This approach transcends methods like Half-Life Regression proven effective on Duolingo, reducing prediction errors demonstrated by lower Mean Absolute Error. Based on the predictive modeling of memory’s half-life and corresponding biological memory patterns, we opt to schedule reviews at the juncture when the memory decays to its half-life point. Empirical validation in real-world settings showed enhanced retention efficiency.